MX190000A
Signal Quality Analyzer-R
Control Software
Operation Manual

12th Edition

- **For safety and warning information, please read this manual before attempting to use the equipment.**
- **Additional safety and warning information is provided within the MP1900A Signal Quality Analyzer-R Operation Manual. Please also refer to it before using the equipment.**
- **Keep this manual with the equipment.**

ANRITSU CORPORATION

Document No.: M-W3913AE-12.0

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

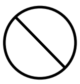
⚠ DANGER This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.

⚠ WARNING This indicates a hazardous procedure that could result in serious injury or death if not performed properly.

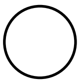
⚠ CAUTION This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manual

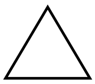
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.



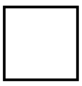
This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.



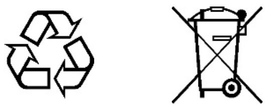
This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.



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.

MX190000A
Signal Quality Analyzer-R Control Software
Operation Manual

19 June 2017 (First Edition)
12 February 2021 (12th 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.

Anritsu Corporation Contact

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.

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This product and its manuals may require an Export License/Approval by the Government of the product's country of origin for re-export from your country.
Before re-exporting the product or manuals, please contact us to confirm whether they are export-controlled items or not.
When you dispose of export-controlled items, the products/manuals need to be broken/shredded so as not to be unlawfully used for military purpose.

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1. If a fault (bug) is discovered in this Software, failing this Software 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.

Article 4. Export Restrictions

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.

Article 10. Governing Law and Court of Jurisdiction

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

Cautions Against Computer Virus Infection

- Copying files and data
  Only files that have been provided directly from Anritsu or generated using Anritsu equipment should be copied to the instrument.
  All other required files should be transferred by means of USB flash drive or CompactFlash media after undergoing a thorough virus check.
- Adding software
  Do not download or install software that has not been specifically recommended or licensed by Anritsu.
- Network connections
  Ensure that the network has sufficient anti-virus security protection in place.
- Protection against malware (malicious software such as viruses).
  This equipment runs on Windows Operating System.
  To connect this equipment to network, the following is advised.
  - Activate Firewall.
  - Install important updates of Windows.
  - Use antivirus software.

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

This manual describes how to operate the MX190000A Signal Quality Analyzer-R Control Software.

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	MU183020A 28G/32G bit/s PPG
MU183021A	MU183021A 28G/32G bit/s 4ch PPG
MU183040B	MU183040B 28G/32G bit/s High Sensitivity ED
MU183041B	MU183041B 28G/32G bit/s 4ch High Sensitivity ED
MU195020A	MU195020A 21G/32G bit/s SI PPG
MU195040A	MU195040A 21G/32G bit/s SI ED
MU195050A	MU195050A Noise Generator
MU196020A	MU196020A PAM4 PPG
MU196040A	MU196040A PAM4 ED
MU196040B	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.

MU196020A-x11

Model　　Option number

Table of Contents

Chapter 1 Outline

This chapter provides an overview and describes the features of the MX190000A Signal Quality Analyzer-R Control Software (hereinafter referred to as “MX190000A”).

1.1 Overview

MX190000A allows users to create the same operation environment on a Windows 7 or Windows 10 PC as the operation functions of the MP1900A Signal Quality Analyzer-R (hereinafter, referred to as “MP1900A”). MX190000A is factory-installed on the MP1900A.

When MX190000A is installed on the external PC, it runs in a mode that emulates MP1900A behavior.
It is useful when you check how to operate the screen and see descriptions of on-screen items and their remote commands via on-screen help even if MP1900A is not available.

1.2 Features

MX190000A allows users to operate modules installed in MP1900A and to perform measurements using the modules.

MX190000A realizes the following functions.

- BER measurements using modules.
- Auto measurement including Eye Margin, Eye Contour and other measurements.
- Capturing test patterns.
- Editing test patterns.
- Configuring settings for linking multiple modules.
- Updating MP1900A's Software.
- On-screen help that describes on-screen items and their remote commands
- Symbol error rate (SER) measurements for PAM4 signals using modules
- Measuring Uncorrectable Codewords and FEC symbol errors in RS-FEC Scrambled Idle pattern using modules

GPIB and LAN are supported as the remote control interfaces. Also, the remote control commands conform to the SCPI (Standard Commands for Programmable Instruments).

Note:

When MX190000A is installed on the external PC, the GPIB interface is not available.

1.3 Operating Environment

Use a PC with at least the performance shown below.

Table 1.3-1 Operating Environment

Item	Specifications
Device type	IBM-PC or compatible PC
CPU	2 GHz or faster, 64-bit (x64) Processor
OS	Windows 10 Pro/Enterprise (64-bit) or Windows 7 Professional/Enterprise/Ultimate (64 bit)
Memory	At least 4 GB
Monitor resolution	At least 1600 × 900 dots
Display colors	At least 65536 colors
Hard disk	At least 200 MB disk space for full installation
Remote interface	At least 100BASE-TX

⚠ CAUTION

The MX190000A 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.

1.4 Module Selection Guide

Each function is offered by a separate module or option so that the MP1900A can meet customer requirements flexibly. By selecting modules and options, the MP1900A can be used with the configuration optimal for the customer's investment timing, and if needed in the future, new functions can be easily expanded or installed.

For details on the functional descriptions and selection criteria of modules and options and the functions that are different depending on combination, refer to the Selection Guide shown below.

Signal Quality Analyzer-R MP1900A series Selection Guide

https://www.anritsu.com/en-US/test-measurement/support/downloads/brochures-datasheets-and-catalogs/dwl18629

Chapter 2 Preparation

This chapter describes how to install, uninstall, start and shut down the MX190000A.

2.1 Installation and Uninstallation

MX190000A can be used in two installation modes.

- Installation on MP1900A
  Users can perform measurement by controlling the MP1900A.
- Installation on an external PC
  Users can display measurement result files and edit patterns even if it is not connected to the MP1900A. (Emulation mode)

2.1.1 Installation

This section explains how to install MX190000A on the MP1900A or on an external PC.

1. If MX190000A is running, shut down it.
   In the system control area located at right-bottom of the screen, touch the **Close** button (). Then, in the **Shutdown/Close** dialog box, select **Shut down the software completely** and touch **OK**.

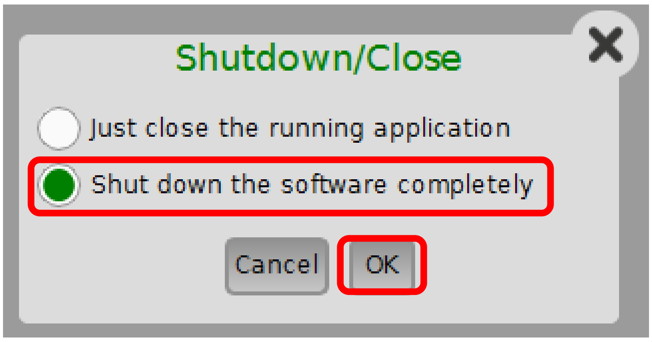


Figure 2.1.1-1 Shutdown/Close Dialog Box

2. Install MX190000A.
   On the MP1900A or on the external PC, execute the following file supplied by Anritsu.

   MX190000A_VER_x_xx_xx.exe

   x_xx_xx above indicates the software version.

   To newly install MX190000A

   On the welcome page of the InstallShield Wizard, touch **Next**.

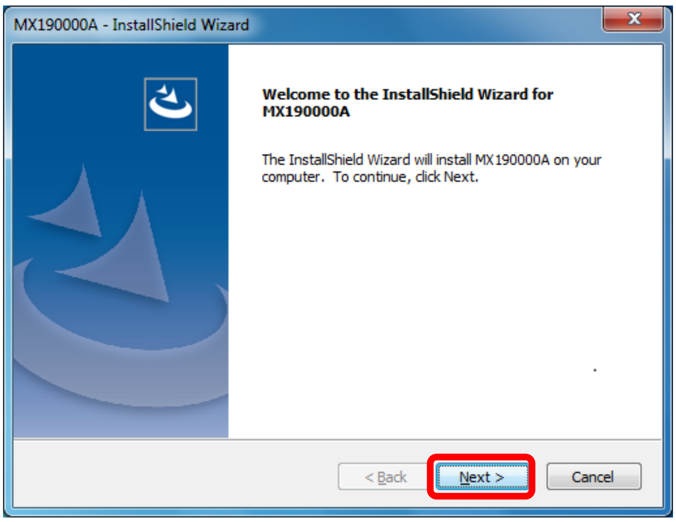


Figure 2.1.1-2 Welcome Page

If MX190000A is already installed

To continue the installation, touch **Yes** when you receive the following prompt: Reinstall all program features installed by the previous setup.
Skip Steps 3 to 7 and proceed to Step 9.

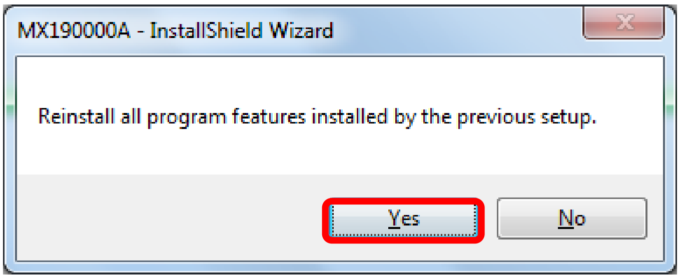


Figure 2.1.1-3 Confirming Reinstallation

Note:

To downgrade MX190000A, touch **No** and cancel the installation. Then, uninstall MX190000A and start the procedure again. For how to uninstall, refer to 2.1.2, "Uninstallation",

3. Enter the user name, company name, and serial number, and then touch **Next**.

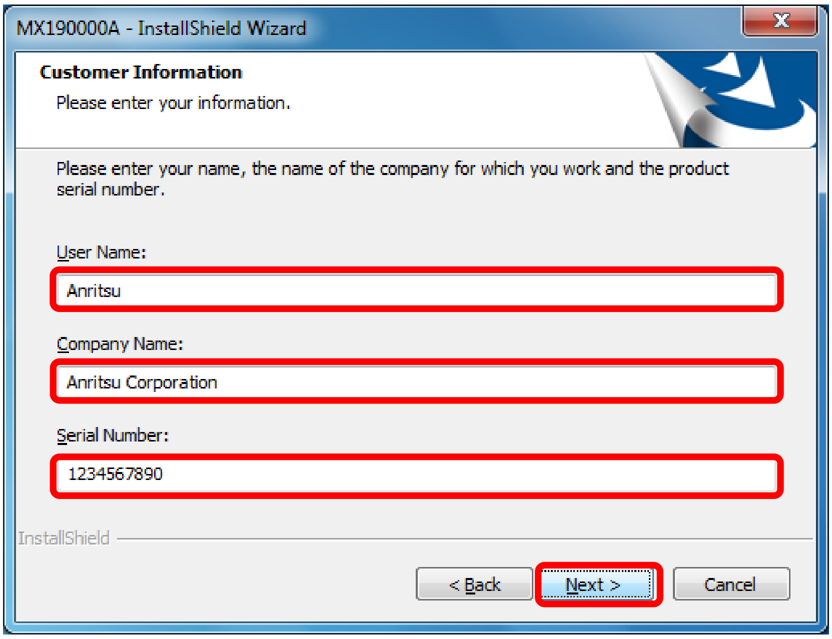


Figure 2.1.1-4 Customer Information Page

4. Select the setup type and touch **Next**.
   To install MX190000A on the MP1900A, select **MP1900A**. To install MX190000A on an external PC, select **External PC**.

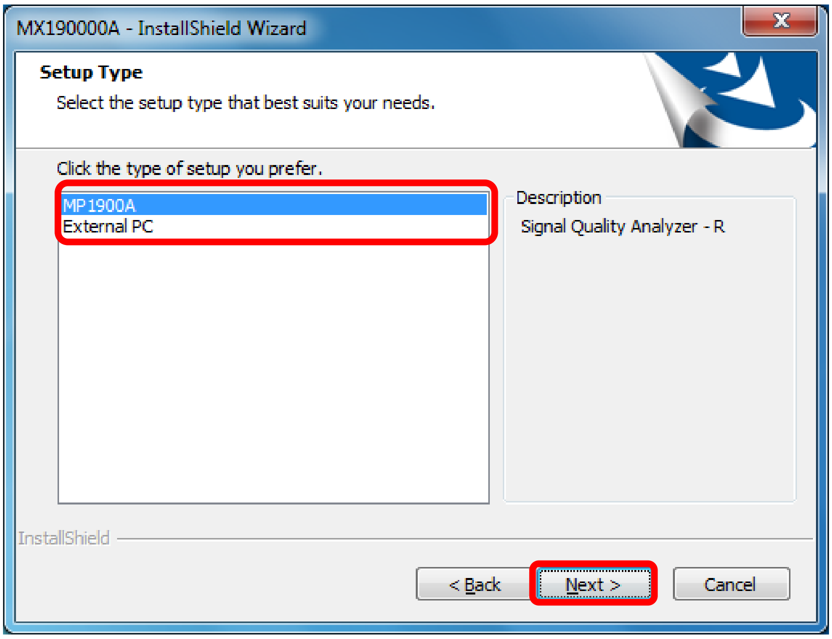


Figure 2.1.1-5 Setup Type Page

5. When **External PC** has been selected on the Setup Type page, the installation destination folder can be changed.
   If you don't want to change it, touch **Next**.
   If you want to change it, touch **Change** and input the destination folder, and then touch **Next**.

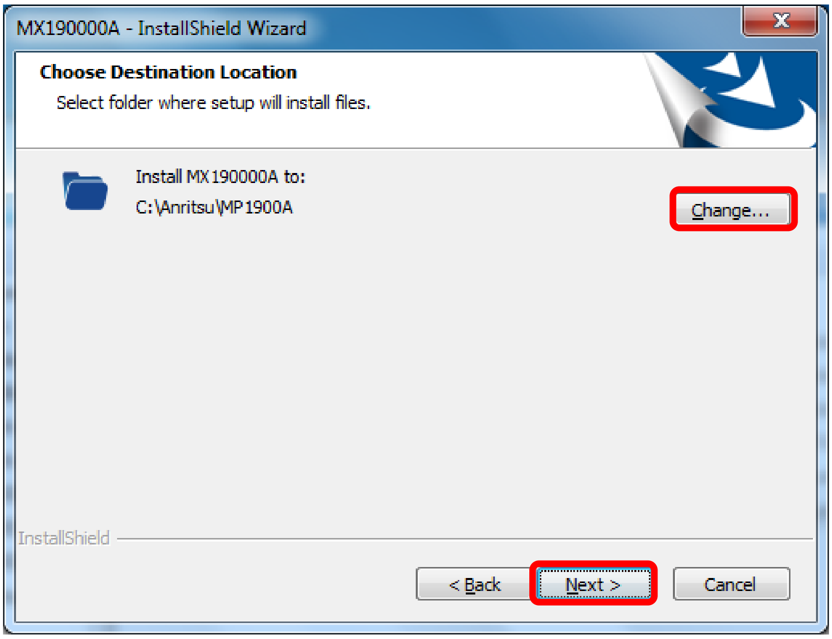


Figure 2.1.1-6 Choose Destination Location Page

6. When **External PC** has been selected on the Setup Type page, select whether to operate MX190000A in Emulation mode.
   To operate it in Emulation mode, select the **Install unit / modules emulator** check box and touch **Next**.

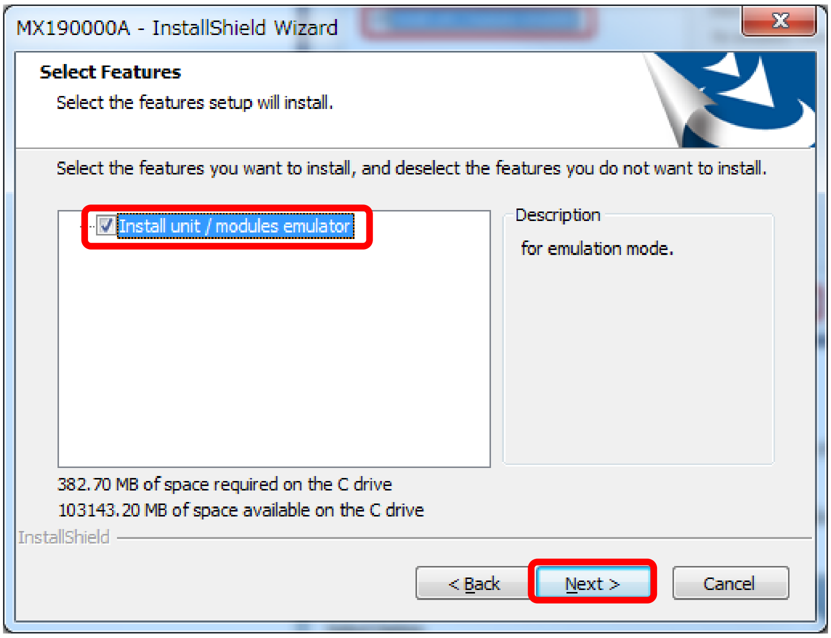


Figure 2.1.1-7 Select Features Page

7. When **External PC** has been selected on the Setup Type page, select whether to create a shortcut on the desktop.
   To create a shortcut on the desktop, select the **Make a shortcut on Desktop.** check box and touch **Next**.

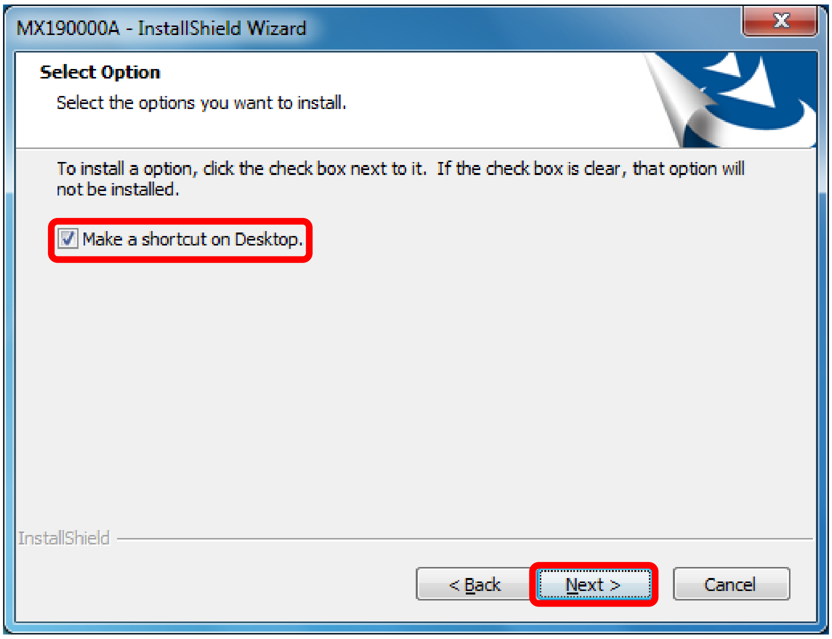


Figure 2.1.1-8 Select Option Page

8. Touch **Install**.

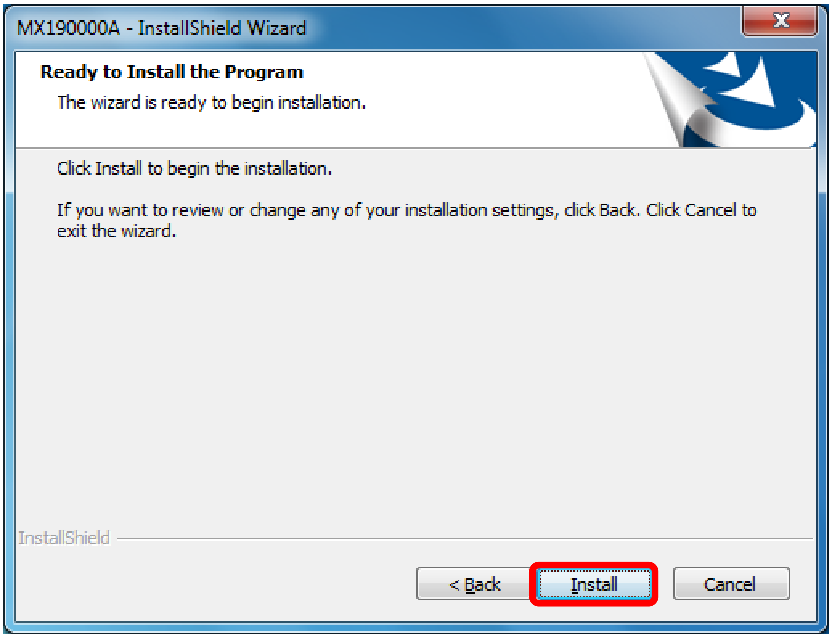


Figure 2.1.1-9 Ready to Install the Program Page

9. When the installation completes successfully, the following dialog box appears. Touch **Finish** to end installation.

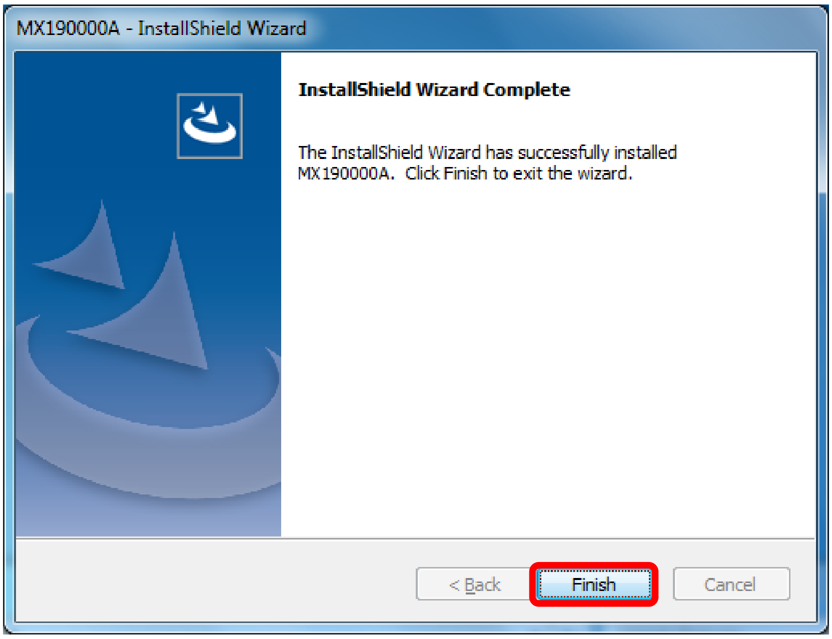


Figure 2.1.1-10 InstallShield Wizard Complete Page

2.1.2 Uninstallation

This section describes how to uninstall MX190000A . On the MP1900A or external PC, perform the following procedure.

1. On the **Start** menu, select **Control Panel**.

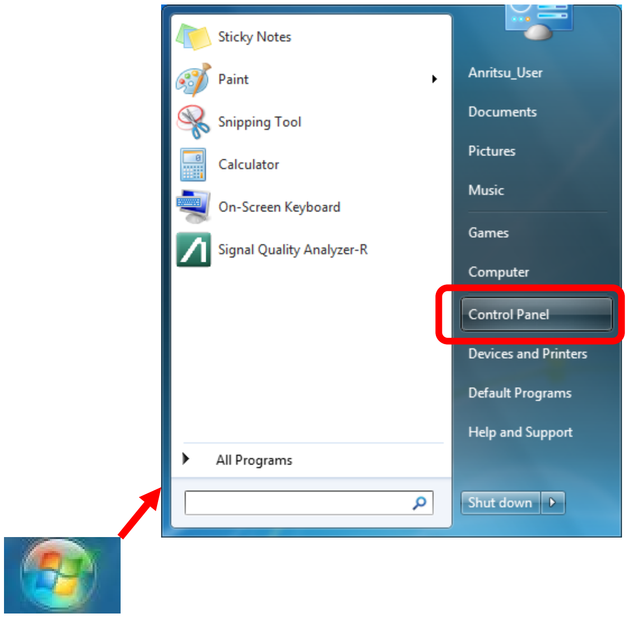


Figure 2.1.2-1 Control Panel

2. In **Control Panel**, touch **Programs and Features**.

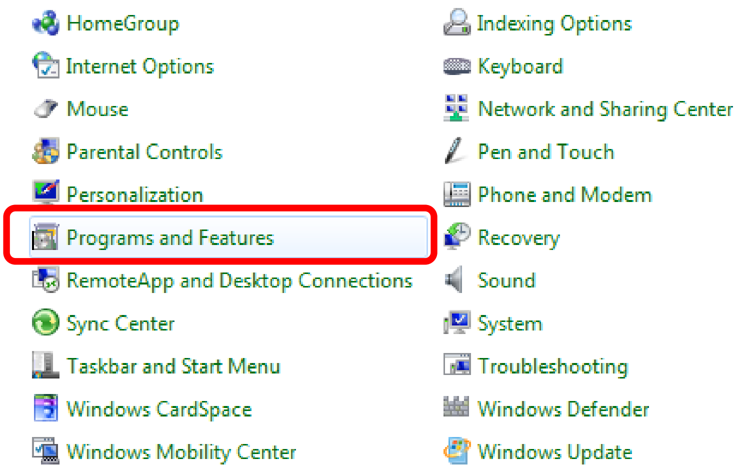


Figure 2.1.2-2 Programs and Features

3. In the Programs and Features window, touch **MX190000A** twice.

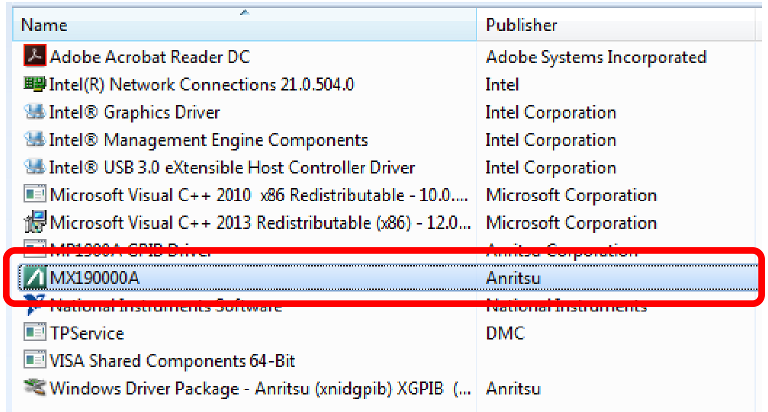


Figure 2.1.2-3 Uninstallation

4. In the following dialog box, touch **Yes**.

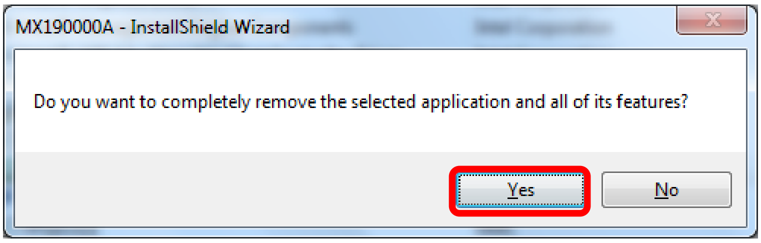


Figure 2.1.2-4 Confirming Uninstallation

5. Touch **No** if you don't want to delete files in the installation folder.
   Touch **Yes** if you want to delete all files in the installation folder.

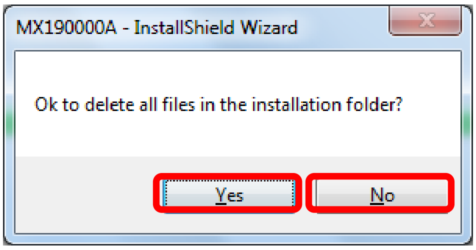


Figure 2.1.2-5 Confirmation of Deleting Folder

6. Upon completion of uninstallation, the following dialog box appears. Touch **Finish** to finish uninstallation.

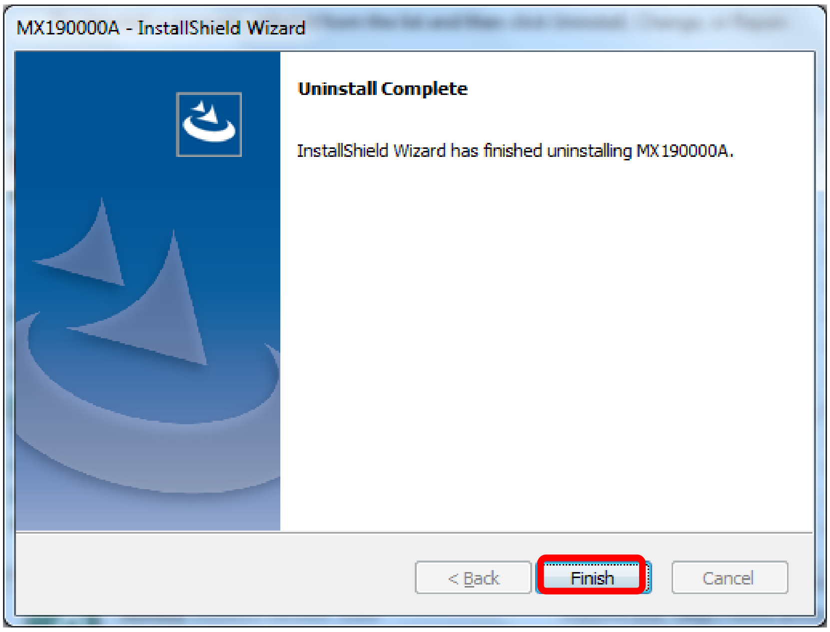


Figure 2.1.2-6 Completion of Uninstallation

2.2 Starting MX190000A

This section describes how to start the MX190000A.

2.2.1 When Installed on MP1900A

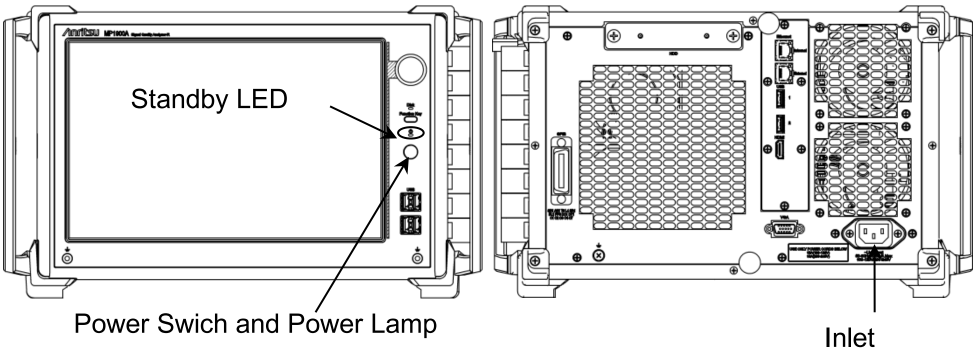


Figure 2.2.1-1 Standby LED and Power Cord Connector of MP1900A

1. Connect the power cord to the inlet on the MP1900A's rear panel. The Standby LED on the front panel lights.

CAUTION

When the Standby LED stays off even if the power cord is connected, the power may have been forcibly turned off due to a system error. In this case, MP1900A cannot be turned on even if the power switch is pressed. Unplug the power cord from the inlet and remove the cause of the system error. Then, reconnect the power cord to the inlet and press the power switch.

2. Turn on the MP1900A power switch, and the Power lamp lights and Windows starts.

3. In the Application Selector screen, touch the icon of the application you wish to start. For details of the Application Selector screen, refer to 3.1.4 “Application Selector”.

Note:

When the **Enable Auto-launch** check box is selected in Auto-launch of 3.1.6.2 “General Settings”, the selected application starts automatically.

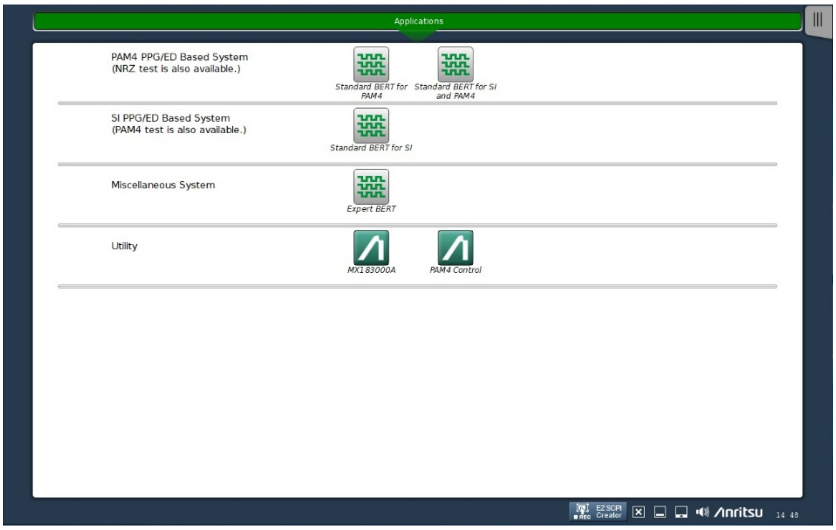


Figure 2.2.1-2 Application Selector Screen

2.2.2 When Installed on External PC

1. Turn on the external PC and start Windows.
2. On the **Start** menu, point to **All Programs, MX190000A**, and then click **MX190000A**.
3. In the Application Selector screen, click the icon of the application you wish to start. For details of the Application Selector screen, refer to 3.1.4 “Application Selector”.

Note:

When the **Enable Auto-launch** check box is selected in Auto-launch of 3.1.6.2 “General Settings”, the selected application starts automatically.

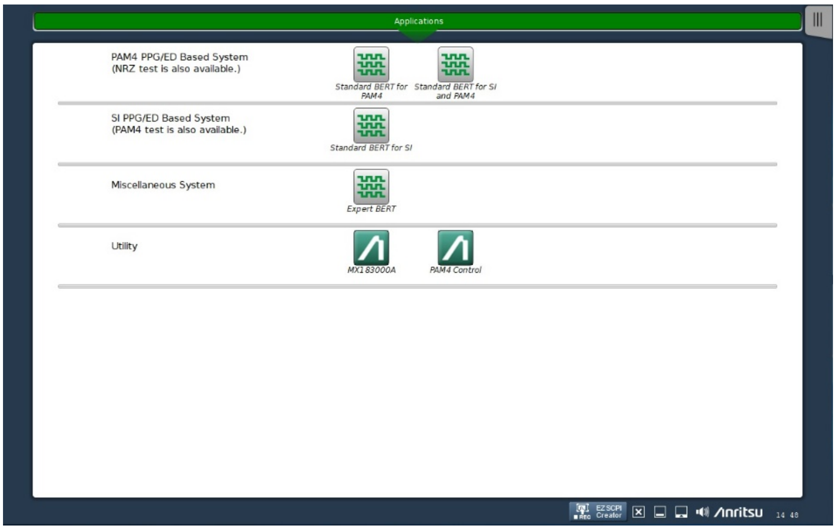


Figure 2.2.2-1 Application Selector Screen

Note:

Go to **Settings** > **System** > **Display**, and then in the **Scale and layout** box, select **100%**. If any other magnification is selected, the MX190000A may not be able to display text correctly.

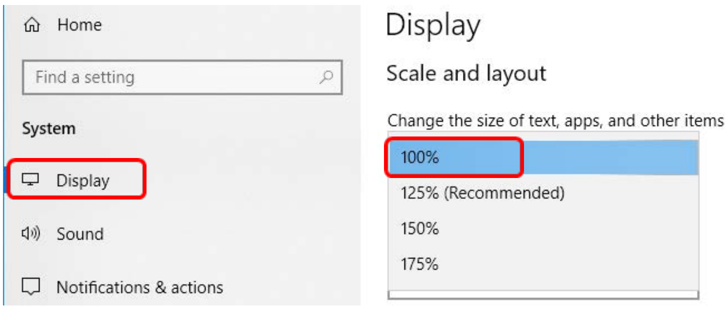


Figure 2.2.2-2 Windows Display Settings

2.2.3 Switching Emulation Modes

When installed on an external PC, MX190000A provides you a tool to switch the following two emulation modes.

- SI PPG/ED Based System
  Emulates a BERT system with a module configuration based on the MU195020A 21G/32G bit/s SI PPG and the MU195040A 21G/32G bit/s SI ED.
- PAM4 PPG/ED Based System
  Emulates a BERT system with a module configuration based on the MU196020A PAM4 PPG and the MU196040B PAM4 ED.

Note:

If the **Install unit/modules emulator** check box is not selected in installation, emulation modes cannot be switched by the tool.

To switch the emulation mode, click the **Start** menu, point to **All Programs**, **MX190000A**, **Configure**, and then click **Emulation Mode**. The Configure the Emulation Mode tool opens as shown below.

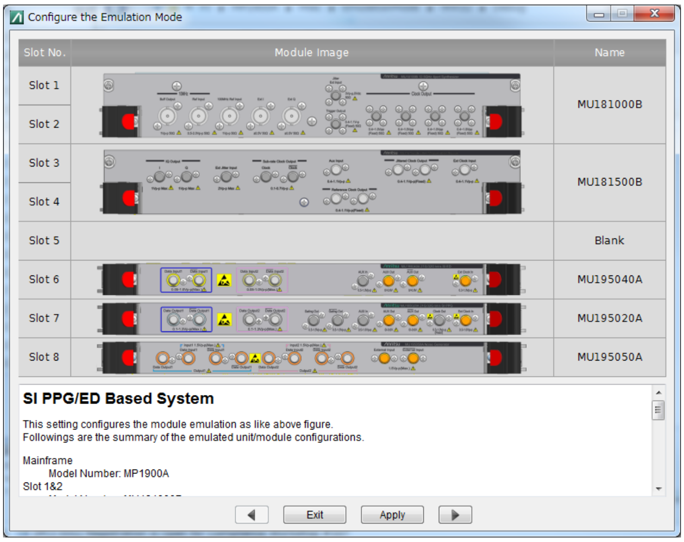


Figure 2.2.3-1 Configure the Emulation Mode Tool

On the tool, use  and  to select the emulation mode, and then click 

to confirm the setting.

When you start MX190000A with the new mode setting, it starts as a BERT system with a selected module configuration. For how to start MX190000A, refer to 2.2.1 “When Installed on MP1900A” and 2.2.2 “When Installed on External PC”.

2.3 Shutting Down MX190000A

MX190000A can be shut down in three ways below:

- On the MP1900A's front panel, press the power switch. The power lamp goes off and the Standby LED lights up (MP1900A will be in standby state).
- In the system control area located at the right-bottom of the screen, touch the **Close** button (). Select **Shut down the software completely** and touch **OK**.
- On the Application Tool bar at right-hand of the screen, touch . Select **Shut down the software completely** and touch **OK**.

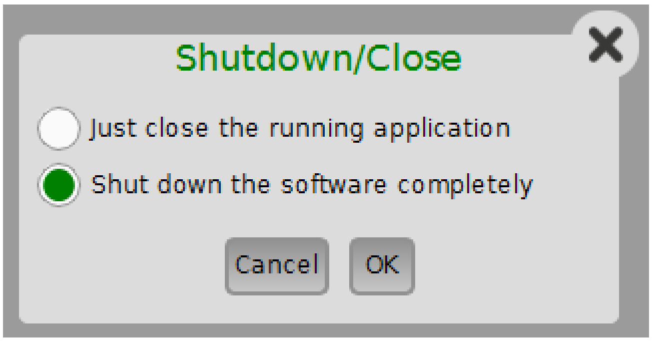


Figure 2.3-1 Shutdown/Close Dialog Box

Note:

Windows does not shut down when exiting MX190000A in the **Shutdown/Close** dialog box.
To be in standby state, press the power switch or shut down Windows.

2.4 Adding Plug-In Module Options

This section explains how to add an option to the plug-in module installed in MP1900A. This procedure applies to only the options with the module model name followed by -3xx (xx: two-digit number).

Note:

When adding one of the following options, make sure the MX190000A version is 5.00.90 or later.

- MU195020A-3xx
- MU195040A-3xx
- MU196020A-3xx
- MU196040B-3xx

1. Connect a USB mouse to the MP1900A.
2. In the system control area located at the right-bottom of the screen, click the **Close** button ( ). Select **Shut down the software completely** and click **OK**.

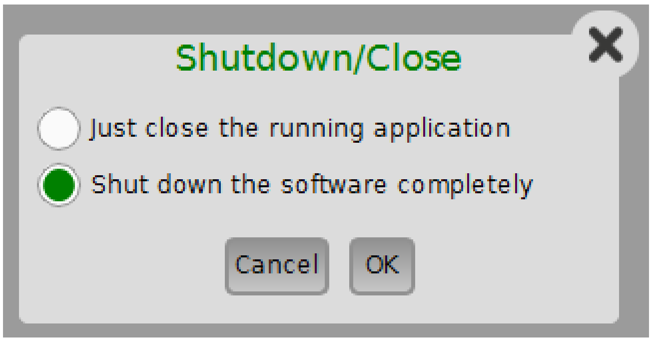


Figure 2.4-1 Shutdown/Close Dialog Box

3. Make sure the MX190000A is closed, and then double-click the OptKey shortcut created on the desktop when installing. The OptKey.exe is located in the following directory:

   C:\Anritsu\MP1900A\OptKey

4. Enter the 25-digit option key provided by Anritsu and click **Add option**.
   The option key can be found in the *Option Key License Certificate* provided by Anritsu.

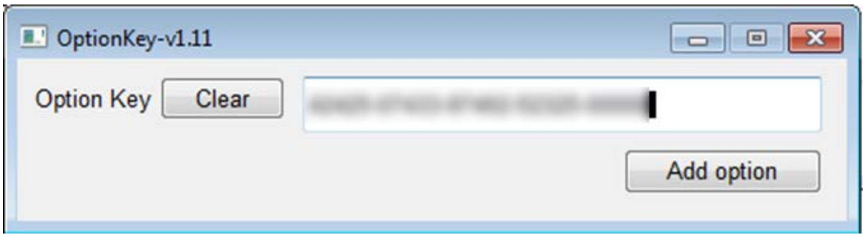


Figure 2.4-2 OptionKey Dialog Box

5. Click **OK**.

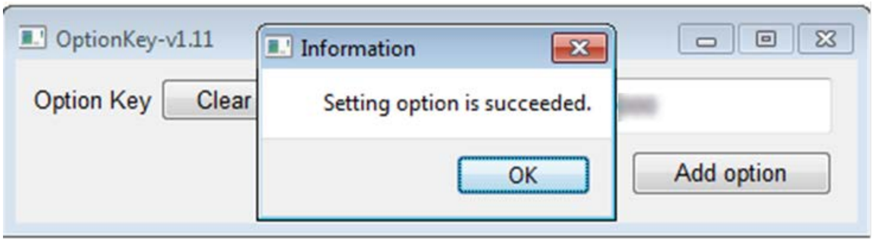


Figure 2.4-3 Information Dialog Box

Now, the option is successfully added to the plug-in module.
At Module(s) Information as described in 3.1.6.1, “System Information”, check that the option is added as a plug-in module.

Slot 7

Model Number: MU195020A

Serial Number: [illegible]

Total Run Time: [illegible]

System version: [illegible]

Firmware version: [illegible]

FPGA PPG_MAIN: [illegible]

FPGA PPG_EXTEND1: [illegible]

IP address: [illegible]

Options

✓ 01 - 32G bit/s Extension

✓ 20 - 2ch Data Output

✓ 21 - 2ch 10Tap Emphasis

✓ 31 - 2ch Data Delay

✓ 41 - 2ch Variable ISI

✓ 50 - Sequence Editor Function

Figure 2.4-4 Example of How Options are Displayed

Chapter 3 Basic Operations

This chapter explains the composition of the screens and the operation method.

In this chapter and Chapter 4, the following modules are correctively referred to as "PPG".

- MU195020A SI PPG
- MU196020A PAM4 PPG
- MU183020A 28G/32G bit/s PPG
- MU183021A 28G/32G bit/s 4ch PPG

Also, the following modules are correctively referred to as "ED".

- MU195040A SI ED
- MU196040A PAM4 ED
- MU196040B PAM4 ED
- MU183040B 28G/32G bit/s High Sensitivity ED
- MU183041B 28G/32G bit/s 4ch High Sensitivity ED

Unless otherwise specified, MU195020A and MU195040A are used for explanation of screens.

3.1 Basic Screen Operations

The MP1900A is equipped with a touch-screen display, which includes all operation keys except for the power switch and function keys. This section explains basic screen operations including how to use the operation keys on the touch-screen display.

3.1.1 GUI Operation Concept

The MP1900A's GUI consists of two functional spaces: Application Selector and workspace.

- The Application Selector is the screen that appears after MX190000A is started, and that consists of two areas:
  Applications area: use for starting an application
  Utility area: use for starting other software than MX190000A (hereinafter, external software)
  For details, refer to 3.1.4 "Application Selector".
- In the workspace, you can operate the application you started from the Application Selector.

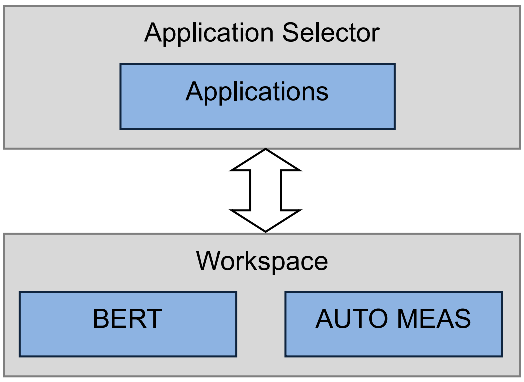


Figure 3.1.1-1 Two Functional Spaces

Note:

Multiple applications cannot be started at the same time from Application Selector.

3.1.2 Display Switching Screens

Switching to Application selector from Workspace

Workspace and Application Selector are switched in vertical direction. Touching a tab displayed at top of each screen in Workspace switches the screen display from Workspace to Application selector.

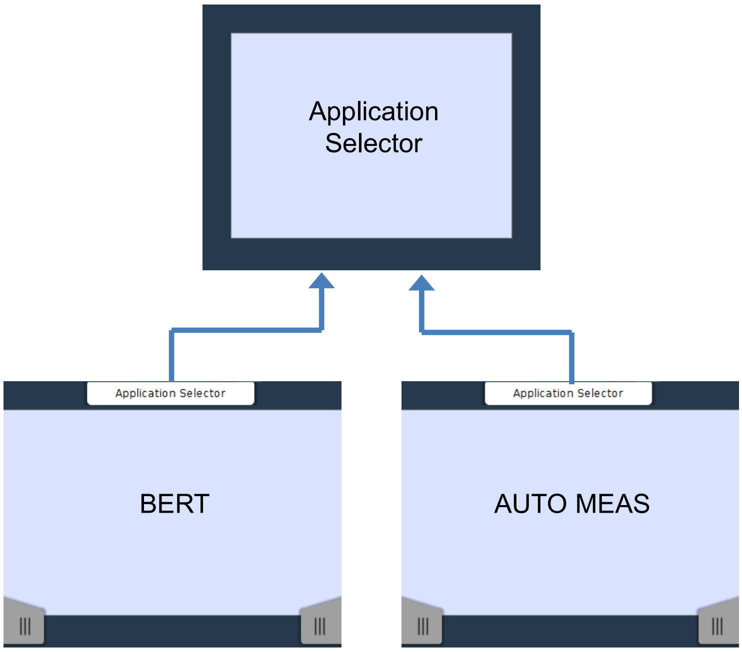


Figure 3.1.2-1 Vertically Switching to Application Selector from Workspace

Switching to Workspace from Application selector

When an application is currently running, the tab appears at bottom center of Application selector. Touching this tab switches the screen display to Workspace.

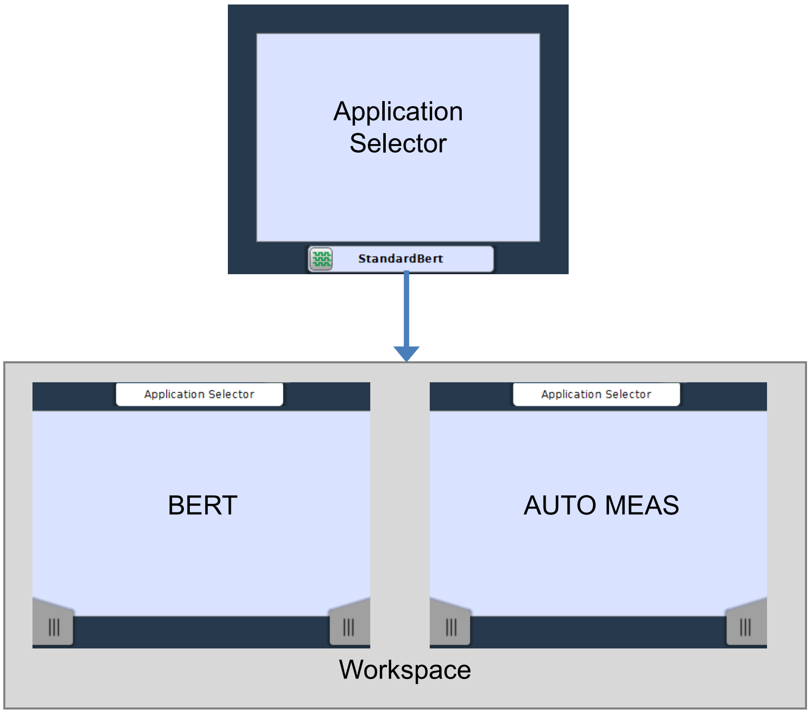


Figure 3.1.2-2 Switching to Workspace from Application Selector

Switching screens within a Workspace

An application has several screens, and these screens are switched horizontally within Workspace.

In the workspace you can switch between BERT screen and AUTO MEAS screen by touching the navigation tabs displayed at the bottom corners of the screen.

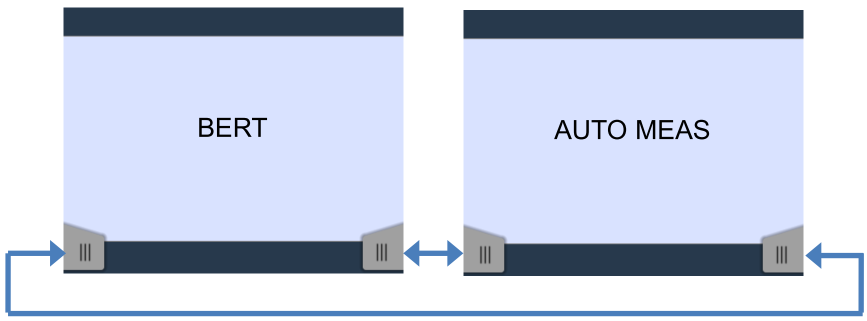


Figure 3.1.2-3 Horizontally Switching by Using Navigation Tabs

The screen name (hereinafter, “screen indicator”) is displayed at bottom of the screen. Screen can be switched by touching the screen indicator.

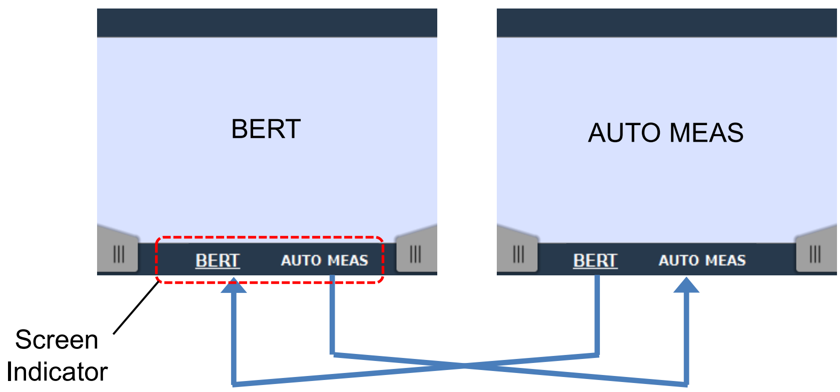


Figure 3.1.2-4 Switching Between Screens by Touching the Screen Indicator

3.1.3 System Control Area

System Control Area is located at right bottom of the screen. In this area, buttons which control basic function of the system are placed.

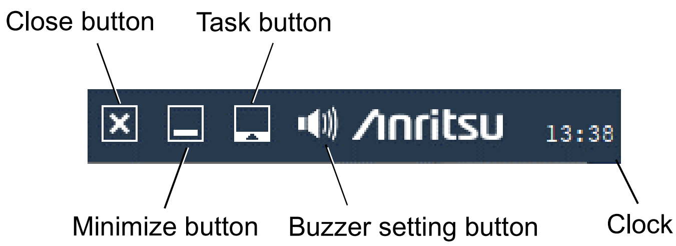


Figure 3.1.3-1 System Control Area

3.1.3.1 Clock

Displays the current time. Touching the clock displays year, month, day, and time.

3.1.3.2 Buzzer setting button

Touching  displays the **Buzzer Settings** dialog box.

Set buzzer volume or on or off of System Alarm, Measurement Alarm, and Measurement Error.

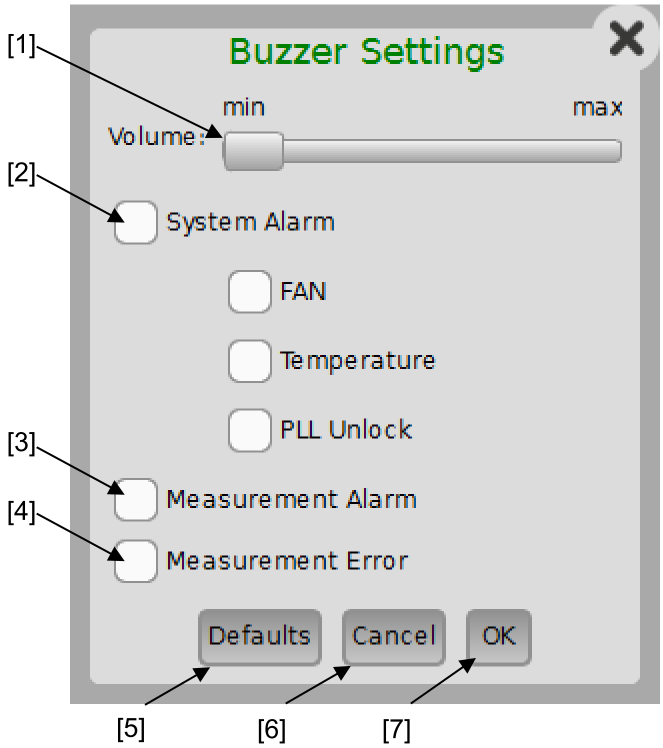


Figure 3.1.3.2-1 Buzzer Settings Dialog Box

[1] Volume
Set buzzer volume.

[2] System Alarm
Turn system alarm buzzer on or off and set items of system alarm. PLL Unlock is enabled and able to set when MU181000A/B is installed.

[3] Measurement Alarm
Turn buzzer on or off for measurement alarm occurrence.

[4] Measurement Error
Turn alarm buzzer on or off for measurement error occurrence.

[5] Defaults
Resets the settings to default.

[6] Cancel
Aborts settings and closes the dialog box.

[7] OK
Sets settings effective and closes the dialog box.

3.1.3.3 Task button

Touching displays the taskbar. For the taskbar, refer to 3.1.5 “Taskbar”.

3.1.3.4 Minimize button

Touching minimizes the screen and hides it.

3.1.3.5 Close button

Touching displays the dialog box below.

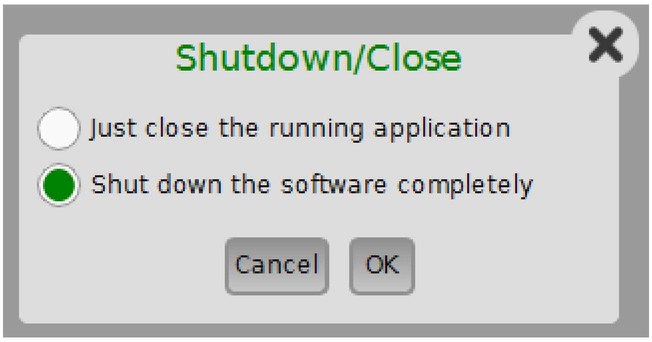


Figure 3.1.3.5-1 Shutdown/Close Dialog Box

Just close the running application:
Closes the running application.

Shut down the software completely:
Exits MX190000A completely including Application Selector.

3.1.4 Application Selector

The Application Selector is the screen that appears after MX190000A is started, and that consists of the PAM4 PPG/ED Based System, SI PPG/ED Based System and Miscellaneous System areas for starting the applications, and the Utility area for starting external software.

3.1.4.1 PAM4 PPG/ED Based System Area

The PAM4 PPG/ED Based System area provides the icons of the applications that operate with the following module configuration.

- One is the icon of the application that operates in a module configuration based on the MU196020A PAM4 PPG and the MU196040B PAM4 ED. The Standard BERT for PAM4 can be started as an application.
- The other is the icon of the application that operates in a module configuration based on the MU196020A PAM4 PPG and the MU195040A SI ED. The Standard BERT for SI and PAM4 can be started as an application.

To start the application, touch the icon.
These icons are not available when an application is already started.

Note:

In this area, you will see the application that uses the PAM4 module, but that can also evaluate NRZ signals.

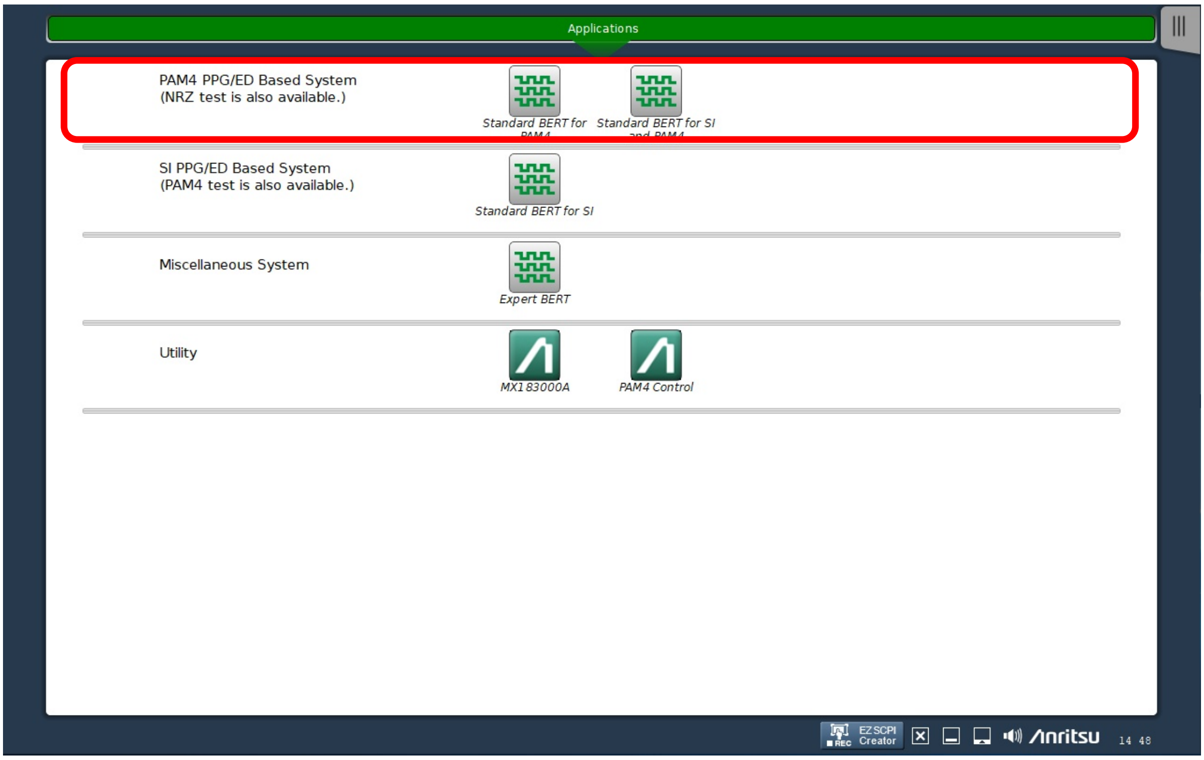


Figure 3.1.4.1-1 PAM4 PPG/ED Based System Area

3.1.4.2 SI PPG/ED Based System Area

The SI PPG/ED Based System area provides the icon of the application that operates in a module configuration based on the MU195020A 21G/32G bit/s SI PPG and the MU195040A 21G/32G bit/s SI ED. The **Standard BERT for SI** can be started by touching the icon.
This icon is not available when an application is already started.

Note:

In this area, you will see the application that uses the SI PPG and SI ED modules, but that can also evaluate PAM4 signals by using the following peripherals together:

- G0374A 64Gbaud PAM4 DAC
- G0375A 32Gbaud Power PAM4 Converter
- G0376A 32Gbaud PAM4 Decoder
- MZ1834A/MZ1834B 4PAM Converter

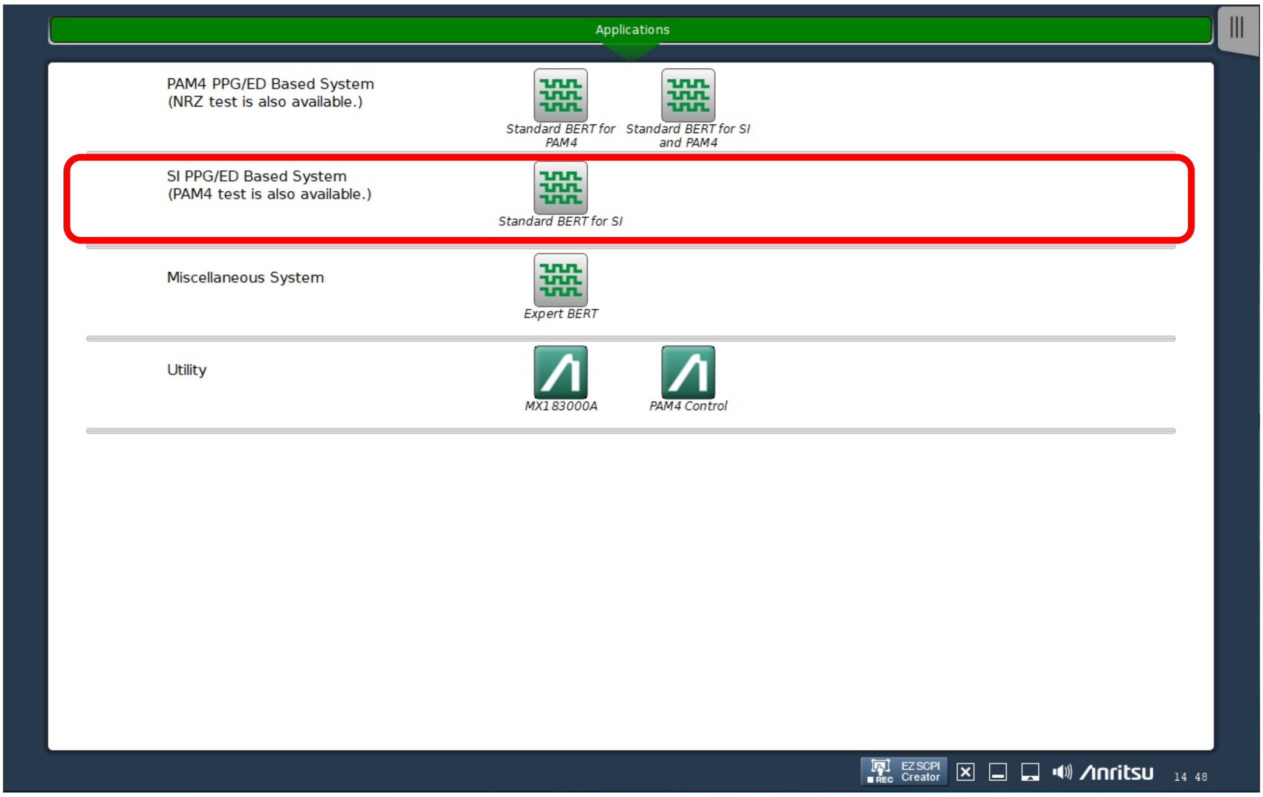


Figure 3.1.4.2-1 SI PPG/ED Based System Area

3.1.4.3 Miscellaneous System Area

The Miscellaneous System area provides the icon of the application that provides the expert BERT function. The **Expert BERT** can be started by touching the icon.

This icon is not available when an application is already started.

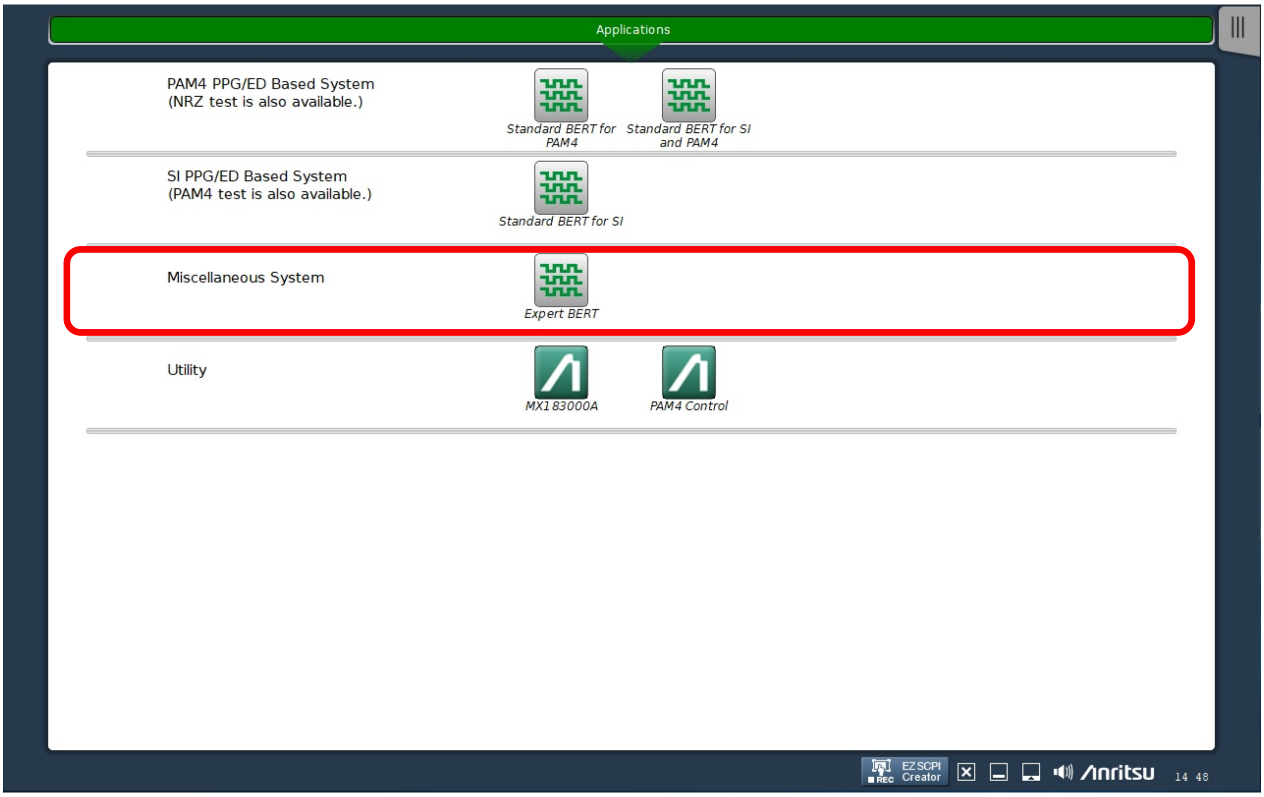


Figure 3.1.4.3-1 Miscellaneous System Area

3.1.4.4 Utility Area

In Utility area, you can start external software which works cooperating with MX190000A. In the current version, MX183000A and PAM4 Control are available as Utilities.

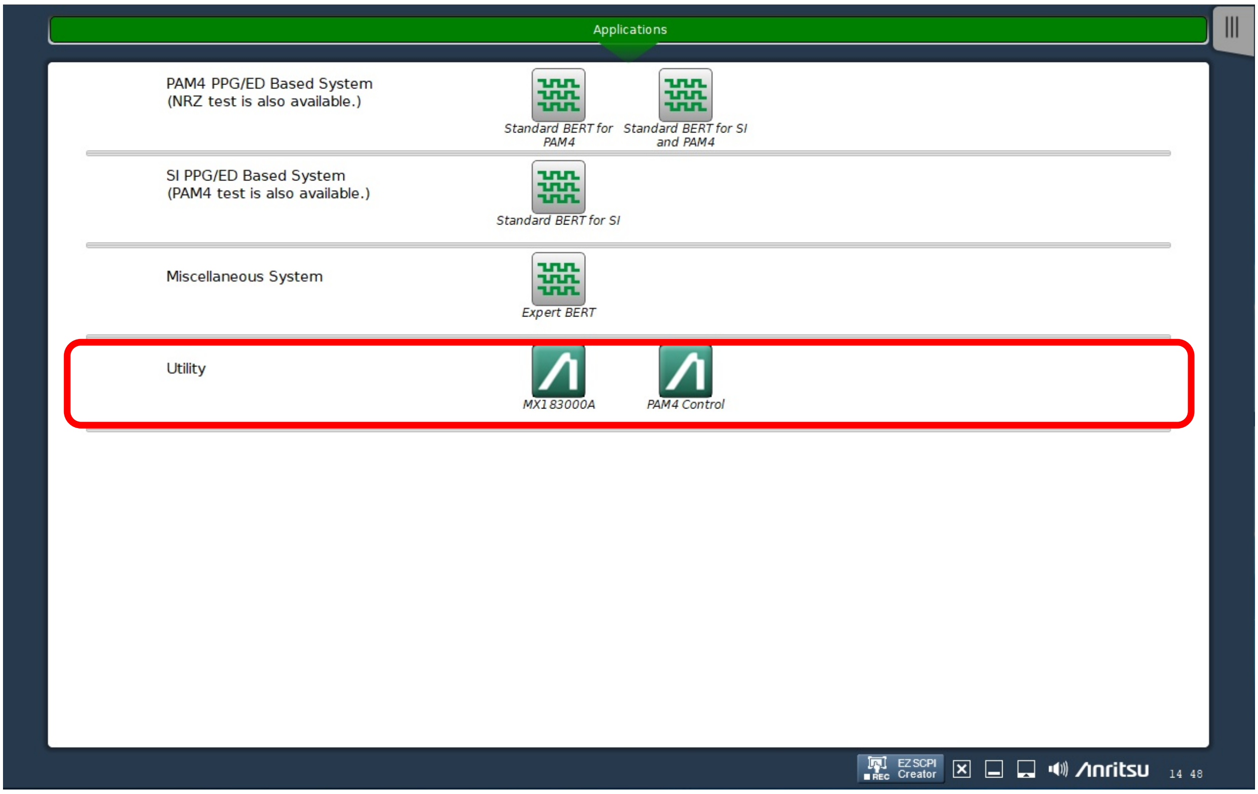


Figure 3.1.4.4-1 Utility Area

3.1.5 Taskbar

The taskbar allows users to switch a task to be displayed. Tasks which can be switched are Application selector, the running application, and the running utility.

The taskbar appears by touching  on the system control area or by pressing MP1900A **Function Key**.

For Application, refer to 3.1.4.1 “PAM4 PPG/ED Based System Area”, 3.1.4.2 “SI PPG/ED Based System Area”, 3.1.4.3 “Miscellaneous System Area”, for Utilities, refer to 3.1.4.4 “Utility Area”.

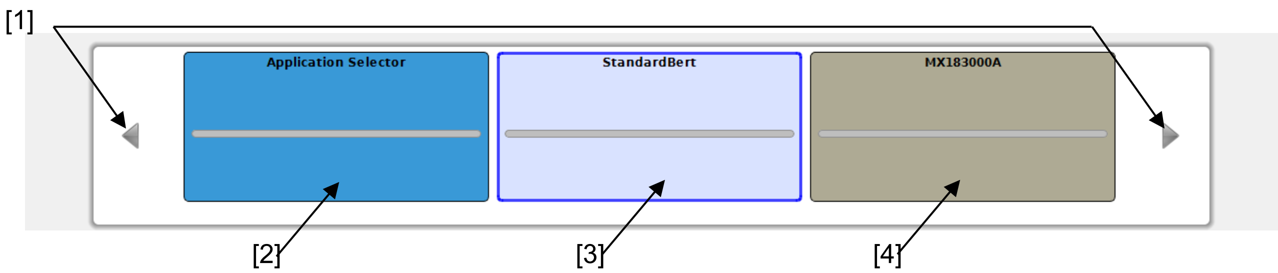


Figure 3.1.5-1 Taskbar

[1] Scroll buttons
These buttons are enabled when there are four or more tasks.
Touching a scroll button slides displayed tasks.

[2] Application Selector Task
Touching this task button changes screen display to Application selector.

[3] Application Task
The name of the application running on Workspace is displayed on a task button.
When no applications are running on Workspace, Application Task does not appear.
Touching this task button changes screen display to the running application.

[4] Utility Task
The name of the running utility is displayed on the task button.
When no utilities are running on Workspace, Utility Task does not appear. Touching this task button changes screen display to the running utility.

3.1.6 System Toolbar

Touching the navigation tab displayed at top right-hand corner of the screen displays the System Toolbar by sliding.

System Toolbar contains screens of System Information, General Settings, File Explorer, Help, and Module Setting.

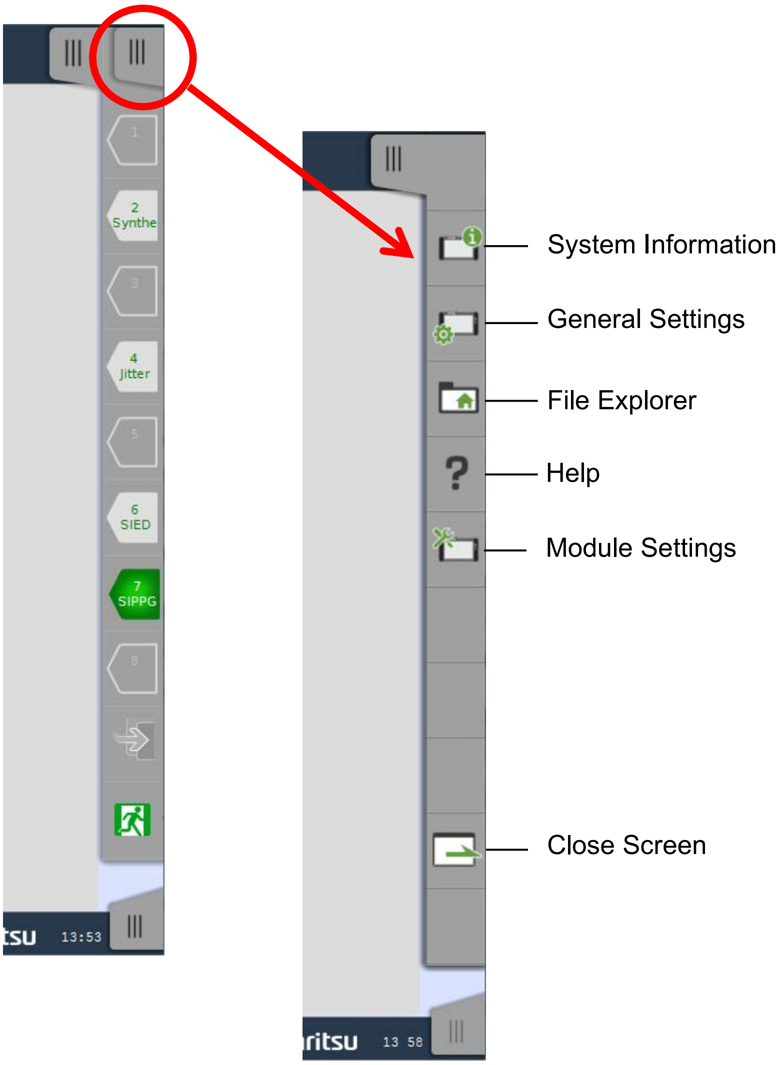


Figure 3.1.6-1 How to Display System Toolbar and Icon Names

3.1.6.1　System Information

Touching displays System Information. Touching **Update About Info** updates System Information to latest one.

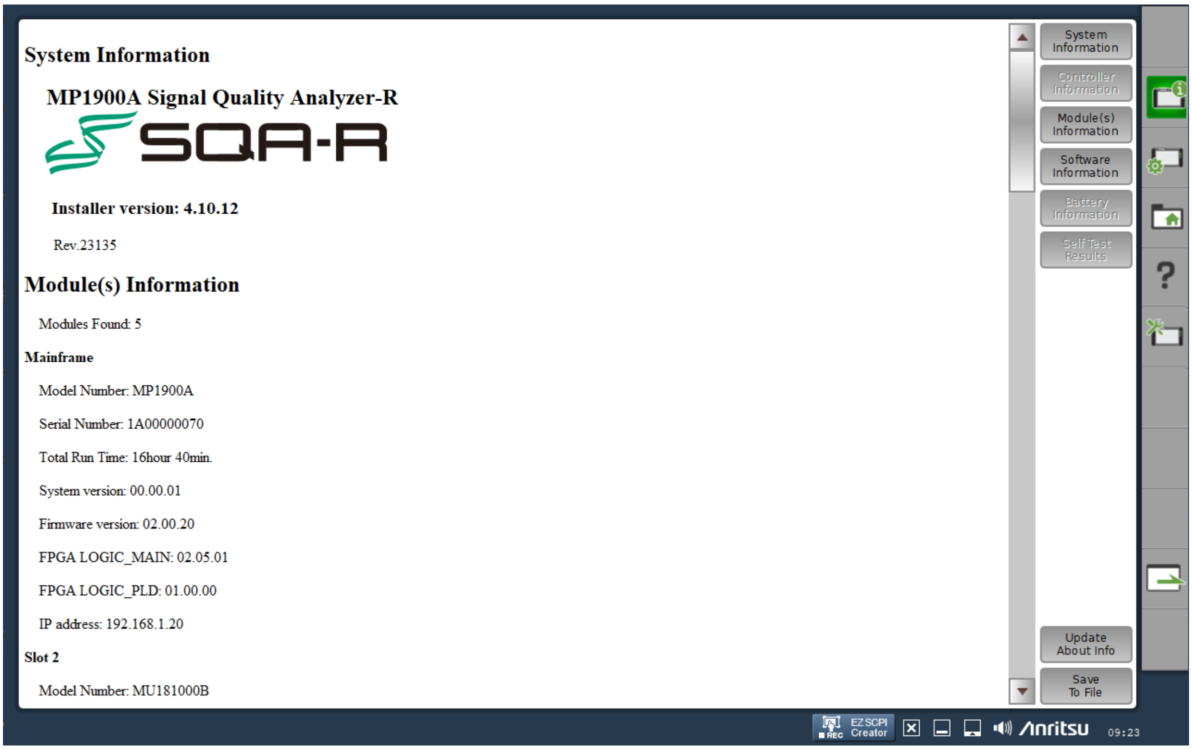


Figure 3.1.6.1-1　System Information

Button changes to while System Information is displayed.

Touching or closes System Information.

System Information displays the following information.

- System Information
  Version number of the current system.
- Module(s) Information
  For MP1900A and each module inserted into slot: Model name, serial number, total running hours, version, IP address, option information.
- Software Information
  For application and utility: version.

Note:

The total operation time is updated when the application is started or **Update About Info** is touched.

The contents displayed in System Information can be saved in HTML format.
Touching **Save To File** opens the **Save System Information** dialog box and you can specify the destination file name and the destination folder.

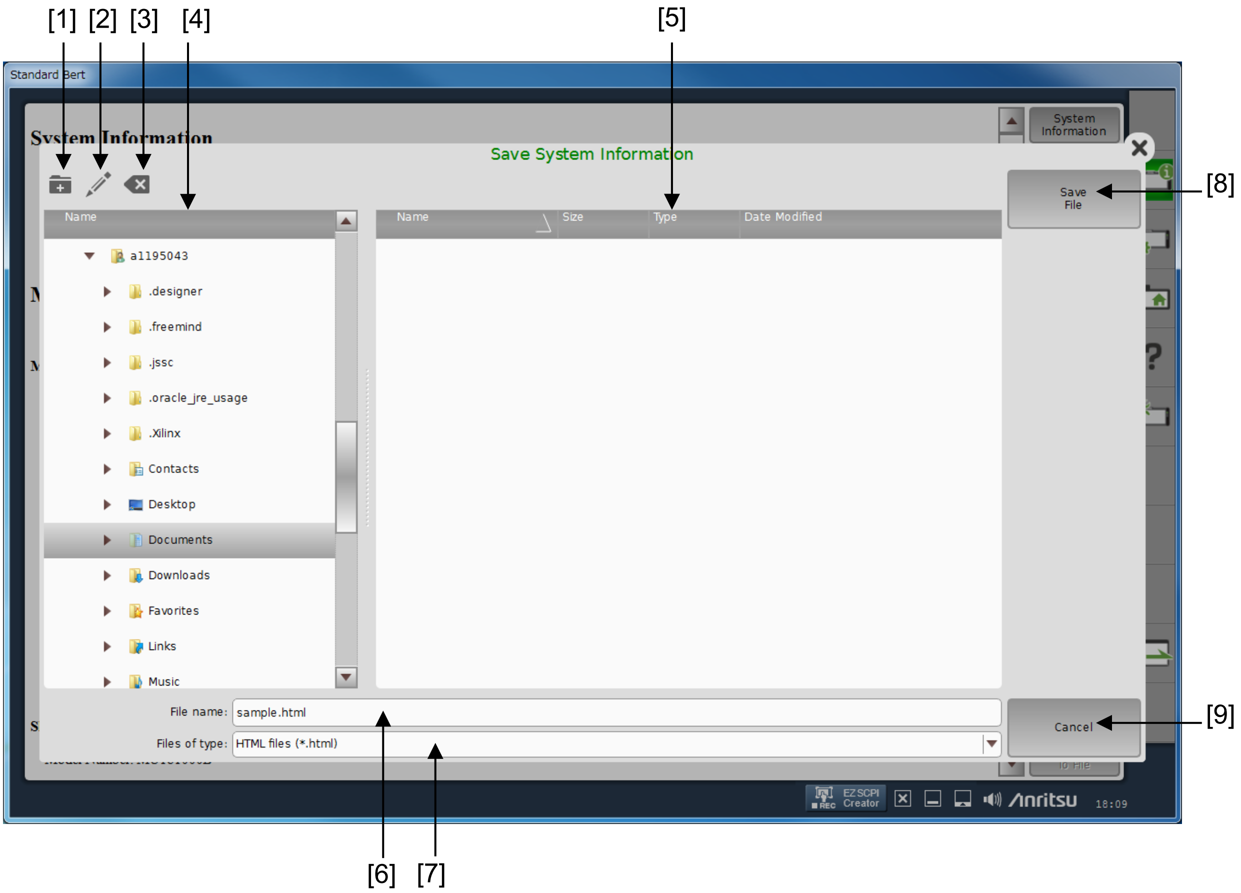


Figure 3.1.6.1-2 Save System Information Dialog Box

[1] Create Folder
Touching this icon creates a folder.

[2] Rename
Touching this icon renames the selected file or folder.

[3] Delete
Touching this icon deletes the selected files or folder.

[4] Folder View
Folders are displayed in a tree format.

[5] File View
Displays file names.

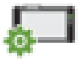
[6] File name
Enter the name for the file to save.

[7] Files of type
Specify a file format.

[8] Save File
Saves a file by the specified file name.

[9] Cancel
Closes the **Save System Information** dialog box.

3.1.6.2 General Settings

Touching  displays General Settings.

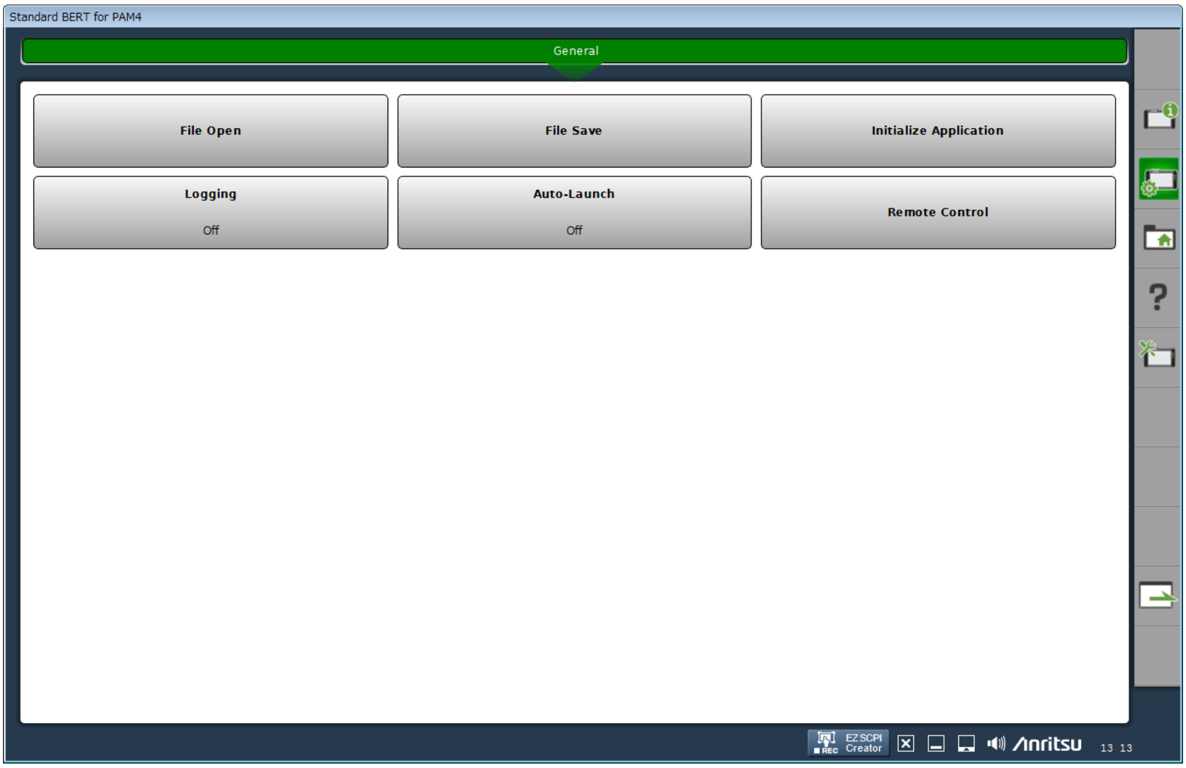


Figure 3.1.6.2-1 General Settings Screen

Button changes to  while General Settings is displayed. Touching  or  closes General Settings.

The following items can be set on General Settings screen.

- File Open
  Displays the **Open Setting File** dialog box.
  For details, refer to 3.1.7 "Loading a File".

- File Save
  Displays the **Save Setting File** dialog box.
  For details, refer to 3.1.8 "Saving to Files"

- Initialize Application
  Sets all modules installed in MP1900A to default settings at factory shipment.

Note:

When the Initialize function is executed while PPG and ED are in Combination or Channel Synchronization status, Independent, which is the initial status, is restored.

- Logging
  Logging allows users to set levels which are output into the log. Always set to **Off**. Other options are reserved for maintenance.

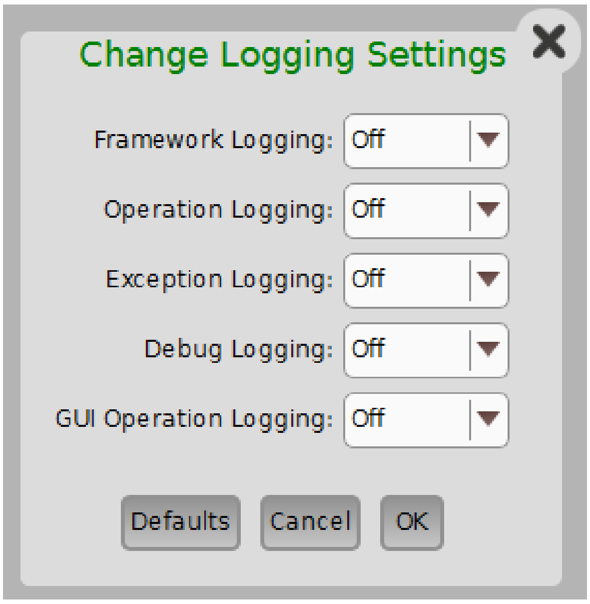


Figure 3.1.6.2-2 Change Logging Settings Dialog Box

- Auto-Launch
  Auto-Launch allows users to set the application which launches automatically after MX190000A has started.

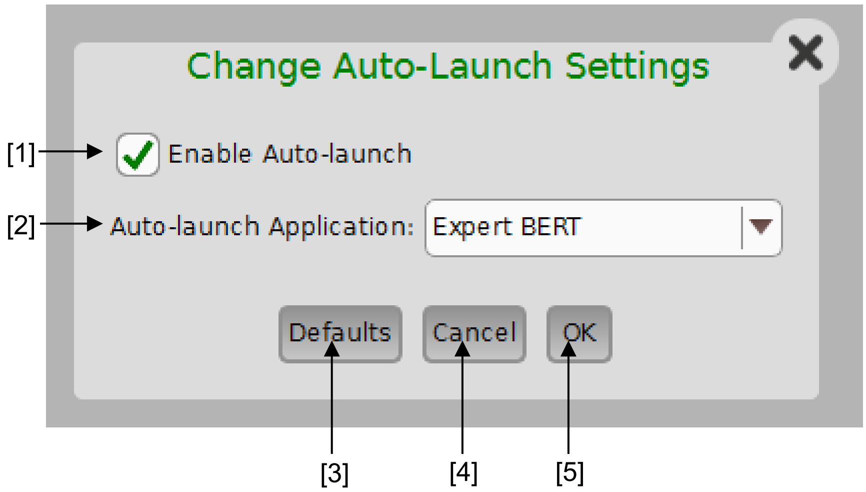


Figure 3.1.6.2-3 Change Auto-Launch Settings Dialog Box

[1] Enable Auto-launch
Selecting the check box enables to launch the application specified at Auto-launch Application after starting MX190000A.
If the check box is cleared, Application selector appears after starting MX190000A.

[2] Auto-launch Application
Specify an application to launch after starting MX190000A.

[3] Defaults
Resets the settings to defaults.

[4] Cancel
Closes the dialog box.

[5] OK
Establishes settings and closes the dialog box.

- Remote Control
  Set port and address for remote controlling MX190000A from an external PC.

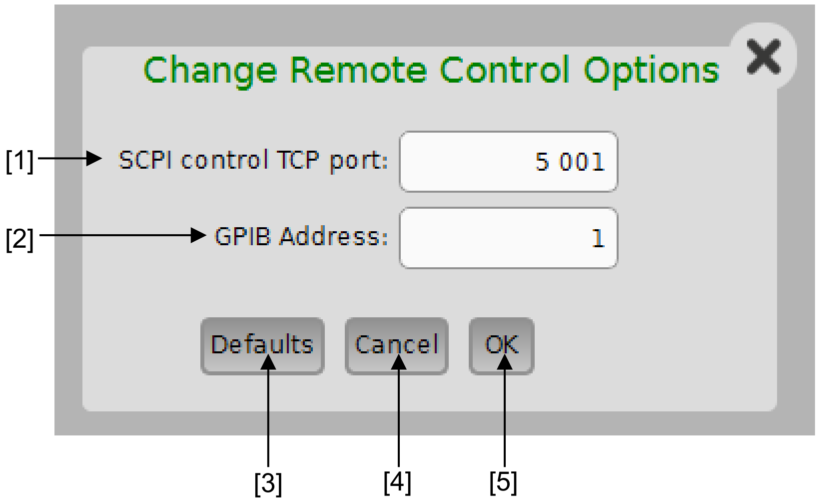


Figure 3.1.6.2-4 Change Remote Control Options Dialog Box

[1] SCPI control TCP port
Set a TCP port number when remote controlling MX190000A with Ethernet interface.
Set the same TCP port number with the controller such as an external PC. As for the socket type, MX190000A behaves as TCP server.

For details of IP address setting, refer to 5.2 “Using Ethernet” in the *MP1900A Signal Quality Analyzer-R Operation Manual*.

[2] GPIB Address
Set a GPIB address when remote controlling MX190000A with GPIB interface.

[3] Defaults
Resets the settings to defaults.

[4] Cancel
Closes the dialog box.

[5] OK
Establishes settings and closes the dialog box.

Note:

TCP port number and GPIB address are not reflected to MP1900A even if you have touched **OK**. Quit MX190000A once and these settings are actually reflected after rebooting MP1900A.

3.1.6.3 File Explorer

 The File Explorer icon launches the file manager screen.

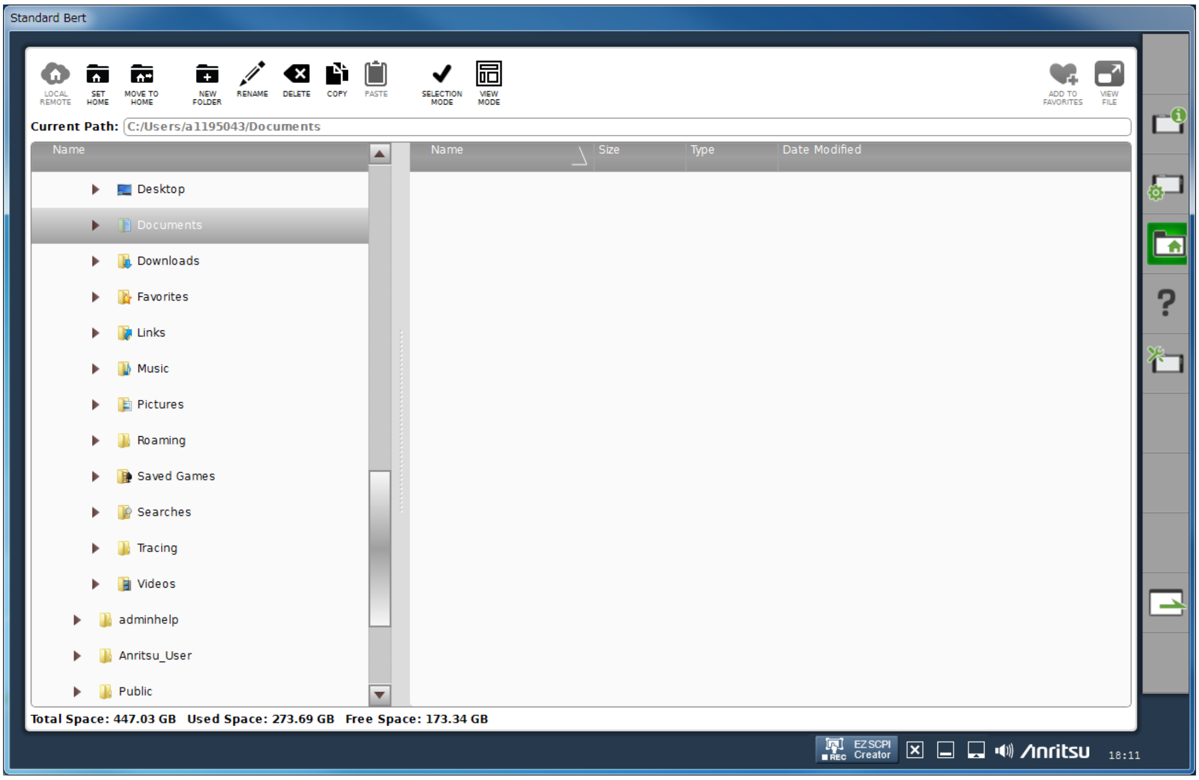


Figure 3.1.6.3-1 File Explorer Screen

Button changes to  while File Explorer is displayed.

Touching  or  closes File Explorer.

File Explorer provides file or folder operation functions, referring to the internal storage and the external storage connected to MP1900A. Details are as below.

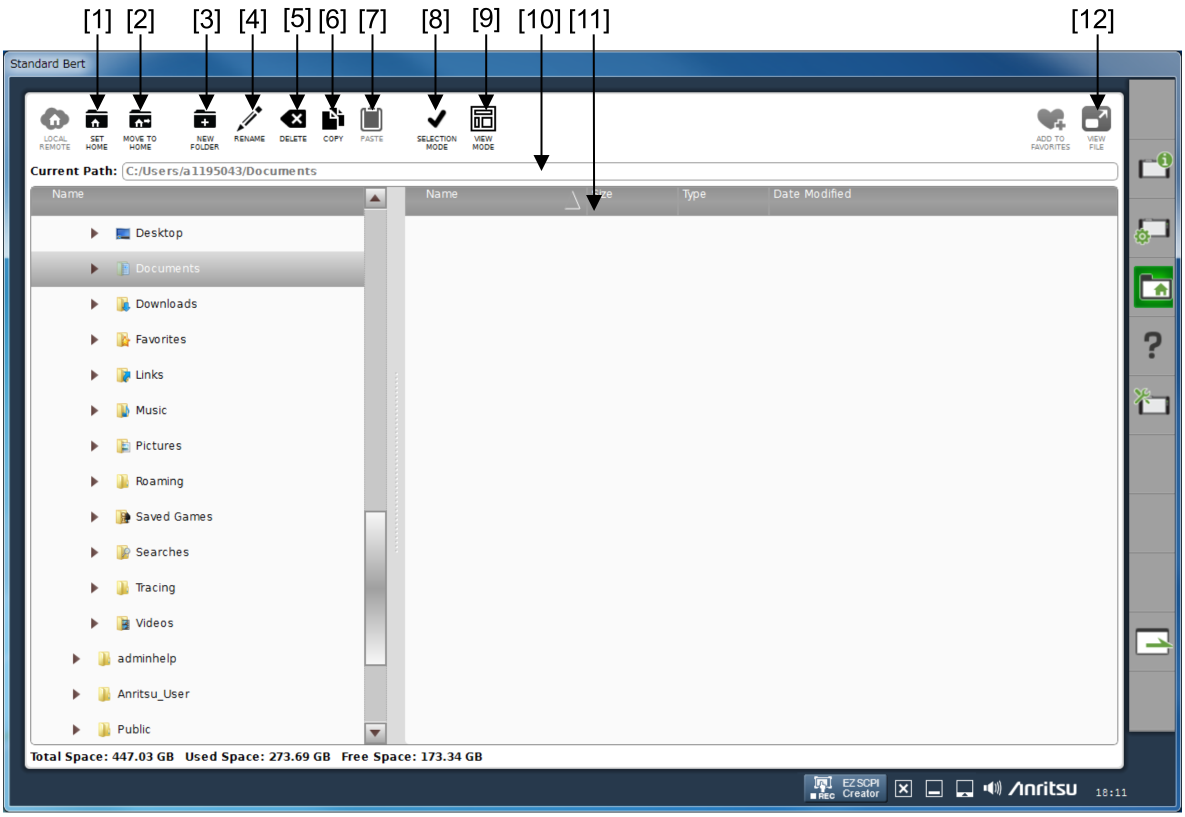


Figure 3.1.6.3-2 File Explorer Screen

[1] SET HOME
Sets the current folder to the home folder.

[2] MOVE TO HOME
Moves to the home folder.

[3] NEW FOLDER
Creates a new folder.

[4] RENAME
Edits the file name or the folder name.

[5] DELETE
Deletes the selected file(s) or folder(s).

[6] COPY
Copies the selected file(s) or folder(s).

[7] PASTE
Pastes the file(s) or folder(s).

[8] SELECTION MODE
Switches between single selection and multiple selection for files or folders.

[9] VIEW MODE
Switches the GUI layout.

[10] Current Path
Displays the path of currently selected folder.

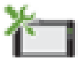
[11] Tree View
Files or folders are displayed in a tree format.

[12] VIEW FILE
Shows contents of a text file.

3.1.6.4 Help

Touching  icon displays the English operation manual in PDF.

3.1.6.5 Module Settings

Touching  displays Module Settings.

Also, Touching  in application screen displays Module Settings.

In Module Settings screen, status of modules installed in MP1900A appears. Modules Settings screen also allows users to updated FPGA and firmware. Furthermore, the **Combination Setting** dialog box, **Grouping** dialog box, and **Multi Channel Calibration** dialog box can be opened from the Module Settings screen.

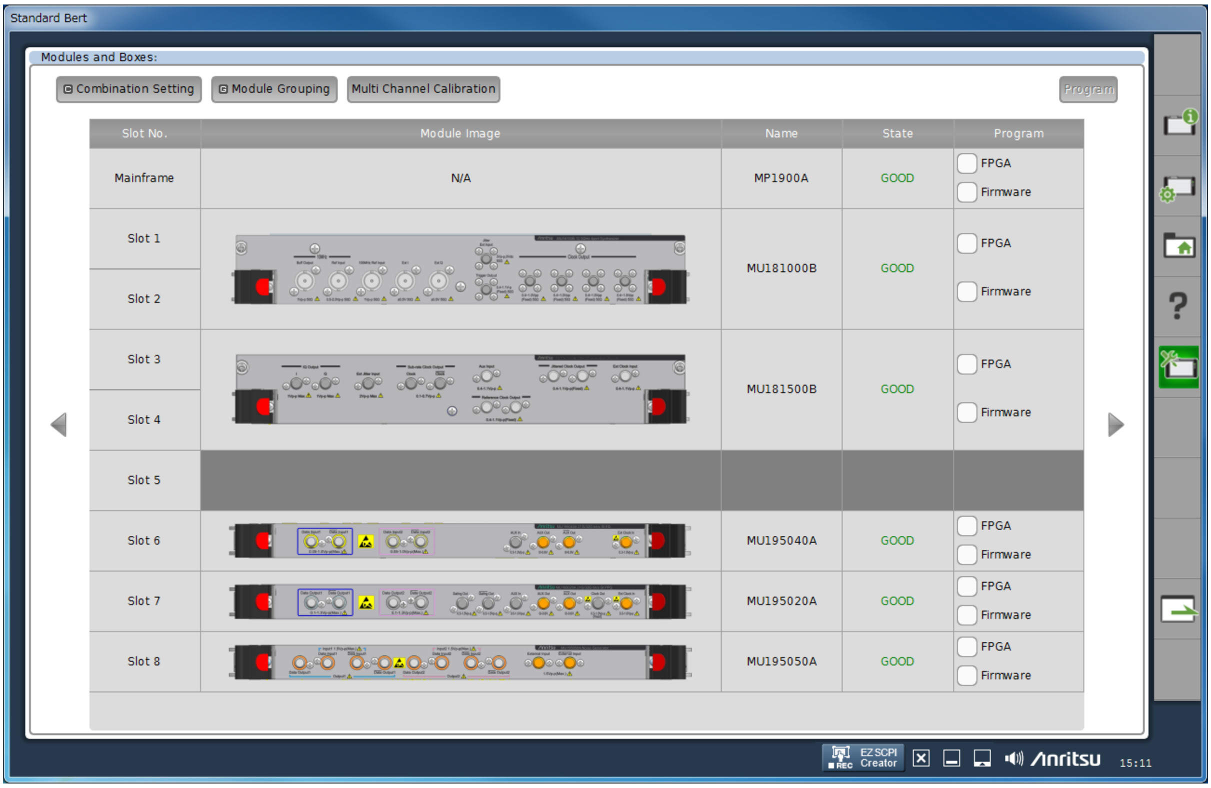
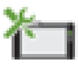
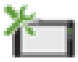


Figure 3.1.6.5-1 Module Settings Screen

 changes to  while Module Settings is displayed. Touching  or  closes Module Settings.

If the trouble has occurred in the module,  changes to 

and  changes to .

And  changes .

Details of Module Settings screen are shown below.

Figure 3.1.6.5-2 Modules Settings Screen

[1]  Combination Setting
Touching this button displays the **Combination Setting** dialog box.
For details, refer to 3.3 “Multi Channel Function”.

[2]  Module Grouping
Touching this button displays the **Grouping** dialog box.
For details, refer to 3.4 “Module Grouping Function”.

[3] Multi Channel Calibration
Touching this button displays the **Module Channel Calibration** dialog box. For details, refer to 3.5 “Multi Channel Calibration Function”.

[4] Program
Touching this button updates the FPGA or the firmware in the module specified by selecting (✓) in the Program column.
Update the firmware after terminating the running application.
Refer to 3.1.3.5, "Close button" for how to terminate the application.

[5] Slot No. column
Slot numbers in MP1900A are displayed.

[6] Module Image column
Panel images of module installed in the slot are displayed.

[7] Name column
Models of modules installed in the slot are displayed.

[8] State column
Models of modules installed in the slot are displayed.

- **Blank**
  Module is not installed.
- **GOOD**
  Module is in normal state.
- Version Mismatch
  FPGA or firmware of the module does not match the version which MX190000A is requiring.
  In case of Version Mismatch, the check box of the FPGA or firmware which is required to update in the Program column is automatically selected (✓).

[9] Program column
To update FPGA or firmware of the module installed in the slot, select each check box (→ ✓) and touch **Program**.
When Version Mismatch is displayed in the State column, the check box of FPGA or firmware which should be updated is automatically selected (✓). Perform update by touching **Program**.

⚠ CAUTION

Do not turn off while updating FPGA or firmware is in progress. Turning off while updating FPGA or firmware is in progress may cause that the module does not work properly.

3.1.7 Loading a File

In the **Open Setting File** dialog box displayed from **File Open** in 3.1.6.2 “General Settings”, load a setting information file (.CND).

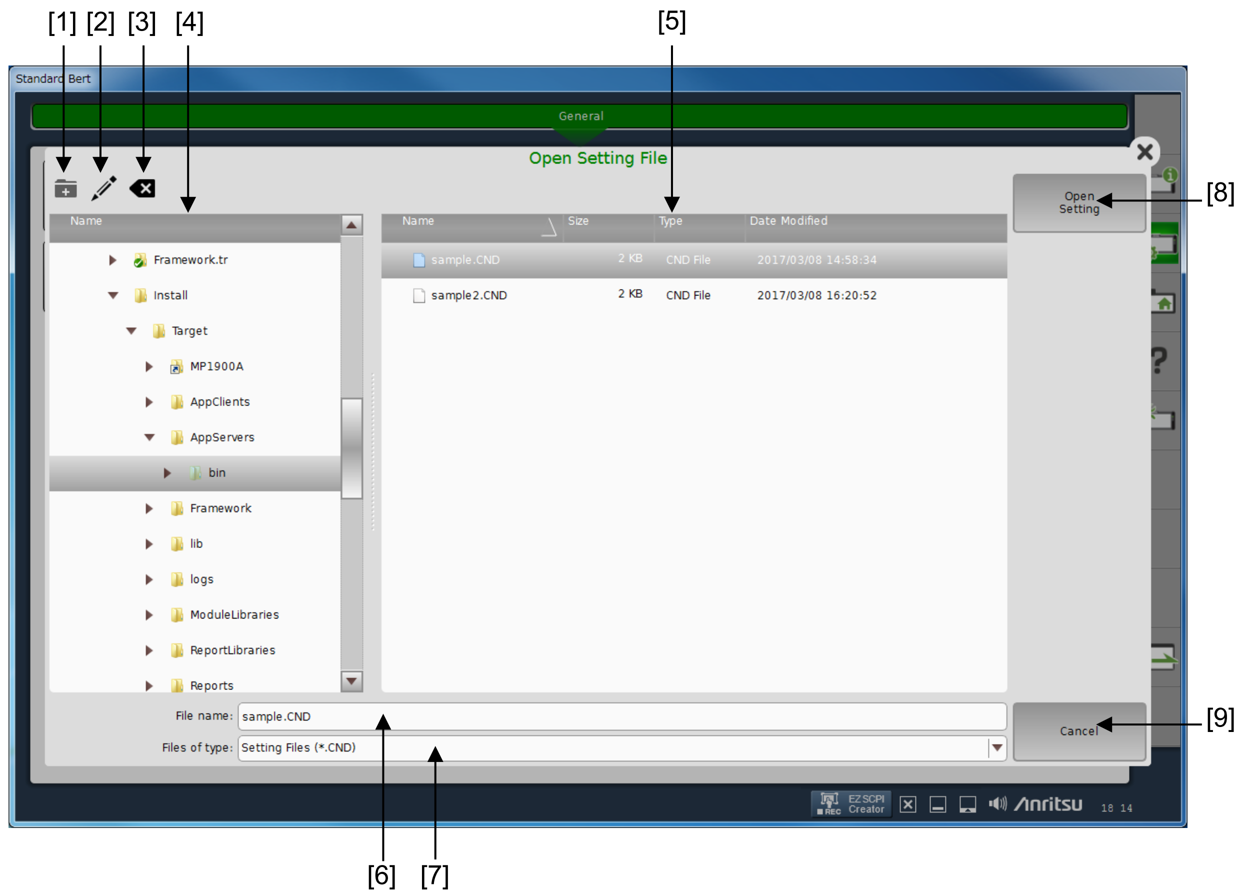


Figure 3.1.7-1 Open Setting File Dialog Box

[1] Create Folder
Creates a new folder.

[2] Rename
Edits the file name or the folder name.

[3] Delete
Deletes the selected file(s) or folder(s).

[4] Folder View
Displays folders in a tree format.

[5] File View
Displays files.

[6] File name
Specify a setting information file name.

[7] Files of type
Specify a file format.

[8] Open Setting
Opens a specified setting file.

[9] Cancel
Closes the **Open Setting File** dialog box.

3.1.8 Saving to Files

In the **Save Setting File** dialog box displayed from **File Save** in 3.1.6.2 “General Settings”, save a setting information file (.CND).

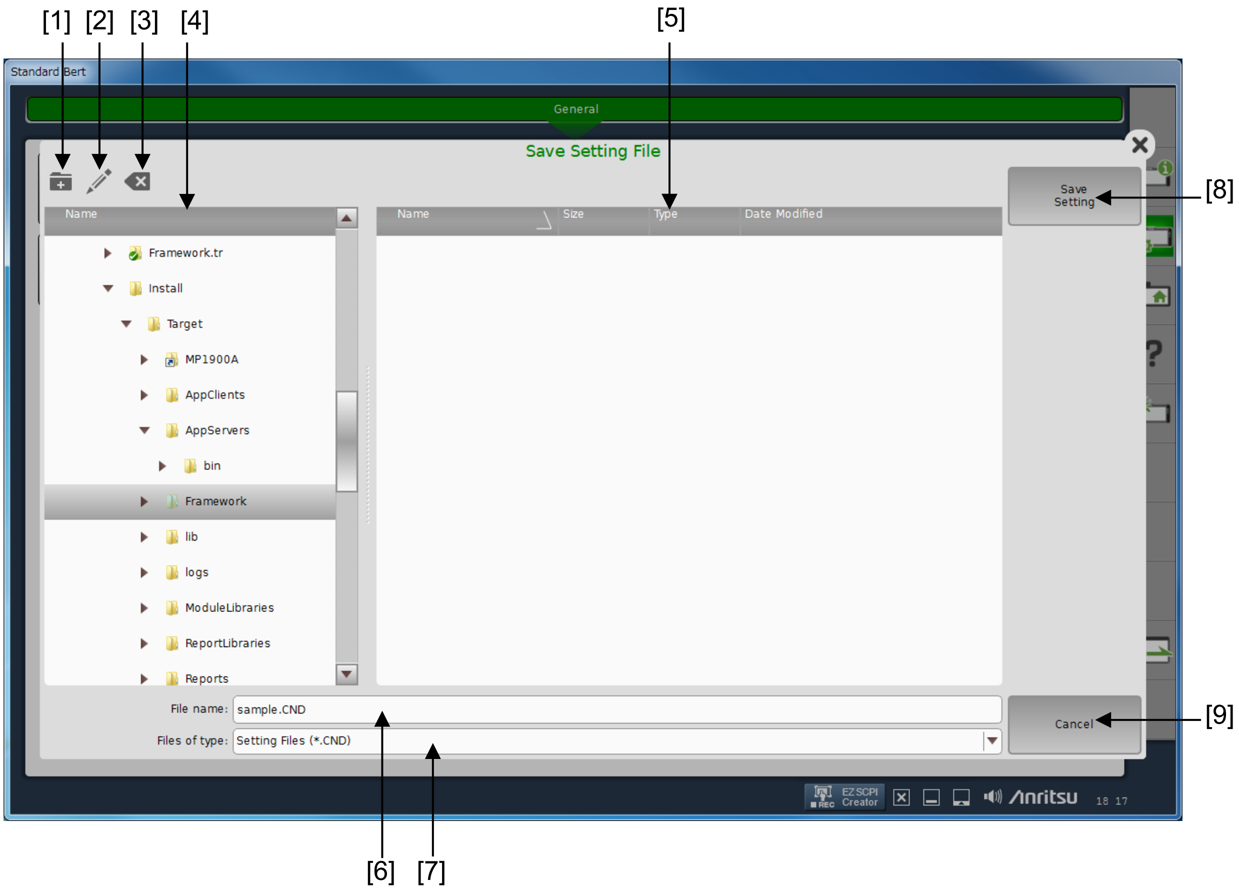


Figure 3.1.8-1 Save Setting File Dialog Box Explanation

[1] Create Folder
Creates a new folder.

[2] Rename
Edits the file name or the folder name.

[3] Delete
Deletes the selected file(s) or folder(s).

[4] Folder View
Displays folders in a tree format.

[5] File View
Displays files.

[6] File name
Specify a setting file to save.

[7] Files of type
Specify a setting file format.

[8] Open Setting
Saves a specified setting file.

[9] Cancel
Closes the **Save Setting File** dialog box.

3.1.9 Changing a numeric value

To change numeric value in MX190000A operation, use numeric value input controller or numeric value input pad. Touching the parameter that you wish to change value displays numeric value input controller or numeric value input pad. This section describes how to use numeric value input controller or numeric value input pad.

3.1.9.1 Numeric Value Input Controller

Touching the parameter to be changed displays Numeric Value Input Controller by sliding to left. It is convenient for adjusting a parameter by using numeric value input controller and MP1900A rotary knob together.

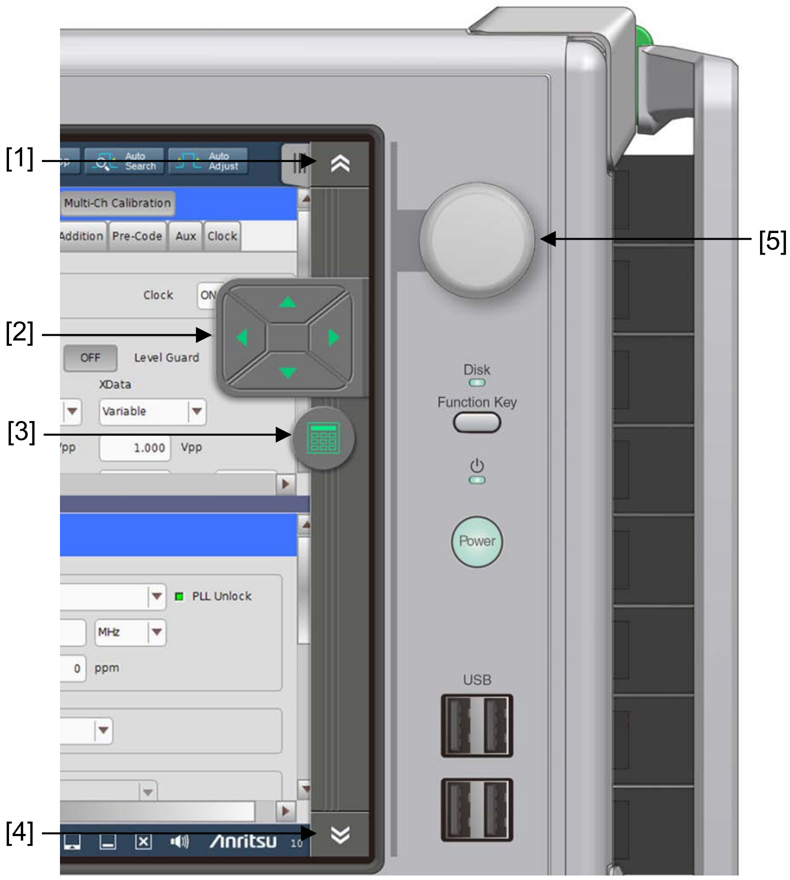


Figure 3.1.9.1-1 Numeric Value Input Controller Explanation

[1] Controller move button (upper)
Touching this button moves numeric value input controller upper direction.

[2] Up-down and left-right buttons

Function differs between up-down buttons and left-right buttons as shown below.

- Up-down buttons

  Touching up-down buttons increase or decrease the value in digit where cursor is positioned.

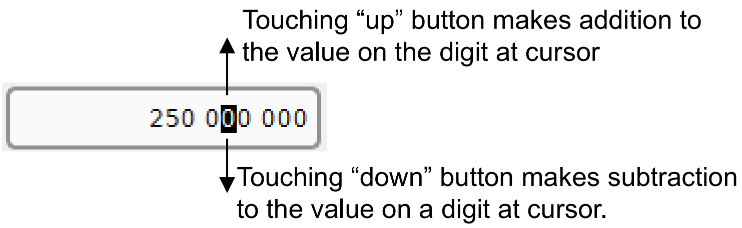


Figure 3.1.9.1-2 Increasing and Decreasing on a Digit at Cursor

- Left-right buttons

  Touching left or right button moves cursor left or right.

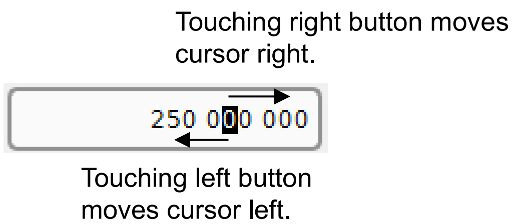


Figure 3.1.9.1-3 Moving Cursor

[3] Numeric value input pad display button

Touching this button displays numeric value input pad.

[4] Controller move button (lower)

Touching this button moves numeric value input controller lower direction.

[5] Rotary knob

Rotating the rotary knob anticlockwise makes subtracting the value on the digit at cursor.

Rotating the rotary knob clockwise makes addition the value on the digit at cursor.

If a USB mouse with center wheel has been connected to USB port of MP1900A, operating numeric value input pad by using the center wheel is available instead of using up-down, left-light buttons and rotary knob.

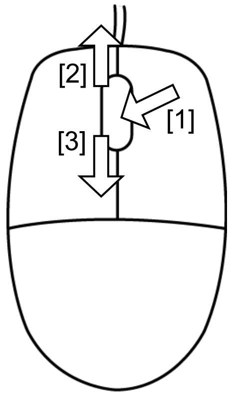


Figure 3.1.9.1-4 How to Use Center Wheel of Mouse

[1] Clicking center wheel
Clicking center wheel switches between “add-subtract mode” which makes addition or subtraction the value on the digit at cursor and “cursor move mode” which allows cursor to move left or right.

[2] Rotating center wheel upward

- In case of “add-subtract mode”
  Rotating center wheel upward increases a number directly under the cursor.

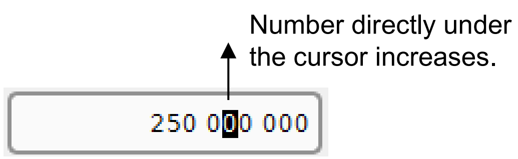


Figure 3.1.9.1-5 Increase a Number under Cursor by Center Wheel Operation

- In case of “cursor move mode”
  Rotating center wheel upward moves cursor left.

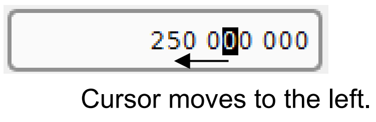


Figure 3.1.9.1-6 Moving Cursor to the Left by Center Wheel Operation

[3] Rotating center wheel downward

- In case of “add-subtract mode”
  Rotating center wheel downward decreases a number directly under the cursor.

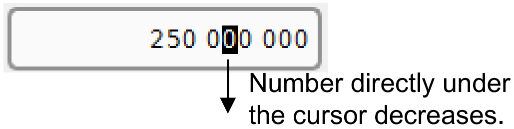


Figure 3.1.9.1-7 Decrease a Number under Cursor by Center Wheel Operation

- In case of “cursor move mode”
  Rotating center wheel downward moves cursor right.

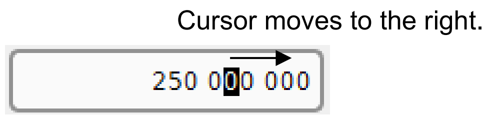


Figure 3.1.9.1-8 Moving Cursor to the Right by Center Wheel Operation

3.1.9.2 Numeric Value Input Pad

Touching the parameter to be changed displays Numeric Value Input Pad depending on the settings.

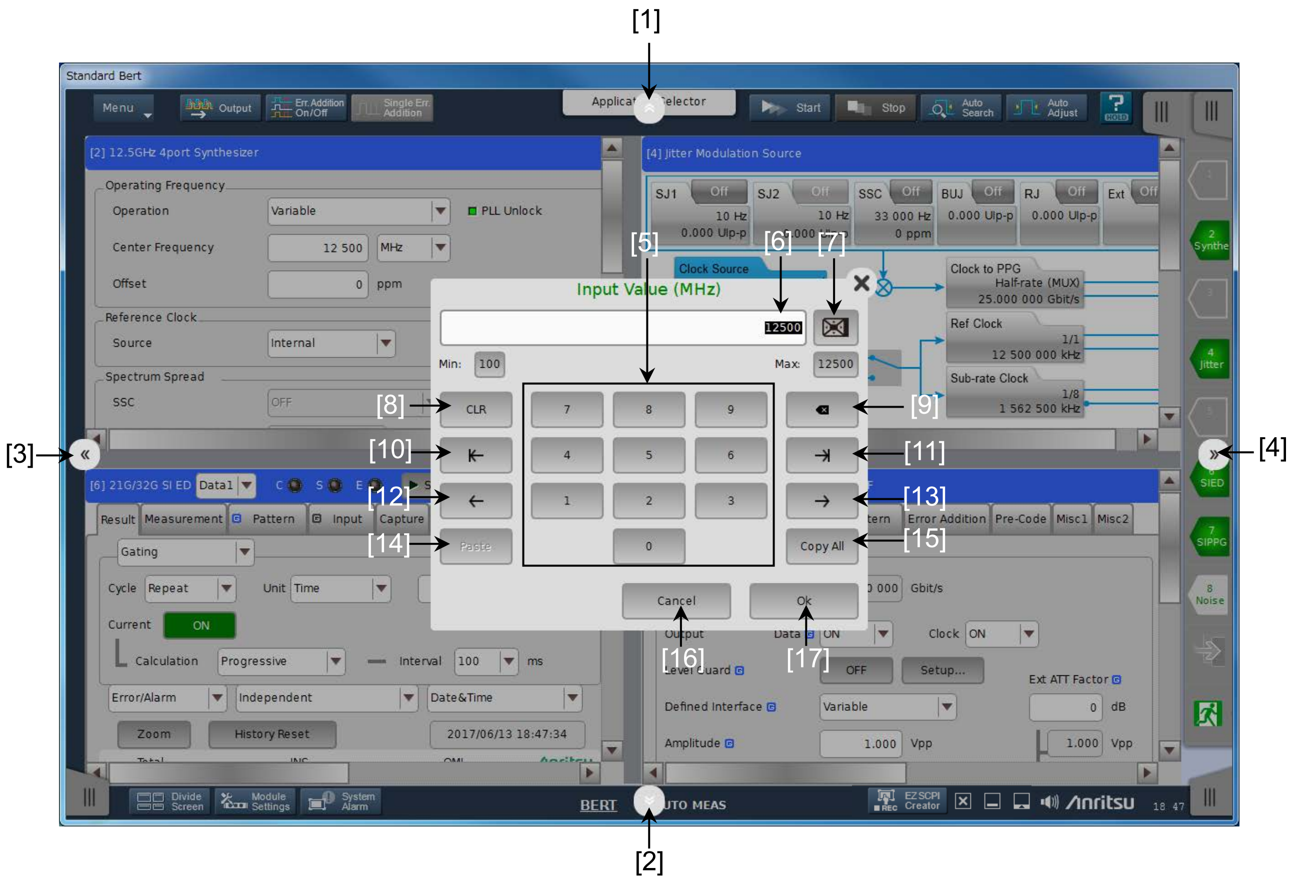


Figure 3.1.9.2-1 Numeric Value Input Pad Explanation

[1] Numeric value input pad move button (upper)
Touching this button moves numeric value input pad upper direction.

[2] Numeric value input pad move button (lower)
Touching this button moves numeric value input pad lower direction.

[3] Numeric value input pad move button (left)
Touching this button moves numeric value input pad in left direction.

[4] Numeric value input pad move button (right)
Touching this button moves numeric value input pad in right direction.

[5] Numeric key
Available to input numeric value 0 to 9.

[6] Numeric value display area
Numeric value to be edited appears here.

[7] Numeric Value Input Controller Display button
Touching this button displays numeric value input controller.

[8] CLR
Deletes all numeric characters displayed in the numeric value display area.

[9] Back Space button
Deletes a numeric character displayed in the numeric value display area. When multiple numeric characters are selected, all of them will be deleted.

[10] Home button
Moves cursor to the most left digit in Numeric value display area.

[11] End button
Moves cursor to the rightmost digit in Numeric value display area.

[12] Left button
Moves cursor left.

[13] Right button
Moves cursor right.

[14] Paste
Pastes a value and cursor position information copied in Clip board to Numeric value display area.

Note:

The cursor position information is pasted only when it is copied using **Copy All** in the numeric value input pad.

[15] Copy All
Copies a value displayed in Numeric value display area and cursor position information to Clip board.

[16] Cancel
Closes numeric value input pad.

[17] Ok
Establishes the value and closes numeric value input pad.

3.2 Operation on Workspace

This section describes basic window operation on the workspace.

3.2.1 Basic Operation on Overall of Workspace

Application toolbar is displayed at right-hand of the screen once an application has started.

3.2.1.1 Application Toolbar

Application toolbar is displayed at right-hand of the workspace. Details are shown below.

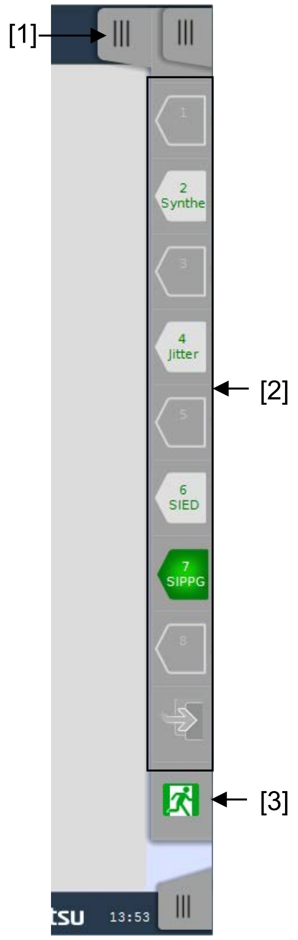


Figure 3.2.1.1-1 Application Toolbar

[1] Navigation tab (Application Toolbar)
Touching this tab displays Extended Application Toolbar.
For details, refer to 3.2.1.2 “Extended Application”.

[2] Application Function buttons
Buttons appear that provide function depending on the application. For details, refer to 3.2.2.1 “Slot Selector Buttons” or 3.2.3.1 “Auto Measurement Selector Buttons”.

[3] Application Exit button
Touching this button displays the **Shutdown/Close** dialog box. To exit the application, touch **Just close the running application** and touch **OK**.

3.2.1.2 Extended Application

Touching the navigation tab of application toolbar displayed at right-top of the screen displays Extended Application Toolbar by sliding toward left.

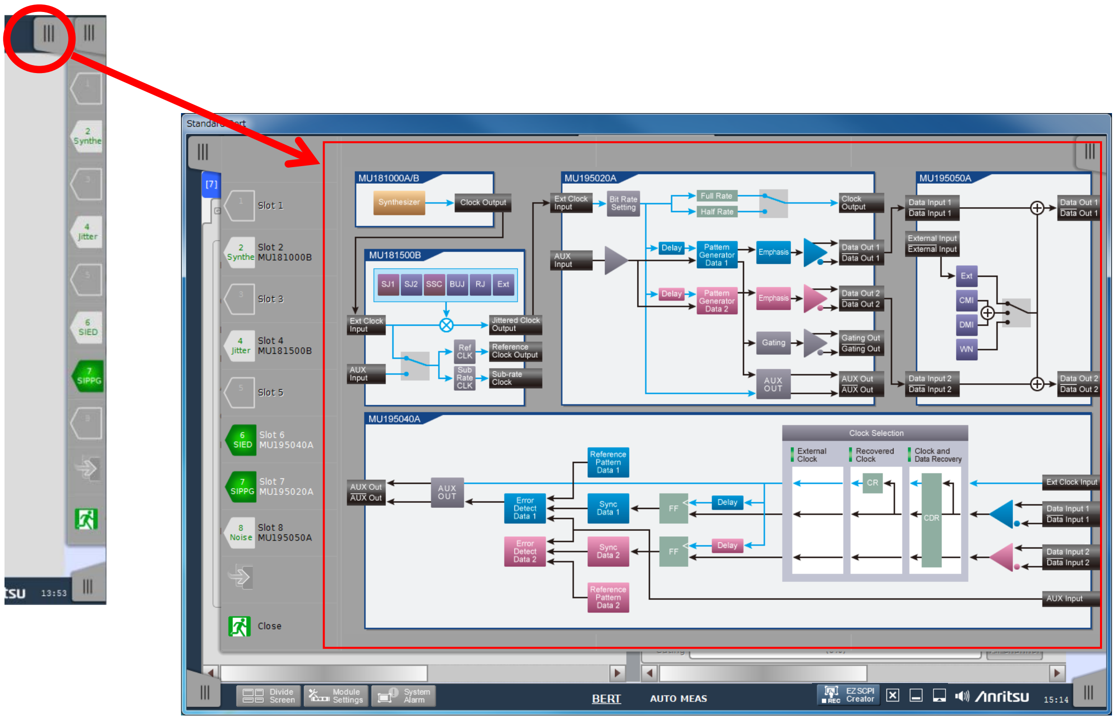


Figure 3.2.1.2-1 How to Display Extended Application

Extended Application provides extended function unique to the application.

Figure 3.2.1.2-1 shows whole block diagram of Standard BERT for SI application as an example of Extended Application.

3.2.1.3 Help

On-screen help provides explanations for the buttons and parameter functions on the application screen, and corresponding remote commands.

Displaying Help by Icon Operation

1. In the upper-right of the screen, touch  to change it to , which indicates "Help mode".
2. To display a help, touch a button, a text box, a list box, or other parts in the window.

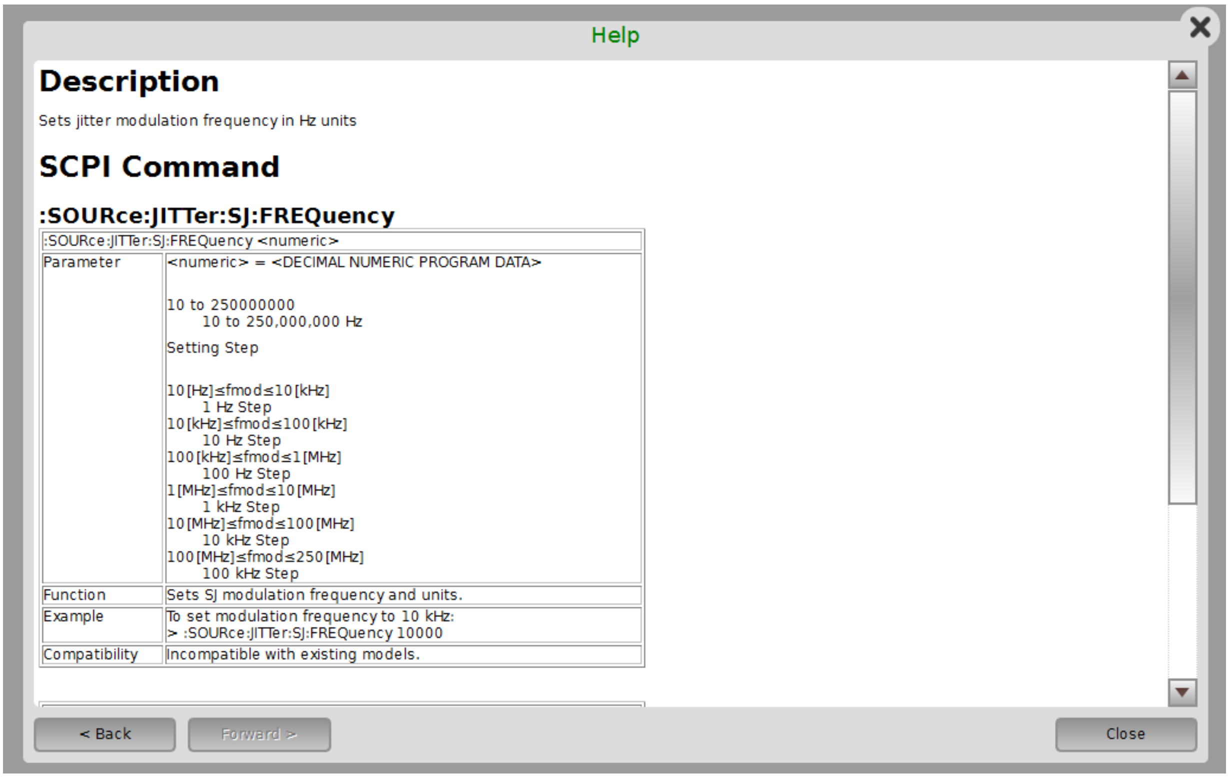


Figure 3.2.1.3-1 On-Screen Help Example

After closing the on-screen help, the button color returns to blue () and the application leaves "Help mode".

Touching  twice, the button changes to green () and "Help mode" is held. In this state, "Help mode" is kept even if closing the on-screen help. This is convenient function when you want to see helps consecutively.

Touching  exits "Help mode".

Displaying Help by Mouse Operation

For mouse operation, right-click the screen item you need help with.

3.2.2 Basic Operations on BERT Screen

In BERT screen, application of modules installed in each slot (hereinafter, module application) is displayed.

This section describes basic operation in BERT screen.

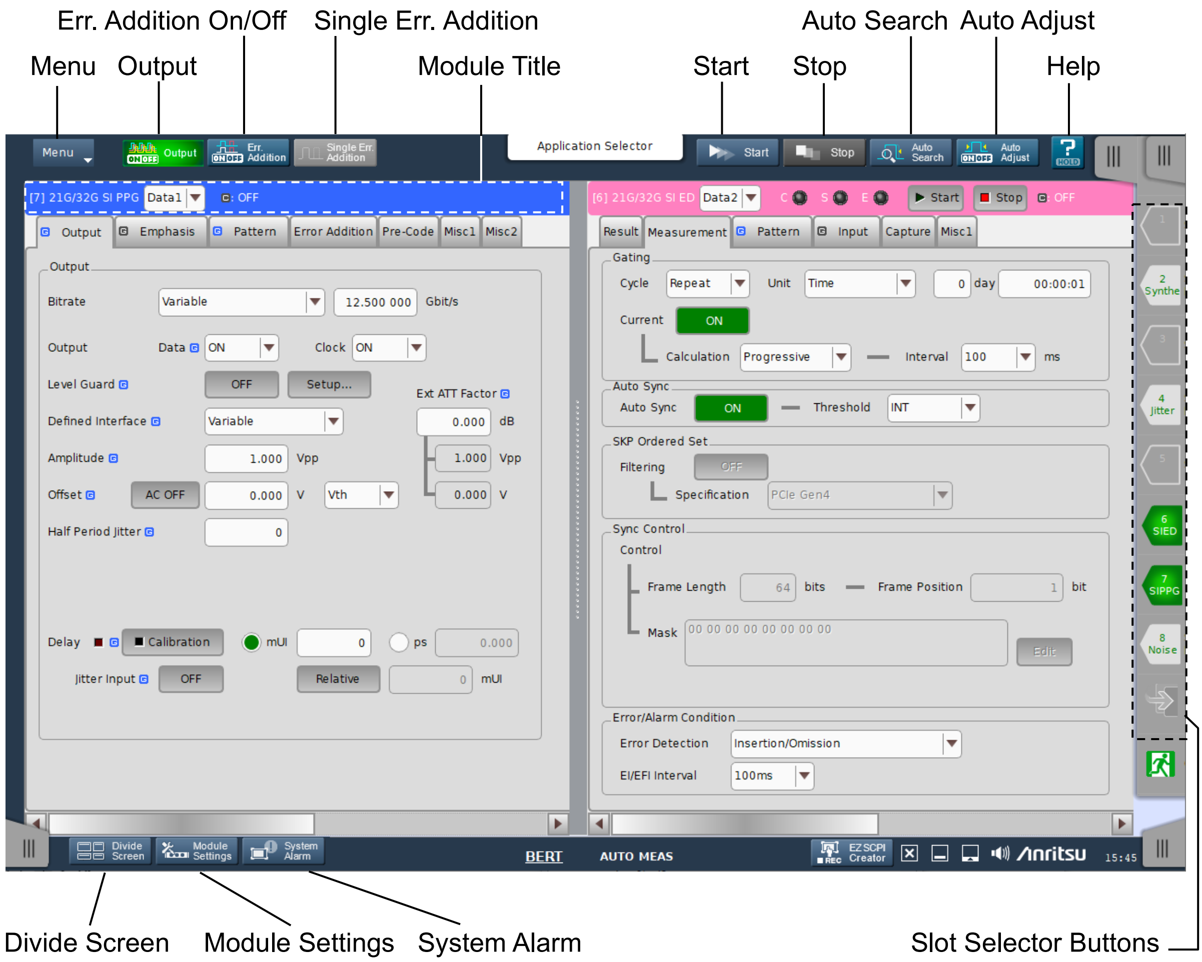


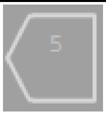
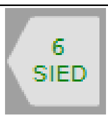
Figure 3.2.2-1 BERT Screen

3.2.2.1 Slot Selector Buttons

Slot selector buttons appear on Application Toolbar.

Slot number is displayed upper half in the slot selector button and the button color changes according to three states below.

Table 3.2.2.1-1 lot Selector Button Indication

Slot Selector Buttons	Description
	No Modules Module is not installed in the slot. No action even if touching the button.
	Module is installed, not selected A module is installed in the slot but its module application has not displayed. Abbreviation of the installed module is displayed on lower half of the button.
	Module is installed and selected A module is installed in the slot and its module application has been displayed. Abbreviation of the installed module is displayed on lower half of the button.

Correspondence between module abbreviation and model is shown below.

Synthe	MU181000A/B
SIPPG	MU195020A
SIED	MU195040A
PAM4PPG	MU196020A
PAM4ED	MU196040A, MU196040B
Jitter	MU181500B
Noise	MU195050B
32GPPG	MU183020A, MU183021A
32GED	MU183040B, MU183041B

When the module is in the slot, the behavior after touching the button varies depending on screen division state as below. For the screen splitting, refer to 3.2.2.11 "Divide Screen".

- When the screen division is not set, the module application of the module installed in the slot is not displayed in divided.
- When the left-right division has been set, the screen selector as following will be displayed.

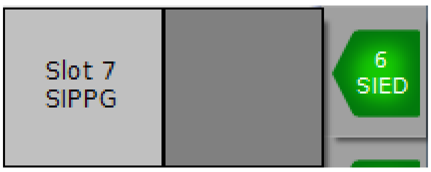


Figure 3.2.2.1-1 Screen Selector (Left-Right Division)

In this example, the module application of Slot7 SIPPG is displayed in left half of the screen and nothing is displayed in right half of the screen.

If you touch left side of the screen selector, the screen selector disappears and the module application of Slot6 SIED is displayed in left half of the screen.

If you touch right side of the screen selector, the screen selector disappears and the module application of Slot6 SIED is displayed on right half of the screen.

- When the up-down screen division has been set, the screen selector as following will be displayed.

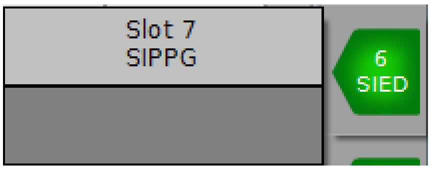


Figure 3.2.2.1-2 Screen Selector (Up-Down Division)

In this example, the module application of Slot7 SIPPG is displayed on upper half of the screen and nothing is displayed on lower half of the screen.

If you touch upper side of the screen selector, the screen selector disappears and the module application of Slot6 SIED is displayed on upper half of the screen.

If you touch lower side of the screen selector, the screen selector disappears and the module application of Slot6 SIED is displayed in lower half of the screen.

- When screen has been set to quarters division, the screen selector as the following will be displayed.

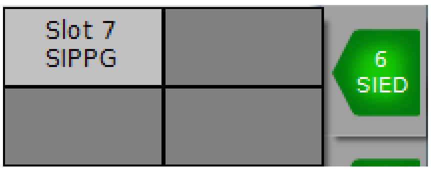


Figure 3.2.2.1-3 Screen Selector (Quarters Division)

In this example, the module application of Slot7 SIPPG is displayed in upper left of the screen and nothing is displayed in other areas.

If you touch left upper part of the screen selector, the screen selector disappears and the module application of Slot6 SIED is displayed on left upper part of the screen.

If you touch right lower part of the screen selector, the screen selector disappears and the module application of Slot6 SIED is displayed on right lower part of the screen.

3.2.2.2 Module Title

The module title is displayed on top of each module application window.

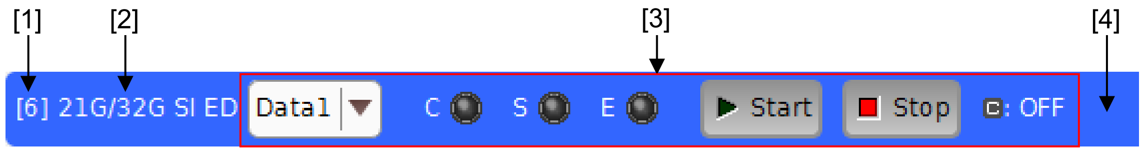


Figure 3.2.2.2-1 Module Title Explanation

[1] Slot Number
Displays slot number of the module.

[2] Module name
Displays the module name.

[3] Module unique function
Module unique function is displayed. Nothing is displayed if the module has no unique function.

[4] Module Title Bar Color

- When the module has only one Data interface, the color is blue.
- When the module has multiple interfaces, the color will be as below.

  Data 1: Blue
  Data 2: Pink

3.2.2.3 Menu

Touching **Menu** at top of the screen displays function.

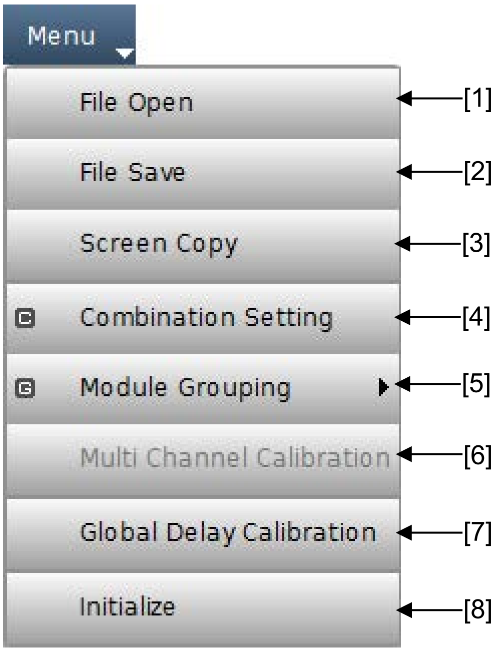


Figure 3.2.2.3-1 Menu Items

[1] File Open
Displays the **Open Setting File** dialog box.
For details, refer to 3.1.7 “Loading a File”.

[2] File Save
Displays the **Save Setting File** dialog box.
For details, refer to 3.1.8 “Saving to Files”.

[3] Screen Copy
Copies a screen copy into Windows clipboard.

[4] Combination Setting
Displays the **Combination Setting** dialog box.
For details, refer to 3.3 “Multi Channel Function”.

[5] Module Grouping
Displays the **Grouping** dialog box.
For details, refer to 3.4 “Module Grouping Function”.

[6] Multi Channel Calibration
Displays the **Multi Channel Calibration** dialog box.
For details, refer to 3.5 “Multi Channel Calibration Function”.

[7] Global Delay Calibration
Displays the **Global Delay Calibration** dialog box.
In the **Global Delay Calibration** dialog box, you can perform delay calibrations of all PPGs and EDs installed in the MP1900A collectively.
For details, refer to on-screen help in the **Global Delay Calibration** dialog box. For how to display the on-screen help, refer to 3.2.1.3 "Help".

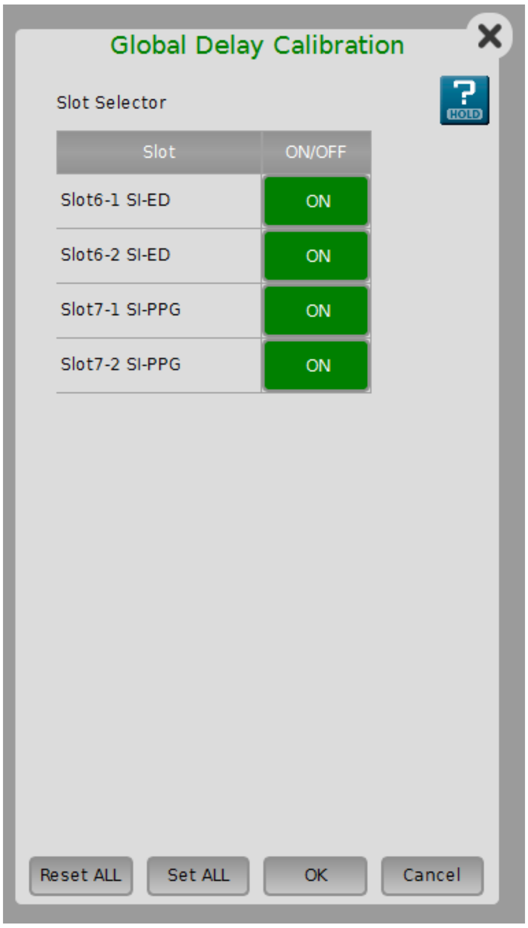


Figure 3.2.2.3-2 Global Delay Calibration Dialog Box

Note:

Delay calibration is not performed on the data interface whose jitter input is On.

[8] Initialize
Sets all modules installed in MP1900A to default settings at factory shipment.

Note:

When the Initialize function is executed while PPG and ED are in Combination or Channel Synchronization status, Independent, which is the initial status, is restored.

3.2.2.4 Output

Output function turns Data and Clock output of all modules on or off simultaneously.
Data and Clock are not output until this button is set to On even if Output of each application is set to On.

If touching 

, the button changes to green (

) and Data and Clock output is set to On.

If touching 

, the button changes to blue and Data and Clock output is set to Off (

).

3.2.2.5 Err. Addition On/Off

Err. Addition On/Off function inserts consecutive errors from all PPGs in according to settings in **Error Addition** tab of PPG module application. For details, refer to the on-screen help in **Error Addition** tab of PPG module application. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

If touching 

, the button changes to green (

) and Error addition is set to On.

If touching 

, the button changes to blue (

) and Error addition is set to Off

3.2.2.6 Single Err. Addition

Single Err. Addition function inserts an error in output of all PPGs in according to settings in **Error Addition** tab of PPG module application. For details, refer to the on-screen help in **Error Addition** tab of PPG module application. For how to display the on-screen help, refer to 3.2.1.3 “Help”.
Touching 

inserts an error in output of all PPGs.

3.2.2.7 Start

Start function starts measurements of all module applications.

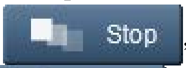
If touching 

, the button changes to green (

) and all module applications start measurement.

3.2.2.8 Stop

Stop function stops measurements of all module applications.

If touching 

, all module applications stop measurement.

Note that 

is effective only while measurement is in processing.

3.2.2.9 Auto Search

Auto Search function adjusts threshold voltage and phase to optimum point depending on the input data. This function sets Threshold and Phase Delay of Data, XData to an optimum point.
This function is useful when performing the measurement, such as BER measurement, in which the threshold voltage and phase are fixed to the optimum values.

Note:

The Auto Search function cannot be performed when:

- The **Input** tab of the ED module application has been grouped.
- The ED is performing the Auto Adjust function.
- In the PAM4 ED application, **Pre Coder** is set to **ON**.

Also, the Auto Search function is terminated unsuccessfully when:

- PAM4 ED receives a signal having a bit phase shift of more than 47 bits between MSB and LSB
- The input pattern is not PRBS or equivalent to Mark Ratio 1/2.
- Each of 0/1, 1/2 and 2/3 levels is not equal.
- A random pattern with a specific cycle is repeatedly specified in the **Pattern Editor** dialog box.

When the MU196040B is installed, **Advanced Mode** is available in the **Auto Search** dialog box. This function adjusts the following settings of the MU196040B optimally for the input signal.

- MSB/LSB Pattern (PRBS inv, Logic, Gray Coder) (Pre Coder is not subject to adjustment.)
- Middle/Upper/Lower Eye Threshold
- Delay
- Equalizer (LFEQ, DFE) (Only when the MU196040B-x11 Equalizer is installed.)

Note:

Advanced Mode is subject to the following restrictions in addition to *Note* for Auto Search (Advanced: OFF).

- **MSB Pattern**, **LSB Pattern**, **Upper**, and **Lower** can be auto-searched only when PAM4 is selected.
- **MSB Pattern** and **LSB Pattern** can be auto-searched only when Test Pattern is set to anything other than **Data** or **QPRBS13**.

Touching  displays the **Auto Search** dialog box.

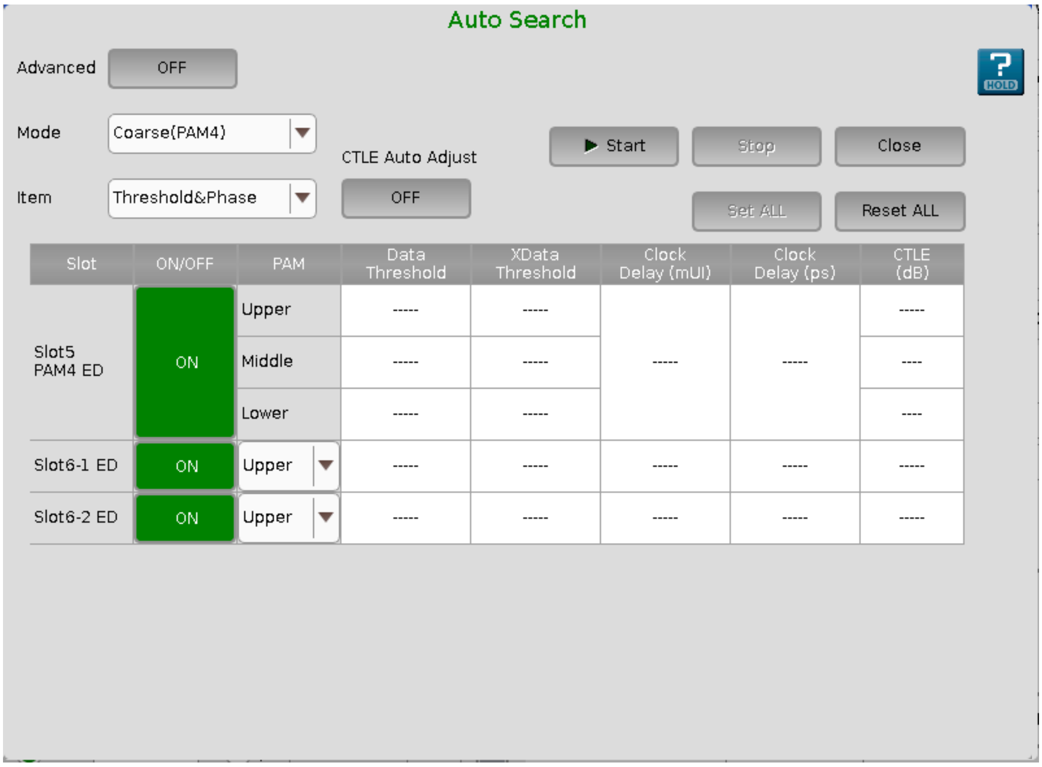


Figure 3.2.2.9-1 Auto Search Dialog Box

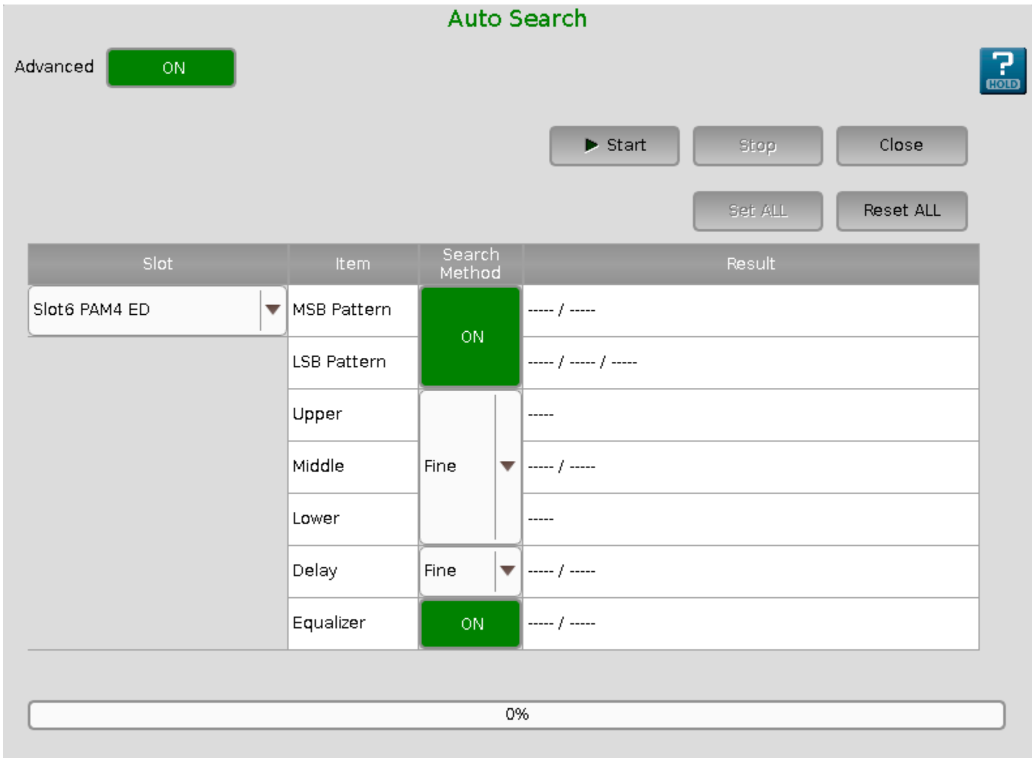


Figure 3.2.2.9-2 Auto Search (Advanced) Dialog Box

For explanation of the **Auto Search** dialog box, refer to the on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

3.2.2.10 Auto Adjust

Auto Adjust function keeps to set the best phase and threshold voltage by following the fluctuation of signal input to ED.
This function is useful when the bit rate of the input signal and the threshold voltage are changed dynamically.

Notes:

- Auto Adjust cannot be performed when the **Input** tab of the ED module application has been grouped.
- The PAM4 ED can perform the Auto Adjust function only in the threshold voltage direction.

Touching 

displays the **Auto Adjust** dialog box.

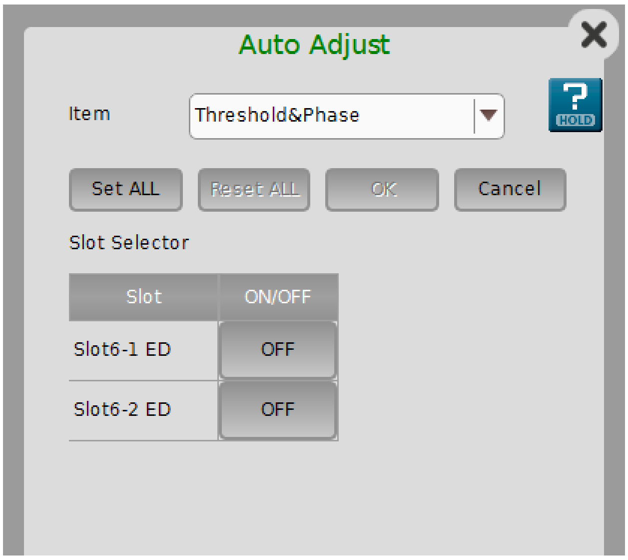


Figure 3.2.2.10-1 Auto Adjust Dialog Box

For details, refer to the on-screen help in the **Auto Adjust** dialog box. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

If touching 

, the button changes to blue (

) and Auto Adjust function stops its operation.

3.2.2.11 Divide Screen

Divide Screen function provides displaying two or four module applications by dividing the screen.

- Single (No dividing)
  Screen is used without being divided as the following figure.

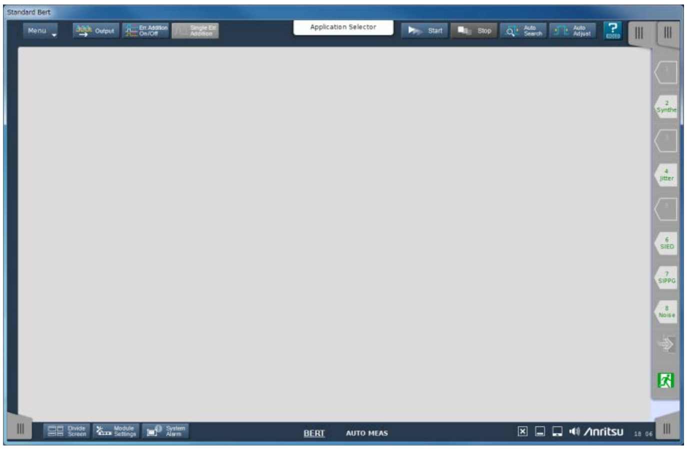


Figure 3.2.2.11-1 No Dividing

- Left-Right (left-right division)
  Screen is divided into left and right parts as the following figure.

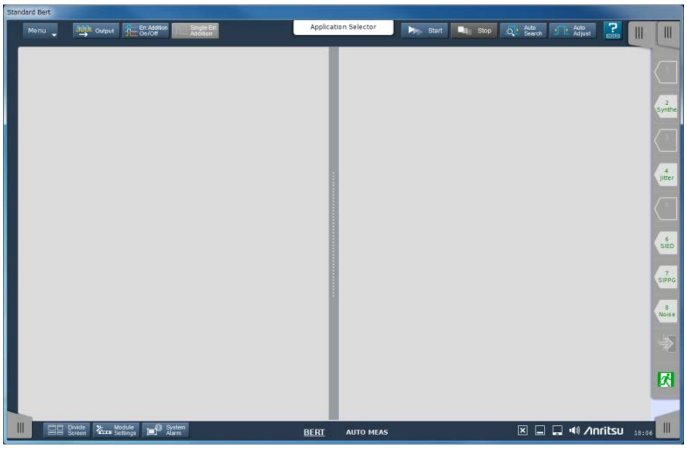


Figure 3.2.2.11-2 Left-Right Division

- Up-Down (up-down division)
  Screen is divided into upper and lower parts as the following figure.

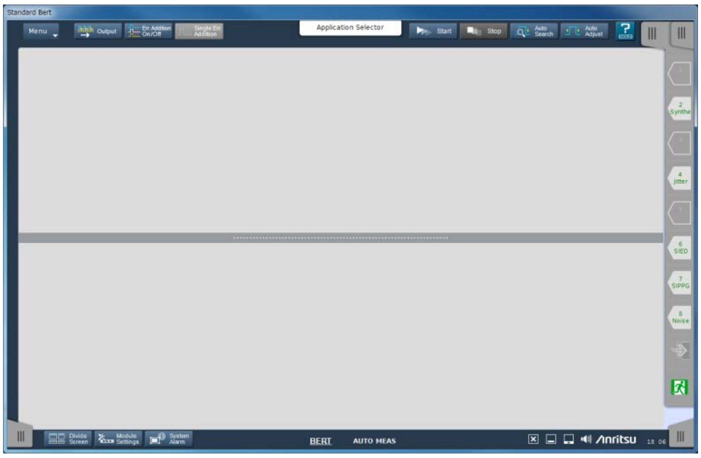


Figure 3.2.2.11-3 Up-Down Division

- Quarters (Quarters division)
  Screen is divided into four parts as the following figure.

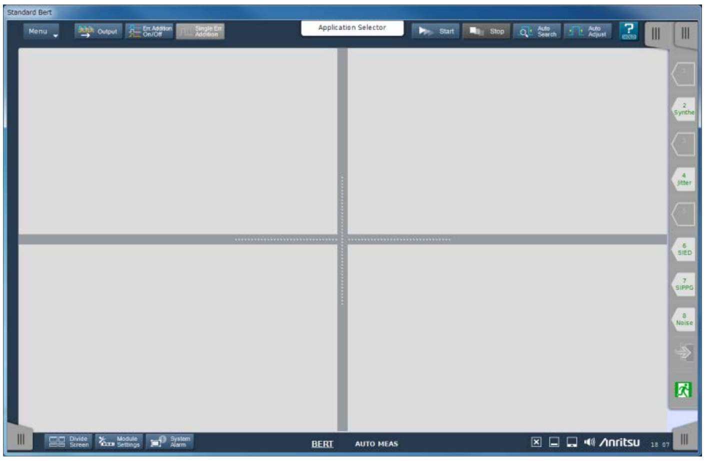


Figure 3.2.2.11-4 Quarters Division

A modules application can be assigned to each screen divided by Divide Screen function by using slot selector buttons.
For details, refer to 3.2.2.1 “Slot Selector Buttons”.

Touching 

displays the **Divide Screen** dialog box shown below.

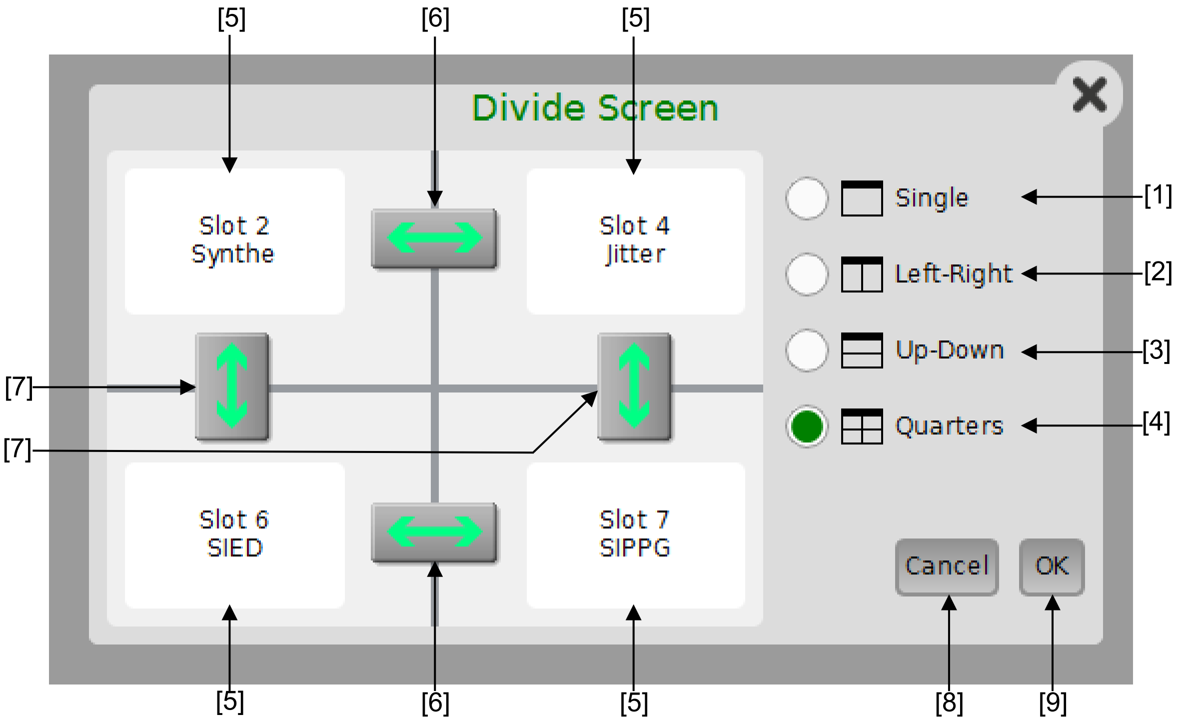


Figure 3.2.2.11-5 Divide Screen Dialog Box

[1] Single
Uses the screen without division.

[2] Left-Right
Uses the screen with left-right division.

[3] Up-Down
Uses the screen with up-down division.

[4] Quarters
Uses the screen with quarters division.

[5] Module Application Preview
Information of module application assigned to the divided screen is displayed. The slot number is displayed in the upper line and the module name abbreviation is displayed in the lower line.

[6] Module application swap button (left and right)
Swaps module applications assigned to the left and right sides of the screen.

[7] Module application swap button (up and down)
Swaps module applications assigned to the upper and lower sides of the screen.

[8] Cancel
Closes the dialog box.

[9] OK
Establishes settings and closes the dialog box.

Horizontal separator or Vertical separator appears when the screen division has been set.

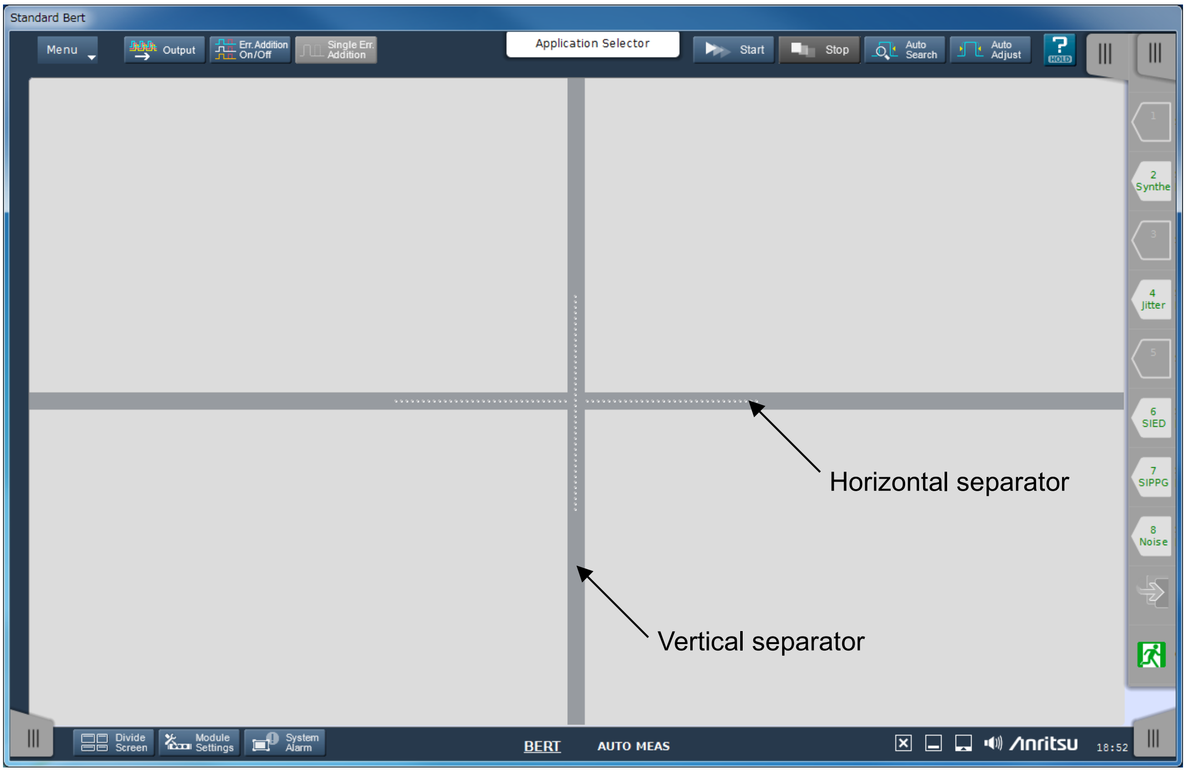


Figure 3.2.2.11-6 Horizontal Separator and Vertical Separator

Dragging the Horizontal separator or the Vertical separator moves its position.
Vertical separator controller appears by touching the Vertical separator.
Vertical separator controller disappears if touching the Vertical separator again.

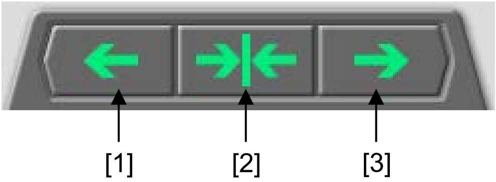


Figure 3.2.2.11-7 Vertical Separator Controller

[1] Vertical Separator Move button (left)
Moves Vertical separator to the left.

[2] Vertical Separator Reset button
Moves Vertical separator to the screen center.

[3] Vertical Separator Move button (right)
Moves Vertical separator to the right.

Horizontal separator controller appears by touching the Horizontal separator. Horizontal separator controller disappears if touching the Horizontal separator again.

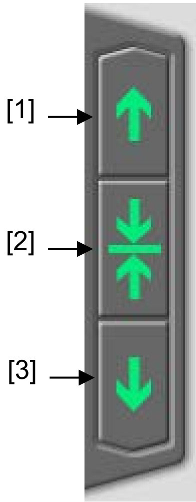


Figure 3.2.2.11-8 Horizontal Separator Controller

[1] Horizontal Separator Move button (up)
Moves Vertical separator up.

[2] Horizontal Separator Reset button
Moves Horizontal separator to the screen center.

[3] Horizontal Separator Move button (down)
Moves Horizontal separator down.

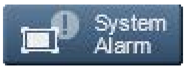
3.2.2.12 Module Settings

Touching  displays Module Setting window.

For description of Module Setting window, refer to 3.1.6.5 “Module Settings”.

If the trouble has occurred in the module, the button indication changes to red ().

3.2.2.13 System Alarm

Touching  on the bottom left of the screen displays the **System Alarm** dialog box.

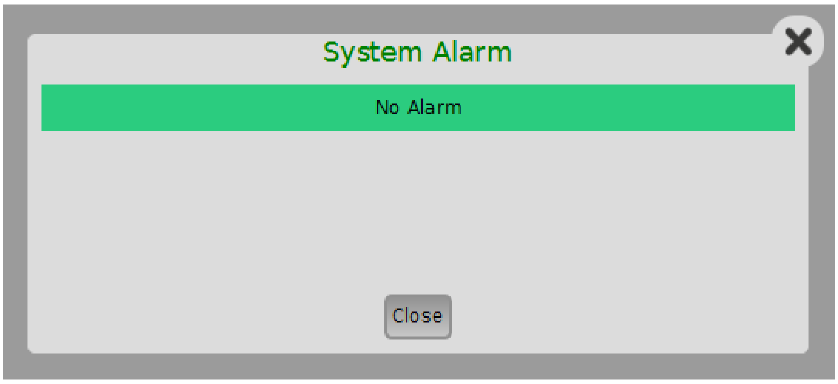


Figure 3.2.2.13-1 System Alarm Dialog Box (No System Errors)

When the system alarm has occurred in MP1900A or in a module, the button indication changes to red (

). Touching the button in this status displays the hardware where errors have occurred and details of system errors.

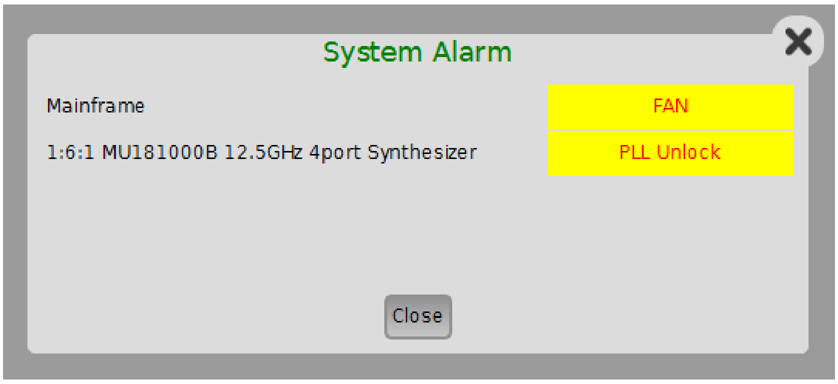


Figure 3.2.2.13-2 System Alarm Dialog Box (FAN Error and PLL Unlock Error)

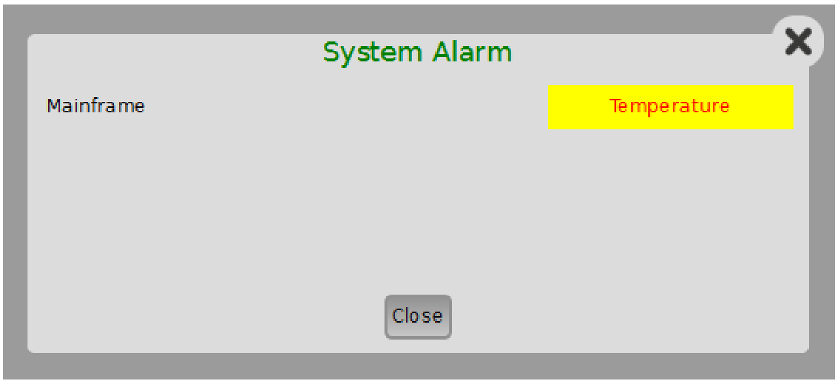


Figure 3.2.2.13-3 System Alarm Dialog Box (Temperature Error)

Contents of MP1900A system errors are listed in Table 3.2.2.13-1.

Table 3.2.2.13-1 System Error

Name	Description
Fan	Raises when MP1900A detected that the fan is abnormal.
Temperature	Raises when MP1900A detected that temperature of an installed module and MP1900A is out of range.
PLL Unlock	Raises when MU181000A detected PLL Unlock.

Note:

The **System Alarm** dialog box is automatically displayed when fan or temperature abnormality has occurred.

When these abnormalities have been raised for 30 seconds or more, MP1900A turns power off.

3.2.3 Basic Operation in AUTO MEAS Screen

AUTO MEAS screen provides measurement function using ED.

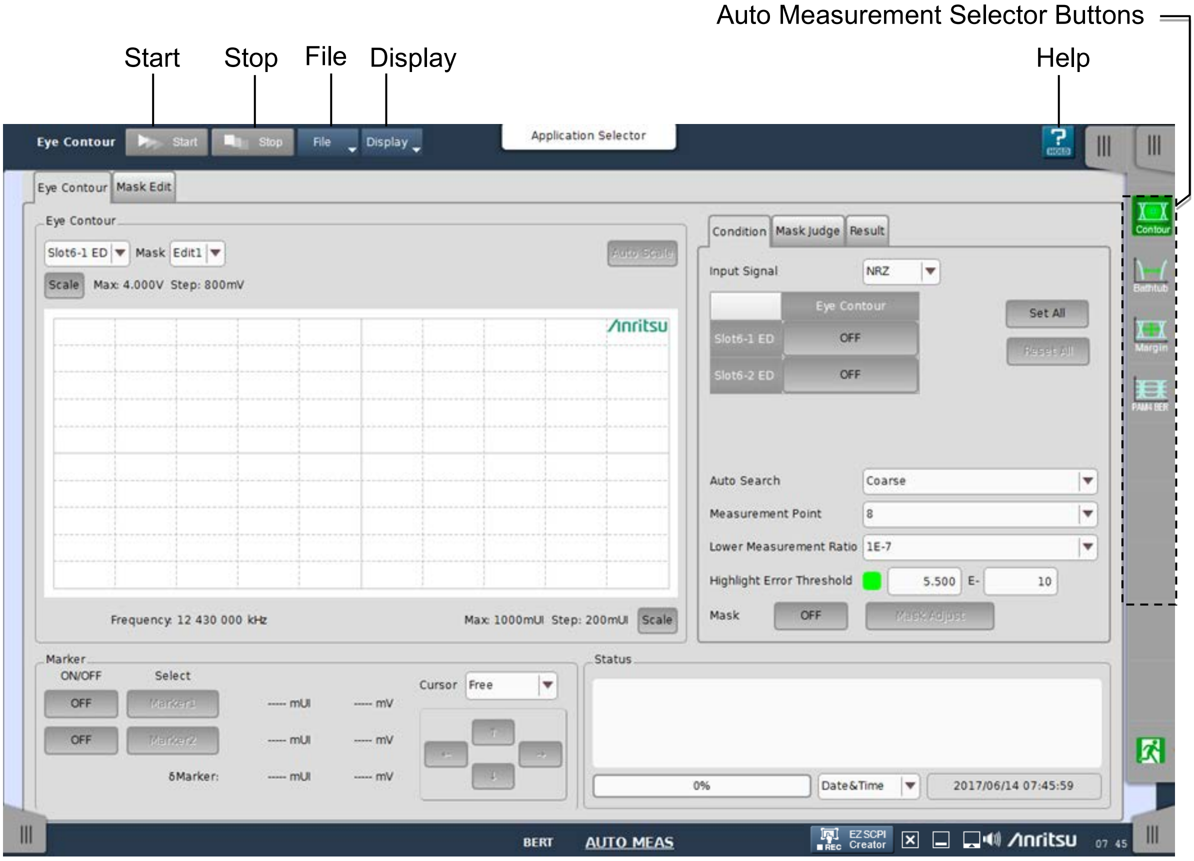


Figure 3.2.3-1 AUTO MEAS Screen

3.2.3.1 Auto Measurement Selector Buttons

Auto Measurement selector buttons are displayed on the Application toolbar by touching **AUTO MEAS** at the bottom center of the screen shown in Figure 3.2.3-1.

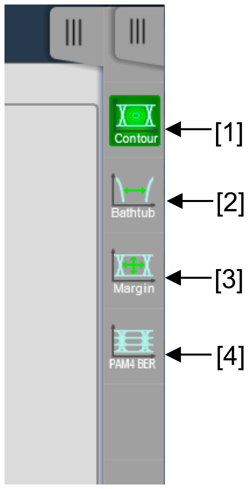


Figure 3.2.3.1-1 Auto Measurement Selector Buttons

There are four Auto Measurement Selector Buttons.

[1] Contour
Touching this buttons displays Eye Contour screen.
For the explanation of Eye Contour screen, refer to 4.4.1 "Eye Contour Measurement".

[2] Bathtub
Touching this button displays Bathtub screen.
For explanation of Bathtub screen, refer to 4.4.2 "Bathtub Measurement".

[3] Margin
Touching this buttons displays Eye Margin screen.
For the explanation of Eye Margin screen, refer to 4.4.3 "Eye Margin Measurement".

[4] PAM4 BER
Touching this button displays PAM BER screen.
For the explanation of PAM BER screen, refer to 4.4.4 "PAM BER Measurement".

3.2.3.2 File

Touching **File** at top of the screen displays functions.

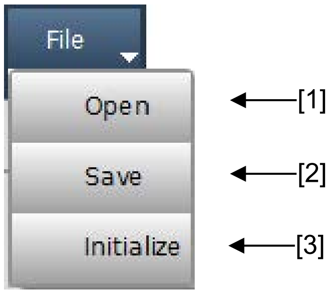


Figure 3.2.3.2-1 File Menu Items

[1] Open
Opens the dialog box, where you can select an auto-measurement related file to open.
For details of operations, refer to 3.1.7 "Loading a File".
Files of type options vary depending on the kind of auto measurement.

[2] Save
Opens the dialog box, where you can save an auto-measurement related file.
For details of operations, refer to 3.1.8 "Saving to Files".
Files of type options vary depending on the kind of auto measurement.

[3] Initialize
Initializes all modules installed in MP1900A to factory default settings.

3.2.3.3 Display

Display is displayed only on the Eye Contour screen. You can select a phase display unit from the list.

3.3 Multi Channel Function

The PPG has a Multi-Channel function that generates data by combing data of multiple channels. The Multi Channel function can be categorized into Combination and Channel Synchronization. Available functions vary depending on model and its option.

Note:

MU196020A will support the Multi Channel function, in Version 3.01.00 or later.

Table 3.3-1 Model which Multi Channel can be applied

Model/Option	2ch/4ch Combination	Inner Module Ch Synchronization	Inter Module Ch Synchronization	Inter Module 2ch Combination Synchronization	64G × 2ch Combination
MU195020A-x20/x31	2ch	✓	Two to four modules	Two to four modules	Two modules
MU195020A-x10/x30	–	–	–	–	–
MU183020A-x2x/x31	2ch	✓	Two to four modules	Two to four modules	Two modules
MU183020A-x1x/x30	–	–	–	–	–
MU183021A-x30	2ch/4ch	✓	–	–	✓
MU196020A-x30/x50	–	–	Two to four modules	✓*	–

*: MU196020A is capable of 2ch Combination using two PPG modules in NRZ mode.

3.3.1 Combination Function

Combination function synchronizes the generation and reception of patterns between the channels of a PPG or an ED, to evaluate 40 Gbit/s and 50 Gbit/s applications.

By combining two channels of 20 Gbit/s data, 40 Gbit/s serial data that is bit rate of 40GbE or OTU3 can be generated.

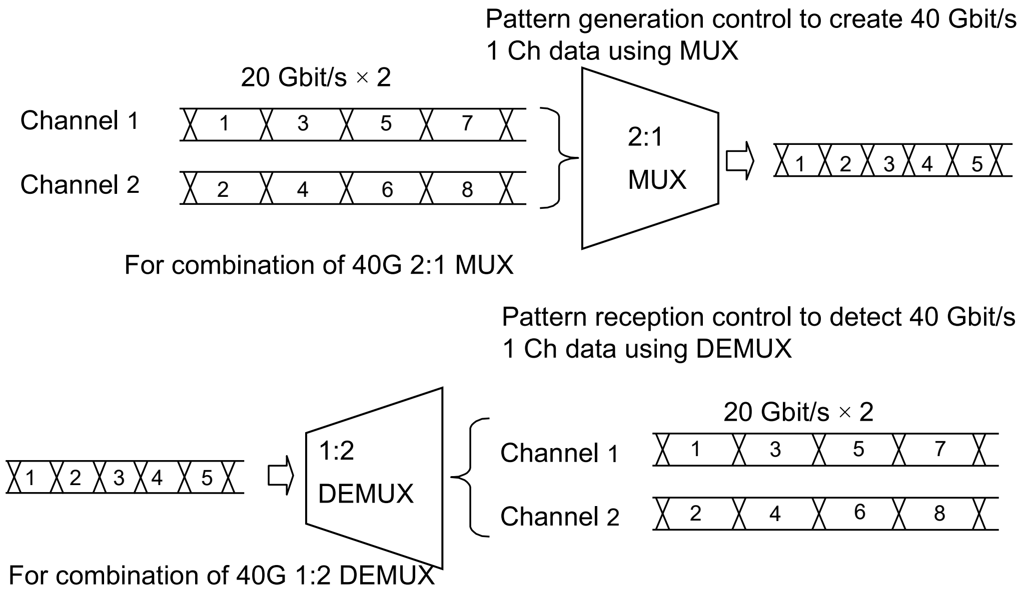


Figure 3.3.1-1 2ch Combination Pattern generation/reception

By using the 64G × 2 ch Combination function, it is possible to generate four sets of 32G data combining up to two sets of 64G data. These two data patterns can be serialized with an external MUX.

This function is available when two modules of MU195020A-x20 + x31 are installed.

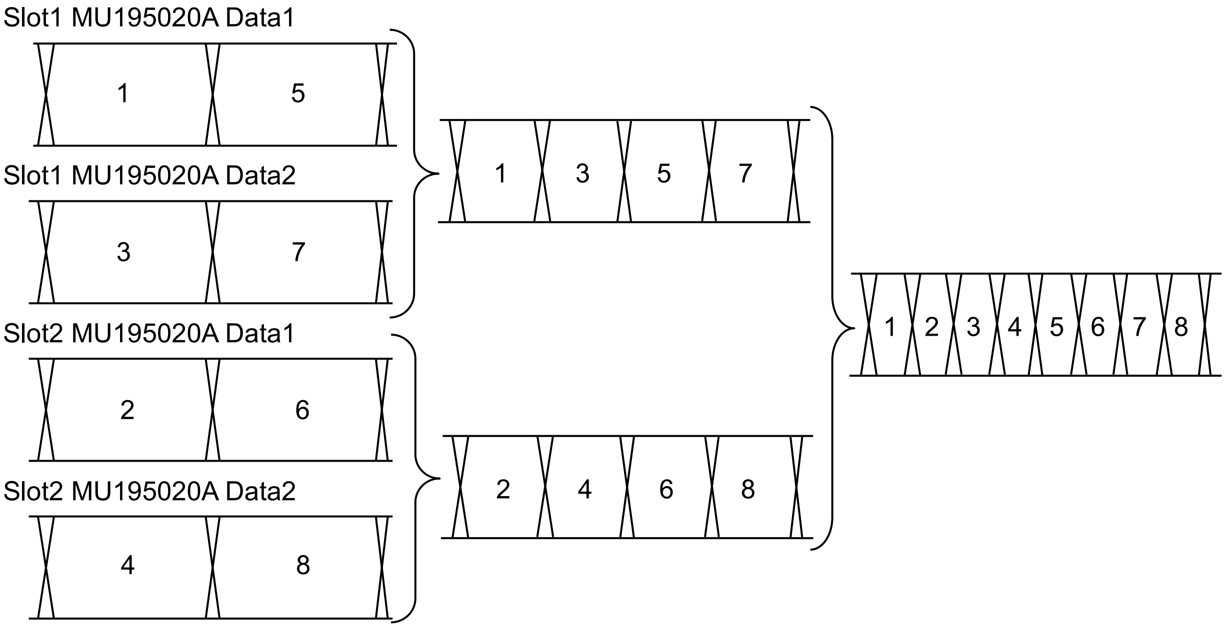


Figure 3.3.1-2 64G × 2ch Combination Pattern Generation (Using 2 modules of MU195020A)

3.3.2 Channel Synchronization Function

Channel Synchronization function synchronizes the timing of data of multiple channels.
Timing synchronization is available even among PPGs. In addition, you can adjust the time delay between channels by setting the skew.

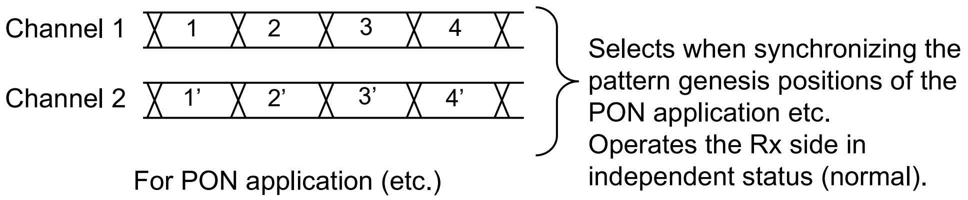


Figure 3.3.2-1 Channel-Synchronized pattern generation

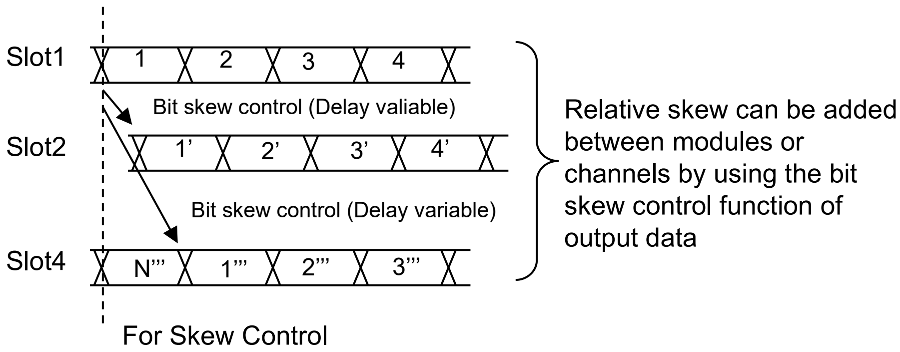


Figure 3.3.2-2 Skew control for Channel-Synchronized pattern generation

It is possible to Ch Synchronize the two signals of Combination 1 - 2 using two modules of PPG and synthesized by 2 ch Combination.

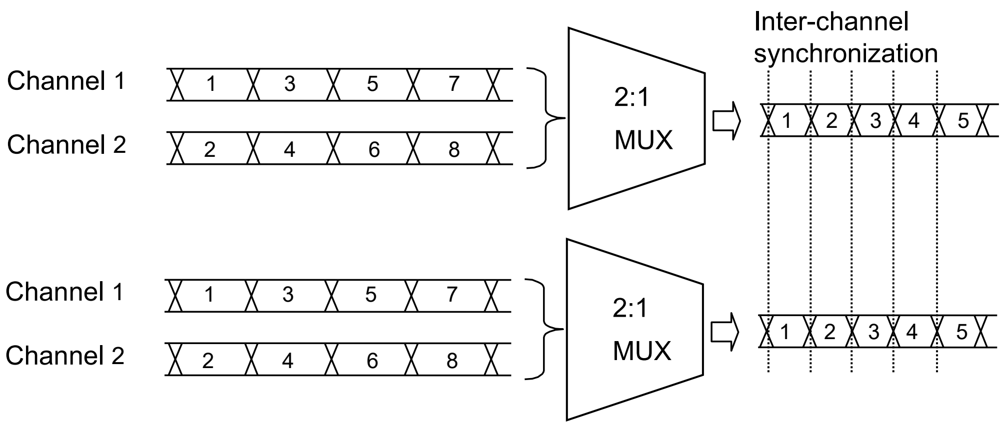


Figure 3.3.2-3 Ch Synchronization of 2Ch Combination

3.3.3 Combination Setting dialog box

Touching **Combination Setting** on the top left of Module Settings screen displays the **Combination Setting** dialog box.

The **Combination Setting** dialog box consists of the following areas:

Inter module combination: Sets inter modules synchronization function.

Inner module combination: Sets inner module synchronization function.

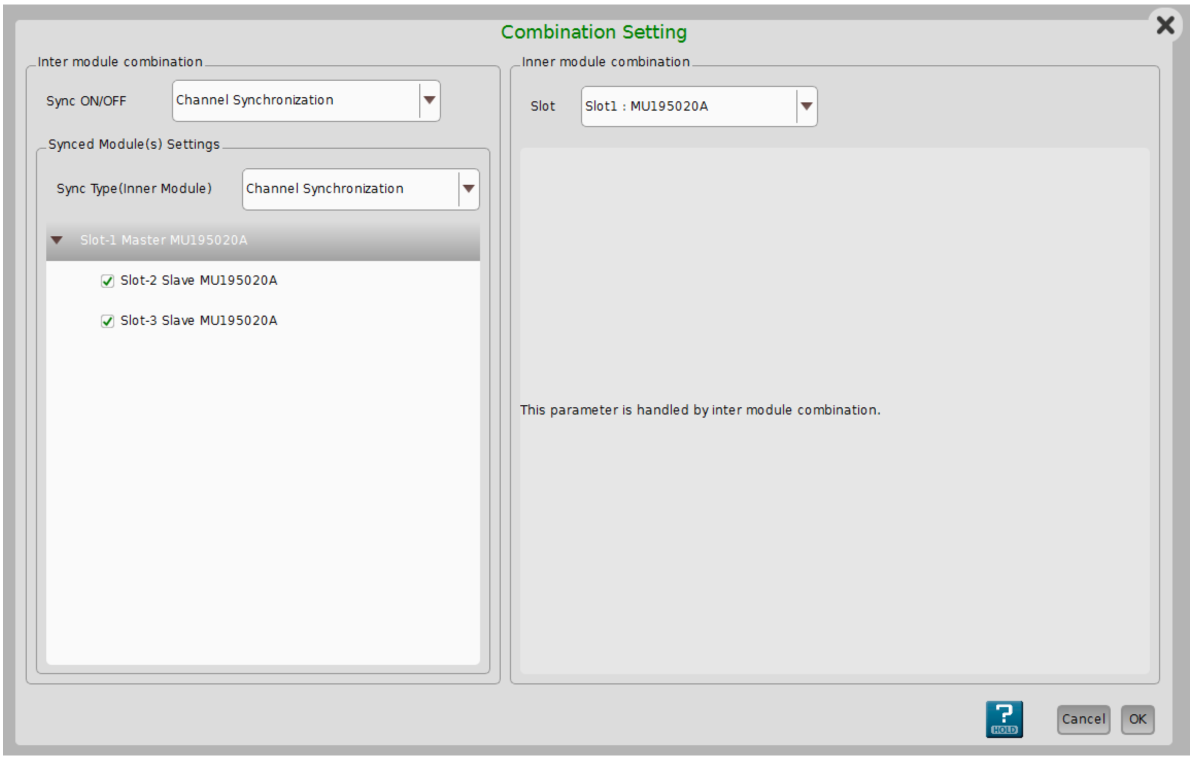


Figure 3.3.3-1 Combination Setting Dialog Box

3.3.3.1 Inter module combination area

In Inter module combination area, set a method to synchronize patterns among modules.

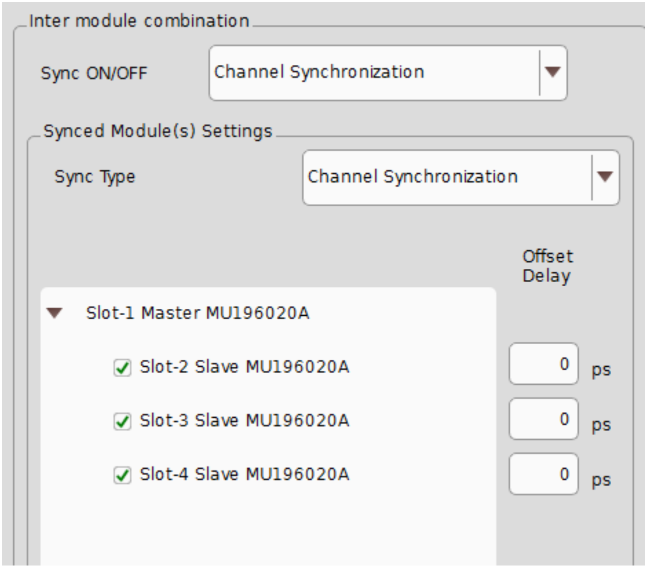


Figure 3.3.3.1-1 Inter module combination area

Table 3.3.3.1-1 Inter module combination settings

Sync ON/OFF	Synced Module(s) Settings	Description
OFF		Does not synchronize pattern with other modules.
Channel Synchronization	Channel Synchronization	Sets Channel Synchronization to all channels of selected modules.
	2CH Combination	Sets selected modules to 2ch Combination and sets Channel Synchronization among modules.
	64G × 2ch Combination	Sets two target MU195020A or MU183020A modules to 2ch Combination to make them to generate patterns with an inter-module delay of 1/4 cycle. (This option is available when two MU195020A or MU183020A modules are installed.) When using this setting, sets the same pattern for each of the two MU195020A.
	Inter-Module 2ch Combination	Sets two installed MU196020A modules to 2ch Combination. (This option is available when two MU196020A modules are installed.) When using this setting, sets the same pattern for each of the two MU196020A.

Note:

When setting Multi Channel function, a message dialog box appears if setting Multi Channel Calibration is required. Refer to 3.5.2 “Multi Channel Calibration Procedure”.

Touch **OK** to enable the inter-module combination function. The icons on the module titles change from (gray): **OFF** to (green): **ON** when they are synchronized. When the inter-module combination function is released, the icon returns from (green): **ON** to (gray): **OFF**.

Offset Delay

When using the Channel Synchronization function, phase-matched cables are required to adjust the phase of clocks input to the PPG. MU196020A requires finer phase adjustment as it is used at high rate (64.2 Gbaud). This setting is used to compensate the phase difference between cables for inputting clocks to MU196020As. Measure the electrical length of the cables to use in advance, and set the phase difference of each of cables to connect to MU196020As in Slot2 to Slot4 with reference to the length of cable to connect to MU196020A in Slot1.

Range: –20 to +20 ps, 1 ps step

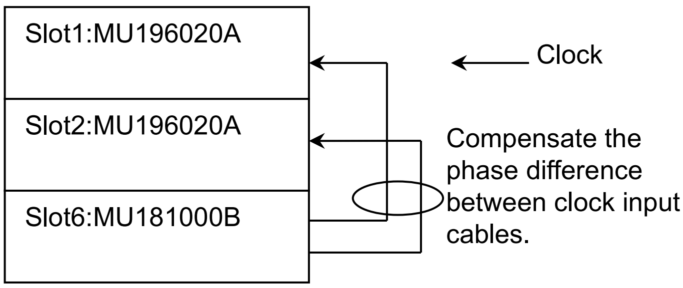


Figure 3.3.3.1-2 Clock Cable Connection

3.3.3.2 Inner module combination area

In Inner Module combination area, set inner modules function.

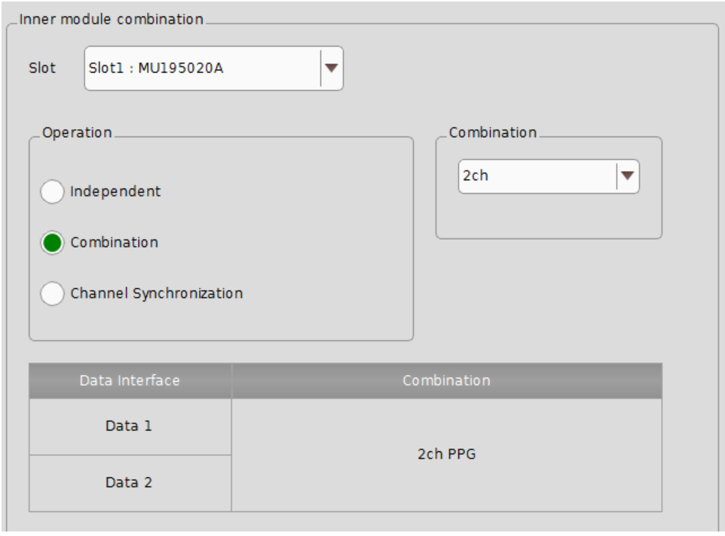


Figure 3.3.3.2-1 2ch Combination Settings

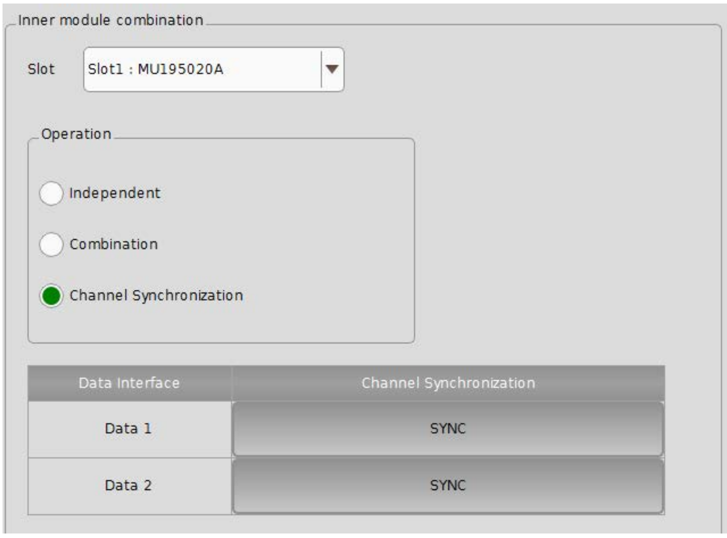


Figure 3.3.3.2-2 Channel Synchronization Settings

Table 3.3.3.2-1 Setting items for Inner module combination area

Operation	Description
Independent	Does not synchronize pattern within the modules. This operation works channels in the module independently.
Combination	Sets Combination to two channels or four channels.
Channel Synchronization	Sets Channel Synchronization to all channels in the module. Select one of the channel synchronization combinations from Data1 to 2, Data1 to 3 and Data1 to 4.

Touch **OK** to enable the inner-module combination function. The icons on the module titles change from (gray): **OFF** to (green): **ON** when they are synchronized. When the inner-module combination function is released, the icon returns from (green): **ON** to (gray): **OFF**.

3.4 Module Grouping Function

Touching **Module Grouping** on the top left of Module Settings window in 3.1.6.5 "Module Settings" displays the **Grouping** dialog box.
Module Grouping function is the function that makes parameters whose mark is displayed change together. This function is able to vary parameters together between channels in the module or among different modules.

- MU195020A Output tab
- MU195020A Emphasis tab
- MU195020A Pattern tab
- MU195040A Input tab
- MU195040A Pattern tab
- MU196020A Output tab
- MU196020A Emphasis tab
- MU196020A Pattern tab
- MU196040A Input tab
- MU196040B Input tab
- MU196040A Pattern tab
- MU196040B Pattern tab
- MU183020A Output tab
- MU183020A Pattern tab
- MU183021A Output tab
- MU183021A Pattern tab
- MU183040B Input tab
- MU183040B Pattern tab
- MU183041B Input tab
- MU183041B Pattern tab

In the **Grouping** dialog box, you can set parameters changing together based on a tab.

Note:

When Module Grouping function is working in **Input** tab, **Output** tab, **Pattern** tab, and **Emphasis** tab the values displayed in the tabs change together, but taking time to set parameters to each module will be longer in proportion to the number of channels to be grouped.

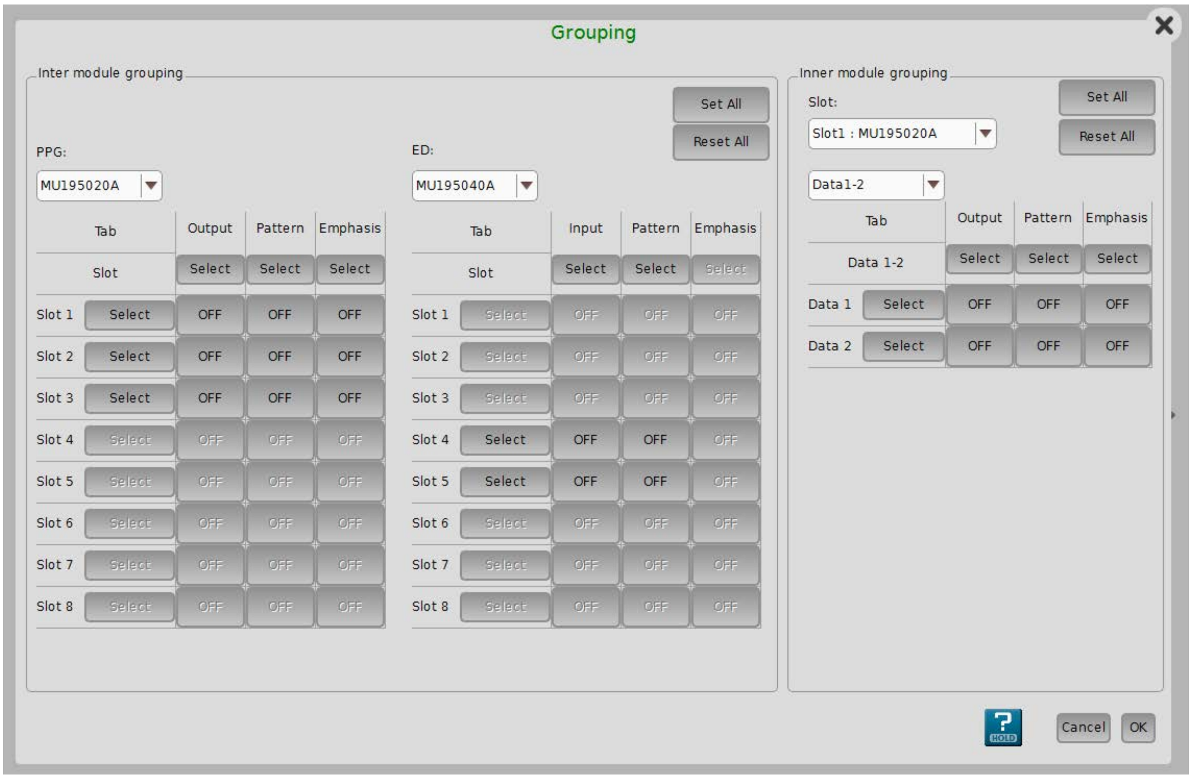


Figure 3.4-1 Grouping Dialog Box

3.4.1 Inter module grouping area

In Inter module grouping area, set the scope of parameters changing together across modules.

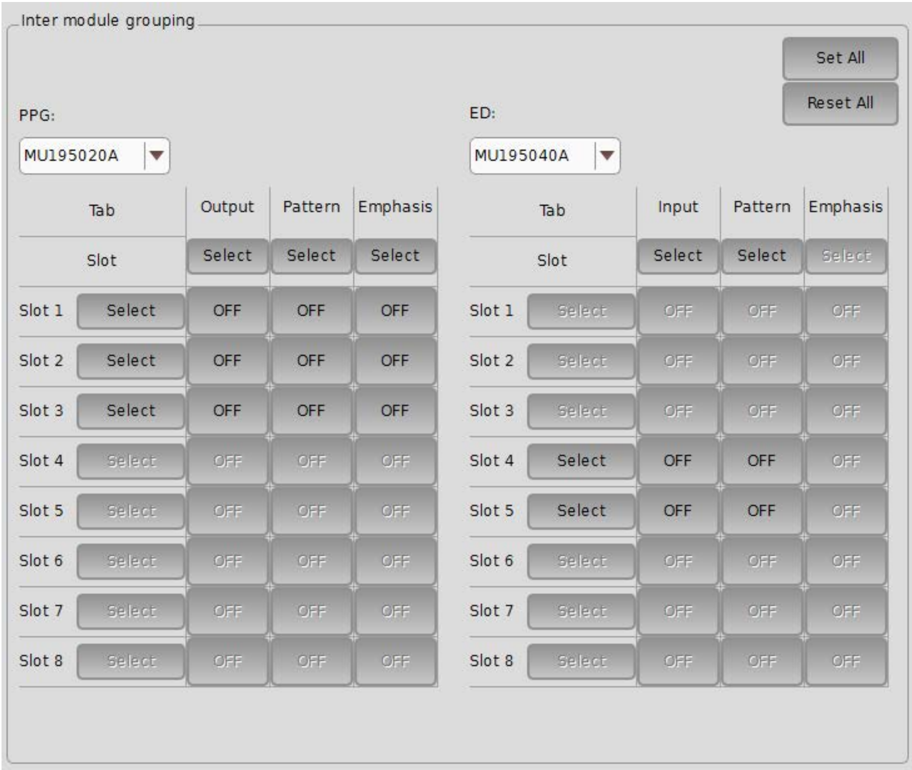


Figure 3.4.1-1 Inter module grouping area

Select a module slot number and the tab which contains parameters to be changed together. Touching **Set All** selects all buttons, and touching **Reset All** cancels all buttons.

When modules are grouped in the Inter module grouping area, the module with the smallest slot number becomes Master, whose parameter settings are reflected to Slave. The parameter settings for Master are reflected to Slave at one of the following times:

- When touching **OK** in the **Grouping** dialog box.
- When touching **Menu** > **Module Grouping** > **Execute** at the upper left of the BERT screen.

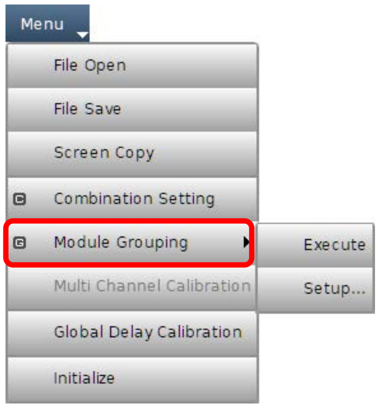


Figure 3.4.1-2 Menu > Module Grouping

The following shows an example of how to group PPG Slot1 to Slot3 in the Inter module grouping area.

1. In the Inter module grouping area, set Output, Pattern, and Emphasis of PPG Slot1 to Slot3 to **ON**.
2. In the **Grouping** dialog box (Figure 3.4-1), touch **OK**. This reflects the Slot 1 parameters subject to grouping to Slot2 and Slot3.
3. On the Application Toolbar of the BERT screen, select PPG Slot1, and on the **Output** tab, the **Pattern** tab, and the **Emphasis** tab, change the parameters.
4. To reflect the parameter settings for Slot1 to Slot2 and Slot3, touch **Menu** > **Module Grouping** > **Execute** at the upper left of the BERT screen.

Notes:

- Module Grouping function across modules is effective for modules whose model, options are the same.
- Module Grouping function across modules is effective when two or more buttons of each tab are set to **ON**.
- To reflect the parameter settings for Master to Slave, touch **OK** in the **Grouping** Dialog Box, or touch **Menu** > **Module Grouping** > **Execute** at the upper left of the BERT screen. Just making changes to the parameter settings for Master does not reflect to Slave.

3.4.2 Inner module grouping area

In Inner module grouping area, set the scope of parameters changing together in the module.

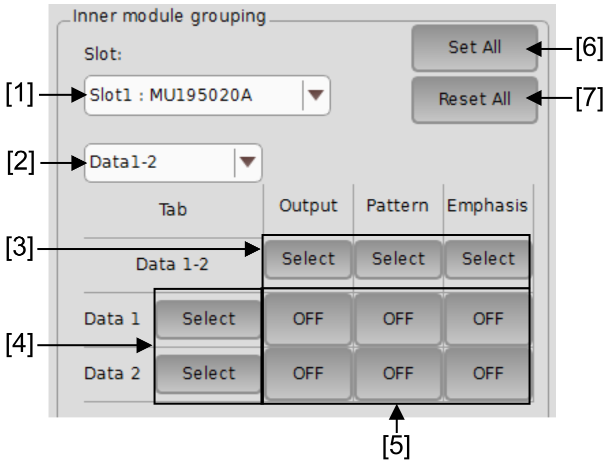


Figure 3.4.2-1 Inner Module Grouping area

[1] Slot
Select a module to set grouping.

[2] Data Interface Selection
Select a combination of interfaces to be grouped.

[3] Tab Selection button
Set the button on the tab changing parameters together to **ON** or **OFF**.

[4] Data Interface Selection Button
Set the Data Interface button of parameters changing together to **ON** or **OFF**.

[5] Grouping Setting button
ON: Sets so that parameters change together with those on other tab.
OFF: Sets so that parameters do not change together with those on other tab.

[6] Set All
Sets all buttons to **ON**.

[7] Reset All
Sets all buttons to Sets all buttons to **OFF**.

Once grouping has set by touching **OK**, Data Interface settings of the master are set to those in grouped Data Interface. And mark of parameters that grouping has set turns to (light blue). If grouping setting is canceled, mark of parameters turns to (gray).

3.5 Multi Channel Calibration Function

When two or more PPGs have been installed in MP1900A, the time difference between data output from PPGs needs to be calibrated.
Perform Multi Channel Calibration in the following cases:

- PPG has been replaced.
- Slot position of PPG has changed.
- Another PPG has been added.
- Changes have been made to the installed module(s) other than PPG.
- MP1900A installed with PAM4 PPG has been powered on. (Version 3.01.00 or later)
- The ambient temperature of PAM4 PPG has changed from the time of calibration. (Version 3.01.00 or later)

At setting Multi Channel function, the dialog box appears if performing Multi Channel Calibration is required.
If Multi Channel Calibration was performed once, it does not need to perform again until module configuration installed in MP1900A is changed. Whether calibration has performed or not can be confirmed in “Figure 3.5.3-1 Calibration Execution Verification”.

Note:

MX190000A Version 3.01.00 or later opens the dialog box recommending that you perform Multi Channel Calibration when powering on MP1900A with the Multi Channel function turned on.

3.5.1 Precautions

Read the following thoroughly before performing Multi Channel Calibration.

- Do not add jitter to the clock which is input to PPG.
- When MU181000A/B and MU181500B are installed in the same MP1900A where PPG is installed, PPG Misc 2 Clock Settings are set automatically as Clock source is MU181000A/B. Confirm Clock Setting after Multi Channel Calibration has finished.
- For how to connect clock signals of PPG, refer to the following:
  3.2 “Inter-Module Connection” in *MU183020A 28G/32G bit/s PPG MU183021A 28G/32G bit/s 4ch PPG Operation Manual*
  3.2 “Inter-Module Connection” in *MU195020A 21G/32G bit/s SI PPG MU195040A 21G/32G bit/s SI ED MU195050A Noise Generator Operation Manual*
  3.2 “Inter-Module Connection” in *MU196020A PAM4 PPG MU196040A PAM4 ED MU196040B PAM4 ED Operation Manual*
- When multiple PPG have been installed, set **CH Sync** of **Channel Synchronization** referring 3.3.3 “Combination Setting dialog box”. In this case, connect between the clock source and Ext Clock Input of each PPG using coaxial cables with the same length.
- Perform the calibration where ambient temperature of MP1900A is in range of 20 to 30°C.

3.5.2 Multi Channel Calibration Procedure

1. When performing calibration is required, the following dialog box appears if Inter Module combination or Channel Synchronization and Combination in 3.3.3 “Combination Setting dialog box” has selected. To execute calibration, touch the **Yes**.

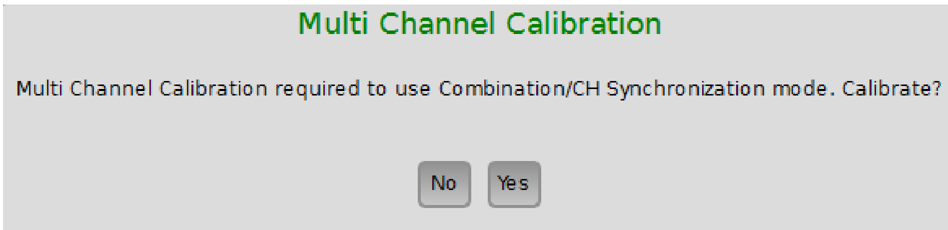


Figure 3.5.2-1 Multi Channel Calibration Dialog Box

When **No** is touched, the dialog shown in below is displayed; if the check box is selected, this calibration-required dialog box will not appear again when calibration is required in future.

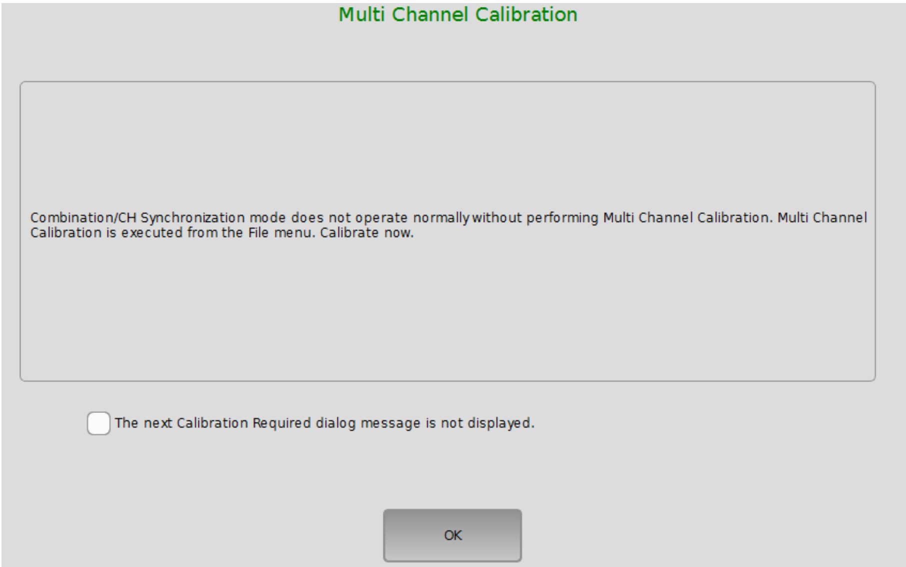


Figure 3.5.2-2 Multi Channel Calibration Dialog Box

For the operation to perform Multi Channel Calibration later, refer to 3.5.3 “Operation from Menu or Module Settings”.

2. Touch **Next** after confirming the explanation.

   Estimated time for the calibration is as follows:

   - SI/32G PPG: about 2 to 3 minutes
   - PAM4 PPG:

     When linked to synthesizer:

     Number of Slave modules × 10 minutes

     When not linked to synthesizer:

     Number of Slave modules × 15 minutes

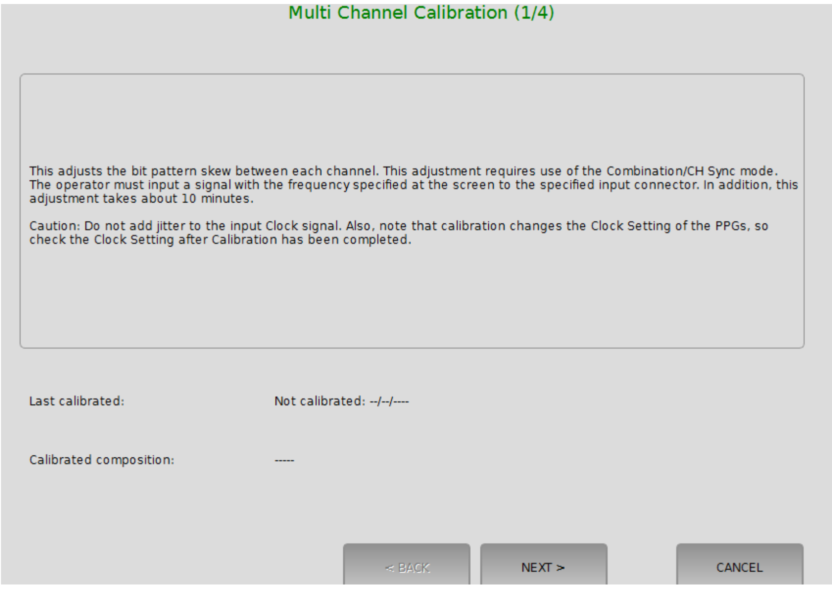


Figure 3.5.2-3 Multi Channel Calibration Dialog Box (1/4)

3. If the following dialog box has appeared, input the clock to PPG.
   - When MU181000A/B and PPG are installed in the same MP1900A, input MU181000A/B clock to each PPG. (Refer to Figure 3.5.4-1 "Example Clock Connection 1".)
   - In other cases, connect between the clock source and PPG using a coaxial cable, input the clock at the frequency displayed in the dialog box to PPG.

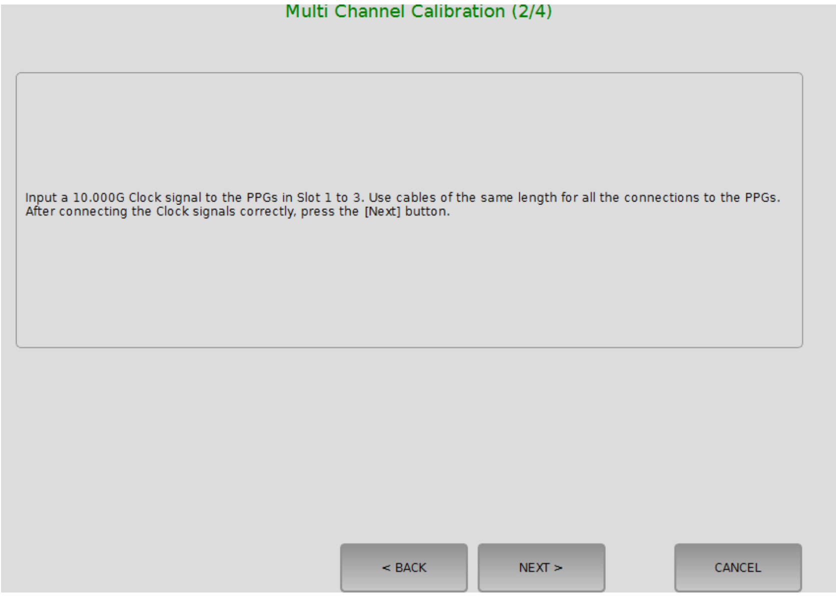


Figure 3.5.2-4 Multi Channel Calibration Dialog Box (2/4)

- On MX190000A Version 3.02.00 or later, the following dialog box is open if MU181000A/B is not installed in the MP1900A in which PPG is installed. Select whether to use an external clock supply source or the MU181000A/B installed in another MP1900A, as the clock source. Refer to 3.5.4 (3) for details.

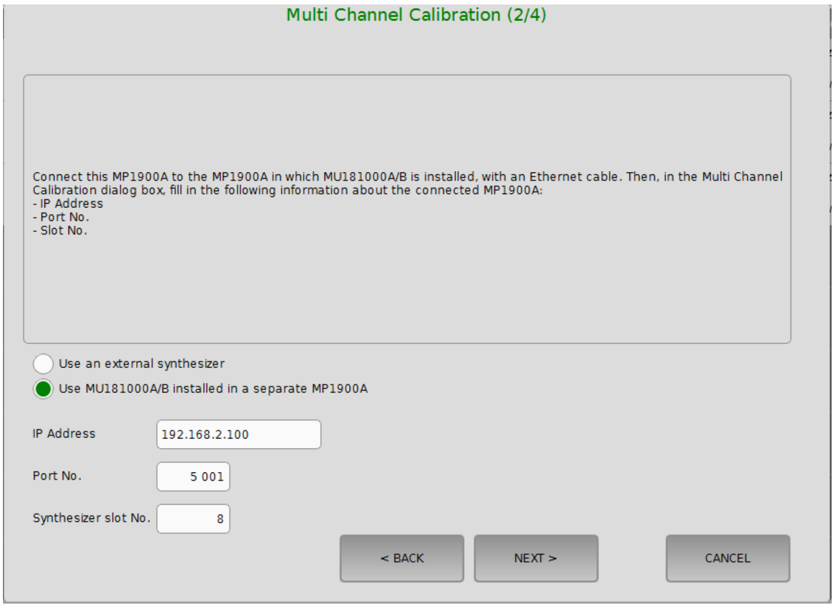


Figure 3.5.2-5 Multi Channel Calibration Dialog Box 2/4

4. Touch **Next**. The Multi Channel Calibration progress is displayed.

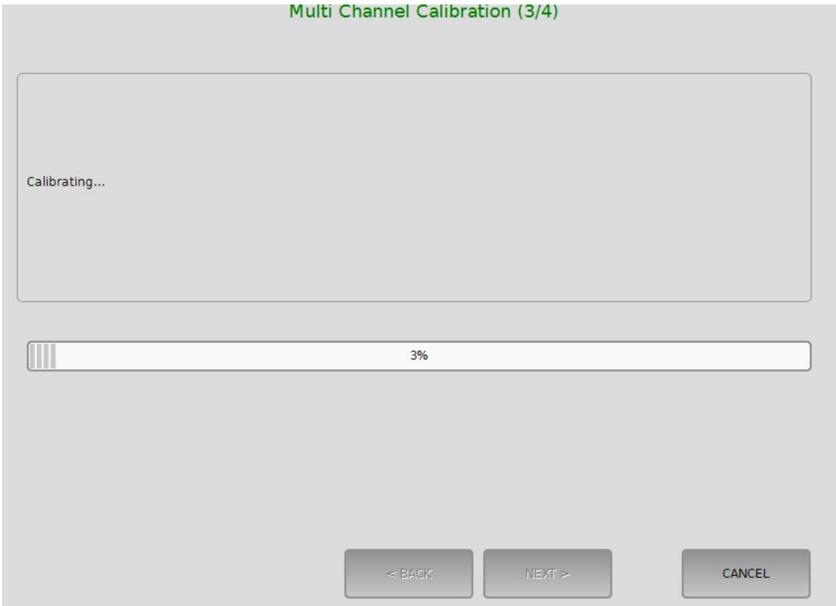


Figure 3.5.2-6 Multi Channel Calibration Dialog Box (3/4)

5. If the message dialog box shown in Figure below is displayed during calibration, change the input clock frequency as indicated and touch **OK**.
   When both the PPG and MU181000A/B synthesizer are installed in the same MP1900A, it is not necessary to change the frequency.

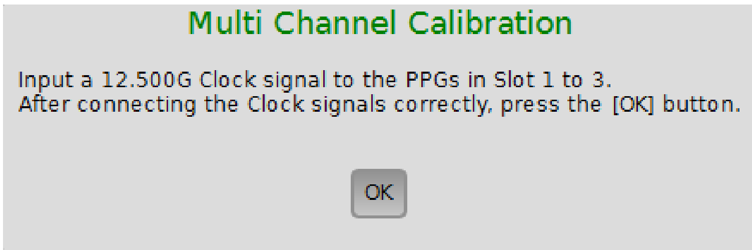


Figure 3.5.2-7 Multi Channel Calibration Dialog Box

6. Touch **Finish** when the screen shown below is displayed to complete the calibration.

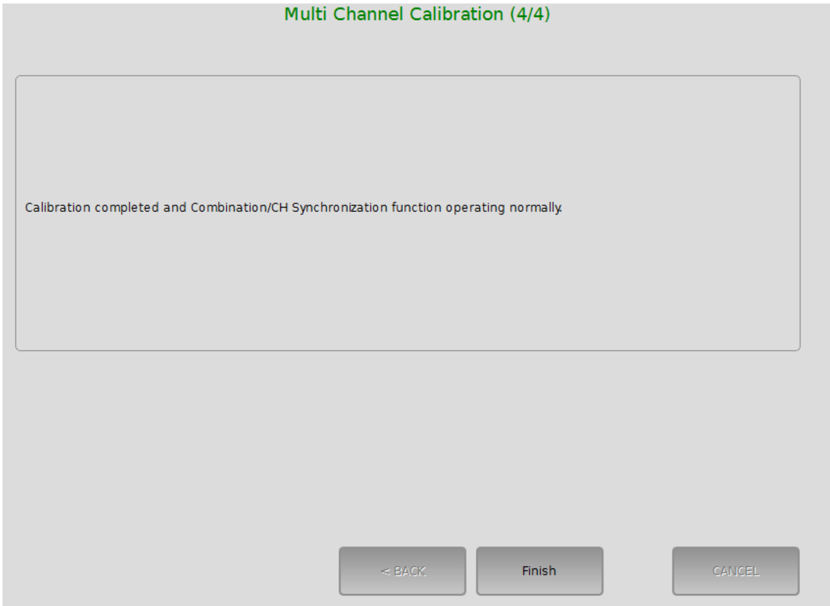


Figure 3.5.2-8 Multi Channel Calibration Dialog Box (4/4)

3.5.3 Operation from Menu or Module Settings

When No was touched in step 1 in 3.5.2 "Multi Channel Calibration Procedure", perform Multi Channel Calibration following the method below.

- Touch **Multi Channel Calibration** in 3.2.2.3 "Menu".
- Touch **Multi Channel Calibration** in 3.1.6.5 "Module Settings".

The following dialog box appears. For operation from this, refer to step 2 or later in 3.5.2 "Multi Channel Calibration Procedure".

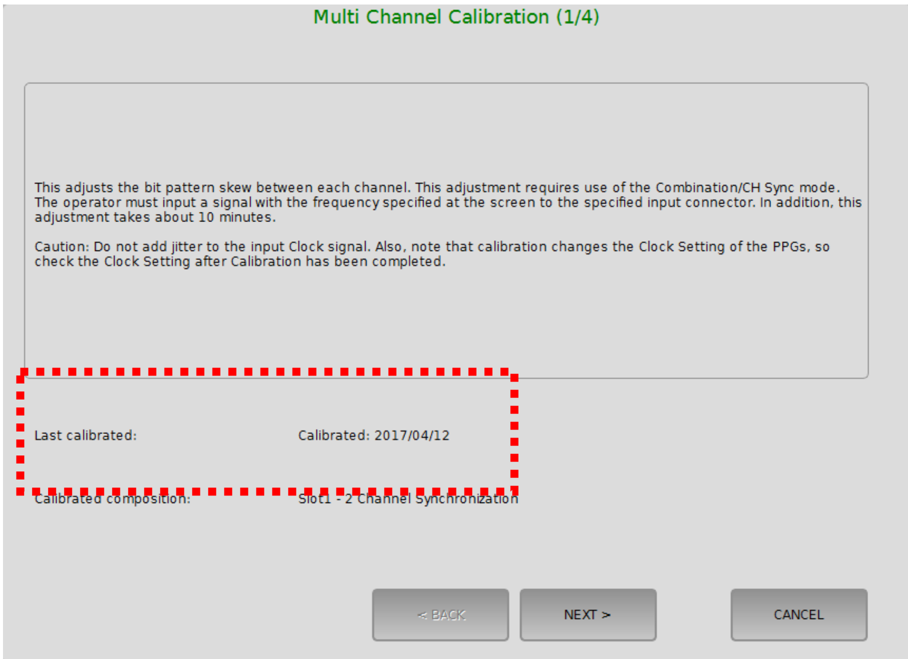


Figure 3.5.3-1 Calibration Execution Verification

If Multi Channel Calibration has ever performed, Last calibrated data is shown.

3.5.4 Performing Multi Channel Calibration Example

This section describes Multi Channel Calibration procedure using typical module configuration. For the detail clock signal connection, refer to Multi Channel in 3.2.4 "Synchronizing Multiple Channels of PPG" in *MU195020A 21G/32G bit/s SI PPG MU195040A 21G/32G bit/s SI ED MU195050A Noise Generator Operation Manual*. The following explanations are the procedures when the initialization has done before performing Multi Channel Calibration.

(1) Two MU195020A units and MU181000B

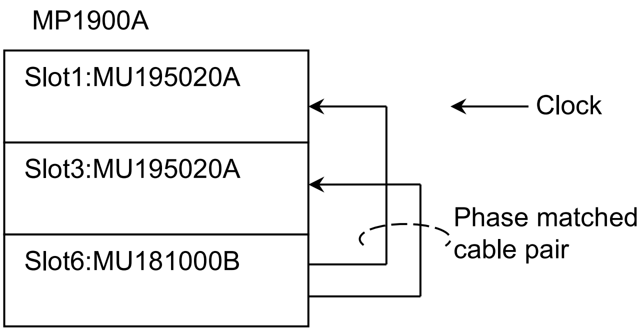
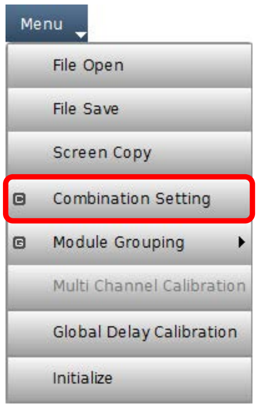
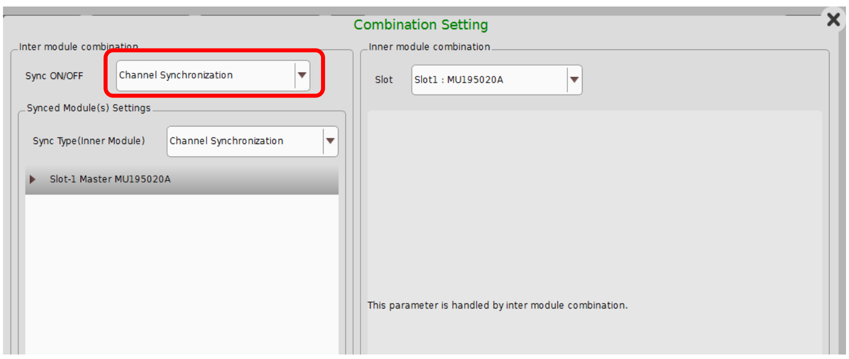


Figure 3.5.4-1 Example Clock Connection 1

1. Touch **Combination Setting** in the Menu.



2. In the **Combination Setting** dialog box, click **Channel Synchronization**.



3. When the Multi Channel Calibration Dialog Box appears as shown in Figure 3.5.2-1, perform the calibration according to the description of step 2 through step 6 in 3.5.2.

(2) Two MU195020A (with MU195020A-x20), MU181500B, and External Synthesizer

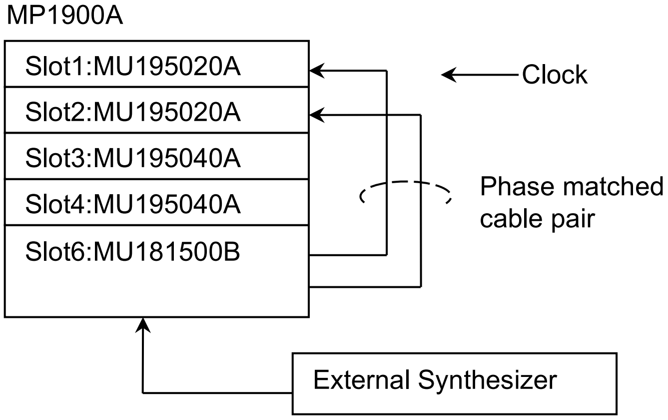
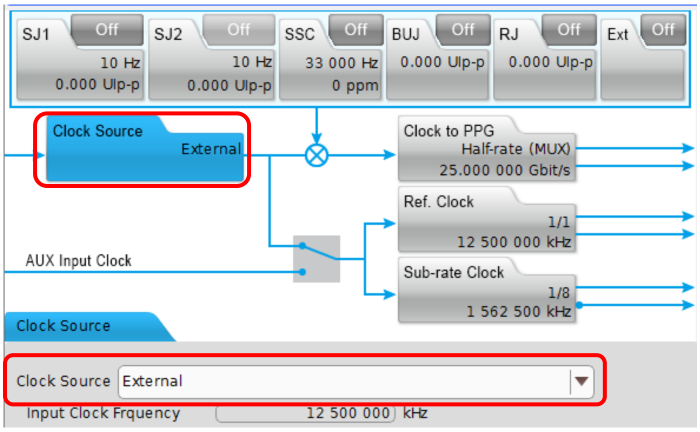
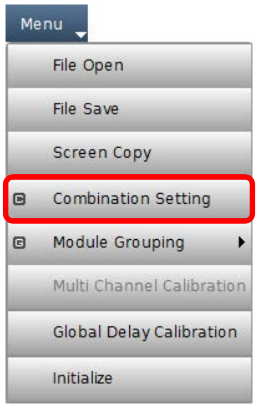


Figure 3.5.4-2 Example Clock Connection 2

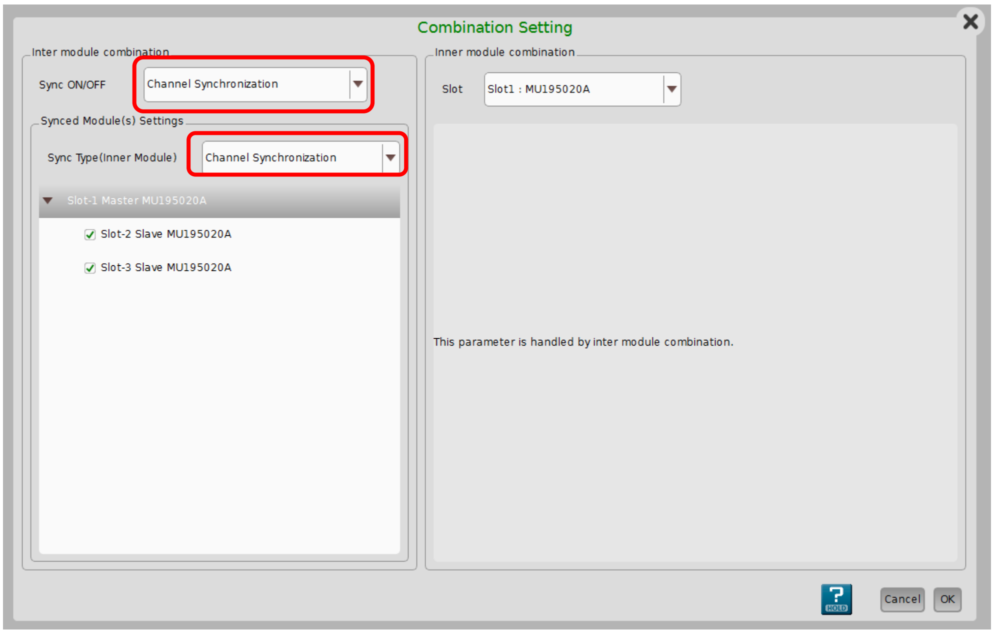
1. Select **External** at Clock Source setting of MU181500B in slot6.



2. Touch **Combination Setting** in Menu.



3. In the **Combination Setting** dialog box, select **Channel Synchronization**, and then select **Channel Synchronization**.



4. When the Multi Channel Calibration Dialog Box appears as shown in Figure 3.5.2-1, perform the calibration according to the description of step 2 through step 6 in 3.5.2.

(3) Four MU196020As (with MU196020A-x30/x50) + One MU181500B + MU181000B installed in another MP1900A

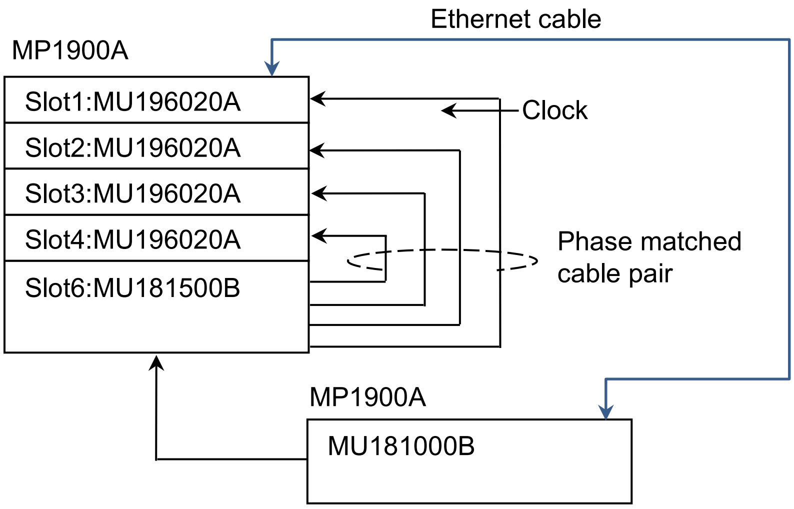
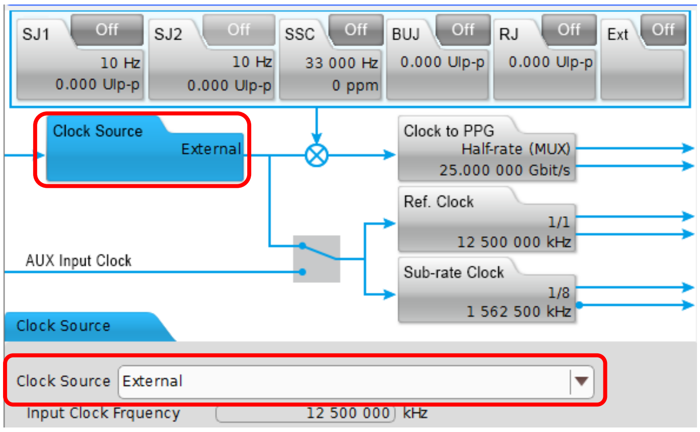
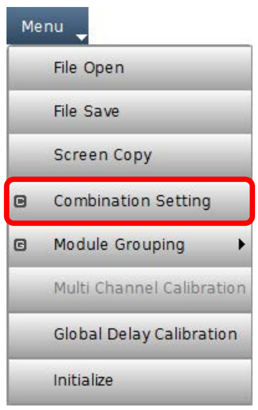


Figure 3.5.4-3 Example Clock Connection 3

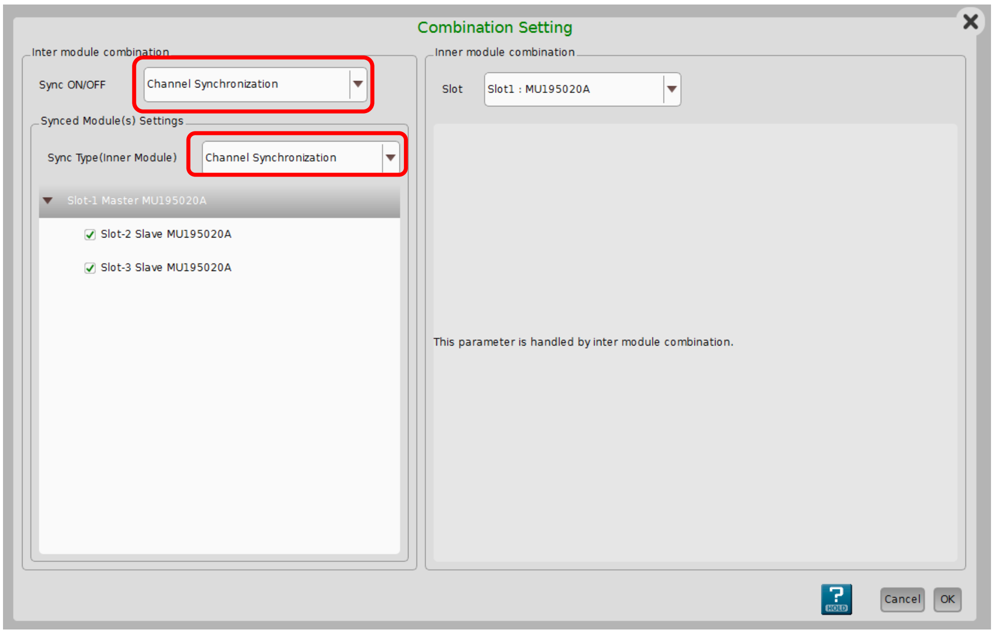
1. Select **External** at Clock Source setting of MU181500B in slot6.



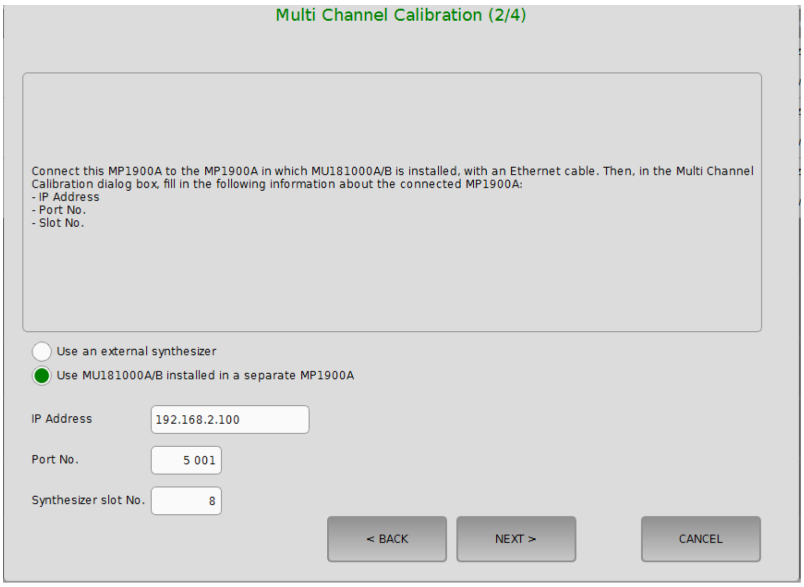
2. Touch **Combination Setting** in Menu.



3. In the **Combination Setting** dialog box, make inter module combination settings as follows:
Sync ON/OFF: **Channel Synchronization**
Sync Type: **Channel Synchronization**

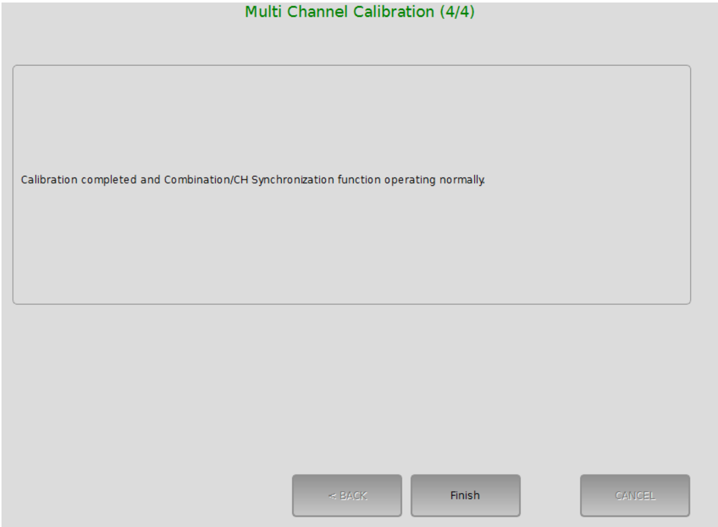


4. The **Multi Channel Calibration** dialog box opens. (Figure 3.5.2-1) In MX190000A Version 3.02.00 or later, the calibration can be performed using MU181000B installed in another MP1900A. As shown in Figure 3.5.4-3, connect MP1900As with an Ethernet cable, fill in the information about the connected MP1900 (**IP Address**, **Port No.** and **Synthesizer slot No.**), and touch **Next**.



5. The progress of Multi Channel Calibration is displayed.

6. When the following dialog box page appears, touch **Finish**.



3.5.5 Bit Shift Adjustment When MU196020A Operates at 32 Gbaud or More

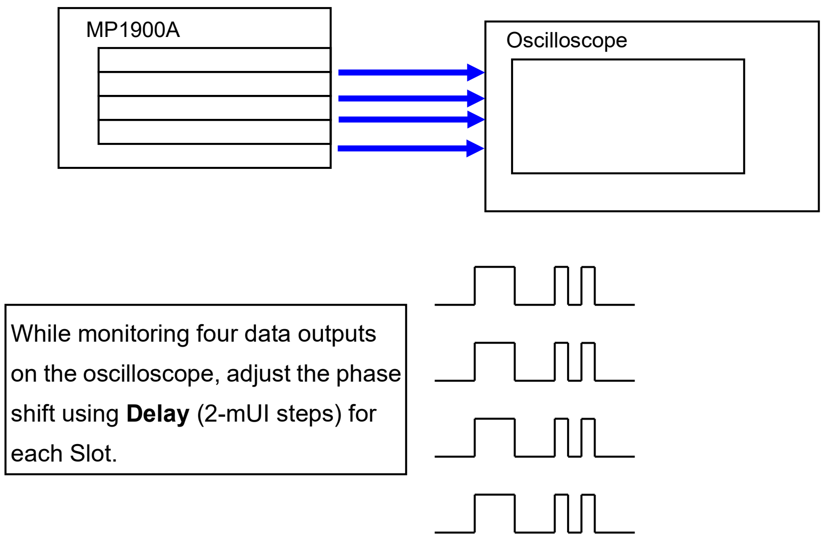
This section explains a bit adjustment procedure when using the Multi Channel function of MU196020A at the operating rate of 32 Gbaud or more.

When MU196020A operates at 32 Gbaud or more, its Multi Channel function causes up to ±5 bits of phase shift to the modules in Slots 2 to 4, respectively, with respect to the reference PPG in Slot 1. Adjust the inter-module bit shift according to the following procedure.

For details on how to connect clock signals, refer to 3.2.4 “Synchronizing Multiple Channels of PPG” in the *MU196020A PAM4 PPG MU196040A PAM4 ED MU196040A PAM4 ED Operation Manual*. Note that perform Multi Channel Calibration before proceeding with the following procedure.

Four MU196020A modules + MU181000B

1. Connect the output connectors of Slots 1 to 4 to the oscilloscope using cables of the same length.



2. On the oscilloscope, check the waveform, and then on the **Output** tab for each slot, set the value for **Delay** and perform bit shift adjustment.

3.6 Unit Sync Function

The Unit Sync function is used to synchronize multiple MP1900A units to generate the same pattern. This section explains how to set the Unit Sync function as well as the operations and restrictions when using this function.

3.6.1 Unit Sync Operation and Restrictions

The Unit Sync function synchronizes two MP1900As by sharing a timing signal between them.
Up to 8ch patterns can be generated in sync with each other by using the Channel Synchronization function that performs inter-module synchronization of modules installed in MP1900As and the Unit Sync function that performs inter-MP1900A synchronization.

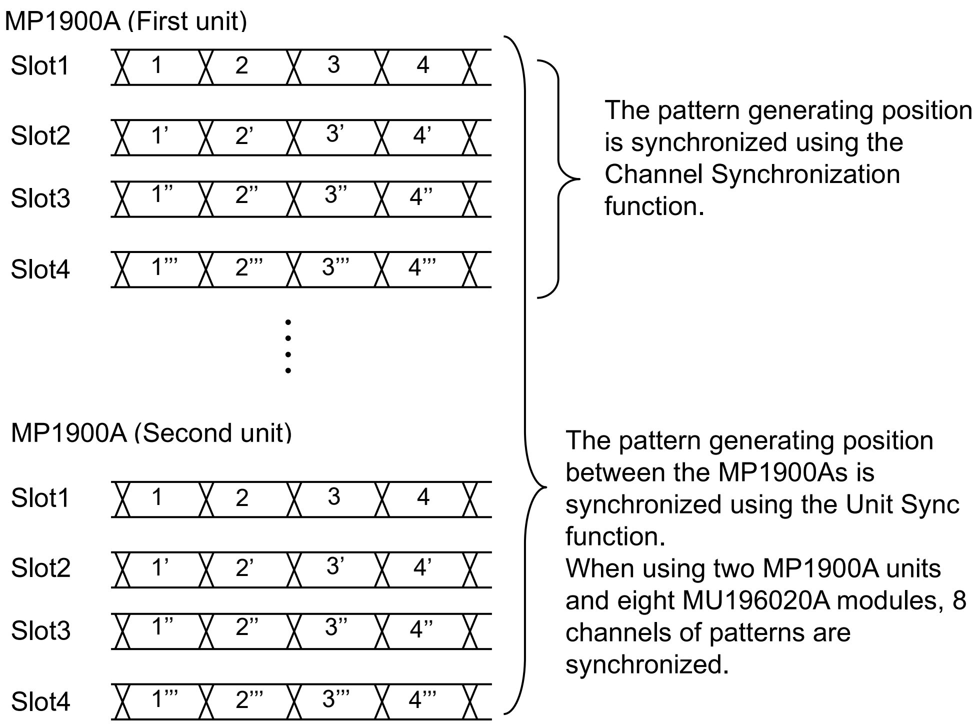


Figure 3.6.1-1 Channel Synchronization Pattern Generation

Furthermore, there are following restrictions when using the Unit Sync function:

- This function is available only when the MU196020A PAM4 PPG (Option x30/x50) is installed.
- Cannot use the Burst function
- Cannot add error using the external signal
- This function is not available with the MU195020A SI PPG and MU183020A/21A 32G PPG.

3.6.2 Unit Sync Setting

In the Module Settings screen shown in 3.1.6.5 “Module Settings”, touch **Combination Setting**, and you will see the **Combination Setting** dialog box.

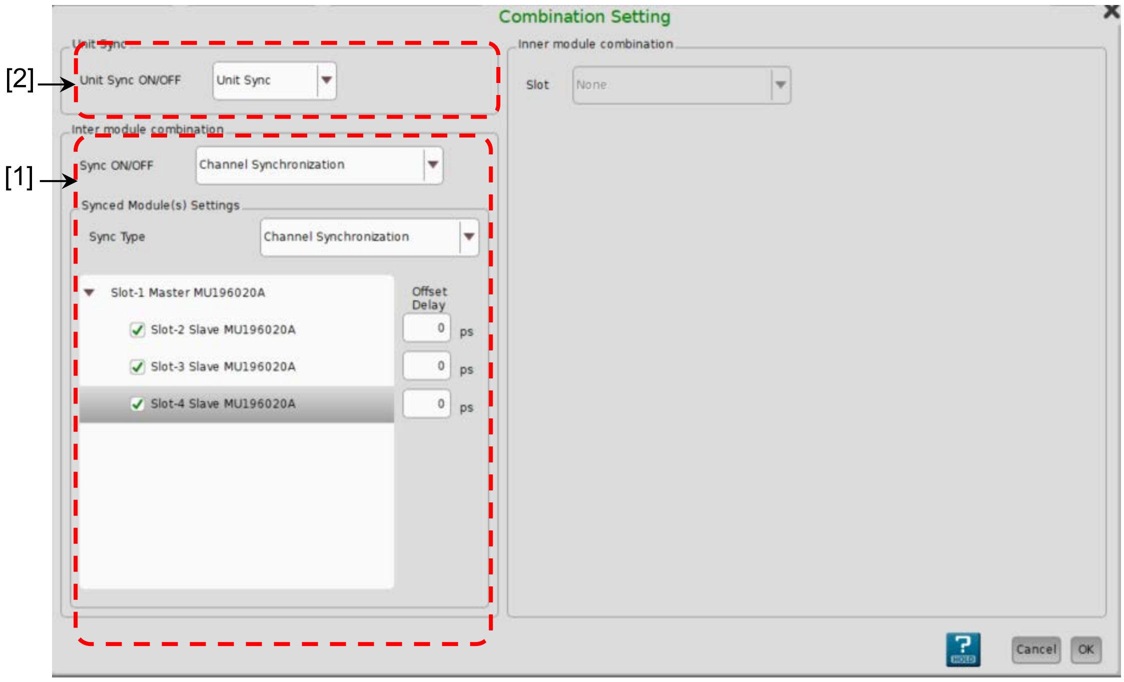


Figure 3.6.2-1 Combination Setting Dialog Box

[1] Turning on the Inter Module Combination function
In the **Sync ON/OFF** box of the **Inter module combination** area, select **Channel Synchronization**, and the **Unit Sync ON/OFF** drop-down list becomes available.

Table 3.6.2-1 lists the combinations available for the Unit Sync function.

Table 3.6.2-1 Combination Settings for Unit Sync

Sync ON/OFF	Sync Type
Channel Synchronization	Channel Synchronization
	Inter-Module 2ch Combination

[2] Turning ON/OFF the Unit Sync function

To enable the function, in the **Unit Sync ON/OFF** list, touch **Unit Sync**, and then touch **OK**. When you receive the message that the settings were changed according to the restrictions given in 3.6.1 "Unit Sync Operation and Restrictions", touch **OK** to confirm. (Figure 3.6.2-2)

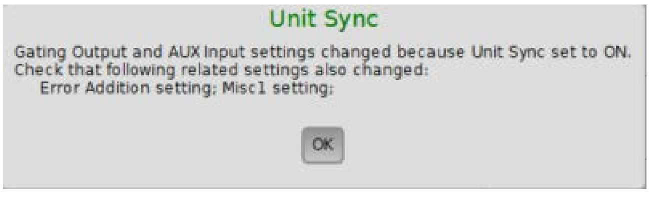


Figure 3.6.2-2 Notification Message for Changes to Settings When Unit Sync Is ON

3.6.3 How to Use Unit Sync Function

This section explains how to use the Unit Sync function. For details on how to connect MP1900As when using the Unit Sync function, refer to 3.6.4.1 “Connecting equipment”.

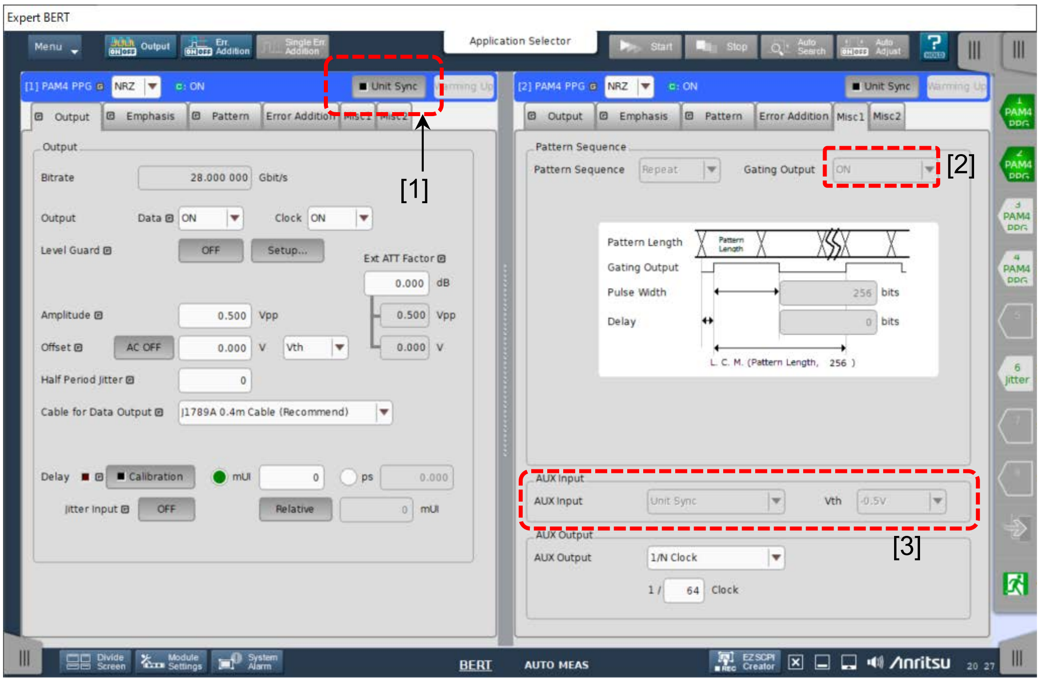


Figure 3.6.3-1 MX190000A Screen

[1] **Unit Sync**
Outputs the timing signal for synchronization with the MP1900A. This button is available only when **Unit Sync** is set to **ON**.

Note:

The status indicator turns orange when there is an interruption or change in the operation clock input. In this case, you need to touch the button to synchronize again.

[2] Gating Output of Pattern Sequence
When **Unit Sync** is **ON**, this is dedicated to output a timing signal for inter-MP1900A synchronization.

[3] AUX Input
When **Unit Sync** is **ON**, this is dedicated to input a timing signal for inter-MP1900A synchronization.

3

Basic Operations

3.6.4 Performing the Unit Sync function

This section explains how to perform the Unit Sync function.
Here, an example is explained using two MP1900As each installed with four MU196020A PAM4 PPGs.

Equipment configuration:

MP1900A:	2
MU196020A PAM4 PPG (MU196020A-001/x30/x50):	8
MU181500B Jitter Modulation Source:	2
MU181000B 12.5GHz 4port Synthesizer:	1

3.6.4.1 Connecting equipment

This section explains how to connect equipment for using the Unit Sync function.

- Connect MU181000B and MU181500B for inputting a clock signal to MU196020A.
- Connect the Gating Out and AUX In connectors of MU196020A. As shown in Figure 3.6.4.1-1, connect the Gating Out and AUX In connectors of modules.
- Connect two MP1900As with an Ethernet cable to execute Multi Channel Calibration, which calibrates the Multi Channel operation of the MU196020As installed in the MP1900As.
- Set the IP address and port number of each MP1900A.

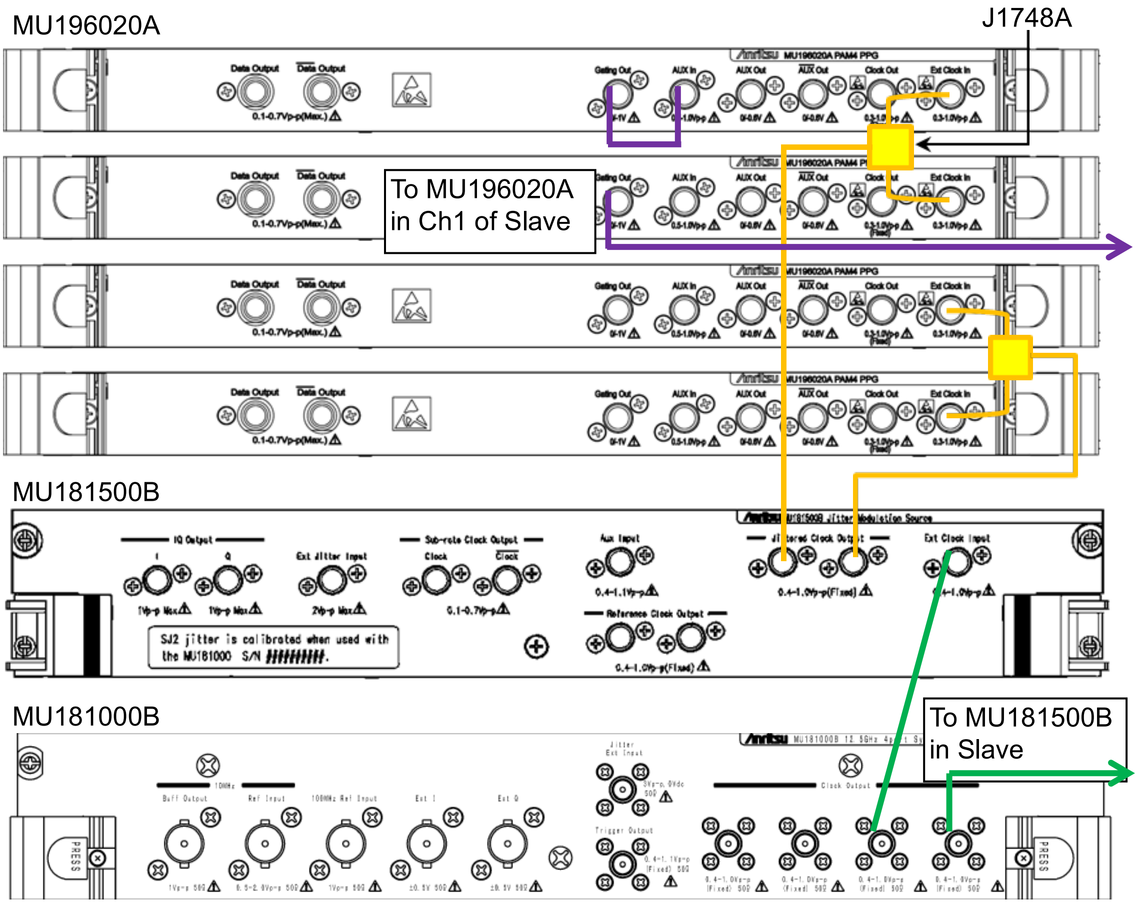


Figure 3.6.4.1-1 Connection Example of MP1900A (Master)

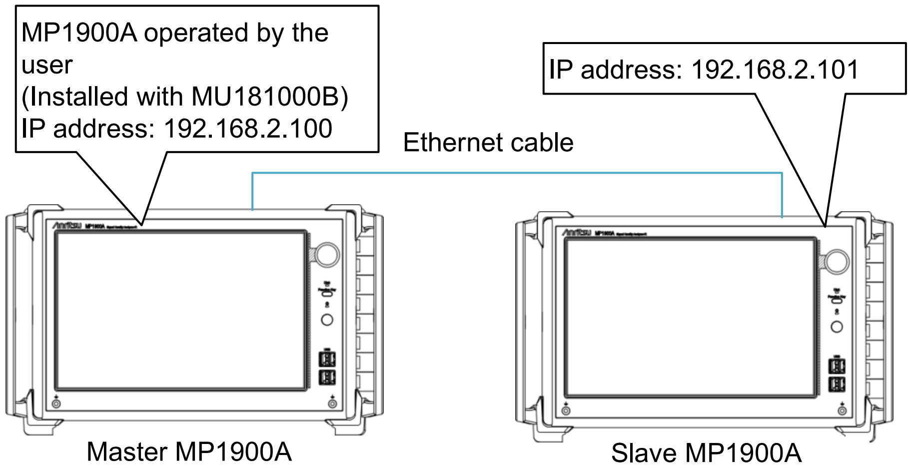


Figure 3.6.4.1-2 Ethernet Cable Connection and IP Address Setting of MP1900As

Of the two MP1900As, one in which MU181000B is installed is defined as Master, and the other as Slave. Connect the clock signal of MU196020A installed in each of Master and Slave.

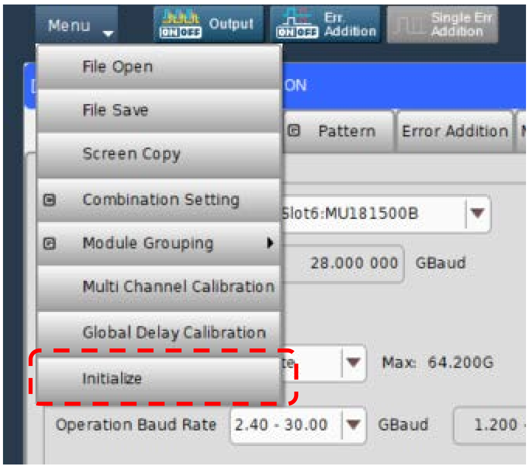
1. Connect the Clock Output connector of MU181000B installed in Slot 7 and 8 of Master and the Ext. Clock Input connector of MU181500B installed in Slot 5 and 6 of Master and Slave by using the J1625A coaxial cables (optional accessories).
2. Connect the Jittered Clock Output connector of MU181500B installed in Slot 5 and 6 of Master and Slave and the Clock In connector of MU196020A each installed in Slot 1 to 4 of Master and Slave by using the J1624A cables and J1748A dividers (optional accessories, respectively).
3. Connect the Gating Out and AUX In connectors of MU196020A installed in Slot 1 of Master by using the J1625A cable (optional accessory).
4. Connect the Gating Out connector of MU196020A installed in Slot 2 of Master and the AUX In connector of MU196020A installed in Slot 1 of Slave by using the J1625A cable (optional accessory).
5. Connect Master and Slave with an Ethernet cable. Be sure to connect the External ports on the rear of Master and Slave MP1900As.
6. Set the IP address and port number of each of Master and Slave. Here, set as follows.

IP Address (Master):	192.168.2.100
IP Address (Slave):	192.168.2.101
Port No. (Master/Slave):	5001

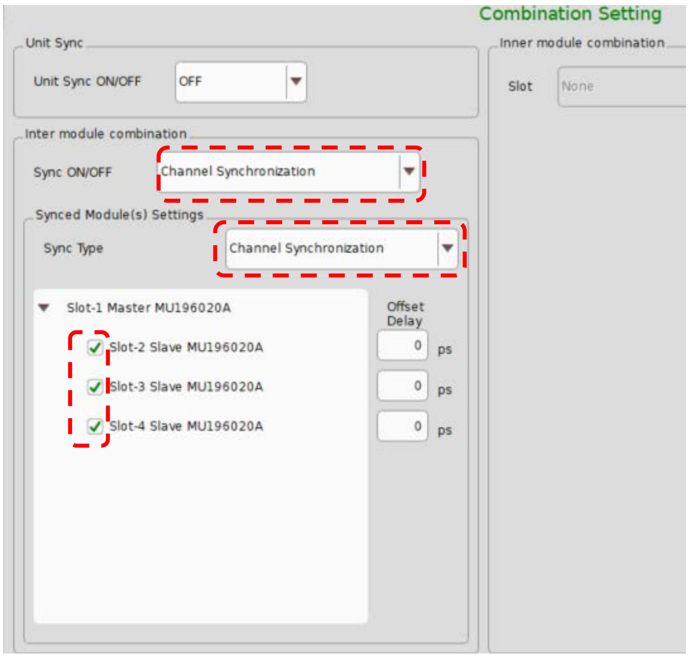
3.6.4.2 How to perform inter-MP1900A pattern synchronization

This section explains how to perform inter-MP1900A pattern synchronization of initialized Master and Slave.

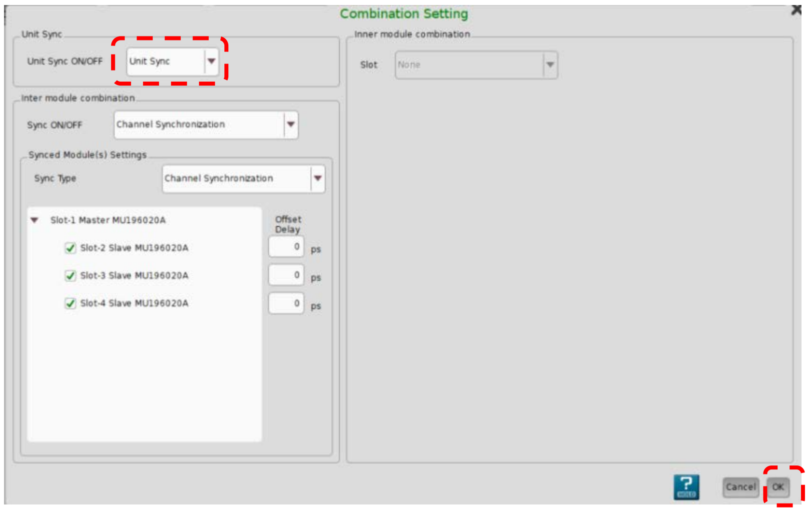
1. In the **Menu** list of each of Master and Slave, touch **Initialize**.
   On initialized Master and Slave, touch **Output** to switch data output to OFF for prevention of unintentional data output during calibration.



2. In the **Menu** list of Slave, touch **Combination Setting**, and make settings for Inter module combination as follows:
   Sync ON/OFF: **Channel Synchronization**
   Sync Type: **Channel Synchronization**
   Select the check boxes for Slot-2 to Slot-4.



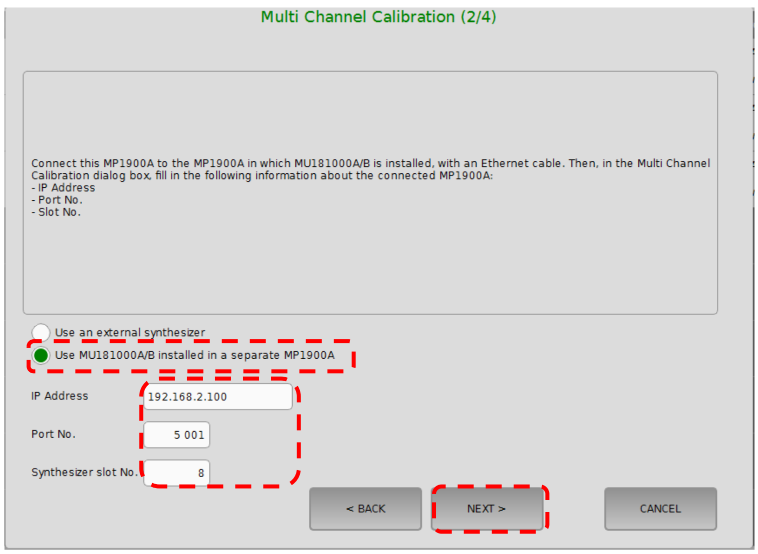
3. In the **Unit Sync ON/OFF** list, touch **Unit Sync**, and then touch **OK**.



4. When Slave prompts for multi channel calibration, touch **Next**.
5. Select **Use MU181000A/B installed in a separate MP1900A**, and fill in as follows:

   IP Address (Master): 192.168.2.100
   Port No.: 5001
   Synthesizer slot No.: 8

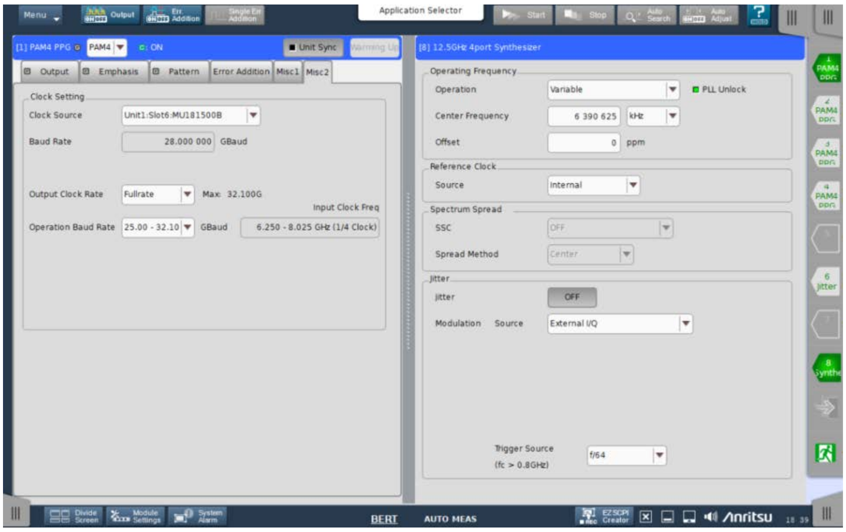
   Then, touch **Next**, and wait until the calibration is complete.



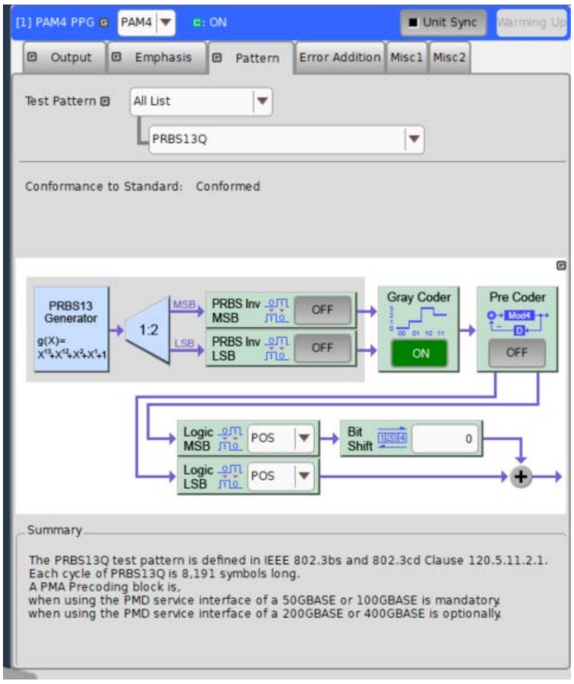
6. On Master, make settings for Inter module combination as in step 2. In the **Multi Channel Calibration** page (2/4), touch **Next**, and wait until the calibration is complete.

7. On each of Master and Slave, make the necessary settings for PPG. Here, make Baudrate and pattern settings, and settings for interlocking with MU181500B.
   In this example, Baudrate is set to 26.5625 GBaud, and pattern is set to PRBS13Q.
   (a) On the **Misc2** tab for MU196020A in Slot 1 of each of Master and Slave, set as follows:
   Clock Source: **MU181500B**
   Output Clock Rate: **Fullrate**
   Operation Baud Rate: **25.00-32.10 GBaud**

(b) Set MU181000B in Slot 8 of Master as follows:
Center Frequency: **6.640625 GHz** (1/4 of 26.5625G)



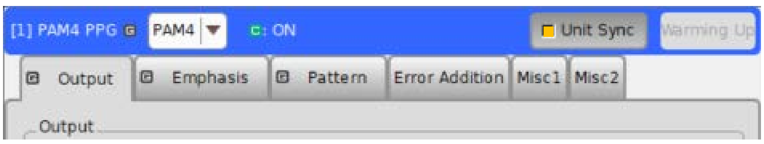
(c) Set **Test Pattern** to **PRBS13Q** for MU196020A in Slot 1 to 4 of each of Master and Slave.



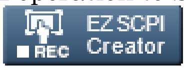
8. Touch **Unit Sync** for MU196020A in Slot 1 of Master. No matter in which of slot screens 1 to 4, **Unit Sync** functions the same when touched. However, **Unit Sync** on Slave cannot perform pattern synchronization. Be sure to touch **Unit Sync** on Master.
9. On Master and Slave, touch **Output** to switch data output to **ON**.

Observe the outputs (total 8 channels) of MU196020As installed in Master and Slave with an oscilloscope, and you can now confirm that the bit phase difference of each channel is within ±1024 UI.

After that, if you change the Baudrate or pattern, the Unit Sync indicator turns orange. This means that Master and Slave are not synchronized, so touch **Unit Sync** on Master again. Synchronization can be performed again by touching **Unit Sync** even if its indicator is off.



3.7 EZ SCPI Creator Function

EZ SCPI Creator is the function to convert GUI operation to SCPI commands and save them as a text file. Touch 

on Figure 3.7-1 to start using this function.

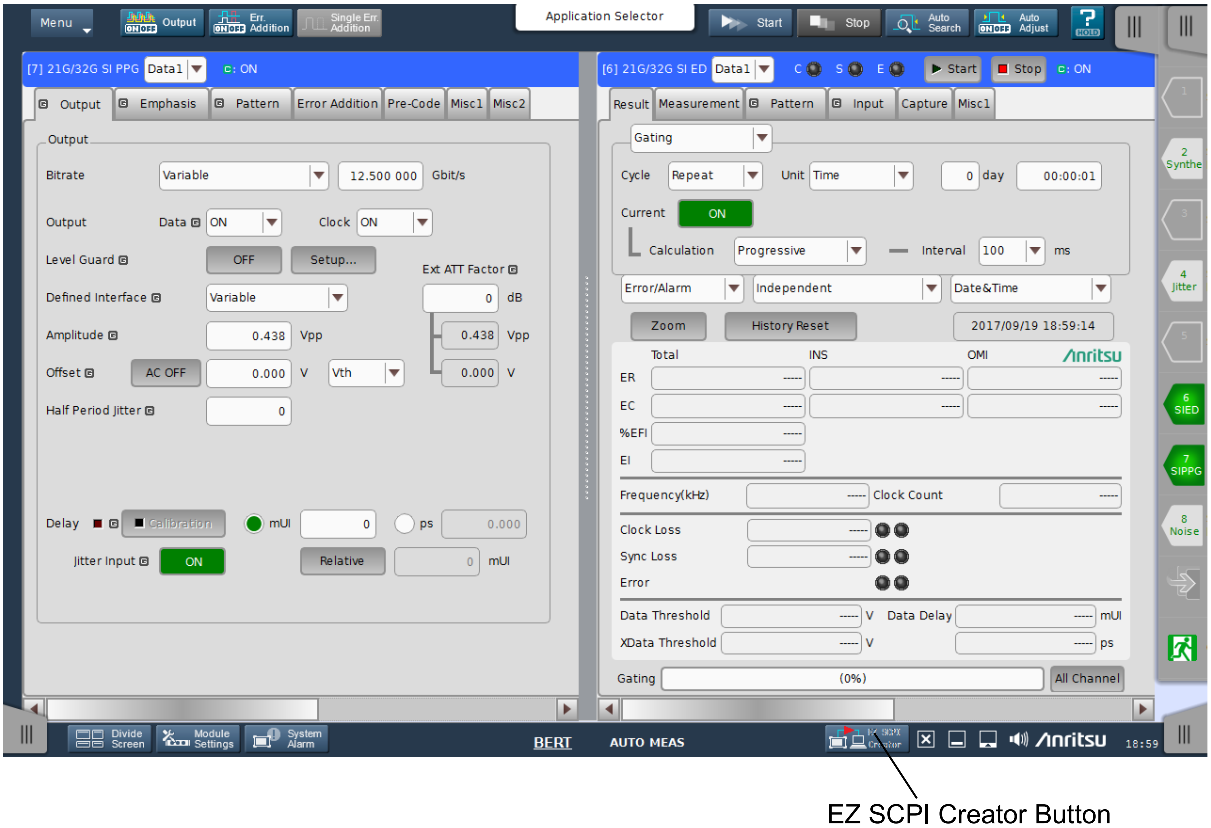


Figure 3.7-1 EZ SCPI Creator Button

3.7.1 EZ SCPI Creator Operation

To start EZ SCPI Creator:

Touch  and the following information dialog box appears.

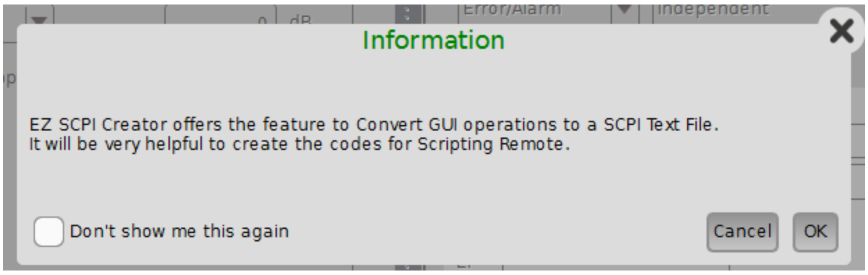


Figure 3.7.1-1 EZ SCPI Creator Information Dialog Box

Touch **OK** and "Figure 3.7.1-2 Save SCPI File Dialog Box" appears.
When touching **Cancel**, EZ SCPI Creator function itself is cancelled.
If you don't want to see this message anymore, select the **Don't show me this again** check box.

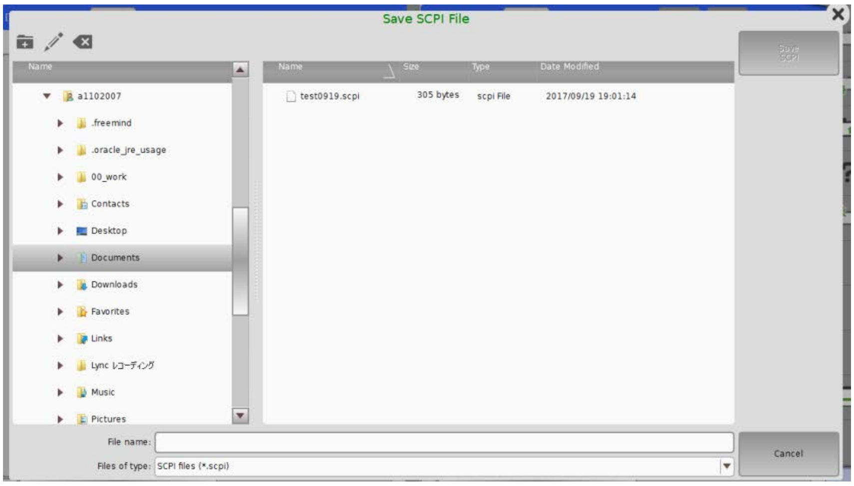


Figure 3.7.1-2 Save SCPI File Dialog Box

Specify the folder to save, input the file name and touch **Save SCPI.** Then, EZ SCPI Creator function starts and the button color changes to green ().

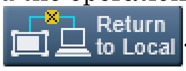
To stop EZ SCPI Creator:

Touch 

and the button color changes to blue (

) and the EZ SCPI Creator stops.

If some Remote control request is received while this function is running EZ SCPI Creator function is stopped and the operation moves to Remote. In this case 

changes to 

. The GUI operation before stopping is saved to the file.

Chapter 4 Operation of Applications

This chapter describes how to operate the applications, by module. Refer to the module operation manuals listed below for the product performance and specifications (1.3, "Specifications") and for options and related products (1.2, "Product Configuration").

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

4.1 Standard BERT Application

Standard BERT application provides generic BERT (bit error rate test) function.
This section provides explanations of Standard BERT applications.

4.1.1 Standard BERT for SI Application

The Standard BERT for SI is an application that provides general BERT functions in the module configuration based on the MU195020A 21G/32G bit/s SI PPG and the MU195040A 21G/32G bit/s SI ED.

Note:

This application can evaluate PAM4 signals by using the following peripherals.

- G0374A 64Gbaud PAM4 DAC
- G0375A 32Gbaud Power PAM4 Converter
- G0376A 32Gbaud PAM4 Decoder
- MZ1834A/MZ1834B 4PAM Converter

To use Standard BERT for SI application, install modules to MP1900A slots listed in Table 4.1.1-1. Standard BERT for SI application does not start for other than this module configuration.

Table 4.1.1-1 Required Module Configuration for Standard BERT for SI Application Use

<table>
<tr><th>Slot Number</th><th>Module Name</th></tr>
<tr><td>1</td><td rowspan="2">MU181000A 12.5GHz Synthesizer
or
MU181000B 12.5GHz 4port Synthesizer</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="2">MU181500B Jitter Modulation Source</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td>Blank or MU196020A PAM4 PPG</td></tr>
<tr><td>6</td><td>MU195040A 21G/32G bit/s SI ED</td></tr>
<tr><td>7</td><td>MU195020A 21G/32G bit/s SI PPG</td></tr>
<tr><td>8</td><td>Blank or MU195050A Noise Generator</td></tr>
</table>

To start Standard BERT for SI application, touch the Standard BERT for SI icon displayed in Application selector.

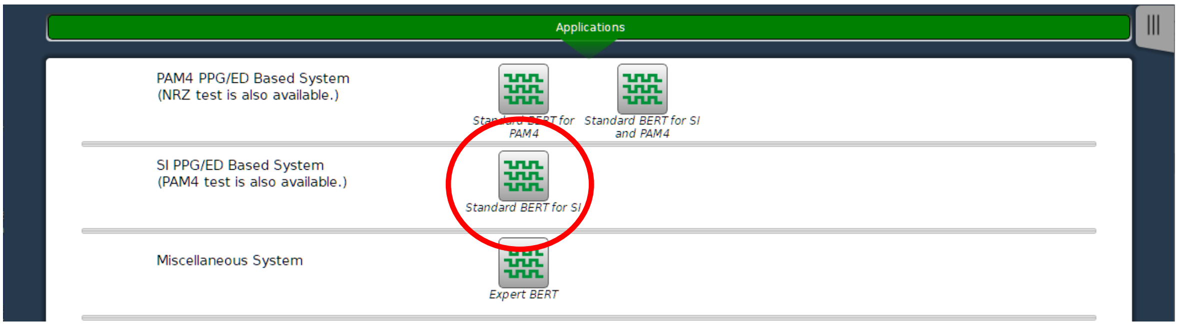


Figure 4.1.1-1 How to Start Standard BERT for SI Application

How to Display Overall Block Diagram

In Standard BERT for SI application, extended application displays overall block diagram.

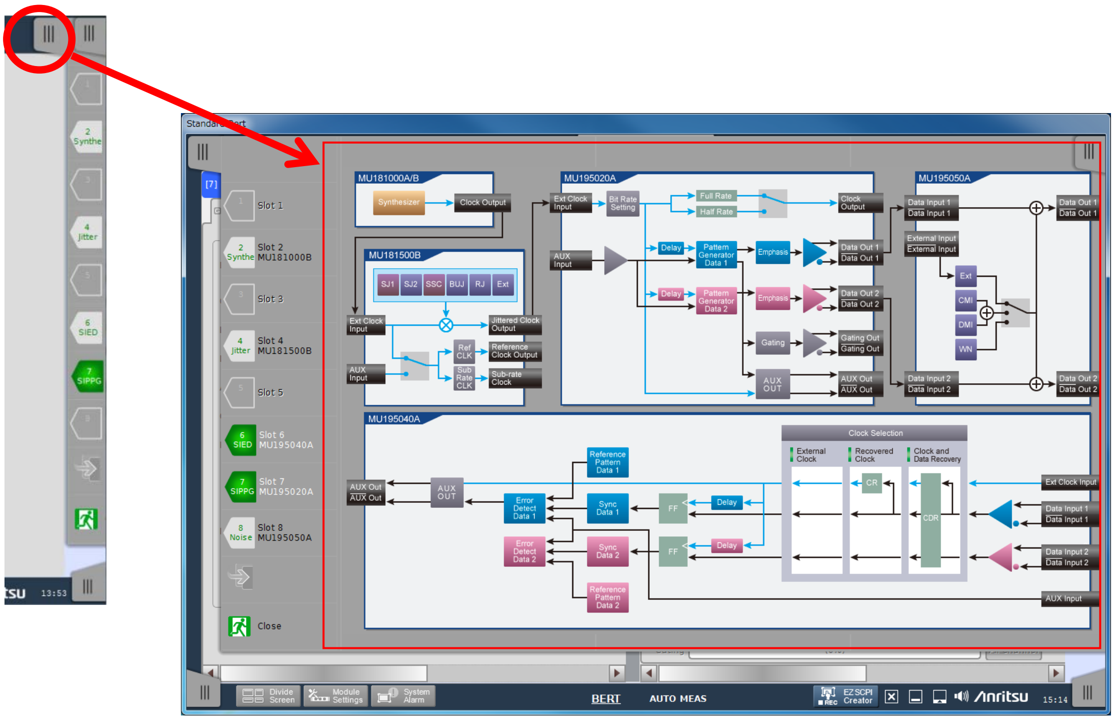


Figure 4.1.1-2 How to Display Overall Block Diagram

Touching a part in the overall block diagram displays the setting window of corresponding module application.

This makes it easy to understand whole BERT system because you can see where the parameters can be set for each part in the overall block diagram.

4.1.2 Standard BERT for PAM4 Application

Standard BERT for PAM4 is an application that provides general BERT functions in the module configuration based on the MU196020A PAM4 PPG and the MU196040B PAM4 ED.

Notes:

- This application uses the PAM4 module but can also evaluate the NRZ signal.
- The MU195050A Noise Generator is guaranteed to work properly only when using at a baud rate of 32.1 Gbaud or less.

To use Standard BERT for PAM4 application, install modules to MP1900A slots listed in Table 4.1.2-1. Standard BERT for PAM4 application does not start for other than this module configuration.

Table 4.1.2-1 Required Module Configuration for Standard BERT for PAM4 Application Use

Slot Number	Module Name
1	MU181000A 12.5GHz Synthesizer or MU181000B 12.5GHz 4port Synthesizer
2	
3	MU181500B Jitter Modulation Source
4	
5	Blank
6	MU196040B PAM4 ED
7	MU196020A PAM4 PPG
8	Blank or MU195050A Noise Generator

To start Standard BERT for PAM4 application, touch the Standard BERT for PAM4 icon displayed in Application selector.

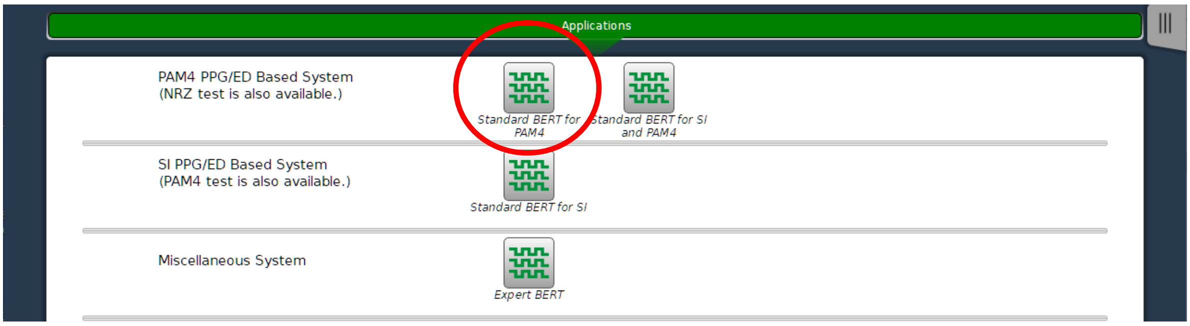


Figure 4.1.2-1 How to Start Standard BERT for PAM4 Application

How to Display Overall Block Diagram

In Standard BERT for PAM4 application, extended application displays overall block diagram.

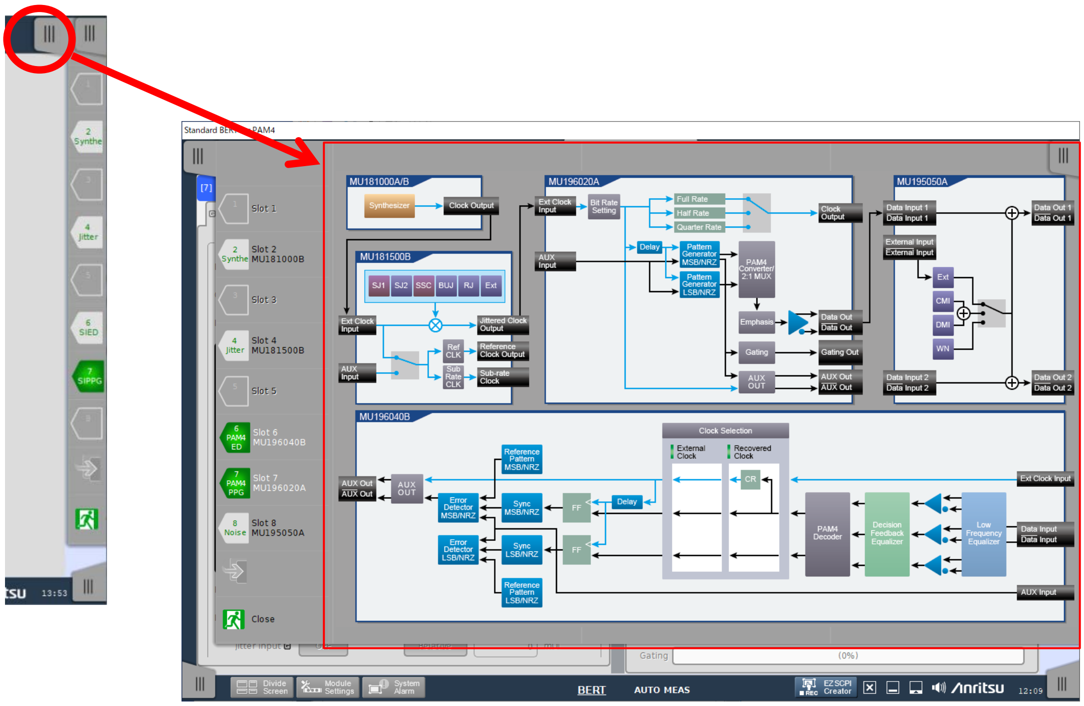


Figure 4.1.2-2 How to Display Overall Block Diagram

Touching a part in the overall block diagram displays the setting window of corresponding module application.

This makes it easy to understand whole BERT system because you can see where the parameters can be set for each part in the overall block diagram.

4.1.3　Standard BERT for SI and PAM4 Application

Standard BERT for SI and PAM4 is an application that provides general BERT functions in the module configuration based on the MU196020A PAM4 PPG and the MU195040A 21G/32G bit/s SI ED.

Notes:

- This application uses the PAM4 module but can also evaluate the NRZ signal.
- The MU195050A Noise Generator is guaranteed to work properly only when using at a baud rate of 32.1 Gbaud or less.

To use Standard BERT for SI and PAM4 application, install modules to MP1900A slots listed in Table 4.1.3-1. Standard BERT for SI and PAM4 application does not start for other than this module configuration.

Table 4.1.3-1　Required Module Configuration for Standard BERT SI and for PAM4 Application Use

Slot Number	Module Name
1	MU181000A 12.5GHz Synthesizer or MU181000B 12.5GHz 4port Synthesizer
2	
3	MU181500B Jitter Modulation Source
4	
5	Blank
6	MU195040A 21G/32G bit/s SI ED
7	MU196020A PAM4 PPG
8	Blank or MU195050A Noise Generator

To start Standard BERT for SI and PAM4 application, touch the Standard BERT for SI and PAM4 icon displayed in Application selector.

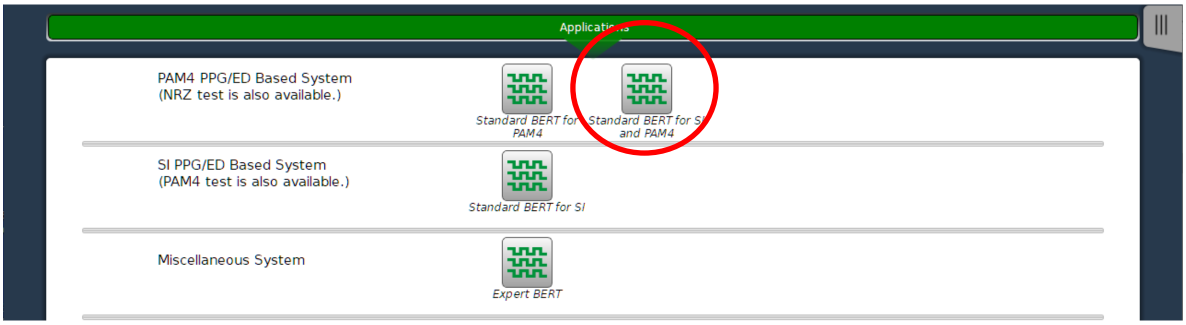


Figure 4.1.3-1　How to Start Standard BERT for SI and PAM4 Application

4.2 Expert BERT Application

Expert BERT application provides professional BERT functions.
The module configuration does not restrict starting this application unlike Standard BERT application. Therefore, this application is useful when the flexible module configuration is required.
To start Expert BERT application, touch the Expert BERT icon displayed in Application selector.

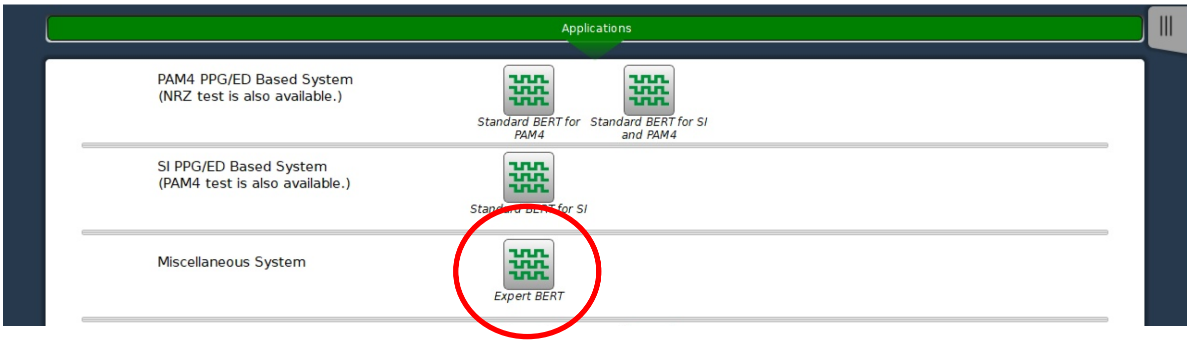


Figure 4.2-1 How to Start Expert BERT Application

Note:

In Expert BERT application, no extended application appears even if touching the navigation tab displayed on right top of the screen.

4.3 Module Application

This section describes module application operation for each module.
To display BERT screen which provides module application function, refer to 3.1.2 “Display Switching Screens” or 3.2.2 “Basic Operations on BERT Screen”. For how to operate MU183020A, MU183021A, MU183040B and MU183041B, refer to the operation manuals that came with them.

4.3.1 MU181000A/B

The MU181000A 12.5GHz Synthesizer and MU181000B 12.5GHz 4port Synthesizer (hereafter, MU181000A/B) are plug-in modules that can be built into MP1900A.

It outputs clock signals of 100 MHz to 12.5 GHz to be input to the MU195020A 21G/32G bit/s SI PPG, MU195040A 21G/32G bit/s SI ED.

The MU181000A/B outputs a 10 MHz reference signal to synchronize an external device with it. The MU181000A/B can also be synchronized with an external device by inputting a 10 MHz reference signal output from that device.

Control window for MU181000B is shown in Figure 4.3.1-1. For details of the window, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch 

, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

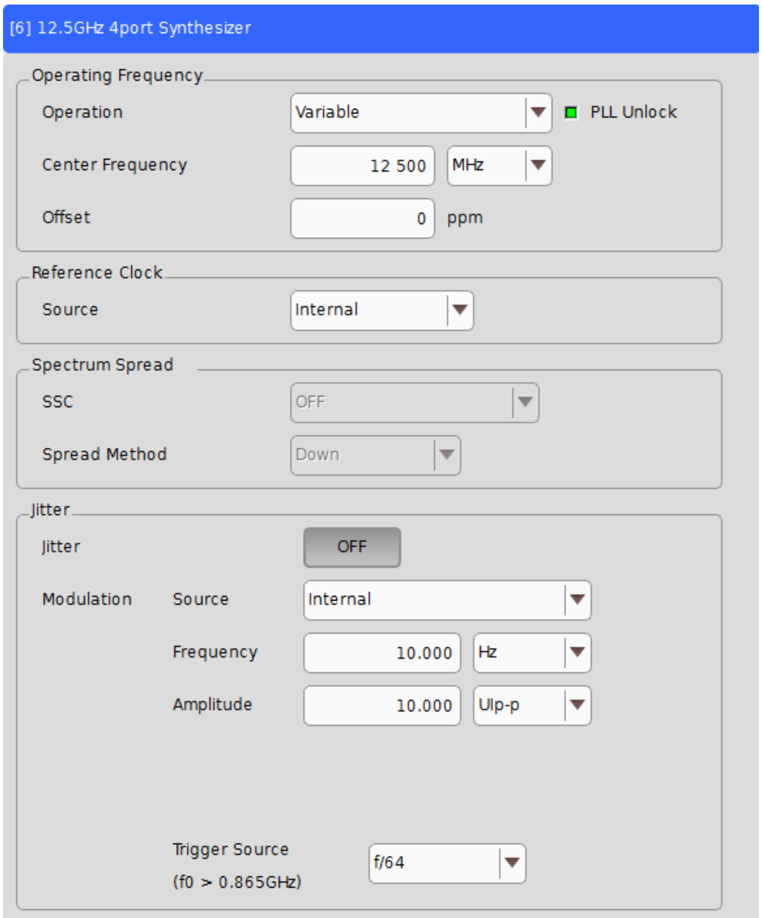


Figure 4.3.1-1 MU181000B Control Window

4.3.2 MU181500B

The MU181500B Jitter Modulation Source (hereafter, MU181500B) is a plug-in module that can be built into MP1900A.

MU181500B generates the following jittered clocks for input and built-in clocks.

- SJ: Sinusoidal Jitter
- SSC: Spread Spectrum Clock
- BUJ: Bounded Uncorrelated Jitter
- RJ: Random Jitter
- Ext: External Jitter

Connecting the output clock of this module to the input of the Pulse Pattern Generator supports bit error measurement of the jittered signals. The features of this module are listed below:

- Adds separate SJ, SSC, BUJ, and RJ to clocks from 800 MHz to 15 GHz.
- Supports linked (tracked) operation with MU181000A/B installed in MP1900A.
- Outputs unmodulated divided clocks required by DUT and measurement system.

At top of MU181500B operation window, buttons corresponding to each jitter and clock are placed. When touching one of the buttons, corresponding setting items are displayed lower part of the window.

The following sections explain each button placed in the MU181500B operation window. For details, refer to on-screen help. On-screen help can be displayed by the following methods.

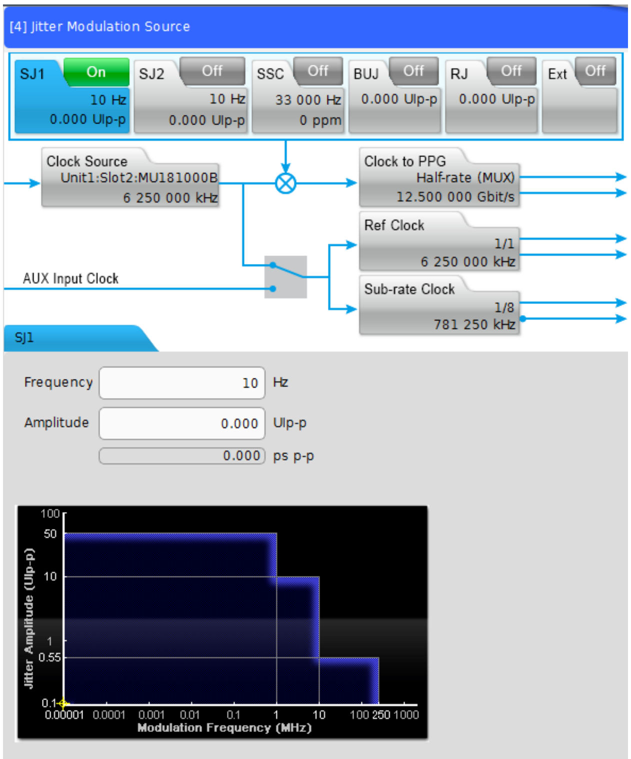
- Touch , and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

SJ1, SJ2 buttons

Provides setting Sinusoidal Jitter. Setting items are shown in Table 4.3.2-1. Figure 4.3.2-1 shows setting windows for SJ1 and SJ2.

Table 4.3.2-1 Setting Items of MU181500B SJ1 and SJ2

Item	Function
SJ2 Mode	Switches the jitter generation mode of SJ2.
Frequency	Sets jitter modulation frequency in Hz units.
Amplitude	Sets amplitude in UIp-p units.



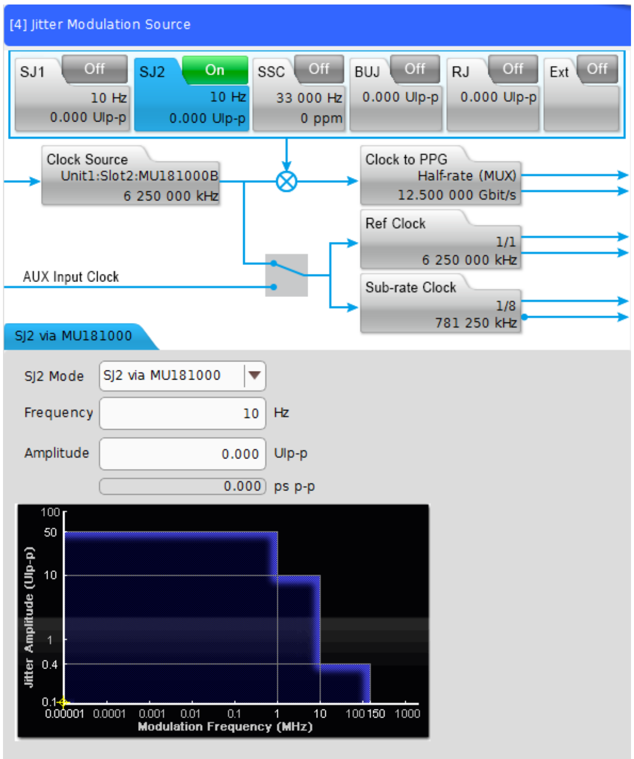


Figure 4.3.2-1 MU181500B Setting Window SJ1 (Left), SJ2 (Right)

4

Operation of Applications

SSC button

Provides setting the spread spectrum clock. Setting items are shown in Table 4.3.2-2. SSC setting window is shown in Figure 4.3.2-2.

Table 4.3.2-2 MU181500B SSC Setting Items

Item	Function
Type	Sets spread method.
Frequency	Sets modulation frequency.
Deviation	Sets frequency deviation.

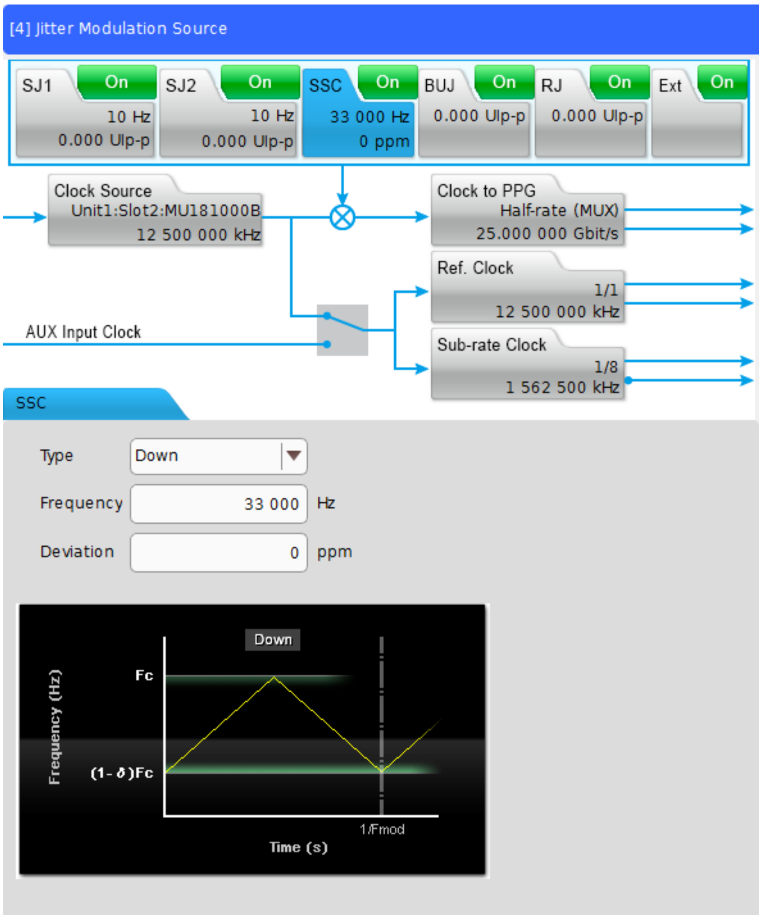


Figure 4.3.2-2 MU181500B SSC Setting Window

BUJ button

Provides setting Bounded Uncorrelated Jitter. Setting items are shown in Table 4.3.2-3. BUJ setting window is shown in Figure 4.3.2-3.

Table 4.3.2-3 MU181500B BUJ Setting Items

Item	Function
PRBS	Sets the PBRS type.
Amplitude	Sets maximum drift in UIp-p units.
Bitrate	Sets BUJ modulation bit rate.
LPF	Sets low-pass filter.

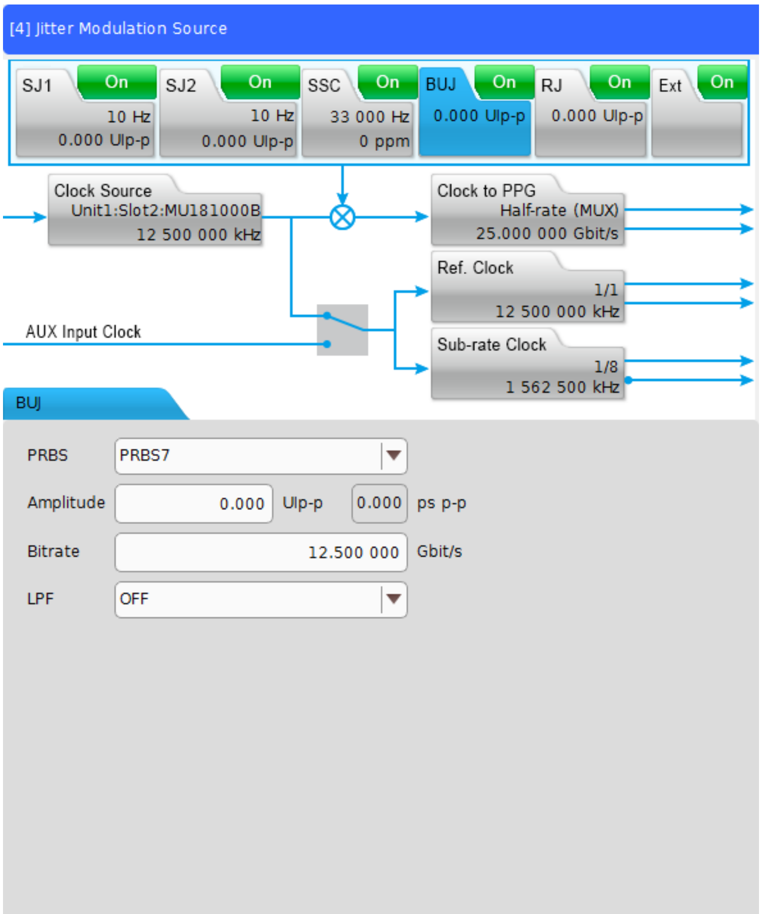


Figure 4.3.2-3 MU181500B BUJ Setting Window

4

Operation of Applications

RJ button

Provides setting Random Jitter. Setting items are shown in Table 4.3.2-4. RJ setting window is shown in Figure 4.3.2-4.

Table 4.3.2-4 MU181500B RJ Setting Items

Item	Function
Amplitude	Sets maximum drift in UIp-p units.
Filter	Sets filter for controlling jitter frequency.
HPF	Sets high-pass filter.
LPF	Sets low-pass filter.
Amplitude LF	When the Filter setting is PCIe, the maximum deviation at the low-frequency side is set.
Amplitude HF	When the Filter setting is PCIe, the maximum deviation at the high-frequency side is set.
Default	When the Filter setting is PCIe, the Amplitude LF and Amplitude HF are set to the default values.

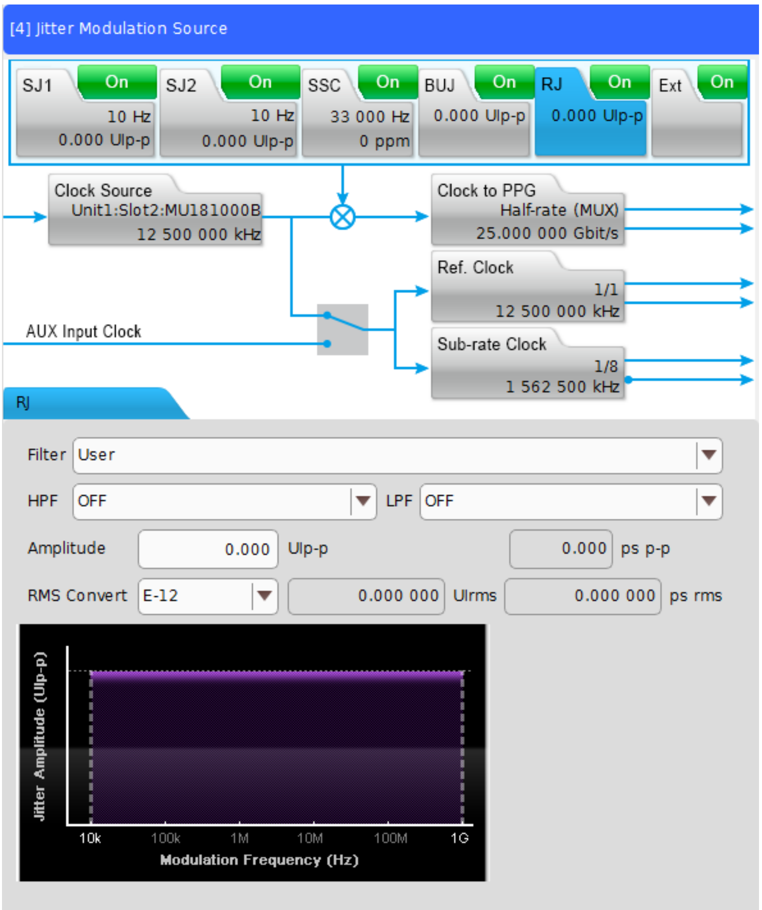


Figure 4.3.2-4 MU181500B RJ Setting Window

Clock Source button

Provides setting a clock source to apply the jitter modulation. Setting items are shown in Table 4.3.2-5. Clock Source setting window is shown in Figure 4.3.2-5.

Table 4.3.2-5 MU181500B Clock Source Setting Items

Item	Function
Clock Source	Selects clock signal source.
Center Frequency	Sets MU181000A/B frequency in kHz units.
Offset	Sets frequency offset of MU181000A/B in ppm units.
Reference Clock	Selects reference clock for MU181000A/B.

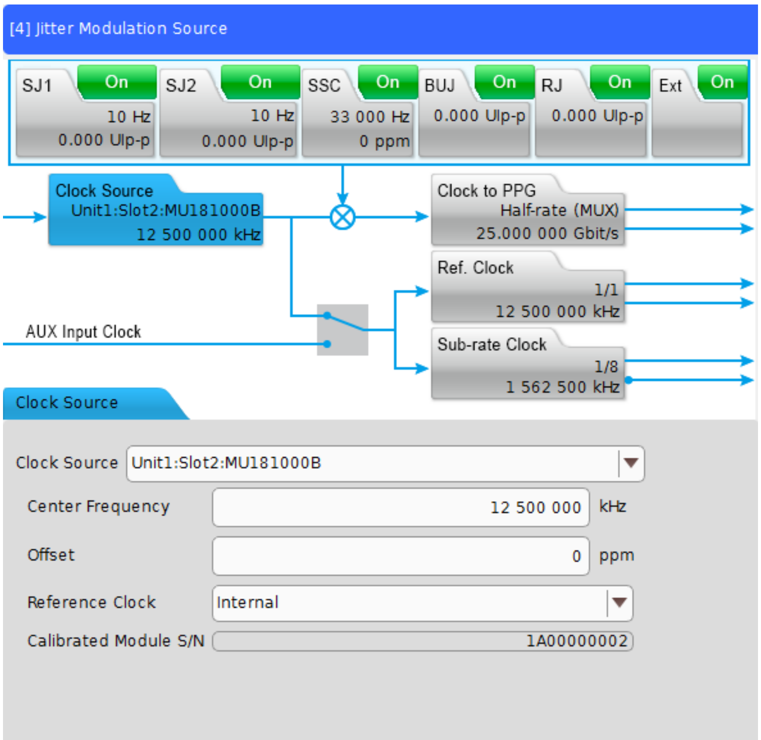


Figure 4.3.2-5 MU181500B Clock Source Setting Window

Clock to PPG button

When MU195020A and MU181500B have been synchronized, select a clock to be provided to MU195020A. Clock to PPG setting window is shown in Figure 4.3.2-6.

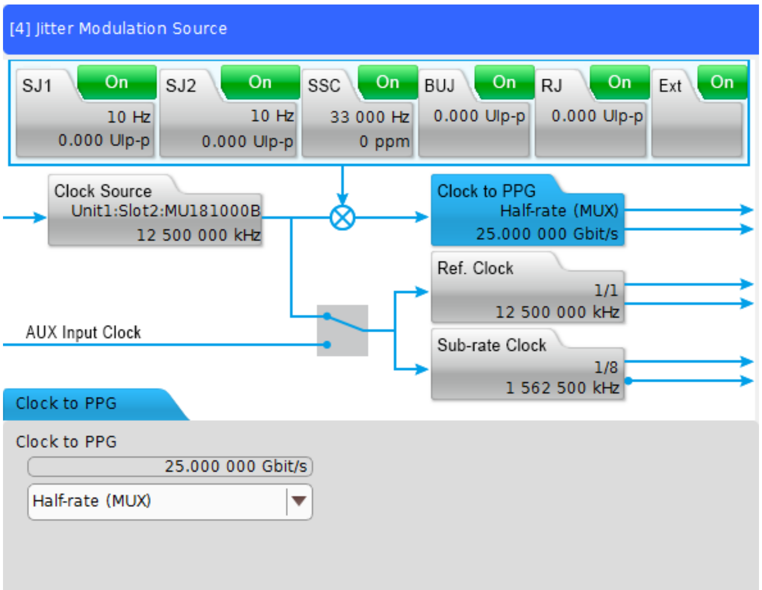


Figure 4.3.2-6 MU181500B Clock to PPG Setting Window

Ref. Clock button

Select a clock to be output to Reference Clock Output connector. Setting items are shown in Table 4.3.2-6. Ref .Clock setting window is shown in Figure 4.3.2-7.

Table 4.3.2-6 MU181500B Ref. Clock Setting Item

Item	Function
Divider	Sets clock division rate.

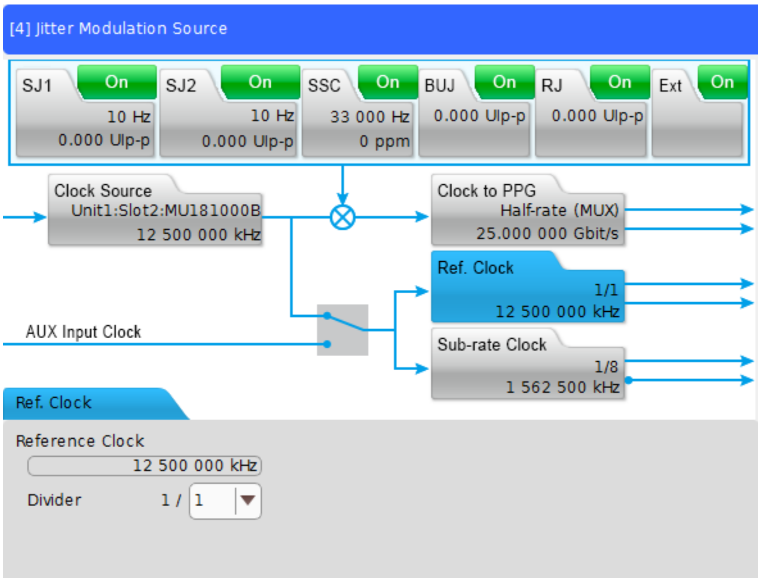


Figure 4.3.2-7 MU181500B Ref .Clock Setting Window

Sub-rate Clock button

Select a clock to be output to AUX Output connector. Setting items are shown in Table 4.3.2-7. Sub-rate Clock setting window is shown in Figure 4.3.2-8.

Table 4.3.2-7 MU181500B Sub-rate Clock Setting Items

Item	Function
Divider	Sets clock division rate.
Amplitude	Sets amplitude.

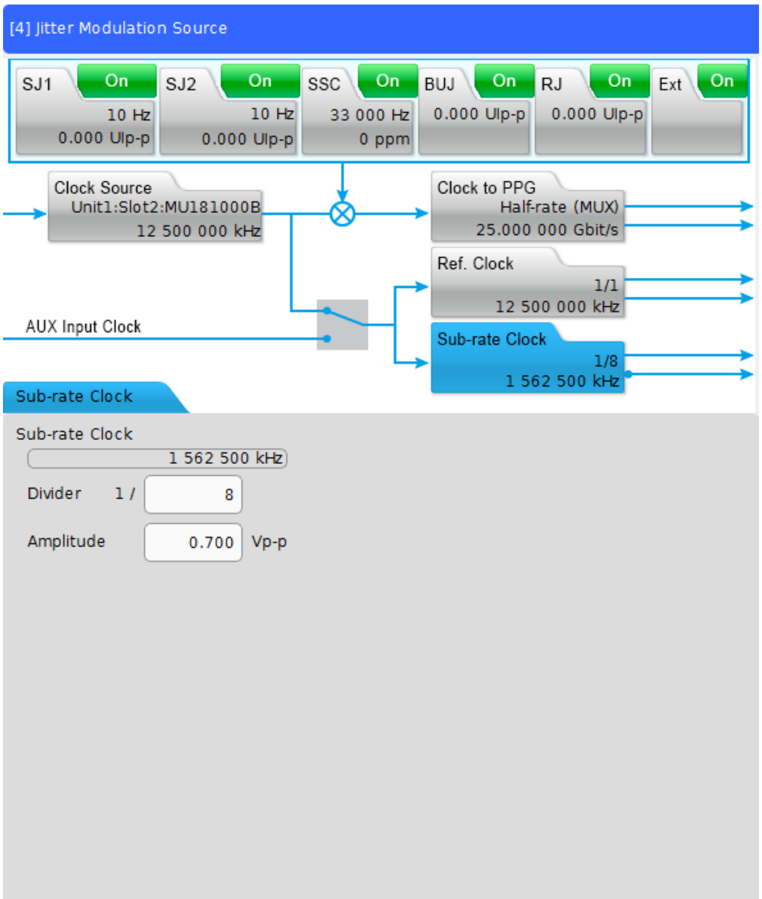


Figure 4.3.2-8 MU181500B Sub-Rate Clock Setting Window

4.3.3 MU195020A

The MU195020A 21G/32G bit/s SI PPG (hereafter, MU195020A) is a plug-in module that can be built into MP1900A. It can generate a variety of patterns within the operating frequency range, including PRBS, DATA, ZeroSubstitution, Alternate, Mixed, PAM4, and Sequence patterns.

Various option configurations are available for the MU195020A. This module is therefore useful for research, development, and production of various types of digital communication equipment, modules, and devices.

This section describes the function of each tab of the MU195020A operation screen. For details of the tabs, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch 

, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

4.3.3.1 Output tab

On the **Output** tab, configure the settings for Data output and Clock output. Data signal is output from the DATA Output1 or DATA Output2 connector of MU195020A and Clock signal is output from the Clock connector. On this tab, Data and Clock signals, Output on or off, Amplitude, and Bit rate can be set. The **Output** tab is shown in Figure 4.3.3.1-1.

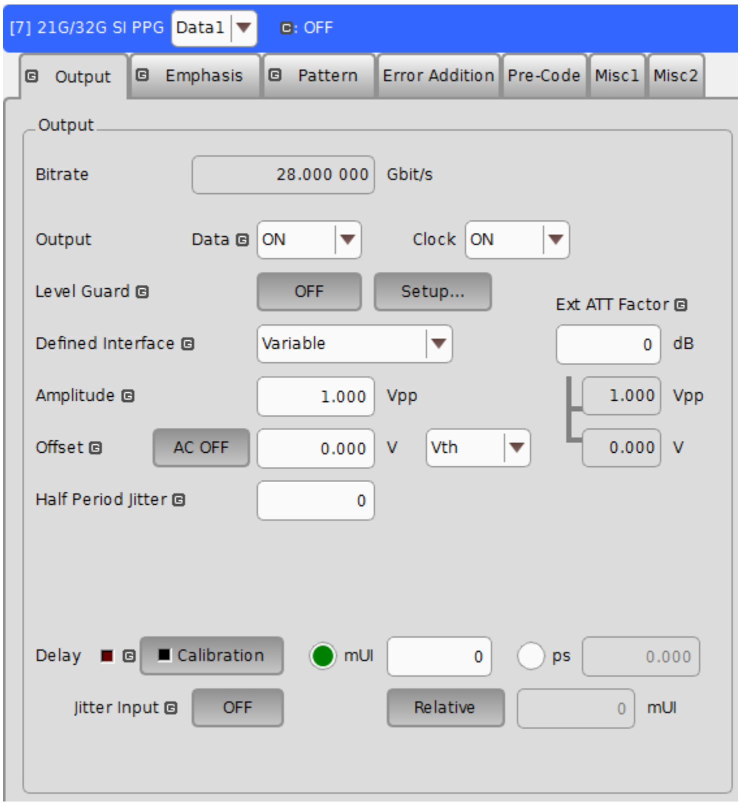


Figure 4.3.3.1-1 MU195020A Output Tab

4.3.3.2 Emphasis tab

On the **Emphasis** tab, you can configure the settings for the emphasis to be added to Data signal and can turn on and off the emphasis waveforms that comply with various standards.

The **Emphasis** tab is shown in Figure 4.3.3.2-1.

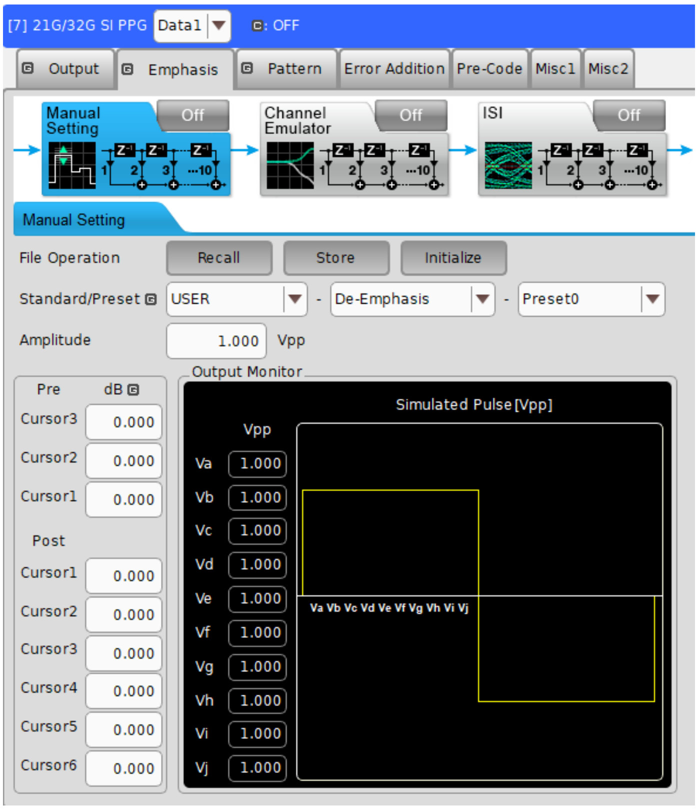


Figure 4.3.3.2-1 MU195020A Emphasis Tab

4.3.3.3 Pattern tab

On the **Pattern** tab, you can select a test pattern and can configure the settings for it. The following six test patterns are available.

- PRBS*
- ZeroSubstitution
- Data*
- Mixed
- PAM4 (When in the Combination Setting screen, **Inner module combination** is set to **Combination**.)
- Sequence (When MU195020A-x50 Sequence Editor Function is installed.)

*: When, after the application is started, **Data** is selected in Test Pattern and loaded successfully, the test pattern output from PPG is switched without pattern loading immediately even if switched between **PRBS** and **Data**.

The **Pattern** tab is shown in Figure 4.3.3.3-1.

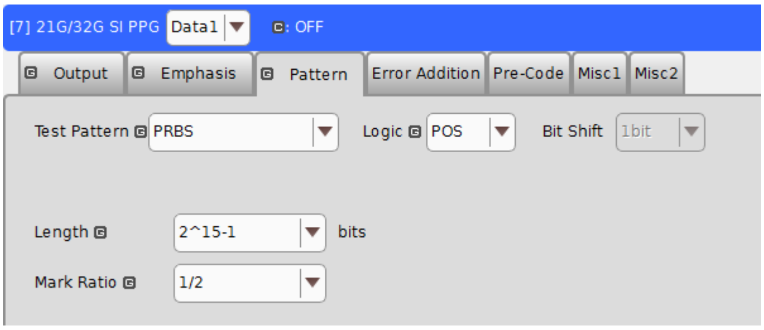


Figure 4.3.3.3-1 MU195020A Pattern Tab

4.3.3.4 Error Addition tab

On the **Error Addition** tab, you can turn on and off error addition to Data signal and can set error rate.

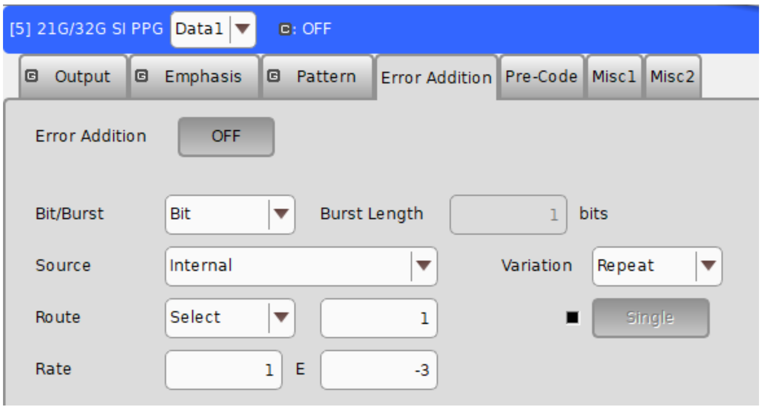


Figure 4.3.3.4-1 MU195020A Error Addition Tab

4.3.3.5 Pre-Code tab

On the **Pre-Code** tab, you can configure the settings for calculating and outputting DATA according to the Pre-Code logical diagram shown in Figure 4.3.3.5-1. The **Pre-Code** tab is available when in the Combination Setting screen, **Inner module combination** is set to **Combination**.

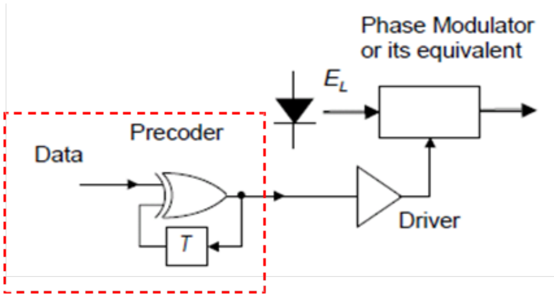


Figure 4.3.3.5-1 Pre-Code Logical Diagram (DQPSK)

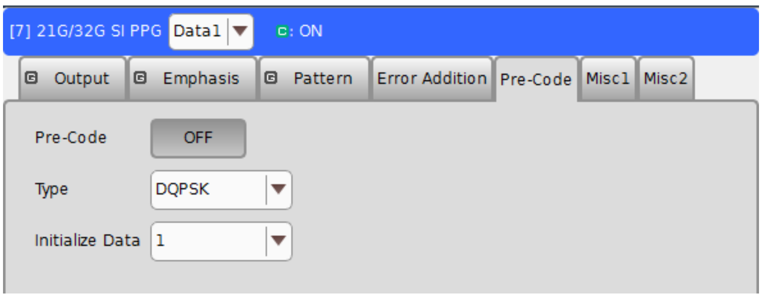


Figure 4.3.3.5-2 MU195020A Pre-Code Tab

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4.3.3.6 Misc1 tab

On the **Misc1** tab, you can configure the signal generation method, synchronization signal output, auxiliary input and output, and other settings. Setting items on the **Misc1** tab are shown in Table 4.3.3.6-1. **Misc1** tab settings are common settings for MU195020A Data1 to Data2. The setting related to pattern length depends on that in Data1.

Table 4.3.3.6-1 Setting items

Item	Description
Pattern Sequence	Set the test pattern generating method.
AUX Input	Configure the settings for the auxiliary input function.
AUX Output	Configure the settings for the auxiliary output function.
Gating Output	Set the timing signal output.

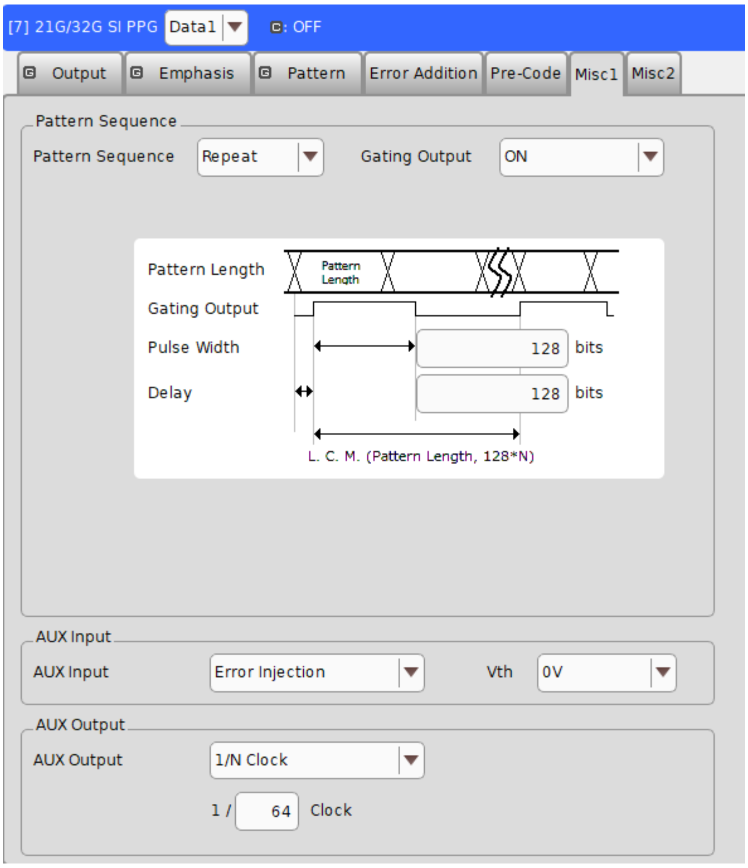

Figure 4.3.3.6-1 MU195020A Misc1 Tab

4.3.3.7 Misc2 tab

On the **Misc2** tab, you can configure the clock source, bitrate, and other settings.

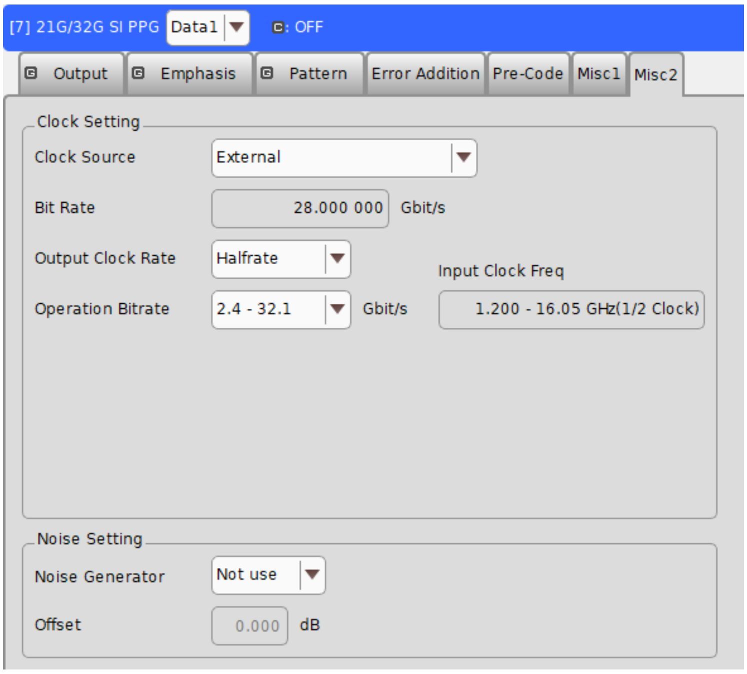

Figure 4.3.3.7-1 MU195020A Misc2 Tab

4.3.4 MU195040A

The MU195040A 21G/32G bit/s SI ED (hereafter, MU195040A) is a plug-in module that can be built into MP1900A. It can measure a variety of patterns within the operating frequency range, including PRBS, Data, ZeroSubstitution, Mixed, and HSSB Data patterns.

This section describes function of the tabs of the MU195040A operation screen. For details of the tabs, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch 

, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

4.3.4.1 Result tab

On the **Result** tab, you can check the BER results in the lower portion of the tab while changing the settings in the upper portion. To change the items to set, select an item in the list box at the module title bar. Setting items and description are shown in Table 4.3.4.1-1.

Table 4.3.4.1-1 Setting Items in Result Tab

Item	Description
Input	Select to configure the settings related to the input signal interface.
Gating	Select to configure the settings related to the measurement period.
Condition	Select to configure the settings related to the measurement conditions.
Auto Sync	Select to configure the settings related to the automatic synchronization establishment function.
Sync Control	Select to configure the settings related to the synchronization establishment method.

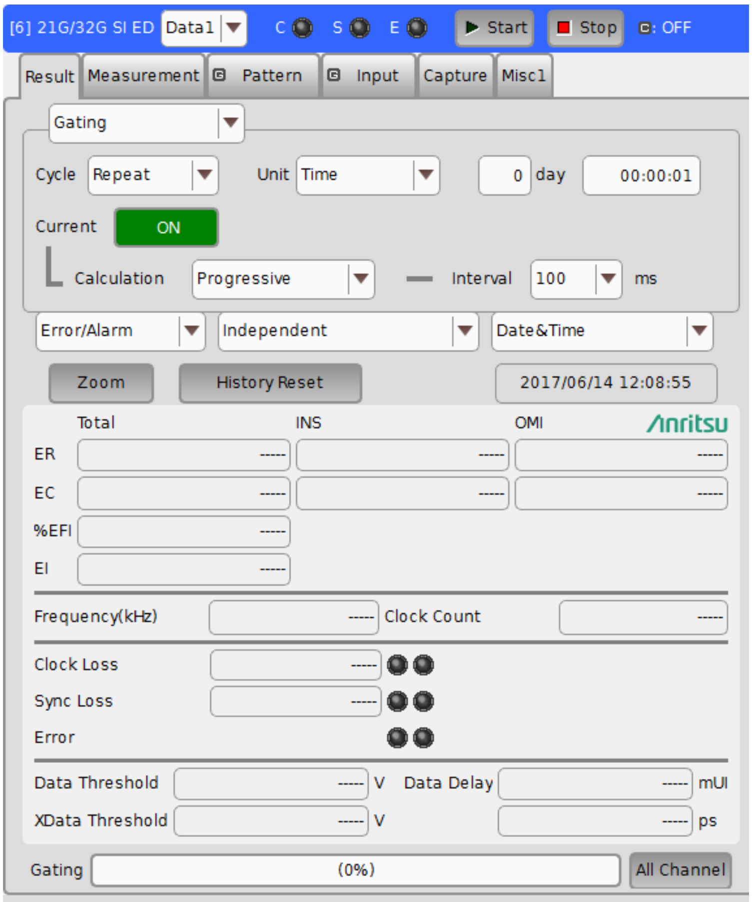

Figure 4.3.4.1-1 MU195040A Result Tab

4.3.4.2 Measurement tab

On the **Measurement** tab, you can set the measurement conditions. The **Measurement** tab consists of five setting groups listed in Table 4.3.4.2-1. These items can be also set on the **Result** tab. Additionally, the advanced settings of Sync Control and Error/Alarm Condition are available on this tab.

Table 4.3.4.2-1 Setting/Display Items in Measurement Tab

Item	Description
Gating	Select to configure the settings related to the measurement period.
Auto Sync	Select to configure the settings related to the automatic synchronization establishment function.
SKP Ordered Set	Select to configure the settings related to the SKP Ordered Set filtering.
Sync Control	Select to configure the settings related to the synchronization establishment method.
Error/Alarm Condition	Select to configure the setting related to the error/alarm detection method.

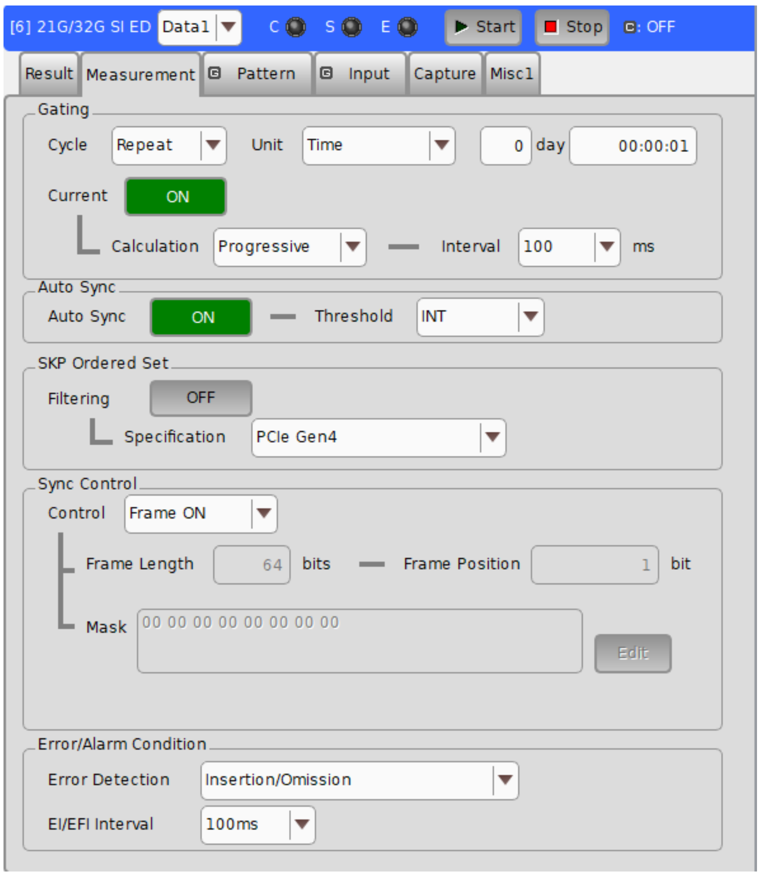

Figure 4.3.4.2-1 MU195040A Measurement Tab

4.3.4.3 Pattern tab

On the **Pattern** tab, you can select a test pattern and can configure the Mask settings. The following six test patterns are available. Setting items vary depending on the selected pattern.

- PRBS
- ZeroSubstitution
- Data
- Mixed
- PAM4 (When in the Combination Setting screen, **Inner module combination** is set to **Combination**)
- HSSB Data

By configuring Mask settings, a received test pattern is masked to prevent detected errors from being counted into the measurement results.
G **Pattern** tab is shown in Figure 4.3.4.3-1.

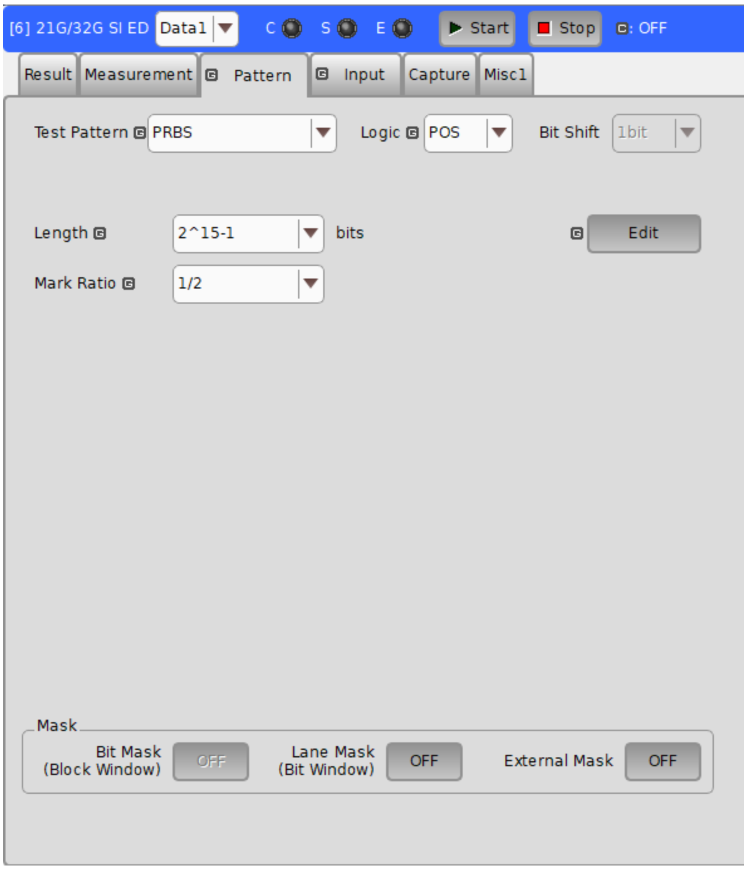

Figure 4.3.4.3-1 MU195040A Pattern Tab

4.3.4.4 Input tab

On the **Input** tab, you can configure the settings for the input interface. The **Input** tab consists of three setting areas: Data, Clock and Measurement Restart. Table 4.3.4.4-1 lists the items to set in each area.

Table 4.3.4.4-1 Setting Items in Input Tab

Item	Description
Data	Differential or Single-Ended input setting and termination voltage setting
Clock	Clock source setting
Measurement Restart	Item selection that measurements restart if the its setting has changed

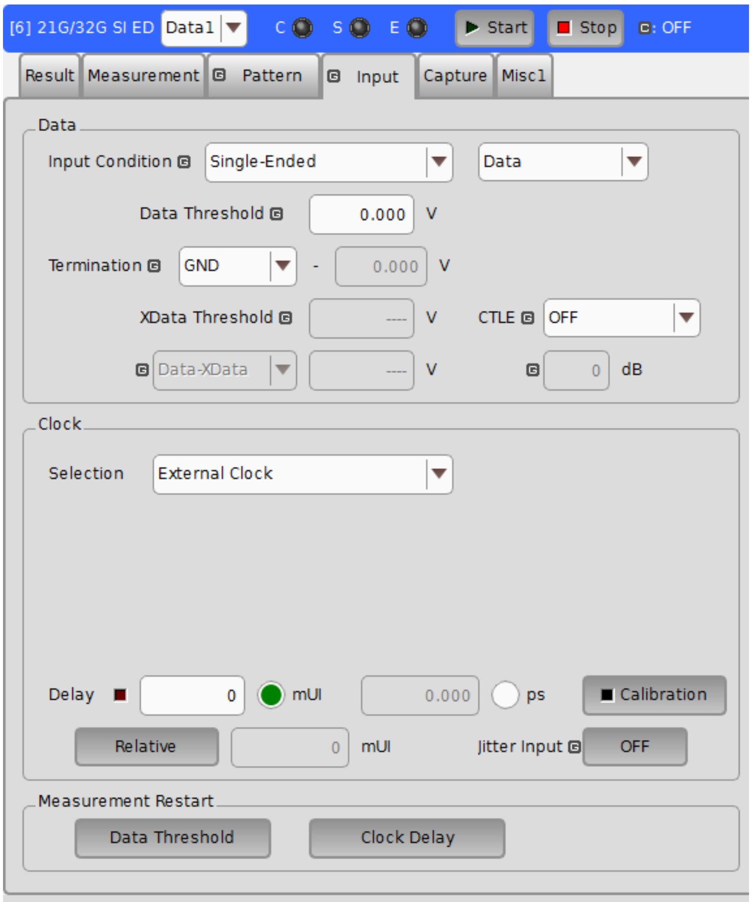

Figure 4.3.4.4-1 MU195040A Input Tab

4.3.4.5 Capture tab

On the **Capture** tab, you can capture the input test pattern and analyze it. Also, you can start and stop capturing pattern data and display captured pattern.

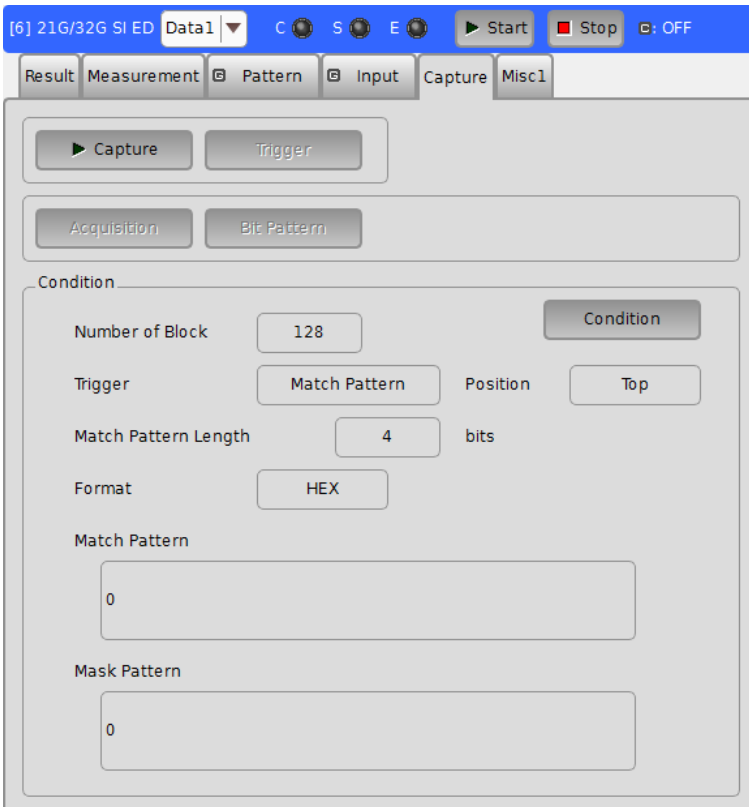

Figure 4.3.4.5-1 MU195040A Capture Tab

4.3.4.6 Misc1 tab

On the **Misc1** tab, you can configure the settings for pattern sequence and auxiliary input and output. Setting items on the **Misc1** tab are shown in Table 4.3.4.6-1.

Table 4.3.4.6-1 Setting Items of Misc1 Tab

Item	Description
Pattern Sequence	Set the test pattern receiving method.
AUX Input	Configure the settings for the auxiliary input function.
AUX Output	Configure the settings for the auxiliary output function.

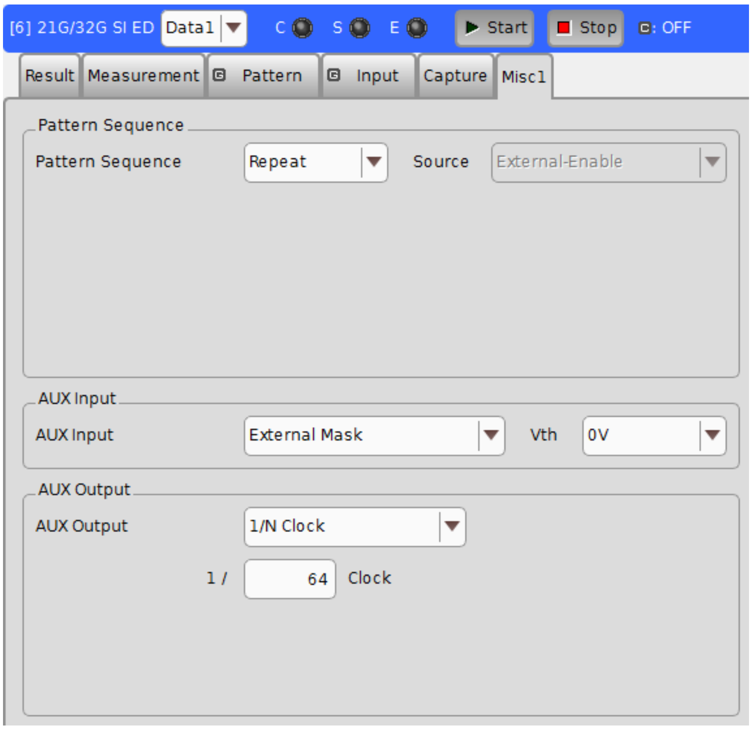

Figure 4.3.4.6-1 MU195040A Misc1 Tab

4.3.5 MU195050A

The MU195050A Noise Generator (hereafter, MU195050A) is a plug-in module that can be built into MP1900A. MU195050A is able to generate white noise or the sinusoidal noise of Common Mode and Differential Mode. By switching MU195050A External Input connector, MU195050A adds generated noise to the input data and outputs it.

Control window for MU195050A is shown in Figure 4.3.5-1. For details of the window, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch , and then touch the screen item you need help with.

- For mouse operation, right-click the screen item you need help with.

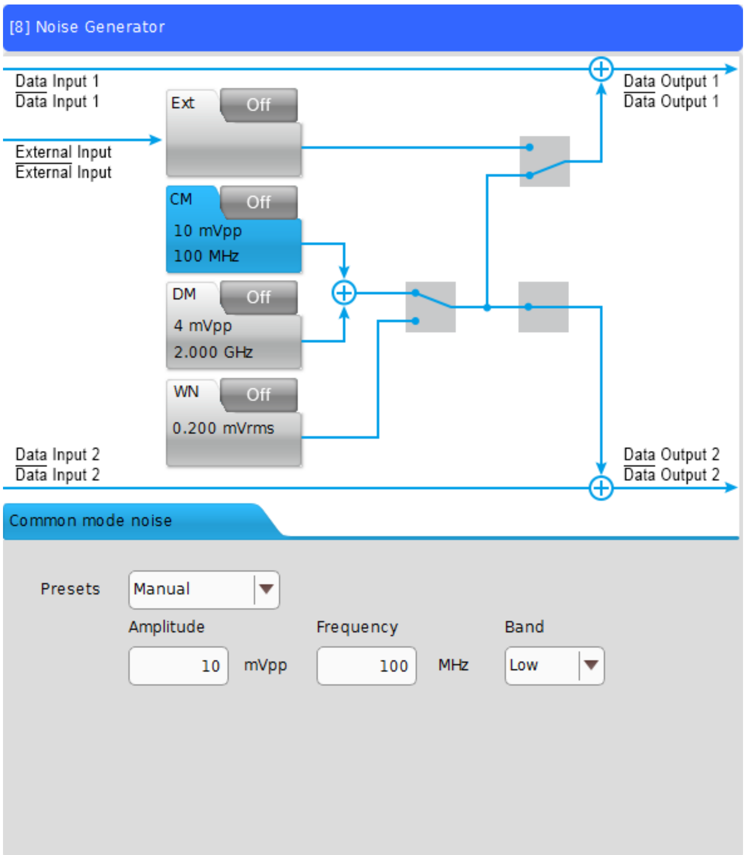

Figure 4.3.5-1 MU195050A Control Window

4.3.6 MU196020A

The MU196020A PAM4 PPG (hereafter, MU196020A) is a plug-in module that can be built into MP1900A. It can generate a variety of patterns within the operating frequency range, including PRBS, DATA, and ZeroSubstitution (NRZ mode only) patterns.

The MU196020A supports various option configurations and can switch the signal modulation mode between NRZ and PAM4, so it is suitable for research and development and manufacture of various digital communication equipment, digital communication modules and devices.

This section describes the function of the tabs of the MU196020A operation screen. For details of the tabs, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch 

, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

Switch the signal modulation mode to NRZ or PAM4 by selecting it in the **NRZ/PAM4** list at the module title bar shown in the following figure before using the MU196020A.

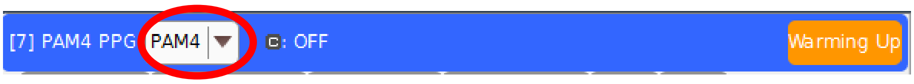

Figure 4.3.6-1 MU196020A NRZ/PAM4 List

4.3.6.1 Output tab

On the **Output** tab, configure the settings for Data output and Clock output. Data signal is output from the DATA Output connector of MU196020A and Clock signal is output from the Clock connector. On this tab, Data and Clock signals, Output on or off, Amplitude, and Bit rate can be set.

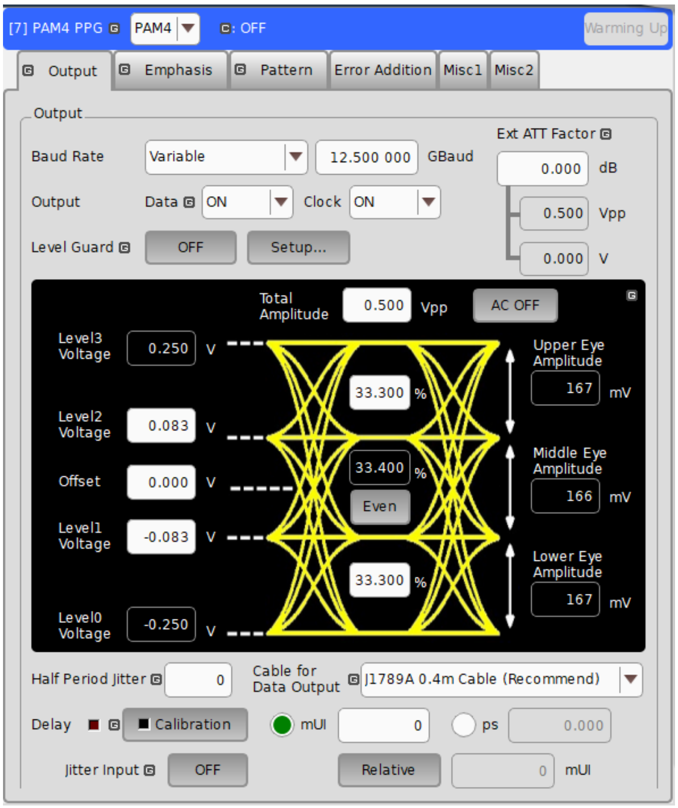

Figure 4.3.6.1-1 MU196020A Output Tab (PAM4 Mode)

4.3.6.2 Emphasis tab

On the **Emphasis** tab, you can configure the settings for the emphasis to be added to Data signal and can turn on and off the emphasis waveforms that comply with various standards.

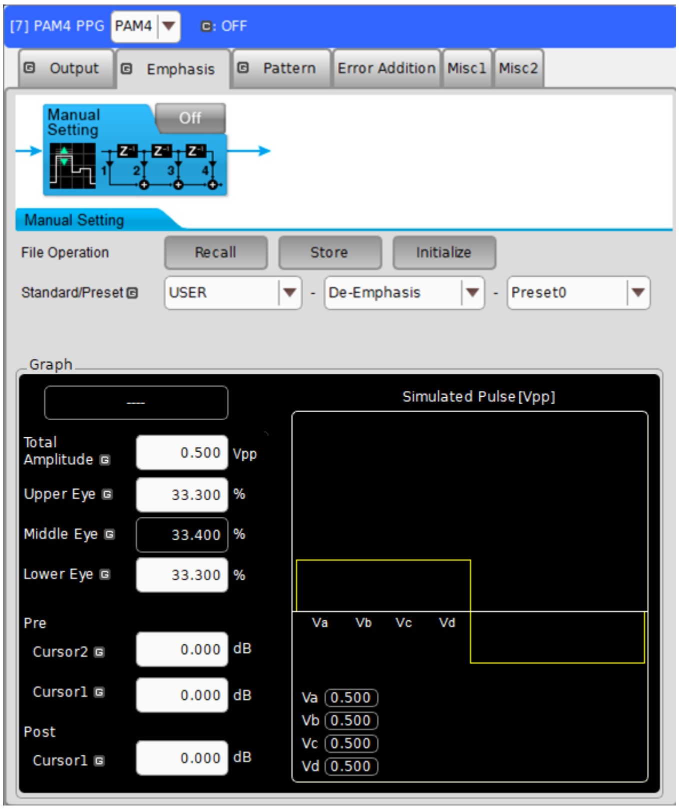

Figure 4.3.6.2-1 MU196020A Emphasis Tab (PAM4 Mode)

When the MU196020A-x40 Adjustable ISI is installed, you can use the Channel Emulator and ISI functions.

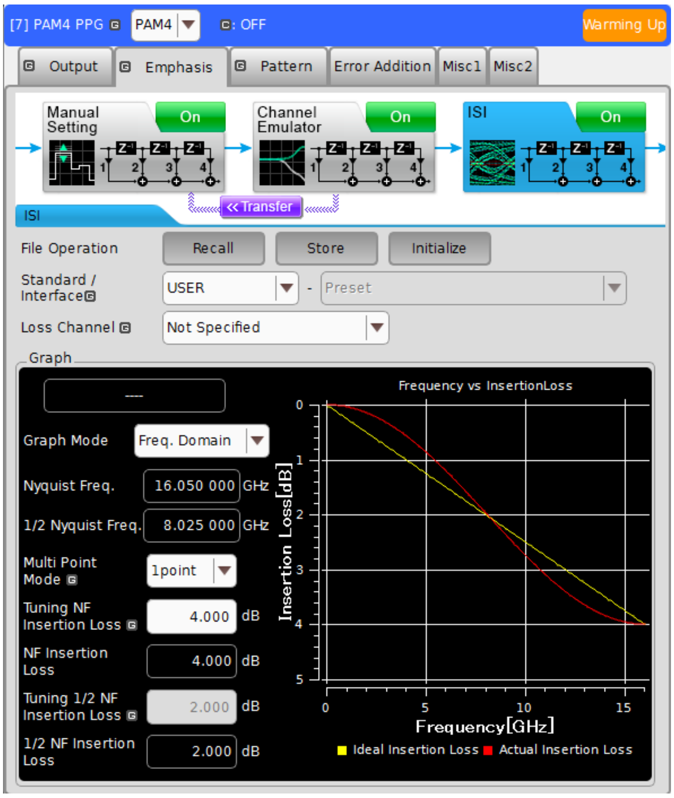

Figure 4.3.6.2-2 MU196020A Emphasis Tab (PAM4 Mode with MU196020A-x40)

4.3.6.3 Pattern tab

On the **Pattern** tab, you can select a test pattern and can configure the settings for it. The following four test patterns are available.

- PRBS
- ZeroSubstitution (NRZ mode only)
- Data
- Standard-compliant pattern

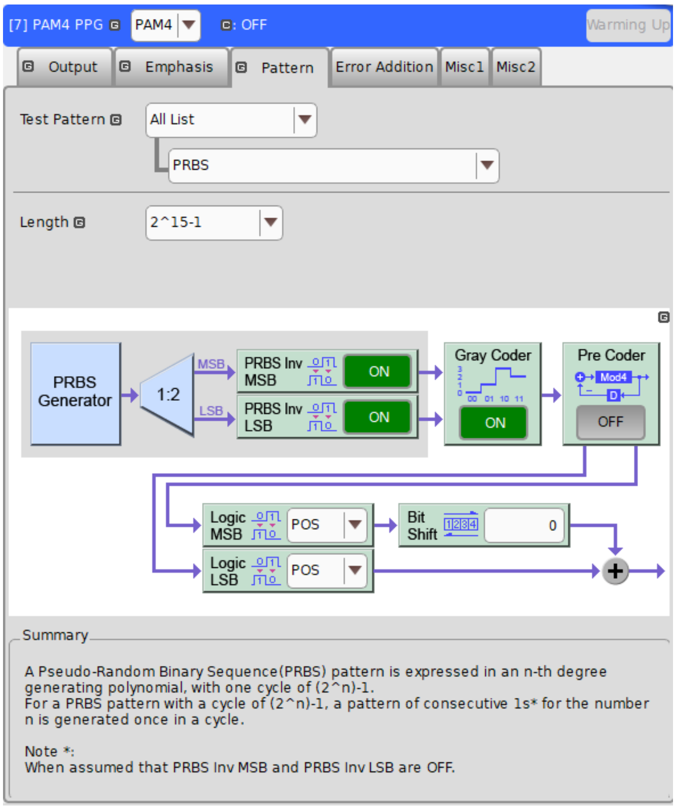

Figure 4.3.6.3-1 MU196020A Pattern Tab (PAM4 Mode)

If you select **Data**, you can edit the test pattern with Patten Editor. For explanation of Pattern Editor, refer to Table 4.3.7.3-1.

When the MU196020A-x42 FEC Pattern Generation is installed, you can set FEC patterns.

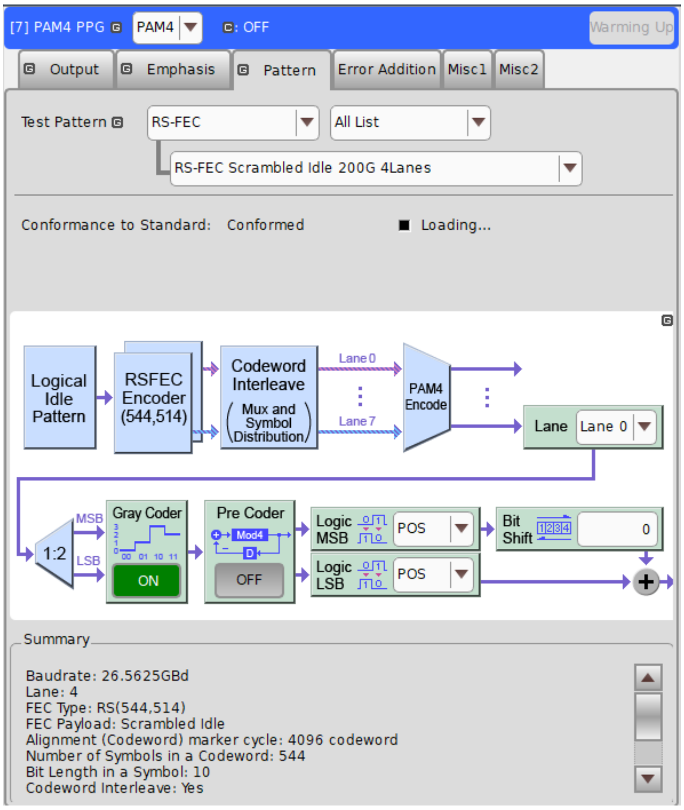

Figure 4.3.6.3-2 MU196020A Pattern Tab (With MU196020A-x42)

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4.3.6.4 Error Addition tab

On the **Error Addition** tab, you can turn on and off error addition to Data signal and can set error rate.

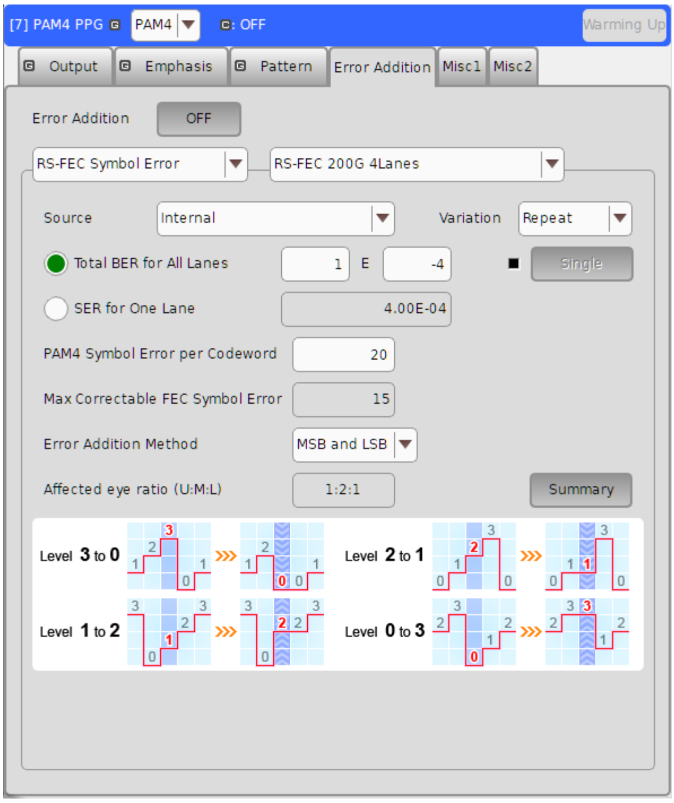

Figure 4.3.6.4-1 MU196020A Error Addition Tab (PAM4 Mode)

When the MU196020A-x42 FEC Pattern Generation is installed, you can enable the FEC error addition feature.

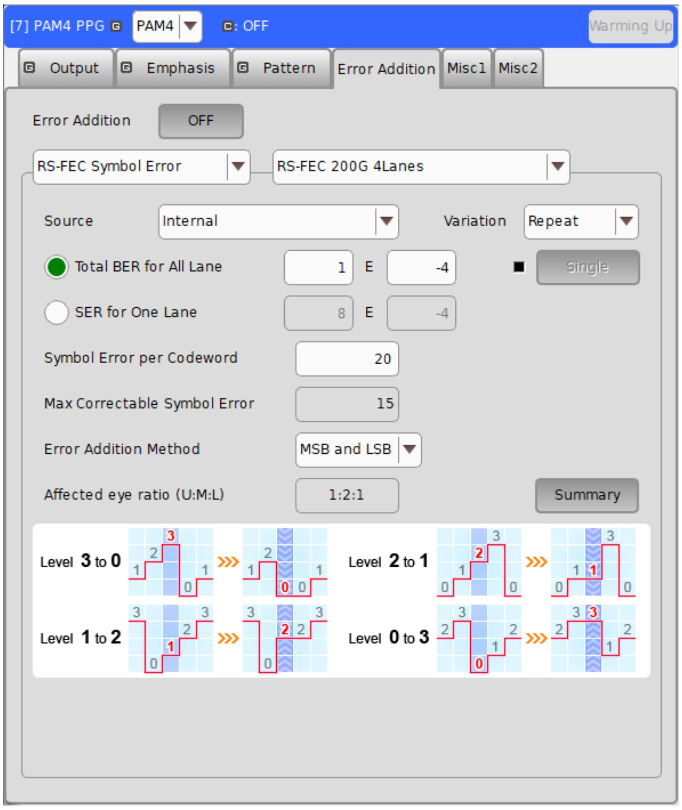

Figure 4.3.6.4-2 MU196020A Error Addition Tab (PAM4 Mode With MU196020A-x42)

4.3.6.5 Misc1 tab

On the **Misc1** tab, you can configure the signal generation method, synchronization signal output, auxiliary input and output, and other settings. Setting items on the **Misc1** tab are shown in Table 4.3.6.5-1.

Table 4.3.6.5-1 Setting Items

Item	Description
Pattern Sequence	Set the test pattern generating method. Gating Output can also be set.
AUX Input	Configure the settings for the auxiliary input function.
AUX Output	Configure the settings for the auxiliary output function.

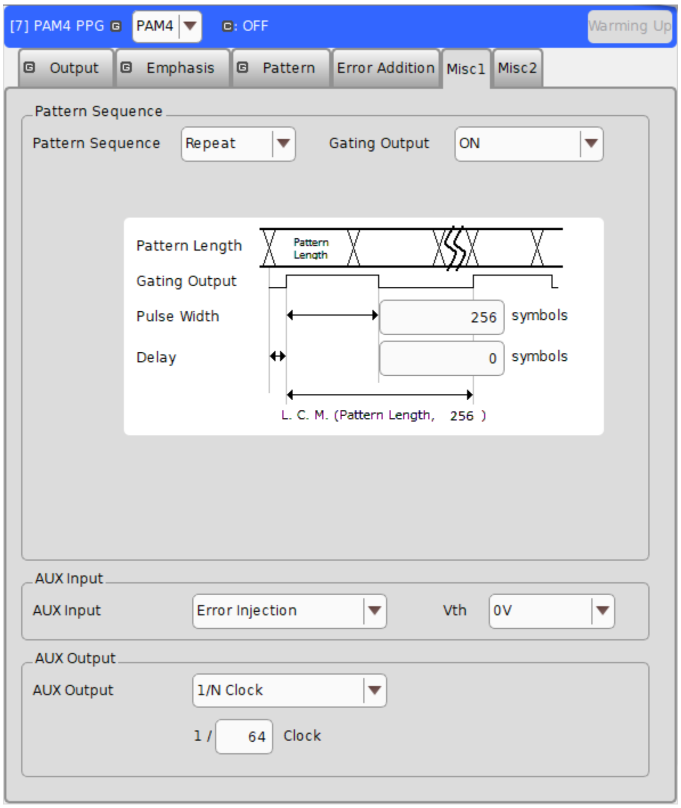

Figure 4.3.6.5-1 MU196020A Misc1 Tab (PAM4 Mode)

4.3.6.6 Misc2 tab

On the **Misc2** tab, you can configure the clock source, bit rate, baud rate, and other settings.

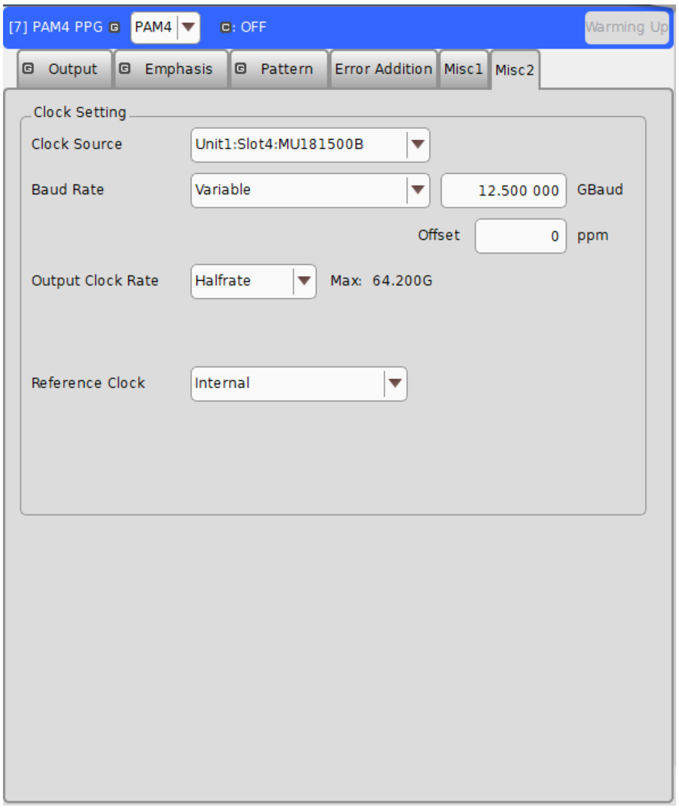

Figure 4.3.6.6-1 MU196020A Misc2 Tab (PAM4 Mode)

4.3.7 MU196040A

The MU196040A PAM4 ED (hereafter, MU196040A) is a plug-in module that can be built into MP1900A. It can measure a variety of patterns within the operating frequency range, including PRBS, Data, and ZeroSubstitution (NRZ mode only) patterns.

The MU196040A supports various option configurations and can switch the signal modulation mode between NRZ and PAM4, so it is suitable for research and development and manufacture of various digital communication equipment, digital communication modules and devices.

This section describes function of the tabs of the MU196040A operation screen. For details of the tabs, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch 

, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

Switch the signal modulation mode to NRZ or PAM4 by selecting it in the NRZ/PAM4 list at the module title bar shown in the following figure before using the MU196040A.

Figure 4.3.7-1 MU196040A NRZ/PAM4 List

4.3.7.1 Result tab

On the **Result** tab, you can check the BER results in the lower portion of the tab while changing the settings in the upper portion. To change the items to set, selecting an item in the list box at the module title bar. Setting items and description are shown in Table 4.3.7.1-1.

Table 4.3.7.1-1 Setting Items in Result Tab

Item	Description
Input	Select to configure the settings related to the input signal interface.
Gating	Select to configure the settings related to the measurement period.
Condition	Select to configure the settings related to the measurement conditions.
Auto Sync	Select to configure the settings related to the automatic synchronization establishment function.
Sync Control	Select to configure the settings related to the synchronization establishment method.

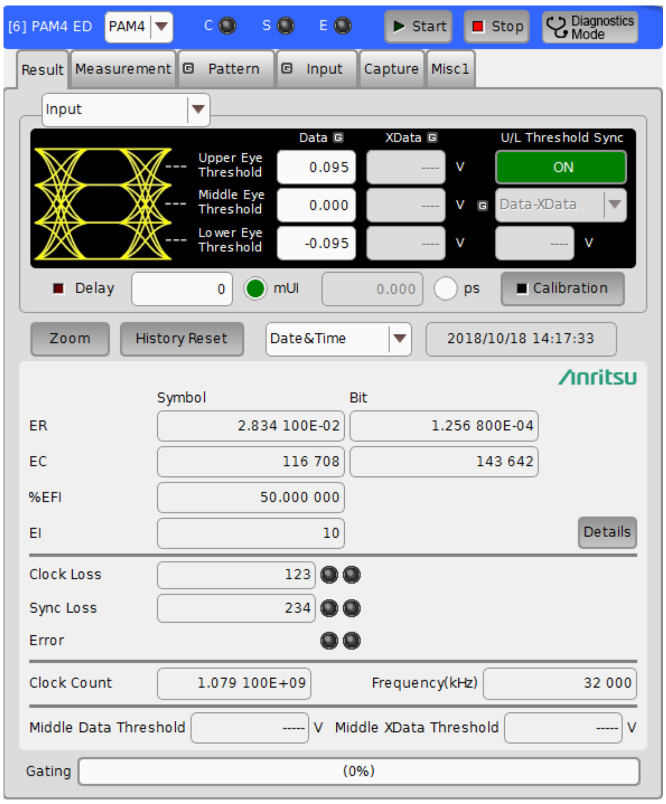

Figure 4.3.7.1-1 MU196040A Result Tab (PAM4 Mode)

Also, in PAM4 mode, touch the **Diagnostic Mode** button in the module title bar shown below, and you can switch to PAM4 Signal Diagnostics mode.

Figure 4.3.7.1-2 MU196040A Diagnostic Mode button

The PAM4 Signal Diagnostic mode is useful for troubleshooting when the PAM4 signal cannot be synchronized as PAM4 symbols.
In PAM4 Diagnostics mode, MSB and LSB bit errors can be measured separately. This allows you to check which of MSBs and LSBs include errors or Sync Loss. Also, in the **MSB/LSB Diff** box, you can check the phase bit shift (between MSB and LSB), which causes Sync Loss in symbol error measurement.

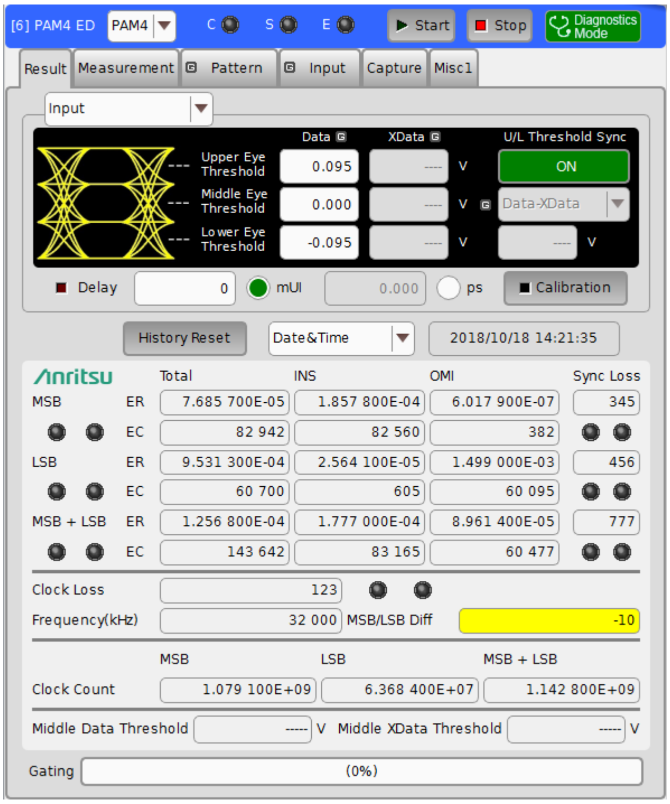

Figure 4.3.7.1-3 MU196040A Result Tab (PAM4 Diagnostics Mode)

Note:

To perform accurate SER measurement, observe the signal input to the MU196040A with the oscilloscope, and make sure the Lower Eye Threshold and Upper Eye Threshold are appropriate.

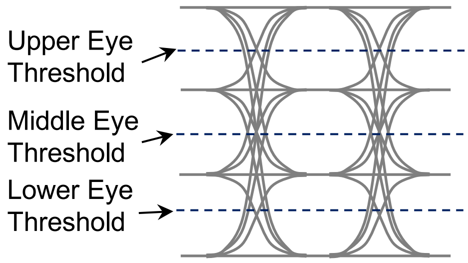

Figure 4.3.7.1-4 Example of Signal with Appropriate Upper Eye Threshold and Lower Eye Threshold

Make sure that the Lower Eye Threshold and Upper Eye Threshold do not go outside the PAM4 waveform range ((a) in (Figure 4.3.7.1-5) or go within the Middle Eye range ((b) in Figure 4.3.7.1-5).

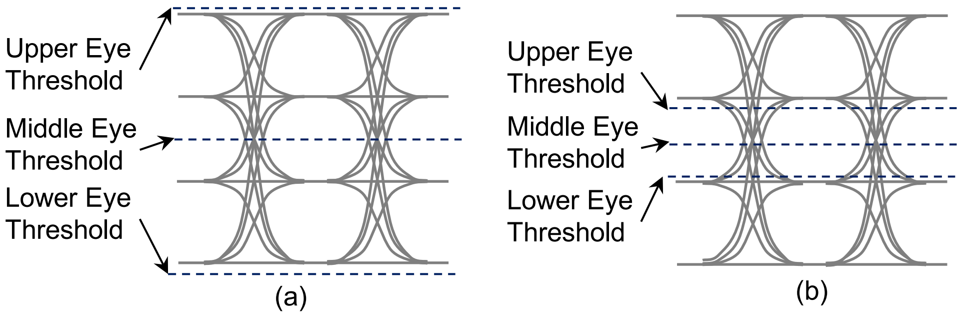

Figure 4.3.7.1-5 Example of Signal with Inappropriate Upper Eye Threshold and Lower Eye Threshold

Symbol ER in Figure 4.3.7.1-1 becomes **Sync Loss**, and when the Diagnostics Mode is started, "---- " is displayed in **LSB/MSB Diff**.

When set as shown in Figure 4.3.7.1-5 (a), the result measured by inverted logic of MSB is displayed in **LSB** for Diagnostics Mode.

When set as shown in Figure 4.3.7.1-5 (b), the measured MSB is displayed in **LSB** for Diagnostics Mode.

These phenomena are likely to occur when **PRBS** is set on the **Pattern** tab.

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4.3.7.2 Measurement tab

On the **Measurement** tab, you can set the measurement conditions. The **Measurement** tab consists of four setting groups listed in Table 4.3.7.2-1. These items can be also set on the **Result** tab. Additionally, the advanced settings of Sync Control and Error/Alarm Condition are available on this tab.

Table 4.3.7.2-1　Setting/Display Items in Measurement Tab

Item	Description
Gating	Select to configure the settings related to the measurement period.
Auto Sync	Select to configure the settings related to the automatic synchronization establishment function.
Sync Control	Select to configure the settings related to the synchronization establishment method.
Error/Alarm Condition	Select to configure the setting related to the error/alarm detection method.

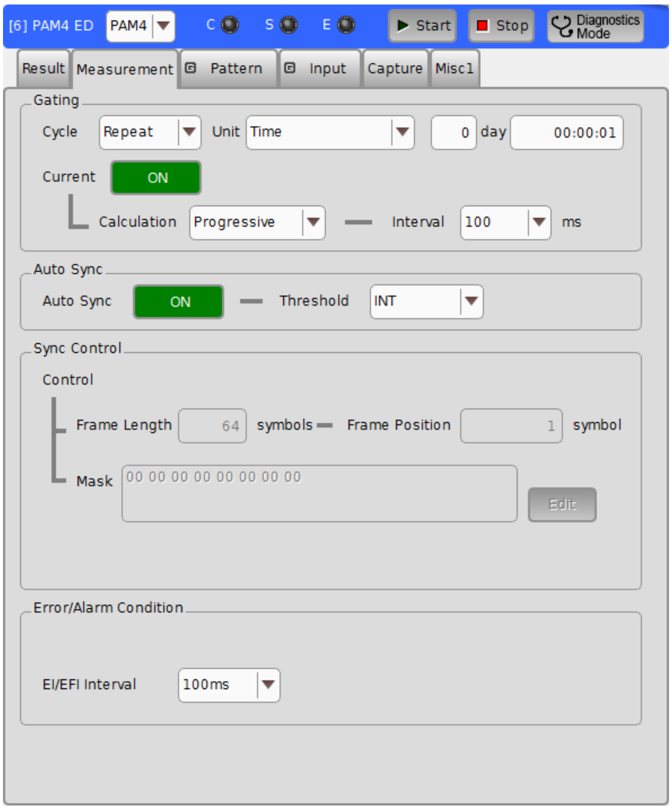


Figure 4.3.7.2-1　MU196040A Measurement Tab (PAM4 Mode)

4.3.7.3 Pattern tab

On the **Pattern** tab, you can select a test pattern and can configure the Mask settings. The following four test patterns are available. Setting items vary depending on the selected pattern.
If you select **Data**, you can edit the test pattern with Patten Editor.

- PRBS
- ZeroSubstitution (NRZ mode only)
- Data
- Standard-compliant pattern

By configuring Mask settings, a received test pattern is masked to prevent detected errors from being counted into the measurement results.

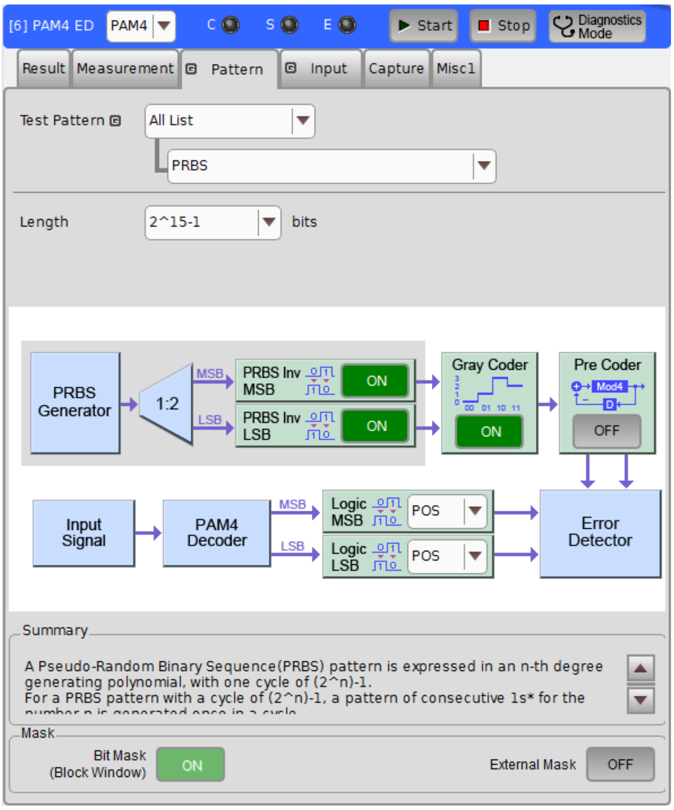


Figure 4.3.7.3-1 MU196040A Pattern Tab (PAM4 Mode)

When you select **Data** for **Test Pattern**, touch **Edit**, and you will see the following dialog box.

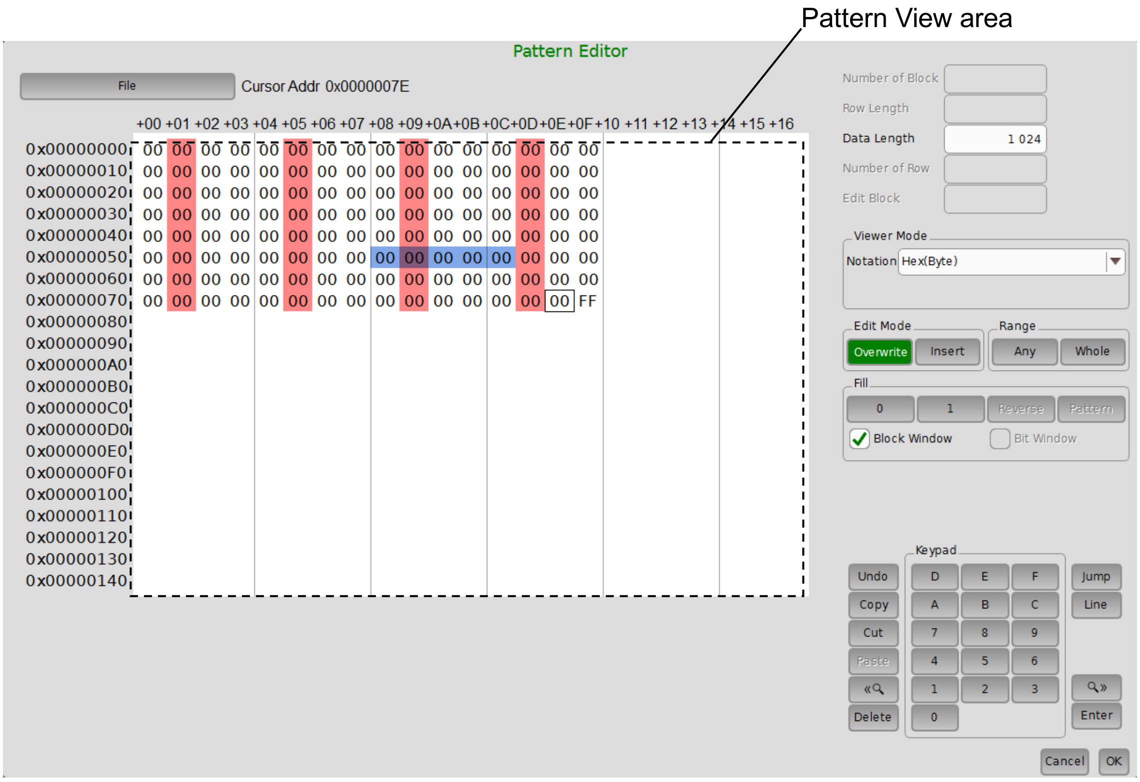


Figure 4.3.7.3-2 MU196040A Pattern Editor (NRZ Mode)

Table 4.3.7.3-1 Setting Items for Pattern Editor

Item	Description
File	Open: Opens the configuration file saved in the following format: Binary Pattern, BIN/HEX Text Pattern*1, BIN/HEX/PAM4 Text Pattern*2
	Save: Saves the configuration file in the following format: Binary Pattern, BIN Text Pattern, HEX Text Pattern, Symbol(PAM4) Text Pattern*2 ***Note:*** The settings will not be read from the saved file if the file name is changed.
Number of Block	This is currently not available.
Row Length	This is currently not available.

*1: For NRZ

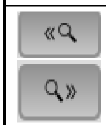
*2: For PAM4

Table 4.3.7.3-1 Setting Items for Pattern Editor (Cont'd)

Item	Description
Data Length	Sets the data length (bit).
Number of Row	This is currently not available.
Edit Block	This is currently not available.
Viewer Mode	Switches the data view format. Notation: Hex(Byte) Hexadecimal Bin Binary Symbol(PAM4)*2 0, 1, 2, 3 Coding: This is available when **Notation** is set to **Symbol(PAM4)**. Options are **No Coding** and **Gray**. When **Gray** is selected, the gray-coded pattern is displayed in the View area. Changes in the pattern due to gray coding can be checked. The data can be gray coded by turning on **Gray Coder** on the **Pattern** tab.
Edit Mode	Specify the pattern edit mode. Overwrite: The selected pattern is overwritten. Insert: The editing pattern is inserted into the position of the selected pattern. Note that Data Length is not changed when Insert is selected. The inserted pattern therefore exceeds the Data Length value, and becomes invalid.
Range	Specify the range to edit. Whole: Selects the whole editing patterns. Any: Displays the **Input Range** dialog box, where you can specify the editing range by an address.
Fill	0: Replaces the bits in the selected range with "0". 1: Replaces the bits in the selected range with "1". Reverse: Reverses the bits in the selected range. Pattern: Replaces the bits in the selected range with the set pattern. Block Window*3: If you select the check box and click **1**, the selected range is set as the block window and is displayed in blue. To cancel the block window, select the block window range and click **0**. Bit Window*3: This check box is available when the modulation mode is NRZ. If you select the check box and click **1**, the selected range is set as the bit window and is displayed in red. To cancel the bit window, select the bit window range and click **0**.
Undo	Cancels the previous operation and restores the previous state.

*3: It is displayed for MU196040A and MU196040B only.

Table 4.3.7.3-1　Setting Items for Pattern Editor (Cont'd)

Item	Description
Cut	Overwrite: Cuts the pattern selected in the Pattern View area and transfers it onto the clipboard. The area that has been cut out becomes 0. Insert: Cuts the selected pattern with its address domain. After cutting, zero pattern with the same amount of the cut domain is added instead at the end of pattern length.
Copy	Copies the pattern selected in the Pattern View area into the internal memory.
Jump	Moves the cursor to a specified address or pattern.
Head	Moves the cursor to the start of the editing pattern.
Tail	Moves the cursor to the end of the editing pattern.
Marker	Moves the cursor to a position specified by the marker when set to ON.
Address	Opens the **Input Address** dialog box. The cursor can be moved to the specified address position.
Pattern	Opens the **Input Pattern** dialog box. Specifies a pattern string to search by binary digits, and a pattern to be masked by an "x". If a pattern matching the search condition is found in the editing pattern, the cursor moves to that position. Both forward search and backward search are supported. To specify the search pattern, click one of the following buttons in the **Input Pattern** dialog box. **Set All**　Sets all the bits selected by Length to "1". **Reset ALL**　Sets all the bits selected by Length to "0". **ALL X**　Sets all bits to **Don't Care**. Select the search direction by clicking **Forward** or **Backward**, and then click **OK**.
Forward Next	Searches for a pattern that matches the search pattern set in the **Input Pattern** dialog box in the forward direction. If a matching pattern is found, the cursor moves to that position.
Backward Next	Searches for a pattern that matches the search pattern set in the **Input Pattern** dialog box in the backward direction. If a matching pattern is found, the cursor moves to that position.
Line	Specifies the number of bits/bytes/symbols per line to display in the Pattern View area.
	The waveform displayed in the Pattern View area can be enlarged or reduced by changing Zoom. The selectable scale is 1/8, 1/4, 1/2, 1, 2, 4, and 8.

4.3.7.4 Input tab

On the **Input** tab, you can configure the settings for the input interface. The **Input** tab consists of three areas: Data, Clock and Measurement Restart. Table 4.3.7.4-1 lists the items to set in each area.

Table 4.3.7.4-1 Setting Items in Input Tab

Item	Description
Data	Differential or Single-Ended input setting and termination voltage setting
Clock	Clock source setting
Measurement Restart	Item selection that measurements restart if the its setting has changed

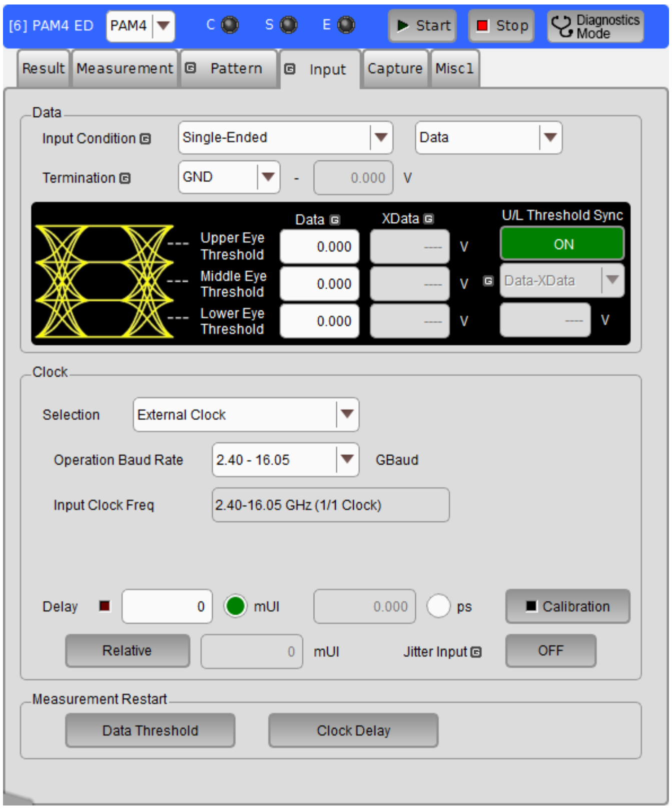


Figure 4.3.7.4-1 MU196040A Input Tab (PAM4 Mode)

4.3.7.5 Capture tab

On the **Capture** tab, you can capture the input test pattern and analyze it. Also, you can start and stop capturing pattern data and display captured pattern.

Note:

The MU196040A does not support this function, which is supported by the MU196040B.

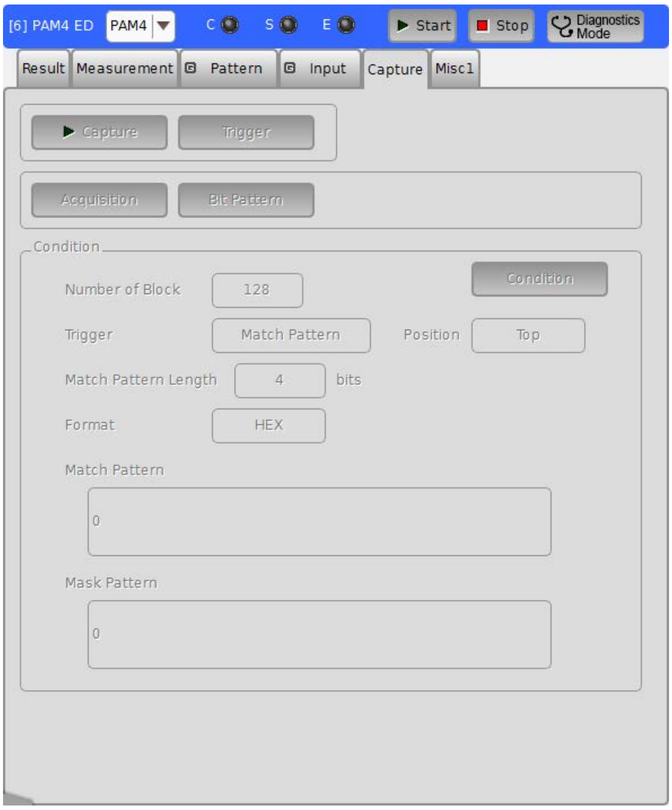


Figure 4.3.7.5-1　MU196040A Capture Tab (PAM4 Mode)

4.3.7.6 Misc1 tab

On the **Misc1** tab, you can configure the settings for pattern sequence and auxiliary input and output. Setting items on the **Misc1** tab are shown in Table 4.3.7.6-1.

Table 4.3.7.6-1 Setting Items in Misc1 Tab

Item	Description
Pattern Sequence	Set the test pattern receiving method.
AUX Input	Configure the settings for the auxiliary input function.
AUX Output	Configure the settings for the auxiliary output function.

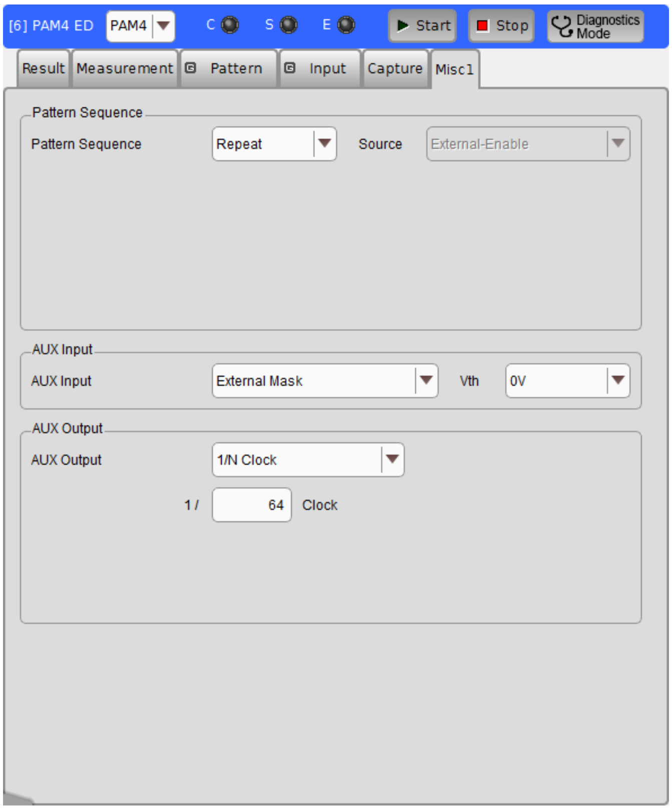


Figure 4.3.7.6-1 MU196040A Misc1 Tab (PAM4 Mode)

4

Operation of Applications

4.3.8 MU196040B

The MU196040B PAM4 ED (hereafter, MU196040B) is a plug-in module that can be built into MP1900A. It can measure a variety of patterns within the operating frequency range, including PRBS, Data, and ZeroSubstitution (NRZ mode only) patterns.

The MU196040B supports various option configurations and can switch the signal modulation mode between NRZ and PAM4, so it is suitable for research and development and manufacture of various digital communication equipment, digital communication modules and devices.

Also, with the MU196040B-x42 FEC Analysis installed, you can carry out RS-FEC Scrambled Idle pattern measurement and RS-FEC signal analysis.

This section describes function of the tabs of the MU196040B operation screen. For details of the tabs, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch 

, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

Switch the signal modulation mode to NRZ or PAM4 by selecting it in the NRZ/PAM4 list at the module title bar shown in the following figure before using the MU196040B.

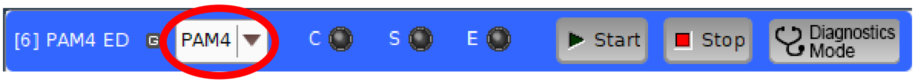


Figure 4.3.8-1 MU196040B NRZ/PAM4 List

This section omits the descriptions of the same functions as the MU196040A. Refer to the description in Section 4.3.7 “MU196040A”.

4.3.8.1 Result tab

On the **Result** tab, you can check the BER results in the lower portion of the tab while changing the settings in the upper portion. To change the items to set, selecting an item in the list box at the module title bar. Setting items and description are shown in Table 4.3.8.1-1.

Table 4.3.8.1-1 Setting Items in Result Tab

Item	Description
Input	Select to configure the settings related to the input signal interface. When the MU196040B-x11 Equalizer is installed, set the **Low Frequency Equalizer** and **DFE** (Decision Feedback Equalizer) values.
Gating	Select to configure the settings related to the measurement period.
Condition	Select to configure the settings related to the measurement conditions.
Auto Sync	Select to configure the settings related to the automatic synchronization establishment function.
Sync Control	Select to configure the settings related to the synchronization establishment method.
RS-FEC Symbol	Select to configure the settings related to the RS-FEC Symbol measurement conditions.

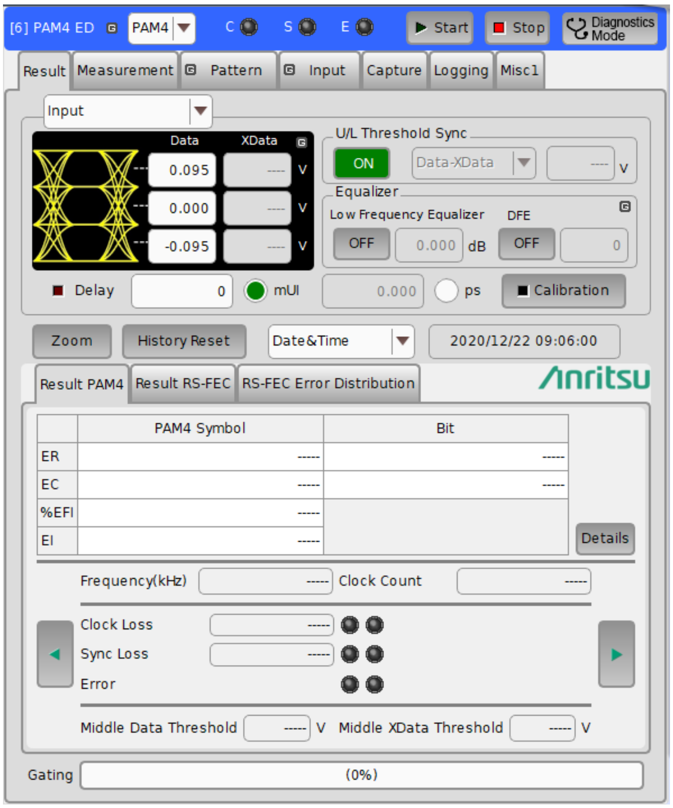


Figure 4.3.8.1-1 MU196040B Result Tab - Result PAM4 Tab (PAM4 Mode)

When the MU196040B-x42 FEC Analysis is installed, RS-FEC-related measurement results are displayed on the Result RS-FEC tab.

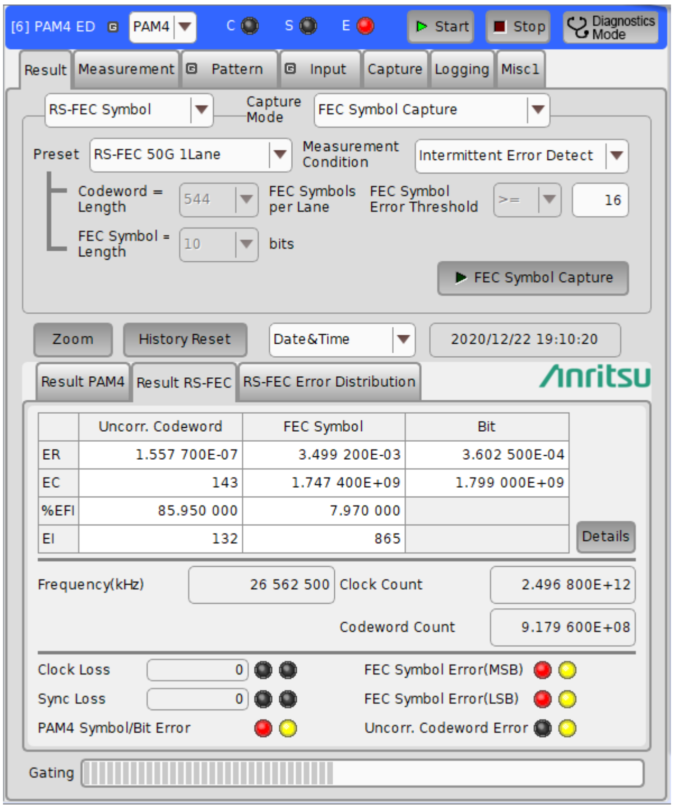


Figure 4.3.8.1-2 MU196040B Result Tab - Result RS-FEC Tab (PAM4 Mode)

Also, in the RS-FEC Error Distribution screen, the number of codewords in which FEC symbol errors occurred is displayed in a graph by the number of FEC symbol errors.
In the graph, the vertical bar at 0 on the horizontal axis shows the number of codewords without FEC symbol errors.
In the graph, the vertical bar at Uncorr. on the horizontal axis shows the number of codewords with FEC symbol errors equal to or greater than the error threshold.

Green: Codewords with FEC symbol errors less than the threshold

Red: Codewords with FEC symbol errors equal to or greater than the error threshold

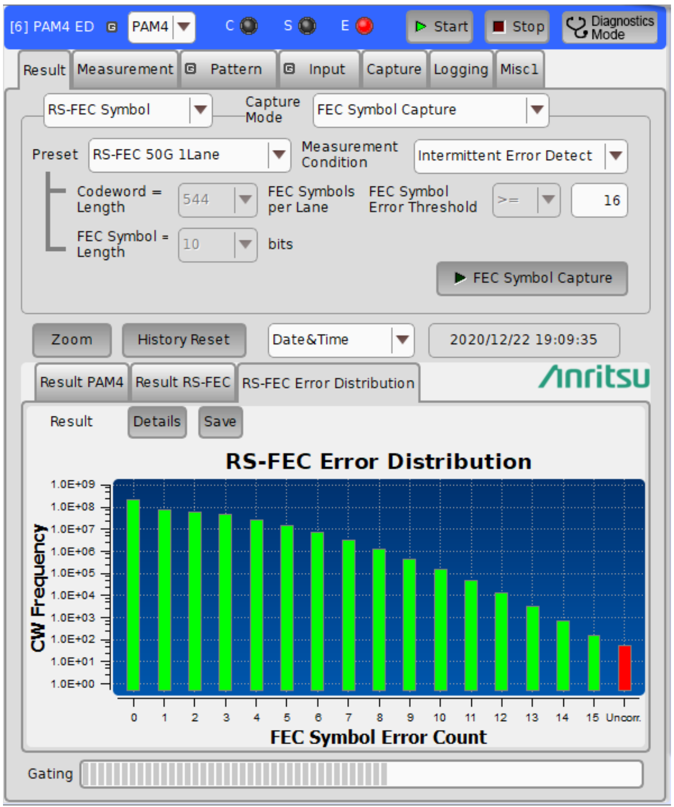


Figure 4.3.8.1-3 MU196040B Result Tab - RS-FEC Error Distribution Tab (PAM4 Mode)

4.3.8.2 Measurement tab

On the **Measurement** tab, you can set the measurement conditions. The **Measurement** tab consists of five setting groups listed in Table 4.3.8.2-1. The items in the following areas can be set also on the **Result** tab: **Gating**, **Auto Sync**, **Sync Control** and **Error/Alarm Condition**. Additionally, the advanced settings of Sync Control and Error/Alarm Condition are available on this tab.

Table 4.3.8.2-1 Setting/Display Items in Measurement Tab

Item	Description
Gating	Select to configure the settings related to the measurement period.
Auto Sync	Select to configure the settings related to the automatic synchronization establishment function.
Sync Control	Select to configure the settings related to the synchronization establishment method.
Error/Alarm Condition	Select to configure the setting related to the error/alarm detection method.
Measurement Restart	Item selection that measurements restart if the its setting has changed

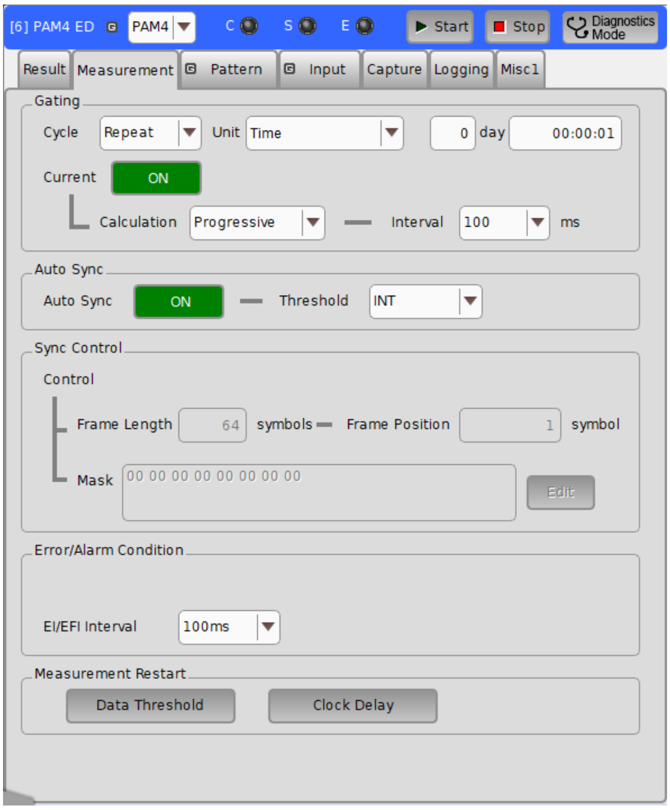


Figure 4.3.8.2-1 MU196040B Measurement Tab (PAM4 Mode)

4.3.8.3 Pattern tab

On the **Pattern** tab, you can select a test pattern and can configure the Mask settings. The description on the **Pattern** tab is the same as that for the MU196040A.

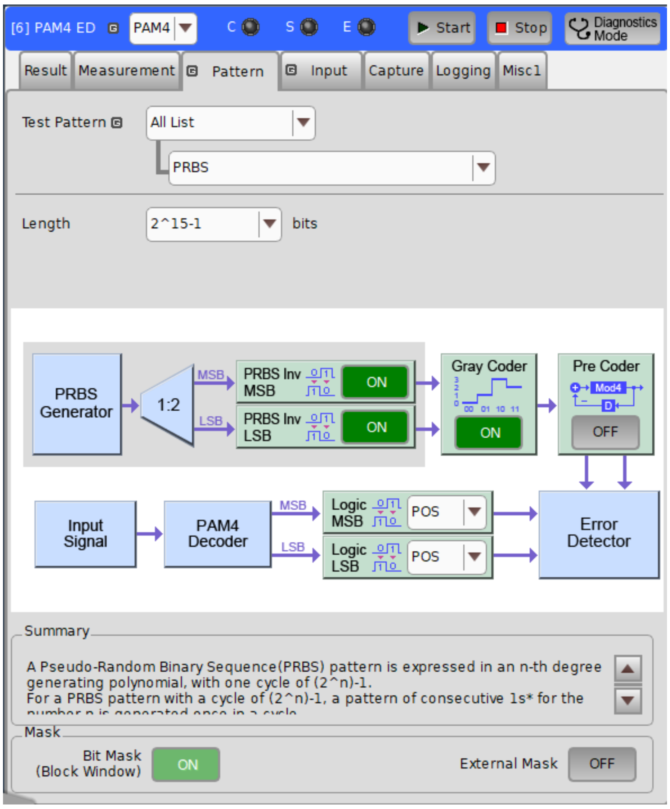


Figure 4.3.8.3-1　MU196040B Pattern Tab (PAM4 Mode)

When the MU196040B-x42 FEC Analysis is installed, you can set FEC patterns.

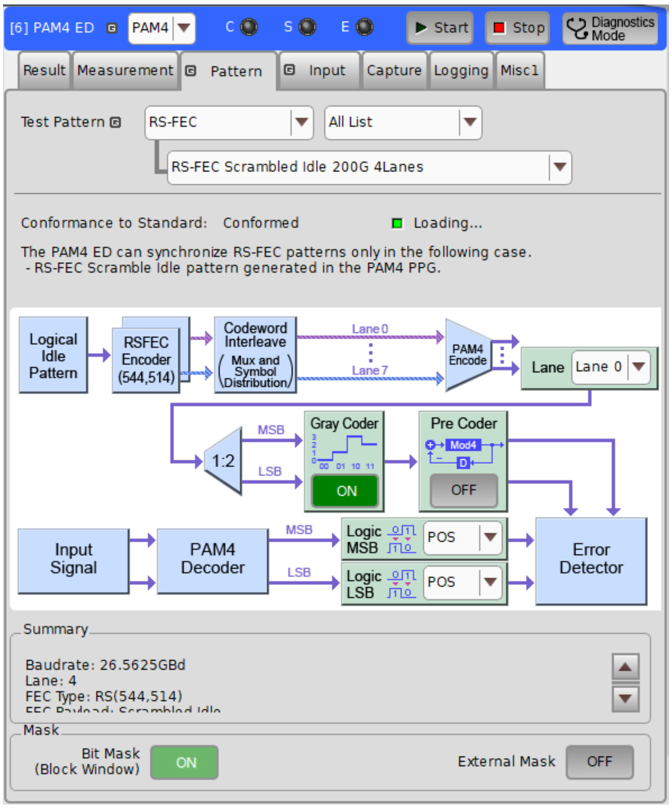


Figure 4.3.8.3-2 MU196040B Pattern tab (With MU196040B-x42)

4.3.8.4 Input tab

On the **Input** tab, you can configure the settings for the input interface. The **Input** tab consists of three areas: Data, Equalizer, and Clock. Table 4.3.8.4-1 lists the items to set in each area.

Table 4.3.8.4-1 Setting Items in Input Tab

Item	Description
Data	Differential or Single-Ended input setting and termination voltage setting
Equalizer	When the MU196040B-x11 Equalizer is installed, set the **Low Frequency Equalizer** and **Decision Feedback Equalizer** values.
Clock	Clock source setting

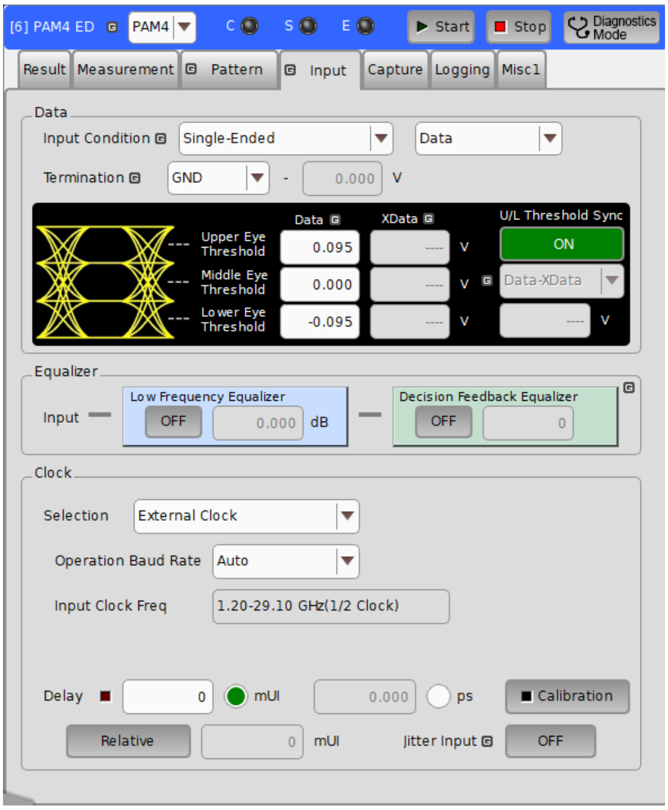


Figure 4.3.8.4-1 MU196040B Input Tab (PAM4 Mode)

4.3.8.5 Capture tab

On the **Capture** tab, you can capture the input test pattern and analyze it. Also, you can start and stop capturing pattern data and display captured pattern.

The size of pattern data to be captured is 4 Msymbols (4 194 304 symbols) in PAM4 mode and 8 Mbits (8 388 608 bits) in NRZ mode. The captured pattern data is divided into groups by the value set at **Number of Blocks** to display the pattern data by block.

Table 4.3.8.5-1 Setting Items on the Capture Tab

Item	Description
Capture Mode	Configure the settings for the pattern data capturing mode.
Capture Result Display	Configure the settings for displaying the pattern after the pattern data is captured.
Condition	Configure the conditions for starting the pattern data capturing.
FEC Symbol Capture Setting	Configure the settings for capturing and displaying the pattern data in FEC Symbol Capture mode.

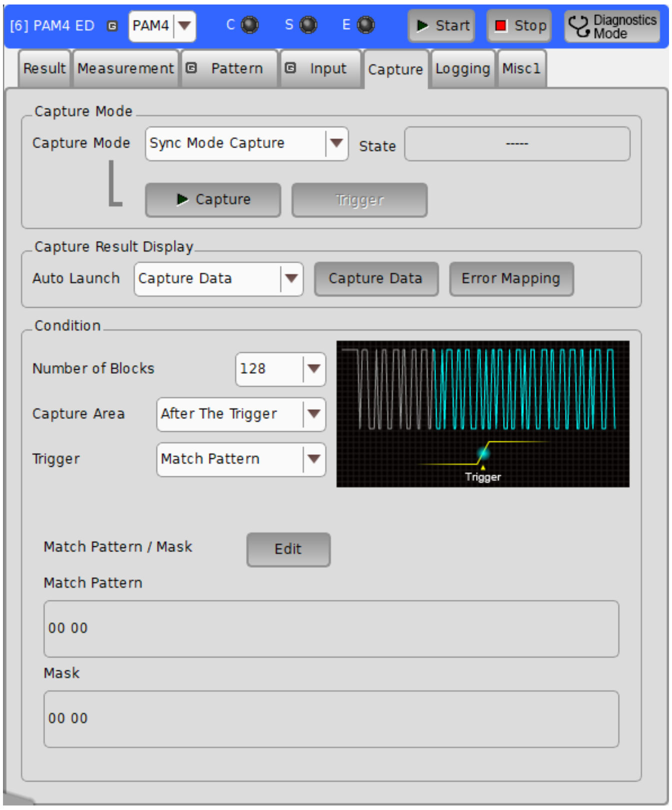


Figure 4.3.8.5-1 MU196040B Capture Tab (Sync Mode Capture) (PAM4 Mode)

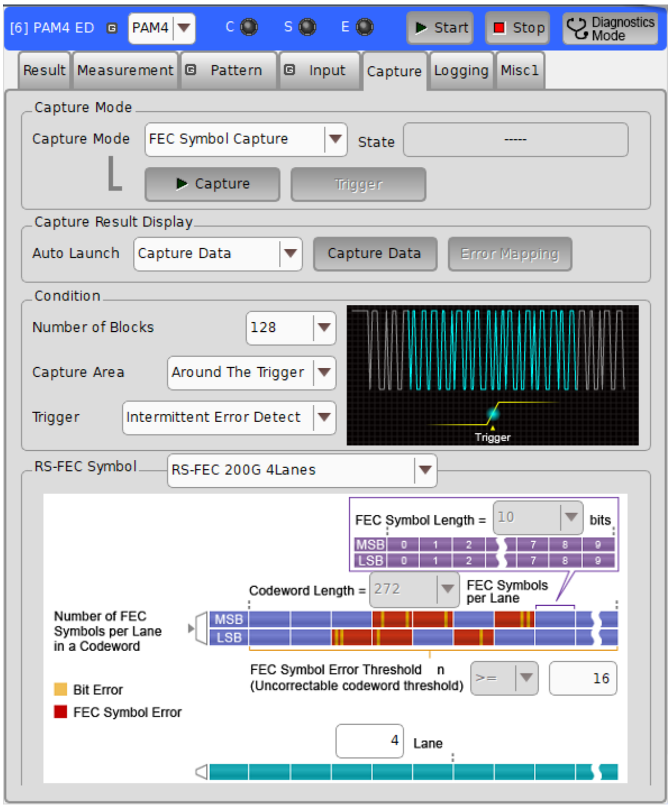


Figure 4.3.8.5-2 MU196040B Capture Tab (FEC Symbol Capture) (PAM4 Mode)

Each time a trigger occurs, 1 block of pattern is captured. If 128 is selected in the **Number of Blocks** list, the pattern data capturing ends when a trigger has occurred 128 times.

Capture Data screen

- For Sync Mode Capture, Raw Data Mode Capture mode

When the data is captured, touch **Capture Data**, and you can display the Capture Data screen. The errors detected in the captured test pattern are displayed in different colors, which help you identify error types.
The data is displayed by symbol (0, 1, 2, 3) or binary numbers in PAM4 mode and displayed by binary or hexadecimal numbers in NRZ mode.

Note:

The following explanation is based on the result display screen when **Capture Mode** is **Sync Mode Capture**. In the Raw Data Capture results screen, some functions are hidden or not valid.

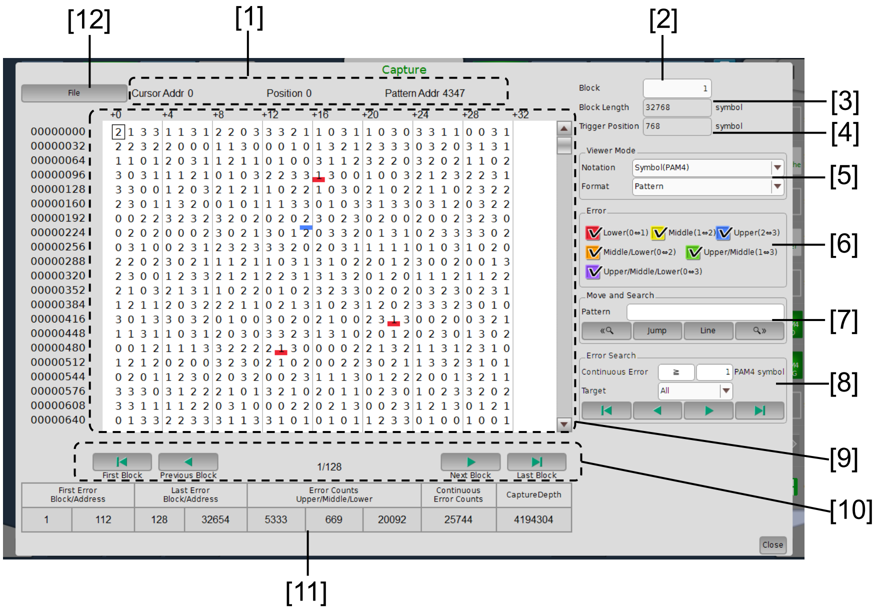
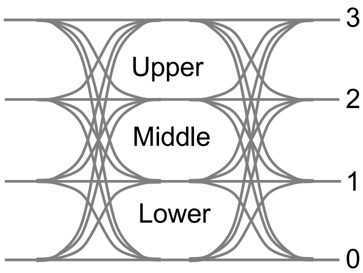


Figure 4.3.8.5-3 Capture Data Screen (PAM4 Mode)

In PAM4 mode, the background color of each symbol is different, depending on between which levels the error occurred.



Lower	Between levels 0 and 1
Middle	Between levels 1 and 2
Upper	Between levels 2 and 3
Middle/Lower	Between levels 0 and 2
Upper/Middle	Between levels 1 and 3
Upper/Middle/Lower	Between levels 0 and 3

Figure 4.3.8.5-4 Names and Occurrence Levels of Errors (PAM4 Mode)

Table 4.3.8.5-2 Description of Screen Items (PAM4 Mode)

No.	Item	Description
[1]	Cursor Addr/ Position/ Pattern Addr	Cursor Addr: Displays the cursor position within the current block. Position: Displays the position within the entire captured data (all blocks). Pattern Addr: Displays the position in the pattern. Data pattern: Displays the position from the first symbol of the pattern. PRBS pattern: Displays the position from the consecutive 0 bits. ***Note:*** For the data captured when **Capture Mode** is **Raw Data Capture**, "---" is displayed at **Pattern Addr**.
[2]	Block	Sets the block number to display. The maximum value is the value in the **Number of Blocks** list in Figure 4.3.8.5-1.
[3]	Block Length	Displays the block length. $\text{Block Length} = \frac{\text{4M symbols}}{\text{Number of Blocks}}$
[4]	Trigger Position	Displays the trigger detected position, in the range of 0 to block length.
[5]	Viewer Mode	Notation: Symbol(PAM4), fixed, BIN(MSB/LSB) Format: Select the view mode of the Capture Data display area. Pattern: Displays symbols 0, 1, 2 and 3, or binary (0, 1) numbers. Pattern + Waveform: Displays "symbols" + "image of PAM4 signal of four values".
[6]	Error*	Displays the legend (color sample) for each of error symbols or error bits. ● For Symbol(PAM4): Lower Eye Error (0 ↔ 1): Red Middle Eye Error (1 ↔ 2): Yellow Upper Eye Error (2 ↔ 3): Blue Middle/Lower Eye Error (0 ↔ 2): Orange Upper/Middle Eye Error (1 ↔ 3): Green Upper/Middle/Lower Eye Error (0 ↔ 3): Purple ● For BIN(MSB/LSB): INS: Insertion Error (0 → 1) Red OMI: Omission Error (1 → 0) Yellow ***Note:*** To show/hide each error in the Capture Data display area, select/clear its check box.

*: For the data captured when **Capture Mode** is **Raw Data Capture**, this item is not displayed.

Table 4.3.8.5-2 Description of Screen Items (PAM4 Mode) (Cont'd)

<table>
<tr><th>No.</th><th>Item</th><th>Description</th></tr>
<tr><td>[7]</td><td>Move and Search</td><td>Searches the captured data for the string.
Pattern: Searches any pattern of the string specified with symbols (0, 1, 2 and 3) by using and .
Jump: Moves the cursor to the specified address or pattern.
Head: Moves the cursor to the head of the captured data pattern.
Tail: Moves the cursor to the tail of the captured data pattern.
Address: Moves the cursor to the specified address.
Trigger Position:
Moves the cursor to the address where the trigger was detected.
Forward Next: Searches forward for a pattern that matches the pattern set in the Pattern box. If found, the cursor is placed at the position.
Backward Next:
Searches backward for a pattern that matches the pattern set in the Pattern box. If found, the cursor is placed at the position.
Line: Sets how many characters to display per line, in the Capture Data display area.</td></tr>
<tr><td>[8]</td><td>Error Search*</td><td>Performs an error search, specifying the number and type of continuous errors.
Continuous Error:
Specifies the number of continuous errors to search for.<table><tr><th>Search Mode</th><th>Range</th></tr><tr><td>PAM4 Symbol</td><td>1 to 256 PAM4 symbols,
1 PAM4 symbol step</td></tr><tr><td>Bit</td><td>1 to 256 bits, 1 bit step</td></tr></table>In the Search Condition box, select = (Exact match) or ≥ (Greater than or equal to).
Target: Select the type of errors to search, from the following: Upper Eye, Middle Eye, Lower Eye, All</td></tr>
<tr><td>[9]</td><td>Capture Data display area</td><td>Displays the captured data (including error information) by symbols (0, 1, 2 and 3) or binary numbers (Bin). The background color of each symbol where an error occurred is different depending on the error type.
When in the Viewer Mode area, Pattern + Waveform is selected in the Format list, a PAM4 pattern image is displayed.
Note:
For the results captured when Capture Mode is Raw Data Capture, error information is not displayed.</td></tr>
<tr><td>[10]</td><td>Block scroll buttons</td><td>Scrolls the block view.</td></tr>
</table>

Table 4.3.8.5-2 Description of Screen Items (PAM4 Mode) (Cont'd)

No.	Item	Description
[11]	Capture result display*	Displays the error detection results of the entire captured data. First Error: Displays the block number and address of where the first error was detected. Last Error: Displays the block number and address of where the last error was detected. Error Counts: For Symbol(PAM4): Displays the number of errors counted in all blocks (Upper/Middle/Lower Eye), separately. ***Note:*** One error may be counted in multiple eyes. Example: Middle/Lower (0 ↔ 2) errors are counted as both Middle Eye Error and Lower Eye Error. For BIN(MSB/LSB): Displays the number of errors counted in all blocks by type (Insertion / Omission / Total). Continuous Error Counts: Displays the number of times an error search detected continuous errors that match the number of symbols set in the **Continuous Error** box of the **Error Search** area. Capture Depth: Displays the number of symbols in the entire captured data.
[12]	File	Saves captured results and pattern to a file and loads the captured result file. Save: Saves the captured results and pattern to a file. The types of saved files are as follows: Symbol(PAM4) Capture File (*.scap): Select when redisplaying the results in the Capture Data screen. Symbol(PAM4) Capture File (export) (*.txt): Select when saving a pattern file including error information. The saved file can be loaded by Pattern Editor of the MU196020A, MU196040A, and MU196040B. Open: Loads a result file to redisplay the captured results. The results are displayed by loading the captured data (Symbol(PAM4) Text) from the scap file. ***Note:*** If **Capture Mode** is **Sync Mode Capture**, the error information cannot be displayed correctly when you open the file of the pattern captured in **Raw Data Capture** mode.

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Operation of Applications

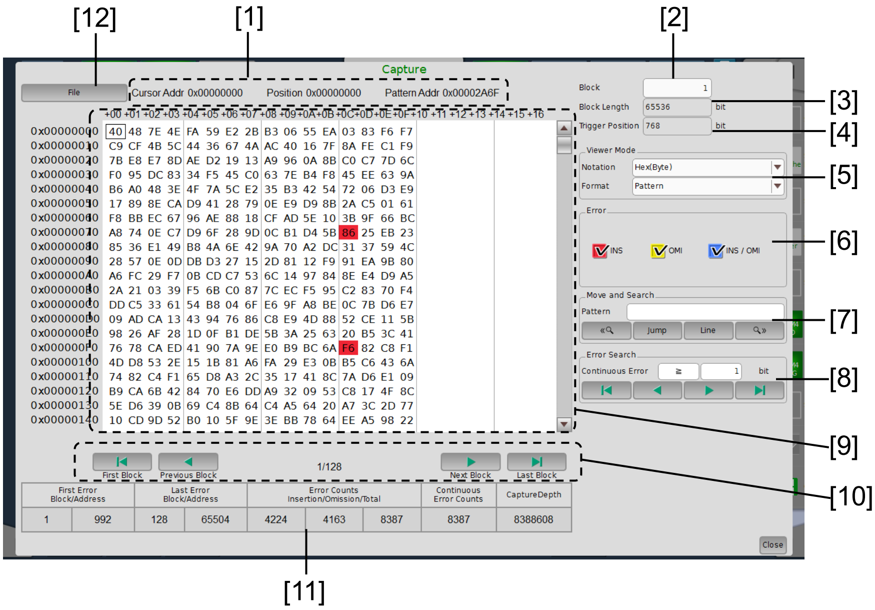


Figure 4.3.8.5-5 Capture Data Screen (NRZ Mode)

Table 4.3.8.5-3 Description of Screen Items (NRZ Mode)

No.	Item	Description
[1]	Cursor Addr/ Position/ Pattern Addr	Cursor Addr: Displays the cursor position within the current block. Position: Displays the position within the entire captured data (all blocks). Pattern Addr: Displays the position in the pattern. Data pattern: Displays the position from the first symbol of the pattern. PRBS pattern: Displays the position from the consecutive 0 bits. ***Note:*** For the data captured when **Capture Mode** is **Raw Data Capture**, "---" is displayed at **Pattern Addr**.
[2]	Block	Sets the block number to display. The maximum value is the value in the **Number of Blocks** list in Figure 4.3.8.5-1.
[3]	Block Length	Displays the block length. $\text{Block Length} = \dfrac{\text{8M bits}}{\text{Number of Blocks}}$
[4]	Trigger Position	Displays the trigger detected position, in the range of 0 to block length.
[5]	Viewer Mode	Notation: Bin Hex(Byte) Format: Select the view mode of the Capture Data display area. Pattern: String of binary (0, 1) or hexadecimal (0-9, A-F) numbers Pattern + Waveform: String of binary (0, 1) numbers and image of NRZ signal

Table 4.3.8.5-3 Description of Screen Items (NRZ Mode) (Cont'd)

No.	Item	Description
[6]	Error*	Displays the legend (color sample) for each of error bits. INS: Insertion Error (0 → 1) Red OMI: Omission Error (1 → 0) Yellow INS/OMI: Insertion and Omission Error Blue ***Note:*** If **Hex (Byte)** is selected in the **Notation** list of the **Viewer Mode** area, bits where both INS and OMI occurred are displayed on blue background. To show/hide each error in the Capture Data display area, select/clear its check box.
[7]	Move and Search	Searches the captured data for the string specified by binary (0, 1) or hexadecimal (0-to 9, A-to F) numbers. Pattern: Searches any pattern using and . Jump: Moves the cursor to the specified address or pattern. Head: Moves the cursor to the head of the captured data pattern. Tail: Moves the cursor to the tail of the captured data pattern. Address: Moves the cursor to the specified address position. Trigger Position: Moves the cursor to the address where the trigger was detected. Forward Next: Searches forward for a pattern that matches the pattern set in the **Pattern** box. If found, the cursor is placed at the position. Backward Next: Searches backward for a pattern that matches the pattern set in the **Pattern** box. If found, the cursor is placed at the position. Line: Sets how many characters to display per line, in the Capture Data display area.
[8]	Error Search*	Performs an error search, specifying the number and type of continuous errors. Continuous Error: Specifies the number of continuous errors to search for. 1 to 256 bits, 1 bit step In the **Search Condition** box, select **=** (Exact match) or **≥** (Greater than or equal to).

*: For the data captured when **Capture Mode** is **Raw Data Capture**, this item is not displayed.

Table 4.3.8.5-3 Description of Screen Items (NRZ Mode) (Cont'd)

No.	Item	Description
[9]	Capture Data display area	Displays the captured results (including error information) by binary (Bin) or hexadecimal (Hex) numbers. The background color of each bit where an error occurred is different depending on the error type. When displayed in binary format, select **Pattern + Waveform** in the **Notation** list of the **Viewer Mode** area, and you will view a pattern image. ***Note:*** For the results captured when **Capture Mode** is **Raw Data Capture**, error information is not displayed.
[10]	Block scroll buttons	Scrolls the block view.
[11]	Capture result display*	Displays the error detection results of the entire captured data. First Error: Displays the block number and address of where the first error was detected. Last Error: Displays the block number and address of where the last error was detected. Error Counts: Displays the number of errors counted in all blocks by type (Insertion, Omission, Total). Continuous Error Counts: Displays the number of times an error search detected continuous errors that match the number of bits set in the **Continuous Error** box of the **Error Search** area. Capture Depth: Displays the number of bits in the entire captured data.
[12]	File	Saves captured results and pattern to a file and loads the captured result file. Save: Saves the captured results and pattern to a file. The types of saved files are as follows: BIN(NRZ) Capture File, HEX(NRZ) Capture File (*.ncap): Select when redisplaying the results in the Capture Data screen. BIN(NRZ) Capture File (export), HEX(NRZ) Capture File (export) (*.txt): Select when saving a pattern file including error information. The saved file can be loaded by Pattern Editor of the MU195020A, MU195040A, MU196020A, MU196040A, and MU196040B. Open: Loads a result file to redisplay the captured results. The results are displayed by loading the captured data (BIN Text, HEX Text) from the ncap file. ***Note:*** If **Capture Mode** is **Sync Mode Capture**, the error information cannot be displayed correctly when you open the file of the pattern captured in **Raw Data Capture** mode.

- For FEC Symbol Capture mode

When the data is captured, touch **Capture Data**, and you can display the Capture Data screen. The errors detected in the captured test pattern are displayed in different colors, which help you identify error types.

The data is displayed by symbol (0, 1, 2, 3) or binary numbers in PAM4 mode, and by binary or hexadecimal numbers in NRZ mode.

Note:

The following explanation is based on the result display screen when Capture Mode is **FEC Symbol Capture**. The descriptions of the same functions as Sync Mode Capture mode are omitted.

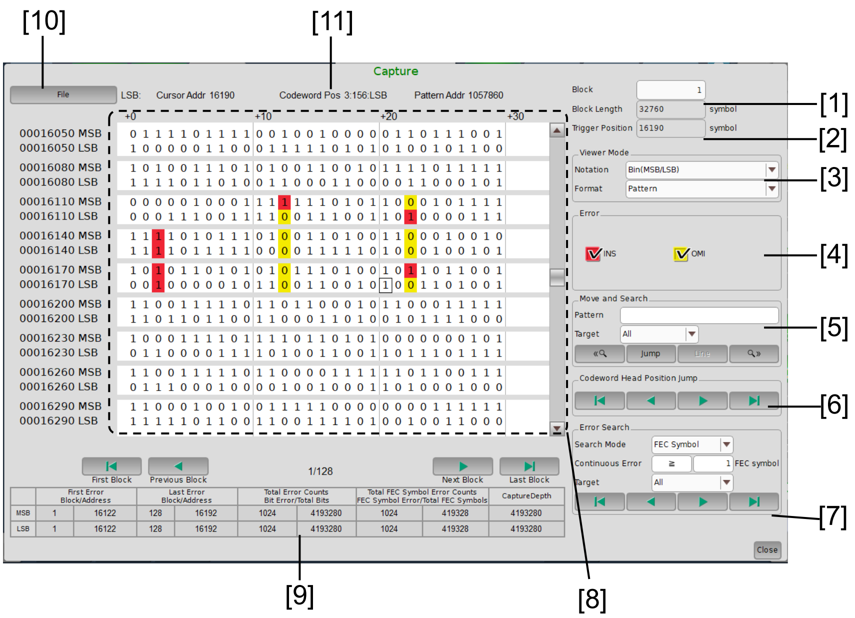


Figure 4.3.8.5-6 Capture Data Screen Items (FEC Symbol Capture in PAM4 Mode)

Table 4.3.8.5-4 Description of Capture Data Screen Items (FEC Symbol Capture in PAM4 Mode)

No.	Item	Description
[1]	Block Length	Displays the block length. Bits shorter than 1FEC Symbol length are discarded. Block Length = $\dfrac{\text{4M symbols}}{\text{Number of Blocks}}$
[2]	Trigger Position	Displays the trigger detected position, in the range of 0 to block length.
[3]	Viewer Mode	Notation: Symbol(PAM4), BIN(MSB/LSB) Format: Select the view mode of the Capture Data display area. Pattern: Displays symbols 0, 1, 2 and 3, or binary (0, 1) numbers. Pattern + Waveform: For Symbol(PAM4): Displays “symbols” + “image of PAM4 signal of four values”. For BIN(MSB/LSB): String of binary (0, 1) numbers and image of NRZ signal
[4]	Error	Displays the legend (color sample) for each of error symbols or error bits. ● For Symbol(PAM4): Lower Eye Error (0 ↔ 1): Red Middle Eye Error (1 ↔ 2): Yellow Upper Eye Error (2 ↔ 3): Blue Middle/Lower Eye Error (0 ↔ 2): Orange Upper/Middle Eye Error (1 ↔ 3): Green Upper/Middle/Lower Eye Error (0 ↔ 3): Purple ● For BIN(MSB/LSB): INS: Insertion Error (0 → 1) Red OMI: Omission Error (1 → 0) Yellow ***Note:*** To show/hide each error in the Capture Data display area, select/clear its check box.

Table 4.3.8.5-4 Description of Capture Data Screen Items (FEC Symbol Capture in PAM4 Mode) (Cont'd)

<table>
<tr><th>No.</th><th>Item</th><th>Description</th></tr>
<tr><td>[5]</td><td>Move and Search</td><td>Searches the captured data for the string.
Pattern: Searches any pattern of the string specified with symbols (0, 1, 2 and 3) by using and .
Jump: Moves the cursor to the specified address or pattern.
Head: Moves the cursor to the head of the captured data pattern.
Tail: Moves the cursor to the tail of the captured data pattern.
Address: Moves the cursor to the specified address.
Trigger Position:
Moves the cursor to the address where the trigger was detected.
Forward Next: Searches forward for a pattern that matches the pattern set in the Pattern box. If found, the cursor is placed at the position.
Backward Next:
Searches backward for a pattern that matches the pattern set in the Pattern box. If found, the cursor is placed at the position.
Line: Sets how many characters to display per line, in the Capture Data display area.
Target: Select the type of errors to search, from the following:
For BIN(MSB/LSB): MSB, LSB, All</td></tr>
<tr><td>[6]</td><td>Codeword Head Position Jump</td><td>Searches the captured data for the beginning of codeword.</td></tr>
<tr><td>[7]</td><td>Error Search</td><td>Performs an error search, specifying the number and type of continuous errors.
Search Mode: Specify the search mode.
FEC Symbol: Searches for errors in units of FEC symbols.
Symbol: Searches for errors in units of PAM4 symbols.
Bit: Searches for errors in units of bits.
Continuous Error:
Specifies the number of continuous errors to search for.
<table>
<tr><th>Search Mode</th><th>Range</th></tr>
<tr><td>FEC Symbol</td><td>1 to 256 FEC symbols,
1 FEC symbol step</td></tr>
<tr><td>PAM4 Symbol</td><td>1 to 256 PAM4 symbols,
1 PAM4 symbol step</td></tr>
<tr><td>Bit</td><td>1 to 256 bits, 1 bit step</td></tr>
</table>
In the Search Condition box, select = (Exact match) or ≥ (Greater than or equal to).
Target: Select the type of errors to search, from the following:
For Symbol(PAM4): Upper Eye, Middle Eye, Lower Eye, All
For BIN(MSB/LSB): MSB, LSB, All</td></tr>
</table>

Table 4.3.8.5-4 Description of Capture Data Screen Items (FEC Symbol Capture in PAM4 Mode) (Cont'd)

No.	Item	Description
[8]	Capture Data display area	Displays the captured data (including error information) by symbols (0, 1, 2 and 3) or by bits (0, 1). The background color of each symbol or bit where an error occurred is different depending on the error type. When in the **Viewer Mode** area, **Pattern + Waveform** is selected in the **Format** list, a PAM4/NRZ pattern image is displayed.
[9]	Capture result display	Displays the error detection results of the entire captured data. First Error: Displays the block number and address of where the first error was detected. Last Error: Displays the block number and address of where the last error was detected. Total Error Counts: Displays the total number of errors and symbols counted in all blocks. Total FEC Symbol Error Counts: Displays the total number of FEC Symbol errors and symbols counted in all blocks. Capture Depth: Displays the number of symbols in the entire captured data.
[10]	File	Saves captured results and pattern to a file and loads the captured result file. Save: Saves the captured results and pattern to a file. The types of saved files are as follows: Symbol(PAM4) Capture File (*.fscap): Select when redisplaying the results in the Capture Data screen. Symbol(PAM4) Capture File (export) (*.txt): Select when saving a pattern file including error information. The saved file can be loaded by Pattern Editor of the MU196020A, MU196040A, and MU196040B. Open: Loads a result file to redisplay the captured results. The results are displayed by loading the captured data from the fscap file.
[11]	Codeword Position	Codeword Pos: Displays the position from the beginning of the codeword in the captured pattern.

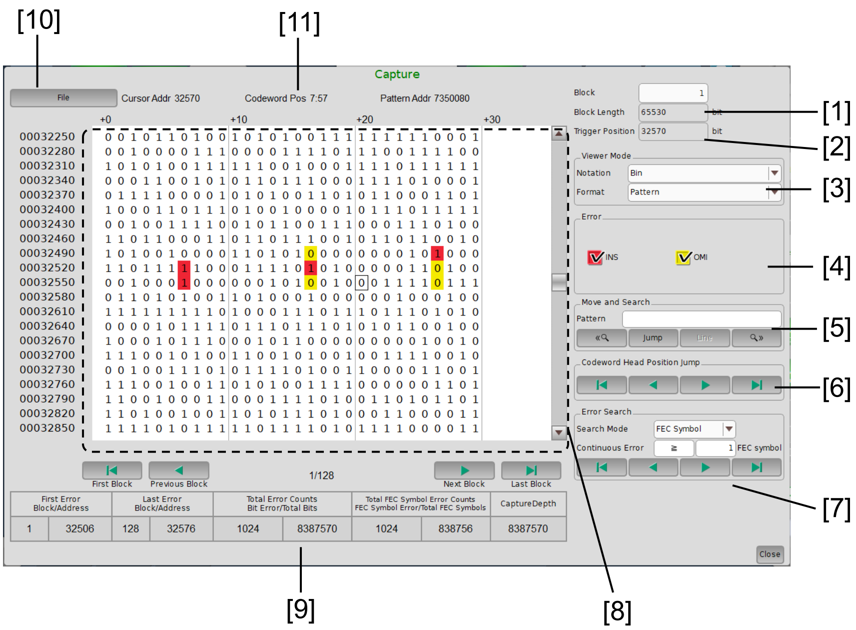


Figure 4.3.8.5-7 Capture Data Screen Items (FEC Symbol Capture in NRZ Mode)

Table 4.3.8.5-5 Description of Capture Data Screen Items (FEC Symbol Capture in NRZ Mode)

No.	Item	Description
[1]	Block Length	Displays the block length. Bits shorter than 1FEC Symbol length are discarded. $\text{Block Length} = \dfrac{\text{8M bits}}{\text{Number of Blocks}}$
[2]	Trigger Position	Displays the trigger detected position, in the range of 0 to block length.
[3]	Viewer Mode	Notation: Bin Format: Select the view mode of the Capture Data display area. Pattern: String of binary (0, 1) numbers Pattern + Waveform: String of binary (0, 1) numbers and image of NRZ signal
[4]	Error	Displays the legend (color sample) for each of error bits. INS: Insertion Error (0 → 1) Red OMI: Omission Error (1 → 0) Yellow ***Note:*** To show/hide each error in the Capture Data display area, select/clear its check box.:

Table 4.3.8.5-5 Description of Capture Data Screen Items (FEC Symbol Capture in NRZ Mode) (Cont'd)

<table>
<tr><th>No.</th><th>Item</th><th>Description</th></tr>
<tr><td>[5]</td><td>Move and Search</td><td>Searches the captured data for the string specified by binary (0, 1) numbers.
Pattern: Searches any pattern using and .
Jump: Moves the cursor to the specified address or pattern.
Head: Moves the cursor to the head of the captured data pattern.
Tail: Moves the cursor to the tail of the captured data pattern.
Address: Moves the cursor to the specified address position.
Trigger Position:
Moves the cursor to the address where the trigger was detected.
Forward Next: Searches forward for a pattern that matches the pattern set in the Pattern box. If found, the cursor is placed at the position.
Backward Next:
Searches backward for a pattern that matches the pattern set in the Pattern box. If found, the cursor is placed at the position.
Line: Sets how many characters to display per line, in the Capture Data display area.::::::</td></tr>
<tr><td>[6]</td><td>Codeword Head Position Jump</td><td>Searches the captured data for the beginning of codeword.</td></tr>
<tr><td>[7]</td><td>Error Search</td><td>Performs an error search, specifying the number and type of continuous errors.
Search Mode: Specify the search mode.
FEC Symbol: Searches for errors in units of FEC symbols.
Bit: Searches for errors in units of bits.
Continuous Error:
Specifies the number of continuous errors to search for.
<table><tr><th>Search Mode</th><th>Range</th></tr><tr><td>FEC Symbol</td><td>1 to 256 FEC symbols,
1 FEC symbol step</td></tr><tr><td>Bit</td><td>1 to 256 bits, 1 bit step</td></tr></table>In the Search Condition box, select = (Exact match) or ≥ (Greater than or equal to).:</td></tr>
</table>

Table 4.3.8.5-5 Description of Capture Data Screen Items (FEC Symbol Capture in NRZ Mode) (Cont'd)

No.	Item	Description
[8]	Capture Data display area	Displays the captured results (including error information) by binary (Bin) or hexadecimal (Hex) numbers. The background color of each bit where an error occurred is different depending on the error type. When displayed in binary format, select **Pattern + Waveform** in the **Notation** list of the **Viewer Mode** area, and you will view a pattern image.
[9]	Capture result display	Displays the error detection results of the entire captured data. First Error: Displays the block number and address of where the first error was detected. Last Error: Displays the block number and address of where the last error was detected. Total Error Counts: Displays the total number of errors and symbols counted in all blocks. Total FEC Symbol Error Counts: Displays the total number of FEC Symbol errors and symbols counted in all blocks. Capture Depth: Displays the number of symbols in the entire captured data.
[10]	File	Saves captured results and pattern to a file and loads the captured result file. Save: Saves the captured results and pattern to a file. The types of saved files are as follows: BIN(NRZ) Capture File, HEX(NRZ) Capture File (*.fncap): Select when redisplaying the results in the Capture Data screen. BIN(NRZ) Capture File (export), HEX(NRZ) Capture File (export) (*.txt): Select when saving a pattern file including error information. The saved file can be loaded by Pattern Editor of the MU195020A, MU195040A, MU196020A, MU196040A, and MU196040B. Open: Loads a result file to redisplay the captured results. The results are displayed by loading the captured data from the fncap file.
[11]	Codeword Position	Codeword Pos: Displays the position from the beginning of the codeword in the captured pattern.

Error Mapping screen

The Error Mapping screen is displayed when capturing the data with **Capture Mode** set to **Sync Mode Capture**.

When the data is captured, touch **Error Mapping**, and you can display the Error Mapping screen. The overall view of the captured block is displayed so that the user can easily understand the error distribution in the captured test pattern.
In PAM4 mode, symbol errors are displayed, and in NRZ mode, bit errors.

Note:

This function is available when **Capture Mode** is set to **Sync Mode Capture**. It is not available when set to **Raw Data Capture** or **FEC Symbol Capture**.

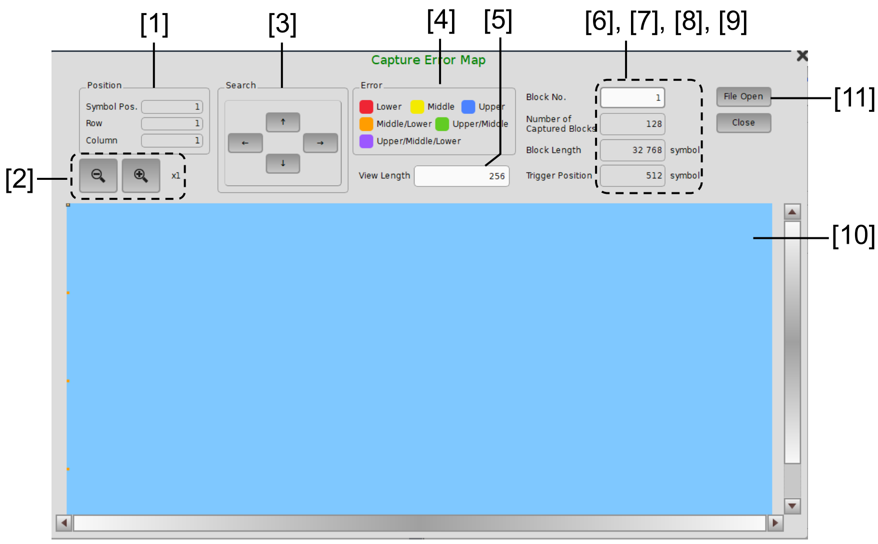


Figure 4.3.8.5-8 Error Mapping Screen (PAM4 Mode)

Table 4.3.8.5-6 Description of Error Mapping Screen Items (PAM4 Mode)

No.	Item	Description
[1]	Position	Displays the cursor position information. Symbol Pos.: Displays the cursor position from the head of the block by the number of symbols. Row: Displays the vertical position of the cursor in the Error Mapping display area by the row count. Column: Displays the horizontal position of the cursor in the Error Mapping display area by the column count.
[2]	Zoom in/out	Zooms in and out the result display screen. Zoom in ( ): 2x, 4x, 8x magnification Zoom out ( ): 1/2, 1/4, 1/8 ***Note:*** In 1x view, each dot represents 1 symbol. In 1/2 view, each dot represents 2 symbols.

Table 4.3.8.5-6 Description of Error Mapping Screen Items (PAM4 Mode) (Cont'd)

No.	Item	Description
[3]	Search	Searches the position of an error from the cursor position. Up button (↑): Searches up for the error nearest from the current position. Down button (↓): Searches down for the error nearest from the current position. Right button (→): Searches right for the error nearest from the current position. Left button (←): Searches left for the error nearest from the current position.
[4]	Error	Displays the legend (color sample) for each of error symbols. Symbols with no errors are displayed in light blue. Lower Eye Error (0 ↔ 1): Red Middle Eye Error (1 ↔ 2): Yellow Upper Eye Error (2 ↔ 3): Blue Middle/Lower Eye Error (0 ↔ 2): Orange Upper/Middle Eye Error (1 ↔ 3): Green Upper/Middle/Lower Eye Error (0 ↔ 3): Purple ***Note:*** When the Error Mapping display area is displayed with zoomed out, each dot containing two or more types of errors is displayed in gray.
[5]	View Length	Sets where to wrap (view length) in the Error Mapping display area. 256 symbols to Block Length, 8 symbols step
[6]	Block No.	Sets the block number to display. The maximum value is the value in the **Number of Blocks** list in Figure 4.3.8.5-1.
[7]	Number of Captured Blocks	Displays the number of captured blocks.
[8]	Block Length	Displays the block length. $\text{Block Length} = \dfrac{4\text{M}}{\text{Number of Blocks}}$
[9]	Trigger Position	Displays the trigger detected position, in the range of 0 (head of block) to block length.
[10]	Error Mapping display area	Displays the error detected positions in each block by color.
[11]	File Open	Loads a result file saved in the Capture Data screen to map the error results. The results are displayed by loading the captured data (Symbol(PAM4) Text) from the scap file. ***Note:*** If **Capture Mode** is **Sync Mode Capture**, the error information cannot be displayed correctly when you open the file of the pattern captured in **Raw Data Capture** mode.

4

Operation of Applications

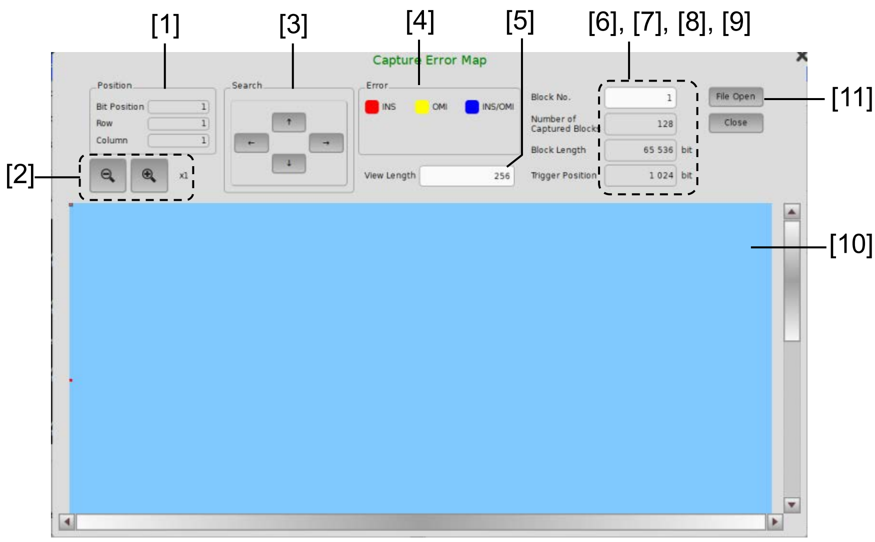


Figure 4.3.8.5-9 Error Mapping Screen (NRZ Mode)

Table 4.3.8.5-7 Description of Error Mapping Screen Items (NRZ Mode)

No.	Item	Description
[1]	Position	Displays the cursor position. Bit Position: Displays the cursor position from the head of the block by the number of bits. Row: Displays the vertical position of the cursor in the Error Mapping display area by the row count. Column: Displays the horizontal position of the cursor in the Error Mapping display area by the column count.
[2]	Zoom in/out	Zooms in and out the result display screen. Zoom in ( ): 2x, 4x, 8x magnification Zoom out ( ): 1/2, 1/4, 1/8 ***Note:*** In 1x view, each dot represents 1 bit. In 1/2 view, each dot represents 2 bits.
[3]	Search	Searches the position of an error from the cursor position. Up button ( ): Searches up for the error nearest from the current position. Down button ( ): Searches down for the error nearest from the current position. Right button ( ): Searches right for the error nearest from the current position. Left button ( ): Searches left for the error nearest from the current position.

Table 4.3.8.5-7 Description of Error Mapping Screen Items (NRZ Mode) (Cont'd)

No.	Item	Description
[4]	Error	Displays the legend (color sample) for each of error bits. Bits with no errors are displayed in light blue. INS: Insertion Error (0 → 1) Red OMI: Omission Error (1 → 0) Yellow INS/OMI: Insertion and Omission Error Blue ***Note:*** When the Error Mapping display area is displayed with zoomed out, each dot containing both INS and OMI errors is displayed in blue.
[5]	View Length	Sets where to wrap (view length) in the Error Mapping display area. 256 bits to Block Length, 8 bits step
[6]	Block No.	Sets the block number to display. The maximum value is the value in the **Number of Blocks** list in Figure 4.3.8.5-1.
[7]	Number of Captured Blocks	Displays the number of captured blocks.
[8]	Block Length	Displays the block length. $\text{Block Length} = \dfrac{8\text{M}}{\text{Number of Blocks}}$
[9]	Trigger Position	Displays the trigger detected position, in the range of 0 (head of block) to block length.
[10]	Error Mapping display area	Displays the error detected positions in each block by color.
[11]	File Open	Loads a result file saved in the Capture Data screen to map the error results. The results are displayed by loading the captured data (BIN Text, HEX Text) from the ncap file. ***Note:*** If **Capture Mode** is **Sync Mode Capture**, the error information cannot be displayed correctly when you open the file of the pattern captured in **Raw Data Capture** mode.

4.3.8.6 Logging tab

On the **Logging** tab, error and alarm information can be logged. Specified bit and symbol errors are logged at the time intervals specified in **Cycle**.

Table 4.3.8.6-1 Setting Items on the Logging Tab

Item	Description
Logging	OFF, ON: Starts logging when set to **ON**. Clear: Clears the logged results displayed in the **Log** area. Save: Saves the logged results to a file.
Cycle	Sets the log display cycle in the range of 5 seconds to 1 hour.
Measurement items	Turn on and off logging of the measurement items. You can check the remaining logging time calculated from the number of selected measurement items and the cycle.
Log display	Displays the occurrence time and result of each of selected measurement items. Up to 100 000 logs can be displayed.

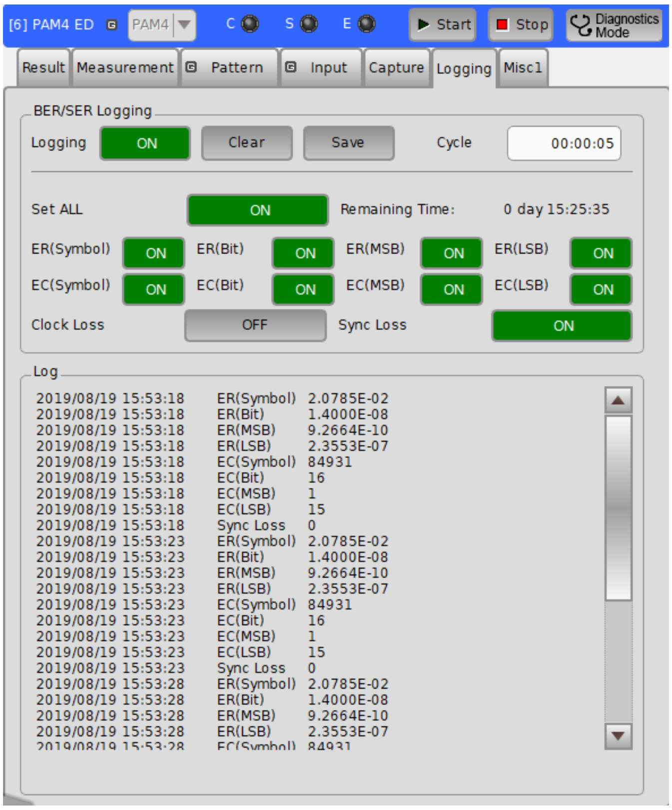


Figure 4.3.8.6-1 MU196040B Logging Tab (PAM4 Mode)

4.3.8.7 Misc1 tab

On the **Misc1** tab, you can configure the settings for pattern sequence and auxiliary input and output. The description on the Misc1 tab is the same as that for the MU196040A.

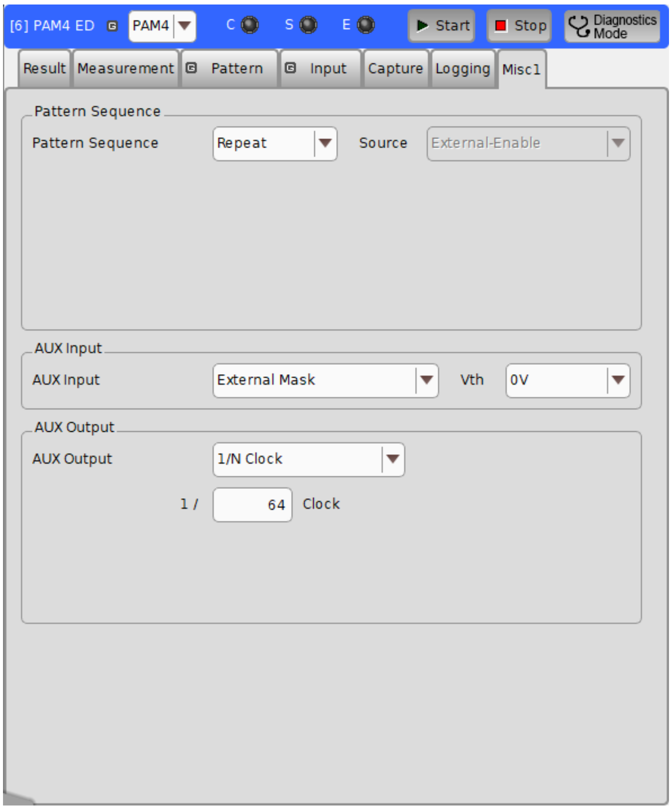


Figure 4.3.8.7-1 MU196040B Misc1 Tab (PAM4 Mode)

4.4 Auto Measurement

The Auto Measurement provides various measurement functions that use PPG and ED. Unless otherwise specified, MU195020A and MU195040A are used for explanation of screens.
To display the AUTO MEAS Screen, refer to 3.1.2 “Display Switching Screens”.

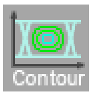
4.4.1 Eye Contour Measurement

The Eye Contour measurement is a function that plots bit-error-rate contours. Contours of bit error rates (1E–6 to 1E–20) are plotted by using measurement results for a number of bit error rates and estimating contours of the other bit error rates.

Notes:

Eye Contour measurement cannot be performed for the following cases.

- When the module being used is MU196040A
- When MU196040B-x41 is not installed in the module being used
- When **Burst** is selected for **Pattern Sequence** on the **Misc1** tab
- When **Auto Adjust** is set to **ON**
- When **OFF** is selected for **Auto Sync** on the **Result** tab
- When the **Input** tab is grouped together with the other tab
- When **CDR** is selected for **Clock Input** on the **Input** tab

Touching 

on Application toolbar displays Eye Contour screen.

Eye Contour screen is shown below. For details of the window, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch 

, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

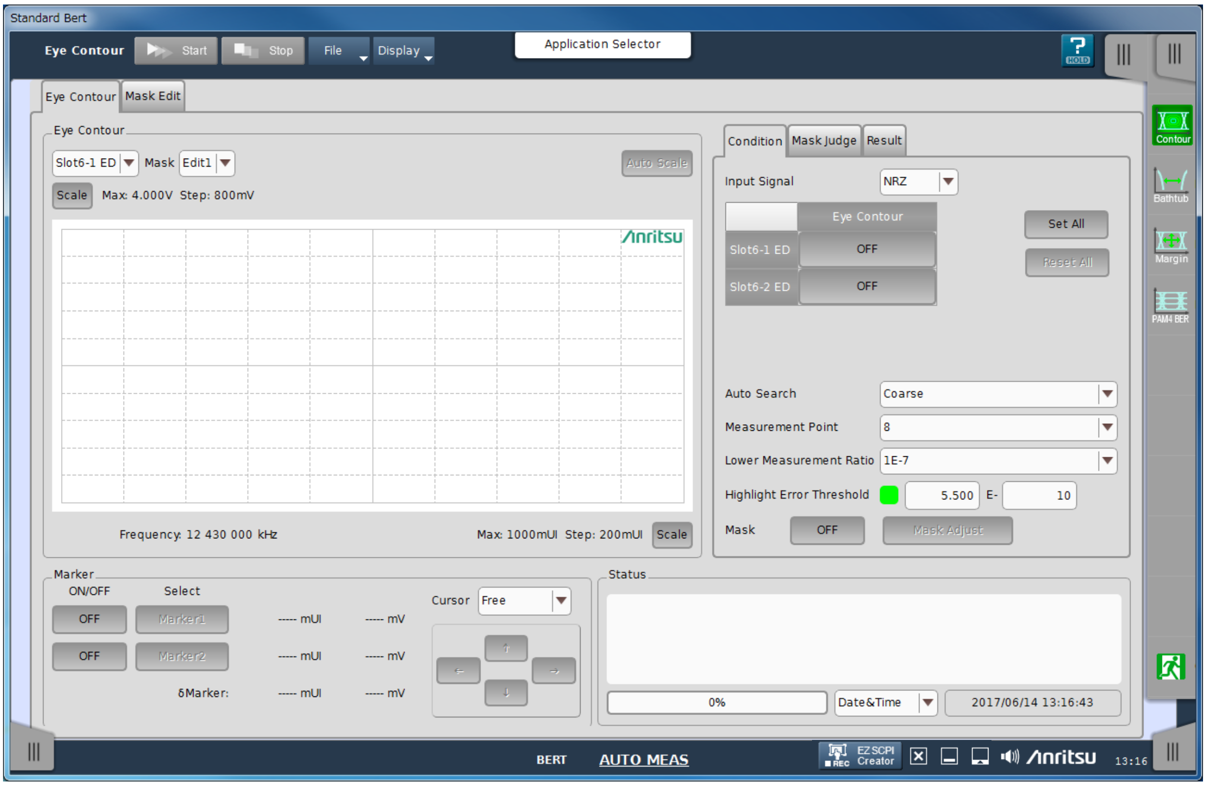


Figure 4.4.1-1 Eye Contour tab

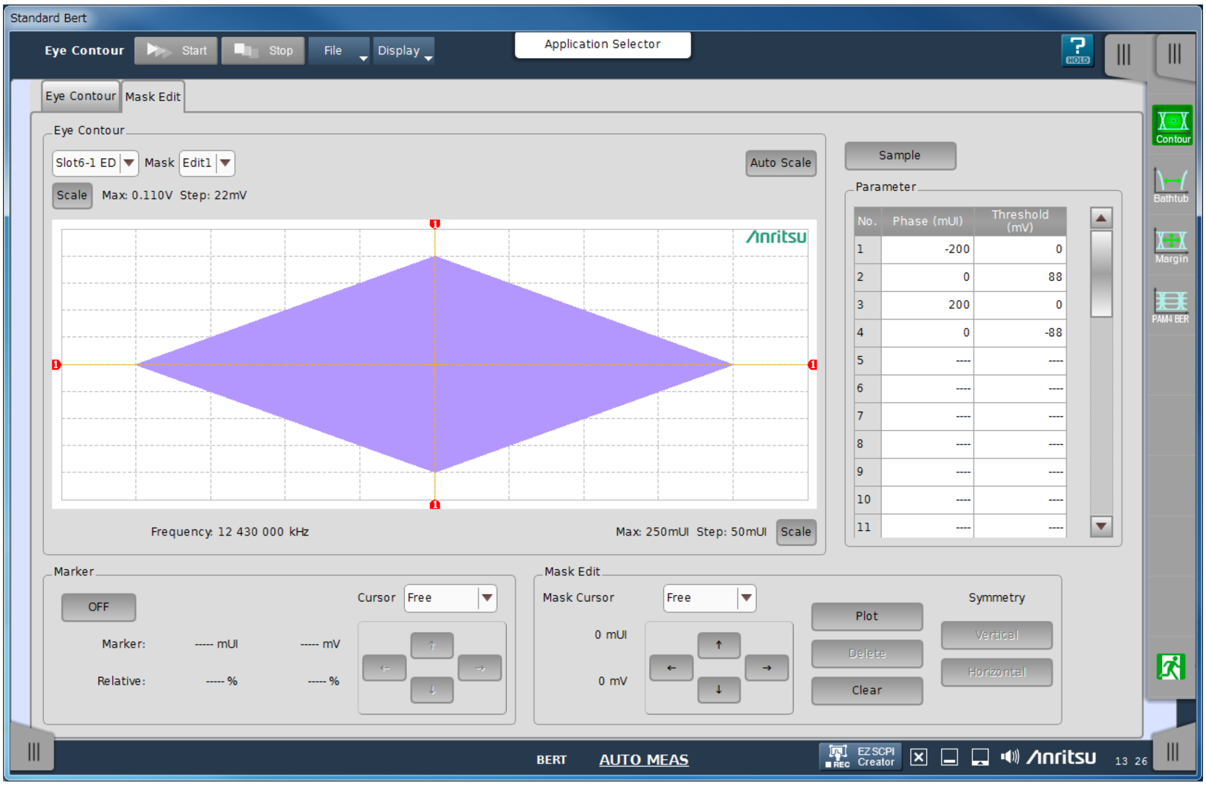


Figure 4.4.1-2 Mask Edit Tab

4.4.2 Bathtub Measurement

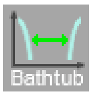
The Bathtub function has the following features.

- Provides rich graph displaying modes.
- Calculates TJ, DJ, RJ, as well as optimum phase and optimum bit error rate.
- Calculates J2 and J9.

The followings are notes of caution for Bathtub measurement.

Notes:

- Bathtub measurement cannot be performed for the following cases.
  - When the module being used is MU196040A
  - When MU196040B-x41 is not installed in the module being used
  - When **Burst** is selected for **Pattern Sequence on** the **Misc1** tab
  - When **Auto Adjust** is set to **ON**
  - When **OFF** is selected for **Auto Sync** on the **Result** tab
  - When the **Input** tab is grouped together with the other tab
  - When **CDR** is selected for **Clock Input** on the **Input** tab
- For accuracy, start Bathtub measurement after the operations below.
  - Execute  **Output** tab / **Delay** / **Calibration** of PPG.
  - Turn off  **Output** tab / **Delay** / **Jitter Input** of PPG.

Touching 

on Application toolbar displays Bathtub screen.

Bathtub screen is shown below. For details of the window, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch 

, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

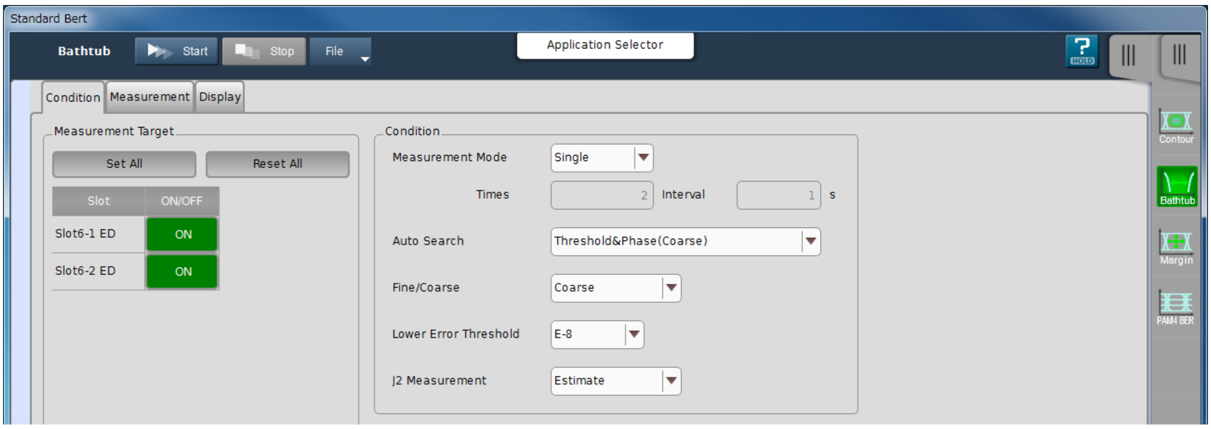


Figure 4.4.2-1 Condition Tab

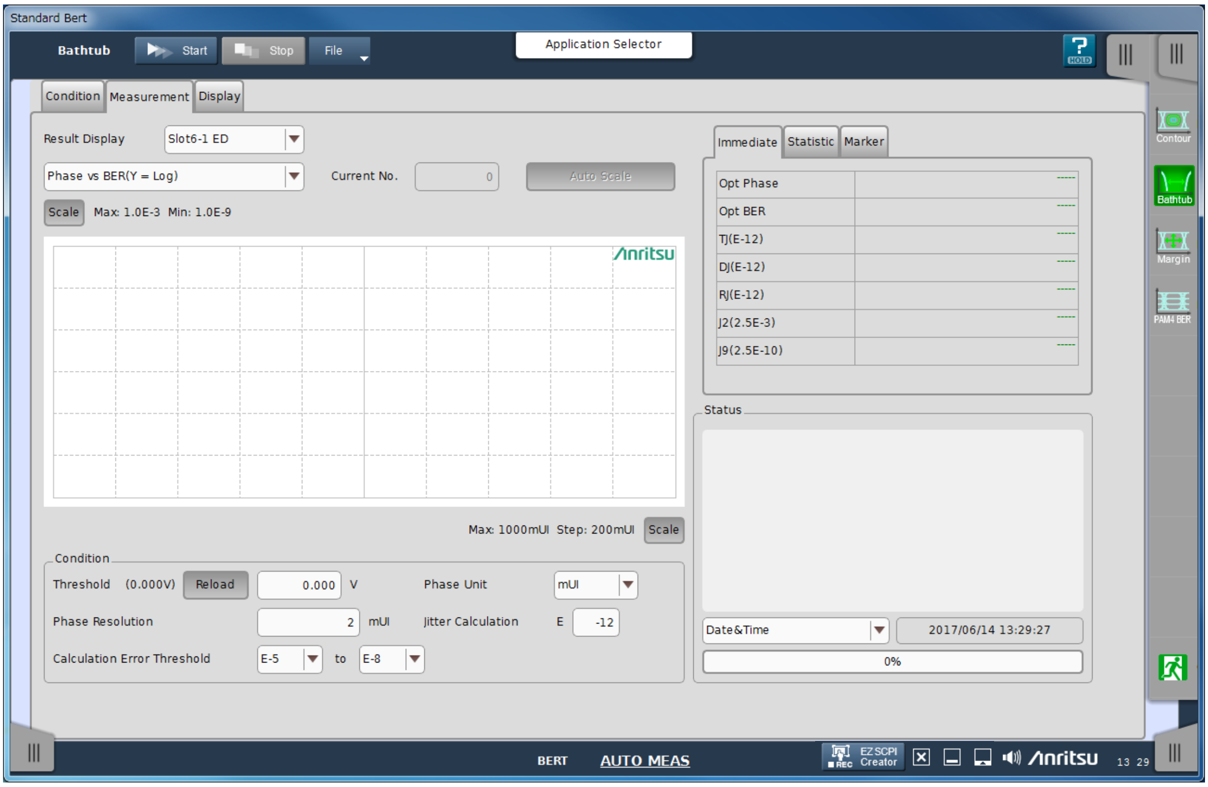


Figure 4.4.2-2 Measurement tab

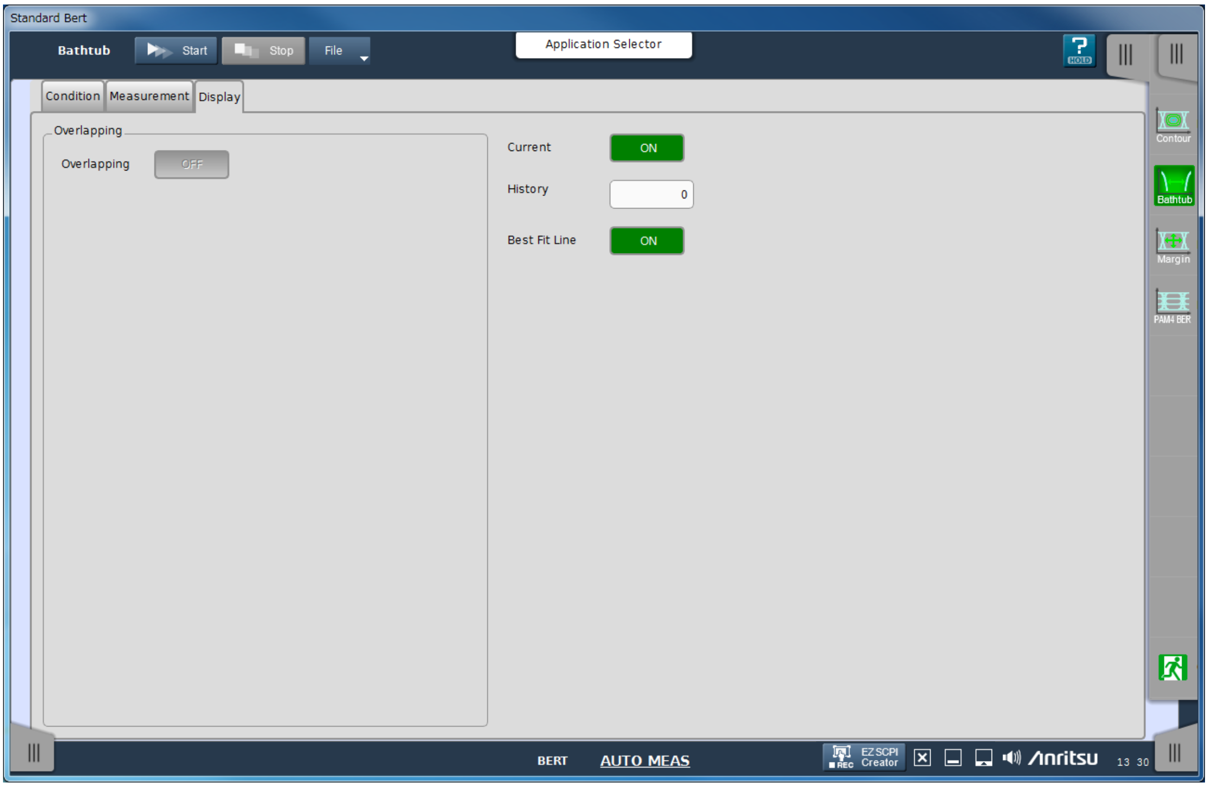


Figure 4.4.2-3 Display Tab

4.4.3 Eye Margin Measurement

Eye Margin measurement measures a phase margin and threshold voltage margin in an eye pattern from the current position.

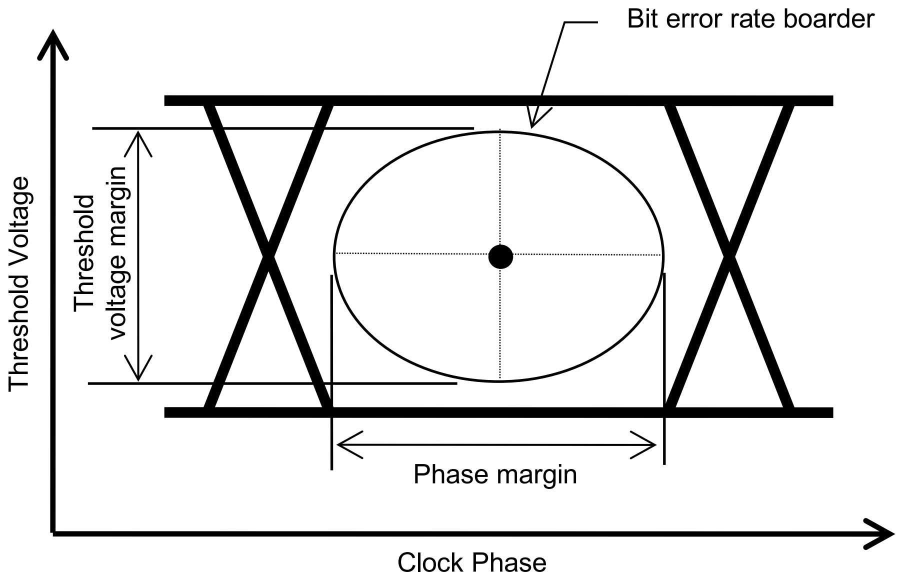


Figure 4.4.3-1 Schematic diagram of Eye Margin measurement

The margin in the clock phase direction (phase margin) and margin in the threshold voltage direction (threshold margin) are measured. The bit error rate to be a margin boarder can be selected from E–3 to E–12.
The bit error rate for the clock phase and threshold voltage at the start of Eye Margin measurement must be less than the specified rate, in order to obtain valid results.
Also, synchronization with the ED must be established (i.e., without Sync Loss) before the start of Eye Margin measurement.

Note:

Eye Margin measurement cannot be performed for the following cases.

- When the module being used is MU196040A/B
- When **Burst** is selected for **Pattern Sequence** on the **Misc1** tab
- When **Auto Adjust** is set to **ON**
- When **OFF** is selected for **Auto Sync** on the **Result** tab
- When the **Input** tab is grouped together with the other tab
- When **CDR** is selected for **Clock Input** on the **Input** tab

Touching 

on Application toolbar displays Eye Margin screen.

Eye Margin screen is shown in Figure 4.4.3-2. For details of the window, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch , and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

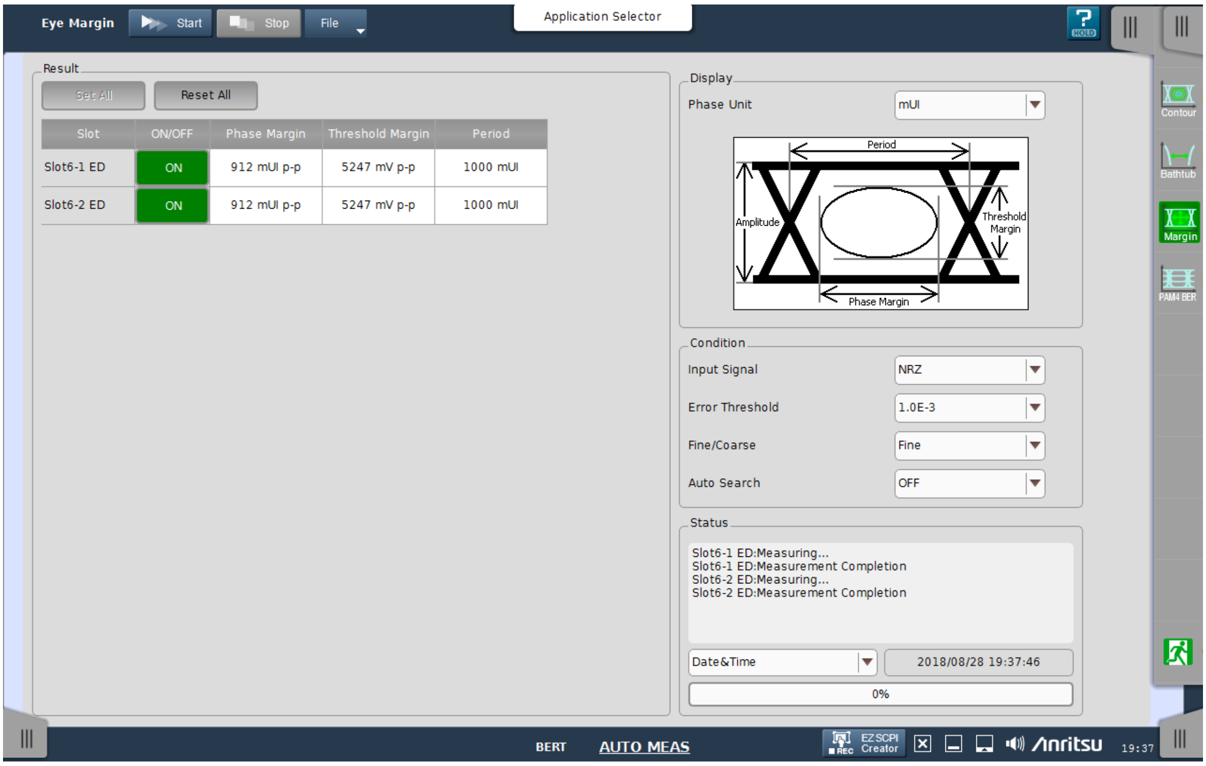


Figure 4.4.3-2 Eye Margin Screen

4.4.4 PAM BER Measurement

PAM BER measurement enables the total BER to be measured by measuring the BER for each PAM4 signal level using 1ch or 3ch for ED.

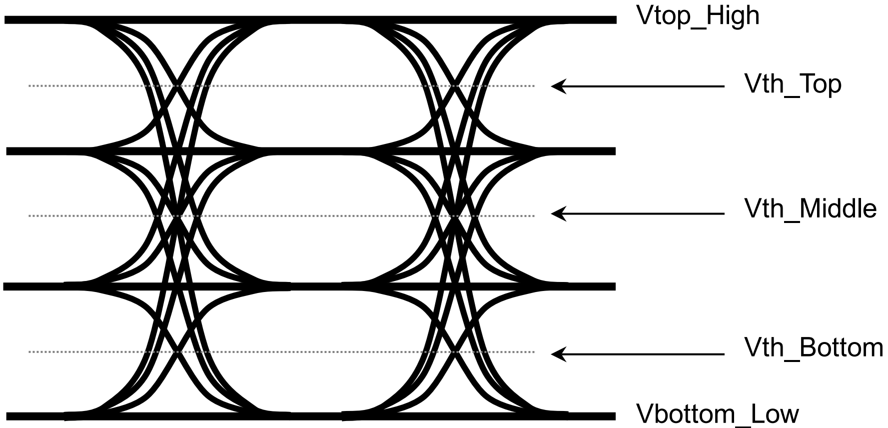


Figure 4.4.4-1 PAM BER Measurement

In the 3 Eye Serial mode, BER of Vth_Top/Vth_Middle/Vth_Bottom is measured respectively using 1 channel of ED. BER measurement is repeated 3 times while changing the threshold. From 3-time measurement results, the PAM4 total BER result is calculated and displayed.

Note:

PAM BER measurement cannot be performed for the following cases.

- When the module being used is MU196040A/B
- When **Auto Adjust** is set to **ON**
- When **OFF** is selected for **Auto Sync** on the **Result** tab
- When the **Input** tab is grouped together with the other tab

Touching 

on Application toolbar displays PAM BER screen.

PAM BER screen is shown in Figure 4.4.4-2. For details of the window, refer to on-screen help. On-screen help can be displayed by the following methods.

- Touch , and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

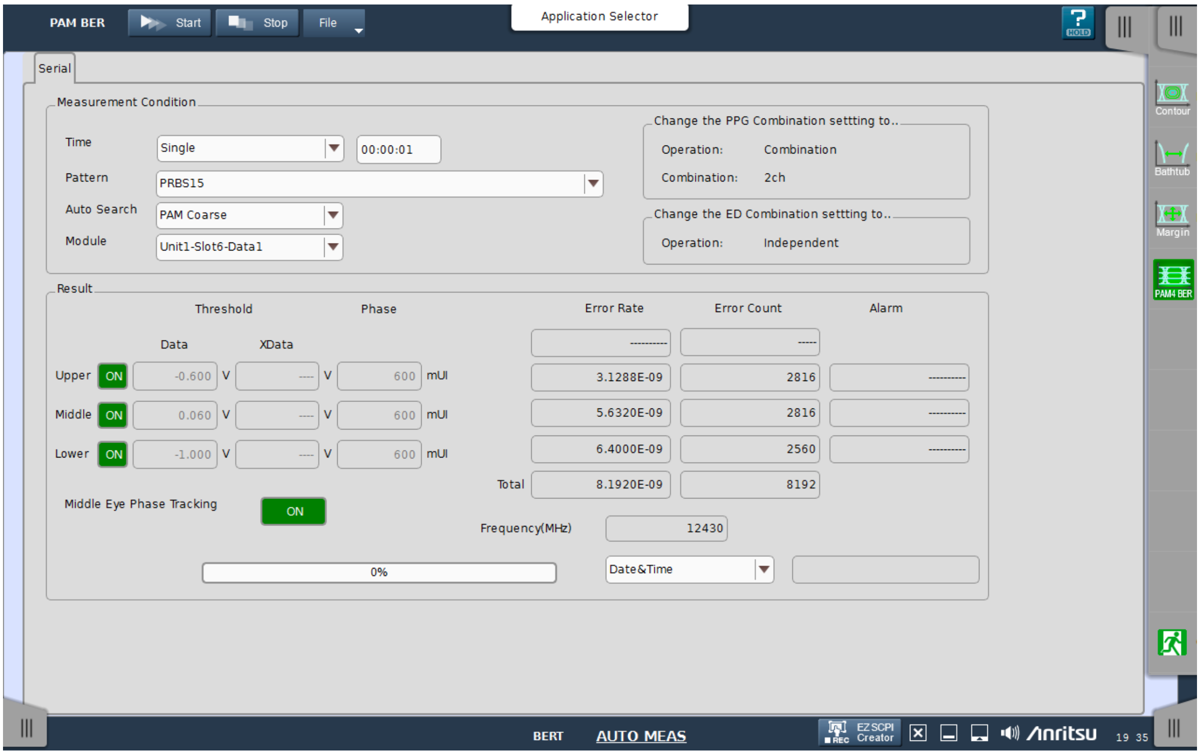


Figure 4.4.4-2 PAM BER Screen

Chapter 5 Remote Commands

This chapter describes remote control of MX190000A.

5.1 Overview

The MP1900A that is controlled by the MX190000A are capable of performing automatic measurements when connected to an external controller. Either the GPIB or Ethernet interface may be used for connection. In addition, the SCPI standard, which is becoming the global standard, is used for the remote control commands. Refer to *SCPI 1999.0 (SCPI Consortium)* for details on SCPI.

The general conditions for using the SCPI standard are described below:

- Commands for GPIB and Ethernet are standardized.
- **General Settings** ( ) and **File Explore** ( ) on the system toolbar are not supported.
- The above conditions can all be read by the command.

5.2 Connections

This section describes the connections of the equipment for using the remote control function and the settings for using the GPIB and Ethernet interfaces.

5.2.1 Connecting MP1900A

The remote control function of the MP1900A is implemented by remotely controlling the MP1900A from a PC for remote control (remote control PC). Use the GPIB or the 100M, 1G Ethernet interface to connect the MP1900A and a remote control PC. An example is shown on "Figure 5.2.1-1 Configuration for remote control of MP1900A from the remote control PC".

Note:

Direct connection without using hub is recommended for the Ethernet connection. Use a crossover cable for direct connection.

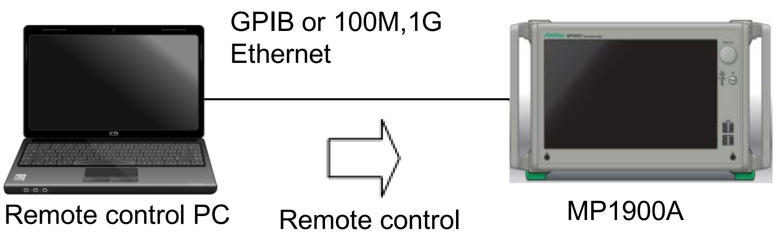


Figure 5.2.1-1 Configuration for remote control of MP1900A from the remote control PC

5.2.2 GPIB Interface

This section describes the GPIB interface functions and settings using the GPIB interface of the MP1900A.

5.2.2.1 GPIB Interface Function

The MP1900A has device functions but no controller function. Therefore, its interface functions are as shown on "Table 5.2.2.1-1 Interface Function" according to the IEEE 488.2 standard.

Table 5.2.2.1-1 Interface Function

Code	Interface Function	IEEE 488.2 Standard
SH1	All functions for source handshake	All functions are standardly equipped
AH1	All functions for acceptor handshake	All functions are standardly equipped
T5	Basic talker functions Talk only mode functions Talker reset functions via MLA	The device must have a subset T5, T6, TE5, or TE6.
L4	Basic listener functions No listen-only mode function Listener reset functions via MTA	The device must have a subset L3, L4, LE3, or LE4.
SR1	All functions for service request	All functions are standardly equipped
RL1	All functions for remote/local	All remote/local functions of RL0 (no function) or RL1 (all functions)
PP0	No parallel poll function	PP0 (no function) or PP1 (all functions)
DC1	All functions for device clear	All functions are standardly equipped
DT1	All functions for device trigger	DT1 (all functions)
C1*1 C2*2 C3*3 C4*4 C7*5	Controller functions except parallel poll	C0 (no function), C4 and C5, or any of C7, C9, or C11

*1: System controller

*2: IFC transmission, controller in charge

*3: REN transmission

*4: Response to SRQ

*5: Interface message transmission, reception and passing of the control, and passing of the control to itself

5.2.2.2 Device message list

Device messages are data messages that are transmitted and received between the remote control PC and the MP1900A via the system interface when the bus mode is the data mode (when the ATN line is "H"). Device messages consist of program messages and response messages.

Program messages are ASCII data messages transferred from the controller to the device. Response messages are data messages transferred from the device to the controller.

Program messages and response messages have the following types.

Table 5.2.2.2-1 Device message

Program Message (See Section 5.3.1.2)	Response Message (See Section 5.3.2.2)
Program instruction • Device-unique command (See 5.6 "SCPI Commands" .) • IEEE 488.2 common command (See 5.4 "IEEE 488.2 Common Commands".)	Program query • Status message (See 5.5 "Status Report".) • Response message

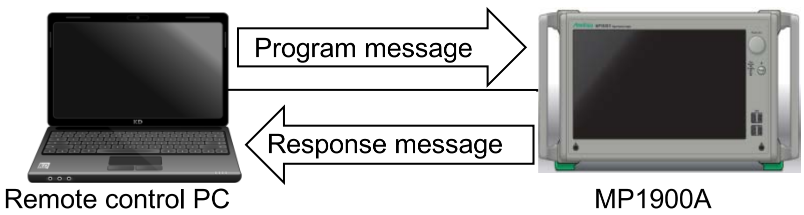


Figure 5.2.2.2-1 Device message

The messages are exchanged via the I/O buffer of the device. The table below briefly describes the I/O buffer.

Table 5.2.2.2-2 I/O buffer

Input Buffer	Output Queue
FIFO (First in First out) type memory area that temporarily stores DABs (program messages and query messages) before syntax analysis. The input buffer size of the MP1900A is 1 Kbytes.	FIFO type queue memory area. All the DABs (response messages) outputted from the device to the controller are stored in this memory until the controller finishes reading them.

5.2.2.3 Bus commands

Bus commands are used for internal communications of the interface transmitted while the bus mode is the command mode (when the ATN line is "L"). The "Table 5.2.2.3-1 Bus commands" lists the bus commands.

Table 5.2.2.3-1 Bus commands

Bus Command	Operation
DCL (Device Clear)	Initializes message exchange of all devices connected to the GPIB bus.
SDC (Selected Device Clear)	Initializes message exchange of the addressed MP1900A. The operation is the same as the DCL.
IFC (Interface Clear)	Initializes the interface.

5.2.2.4 Connecting GPIB cable

Connect the GPIB cable to the GPIB connector on rear back panel of the MP1900A.
Systems using GPIB have the following restrictions:

Number of connectable devices	≤ 15 units
Total cable length	≤ 2 m × Number of devices (20 m, max.)

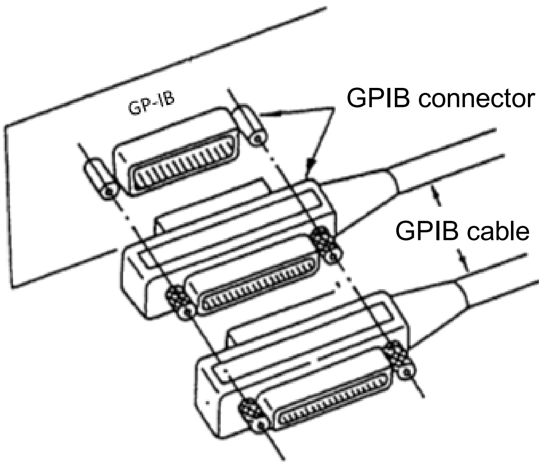


Figure 5.2.2.4-1 GPIB cable connection

5.2.2.5 Setting GPIB

To use the GPIB as a remote interface, set the MP1900A to Local, and perform the following settings on the Remote Control of the Instrument Tool bar.

Table 5.2.2.5-1 Setting GPIB

Setting Detail	Setting Item	Setting Value
Address setting	GPIB Address	1 to 30

Setting procedure:

(1) Touch the Instrument Tool bar tab, and touch **Remote Control**.

(2) Input GPIB address and touch **OK**.

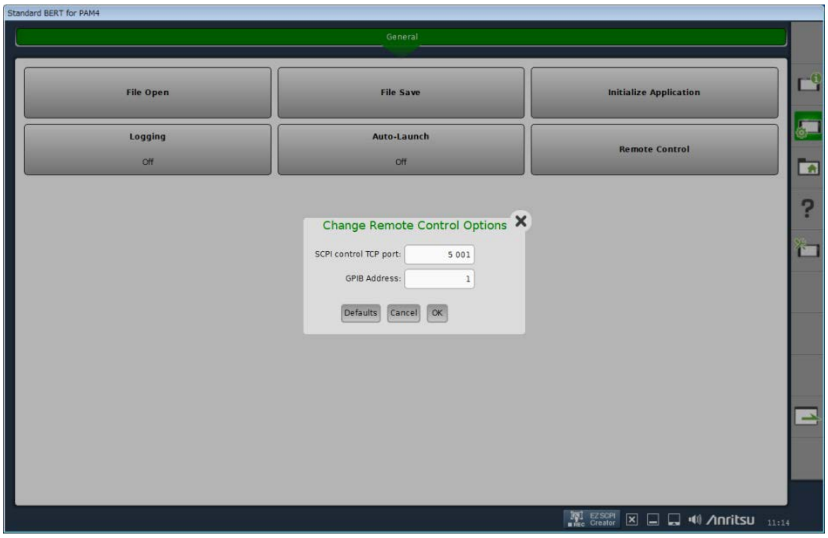


Figure 5.2.2.5-1 Remote Control Setting Example

5.2.2.6 System initialization

IEEE 488.2 defines system initialization in three levels: bus initialization, message initialization, and device initialization.

Table 5.2.2.6-1 Device initialization

Level	Initialization Type	Description
1	Bus initialization	Initializes all interface functions connected to the bus with IFC message from the controller.
2	Message initialization	Disables function to report completion of initialization of message exchange or operation of all devices on the GPIB with the GPIB bus command DCL or the device specified with the bus command SDC, to the controller.
3	Device initialization	Recovers the known state that is specific to the device with the *RST command regardless of the past use conditions.

Bus initialization

IFC Initializes the bus with IFC statement.

Function Activates the IFC line for about 100 μs to initialize interface functions of all devices connected to the GPIB bus line. Only the system controller can transmit IFC.

Message initialization

DCL, SDC Message exchange initialization using the DCL/SDC bus command

DCL: Initializes message exchange for all devices on the GPIB.

SDC: Initializes message exchange for the specified device.

Function Initializes message exchange for all devices on the GPIB or only the specified device. Initialize message exchange when change of the panel setting state is not required, but if the parts related to message exchange inside the device are in a state that is not suitable for control from the controller due to execution of other programs. When message exchange is initialized, new instructions can be transmitted from the controller.

Device initialization

*RST Initializes the device with the *RST command.

Function Resets the device-unique function to a known state, regardless of the past use history. For the MP1900A, the factory-shipped settings are restored.

Device state upon application startup

When the application of the MP1900A starts up, it enters the following state:

- The state in which the application was terminated is set.
- The input buffer and output queue are cleared.
- The syntax analyzer, execution controller, and response creator are reset.
- Messages can be transmitted and received only when the application is running.

5.2.3 Ethernet Interface

This section describes the settings for using the Ethernet interface of the MP1900A.

5.2.3.1 Device message list

Device messages are data messages that are transmitted and received between the controller and device via the system interface. Device messages consist of program messages and response messages.

Program messages are ASCII data messages transferred from the controller to the device. Response messages are data messages transferred from the device to the controller.

Program messages and response messages have the following types.

Table 5.2.3.1-1 Device message

Program message (See Section 5.3.1.2)	Response message (See Section 5.3.2.2)
Program instruction • Device-unique command (See 5.6 “SCPI Commands”.) • IEEE 488.2 common command (See 5.4 “IEEE 488.2 Common Commands”.)	Program query • Status message (See 5.5 “Status Report”.) • Response message

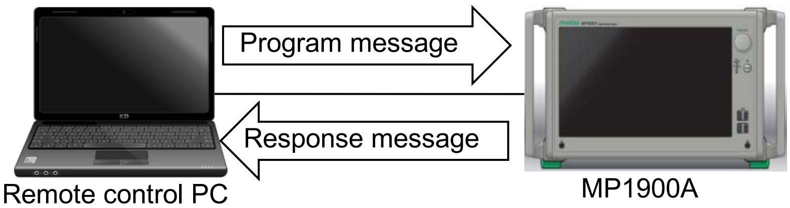


Figure 5.2.3.1-1 Device messages

The messages are exchanged via the I/O buffer of the device. The table below briefly describes the I/O buffer.

Table 5.2.3.1-2 I/O buffer

Input Buffer	Output Queue
FIFO (First in First out) type memory area that temporarily stores DABs (program messages and query messages) before syntax analysis. The input buffer size of the MP1900A is 1 Kbytes.	FIFO type queue memory area. All the DABs (response messages) outputted from the device to the controller are stored in this memory until the controller finishes reading them.

The MP1900A must be connected to the TCP/IP network, for the Ethernet interface to be used. In this instance, the MP1900A works as the server.

5.2.3.2 Connecting via Ethernet Cable

Connect an Ethernet cable to an external connector installed on the rear panel.

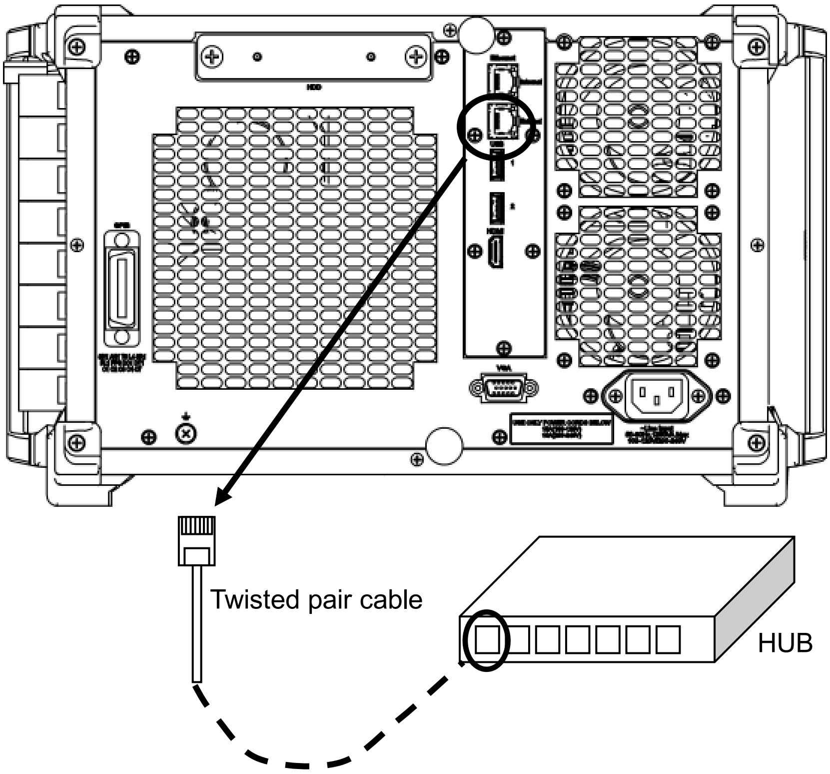


Figure 5.2.3.2-1 Connection via Ethernet Cable

5.2.3.3 Setting Ethernet port

To use the Ethernet as a remote interface, set the MP1900A to Local, set a port number in the dialog box of Figure 5.2.2.5-1 in accordance with Table 5.2.3.3-1 by key operation.

Setting procedure:

(1) Touch the Instrument Tool bar tab, and touch **Remote Control**.

(2) Input an integer in range of 1024 to 65535 to SCPI control TCP port.

Notes:

- For the IP address of the remote interface, set the address other than “192.168.1.xxx”. The “192.168.1.xxx” address is used for the module address. If this address is set, the module may not operate properly.

- IP address
  In a network using TCP/IP, devices connected to the network are identified by IP addresses. An IP address must therefore be assigned to each device. An IP address is a 32-bit number, and expressed as four 8-bit portions separated by dots (called dot notation).
  IP addresses include network information in addition to the device (host) information. The data lengths of the network part and host part of an IP address is defined depending on the network class. Class C has 24-bit network part and 8-bit host part, and up to 254 hosts can be connected. Classes A through E are available; however, only Classes A through C are normally used.

Table 5.2.3.3-1 IP address

Class	Network part length	Host part length	Number of hosts that can be assigned
A	8 bits	24 bits	16 777 214 units
B	16 bits	16 bits	65 534 units
C	24 bits	8 bits	254 units

- Subnet mask
  The subnet mask is used to indicate the network part in the IP address when the network is divided into subnets. The network part of the IP address above (including the extended subnet part) is indicated by “1”, and the host part is defined by “0”. If this setting is wrong, IP packets cannot be transmitted or received correctly to or from the connected network that uses subnets.

- Gateway
  A device called a gateway is used to connect networks. Gateways include dedicated devices such as routers. In a TCP/IP network, IP packets can be directly exchanged within the same network. To exchange IP packets among different networks (i.e., terminals that have IP addresses with different network parts), however, communication with a device connecting to other network connected to the gateway via the gateway is required.

5.2.3.4 Network connection and data flow

Connect the Ethernet cable to the MP1900A to connect to the network. The communication with MP1900A is data communication via the TCP connection. For communication, creating a communication program (socket client) at the remote control PC side is required.
For the socket interface used for communication, see the operation manuals of the remote control PC, the network interface board installed, and the driver software.

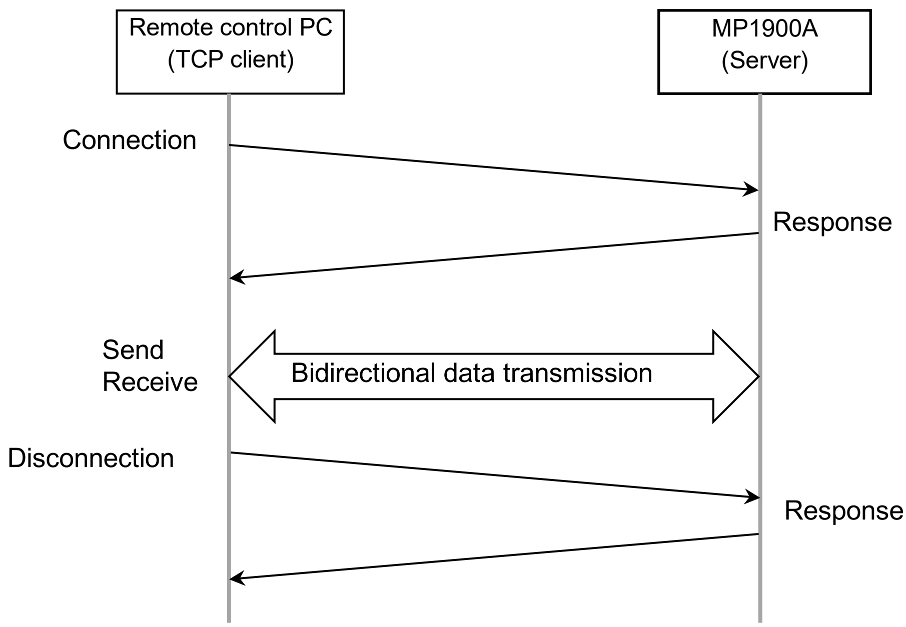


Figure 5.2.3.4-1 Data flow

Data communication
The data from the client is saved in the reception buffer. Flow control of TCP occurs when the internal buffer is full, and no command-level response may return to the client. Some applications may be abnormally terminated due to timeout. In this case, the connection with the client is not disconnected. In some cases, you need to protect application operations by re-transmission.

5.3 SCPI Format

This section describes the SCPI command system.

5.3.1 SCPI Lister Input Format

This section describes the format of program messages received by the listener (MP1900A) from the talker (remote control PC).

The device-unique commands of the MP1900A comply with the SCPI, so the SCPI commands are used in the examples in this section .

5.3.1.1 SCPI listener input program message format

The following figure shows a sample program message, which sets the data output to ON and sets the test pattern to PRBS.

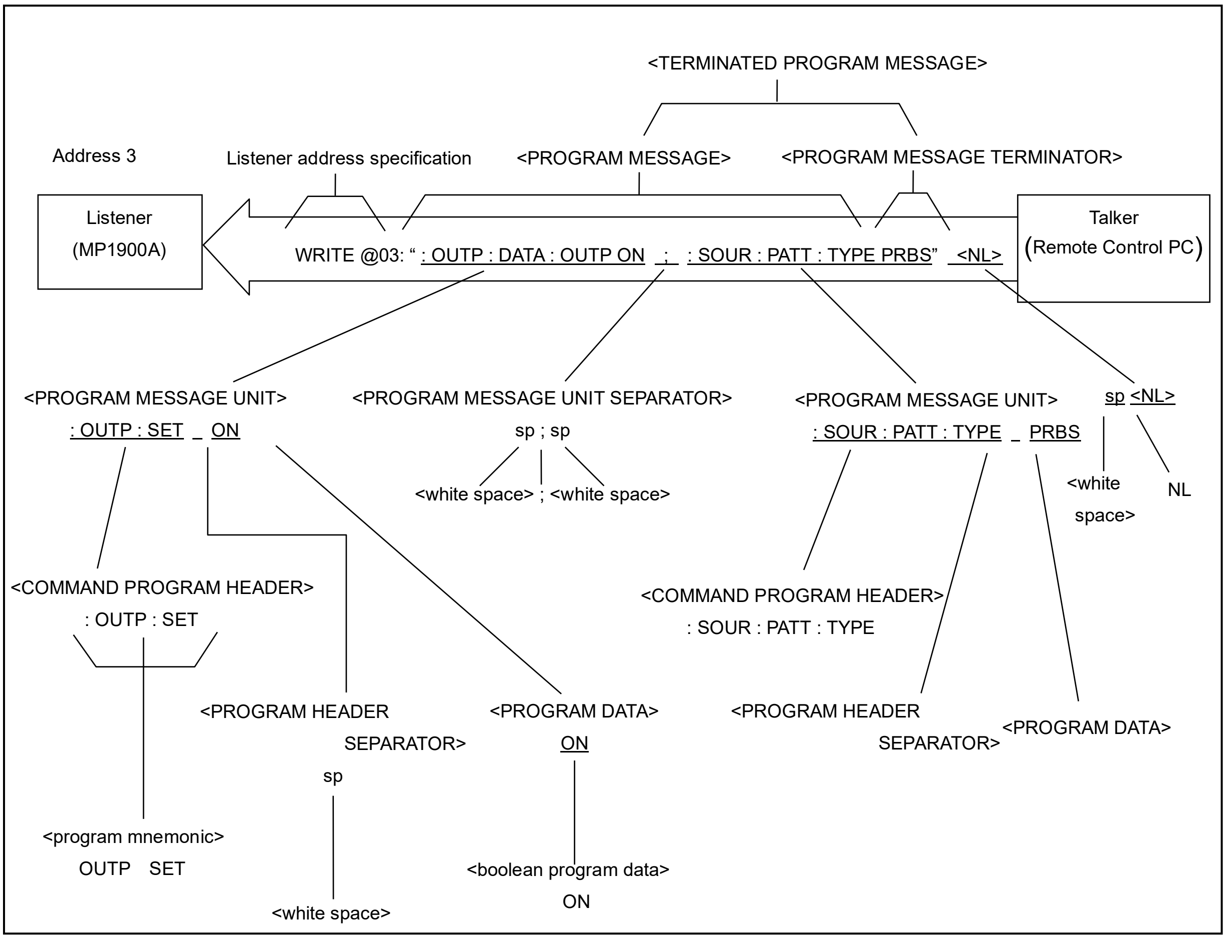


Figure 5.3.1.1-1 SCPI listener input program message

The program message format consists of a sequence of functional elements, which are the minimum level units to indicate a function. In the figure above, the words written in uppercase alphabetical characters enclosed within brackets (< >) indicate examples of functional elements.

The WRITE and READ commands have the following formats.

WRITE @

Outputs data to the MP1900A.

★Format

WRITE @Device number: Data

Data→ Mathematical expression
String expression

Example: The same as the previous page

WRITE @

Outputs the data to the MP1900A

★Format

WRITE @Device number: Data

Data→ Mathematical expression
String expression

Example: The same as the example on the previous page

WRITE @03: " : OUTP : DATA : OUTP ON ; : SOUR : PATT : TYPE PRBS"

Listener address (When the GPIB address of MP1900A is 3)

READ @

Substitutes the data inputted from the MP1900A into the variable.

★Format

READ @Device number: Variable

Example: data input from the MP1900A (input connector setting) to the variable A$.

WRITE @03: " :OUTP : DATA : OUTP?" ← Queries the input connector setting.

READ @03: A$

Listener address (when the GPIB address of MP1900A is 3)

5.3.1.2 Functional elements of program messages

MP1900A receives a program message by detecting the terminator at the end of the program message. The functional elements of program messages are described below.

(1) <TERMINATED PROGRAM MESSAGE>

The following figure shows a <TERMINATED PROGRAM MESSAGE> that transmits two instructions.

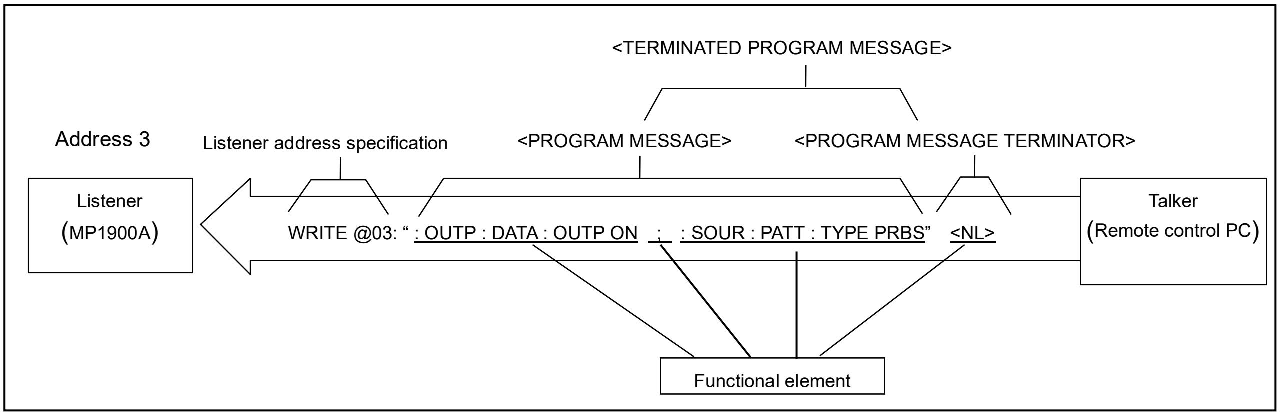
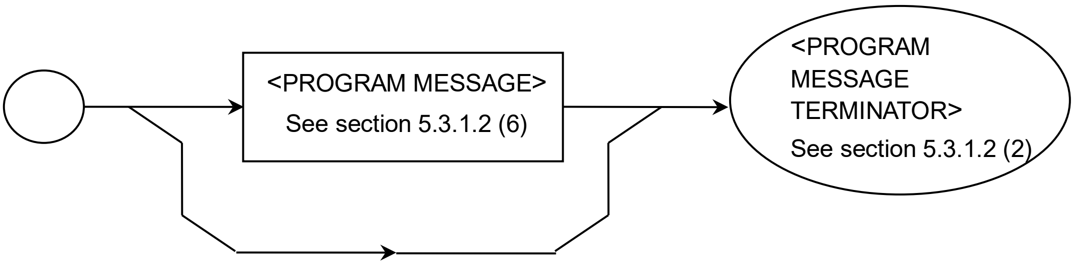


Figure 5.3.1.2-1 <TERMINATED PROGRAM MESSAGE>

<TERMINATED PROGRAM MESSAGE> is defined as follows:

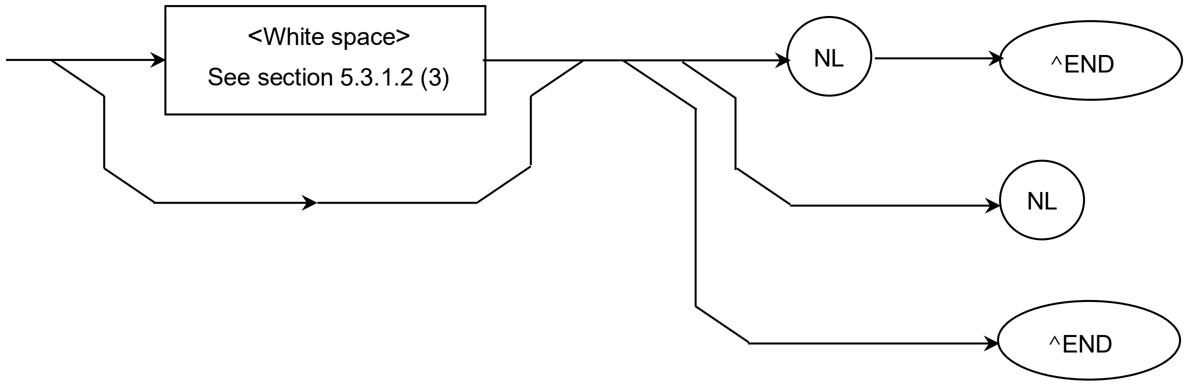


<TERMINATED PROGRAM MESSAGE> is a data message containing all the functional elements required for transmitting the message from the remote control PC to the MP1900A. A <PROGRAM MESSAGE TERMINATOR> is added to the end of a <PROGRAM MESSAGE> to complete transmission of the <PROGRAM MESSAGE>.

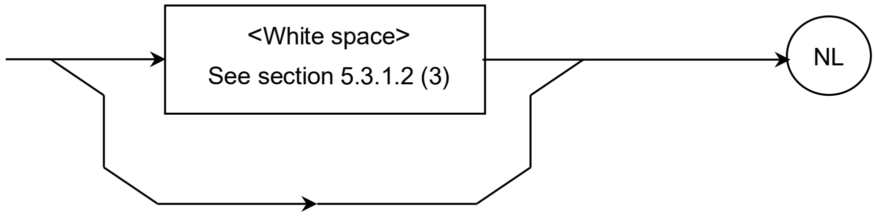
(2) <PROGRAM MESSAGE TERMINATOR>

<PROGRAM MESSAGE TERMINATOR> is placed to terminate a sequence of one or more <PROGRAM MESSAGE UNIT> elements. The definition of the <PROGRAM MESSAGE TERMINATOR> differs according to the used interface.

(a) For GPIB interface



(b) For Ethernet interface

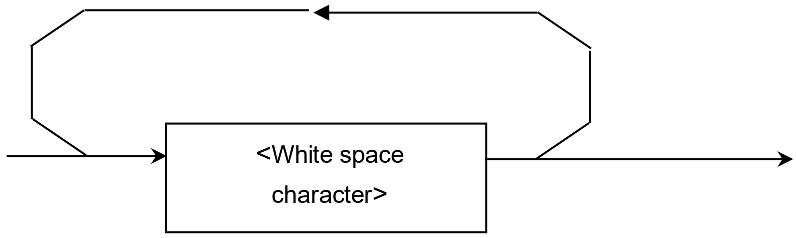


NL Defined as a single ASCII code byte 0A (decimal number 10), i.e. the ASCII control character LF (Line Feed) that performs the carriage return operation bringing the print position to the same character position in the next line. It is also called NL (New Line) because it starts from a new line.
For line feed, the CR + LF code may be used instead of the LF code. If the remote control PC runs on MS-DOS or Windows, line feed is done with "CR + LF", while it is done with only "LF" for UNIX.

END Generates an EOI signal by setting the EOI (End-or-Identify) line of the GPIB control bus to TRUE (low level).

(3) <White space>

<White space> is defined as follows:



<white space Character> is defined as a single ASCII code byte within the range of the ASCII code bytes 00 to 09 and 0B to 20 (decimal numbers 0 to 9 and 11 to 32). The range includes the ASCII control symbols and space signals except New Line. The MP1900A processes these ASCII symbols simply as spaces or just ignores them, instead of interpreting them as ASCII control symbols.

(4) <PROGRAM MESSAGE>

The following figure shows a setting example, which activates the alarm when an error occurs and sets the test pattern to PRBS.

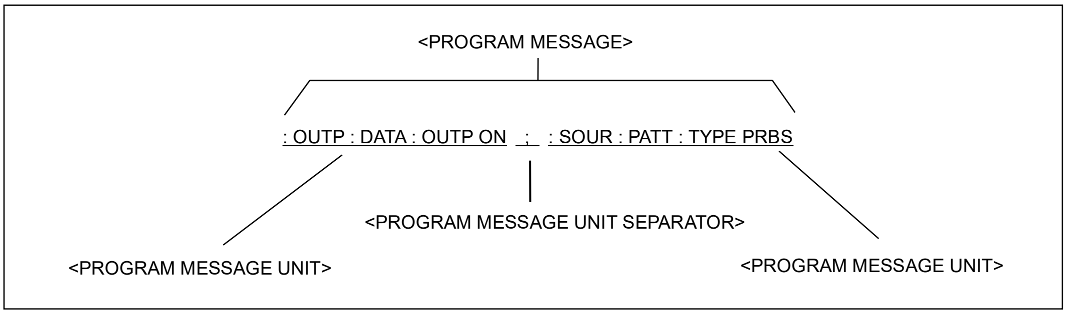
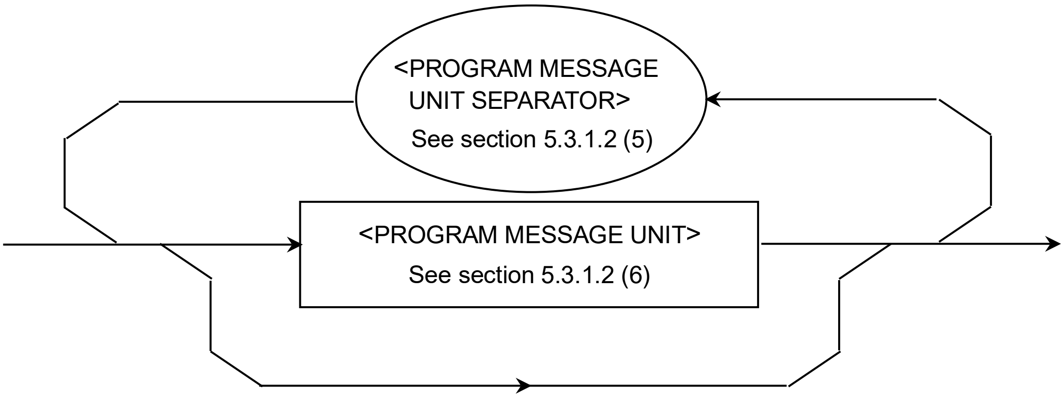


Figure 5.3.1.2-2 <PROGRAM MESSAGE>

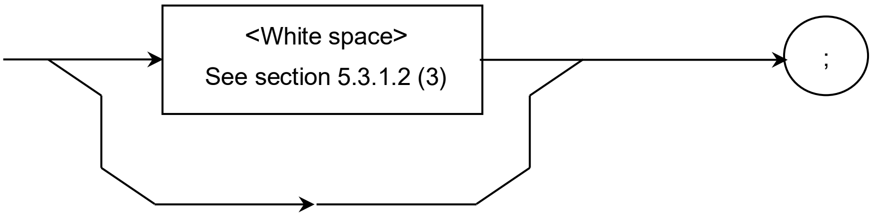
<PROGRAM MESSAGE> is defined as follows:



<PROGRAM MESSAGE> is a sequence of zero, one or more <PROGRAM MESSAGE UNIT> elements. The <PROGRAM MESSAGE UNIT> element indicates a programming instruction or data to be sent from the remote control PC to the MP1900A. <PROGRAM MESSAGE UNIT SEPARATOR> is used to separate two or more <PROGRAM MESSAGE UNIT> elements.

(5) <PROGRAM MESSAGE UNIT SEPARATOR>

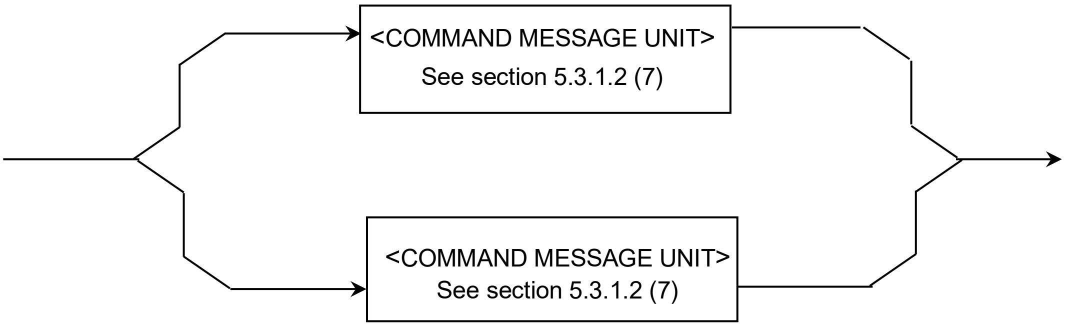
<PROGRAM MESSAGE UNIT SEPARATOR> is defined as follows:



<PROGRAM MESSAGE UNIT SEPARATOR> separates a sequence of two or more <PROGRAMMESSAGE UNIT> elements into <PROGRAM MESSAGE> elements. The MP1900A interprets a semicolon (;) as the separator of the <PROGRAM MESSAGE UNIT>. The <white space character> elements before and after the semicolon are therefore ignored. The <white space character> is useful, however, to make the program readable.

(6) <PROGRAM MESSAGE UNIT>

<PROGRAM MESSAGE UNIT> is defined as follows:



<PROGRAM MESSAGE UNIT> consists of <COMMAND MESSAGE UNIT>, a single command message received by the MP1900A, or <QUERY MESSAGE UNIT>, a single query message. Setting and query can be performed for the MP1900A in units of <PROGRAM MESSAGE UNIT>.

(7) <COMMAND MESSAGE UNIT> and <QUERY MESSAGE UNIT>

For both <COMMAND MESSAGE UNIT> and <QUERY MESSAGE UNIT>, when program data follows the program header, one space must be inserted as a separator between them. The program header identifies the application, function, and operation of the program. If no program data is added, the header alone indicates the application, function, and operation for the MP1900A.

Among program headers, <COMMAND PROGRAM HEADER> is a command used to control the MP1900A from the remote control PC. <QUERY PROGRAM HEADER> is a query command to be transmitted from the remote control PC to the MP1900A in advance for the remote control PC to receive response messages from the MP1900A. A query indicator (?) is added to the end of the header.

(a) <COMMAND MESSAGE UNIT>

Example: The following shows a date setting command.

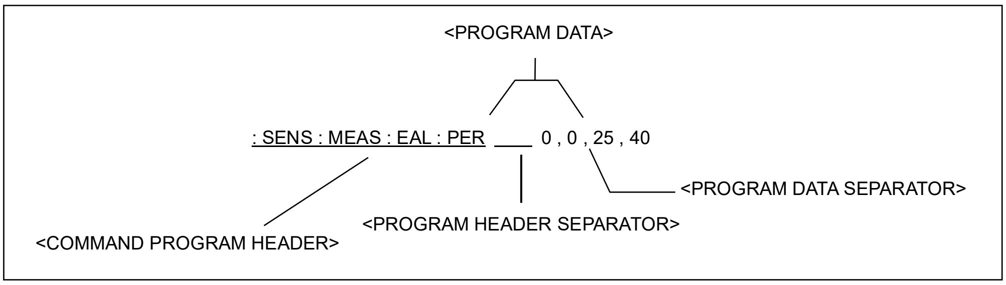
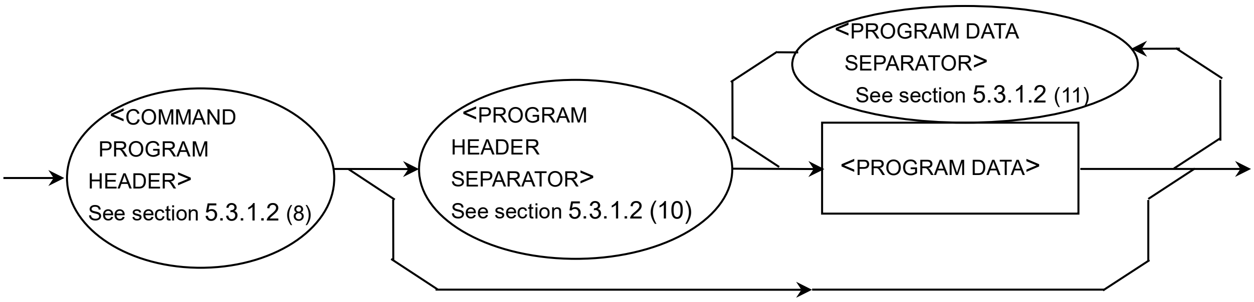


Figure 5.3.1.2-2 <COMMAND MESSAGE UNIT>

<COMMAND MESSAGE UNIT> is defined as follows:



(b) <QUERY MESSAGE UNIT>

Example: The following shows a query that queries the area to add a bit error.

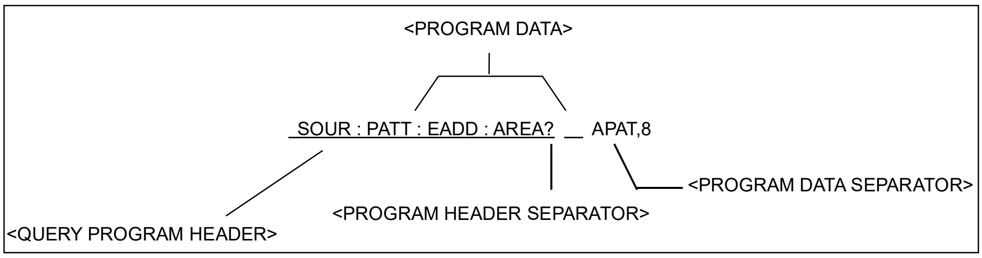
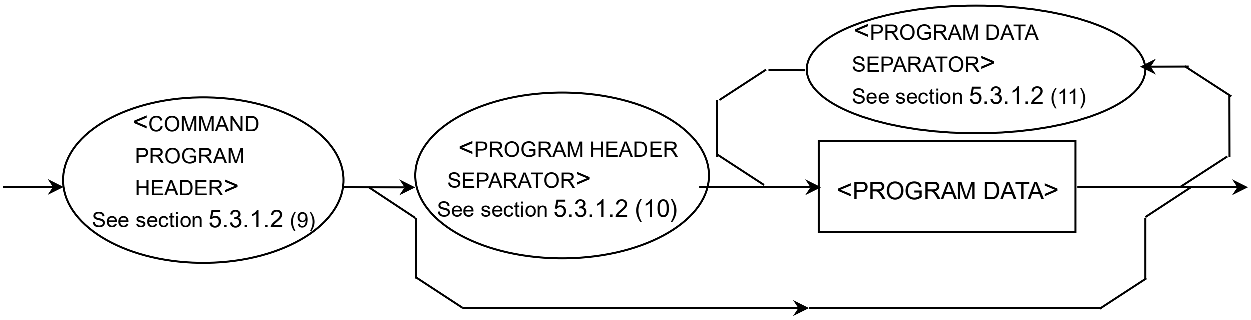


Figure 5.3.1.2-3 <QUERY MESSAGE UNIT>

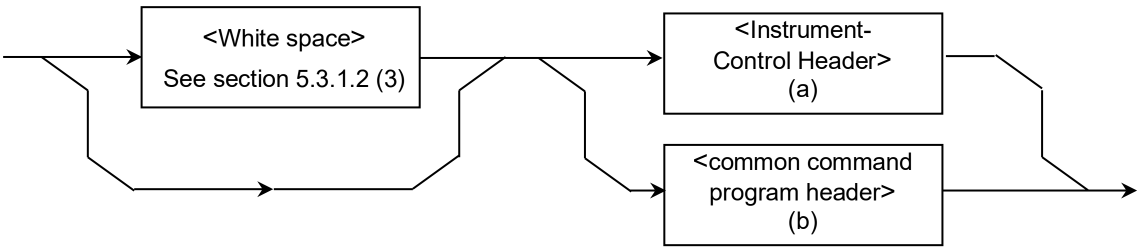
<QUERY MESSAGE UNIT> is defined as follows:



(8) <COMMAND PROGRAM HEADER>

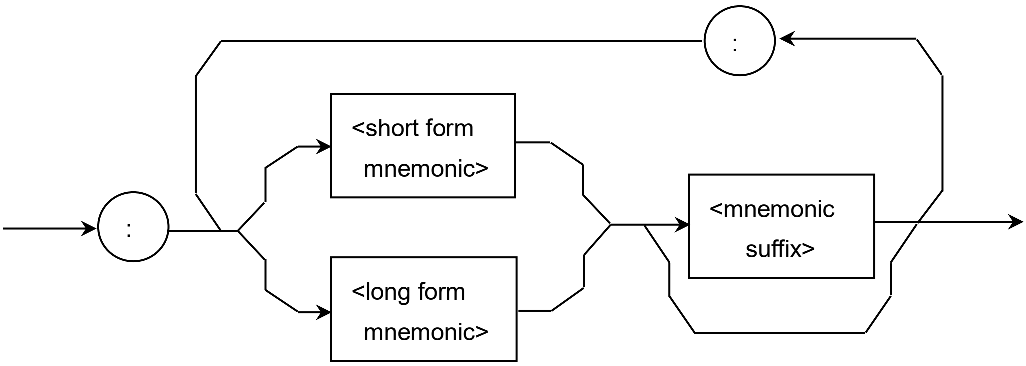
<COMMAND PROGRAM HEADER> indicates the application, function, and operation of the program data executed by the MP1900A. If no program data is added, the header alone indicates the application, function, and operation for the MP1900A. <program mnemonic> expresses the meaning in ASCII code characters, and is generally just called a mnemonic.

<COMMAND PROGRAM HEADER> is defined as follows:
A <white space> can be inserted in front of each header.



(a) <Instrument-Control Header>

<Instrument-Control Header> is defined as follows:



<Instrument-Control Header> is defined in the SCPI. The device-unique commands of the MP1900A comply with the SCPI, so the command format conforms to the SCPI.

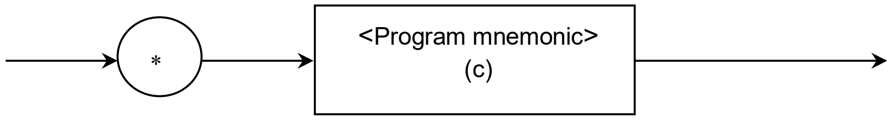
<short form mnemonic> and <long form mnemonic>
Correspond to the short form and long form of the SCPI commands, respectively. For the specifications of mnemonics, the specifications of <program mnemonic> described earlier are applied as they are.

<numeric suffix>
Defined as a single ASCII code byte, within the range of the ASCII code bytes 30 to 39 (decimal numbers 48 to 57 = numerical values 0 to 9).

5
Remote Commands

(b) <common command program header>

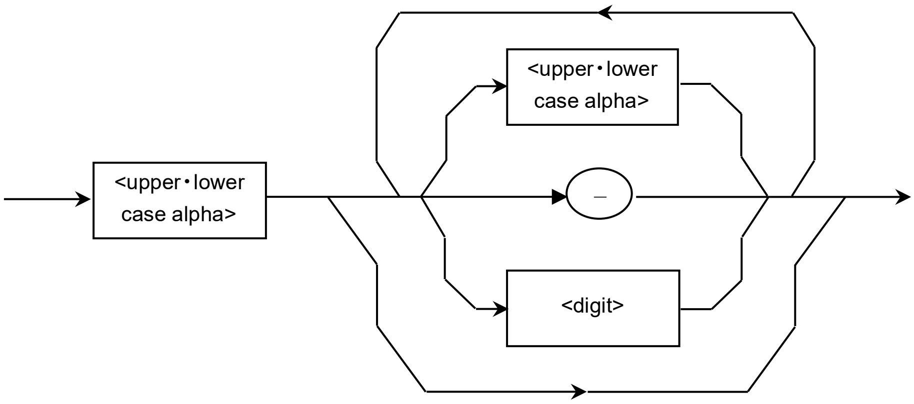
<common command program header> is defined as follows:



<common command program header> For <common command program header>, an asterisk (*) must be added before the <program mnemonic> (refer to 5.4 "IEEE 488.2 Common Commands" for details).

(c) <Program mnemonic>

<Program mnemonic> is defined as follows:



A mnemonic must start with an uppercase or lowercase alphabetic character, followed by any combination of uppercase alphabetic characters ("A" to "Z"), lowercase alphabetic characters ("a" to "z"), underbar (_), and numbers ("0" to "9"). The maximum length of a mnemonic is twelve characters. Space must not be inserted between characters.

<upper, lower case alpha>
Defined as a single ASCII code byte, within the range of the ASCII code bytes 41 to 5A and 61 to 7A (decimal numbers 65 to 90, 97 to 122 = uppercase alphabetic characters A to Z, lowercase alphabetic characters a to z).

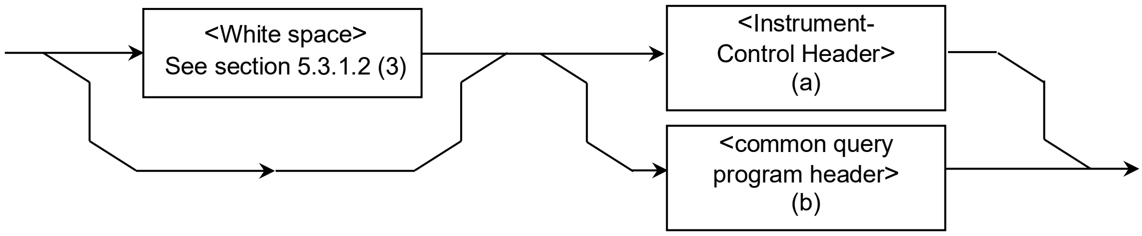
<digit>
Defined as a single ASCII code byte, within the range of the ASCII code bytes 30 to 39 (decimal numbers 48 to 57 = numerical values 0 to 9).

(_)
A Indicates the ASCII code byte 5F (decimal number 95 = underbar). It is defined as a single ASCII code byte.

Example: :SYSTem (The subsequent part is omitted.)

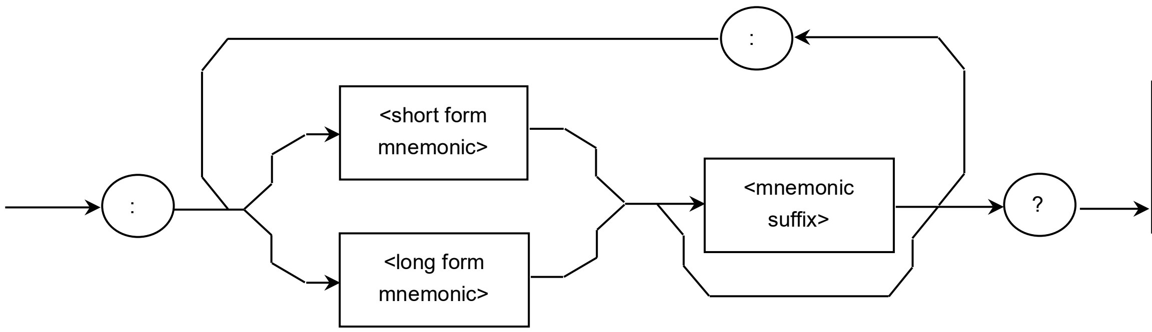
(9) <QUERY PROGRAM HEADER>

<QUERY PROGRAM HEADER> is defined as follows. A <white space> can be inserted in front of each header.



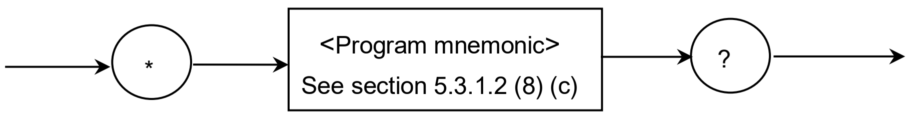
(a) <Instrument-Control Headers>

<Instrument-Control Headers> is defined as follows:



(b) <common query program header>

<common query program header> is defined as follows:



<QUERY PROGRAM HEADER> is a query command transmitted from the remote control PC to the MP1900A in advance for the remote control PC to receive response messages from the MP1900A. A query indicator (?) must be added to the end of the header.

Example: :SYSTem:DATE?

The format of <QUERY PROGRAM HEADER> above is the same as <COMMAND PROGRAM HEADER> except that the query indicator (?) is added to the end of the header. For details, refer to Section 5.3.1.2 (9) <QUERY PROGRAM HEADER>.

(10) <PROGRAM HEADER SEPARATOR>

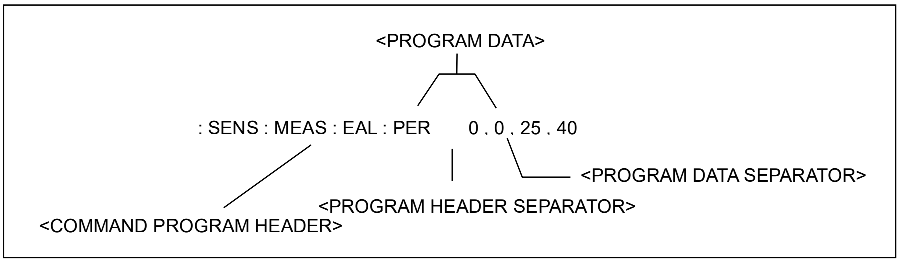
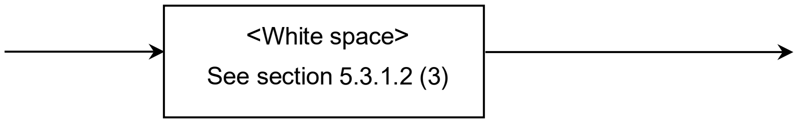


Figure 5.3.1.2-4 <PROGRAM HEADER SEPARATOR >

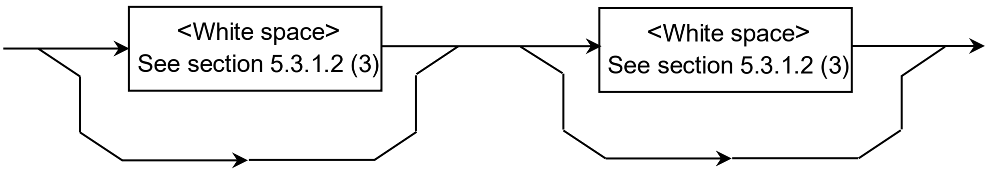
<PROGRAM HEADER SEPARATOR> is defined as follows.



<PROGRAM HEADER SEPARATOR> is used as a separator between <COMMAND PROGRAM HEADER> or <QUERY PROGRAM HEADER> and <PROGRAM DATA>. If there are two or more <white space character> elements between the program header and program data, only the first <white space character> is interpreted as a separator, and the others are ignored. The <white space character> is useful, however, to make the program readable. That is, only one header separator must exist between the header and data, which indicates the end of the program as well as the beginning of the program data.

(11) <PROGRAM DATA SEPARATOR>

<PROGRAM DATA SEPARATOR> is defined as follows:



If <COMMAND PROGRAM HEADER> or <QUERY PROGRAM HEADER> has many parameters, <PROGRAM DATA SEPARATOR> is used to separate them. Using this data separator requires commas, but no <white space character>. <white space character> before and after the comma are ignored. The <white space character> is useful, however, to make the program readable.

5.3.1.3 Program data format

Among the terminated program message formats described above, this section presents an example of the format of <PROGRAM DATA> shown in the functional grammar diagram in 5.3.1.3 “Program data format”.

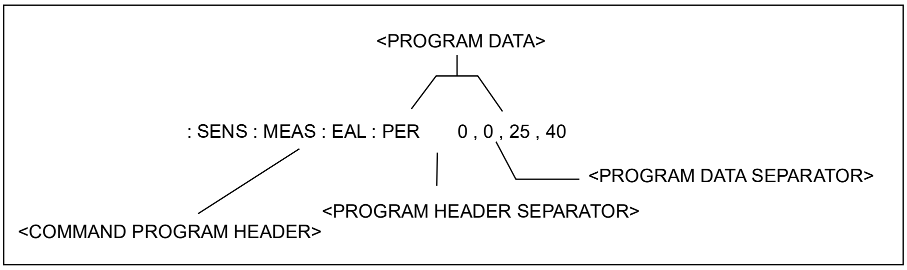


Figure 5.3.1.3-1 <PROGRAM DATA>

The functional elements of <PROGRAM DATA> are used to transmit the parameters of the type related to the program header. The following table lists the program data used by the MP1900A.

Table 5.3.1.3-1 Program data format

<PROGRAM DATA>	Type
<CHARACTER PROGRAM DATA>	Indicates short alphabetic or alphanumeric data.
<DECIMAL NUMERIC PROGRAM DATA>	Indicates a decimal numerical constant.
<NON-DECIMAL NUMERIC PROGRAM DATA>	Indicates an alphanumeric character other than a decimal.
<BOOLEAN PROGRAM DATA>	Indicates a theoretical value (defined in SCPI).
<STRING PROGRAM DATA>	Indicates a string enclosed within double quotation marks (" ") or single quotation marks (' ').

(1) <CHARACTER PROGRAM DATA>

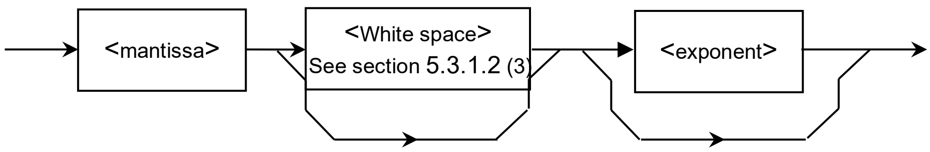
<CHARACTER PROGRAM DATA> indicates short alphabetic or alphanumeric data.

Example: :SENSe:PATTern:TYPE PRBS (Mnemonic data indicating PRBS)
:SENSe:MEASure:EALarm:UNIT CLOCk
(Mnemonic data indicating the measurement cycle in Clock Count units.)

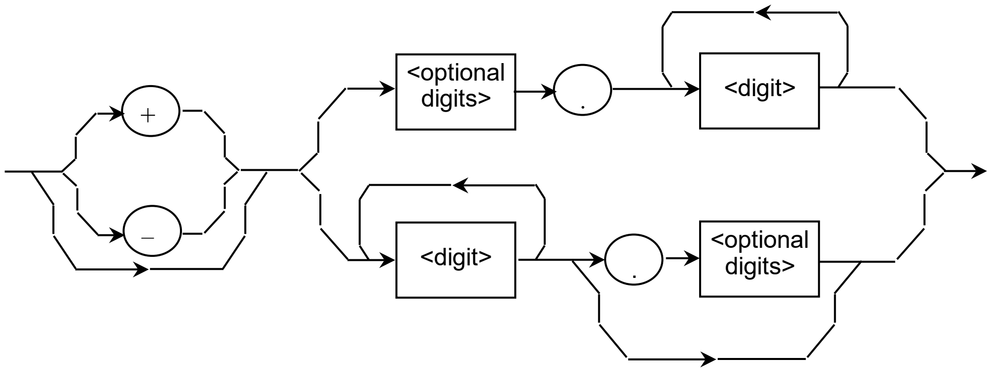
The character data is the same as those described <Program mnemonic> in 5.3.1.2 (8) (c).

(2) <DECIMAL NUMERIC PROGRAM DATA>

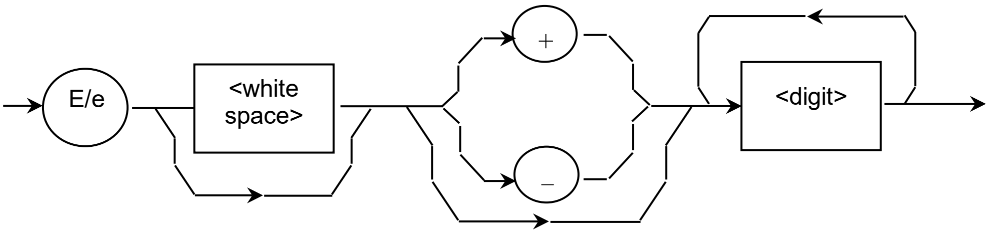
<DECIMAL NUMERIC PROGRAM DATA> indicates a decimal numerical value, and is defined as follows:



<mantissa> is defined as follows:



<exponent> is defined as follows:



The MP1900A uses the decimal integer format.

■ Integer format

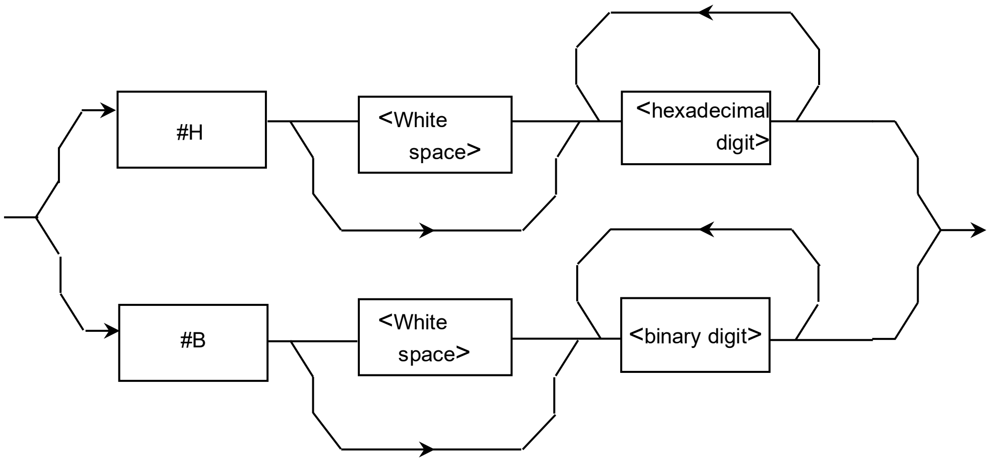
Δ represents a space.

• Indicates a decimal integer value.	
• Zeros can be entered in the beginning. →	005
• No space can be inserted between the sign and the numerical value.→	+5 (applicable), +Δ5 (not applicable)
• Spaces can be inserted after the numerical value. →	+5ΔΔ
• Positive sign (+) may be omitted. →	+5, 5
• Commas cannot be used for separating digits. →	1,234 (not applicable)

Example:	: SOURce : PATTern : PRBS : LENGth 7

(3) <NON-DECIMAL NUMERIC PROGRAM DATA>

<NON-DECIMAL NUERIC PROGRAM DATA> indicates a numerical value other than a decimal (e.g., binary, hexadecimal), and is defined as follows:



<hexadecimal digit>: Hexadecimal format

The hexadecimal format consists of #H and the subsequent numbers (0 to 9) and/or alphabetic characters (A to F). Δ represents a space.

- Spaces can be inserted following #H.
  #H1234 → #HΔ1234
  #H00AF → #HΔΔΔ00AF
- Zeros can be omitted.
  #H00FF → #HFF
  #H0000 → #H0

Example:	:SOURce:PATTern:DREVerse:ADDRess #H0,#H1F

<binary digit>: Binary format

The binary format consists of #B and the subsequent 0s and/or 1s.
Δ represents a space.

- Spaces can be inserted following #B.
  #B11011011 → #BΔ11011011
  #B00100100 → #BΔΔΔ00100100

(4) <BOOLEAN PROGRAM DATA>

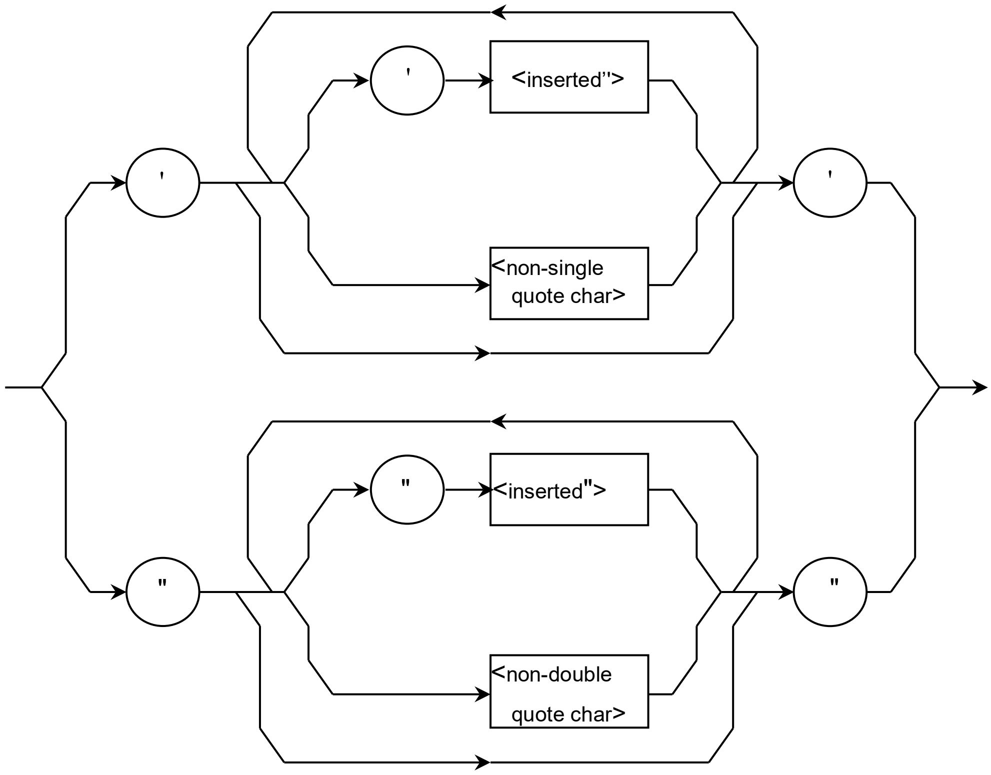
<BOOLEAN PROGRAM DATA> is the program data that is defined in the SCPI, and indicates a theoretical value. As the values corresponding to True and False, ON and OFF of <CHARACTER PROGRAM DATA> and 1 and 0 of <DECIMAL NUMREIC PROGRAM DATA> are defined.

Example:	:SOURce:PATTern:EADDition:SET ON
	:SOURce:PATTern:EADDition:SET 1

(5) <STRING PROGRAM DATA>

< STRING PROGRAM DATA> is character string data, enclosed within double quotation marks (" ") or single quotation marks (' '). If the character string includes a double (" ") or single quotation mark (' '), the same type of quotation mark must be described to enclose the string.

It is defined as follows:



(a) <inserted'> is defined as a single ASCII symbol of a value 27 (decimal number, 39 = ').

(b) <non-single quote char> is defined as a single ASCII symbol of a value other than 27 (decimal number, 39 = ').

(c) <inserted"> is defined as a single ASCII symbol of a value 22 (decimal number, 34 = ").

(d) <non-double quote char> is defined as a single ASCII symbol of a value other than 22 (decimal number, 34 = ").

<Example of description>

When a character string is enclosed within single quotation marks (' '):

'calculate'	
'remote"control'	(The double quotation mark (") between single quotation marks is regarded as a string.)
'"Jan. " "Feb. " '	(The double quotation marks (" ") between single quotation marks are regarded as a string.)
'remote"control'	(The double quotation mark (") between single quotation marks is regarded as a string.)

When a character string is enclosed within double quotation marks (" "):

"calculate"	
"It's a nice day. "	(The single quotation mark (') between double quotation marks is regarded as a string.)
" 'Mar. "Apr. ' " '	(The single quotation marks (' ') and the double quotation mark (") between outer double quotation marks are regarded as a string.)
"program" "data"	(The double quotation marks (" ") between outer double quotation marks are regarded as a string.)

As shown above, use the same type of quotation marks for enclosing a character string.

Actual commands are described as follows:

Example:	:CALCulate:ADATa:EALarm? "1-1", "CURRent:ER:TOTal" (The character string representing the slot of the module, the character string representing the display method and data type)

5.3.2 SCPI Talker Output Format

This section describes the format of response messages returned from the talker (transmitter) to the listener (receiver).

5.3.2.1 SCPI talker output response message format

The following figure shows the response to a data output query command :OUTP:DATA:OUTP?, and test pattern selection query commands :SOUR:PATT:TYPE? and :OUTPut:RCLock:SeLect?. The SCPI response has no header, so the response contains only data.

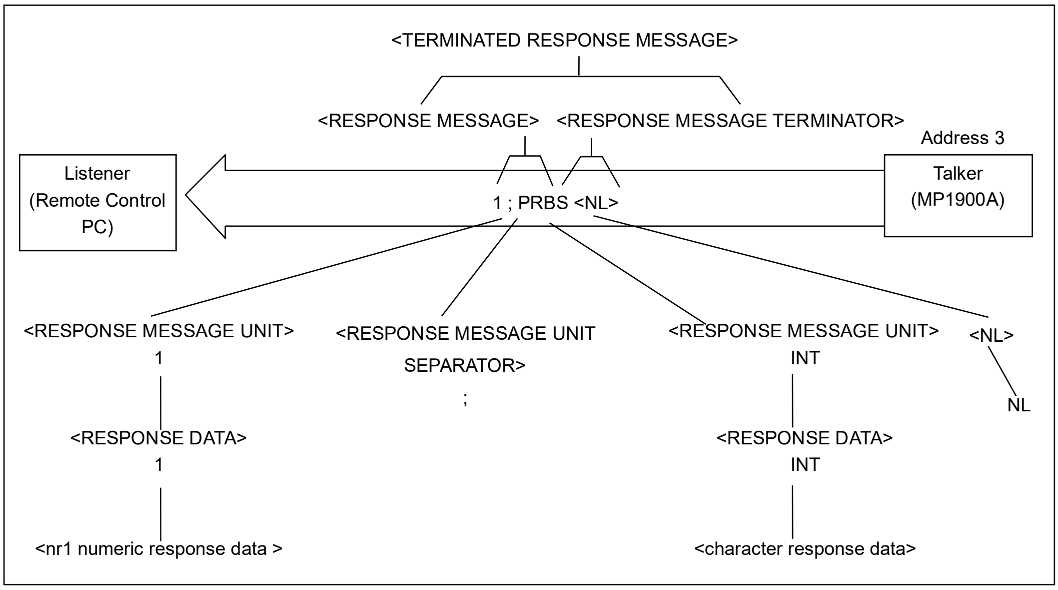


Figure 5.3.2.1-1 <TERMINATED RESPONSE MESSAGE>

As in the case of program messages, the format of response messages consists of a sequence of functional elements, which are the minimum level units to indicate a function. In the figure above, the words written in uppercase alphabetical characters enclosed within brackets (< >) indicate examples of functional elements. A functional element is further divided into coding elements. In this figure, the words written in lowercase alphabetical characters enclosed within brackets (< >) indicate examples of coding elements. Syntax notations are therefore the same for both the talker and listener.

5.3.2.2 Functional elements of response messages

(1) <TERMINATED RESPONSE MESSAGE>

The following figure shows a <TERMINATED RESPONSE MESSAGE> with two message units linked.

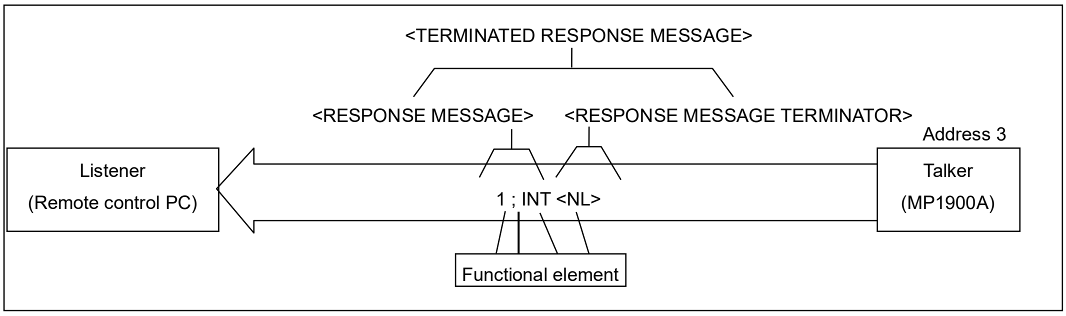
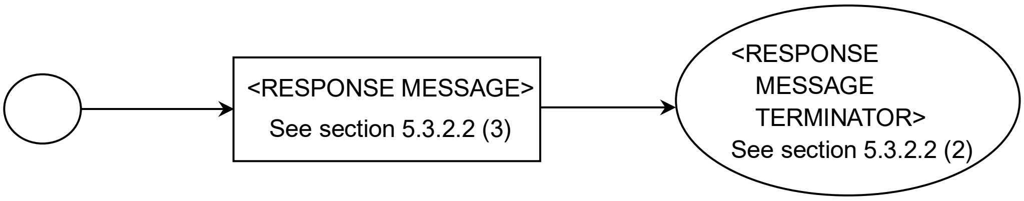


Figure 5.3.2.2-1 <TERMINATED RESPONSE MESSAGE>

<TERMINATED RESPONSE MESSAGE>is defined as follows:

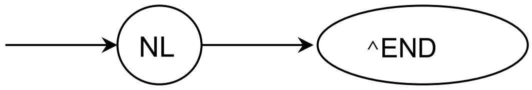


<TERMINATED RESPONSE MESSAGE> is a data message containing all the functional elements required for transmitting the message from the talker (MP1900A) to the remote control PC. A <RESPONSE MESSAGE TERMINATOR> is added to the end of a <RESPONSE MESSAGE> to complete transmission of <RESPONSE MESSAGE>.

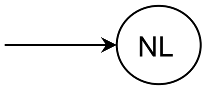
(2) <RESPONSE MESSAGE TERMINATOR>

<RESPONSE MESSAGE TERMINATOR> is placed after the last <RESPONSE MESSAGE UNIT> to terminate a sequence of one or more <RESPONSE MESSAGE UNIT> elements. The definition of <RESPONSE MESSAGE TERMINATOR> differs according to the used interface.

a. For GPIB interface



b. For Ethernet interface



NL Defined as a single ASCII code byte 0A (decimal number 10), i.e. the ASCII control character LF (Line Feed) that performs the carriage return operation bringing the print position to the same character position in the next line. It is also called NL (New Line) because it starts from a new line.
For line feed, the CR + LF code may be used instead of the LF code. If the remote control PC runs on MS-DOS or Windows, line feed is done with “CR + LF”, while it is done with only “LF” for UNIX.

END Generates an EOI signal by setting the EOI (End-or-Identify) line of the GPIB control bus to TRUE (low level).

Example: A typical program that reads the state of the Synthesizer reference signal currently set is shown below.

```
10 WRITE @03:”:OUTP:RCL:SEL?”
20 READ @03:A$
30 PRINT A$
40 END
```

(3) <RESPONSE MESSAGE>

The following figure shows an example of a response to a query command that queries the selected input connector and a query command that queries the bit rate set for reception signals.

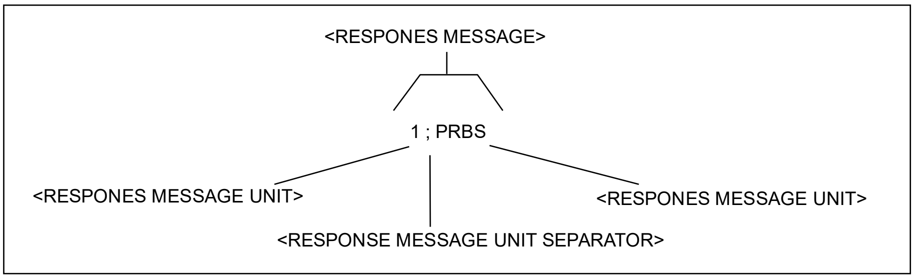
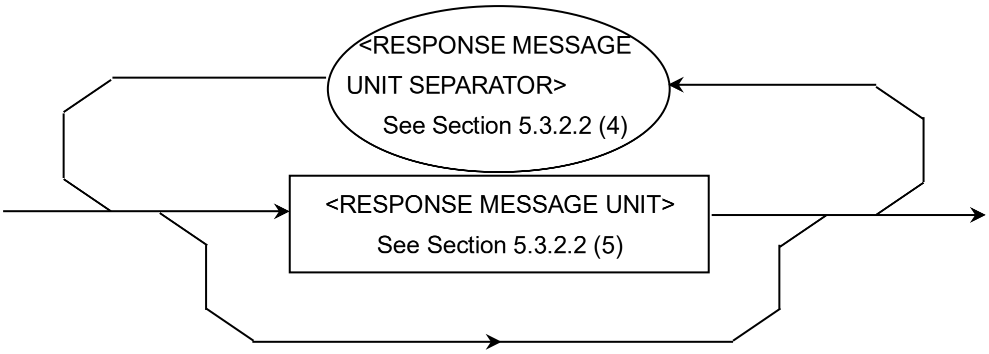


Figure 5.3.2.2-2 <TERMINATED RESPONSE MESSAGE>

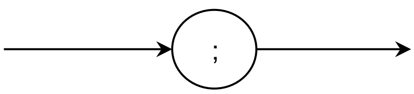
<RESPONSE MESSAGE> is defined as follows:



<RESPONSE MESSAGE> is a sequence of one or more <RESPONSE MESSAGE UNIT> elements. The <RESPONSE MESSAGE UNIT> element indicates a single message to be sent from the MP1900A to the remote control PC. The <RESONSE MESSAGE UNIT SEPARATOR> element is used to separate two or more <RESPONSE MESSAGE UNIT> elements.

(4) <RESPONSE MESSAGE UNIT SEPARATOR>

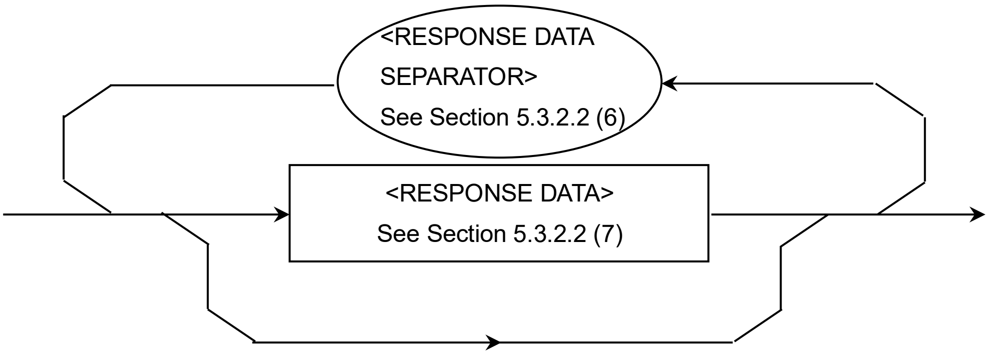
<RESPONSE MESSAGE UNIT SEPARATOR>is defined as follows:



<RESPONSE MESSAGE SEPARATOR> separates two or more <RESPONSE MESSAGE UNIT> elements with the <UNIT SEPARATOR> semicolon (;) when a sequence of them is output in one <RESPONSE MESSAGE>.

(5) <RESPONSE MESSAGE UNIT>

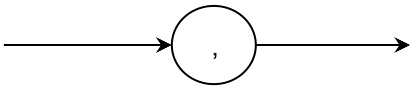
<RESPONSE MESSAGE UNIT> of the MP1900A is a response message unit with no header, and returns only the measurement result data. <RESPONSE MESSAGE UNIT>is defined as follows:



(6) <RESPONSE DATA SEPARATOR>

<RESPONSE DATA SEPARATOR> is used to separate data when two or more <RESPONSE DATA> elements are output.

<RESPONSE DATA SEPARATOR>is defined as follows:



(7) <RESPONSE DATA>

The <RESPONSE DATA> elements used in the MP1900A are described below. The response data to be returned depends on the query message.

Table 5.3.2.2-1 Response data

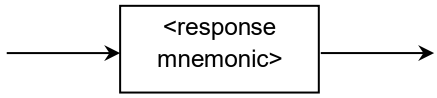
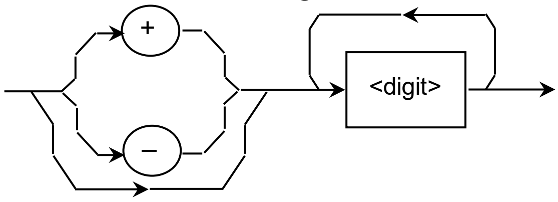
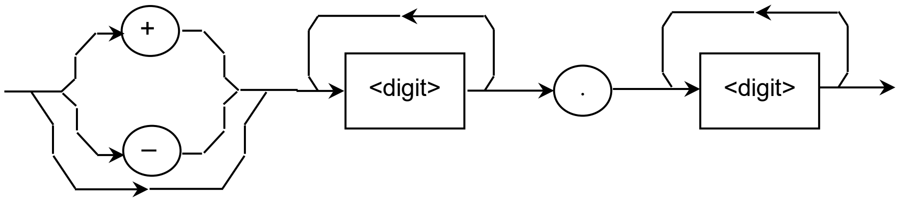
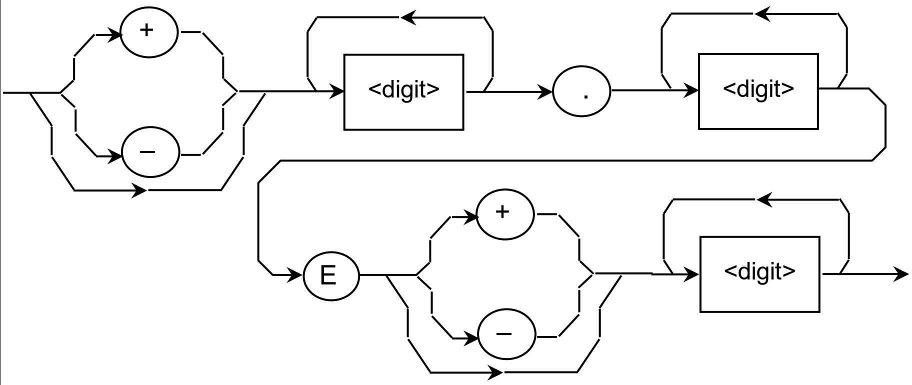
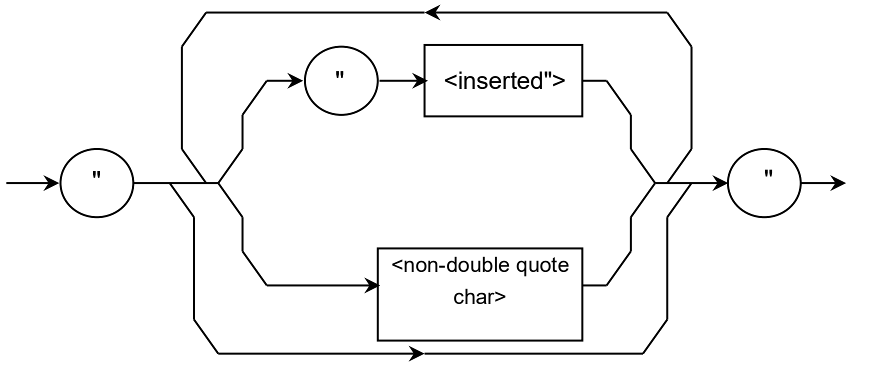
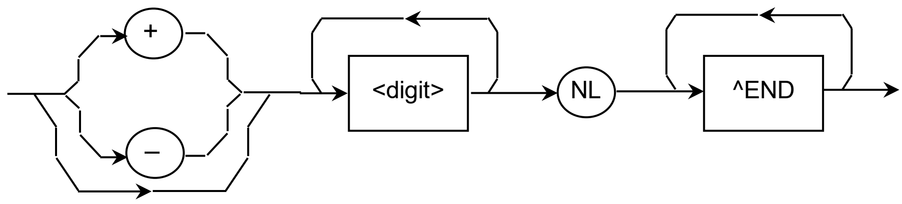
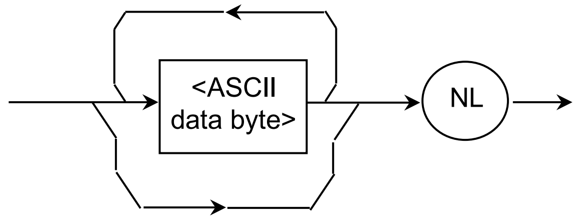
Element	Function
(1) CHARACTER RESPONSE DATA Example: ABC DEFG	Indicates short mnemonic data. 
(2) NR1 NUMERIC RESPONSE DATA Example: 123 +123 –1234	Indicates a decimal integer. 
(3) NR2 NUMERIC RESPONSE DATA Example: 12.3 +12.34 –12.345	Indicates a fixed-point numerical value. 
(4) NR3 NUMERIC RESPONSE DATA Example: 1.23E+45 –12.3E+45	Indicates a real decimal number with an exponent. 

Table 5.3.2.2-1 Response data (Cont'd)

Element	Function
(5) STRING RESPONSE DATA Example: "1234" "ABCD" "1234.5"	Indicates a character string enclosed within double quotation marks(" "). 
(6) ARBITRARY ASCII RESPONSE DATA Example: <ASCII Byte><ASCII Byte>NL^END	Transmits an ASCII data byte without separation, excluding NL characters. The message is terminated without exit as NL^END (or NL only) is inserted next to the last data. (a) For GPIB interface  (b) For Ethernet interface 

5.3.2.3 Syntax differences between listener input format and talker output format

The differences in syntax between the listener input format and the talker output format are as follows:

Listener input format

A listener input message possesses flexibility so that the MP1900A can easily receive program messages from the remote control PC.
Easy-to-read programs can be created since uppercase and lowercase alphabetical are not identified (non case sensitive), and any <white spaces> can be added as desired to the separator or terminator in this format.

Talker output format

A talker output message is, on the other hand, transmitted strictly according to the syntax so that the remote control PC can easily accept response messages output from the MP1900A.
There is only one response message for one function.

Table 5.3.2.3-1 Syntax difference

Item	Listener Input Program Message	Talker Output Program Message
Characteristics	Flexible	Strict
Alphabetic characters	Uppercase and lowercase characters have the same meanings (non case sensitive).	Uppercase characters only
Before and after the NR3 exponent part E	Δ+E, e+Δ (Δ is 0 or more)	Uppercase E only
Positive sign (+) of the NR3 exponent part	Can be omitted	Cannot be omitted
<white space> (: Δ)*1	Two or more <white space> can be added before and after the separator and before the terminator.	Not used
Unit separator	Δ + semicolon (Δ is 0 or more)	Semicolon only
Blank before header	Δ + header (Δ is 0 or more)	Header only
Header separator	Header + Δ (Δ is 1 or more)	Header + one $20*2
Data separator	Δ + comma + Δ (Δ is 0 or more)	Comma only
Terminator	Δ + {NL, EOI, or NL+EOI} (Δ is 0 or more)	NL+EOI*3

*1: Δ indicates <white space>.

*2: ASCII code byte 20 (decimal number 32 = ASCII character SP, space)

*3: “NL + EOI” and “CR + NL + EOI” can be switched by the SYSTem:TERMination command. CR is defined as the ASCII code 0D.

5.3.3 Command Configuration

The SCPI commands have a hierarchic structure. The SCPI are grouped by the related functions, and each group forms a hierarchic structure called a “subsystem”. In this document, subsystems are expressed in a command tree, as shown below.

Table 5.3.3-1 Example of SCPI command tree

:INPut	:CLOCk	:SELection	<clock>
		:SELection?	
		:RECovery	<string>
		:RECovery?	

The same headers can exist in an SCPI command tree, and the position where the header exists corresponds to its function. Thus, a command must be described in full path to the header used.

5.3.4 Command Syntax

Table 5.3.4-1 Example of SCPI commands

:INPut:CLOCk:SELection <clock>
:INPut:CLOCk:SELection?
:INPut:CLOCk:RECovery <string>
:INPut:CLOCk:RECovery?

The SCPI command tree shown in 5.3.3 "Command Configuration" contains the SCPI commands above. The following describes rules on SCPI command description.

<Command format>

A command always starts with a colon (:). A command consists of headers connected by colons (:).

<Abbreviated format for headers>

The headers are classified into short and long forms. The short form is an abbreviated form of the long form. The command is interpreted as the identical command, regardless whether it is described in the short form or in the long form. Short and long forms can also be used in combination. Although uppercase and lowercase characters are used to distinguish between the short and long forms (uppercase characters indicate the short form) in this document, they are not case sensitive when actually used.

Example:

Long form	> :INPUT:CLOCK:SELECTION RECOVERED
Short form	> :INP:CLOC:SEL REC
Long + short form	> :Inp:CLOC:SELECTION REC

<Optional node>

Square brackets ([ ]) indicate optional nodes.

A header enclosed within square brackets can be omitted; it is interpreted as being the same command, regardless of whether it is omitted.

Example:

:STATus:OPERation:[EVENt]?

When a header is not omitted	> :STATus:OPERation:EVENt?
When a header is omitted	> :STATus:OPERation?

<Header separator>

At least one space must be inserted between a command and parameter. Two or more parameters must be separated by commas (,).

5.3.5 Command Combinations

Commands can be combined using a semicolon (;), as shown in the examples below. The second command is referred to as the same level as the lowest hierarchy of the first command. Thus, the second command can be described in full path, as shown in Example 1, or described omitting the higher-level headers than "SELection", as shown in Example 2.

Example 1: >:INPut:CLOCk:SELection
RECovered;:INPut:CLOCk:RECovery" "OC_3"
Example 2: :INPut:CLOCk:SELection RECovered;RECovery "OC_3"

Note:

Commands that handle some kind of binary data cannot be combined.

Example:
:SOURce:PATTern:BDATA:WHOLe
WRT, RED?

5.3.6 Parameters

The following table shows the parameter types used in the MP1900A. In this document, parameter types are indicated by the lowercase alphabetical characters within brackets (< >). The corresponding <PROGRAM DATA> types as defined in IEEE 488.2 (or SCPI) are indicated by uppercase alphabetical.

Table 5.3.6-1 Description of parameter types

Parameter Type	Description
<numeric> <DECIMAL NUMERIC PROGRAM DATA>	Indicates a decimal integer.
<numeric> <NON-DECIMAL NUMERIC PROGRAM DATA>	Indicates a numeric value other than a decimal (binary, octal, etc.).
<boolean> <BOOLEAN PROGRAM DATA>	Indicates a logical value. OFF or 0 corresponds to False, and ON or 1 corresponds to True. Either 0/1 or OFF/ON can be used for setting, but responses to a query use 0/1.
<string>,<display>...etc <STRING PROGRAM DATA>	Indicates a character string. It is an ASCII character string enclosed within single quotation marks (' ') or double quotation marks (" "). Example: 'SES_3:DM_6' or "SES_3:DM_6"
<brate>,<type>...etc <CHARACTER PROGRAM DATA>	Indicates character data. It is expressed as a short string corresponding to the setting details.
<bdata>...etc <ARBITRARY BLOCK PROGRAM DATA>	Used to transmit 8-bit binary data.

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Remote Commands

5.3.7 Responses

The following table shows the response types used in the MP1900A. In this document, response types are indicated by the lowercase alphabetical characters enclosed within brackets (< >). The corresponding <RESPONSE DATA> types as defined in IEEE 488.2 (or SCPI) are indicated by uppercase alphabetical.

Table 5.3.7-1 Description of response types

Response Type	Description
<numeric> <NR1 NUMERIC RESPONSE DATA>	The number of digits of the response is variable, and the maximum number of digits of the numerical value range is the maximum number of digits of the response. No space must be inserted between the sign and numerical value. > :SYSTem:DATE? < 2006,7,14
<numeric> <NR2 NUMERIC RESPONSE DATA>	The number of digits of the response is variable, and the maximum number of digits of the numerical value (including decimal numbers) range is the maximum number of digits of the response. A space must not be inserted between the sign and numerical value. > :OUTPut:DATA:AMPLitude? < 1.000
<brate>,<type>...etc <CHARACTER RESPONSE DATA>	Returns the short form of the character. > :SOURce:SYNThesizer:JITTer:MODulation:SELect? < INT
<string>,<display>...etc <STRING RESPONSE DATA>	Returns a string enclosed within double quotation marks (" "). If there are short and long forms for the string of the corresponding program command, the short form is returned. > :DISPlay:CUSTomize:BUTTon:NOW? < 1, "EADD" (The short form of "EADDition")
<ARBITRARY ASCII RESPONSE DATA>	Returns 7-bit ASCII text data without separation. The last data byte is terminated by NL^END or NL only. > *OPT? < OPT301,OPT302,MU181000A,OPT101,…

5.4 IEEE 488.2 Common Commands

This section describes IEEE 488.2 Common Commands support to MP1900A.

Common commands can be used commonly on any of the GPIB interface and Ethernet interface. All common commands supported by the MP1900A are sequential commands. Table 5.4-1 below lists the IEEE 488.2 common commands supported by the MP1900A.

Table 5.4-1 IEEE 488.2 Common Commands List

Mnemonic	Command's full spell
*IDN?	Identification Query
*RST	Reset Command
*OPC	Operation Complete Command
*OPC?	Operation Complete Query
*WAI	Wait Continue Command
*CLS	Clear Status Command
*ESE	Standard Event Status Enable Command
*ESE?	Standard Event Status Enable Query
*ESR?	Standard Event Status Register Query
*SRE	Service Request Enable Command
*SRE?	Service Request Enable Query
*STB?	Read Status Byte Query
*TRG	Trigger Command
*OPT?	Option Identification Query

*IDN? Identification Query

Parameter	None
Response	<Manufacturer>, <Model>, <Serial No.>
	<Manufacturer>,
	ANRITSU
	<Model> = <CHARACTER RESPONSE DATA>
	MP1900A
	<Serial No.> = <NR1 NUMERIC RESPONSE DATA>
	0000000000 to 9999999999
	Main frame Serial number
Function	Reports manufacture name, model, etc.
Example	`> *IDN?`
	`< ANRITSU,MP1900A,0123456789`

*RST Reset Command

Parameter	None
Function	Initializes entire system.
	Cancels the measurement and clear the contents.
	To reset to the factory default, perform SCPI command
	:SYSTem:MEMory:INITialize
Example	`> *RST`

*OPC Operation Complete Command

Parameter	None
Function	Sets bit 0 (operation complete bit) of standard event status register and sets SRQ to ON, when execution of preceding command is completed.
Example	`> *OPC`

*OPC? Operation Complete Query

Parameter	None
Response	<NR1 NUMERIC RESPONSE DATA>
	1
Function	Returns 1 when preceding command is completed.
Example	`> *OPC?`
	`< OPC 1`

*WAI Wait to Continue Command

Parameter None

Function Waits to execute the succeeding command until execution of preceding command is completed.
Executes overlapped commands as sequential commands.
This function is enabled only for preceding command.

Example `> *WAI`

*CLS Clear Status Command

Parameter None

Function Clear all event registers and queues, except output queue and MAV summary message.
Reset of enable registers and transition filters for the device unique status registers is executed using the SCPI command :STATus:PRESet.
Both output queue and MAV bits are also cleared when an *CLS is sent immediately after <PROGRAM MESSAGE TERMINATOR> and before <QUERY MESSAGE UNIT> element. Execution of succeeding commands is set to wait until execution of the preceding command is completed.

Example `> *CLS`

*ESE Standard Event Status Enable Command

Parameter	<DECIMAL NUMERIC PROGRAM DATA> An integer between 0 and 255 The parameter represents the total of bit digit values when bits to be enabled are selected from bits of standard event enable register. The digit value for bit to be disabled is set to 0. For the MP1900A, register settings are as listed below: Bit 7 ($2^7 = 128$) Power On Bit 5 ($2^5 = 32$) Command error Bit 4 ($2^4 = 16$) Execution error Bit 3 ($2^3 = 8$) Errors other than command, query and execution errors Bit 0 ($2^0 = 1$) Completion of operation
Function	Sets or clears standard event status enable register.
Example	To set bits 3 (= 8) and 4 (= 16) of enable register: `> *ESE 24`

*ESE? Standard Event Status Enable Query

Parameter	None
Response	<NR1 NUMERIC RESPONSE DATA> 0 to 255: Total of digit values of standard event status enable register bits. For bit settings of standard status register, refer to the *ESE command.
Function	Queries current value of standard event status enable register.
Example	`> *ESE?` `< ESE 24`

*ESR? Standard Event Status Register Query

Parameter	None
Response	<NR1 NUMERIC RESPONSE DATA> 0 to 255: Total of digit values of standard event status register bits. For bit settings of standard status register, refer to the *ESE command.
Function	Queries current value of standard event status register.

Example	When a command error exists:
	`> *ESR?`
	`< ESR 32`

*SRE Service Request Enable Command

Parameter
<DECIMAL NUMERIC PROGRAM DATA>
An integer between 0 and 255
Parameter represents the total of bit digit values when bits to be enabled are selected from bits of service request enable register. The digit value for a bit to be disabled is set to 0.
For the MP1900A, register settings are as listed below:

Bit 7 (2^7 = 128)	Operation status register summary
Bit 5 (2^5 = 32)	Event status register summary
Bit 4 (2^4 = 16)	Indicates that the output queue is not empty.
Bit 3 (2^3 = 8)	Questionable status register summary
Bit 2 (2^2 = 4)	Indicates that the error and event queues are not empty.

Function
Sets bits of service request enable register.

Example
To set bit 4 (= 16) of enable register:
```
> *SRE 16
```

*SRE? Service Request Enable Query

Parameter
None

Response
<NR1 NUMERIC RESPONSE DATA>
0 to 255: Total of digit values of service request enable register bits.
For bit settings of service request enable register bits, refer to the *SRE command.

Function
Function Queries current value of service request enable register.

Example
```
> *SRE?
< SRE 16
```

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*STB? Read Status Byte Query

Parameter None

Response <NR1 NUMERIC RESPONSE DATA>

Bit 7 ($2^7 = 128$)	Operation status register summary
Bit 6 ($2^6 = 64$)	MSS (Master Summary Status) summary message
Bit 5 ($2^5 = 32$)	Event status register summary
Bit 4 ($2^4 = 16$)	Indicates that output queue is not empty.
Bit 3 ($2^3 = 8$)	Questionable status register summary
Bit 2 ($2^2 = 4$)	Indicates that error and event queues are not empty.

Function Queries current value of status byte including MSS (Master Summary Status) bit.

Example When the event status register summary is true:

```
> *STB?
< STB 32
```

*TRG Trigger Command

Parameter None

Function Operates the same as that of IEEE 488.2 GET (Group Execute Trigger bus command). It starts or restarts measurement when the MP1900A receives the *TRG command.
This command is valid only for measurements in the Error and Alarm mode.

Example

```
> *TRG
```

*OPT? Option Identification Query

Parameter None

Response <ARBITRARY ASCII RESPONSE DATA>
Characters (refer to Table below) corresponding to the name of an option or module installed.

Function Queries the options installed in the MP1900A.
All module options installed are returned in a comma-separated string. However, there are no available MP1900A options at present, so this query always returns a NULL.

Example

```
> *OPT?
<
```

5.5 Status Report

This section describes Status Register configuration and bit definition of Status Register. For the MP1900A, installed Status Register is as below:

- IEEE 488.2 Regulated Register
  Standard Event Register, Status Byte Register
- SCPI Regulated Register
  OPERational Status Register
- Device-unique Status Registers
  Device-Unique Status Register (However, separated from Regulated Register)

5.5.1 Overview

For MP1900A, Status Register Configuration is as shown on the Figure 5.5.1-1.

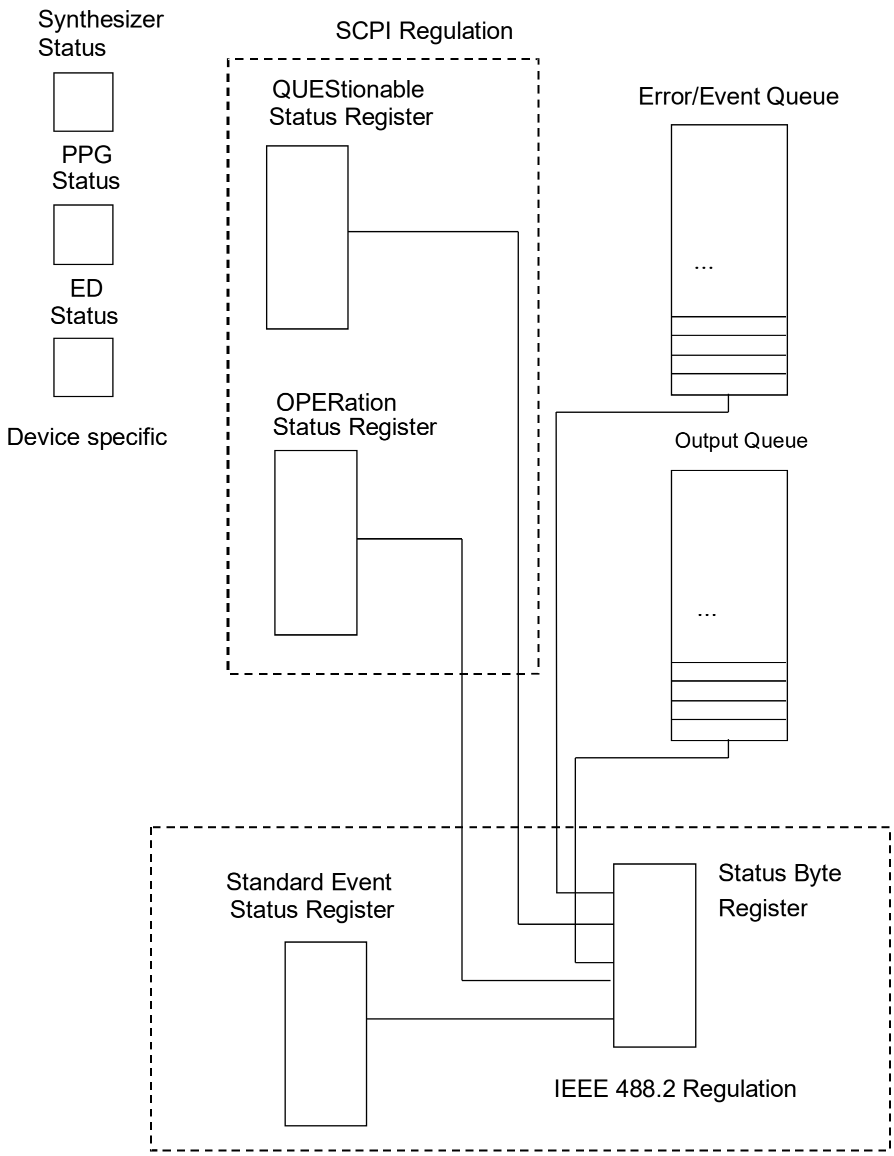

Figure 5.5.1-1 Status Register Configuration

5.5.2 IEEE 488.2 Regulated Register

The bits of the following two IEEE 488.2 regulated registers are defined as follows,

Table 5.5.2-1 IEEE 488.2 Regulated Register

Name	Description
Status byte register	This register can set RQS and 7 summary message bits. It is used as a pair with the service request enable register. When OR of both registers is not 0, RQS turns ON. RQS is programmed in bit 6. This bit is used to report to the remote control PC that a service request is given.
Standard event status register	Stores 8 events which the device encounters as the standard events. The logical OR output bit is summarized and displayed in bit 5 of the status byte register as an ESB (Event Status Bit) summary message.

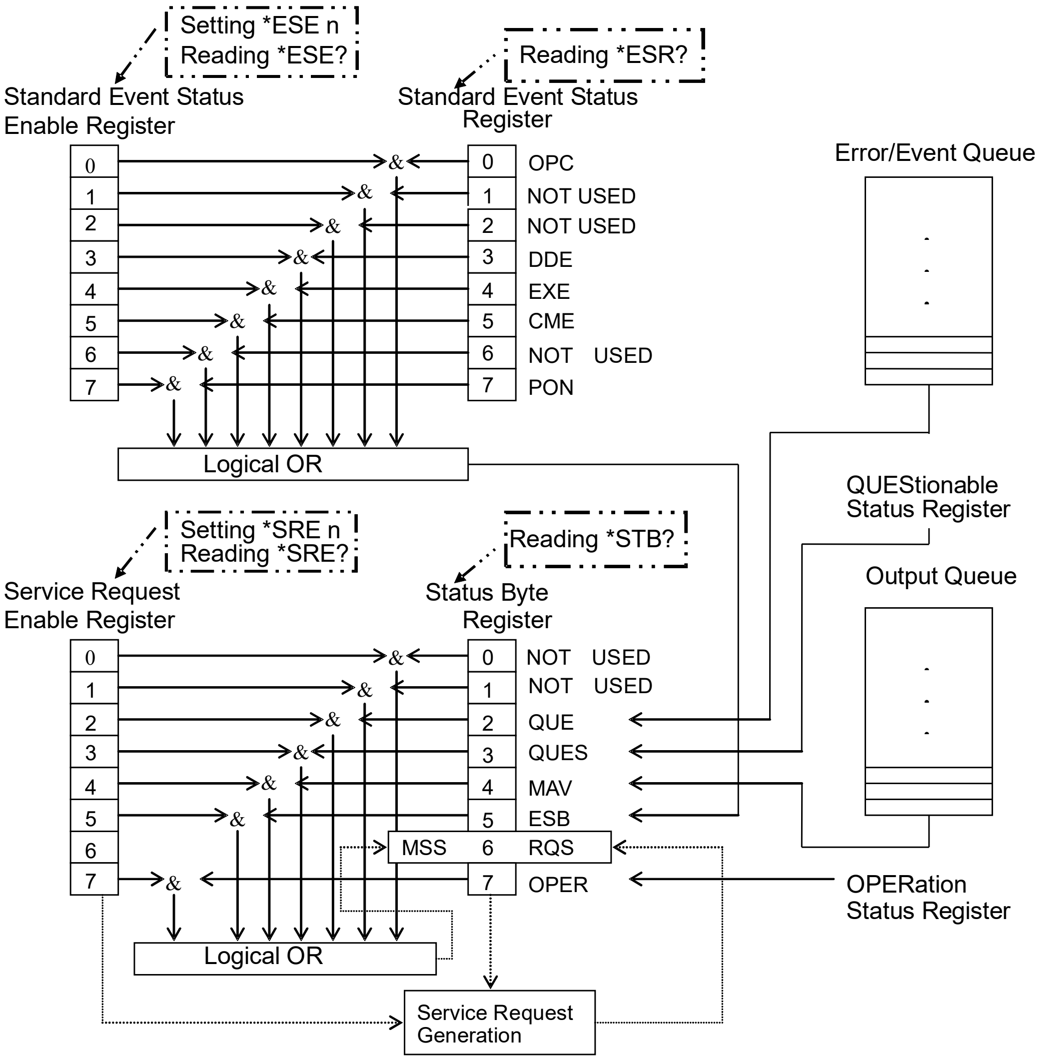

Figure 5.5.2-1 Status Register Configuration

Table 5.5.2-2 Status Byte Register Bit Definition

Bit	Mnemonic	Description
DB2	QUE (error/event QUEue)	Indicates that the error and event queues not empty.
DB3	QUES (QUEStionable status register summary)	QUEStionable status register summary.
DB4	MAV (Message AVailable)	Indicates that the output queue is not empty. When the device is ready to receive the response message send-out request from the controller, the MAV summary message bit is set to 1 (TRUE). This message can be used to allow the controller to send the queue command to the device and wait until MAV turns TRUE.
DB5	ESB (Event Summary Bit)	Standard event status register summary
DB6	RQS (ReQuest Service)	Returns a 7-bit status byte and this RQS to the controller in the serial pole mode.
	MSS (Master Summary Status)	Indicates that the MP1900A has reason to request at least one service. When inquiring the status byte by the *STB? command, this MSS summary message appears in bit 6 in place of the RQS message.
DB7	OPER (OPERation status register summary)	OPERation status register summary

Table 5.5.2-3 Standard Event Status Register Bit Definition

Bit	Mnemonic	Description
DB0	OPC (OPeration Complete)	Indicates that all the specified operations are completed.
DB3	DDE (Device-Dependent Error)	Indicates that an error other than command error or execution error occurs.
DB4	EXE (EXecution Error)	Indicates that an execution error occurs.
DB5	CME (CoMmand Error)	Indicates that a command error occurs.
DB7	PON (Power ON)	Indicates that the power supply turns from OFF to ON.

Note:

See 5.4 "IEEE 488.2 Common Commands" for the setting and query commands for the Status Byte Register and Standard Event Status Registers.

5.5.3 SCPI-Regulated Status Register

SPCI regulates that the Instrument should contain the following registers in addition to those regulated in IEEE 488.2. Table 5.5.3-1 shows the SCPI regulated Status Registers definition.

Table 5.5.3-1 SCPI-regulated Status Registers

Name	Description
QUEStionable Status register	Reports a signal status such as a measurement result. This register is used to send a service request to an external controller when an error occurs. Note that the MP1900A does not use this register.
OPERation Status register	Reports some MP1900A statuses.

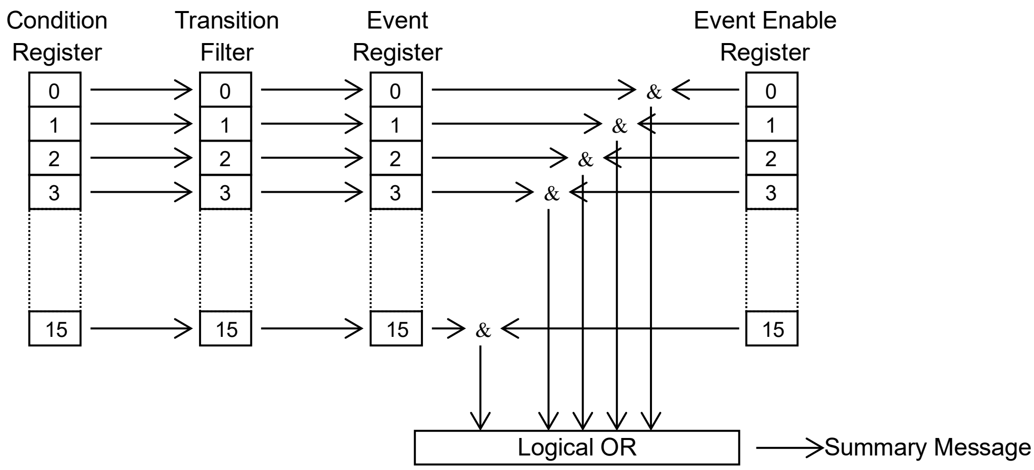

Figure 5.5.3-1 OPERation Status Register

Table 5.5.3-2 OPERation Status Register Bit Definition

Bit	Mnemonic	Description
DB3	BAT (BAThtub measuring)	Indicates that the Instrument is measuring Bathtub.
DB4	MEAS (MEASuring)	Indicates that the Instrument is measuring when any port is in execution.*
DB6	PAMB (PAM Ber)	Indicates that the Instrument is measuring PAM4 BER.
DB7	AAD (Auto ADjust)	Indicates that the Instrument is in Auto Adjust.
DB8	ASE (Auto SEarching)	Indicates that the Instrument is in Auto Search.
DB9	EMM (Eye Margin Measuring)	Indicates that the Instrument is measuring eye margin.
DB10	EDI (Eye Contour)	Indicates that the Instrument is measuring Eye Contour.
DB11	PSET (Pattern SETing)	Indicates that the Instrument is setting pattern.
DB12	INI (INItialize)	Indicates that the Instrument is in initialization.

*: When re-measurement is performed during measurement, DB4 becomes OFF and then ON again. DB4 bit becomes on at the same time when measurement is started.

5.5.4 How to Read and Write Status Register

Table 5.5.4-1 shows how to read and write status register.

Table 5.5.4-1 Reading and Writing the Status Register

Register	Reading	Writing
Status byte register	Read the register bits using the serial pole. A 7-bit status byte and a RQS message bit are returned. The status byte value does not change. *STB? Common query A numeric value composed of the statusbyte register value and the MSS summary message is returned. The Status register does not change at this time.	Disabled
Service request Enable register	*SRE? common query The register bits do not change.	*SRE common command
Standard status register	*ESR? common query The register bits are cleared after being read.	Disabled
Standard event status enable register	*ESE? common query The register bits do not change.	*ESE common command
SCPI event register	:STATus:...:EVENt? Device-unique command The register bits are cleared.	Disabled
SCPI enable register	:STATus:...:ENABle? The contents of the register do not change.	:STATus:...:ENABle
SCPI Transition filter	:STATus:...:PTRansition? :STATus:...:NTRansition? Device-unique command The contents of register bits do not change.	Device-unique command :STATus:...:PTRansition :STATus:...:NTRansition
Error/event queue	:SYSTem:ERRor?	Disabled

Note:

The SCPI event register, SCPI enable register, and SCPI Transition filter listed above indicate the SCPI-regulated status registers and an event or a transition filter in a device-unique status.

5.5.5 How to Clear and Reset Status Register

Table 5.5.5-1 shows how to clear and reset status register.

Table 5.5.5-1 Clearing and Resetting the Status Registers

Register	*RST	*CLS	Power ON	STATus:PRESet	Other method to clear register
Status byte register	No change	Clear	Clear	No change	
Service request enable register	No change	No change	Clear	No change	Executing *SRE 0
Standard event status register	No change	Clear	Clear*2	No change	Cleared when an event is read by *ESR?
Standard event status enable register	No change	No change	Clear*1	No change	Executing *ESE 0
SCPI event register	No change	Clear	Clear*1	No change	Cleared when an event is read by :STATus:...:EVENt?
SCPI enable register	No change	No change	Reset*1	Reset	Executing :STATus:...:ENABle 0
SCPI Transition filter	No change	Reset	Reset*1	Reset	Executing :STATus:...:PTRansition 0 and :STATus:...:NTRansition 0
Error/event queue	No change	Clear	Clear	No change	Reading all events by :SYSTem:ERRor?

*1: When power on as PSC (Power-ON Status Clear) flag is true, it will be cleared (or reset).

*2: To be 128 bits.

Note:

The SCPI event register, SCPI enable register, and SCPI Transition filter listed above indicate the SCPI-regulated status registers.

Table 5.5.5-2 shows the reset values of the registers influenced by the :STATus:PRESet command.

Table 5.5.5-2 Values Reset by the :STATus:PRESet Command

Register	Enable/filter	Reset value
OPERational status register	Enable register	All 0
	PTRansition filter	All 1
	NTRansition filter	All 0

5.5.6 Device-Unique Status

MP1900A supports each module status as device-unique status. Figure 5.5.6-1 shows Device-unique Status Configuration.

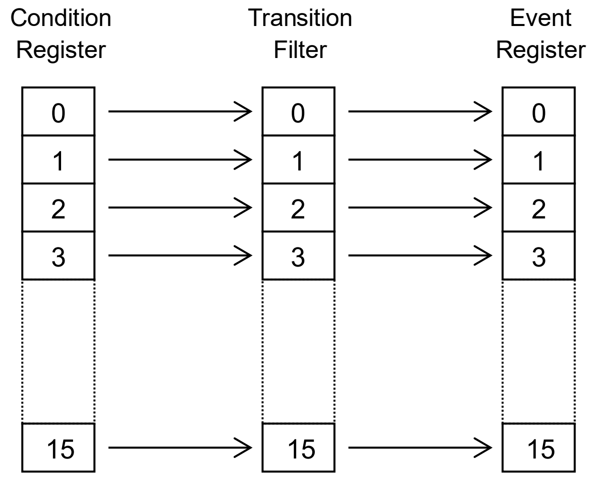

Figure 5.5.6-1 Each Status Configuration

Condition Register

Monitors the device status and changes real time in response to the device status. Thus, this register does not memorize the status.

Transition Filter

Sets the Condition Register data in the Event Register. The following three types of transition filters are available depending on which change of the Condition Register is to be evaluated.

Positive direction change:

The event becomes true only when the corresponding condition changes from false to true.

Negative direction change:

The event becomes true only when the corresponding condition changes from true to false.

Bi-directional change:

The event becomes true when a change arise either in the positive or negative direction.

Event Register

Memorizes output from Transition Filter.

The following show module status bit definition.

Table 5.5.6-1 Module Status

Status	Contents
Synthesizer Status	Reports MU181000A/B status.
PPG Status	Reports PPG status.
ED Status	Reports ED status.

Table 5.5.6-2 Synthesizer Status Bit Definition

BIT	Contents
DB0	Indicates PLL Unlock occurred.

Table 5.5.6-3 ED Status Bit Definition

BIT	Contents
DB0	Indicates Insertion Error was detected.
DB1	Indicates Omission Error was detected.
DB2	Indicates Total Error was detected.
DB4	Indicates Pattern Sync Loss occurred.
DB5	Indicates Clock Loss occurred.
DB6	Indicates Delay Busy occurred.
DB8	Indicates Transition Error was detected.
DB9	Indicates Non Transition Error was detected.
DB10	Indicates CR Unlock occurred.
DB11	Indicates Delay Calibration Require occurred.

Table 5.5.6-4 PPG Status Bit Definition

BIT	Contents
DB1	Indicates CMU-MUX Unlock occurred.
DB2	Indicates Delay Busy occurred.
DB4	Indicates Delay Calibration Require occurred.

5.5.7 Status Commands

This section explains about OPERational Status Register and each module-unique status commands.

When reading and writing each module-unique status, the following three commands must be transmitted before transmitting a status command.

(1) :UENTry:ID <unit_number>

(2) :MODule:ID <module_number>

(3) :PORT:ID <port_number>

These three commands identify the operating module, and any commands sent/received after them operate for the identified module.
However, :PORT:ID <port_number> can be omitted.

5.5.7.1 Status Preset

The following command initializes the Enable Register and filter of the OPERational Status Register.

:STATus:PRESet

Function	Initializes the event status register and filter.
Example	`> :STATus:PRESet`

5.5.7.2 Operation Status Register

The Operation Status Register is used to indicate an operation status such as "measurement in progress".

:STATus:OPERation[:EVENt]?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 8184	Sum of all bits set in the event register (DECIMAL)
	Available bit	
	8 (Bit 3)	Bathtub measurement in progress
	16 (Bit 4)	Measurement in progress
	128 (Bit 7)	Auto Adjust in progress
	256 (Bit 8)	Auto Search in progress
	512 (Bit 9)	Eye Margin measurement in progress
	1024 (Bit 10)	Eye Contour measurement in progress
	2048 (Bit 11)	Pattern loading in progress
	4096 (Bit 12)	Initialization in progress PAM4 BER measurement in progress
Function	Queries events register at OPERation Status Register.	

Example	`> :STATus:OPERation:EVENt?`
	or
	`> :STATus:OPERation?`
	`< 16`	

:STATus:OPERation:CONDition?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 8184	Sum of all bits set in the condition register (DECIMAL)
	Available bit	
	8 (Bit 3)	Bathtub measurement in progress
	16 (Bit 4)	Measurement in progress
	128 (Bit 7)	Auto Adjust in progress
	256 (Bit 8)	Auto Search in progress
	512 (Bit 9)	Eye Margin measurement in progress
	1024 (Bit 10)	Eye Contour measurement in progress
	2048 (Bit 11)	Pattern loading in progress
	4096 (Bit 12)	Initialization in progress PAM4 BER measurement in progress
Function	Queries condition register at OPERation Status Register.	
Example	`> :STATus:OPERation:CONDition?` `< 16`	

:STATus:OPERation:ENABle <numeric>

Parameter	<numeric> = <DECIMAL NUMERIC PROGRAM DATA>	
	0 to 8184	Sum of all bits that you want to enable in event enable register (DECIMAL)
	Available bit	
	8 (Bit 3)	Bathtub measurement in progress
	16 (Bit 4)	Measurement in progress
	128 (Bit 7)	Auto Adjust in progress
	256 (Bit 8)	Auto Search in progress
	512 (Bit 9)	Eye Margin measurement in progress
	1024 (Bit 10)	Eye Contour measurement in progress
	2048 (Bit 11)	Pattern load in progress
	4096 (Bit 12)	Initialization in progress
		PAM4 BER measurement in progress
	If set to 0, all bits are masked.	
Function	Sets mask value of event enable register at OPERation status register	
Example	To set event enable register to 16 at OPERation status register.	
	`> :STATus:OPERation:ENABle 16`	

:STATus:OPERation:ENABle?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 8184	Sum of all bits set in the event enable register (DECIMAL)
Function	Queries enable register at OPERation status register.	
Example	`> :STATus:OPERation:ENABle?`	
	`< 16`	

:STATus:OPERation:PTRansition <numeric>

Parameter	<numeric> = <DECIMAL NUMERIC PROGRAM DATA>	
	0 to 8184	Sum of all the transition filter bits you want to set in the transition filter (DECIMAL)
	Available bit	
	8 (Bit 3)	Bathtub measurement in progress
	16 (Bit 4)	Measurement in progress
	128 (Bit 7)	Auto Adjust in progress
	256 (Bit 8)	Auto Search in progress
	512 (Bit 9)	Eye Margin measurement in progress
	1024 (Bit 10)	Eye Contour measurement in progress
	2048 (Bit 11)	Pattern load in progress
	4096 (Bit 12)	Initialization in progress PAM4 BER measurement in progress
Function	Sets the transition filter (positive direction change) of the OPERation status register.	
Example	To set the transition filter (positive direction change) of the OPERation status register to 16. `> :STATus:OPERation:PTRansition 16`	

:STATus:OPERation:PTRansition?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 8184	Sum of all bits set in the transition filter (DECIMAL)
Function	Queries the transition filter (positive direction change) of the OPERation status register.	
Example	`> :STATus:OPERation:PTRansition?` `< 16`	

:STATus:OPERation:NTRansition <numeric>

Parameter	<numeric> = <DECIMAL NUMERIC PROGRAM DATA>	
	0 to 8184	Sum of all the transition filter bits you want to set in the transition filter (DECIMAL)
	Available bit	
	8 (Bit 3)	Bathtub measurement in progress
	16 (Bit 4)	Measurement in progress
	128 (Bit 7)	Auto Adjust in progress
	256 (Bit 8)	Auto Search in progress
	512 (Bit 9)	Eye Margin measurement in progress
	1024 (Bit 10)	Eye Contour measurement in progress
	2048 (Bit 11)	Pattern load in progress
	4096 (Bit 12)	Initialization in progress PAM4 BER measurement in progress
Function	Sets the transition filter (negative direction change) of the OPERation status register.	
Example	To set the transition filter (negative direction change) of the OPERation status register to 16. `> :STATus:OPERation:NTRansition 16`	

:STATus:OPERation:NTRansition?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 8184	Sum of all bits set in the transition filter (DECIMAL)
Function	Queries the transition filter (negative direction change) of the OPERation status register.	
Example	`> :STATus:OPERation:NTRansition?` `< 16`	

5.5.7.3 Synthesizer Status

Synthesizer Status displays faults at the MU181000A/B.

:INSTrument:SYG125[:EVENt]?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 1	Sum of all bits set in the event register (DECIMAL)
	Available bit	
	1 (Bit 0)	PLL Unlock occurs
Function	Queries events at Synthesizer.	

Example	`> :INSTrument:SYG125:EVENt?`
	or
	`> :INSTrument:SYG125?`
	`< 1`	

:INSTrument:SYG125:CONDition?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 1	Sum of all bits set in the condition register (DECIMAL)
	Available bit	
	1 (Bit 0)	PLL Unlock occurs
Function	Queries condition at Synthesizer.	
Example	`> :INSTrument:SYG125:CONDition?` `< 1`	

:INSTrument:SYG125:PTRansition <numeric>

Parameter	<numeric> = <DECIMAL NUMERIC PROGRAM DATA>	
	0 to 1	Sum of all the transition filter bits you want to set in the transition filter (DECIMAL)
	Available bit	
	1 (Bit 0)	PLL Unlock occurs
Function	Sets the transition filter (positive direction change) of the Synthesizer Status.	
Example	To set the transition filter (positive direction change) of the Synthesizer Status to 1. `> :INSTrument:SYG125:PTRansition 1`	

:INSTrument:SYG125:PTRansition?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 1	Sum of all bits set in the transition filter (DECIMAL)
Function	Queries the transition filter (positive direction change) of the Synthesizer Status.	
Example	`> :INSTrument:SYG125:PTRansition?` `< 1`	

:INSTrument:SYG125:NTRansition <numeric>

Parameter	<numeric> = <DECIMAL NUMERIC PROGRAM DATA>	
	0 to 1	Sum of all the transition filter bits you want to set in the transition filter (DECIMAL)
	Available bit	
	1 (Bit 0)	PLL Unlock occurs
Function	Sets the transition filter (negative direction change) of the Synthesizer Status.	
Example	To set the transition filter (negative direction change) of the Synthesizer Status to 1. `> :INSTrument:SYG125:NTRansition 1`	

:INSTrument:SYG125:NTRansition?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 1	Sum of all bits set in the transition filter (DECIMAL)
Function	Queries the transition filter (negative direction change) of the Synthesizer Status.	
Example	`> :INSTrument:SYG125:NTRansition?` `< 1`	

:INSTrument:SYG125:RESet

Function	Initializes event at Synthesizer.
Example	`> :INSTrument:SYG125:RESet`

5.5.7.4 ED Status

ED Status is used to indicate an alarm and error of MU195040A, MU196040A and MU196040B.
It is compatible with the MU183040A, MU183040B, MU183041A and MU183041B.

:INSTrument:EDG32[:EVENt]?

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 16383	Sum of all bits set in the event register (DECIMAL)
Available bit	
1 (Bit 0)	Error (Data1)
2 (Bit 1)	Error (Data2)
16 (Bit 4)	Pattern Sync Loss (Data1)
32 (Bit 5)	Pattern Sync Loss (Data2)
256 (Bit 8)	Clock Loss
1024 (Bit 10)	Delay Calibration Require (Data1)
2048 (Bit 11)	Delay Calibration Require (Data2)

Function

Queries events at MU195040A, MU196040A, and MU196040B status

Example

```
> :INSTrument:EDG32:EVENt?
```

or

```
> :INSTrument:EDG32?
< 1
```

:INSTrument:EDG32:CONDition?

Response

<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 16383	Sum of all bits set in the condition register
(DECIMAL)	
Available bit	
1 (Bit 0)	Error (Data1)
2 (Bit 1)	Error (Data2)
16 (Bit 4)	Pattern Sync Loss (Data1)
32 (Bit 5)	Pattern Sync Loss (Data2)
256 (Bit 8)	Clock Loss
1024 (Bit 10)	Delay Calibration Require (Data1)
2048 (Bit 11)	Delay Calibration Require (Data2)

Function

Queries condition at MU195040A, MU196040A, and MU196040B status.

Example

```
> :INSTrument:EDG32:CONDition?
< 1
```

:INSTrument:EDG32:PTRansition <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 16383	Sum of all the transition filter bits you want to enable in the transition filter (DECIMAL)
	Available bit	
	1 (Bit 0)	Error (Data1)
	2 (Bit 1)	Error (Data2)
	16 (Bit 4)	Pattern Sync Loss (Data1)
	32 (Bit 5)	Pattern Sync Loss (Data2)
	256 (Bit 8)	Clock Loss
	1024 (Bit 10)	Delay Calibration Require (Data1)
	2048 (Bit 11)	Delay Calibration Require (Data2)

Function: Sets transition filter (positive direction transition) at MU195040A, MU196040A, and MU196040B status.

Example: To set the transition filter (positive direction transition) at MU195040A, MU196040A, and MU196040B status to 1:

```
> :INSTrument:EDG32:PTRansition 1
```

:INSTrument:EDG32:PTRansition?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 16383	Sum of all bits set in the transition filter (DECIMAL)

Function: Queries contents of transition filter (positive direction transition) at MU195040A, MU196040A, and MU196040B status.

Example:

```
> :INSTrument:EDG32:PTRansition?
< 1
```

:INSTrument:EDG32:NTRansition <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 16383	Sum of all the transition filter bits you want to set in the transition filter (DECIMAL)
	Available bit	
	1 (Bit 0)	Error (Data1)
	2 (Bit 1)	Error (Data2)
	16 (Bit 4)	Pattern Sync Loss (Data1)
	32 (Bit 5)	Pattern Sync Loss (Data2)
	256 (Bit 8)	Clock Loss
	1024 (Bit 10)	Delay Calibration Require (Data1)
	2048 (Bit 11)	Delay Calibration Require (Data2)
Function	Sets transition filter (negative direction transition) at MU195040A, MU196040A, and MU196040B status.	
Example	To set the transition filter (negative direction transition) at MU195040A, MU196040A, and MU196040B status to 1: `> :INSTrument:EDG32:NTRansition 1`	

:INSTrument:EDG32:NTRansition?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 16383	Sum of all bits set in the transition filter (DECIMAL)
Function	Queries contents of transition filter (negative direction transition) at MU195040A, MU196040A, and MU196040B status.	
Example	`> :INSTrument:EDG32:NTRansition?` `< 1`	

:INSTrument:EDG32:RESet

Function	Initializes event at MU195040A, MU196040A, and MU196040B status.
Example	`> :INSTrument:EDG32:RESet`

5.5.7.5 PPG Status

The PPG Status is used to indicate an alarm and error of the MU195020A and MU196020A. It is compatible with the MU183020A and MU183021A.

:INSTrument:PPGG32[:EVENt]?

Response
<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 15	Sum of all bits set in the event register (DECIMAL)
Available bit	
1 (Bit 0)	Delay Calibration Require (Data1)
2 (Bit 1)	Delay Calibration Require (Data2)

Function
Queries events at MU195020A and MU196020A status.

Example
```
> :INSTrument:PPGG32:EVENt?
```
or
```
> :INSTrument:PPGG32?
< 4
```

:INSTrument:PPGG32:CONDition?

Response
<numeric>=<NR1 NUMERIC RESPONSE DATA>

0 to 15	Sum of all bits set in the condition register (DECIMAL)
Available bit	
1 (Bit 0)	Delay Calibration Require (Data1)
2 (Bit 1)	Delay Calibration Require (Data2)

Function
Queries condition at MU195020A and MU196020A status.

Example
```
> :INSTrument:PPGG32:CONDition?
< 4
```

:INSTrument:PPGG32:PTRansition <numeric>

Parameter
<numeric>=<DECIMAL NUMERIC PROGRAM DATA>

0 to 15	Sum of all the bits that you want to enable in the transition filter (DECIMAL)
Available bit	
1 (Bit 0)	Delay Calibration Require (Data1)
2 (Bit 1)	Delay Calibration Require (Data2)

Function
Sets transition filter (positive direction transition) at MU195020A and MU196020A status.

Example
To set the transition filter (positive direction transition) at MU195020A and MU196020A status to 1:
```
> :INSTrument:PPGG32:PTRansition 4
```

:INSTrument:PPGG32:PTRansition?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 15	Sum of all bits set in the transition filter (DECIMAL)
Function	Queries contents of transition filter (positive direction transition) at MU195020A and MU196020A status.	
Example	`> :INSTrument:PPGG32:PTRansition?` `< 4`	

:INSTrument:PPGG32:NTRansition <numeric>

Parameter	<numeric>=<DECIMAL NUMERIC PROGRAM DATA>	
	0 to 15	Sum of all the transition filter bits you want to set in the transition filter (DECIMAL)
	1 (Bit 0)	Delay Calibration Require (Data1)
	2 (Bit 1)	Delay Calibration Require (Data2)
Function	Sets transition filter (negative direction transition) at MU195020A and MU196020A status.	
Example	To set the transition filter (negative direction transition) at MU195020A and MU196020A status to 1: `> :INSTrument:PPGG32:NTRansition 4`	

:INSTrument:PPGG32:NTRansition?

Response	<numeric>=<NR1 NUMERIC RESPONSE DATA>	
	0 to 15	Sum of all bits set in the transition filter (DECIMAL)
Function	Queries contents of transition filter (negative direction transition) at MU195020A and MU196020A status.	
Example	`> :INSTrument:PPGG32:NTRansition?` `< 4`	

:INSTrument:PPGG32:RESet

Function	Initializes event at MU195020A and MU196020A status.
Example	`> :INSTrument:PPGG32:RESet`

5.6 SCPI Commands

This section describes the SCPI commands.
Examples of command expression are shown below.

<Example of a Program Command>

Parameter Type Name (SCPI, device-unique)

Parameter Type (IEEE 488.2,SCPI)

Program Command

:SOURce:PATTern:TYPE <type>

Parameter	<type>=<CHARACTER PROGRAM DATA>	
	PRBS	PRBS pattern
	ZSUBstitution	Zero-substitution pattern
	DATA	Data pattern
	ALTernate	Alternate pattern
	MIXData	Mixed Data pattern
	MIXalt	Mixed Alternate pattern
	SEQuence	Sequence pattern
Function	Sets the type of the test pattern.	
Example	To set the test pattern type to the Mixed Data pattern:	
	> :SOURce:PATTern:TYPE MIXData	
Compatibility	Partially compatible with the MP1800A (ZSUBstitution only).	

Parameter Content

Compatibility

Example use of command

< Example of a Query Command>

Parameter Type (SCPI, device-unique)

Program Command

Parameter Type (IEEE 488.2, SCPI)

:SOURce:PATTern:TYPE?

Response	<type>=<CHARACTER RESPONSE DATA> PRBS,ZSUB,DATA,ALT,MIXD,MIX,SEQ
Function	Queries the type of the test pattern.
Example	> :SOURce:PATTern:TYPE? < MIXD
Compatibility	Partially compatible with the MP1800A (ZSUBstitution only).

Example use of command

Compatibility

Notes:

- All the MP1900A commands are sequential commands.
- If a command affects other settings, the command may have restrictions. For setting parameters subject to be affected and command conditions to be restricted, see on-screen help. For how to display the on-screen help, refer to 3.2.1.3 "Help".
- The parameters of a query command may be omitted when they are the same as those of the corresponding program command.

5.6.1 Common Commands

This section describes the commands related to common settings and functions of the control software. The commands in this section are compatible with MP1800A.

5.6.1.1 Commands for common settings

Table 5.6.1.1-1 Common setting commands

Setting Items	Commands
Number of the unit to be operated	:UENTry:ID
	:UENTry:ID?
Number of the module to be operated (slot position)	:MODule:ID
	:MODule:ID?
Automatic measurement function to be performed	:SYSTem:CFUNction
	:SYSTem:CFUNction?
Query for error message	:SYSTem:ERRor?
Query for SCPI version	:SYSTem:VERSion?
Query for software status	:SYSTem:CONDition?
Query for hardware system configuration	:SYSTem:ORGanization:HARDware?
Query for system error	:SYSTem:INFormation:ERRor?
Terminator type	:SYSTem:TERMination
	:SYSTem:TERMination?
Query for model name of mainframe and module	:SYSTem:CONDition:UNITs?
Query for mainframe information	:SYSTem:UNIT?
Query for module information	:SYSTem:MODule?
Measured Results Screen Drawing Settings	:SYSTem:DISPlay:RESult
	:SYSTem:DISPlay:RESult?
Module screen display	:DISPlay:ACTive

:UENTry:ID <unit_number>

Parameter	<unit_number> = <DECIMAL NUMERIC PROGRAM DATA>	
	1 to 4	Unit number
Function	Sets the number of the unit to be operated.	
Example	To set the number of the unit to be operated to 2:	
	`> :UENTry:ID 2`	
Compatibility	Compatible with MP1800A.	

:UENTry:ID?

Response	<unit_number> = <NR1 NUMERIC RESPONSE DATA>
	1 to 4
Function	Queries the number of the unit being operated.
Example	`> :UENTry:ID?`
	`< 2`
Compatibility	Compatible with MP1800A.

:MODule:ID <module_number>

Parameter	<module_number> = <DECIMAL NUMERIC PROGRAM DATA>	
	1 to 8	Module number
Function	Sets the number of the module to be operated (slot position).	
Example	To set the number of the module to be operated (slot position) to 6:	
	`> :MODule:ID 6`	
Compatibility	Compatible with MP1800A.	

:MODule:ID?

Response	<module_number> = <NR1 NUMERIC RESPONSE DATA>
	1 to 8
Function	Queries the number of the module being operated (slot position).
Example	`> :MODule:ID?`
	`< 6`
Compatibility	Compatible with MP1800A.

:SYSTem:CFUNction <function>

Parameter	<function> = <CHARACTER PROGRAM DATA>	
	ASE32	Auto Search
	EMAR32	Eye Margin measurement
	ECT	Eye Contour measurement
	BTUB32	Bathtub measurement
	AADJ32	Auto Adjust
	PAMB	PAM4 BER measurement
	OFF	Off
	Note: When "Off" is set, the operation returns to the port operation previously performed.	
Function	Sets the automatic measurement function to be performed.	
Example	To set the common function to be performed to Auto Search: `> :SYSTem:CFUNction ASE32`	
Compatibility	Compatible with MP1800A.	

:SYSTem:CFUNction?

Response	<function> = <CHARACTER RESPONSE DATA>	
	ASE32	Auto Search
	EMAR32	Eye Margin measurement
	ECT	Eye Contour measurement
	BTUB32	Bathtub measurement
	AADJ32	Auto Adjust
	PAMB	PAM4 BER measurement
	OFF	Off
Function	Queries the automatic measurement function being performed.	
Example	`> :SYSTem:CFUNction?` `< ASE32`	
Compatibility	Compatible with MP1800A.	

:SYSTem:ERRor?

Response	<error/event_number>,"<error/event_description>" <error/event_number> = <NR1 NUMERIC RESPONSE DATA> –32768 to 32767 "0" indicates that no errors and events have occurred. Other values return a general error reserved by SCPI or a device-unique error. <error/event_description> = <STRING RESPONSE DATA> This is an error message corresponding to <error/event_number>. The maximum character-string length is 255 characters.
Function	Queries the error message in the error/event queue.
Example	`> :SYSTem:ERRor?` `< 0,"No error"`
Compatibility	Compatible with the MP1632C Digital Data Analyzer (hereinafter, referred to as "MP1632C"), MP1776A Error Detector (hereinafter, referred to as "MP1776A") and MP1800A.

:SYSTem:VERSion?

Response	<version> = <NR2 NUMERIC RESPONSE DATA> YYYY.V — YYYY: Year V: Revision number
Function	Queries the SCPI version to which the MP1900A conforms.
Example	`> :SYSTem:VERSion?` `< 1999.0`
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.

:SYSTem:CONDition?

Response

<mainframe>,<slot1>,...,<slot64>

<mainframe> = <serial>,<mver>,<hver>,<opt1>,<sbver>,<saver>,<opt2>

<serial> = <STRING RESPONSE DATA>

XXXXXXXXXX	0000000000 to 9999999999 MP1900A serial number

Note:

Alphabetic characters may be included.

<mver> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 MX190000A software version

<hver> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 MP1900A hardware version

<opt1> = <STRING RESPONSE DATA>

OPTXXX	Option number (MP1900A) See “Table 5.6.1.1-2 Option character correspondence table”.

Note:

Outputs the numbers for all installed options.
NONE is output if no option is installed.

<sbver> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 Sub application software version (Boot part)

<saver> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 Sub application software version (Application part)

<opt2> = <STRING RESPONSE DATA>

<slot x> = <module>,<serial>,<fpga1>[,<fpga2>],<boot>,<application>,<opt>

x indicates a slot number. The slot number varies depending on the unit number as follows.

Unit 1: 1 to 16	Numbers from 1 to 8 correspond to actual slots.
Unit 2: 17 to 32	
Unit 3: 33 to 48	
Unit 4: 49 to 64	

<module> = <STRING RESPONSE DATA>

XXXXXXXXX	Module model name (e.g.: MU195020A) See “Table 5.6.1.1-2 Option character correspondence table”.

Note:

NONE is output if no module is installed.
For a module that uses two slots, only the slot with the greater number is valid.

<serial> = <STRING RESPONSE DATA>

XXXXXXXXXX	0000000000 to 9999999999 Serial number

Note:

“------------” is output if no module is installed.
For a module that uses two slots, only the slot with the greater number is valid.

<fpga1>[,<fpga2>,.....] = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 FPGA version

<boot> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 Logic Boot version

Note:

"-------------" is output if Logic boot is not installed.
For a module that uses two slots, only the slot with the greater number is valid.

<application> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 Logic Application version

Note:

"-------------" is output if Logic Application is not installed.
For a module that uses two slots, only the slot with the greater number is valid.

<opt> = <STRING RESPONSE DATA>

XXXXXX/XXXXX	Option number OPTXXX: For MP1900A

Note:

Outputs the numbers for all installed options. NONE is output if no module is installed.
For a module that uses two slots, only the slot with the greater number is valid.

Function

Queries the software status of the MP1900A.

Example

```
> :SYSTem:CONDition?
<
6201234567,1.00.00,1.00.20,OPT302,1.00.00,1.00.00,OPT12,
OPT14,
MU181000A,6201234568,1.00.00,1.00.00,1.00.00,OPT101,
MU181020A,6201234569,1.00.00,1.00.00,1.00.00,OPT001,OPT2
20,
MU195040A,6201234571,1.00.00,1.00.00,1.00.00,OPT002,OPT2
20
```

Compatibility Compatible with MP1800A.

Table 5.6.1.1-2 Option character correspondence table

Model/Name	Option Number*	Option Name
MX190000A Signal Quality Analyzer-R Control Software	–	–
MU181000A 12.5GHz Synthesizer	OPTx01	Jitter Modulation
MU181000B 12.5GHz 4port Synthesizer	OPTx01	Jitter Modulation
	OPTx02	SSC Extension
MU195020A 21G/32G bit/s SI PPG	OPT001	32G bit/s Extension
	OPT010	1ch Data Output
	OPT020	1ch 10Tap Emphasis
	OPT011	2ch Data Output
	OPT021	2ch 10Tap Emphasis
	OPT030	1ch Data Delay
	OPT031	2ch Data Delay
	OPT040	1ch ISI Injection
	OPT041	2ch ISI Injection
	OPT050	Sequence Editor Function
MU195040A 21G/32G bit/s SI ED	OPT001	32Gbit/s Extension
	OPT010	1ch ED
	OPT020	2ch ED
	OPT011	1ch CTLE
	OPT021	2ch CTLE
	OPT022	Clock Recovery
MU195050A Noise Generator	OPT001	White Noise
MU196020A PAM4 PPG	OPT001	32G baud
	OPT002	58G baud
	OPT003	64G baud
	OPTx11	4Tap Emphasis
	OPTx12	32G to 58G baud Extension
	OPTx13	32G to 64G baud Extension
	OPTx23	58G to 64G baud Extension
	OPTx30	Data Delay
	OPTx40	Adjustable ISI
	OPTx42	FEC Pattern Generation
	OPTx50	Inter-Module Synchronization

*: “x” in an option number represents any numeral.

Table 5.6.1.1-2 Option character correspondence table (Cont'd)

Model/Name	Option Number*	Option Name
MU196040A PAM4 ED	OPT001	32.1G baud Decoder
	OPTx22	25.5G to 32.1G baud Clock Recovery
	OPTx41	SER Measurement
MU196040B PAM4 ED	OPT001	32.1G baud
	OPT002	58.2G baud
	OPTx11	Equalizer
	OPTx12	32G to 58G baud Extension
	OPTx21	29G baud Clock Recovery
	OPTx22	32G baud Clock Recovery
	OPTx23	58G baud Clock Recovery Extension
	OPTx24	32G baud Clock Recovery Extension
	OPTx41	SER Measurement
	OPTx42	FEC Analysis
MU183020A 28G/32G bit/s PPG	OPTx01	32G bit/s Extension
	OPTx12	1ch 2V Data Output
	OPTx13	1ch 3.5V Data Output
	OPTx30	1ch Data Delay
	OPTx22	2ch 2V Data Output
	OPTx23	2ch 3.5V Data Output
	OPTx31	2ch Data Delay
MU183021A 28G/32G bit/s 4ch PPG	OPTx01	32G bit/s Extension
	OPTx12	4ch 2V Data Output
	OPTx13	4ch 3.5V Data Output
	OPTx30	4ch Data Delay
MU183040B 28G/32G bit/s High Sensitivity ED	OPTx01	32G bit/s Extension
	OPTx10	1ch ED
	OPTx20	2ch ED
	OPTx22	2.4G to 28.1G bit/s Clock Recovery
	OPTx23	25.5G to 32.1G bit/s Clock Recovery
MU183041B 28G/32G bit/s 4ch High Sensitivity ED	OPTx01	32G bit/s Extension
	OPTx22	2.4G to 28.1G bit/s Clock Recovery
	OPTx23	25.5G to 32.1G bit/s Clock Recovery

:SYSTem:ORGanization:HARDware?

Response

<slot1>,...,<slot64>

<slotx> =

<module>,<serial>,<fpga1>[,<fpga2>],<boot>,<application>,<opt>

x indicates a slot number. The slot number varies depending on the unit number as follows.

Unit 1: 1 to 16	Numbers from 1 to 8 correspond to actual slots.
Unit 2: 17 to 32	
Unit 3: 33 to 48	
Unit 4: 49 to 64	

<module> = <STRING RESPONSE DATA>

XXXXXXXXX	Module model name (e.g.,: MU195020A) See "Table 5.6.1.1-2 Option character correspondence table".

Note:

NONE is output if no module is installed.

For a module that uses two slots, only the slot with the greater number is valid.

<serial> = <STRING RESPONSE DATA>

XXXXXXXXXX	0000000000 to 9999999999 Serial number

Note:

"---------" is output if no module is installed.

For a module that uses two slots, only the slot with the greater number is valid.

<fpga1>[,<fpga2>,.....] = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 FPGA version

<boot> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 Logic Boot version

Note:

"---------" is output if Logic Boot is not installed.

For a module that uses two slots, only the slot with the greater number is valid.

	<application> = <STRING RESPONSE DATA>	
	XXXX.XX.XX	1.00.00 to 9999.99.99 Logic Application version

Note:

"---------" is output if Logic Application is not installed.
For a module that uses two slots, only the slot with the greater number is valid.

	<opt> = <STRING RESPONSE DATA>	
	XXXXXX/XXXXX	Option number OPTXXX

Note:

NONE is output if no module is installed.
For a module that uses two slots, only the slot with the greater number is valid.

Function — Queries the hardware system configuration of the MP1900A.

Example

```
> :SYSTem:ORGanization:HARDware?
< MU181000A,6201234568,1.00.00,1.00.00,1.00.00,OPT101,
MU195020A,6201234569,1.00.00,1.00.00,1.00.00,OPT001,OPT2
20,MU195040A,6201234571,1.00.00,1.00.00,1.00.00,OPT002,O
PT220
```

Compatibility — Partially compatible with the MP1632C and MP1776A. Compatible with the MP1800A.

:SYSTem:INFormation:ERRor? <unit>

Parameter	<unit> = <DECIMAL NUMERIC PROGRAM DATA>	
	1 to 4	1 to 4, 1 step
Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	NONE
	1	PLL Unlock
	2	Temperature
	3	Fan
	All the system errors that have currently occurred are displayed, delimited with a comma (,).	
Function	Queries the System Error contents.	
Example	`> : SYSTem:INFormation:ERRor? 3`	
	`< 1,2,3` (when a system error has occurred for PLL Unlock, Temperature, or Fan)	
	`< 0` (when no system error has occurred)	
Compatibility	Compatible with MP1800A.	

:SYSTem:TERMination <numeric>

Parameter	<numeric> = <DECIMAL NUMERIC PROGRAM DATA>	
	0	LF + EOI
	1	CR + LF + EOI
Function	Sets the terminator type of the response data.	
Example	To set the terminator type to LF + EOI: `> :SYSTem:TERMination 0`	
Compatibility	Compatible with the MP1632C and MP1800A.	

:SYSTem:TERMination?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	LF + EOI
	1	CR + LF + EOI
Function	Queries the terminator type of the response data.	
Example	`> :SYSTem:TERMination?` `< 0`	
Compatibility	Compatible with the MP1632C and MP1800A.	

:SYSTem:CONDition:UNITs?

Response

<unit1>,...,<unit4>,<slot1>,...,<slot8>
="<mainframe1>,...,<mainframe4>,<module1>,...,<module6>"
<mainframe1> to <mainframe4> = <STRING RESPONSE DATA>

XXXXXXXXX Mainframe model name (e.g.,: MP1900A)
See“Table 5.6.1.1-2 Option character correspondence table”.

Note:

NONE is output for mainframe2 to mainframe4, if no MP1900A is connected.

<module1> to <module64> = <STRING RESPONSE DATA>

XXXXXXXXX Module model name (e.g.,: MU195020A)
See“Table 5.6.1.1-2 Option character correspondence table”.

Note:

NONE is output if no module is installed.
For a module that uses two slots, only the slot with the greater number is valid.

Function

Queries the model name of the MP1900A and module.

Example

```
> :SYSTem:CONDition:UNITs?
< "MP1900A,NONE,NONE,NONE,MU181000A,NONE,MU195020A,
MU195040A,NONE,…,NONE”
```

Compatibility

Compatible with MP1800A.

:SYSTem:UNIT? <numeric>

Parameter	<numeric> = <NR1 NUMERIC PROGRAM DATA>	
	1 to 4	MP1900A number
	"1" for the MP1900A.	
Response	<mainframe> =	
	<unit>,<serial>,<mver>,<hver>,<opt1>,<sbver>,<saver>,<opt2>	
	<unit> = <STRING RESPONSE DATA>	
	XXXXXXXXX	Mainframe model name (e.g., : MP1900A) See "Table 5.6.1.1-2 Option character correspondence table".

Note:

NONE is output if no module is installed.
For a unit that uses two slots, only the slot with the lower number is valid.

<serial> = <STRING RESPONSE DATA>	
XXXXXXXXXX	0000000000 to 9999999999 MP1900A serial number

Note:

Alphabetic characters may be included.

<mver> = <STRING RESPONSE DATA>	
XXXX.XX.XX	1.00.00 to 9999.99.99 MX190000A software version
<hver> = <STRING RESPONSE DATA>	
XXXX.XX.XX	1.00.00 to 9999.99.99 MP1900A hardware version
<opt1> = <STRING RESPONSE DATA>	
OPTXXX	Option number (MP1900A) See "Table 5.6.1.1-2 Option character correspondence table".

Note:

Outputs the numbers for all installed options.
NONE is output if no option is installed.

<sbver> = <STRING RESPONSE DATA>	
XXXX.XX.XX	1.00.00 to 9999.99.99 Sub application software version (Boot part)
<saver> = <STRING RESPONSE DATA>	
XXXX.XX.XX	1.00.00 to 9999.99.99 Sub application software version (Application part)

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	<opt2> = <STRING RESPONSE DATA>
Function	Queries the MP1900A information including model and serial number.
Example	`> :SYSTem:UNIT? 1`
	`< MP1900A,6201234568,1.00.00,1.00.00,1.00.00,1.00.00`
Compatibility	Compatible with MP1800A.

:SYSTem:MODule? <numeric>

Parameter

<numeric> = <NR1 NUMERIC PROGRAM DATA>

1 to 8	Slot

1 to 8 when using the MP1900A.

Response

<slot> = <module>,<serial>,<fpga1>,<fpga2>,<boot>,<application>,<opt>

<module> = <STRING RESPONSE DATA>

XXXXXXXXX	Module model name (e.g.,: MU195020A) See “Table 5.6.1.1-2 Option character correspondence table”.

Note:

NONE is output if no module is installed.
For a module that uses two slots, only the slot with the greater number is valid.

<serial> = <STRING RESPONSE DATA>

XXXXXXXXXX	0000000000 to 9999999999 Serial number

Note:

“---------” is output if no module is installed.
For a module that uses two slots, only the slot with the greater number is valid.

<fpga1>,<fpga2> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 FPGA version

<boot> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 Logic Boot version

Note:

“---------” is output if Logic Boot is not installed.
For a module that uses two slots, only the slot with the greater number is valid.

<application> = <STRING RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99 Logic Application version

Note:

"---------" is output if Logic Application is not installed.
For a module that uses two slots, only the slot with the greater number is valid.

<opt> = <STRING RESPONSE DATA>

XXXXXX/XXXXX	Option number OPTXXX: For MP1900A

Note:

Outputs the numbers for all installed options.
NONE is output if no option is installed.
For a module that uses two slots, only the slot with the greater number is valid.

Function — Queries the module information on the specified slot.

Example — To query the module information on Slot 3:

```
> :SYSTem:MODule? 3
<
MU195020A,6201234568,1.00.00,---------,1.00.00,1.00.00,O
PT001,OPT020,OPT021,OPT031
```

Compatibility — Compatible with MP1800A.

:SYSTem:DISPlay:RESult <boolean>

Parameter — <boolean> = <BOOLEAN PROGRAM DATA>

OFF or 0	Drawing Processing OFF
ON or 1	Drawing Processing ON (default)

Function — Sets measured results drawing processing ON/OFF

Example — Set measured results drawing processing to OFF

```
> :SYSTem:DISPlay:RESult OFF
```

Compatibility — Compatible with MP1800A.

Remarks — When measured results drawing processing is set to OFF, a dialog indicating drawing processing is stopped is displayed. Issue the command to set drawing processing to ON or Touch the **Remote** to restart measured results drawing processing.

:SYSTem:DISPlay:RESult?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	Drawing Processing OFF
	1	Drawing Processing ON (default)
Function	Sets drawing processing ON/OFF	
Example	`> :SYSTem:DISPlay:RESult?`	
	`< 0`	
Compatibility	Compatible with MP1800A.	

:DISPlay:ACTive <unit>,<slot>[,<tab>]

Parameter	<unit> = <DECIMAL NUMERIC PROGRAM DATA>	
	1 to 4	MP1900A No.1 to 4
	<slot> = <DECIMAL NUMERIC PROGRAM DATA>	
	1 to 8	Slot No.1 to 8
	[<tab>] = <DECIMAL NUMERIC PROGRAM DATA>	
	1 to X	Tab ID No.1 to X
	When [,<tab>] is omitted, 1 is specified.	
	Tab ID is set to No.1 at the left side dialog, and then the tab ID No. is set to 2, 3, 4…toward the right side.	
	The maximum number (X) of the tab ID varies depending on the module options.	
Function	Displays the specified module screen to the front.	

Note:

When the screen processing for measurement result is Off, this function cannot be used. If using this function, set the screen processing to On using the :SYSTem:DISPlay:RESult .

Example	To display the Pattern tab of the MU195020A module: (when installing the MU195020A in the unit1 slot1)
	`> :DISPlay:ACTive 1,1,2`
Compatibility	Compatible with MP1800A.

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5.6.1.2 Common Functions

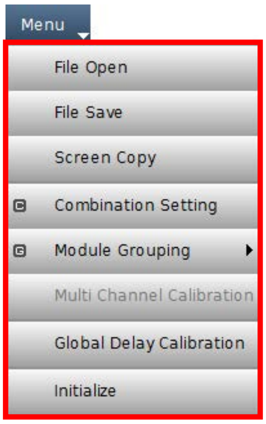

Figure 5.6.1.2-1 Common Functions

Table 5.6.1.2-1 Common Functions Commands

Setting Item	Command
Open	:SYSTem:MMEMory:QRECall
Save	:SYSTem:MMEMory:QSTore
	:SYSTem:MMEMory:STORe
Screen Copy Execute	:SYSTem:PRINt:COPY
Combination Setting	:COMBination:OPERation:ABILity:CHSYnc?
	:COMBination:OPERation:CHSetting
Initialize	:SYSTem:MEMory:INITialize
Output ON/OFF	:SOURce:OUTPut:ASET
	:SOURce:OUTPut:ASET?
Error Addition On/Off	:SOURce:PATTern:EADDition:ASET
	:SOURce:PATTern:EADDition:ASET?
Single Error Addition	:SOURce:PATTern:EADDition:ASINgle
Meas. Start	:SENSe:MEASure:ASTRt
Meas. Stop	:SENSe:MEASure:ASTP
(Query for measurement status)	:SENSe:MEASure:ASTate?
Error ON/OFF	:SYSTem:BEEPer:ERRor:SET
	:SYSTem:BEEPer:ERRor:SET?
Alarm ON/OFF	:SYSTem:BEEPer:ALARm:SET
	:SYSTem:BEEPer:ALARm:SET?
System Error ON/OFF	:SYSTem:BEEPer:SYSTem:SET
	:SYSTem:BEEPer:SYSTem:SET?
System Error	:SYSTem:BEEPer:SYSTem:TYPE
	:SYSTem:BEEPer:SYSTem:TYPE?

:SYSTem:MMEMory:QRECall <file_name>

Parameter	<file_name> = <STRING PROGRAM DATA> "<drv>:\[<dir>]<file>" <drv> = C, D, E, F <dir> = <dir1>\<dir2>\... (Omitted for the root directory) <file> = File name
Function	Opens all setting data.
Example	To read all setting files from the specified save destination. `> :SYSTem:MMEMory:QRECall "C:\Test\example"`
Compatibility	Commands are compatible with the MP1632C. Parameters are incompatible. Commands and parameters are compatible with the MP1800A.

:SYSTem:MMEMory:QSTore <file_name>,<comment>

Parameter	<file_name> = <STRING PROGRAM DATA> "<drv>: \[<dir>]<file>" <drv> = C, D, E, F <dir> = <dir1>\<dir2>\...(Omitted for the root directory) <file> = File name <comment> = <STRING PROGRAM DATA> "XXXXXX..." Specify a comment of a character string within 60 characters into the file.
Function	Executes “Quick Save”. ***Note:*** The settings will not be read from the saved file if the file name is changed.
Example	To specify save destination for all setting files and save them with a comment and measurement result data: `> :SYSTem:MMEMory:QSTore "C:\Test\example","setup all"`
Compatibility	Commands are compatible with the MP1632C. Parameters are incompatible. Commands and paramters are compatible with the MP1800A.

:SYSTem:MMEMory:STORe <file_name>,<module>,<data_type>,<file_type>

Parameter	<file_name> = <STRING PROGRAM DATA>	
	"<drv>:\[<dir>]<file>"	
	<drv> = C, D, E, F	
	<dir> = <dir1>\<dir2>\... (Omitted for the root directory)	
	<file> = File name	
	<module> = <STRING PROGRAM DATA>	
	"<unit>:<slot>:<port>:<module>"	
	<unit> = 1, 2, 3, 4	
	<slot> = 1, 2, 3, 4, …, 8	
	<port> = 1	
	<module> = Module model name	
	<data_type> = <CHARACTER PROGRAM DATA>	
	CAP	Saves the captured data.
	CEX	Saves the captured pattern file.
	<file_type> = <CHARACTER PROGRAM DATA>	
	TXT	Text File (Binary)
	HEX	Text File (Hexadecimal)
Function	Saves the captured data and captured pattern file.	
Example	To save the captured data to a text file in a binary format::	
	`> :SYSTem:MMEMory:STORe "C:\Test\example","1:6:1 MU195040A",CAP,TXT`	
Compatibility	Compatible with the MP1800A commands. Parameters are incompatible.	

:SYSTem:PRINt:COPY

Function	Takes a screen shot.
Example	`> :SYSTem:PRINt:COPY`
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.

:COMBination:OPERation:ABILity:CHSYnc? [<unit>]

Parameter	[<unit>] = <DECIMAL NUMERIC PROGRAM DATA> 1 to 4 — MP1900A No. 1 to 4 Can be omitted. MP1900A No. 1 is specified when omitted.
Response	<numeric> = <NR1 NUMERIC RESPONSE DATA> 0 to 255 — Total number of PPGs that can configure channel synchronization (decimal) Available bits: 0 No PPG that can configure channel synchronization 1 (Bit 0) — PPG in Slot 1 2 (Bit 1) — PPG in Slot 2 4 (Bit 2) — PPG in Slot 3 8 (Bit 3) — PPG in Slot 4 16 (Bit 4) — PPG in Slot 5 32 (Bit 5) — PPG in Slot 6 64 (Bit 6) — PPG in Slot 7 128 (Bit 7) — PPG in Slot 8
Function	Queries the slot where PPG that can configure channel synchronization combination is inserted.

Example	To query the slot in Unit 3 where PPG that can configure channel synchronization is inserted:
	`> :COMBination:OPERation:ABILity:CHSYnc? 3`
	`< 7`

Compatibility	Compatible with MP1800A.

:COMBination:OPERation:CHSetting <configuration>[,<unit>]

Parameter	<configuration> = <NR1 NUMERIC RESPONSE DATA>	
	0 to 254	Total number of PPGs that can configure channel synchronization (decimal)
	Available bits:	
	2 (Bit 1)	PPG in Slot 2
	4 (Bit 2)	PPG in Slot 3
	8 (Bit 3)	PPG in Slot 4
	16 (Bit 4)	PPG in Slot 5
	32 (Bit 5)	PPG in Slot 6
	64 (Bit 6)	PPG in Slot 7
	128 (Bit 7)	PPG in Slot 8
	[<unit>] = <DECIMAL NUMERIC PROGRAM DATA>	
	1 to 4	MP1900A No. 1 to 4
	Can be omitted. MP1900A No. 1 is specified when omitted.	
Function	Specify the slot where the PPG for which channel synchronization is to be set is inserted.	
Example	To set channel synchronization for the PPGs in Slots 1 through 4 of Unit 3:	
	`> :COMBination:OPERation:CHSetting 14`	
Compatibility	Compatible with MP1800A.	

:SYSTem:MEMory:INITialize

Function	Initializes the internal setting data to the initial settings at factory shipment.
Example	`> :SYSTem:MEMory:INITialize`
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.

:SOURce:OUTPut:ASET <boolean>

Parameter	<boolean> = <BOOLEAN PROGRAM DATA>	
	OFF or 0	Output OFF
	ON or 1	Output ON
Function	Sets Data and Clock outputs of optical output and PPG ON or OFF.	
Example	To set Data and Clock outputs of PPG to ON: `> :SOURce:OUTPut:ASET ON`	
Compatibility	Compatible with MP1800A.	

:SOURce:OUTPut:ASET?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	Output OFF
	1	Output ON
Function	Queries the ON/OFF state for Data and Clock outputs of optical output and PPG.	
Example	`> :SOURce:OUTPut:ASET?` `< 1`	
Compatibility	Compatible with MP1800A.	

:SOURce:PATTern:EADDition:ASET <boolean>

Parameter	<boolean> = <BOOLEAN PROGRAM DATA>	
	OFF or 0	Error addition OFF
	ON or 1	Error addition ON
Function	Sets error addition for all valid modules ON/OFF.	
Example	To set error addition for all valid modules to ON: `> :SOURce:PATTern:EADDition:ASET ON`	
Compatibility	Compatible with MP1800A.	

:SOURce:PATTern:EADDition:ASET?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	Error addition OFF
	1	Error addition ON
Function	Queries the error addition ON/OFF state for all valid modules.	
Example	`> :SOURce:PATTern:EADDition:ASET?`	
	`< 1`	
Compatibility	Compatible with MP1800A.	

:SOURce:PATTern:EADDition:ASINgle

Function	Adds a single error for all valid modules.
Example	`> :SOURce:PATTern:EADDition:ASINgle`
Compatibility	Compatible with MP1800A.

:SENSe:MEASure:ASTRt

Function	Starts measurement for all modules.
Example	`> :SENSe:MEASure:ASTRt`
Compatibility	Compatible with MP1800A.

:SENSe:MEASure:ASTP

Function	Stops measurement for all modules.
Example	`> :SENSe:MEASure:ASTP`
Compatibility	Compatible with MP1800A.

:SENSe:MEASure:ASTate?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	Measurement stops for all modules.
	1	During measurement
	Note: If any module is being measured, “1 (During measurement)” is returned.	
Function	Queries the measurement state for all modules.	
Example	`> :SENSe:MEASure:ASTate?`	
	`< 0`	
Compatibility	Compatible with MP1800A.	

:SYSTem:BEEPer:ERRor:SET <boolean>

Parameter	<boolean> = <BOOLEAN PROGRAM DATA>	
	OFF or 0	Buzzer OFF
	ON or 1	Buzzer ON
Function	Sets buzzer at error occurrence ON/OFF.	
Example	To set buzzer at error occurrence ON:	
	`> :SYSTem:BEEPer:ERRor:SET ON`	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

:SYSTem:BEEPer:ERRor:SET?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	Buzzer OFF
	1	Buzzer ON
Function	Queries the buzzer ON/OFF state at error occurrence.	
Example	To query the buzzer ON/OFF state at error occurrence:	
	`> :SYSTem:BEEPer:ERRor:SET?`	
	`< 1`	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

:SYSTem:BEEPer:ALARm:SET <boolean>

Parameter	<boolean> = <BOOLEAN PROGRAM DATA>	
	OFF or 0	Buzzer OFF
	ON or 1	Buzzer ON
Function	Sets buzzer at alarm occurrence ON/OFF.	
Example	To set buzzer at alarm occurrence OFF:	
	`> :SYSTem:BEEPer:ALARm:SET OFF`	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

:SYSTem:BEEPer:ALARm:SET?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	Buzzer OFF
	1	Buzzer ON
Function	Queries the buzzer ON/OFF state at alarm occurrence.	
Example	`> :SYSTem:BEEPer:ALARm:SET?`	
	`< 0`	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

:SYSTem:BEEPer:SYSTem:SET <boolean>

Parameter	<boolean> = <BOOLEAN PROGRAM DATA>	
	OFF or 0	Buzzer OFF
	ON or 1	Buzzer ON
Function	Sets buzzer at system error occurrence ON/OFF.	
Example	To set buzzer at system error occurrence ON:	
	`> :SYSTem:BEEPer:SYSTem:SET ON`	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

:SYSTem:BEEPer:SYSTem:SET?

Response	<numeric> = <NR1 NUMERIC RESPONSE DATA>	
	0	Buzzer OFF
	1	Buzzer ON
Function	Queries the buzzer ON/OFF state at system error occurrence.	
Example	`> :SYSTem:BEEPer:SYSTem:SET?`	
	`< 1`	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

:SYSTem:BEEPer:SYSTem:TYPE <type>,<boolean>

Parameter	<type> = <CHARACTER PROGRAM DATA>	
	PUNLock	PLL unlock
	FAN	FAN
	TEMPerature	Temperature
	ALL	Selects all system errors
	<boolean> = <BOOLEAN PROGRAM DATA>	
	OFF or 0	
	ON or 1	
Function	Sets system error buzzer for the target item ON/OFF.	
Example	To set system error buzzer for "Temperature" ON:	
	`> :SYSTem:BEEPer:SYSTem:TYPE TEMPerature,ON`	
Compatibility	Partially compatible with the MP1632C.	
	Compatible with the MP1800A.	

:SYSTem:BEEPer:SYSTem:TYPE?

Response	<type> = <CHARACTER RESPONSE DATA>	
	PUNL, FAN, TEMP, ALL	
	XXX, XXX,	Errors for which buzzer is set to ON are delimited with commas (,) and returned.
	NONE	Buzzer is set to OFF for all items.
Function	Queries the ON/OFF state of system error buzzer for target items.	
Example	To query the ON/OFF state of system error buzzer for target items:	
	`> :SYSTem:BEEPer:SYSTem:TYPE?`	
	`< PUNL,TEMP`	
Compatibility	Compatible with the MP1632C and MP1800A.	

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5.6.1.3 Auto Search

Auto Search setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

Before executing a setting/query command, specify the Auto Search by using the :SYSTem:CFUNction command.

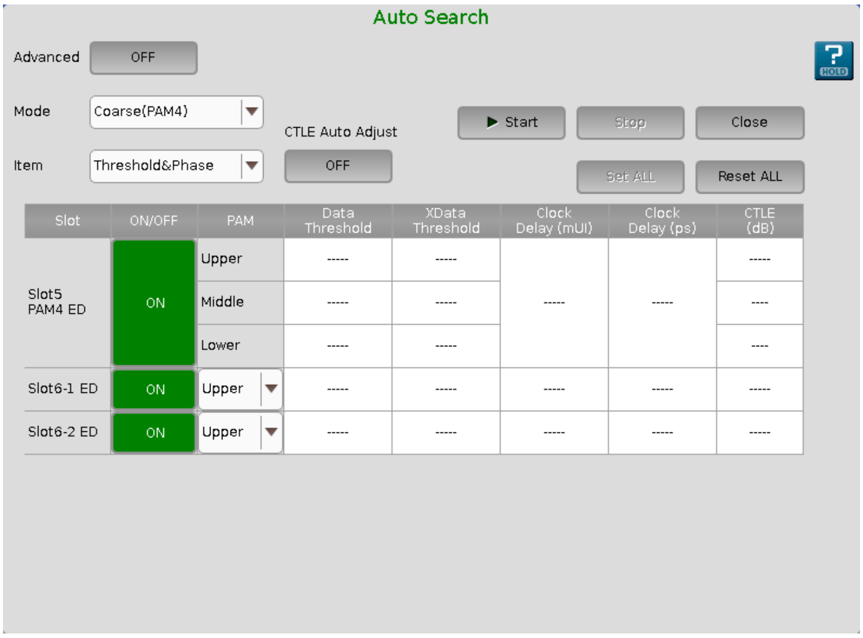

Figure 5.6.1.3-1 Auto Search setting screen

5.6.1.4 Auto Adjust

AutoAdjust setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

Before executing a setting/query command, specify the Auto Adjust by using the :SYSTem:CFUNction command.

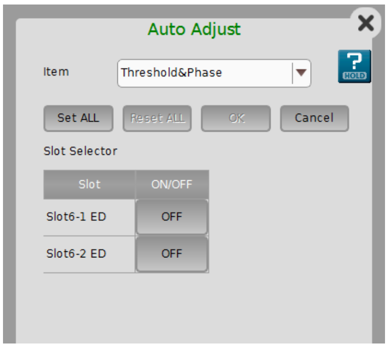

Figure 5.6.1.4-1 Auto Adjust setting screen

5.6.1.5 Pattern Editor

This section describes the pattern file save/read commands for the PPG and the ED. Before executing a setting/query command, specify the slot number of the module to be remotely controlled, by using the :MODule:ID command. Refer to 5.6.1.1 “Commands for common settings” for how to specify a slot number with the :MODule:ID command

Table 5.6.1.5-1 Pattern Editor setting commands

Setting Items	Commands
Open	:SYSTem:MMEMory:PATTern:RECall
Save	:SYSTem:MMEMory:PATTern:STORe

:SYSTem:MMEMory:PATTern:RECall <file_name>,<file_type>

Parameter	<file_name> = <STRING PROGRAM DATA>	
	"<drv>:\[<dir>]<file>"	
	<drv> = C, D, E, F	
	<dir> = <dir1>\<dir2>\... (Omitted for the root directory)	
	<file> = File name	
	<file_type> = <CHARACTER PROGRAM DATA>	
	BIN	Binary file
	TXT	Text file
Function	Opens a pattern file.	
Example	To open a pattern file in the specified file format from the specified destination:	
	`> :SYSTem:MMEMory:PATTern:RECall "C:\Test\example",BIN`	
Compatibility	Compatible with MP1800A.	

:SYSTem:MMEMory:PATTern:STORe <file_name>,<file_type>

Parameter	<file_name> = <STRING PROGRAM DATA>	
	"<drv>:\[<dir>]<file>"	
	<drv> = C, D, E, F	
	<dir> = <dir1>\<dir2>\... (Omitted for the root directory)	
	<file> = File name	
	<file_type> = <CHARACTER PROGRAM DATA>	
	BIN	Binary file
	TXT	Text file
Function	Saves a pattern file.	
	Note:	
	The settings will not be read from the saved file if the file name is changed.	
Example	To save a pattern file to the specified destination in the specified file format:	
	`> :SYSTem:MMEMory:PATTern:STORe "C:\Test\example",TXT`	
Compatibility	Compatible with MP1800A.	

5.6.2 Synthesizer Commands

MU181000A/B setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

Before executing a setting/query command for the Synthesizer, specify the slot number of the module to be remotely controlled, by using the :MODule:ID command. Refer to 5.6.1.1 “Commands for common settings” for how to specify a slot number with the :MODule:ID command.

5.6.3 Jitter Commands

MU181500B setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

Before executing a setting/query command for the MU181500B, specify the slot number of the module to be remotely controlled, by using the :MODule:ID command. Refer to 5.6.1.1 “Commands for common settings” for how to specify a slot number with the :MODule:ID command.

5.6.3.1 Commands List

Table 5.6.3.1-1 MU181500B Command List

No.	Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command/ Query	Remarks
1	:OUTPut	:AUX	:JCONdition		Q	
2			:REFClock		C/Q	
3				:MONitor	Q	
4			:SELect		C/Q	
5			:SUBRateclock		C/Q	
6				:AMPLitude	C/Q	
7				:MONitor	Q	
8		:CLOCk	:FREQuency		C/Q	Synthesizer compatible
9			:OFFset	:PPM	C/Q	Synthesizer compatible
10		:RCLock	:SELect		C/Q	Synthesizer compatible

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Table 5.6.3.1-1 MU181500B Command List (Cont'd)

No.	Command Header 1	Command Header 2	Command Header 3	Command Header 4	Command/ Query	Remarks
11	:SOURce	:JITTer	:BUJ	:AMPLitude	C/Q	
12				:BITRate	C/Q	
13				:ENABle	C/Q	
14				:LPFilter	C/Q	
15				:PRBS	C/Q	
16			:EXTJitter	:ENABle	C/Q	
17			:RJ	:AMPLitude	C/Q	
18				:DEFault	C	
19				:ENABle	C/Q	
20				:FILTer	C/Q	
21				:HFAMplitude	C/Q	
22				:HPFilter	C/Q	
23				:LFAMplitude	C/Q	
24				:LPFilter	C/Q	
25				:MONitor	Q	
26			:SJ[2]	:AMPLitude	C/Q	
27				:ENABle	C/Q	
28				:FREQuency	C/Q	
29			:SSC	:DEViation	C/Q	
30				:ENABle	C/Q	
31				:FREQuency	C/Q	
32				:TYPE	C/Q	
33		:OUTPut	:PATA	:JOVerload	Q	
34				:MONitor	Q	
35				:SELect	C/Q	
36	:SYSTem	:INPut	:CSELect		C/Q	
37				:MODule	Q	
38		:MMEMory	:RECall		C	
39			:STORe		C	

5.6.4 21G/32G bit/s SI PPG Commands

MU195020A setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

Before executing a setting/query command, specify the slot number of the module to be remotely controlled, by using the :MODule:ID command. Refer to 5.6.1.1 “Commands for common settings” for how to specify a slot number with the :MODule:ID command.

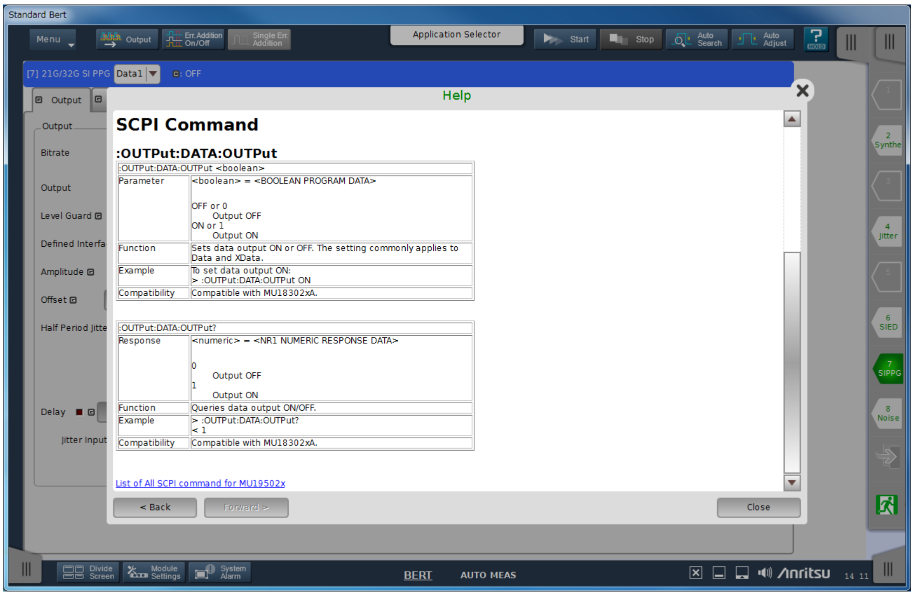

Figure 5.6.4-1 Example of On-Screen Help

5.6.5 21G/32G bit/s SI ED Commands

MU195040A setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

Before executing a setting/query command, specify the slot number of the module to be remotely controlled, by using the :MODule:ID command. Refer to 5.6.1.1 “Commands for common settings” for how to specify a slot number with the :MODule:ID command.

5.6.6 Noise Generator Commands

MU195050A setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

Before executing a setting/query command, specify the slot number of the module to be remotely controlled, by using the :MODule:ID command. Refer to 5.6.1.1 “Commands for common settings” for how to specify a slot number with the :MODule:ID command.

5.6.7 PAM4 PPG Commands

MU196020A setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”

Before executing a setting/query command, specify the slot number of the module to be remotely controlled, by using the :MODule:ID command. Refer to 5.6.1.1 “Commands for common settings” for how to specify a slot number with the :MODule:ID command.

5.6.8 PAM4 ED Commands

MU196040A/B setting and query commands explanation can be referred to from on-screen help. For how to display the on-screen help, refer to 3.2.1.3 “Help”.

Before executing a setting/query command, specify the slot number of the module to be remotely controlled, by using the :MODule:ID command. Refer to 5.6.1.1 “Commands for common settings” for how to specify a slot number with the :MODule:ID command.

Appendix A Software Licenses

This product includes the software listed in the following table.

For the software details, refer to the Anritsu Web site at
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Package software in the table is not included our software licensing.

Table A-1 Packages and Corresponding Licenses

Package	License	Remarks
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(*2) LGPL:

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Version 2.1, February 1999

[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

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