# MX190000A Signal Quality Analyzer-R Control Software Operation Manual

## **Eighth 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**

# 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



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



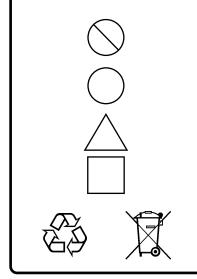
This indicates a hazardous procedure that could result in serious injury or death if not performed properly.



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)
- 8 November 2019 (Eighth Edition)

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- 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.

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In the event of this equipment malfunctions, 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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  - ii) If this Software is used in conjunction with other non-Anritsu-approved software.
  - iii) Recovery of lost or damaged data.
  - iv) If this Software or the Equipment has been modified, repaired, or otherwise altered without Anritsu's prior approval.
  - v) For any other reasons out of Anritsu's direct control and responsibility, such as but not limited to, natural disasters, software virus infections, etc.
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## **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 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 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 memory stick 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 memory stick and CF memory card).

• Connecting to network Connect your computer to the network that provides adequate protection against computer viruses.

## Cautions on Proper Operation of Software

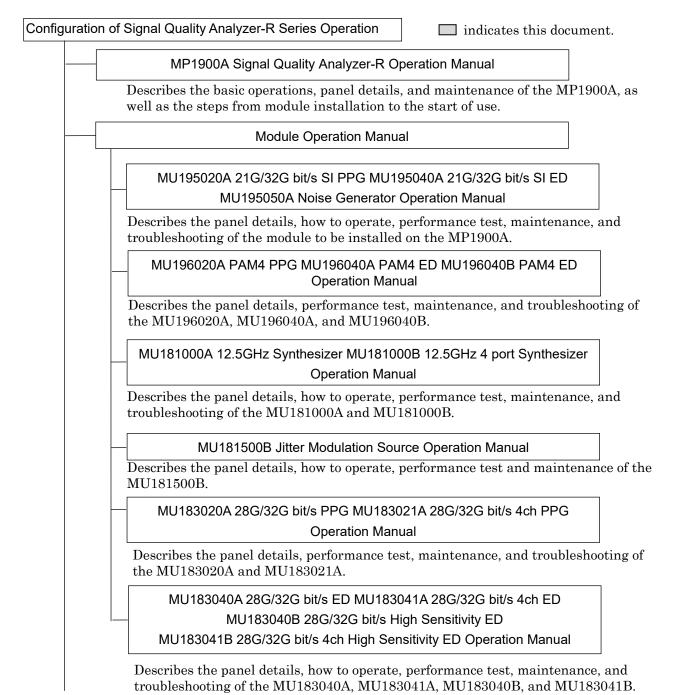
This software may not operate normally if any of the following operations are performed on your computer:

- 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 Manuals (Cont'd)

 $\hfill \square$  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.

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

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# 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").

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## 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

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

## **1.3 Operating Environment**

Use a PC with at least the performance shown below.

ltem	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 $1600 \times 900$ dots
Display colors	At least 65536 colors
Hard disk	At least 200 MB disk space for full installation
Remote interface	At least 100BASE-TX

 Table 1.3-1
 Operating Environment

# ▲ CAUTION

Operation failure may arise if any of the following occurs on the PC when the MX190000A is operating.

- Simultaneous execution with another application
- Closing the display (for laptop PCs)
- Screensaver activation
- Battery saving function activation (for laptop PCs)

Refer to the operation manual of the PC used for how to turn off each function.

# Chapter 2 Preparation

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

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# 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.

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

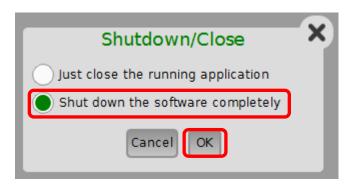


Figure 2.1.1-1 Shutdown/Close Dialog Box

2. Install MX190000A.

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

MX190000A\_VER\_x\_xx.exe

x\_xx\_xx above indicates the software version.

To newly install MX190000A

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

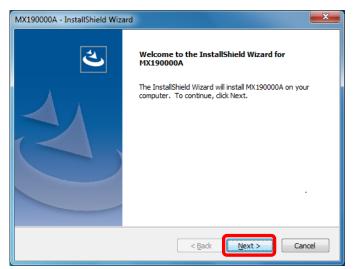


Figure 2.1.1-2 Welcome Page

2

### 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.

Í	MX190000A - InstallShield Wizard
	Reinstall all program features installed by the previous setup.
	<u>Y</u> es <u>N</u> o

Figure 2.1.1-3 Confirming Reinstallation

### Note:

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

MX190000A - InstallShield Wizard
Customer Information Please enter your information.
Please enter your name, the name of the company for which you work and the product serial number.
User Name:
Anritsu
<u>C</u> ompany Name:
Anritsu Corporation
Serial Number:
1234567890
InstallShield
< <u>Back</u> Cancel

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**.

MX190000A - InstallShield Wizard	×
Setup Type Select the setup type that best suits your needs.	
Click the type of setup you prefer.	
MP 1900A	Description
External PC	Signal Quality Analyzer - R
InstallShield	
< <u>B</u> ac	k Next > Cancel

Figure 2.1.1-5 Setup Type Page

2

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**.

MX1900	000A -	InstallShield Wizard		<b>— X</b>
		estination Location der where setup will install files		
		Install MX190000A to: C:\Anritsu\MP1900A		<u>C</u> hange
InstallSh	ield —		< Back Next >	Cancel

Figure 2.1.1-6 Choose Destination Location Page

 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.

Select Features Select the features setup will install.	
Install unit / modules emulator	deselect the features you do not want to install. Description for emulation mode.
382.70 MB of space required on the C drive 103143.20 MB of space available on the C d istallShield	
ISTAIRDI IICIA	< Back Next > Cancel

Figure 2.1.1-7 Select Features Page

2

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**.

MX190000A - InstallShield Wizard	×
Select Option Select the options you want to install.	5
To install a option, dick the check box next to it. If the check box is clear, that option w not be installed.	йll
Make a shortcut on Desktop.	
InstallShield	
< <u>Back</u> <u>N</u> ext > Car	icel

Figure 2.1.1-8 Select Option Page

8. Touch Install.

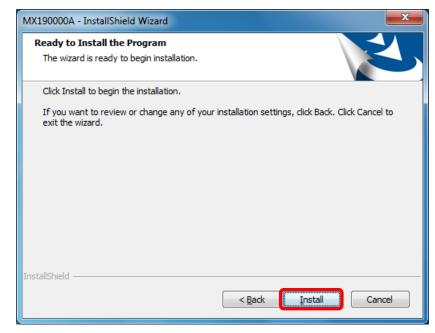


Figure 2.1.1-9 Ready to Install the Program Page

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

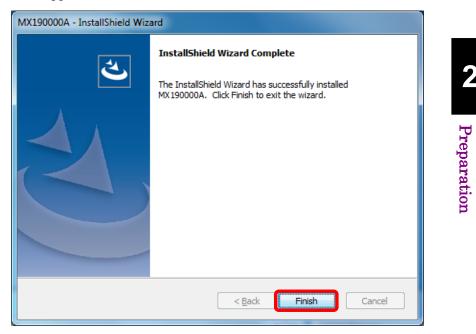


Figure 2.1.1-10 InstallShield Wizard Complete Page

2

### 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**.

Sticky Notes	
Paint •	Anritsu_User
Snipping Tool	Documents
Calculator	Pictures
On-Screen Keyboard	Music
Signal Quality Analyzer-R	Games
	Computer
	Control Panel
	Devices and Printers
	Default Programs
X	Help and Support
All Programs	
	Shut down 🕨

Figure 2.1.2-1 Control Panel

2. In Control Panel, touch Programs and Features.

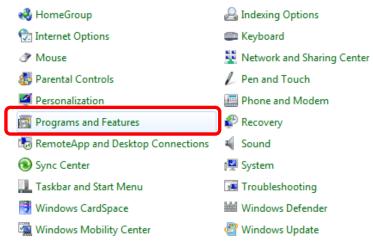


Figure 2.1.2-2 Programs and Features

Name	Publisher
Adobe Acrobat Reader DC	Adobe Systems Incorporated
Intel(R) Network Connections 21.0.504.0	Intel
😹 Intel® Graphics Driver	Intel Corporation
😹 Intel® Management Engine Components	Intel Corporation
😹 Intel® USB 3.0 eXtensible Host Controller Driver	Intel Corporation
💷 Microsoft Visual C++ 2010 x86 Redistributable - 10.0	Microsoft Corporation
Microsoft Visual C++ 2013 Redistributable (x86) - 12.0	Microsoft Corporation
MP1900A GPID Driver	Amitsu Corporation
MX190000A	Anritsu
Vational Instruments Software	National Instruments
TPService	DMC
VISA Shared Components 64-Bit	
💐 Windows Driver Package - Anritsu (xnidgpib) XGPIB (	Anritsu

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

Figure 2.1.2-3 Uninstallation

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

1	MX190000A - InstallShield Wizard
	Do you want to completely remove the selected application and all of its features?
	<u>Y</u> es <u>N</u> o

Figure 2.1.2-4 Confirming Uninstallation

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.

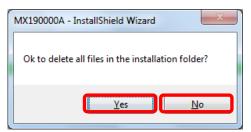


Figure 2.1.2-5 Confirmation of Deleting Folder

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

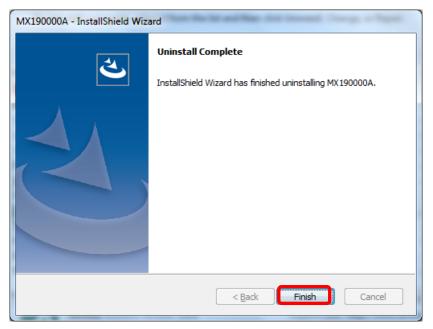


Figure 2.1.2-6 Completion of Uninstallation

# 2.2 Starting MX190000A

This section describes how to start the MX190000A.

## 2.2.1 When Installed on MP1900A

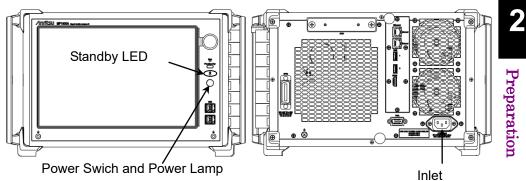


Figure 2.2.1-1 Standby LED and Power Cord Connector of MP1900A

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



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.

	Applications		
PAM4 PPG/ED Based System (NRZ test is also available.)	Standard BERT for PAM4		
SI PPG/ED Based System (PAM4 test is also available.)	Standard BERT for SI		
Miscellaneous System	Expert BERT		
Utility	MX183000A PAM4 Control		
		🙀 ESCA	J

Figure 2.2.1-2 Application Selector

## 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.

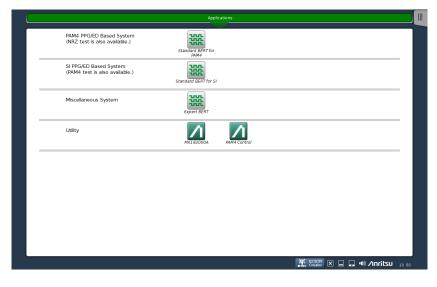


Figure 2.2.2-1 Application Selector

### 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.

命 Home	Display
Find a setting	Scale and layout
System	Change the size of text, apps, and other items
🖵 Display	125% (Recommended)
4》 Sound	150%
Notifications & actions	175%

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.

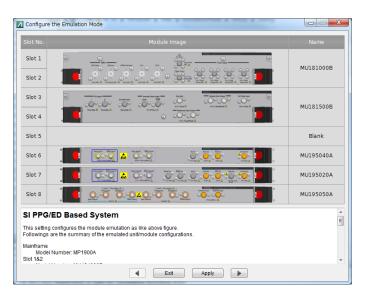


Figure 2.2.3-1 Configure the Emulation Mode Tool

On the tool, use **and b** to select the emulation mode, and then click **Apply** 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 **R**. Select **Shut down the software completely** and touch **OK**.

Shutdown/Close	X
<ul> <li>Just close the running application</li> <li>Shut down the software completely</li> </ul>	
Cancel 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.

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.

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# 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 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.

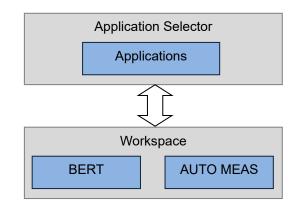


Figure 3.1.1-1 Two Functional Spaces

#### 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.

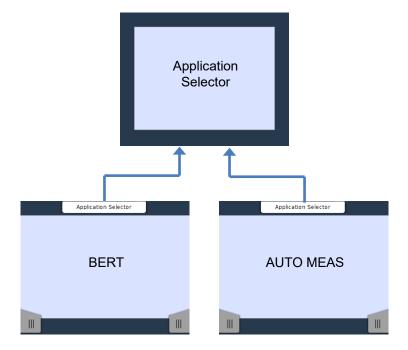


Figure 3.1.2-1 Vertically Switching to Application Selector from Workspace

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.

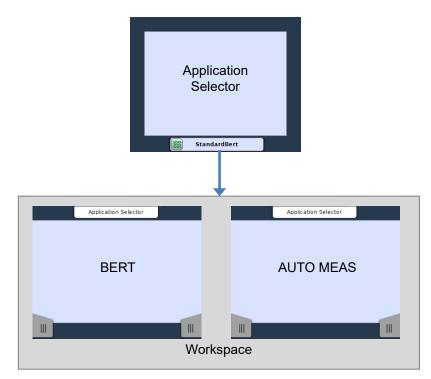


Figure 3.1.2-2 Switching to Workspace from Application Selector

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.

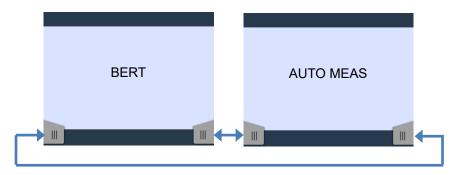


Figure 3.1.2-3 Horizontally Switching by Using Navigation Tabs

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

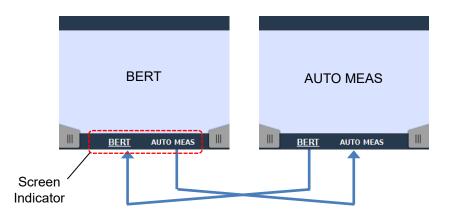


Figure 3.1.2-4 Switching Between Screens by Touching the Screen Indicator

# 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.

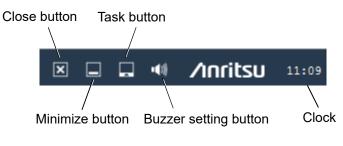


Figure 3.1.3-1 System Control Area

# 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.

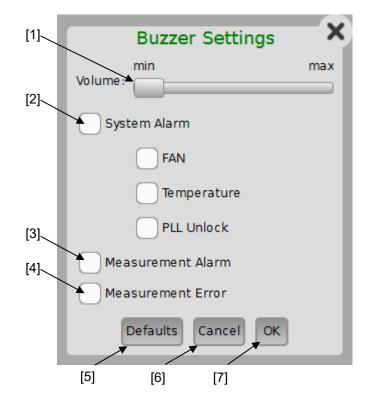


Figure 3.1.3.2-1 Buzzer Settings Dialog Box

- [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 **X** displays the dialog box below.

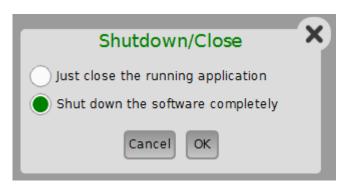


Figure 3.1.3.5-1 Shutdown/Close Dialog Box

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 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 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 PAM4 module, but that can also evaluate NRZ signals.

	Applications	
PAM4 PPG/ED Based System (NRZ test is also available.)	Standard BERT for	
SI PPG/ED Based System (PAM4 test is also available.)	Standard BERT for SI	
Miscellaneous System	Expert BERT	
Utility	MX1 83000A PAM4 Control	
	🙀 EZSCPI 🛛 🗖 🖬 Vinrit	<b>ISU</b> 13 50

Figure 3.1.4.1-1 PAM4 PPG/ED Based System Area

# 3.1.4.2 SI PPG/ED Based System Area

The **SIPPG/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

	Applications	
PAM4 PPG/ED Based System (NRZ test is also available.)	Standard BERT for PAM4	
SI PPG/ED Based System (PAM4 test is also available.)	Standard BERT for SI	
Miscellaneous System	Expert BERT	
Utility	MX183000A PAM4 Control	
	ingi ez ∎raco Cr	eator 🗵 🗖 📮 📢 Anritsu 13 50

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.

	Applications	
PAM4 PPG/ED Based System (NRZ test is also available.)	Standard BERT for PAM4	
SI PPG/ED Based System (PAM4 test is also available.)	Standard BERT for SI	
Miscellaneous System	Expert BERT	
Utility	MX183000A PAM4 Control	
		na Ezsceri ⊠ 🗖 📮 📢 ∕nnritsu 13 50

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.

		Applications		
	PAM4 PPG/ED Based System (NRZ test is also available.)	Standard BERT for PAM4		
	SI PPG/ED Based System (PAM4 test is also available.)	Standard BERT for SI		
	Miscellaneous System	Expert BERT		
$\square$	Utility	MX1 83000A PAM4 Control		
			Figure Creator ≥ □ □ □ • • • /nritsu 13 50	

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 **I** 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".

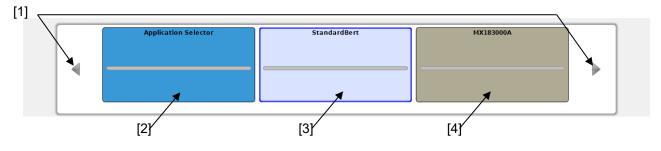


Figure 3.1.5-1 Taskbar

[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.

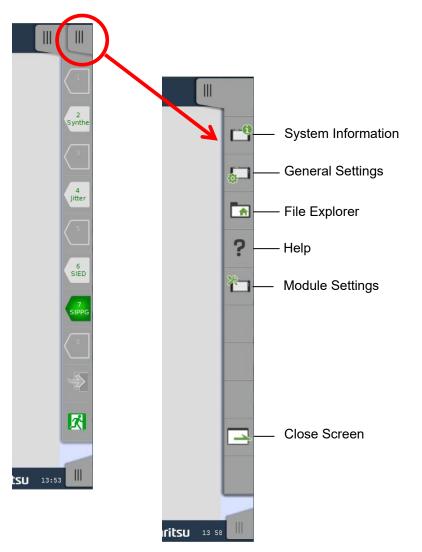
[4] Utility Task

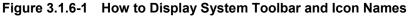
The name of the running utility is displayed on the task button. When no utilities are running on Workspace, Utility Task does not appear. Touching this task button changes screen display to the running utility.

# 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.





#### 3.1.6.1 System Information

Touching Isplays System Information. Touching Update About

Info updates System Information to latest one.

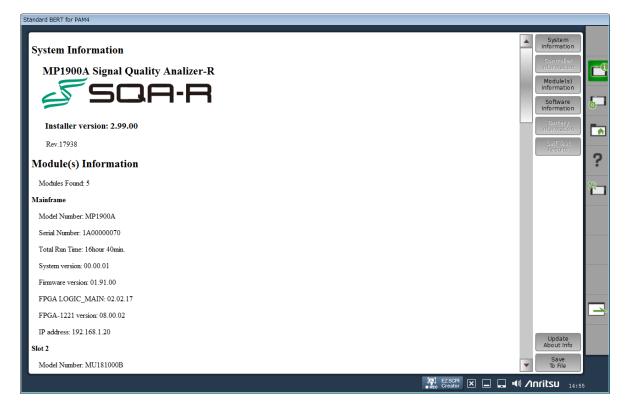


Figure 3.1.6.1-1 System Information

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.

3

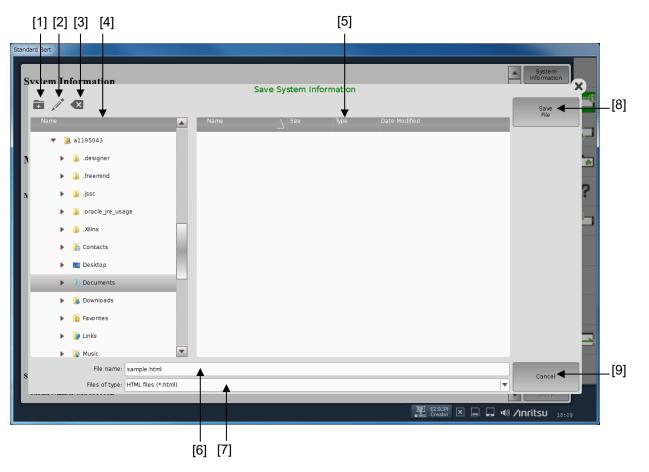
**Basic Operations** 

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.





- [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.

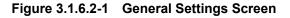
[5]	File View
	Displays file names.
[6]	File name
	Enter the name for the file to save.
[7]	Files of type
	Specify a file format.
[8]	Save File
	Saves a file by the specified file name.
[9]	Cancel
	Closes the <b>Save System Information</b> dialog box.

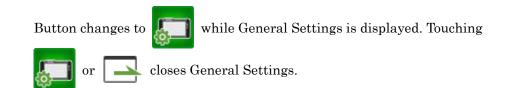
# 3.1.6.2 General Settings

Touching

displays General Settings.

Standard BERT for PAM4		
	General	
File Open	File Save	Initialize Application
Logging	Auto-Launch	
Off	Off	Remote Control
		?
		1
L		
		🙀 EZSOPI 🗵 🗔 📮 🕬 /infitsu 13 13





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.

Change Logging Settings 🗙
Framework Logging: Off
Operation Logging: Off
Exception Logging: Off
Debug Logging: Off
GUI Operation Logging: Off
Defaults Cancel OK

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.

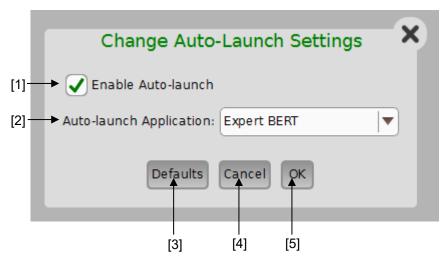


Figure 3.1.6.2-3 Change Auto-Launch Settings Dialog Box

#### [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.

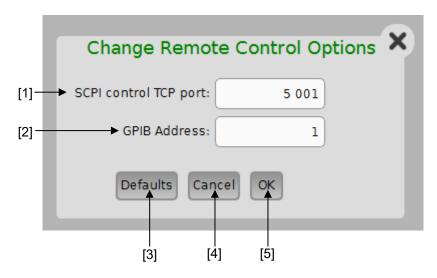


Figure 3.1.6.2-4 Change Remote Control Options Dialog Box

[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.

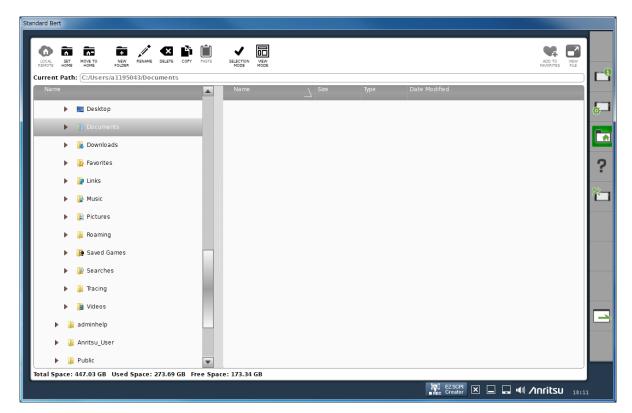


Figure 3.1.6.3-1 File Explorer Screen

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.

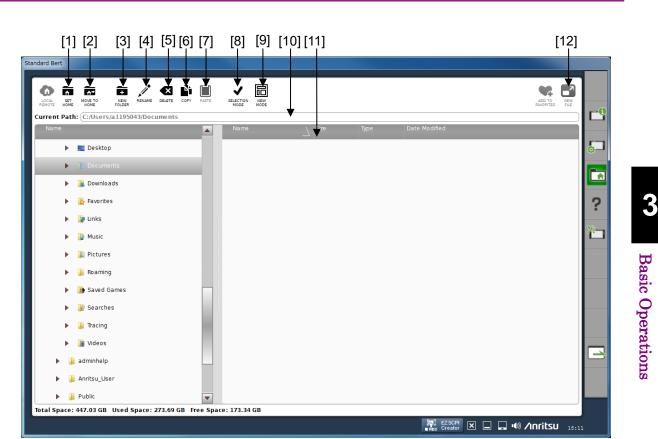


Figure 3.1.6.3-2 File Explorer Screen

[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.

3-23

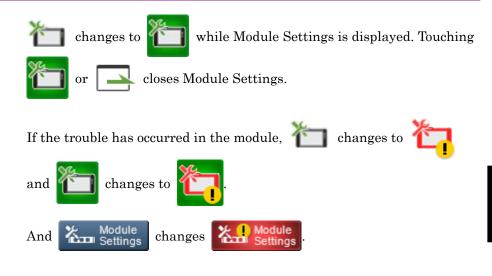
3.1

		[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	0		
		Touching 🛛 🛜 icon displays the English operation manual in PDF.		
3.1.6.5	Module Setting	S		
		Touching Touching displays Module Settings.		
		Also, Touching Kodule 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.

C Co	ombination Setting	Module Grouping     Multi Channel Calibration			Prog	ram
	Slot No.	Module Image	Name	State	Program	
	Mainframe	N/A	MP1900A	GOOD	FPGA Firmware	
	Slot 1			c	FPGA	
	Slot 2		MUISIOOB	GOOD	Firmware	
	Slot 3			GOOD	FPGA	
	Slot 4			000	Firmware	
	Slot 5					
	Slot 6		MU195040A	GOOD	FPGA Firmware	
	Slot 7		MU195020A	GOOD	FPGA Firmware	
	Slot 8		MU195050A	GOOD	FPGA Firmware	

Figure 3.1.6.5-1 Module Settings Screen



#### Details of Module Settings screen are shown below.

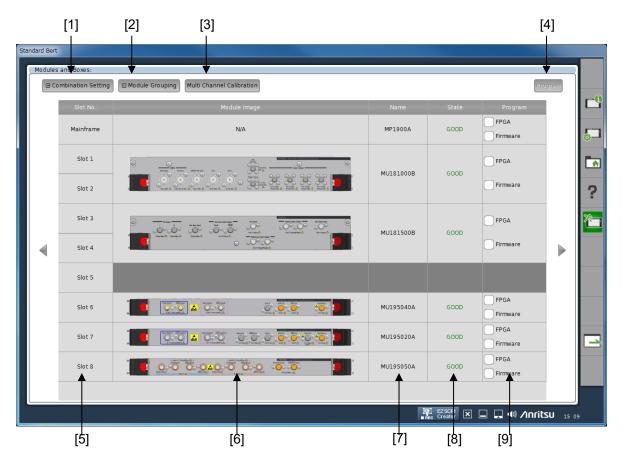


Figure 3.1.6.5-2 Modules Settings Screen

[1] 🖸 Combination Setting

Touching this button displays the **Combination Setting** dialog box. For details, refer to 3.3 "Multi Channel Function".

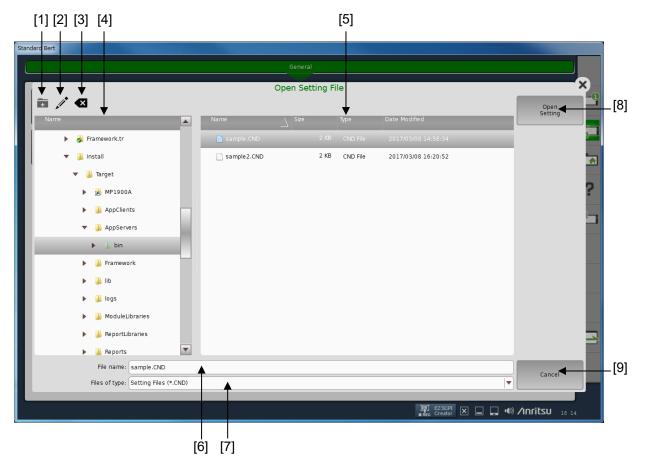
[2]	G Module Grouping Touching this button displays the <b>Grouping</b> dialog box.
	For details, refer to 3.4 "Module Grouping Function".
[3]	Multi Channel Calibration
	Touching this button displays the <b>Module Channel Calibration</b> dialog box. For details, refer to 3.5 "Multi Channel Calibration 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 <b>Version Mismatch,</b> 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 $( \bigcirc \rightarrow \checkmark )$ and touch <b>Program</b> .
	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 <b>Program</b> .

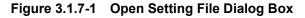
# 

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).





- [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).

	Folder View Displays folders in a tree format.
[5]	File View Displays files.
	File name Specify a setting information file name.
[7]	Files of type Specify a file format.
	Open Setting Opens a specified setting file.
	Cancel Closes the <b>Open Setting File</b> 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).

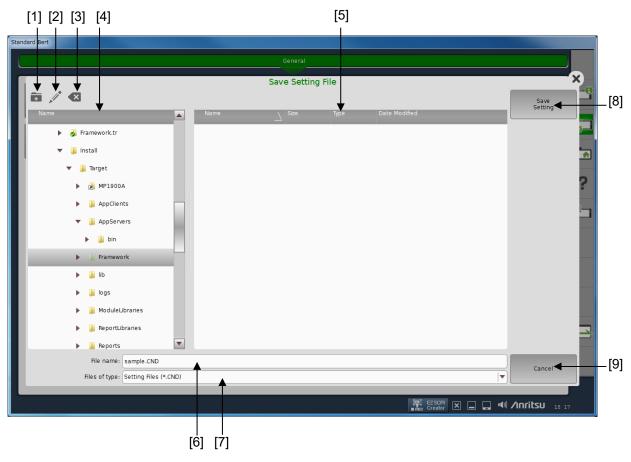


Figure 3.1.8-1 Save Setting File Dialog Box Explanation

[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 <b>Save Setting File</b> 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.





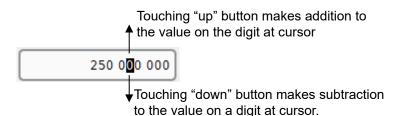
 Controller move button (upper) Touching this button moves numeric value input controller upper direction.

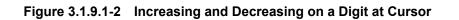
#### [2] Up-down and left-right buttons

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

• Up-down buttons

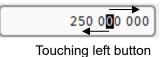
Touching up-down buttons increase or decrease the value in digit where cursor is positioned.





Left-right buttons
 Touching left or right button moves cursor left or right.

Touching right button moves cursor right.



moves cursor left.

#### 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.

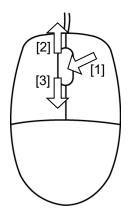
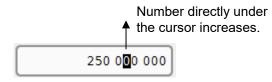


Figure 3.1.9.1-4 How to Use Center Wheel of Mouse

[1] Clicking center wheel

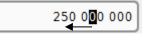
Clicking center wheel switches between "add-subtract mode" which makes addition or subtraction the value on the digit at cursor and "cursor move mode" which allows cursor to move left or right.

- [2] Rotating center wheel upward
  - In case of "add-subtract mode" Rotating center wheel upward increases a number directly under the cursor.

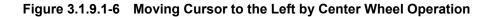


### Figure 3.1.9.1-5 Increase a Number under Cursor by Center Wheel Operation

• In case of "cursor move mode" Rotating center wheel upward moves cursor left.



Cursor moves to the left.



#### [3] Rotating center wheel downward

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

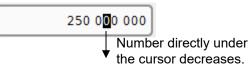


Figure 3.1.9.1-7 Decrease a Number under Cursor by Center Wheel Operation

• In case of "cursor move mode" Rotating center wheel downward moves cursor right.

Cursor moves to the 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.

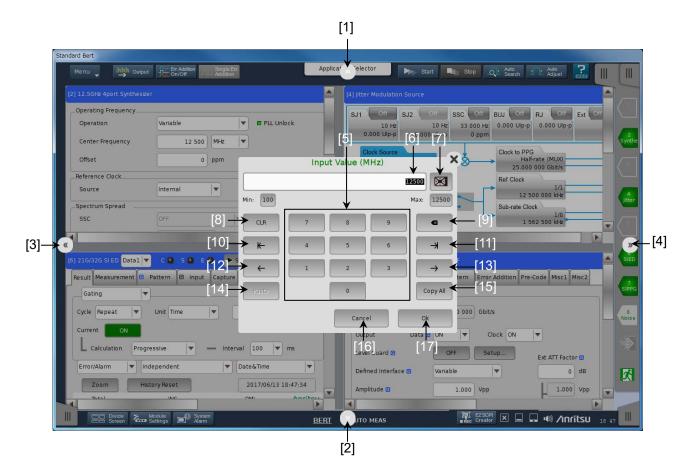


Figure 3.1.9.2-1 Numeric Value Input Pad Explanation

- 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 areaNumeric value to be edited appears here.

- Deletes a numeric character displayed in the numeric value display area. When multiple numeric characters are selected, all of them will 3
  - **Basic Operations**

[12] Left button

[7] Numeric Value Input Controller Display button

Touching this button displays numeric value input controller.

Deletes all numeric characters displayed in the numeric value

Moves cursor to the most left digit in Numeric value display area.

Moves cursor to the rightmost digit in Numeric value display area.

Moves cursor left.

[13] Right button

Moves cursor right.

[14] Paste

[8]

CLR

display area. [9] Back Space button

be deleted.

[10] Home button

[11] End button

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

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.

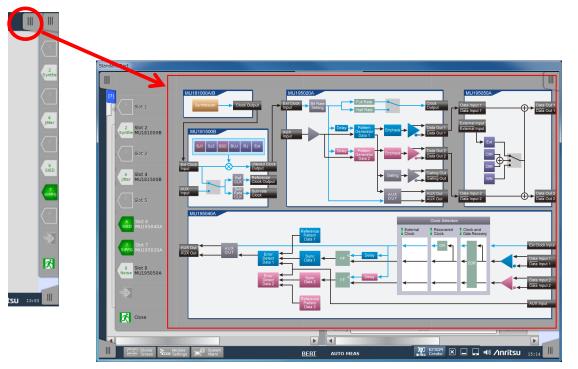


Figure 3.2.1.2-1 How to Display Extended Application

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.

	He	lp
Descrip	otion	
- Sets jitter mod	lulation frequency in Hz units	
	ommand	
SCFIC	omnand	
	:JITTer:SJ:FREQuency	
:SOURce:JITTer	:SJ:FREQuency <numeric></numeric>	
Parameter	<numeric> = <decimal data="" numeric="" program=""></decimal></numeric>	
	10 to 25000000 10 to 250,000,000 Hz	
	Setting Step	
	10[Hz]≤fmod≤10[kHz] 1 Hz Step 10(Hz]≤fmod≤100[kHz] 10 Hz Step 100[kHz]≤fmod≤1[MHz] 100 Hz Step 1[MHz]≤fmod≤10[MHz]	
	1 kHz Step 10[HHz]≤fmod≤100[MHz] 10 kHz Step 100[MHz]≤fmod≤250[MHz] 100 kHz Step	
Function	Sets SJ modulation frequency and units.	
Example	To set modulation frequency to 10 kHz: > :SOURce:JITTer:SJ:FREQuency 10000	
Compatibility	Incompatible with existing models.	
< Back	Forward >	Close

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 **P** twice, the button changes to green (



"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.

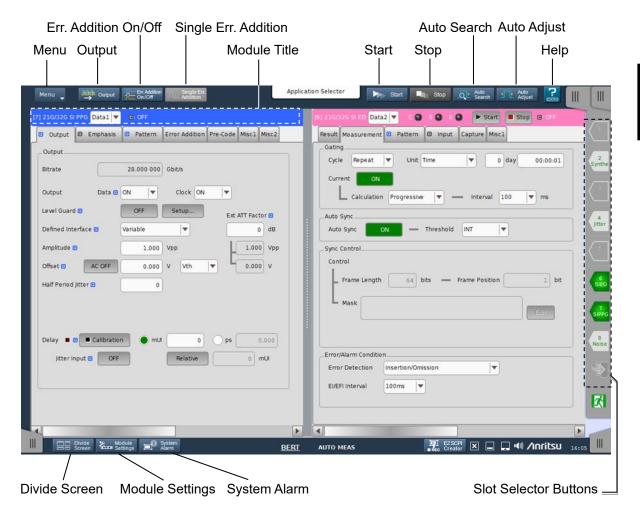


Figure 3.2.2-1 BERT Screen

### 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.

Slot Selector Buttons	Description
5	No Modules Module is not installed in the slot. No action even if touching the button.
6 SIED	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.
7 SIPPG	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.

Table 3.2.2.1-1 lot Selector Button Indication

Correspondence between module abbreviation and model is shown below.

-	
Synthe	MU181000A/B
SIPPG	MU195020A
SIED	MU195040A
PAM4PPC	HU196020A
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 Slot 7 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 Slot 6 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 Slot 6 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.

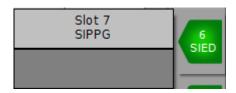


Figure 3.2.2.1-2 Screen Selector (Up-Down Division)

In this example, the module application of Slot 7 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 Slot 6 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 Slot 6 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 Slot 7 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 Slot 6 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 Slot 6 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

 Slot Number Displays slot number of the module.
 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.

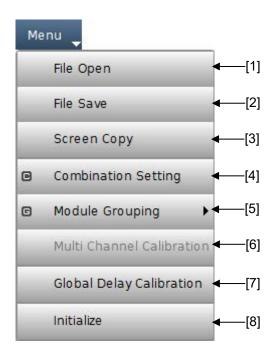


Figure 3.2.2.3-1 Menu Items

[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] **G** 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".

Global Delay	Calibrati	on X
Slot Selector		
Slot	ON/OFF	
Slot6-1 SI-ED	ON	
Slot6-2 SI-ED	ON	
Slot7-1 SI-PPG	ON	
Slot7-2 SI-PPG	ON	
Reset ALL Set ALL	ОК	Cancel

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.

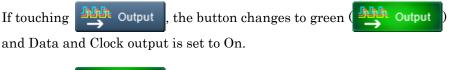
### Note:

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.





## 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".







and Error addition is set to On.



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".

3

		Touching Single Err. Addition inserts an error in output of all PPGs.
3.2.2.7	Start	
		Start function starts measurements of all module applications.
		If touching Start , the button changes to green ( Start )
		and all module applications start measurement.
3.2.2.8	Stop	
		Stop function stops measurements of all module applications.
		If touching Stop, all module applications stop measurement.
		Note that Stop 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.

Auto Search

• In the PAM4 ED application, **Pre Coder** is set to **ON**.

Also, if the PAM4 ED receives a signal having a bit phase shift of more than 48 bits between MSB and LSB, the Auto Search function is terminated unsuccessfully.

Touching

displays the **Auto Search** dialog box.

#### 3.2 **Operation on Workspace** Auto Search **?** Coarse Mode T Close Start CTLE Auto Adjust Threshold&Phase ▼ lte m Set ALL Data Threshold XData Threshold Clock Delay (mUI) Clock Delay (ps) CTLE (dB) Slot6-1 ED OFF -----\_\_\_\_\_ ---------------Slot6-2 ED OFF \_\_\_\_\_ \_\_\_\_\_ -----\_\_\_\_\_ \_\_\_\_\_

Figure 3.2.2.9-1 Auto Search 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".

Pasic Operations

### 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.

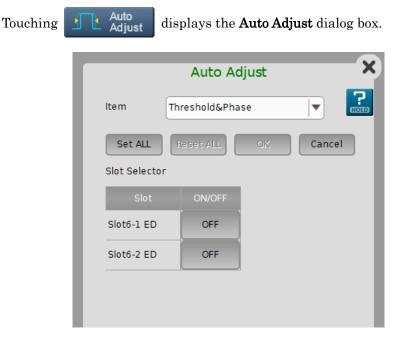
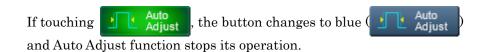


Figure 3.2.2.10-1 Auto Adjust Dialog Box

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".



## 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.

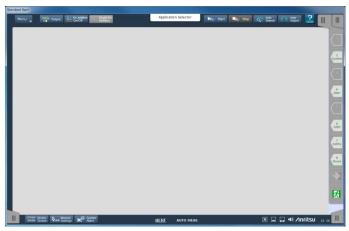


Figure 3.2.2.11-1 No Dividing

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

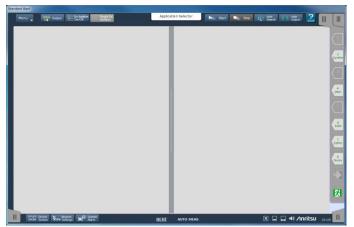
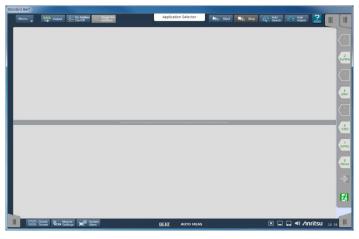


Figure 3.2.2.11-2 Left-Right Division



- 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.

Standard Bert						
Menu Output	Addion Single Em Addisin	Applicatio	on Selector	🖡 Start 🔳 Stop	Q: Auto	
						2 Synthe
						13
						4 sther
				*******		Set.
						7 SIRPO
		1				
						Noise
						-5
		_				23
		_				
II Divide Kan Module	P System Marm	BERT	AUTO MEAS			inritsu 18 87 📗
and action with settings		UTERIT.	AGIO MEAS			

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".

3

## 3.2 Operation on Workspace

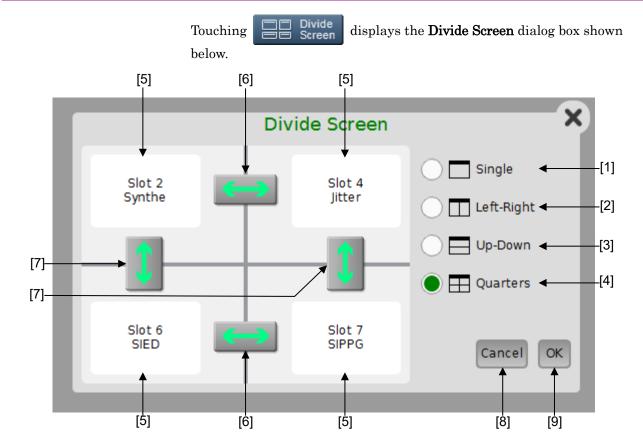


Figure 3.2.2.11-5 Divide Screen Dialog Box

[1] Single

Uses the screen without division.

- [2] Left-RightUses 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.

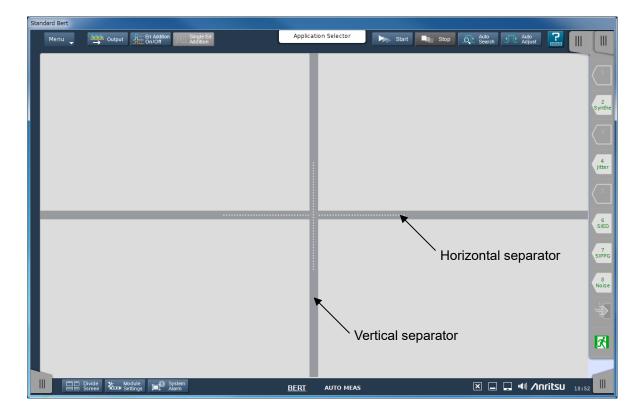


Figure 3.2.2.11-6 Horizontal Separator and Vertical Separator

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.

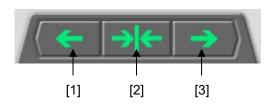


Figure 3.2.2.11-7 Vertical Separator Controller

- [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.

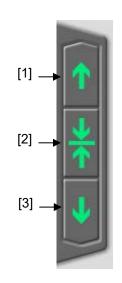


Figure 3.2.2.11-8 Horizontal Separator Controller

- [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.

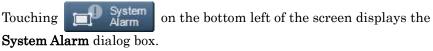
### 3.2.2.12 Module Settings

Touching Kodule Settings 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 (Kell Module).

### 3.2.2.13 System Alarm



System Alarm	×
No Alarm	
_	
Close	

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 (System). 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)

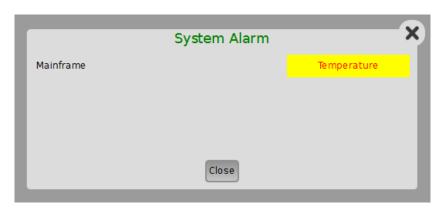


Figure 3.2.2.13-3 System Alarm Dialog Box (Temperature Error)

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.

	Auto Measurement Selector Buttons
Start Stop File Display	Help
Eye Contour Start La Stop File Display Application Selector	
Eye Contour Mask Edit	
Eye Contour	Condition Mask judge Result
Slot6-1 ED V Mask Edit1 V AutorScale	Input Signal NRZ
Scale Max 4.000V Step: 800mV	Eye Contour Set All
Anritsu	Slot6-1 ED OFF Reset All
	Slot6-2 ED OFF
	Auto Search Coarse V Measurement Point 8
	Lower Measurement Ratio 1E-7
	Highlight Error Threshold 5.500 E- 10
Frequency: 12 430 000 kHz Max: 1000mUI Step: 200mUI Scale	Mask OFF Mask Adjust
Marker Status	
ON/OFF Select Cursor Free	
OFF Markers mV	
5Marker www.ml/ www.ml/	
	0% Date&Time 🔻 2017/06/14 07:45:59
BERT AUTO MEAS	🙀 EZSCPI 🗵 🗖 🚚 🕪 /nritsu 🔐 45

Figure 3.2.3-1 AUTO MEAS Screen

### 3.2.3.1 Auto Measurement Selector Buttons

Auto measurement selector buttons appear on Application Toolbar.

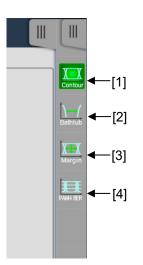


Figure 3.2.3.1-1 Auto Measurement Selector Buttons

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.

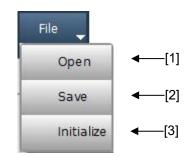


Figure 3.2.3.2-1 File Menu Items

[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 V3.01.00 or later.

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	$\checkmark$	Two to four modules	Two to four modules	Two modules
MU195020A-x10/x30	_	_	_	_	_
MU183020A-x2x/x31	2ch	$\checkmark$	Two to four modules	Two to four modules	Two modules
MU183020A-x1x/x30	_	_	_	_	_
MU183021A-x30	2ch/4ch	$\checkmark$	_	_	$\checkmark$
MU196020A-x30/x50	_	_	Two to four modules	√*	_

 Table 3.3-1
 Model which Multi Channel can be applied

\*: 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.

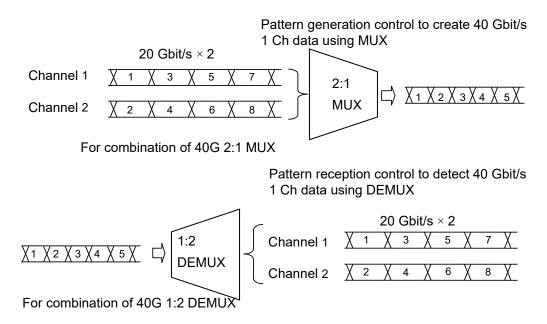


Figure 3.3.1-1 2ch Combination Pattern generation/reception

By using the  $64G \times 2$  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.

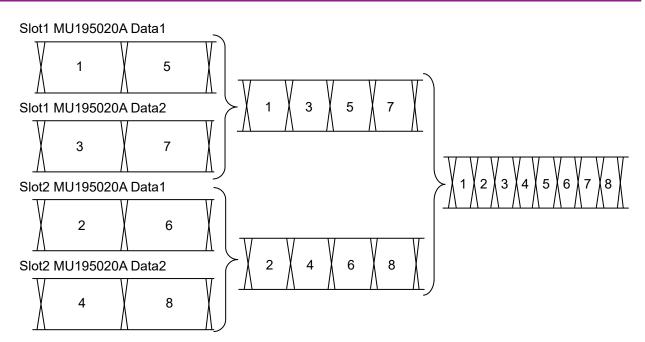
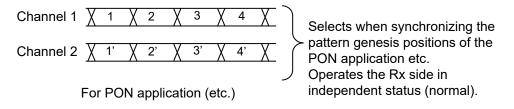


Figure 3.3.1-2 64G x 2ch Combination Pattern Generation (Using 2 modules of MU195020A)

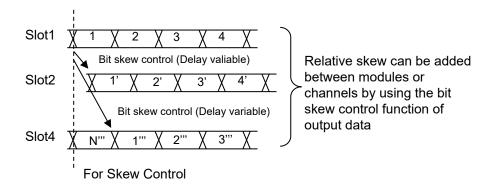
# 3.3.2 Channel Synchronization Function

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.

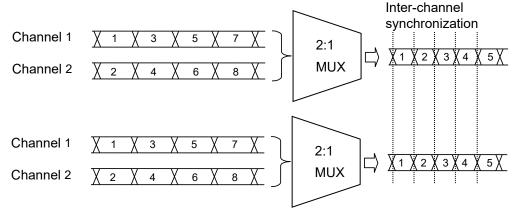








It is possible to Ch Synchronize the two signals of Combination 1 - 2 using two modules of PPG and synthesized by 2 ch Combination.





# 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.

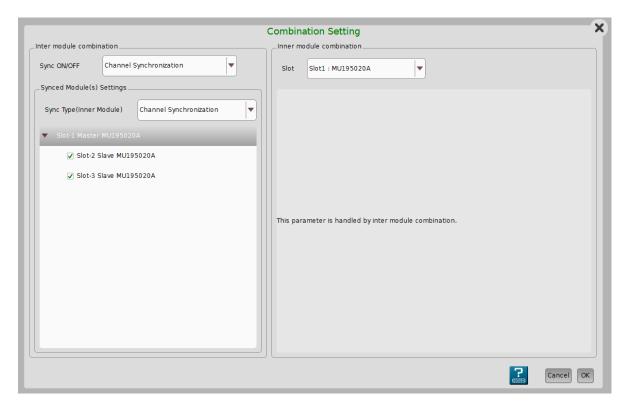


Figure 3.3.3-1 Combination Setting Dialog Box

## 3.3.3.1 Inter module combination area

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

_ Inter module combination					
on 💌					
Offset Delay					
0 ps					
0 ps					
0 ps					

Figure 3.3.3.1-1 Inter module combination area

Table 3.3.3.1-1	Inter module combination settings
	inter medale combination cottinge

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 Slots 2 to 4 with reference to the length of cable to connect to MU196020A in Slot 1.

Range: -20 to +20 ps, 1 ps step

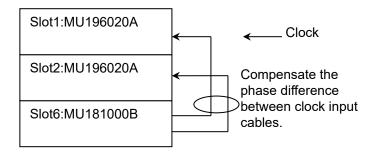


Figure 3.3.3.1-2 Clock Cable Connection

## 3.3.3.2 Inner module combination area

In Inner Module combination area, set inner modules function.

Inner module combination	
Slot Slot1 : MU195020A	
Operation	Combination
Independent	
Combination	
Channel Synchronization	n
Data Interface	Combination
Data 1	2ch PPG
Data 2	201770
L	

Figure 3.3.3.2-1 2ch Combination Settings

Slot1 : MU195020A	T
peration	
Independent	
Combination	
Channel Synchronization	
Channel Synchronization	Channel Synchronization
	Channel Synchronization SYNC

Figure 3.3.3.2-2 Channel Synchronization Settings

Table 3.3.3.2-1 S	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 **G** 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

**E** 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.



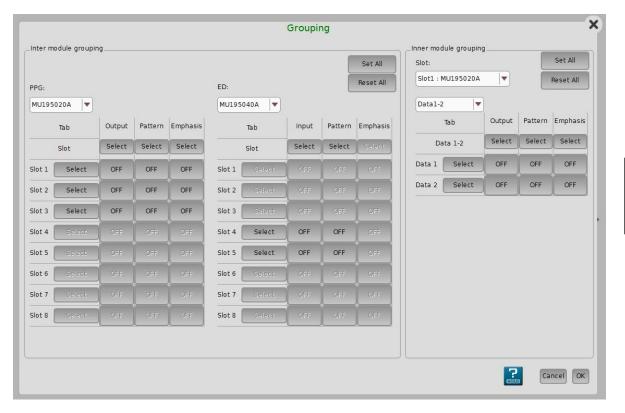


Figure 3.4-1 Grouping Dialog Box

3

**Basic Operations** 

# 3.4.1 Inter module grouping area

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

PPG:					ED:				Reset All
MU1950	020A 💌				MU1950	040A 🔻			
	Tab	Output	Pattern	Emphasis		Tab	Input	Pattern	Emphasis
	Slot	Select	Select	Select		Slot	Select	Select	Select
Slot 1	Select	OFF	OFF	OFF	Slot 1	Select	OFF	OFF	OFF
Slot 2	Select	OFF	OFF	OFF	Slot 2	Select	OFF		OFF
Slot 3	Select	OFF	OFF	OFF	Slot 3	Select	OFF		OFF
Slot 4	Select	OFF		OFF	Slot 4	Select	OFF	OFF	OFF
Slot 5	Select	OFF		OFF	Slot 5	Select	OFF	OFF	OFF
Slot 6	Select	OFF		OFF	Slot 6	Select	OFF		OFF
Slot 7	Select	OFF		OFF	Slot 7	Select	OFF		OFF
Slot 8	Select	OFF		+ ≮ OFF	Slot 8	Select	OFF		

Figure 3.4.1-1 Inter module grouping area

Select a module slot number and the tab which contains parameters to be changed together. The module with the lowest Slot No. is assumed to be the master module.

Touching **Set All** selects all buttons, and touching **Reset All** cancels all buttons.

### 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**.

# 3.4.2 Inner module grouping area

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

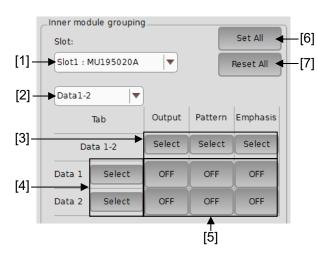


Figure 3.4.2-1 Inner Module Grouping area

[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 **C** mark of parameters that grouping has set turns to **C** (light blue). If grouping setting is canceled, **C** mark of parameters turns to **C** (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. (V3.01.00 or later)
- The ambient temperature of PAM4 PPG has changed from the time of calibration. (V3.01.00 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 V3.01.00 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**.

Multi Channel Calibration
Multi Channel Calibration required to use Combination/CH Synchronization mode. Calibrate?
No Ye s

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.

Multi Channel Calibration
Combination/CH Synchronization mode does not operate normally without performing Multi Channel Calibration. Multi Channel Calibration is executed from the File menu. Calibrate now.
The next Calibration Required dialog message is not displayed.
ОК

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.

Estimated time	or the calibration is as follows:
• SI/32G PPG:	bout 2 to 3 minutes
• PAM4 PPG:	
When linked	o synthesizer: Number of Slave modules × 10
minutes	
When not lin	ed to synthesizer: Number of Slave modules ×
minutes	
	Multi Channel Calibration (1/4)
The operator must input a signa adjustment takes about 10 min	put Clock signal. Also, note that calibration changes the Clock Setting of the PPGs, so
Last calibrated:	Not calibrated:/
Calibrated composition:	
	< EACK NEXT > CANCEL

Touch **Next** after confirming the explanation.

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.

Multi Channel Calibration (2/4)			
Input a 10.000G Clock signal to the PPGs in Slot 1 After connecting the Clock signals correctly, press	to 3. Use cables of the the [Next] button.	e same length for all the	e connections to the PPGs,
	< BACK	NEXT >	CANCEL

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.

Multi Channel Calibration (2/4)		
Connect this MP1900A to the MP1900A in which MU181000A/B is installed, with an Ethernet cable. Then, in the Multi Channel Calibration dialog box, fill in the following information about the connected MP1900A: - IP Address - Port No. - Slot No.		
Use an external synthesizer		
Use MU181000A/B installed in a separate MP1900A		
IP Address 192.168.2.100		
Port No. 5 001		
Synthesizer slot No. 8		
< BACK NEXT > CANCEL		

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

4. Touch **Next**. The Multi Channel Calibration progress is displayed. Multi Channel Calibration (3/4)

Calibrating		
	3%	
	< BACK NEXT >	CANCEL

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.

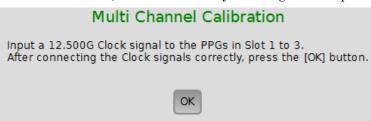


Figure 3.5.2-7 Multi Channel Calibration Dialog Box

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

Multi Channel Calibration (4/4)					
Calibration completed and	Combination/CH Synchroniza	ation function ope	rating normally.		
· ·			<u> </u>		
		< BACK	Finish	CANCEL	

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".

	Multi Channel Calibrati	ion (1/4)	
This adjusts the hit pattern	skew between each channel. This adjustment	requires use of the Corr	hipptics/CH Supermode
The operator must input a si adjustment takes about 10 i	ignal with the frequency specified at the scree	n to the specified input	connector. In addition, this
Caution: Do not add jitter to	the input Clock signal. Also, note that calibrat r Calibration has been completed.	tion changes the Clock S	Setting of the PPGs, so
check the clock setting alte	r calibration has been completed.		
Last calibrated:	Calibrated: 2017/04/12		
Calibrated composition:	Slot1 - 2 Channel Synchronization		

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

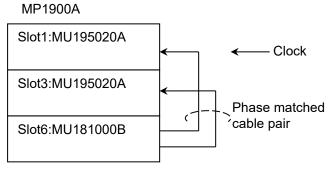


Figure 3.5.4-1 Example Clock Connection 1

#### 1. Touch 🔲 Combination Setting in the Menu.



-		
	Combination Setting	X
Inter module combination Sync ON/OFF Channel Synchronization Synced Module(s) Settings	Slot Slot1 : MU195020A	
Sync Type (Inner Module) Channel Synchronization		
	This parameter is handled by inter module combination.	

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

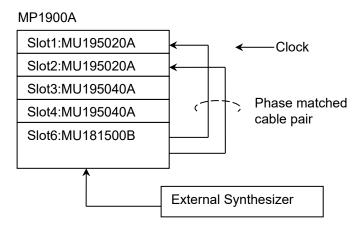
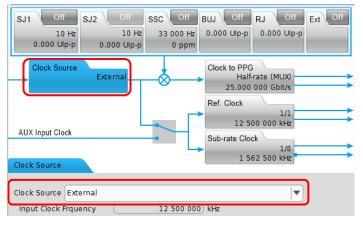


Figure 3.5.4-2 Example Clock Connection 2

1. Select **External** at Clock Source setting of MU181500B in slot 6.



2. Touch 🕒 Combination Setting in Menu.



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

	Combination Setting
_Inter module combination	_Inner module combination
Sync ON/OFF	Slot Slot1 : MU195020A
Synce Module(s) Settings Sync Type(Inner Module) Slot-1 Master MU195020A Slot-2 Slave MU195020A Slot-3 Slave MU195020A	This parameter is handled by inter module combination.
	Cancel OK

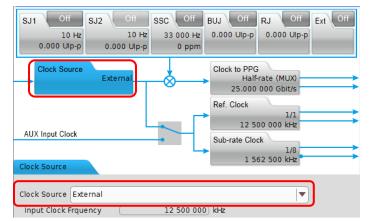
4. When the Multi Channel Calibration Dialog Box appears as shown in Figure 3.5.2-1, perform the calibration according to the description of step 2 through step 6 in 3.5.2.

Ethernet cable MP1900A Slot1:MU196020A Slot2:MU196020A Slot3:MU196020A Slot4:MU196020A Slot6:MU181500B MP1900A MD1900A MU181000B

(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 slot 6.



2. Touch 🖸 Combination Setting in Menu.



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

Sync Type: Channel Synchronization

Combination Setting			
Inter module combination	_Inner module combination		
Sync ON/OFF Channel Synchronization	Slot Slot1: MU195020A		
Synced Module(s) Settings			
Sync Type(Inner Module)			
▼ Slot-1 Master MU195020A			
✓ Slot-2 Slave MU195020A			
✓ Slot-3 Slave MU195020A			
	This parameter is handled by inter module combination.		
	Cancel OK		

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**.

		Multi Channel (	Calibratior	n (2/4)		
Connect this MP19 Calibration dialog t IP Address - Port No. - Slot No.	00A to the MP1900A i lox, fill in the following	n which MU181000A/B i information about the	s installed, wi connected Mf	h an Ethernet cab 1900A:	le. Then, in the Mi	ulti Channel
Use an externa	al synthesizer )A/B installed in a sep	arate MP1900A				
IP Address	192.168.2.100					
Port No.	5 001					
Synthesizer slot No	. 8					
		< BAC	ж	NEXT >	C	ANCEL

Multi Channel Calibration (3/4)			
Calibrating			
	3%		
	< BACK NEXT >	CANCEL	
	HEAT &		

5. The progress of Multi Channel Calibration is displayed.

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



Calibration completed and Combination/CH Synch	ronization function ope	rating normally.	
	BACK	Finish	CANCEL

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

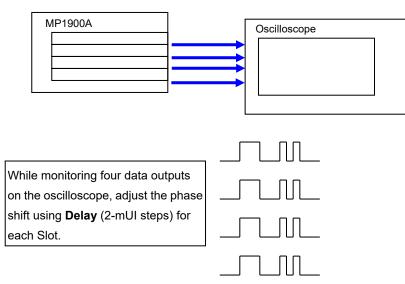
This section explains a bit adjustment procedure when using the Multi Channel function of MU196020A at the operating rate of 32 Gbaud or more.

When MU196020A operates at 32 Gbaud or more, its Multi Channel function causes up to  $\pm 5$  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.

Delay E Calibration	mUI     0     ps     0.000
Jitter Input 🛛 OFF	Relative 0.000 mUI

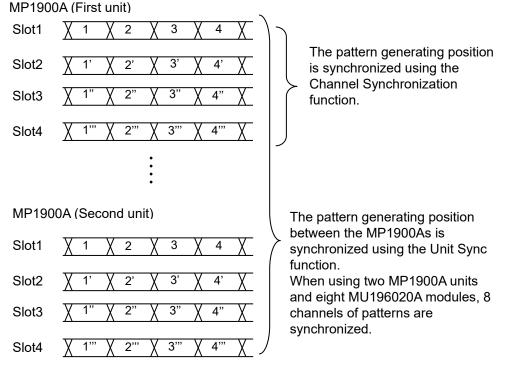
## 3.6 Unit Sync Function

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.





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.

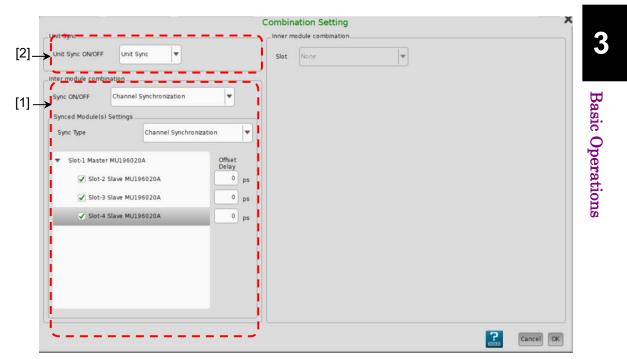


Figure 3.6.2-1 Combination Setting Dialog Box

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.

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

[2] Turning ON/OFF the Unit Sync functionTo enable the function, in the Unit Sync ON/OFF list, touch UnitSync, 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".

Expert BERT	
Menu Applicat	ion Selector Start Stop Ol Addo Control Adda Control III III
[1] PAM4 PPG (B) NRZ 💌 C: ON	2] PAM4 PPG @ NRZ 💌 c: ON E Unit Sync Warming Up
Output III Emphasis III Pattern Error Addition mst mist?	Output      Emphasis     Pattern     Error Addition     Misc1     Misc2     Pattern     Pattern
Output	Pattern Sequence
Bitrate 28.000 000 Gbit/s [1]	Pattern Sequence Repeat T Gating Output ON T [2]
Output Data @ ON V Clock ON V	3 PAMA
Level Guard @ OFF Setup Ext ATT Factor @	Pattern Length X Pattern X XXX 4
0.000 dB	Gating Output
Amplitude @ 0.500 Vpp 0.500 Vpp	Pulse Width 256 bits
Offset @ AC OFF 0.000 V Vth V 0.000 V	
Half Period Jitter @ 0	L. C. M. (Pattern Length, 256 ) 6 jitter
Cable for Data Output @ (1789A 0.4m Cable (Recommend)	
Delay	AUX Input
litter input @ OFF Relative 0 mUl	AUX Input Unit Sync Vth 0.5V V
	AUX Output
	AUX Output 1/N Clock
	1/ 64 Clock
III Divide Kun Module III System BERT	AUTO MEAS

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.

## 3.6.4 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.

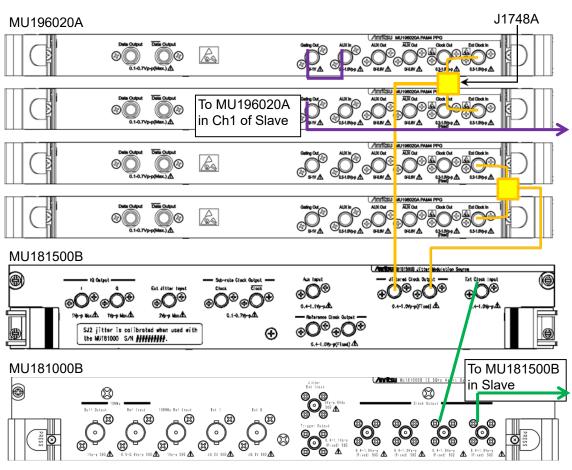


Figure 3.6.4.1-1 Connection Example of MP1900A (Master)

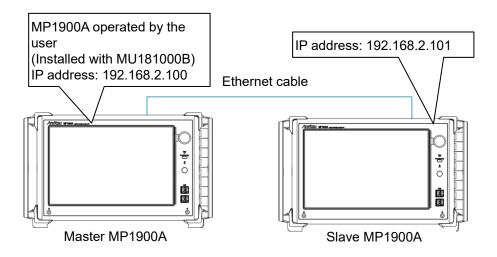


Figure 3.6.4.1-2 Ethernet Cable Connection and IP Address Setting of MP1900As

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.

3

**Basic Operations** 

- 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).
- 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

5001

#### 3.6.4.2 How to perform inter-MP1900A pattern synchronization

Port No. (Master/Slave):

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

 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.

Me	nu 🚽	OHOEE Outpu	I OHOS	Err. Addition	Single Err Addition
	File Op	en	ON		
	File Sa	ve			Ĭe
	Screen	Сору	C	Pattern	Error Addition
•	Combin	nation Setting	Slot	6:MU1815	00B
G	Module	Grouping	•	28.000 00	00 GBaud
	Multi C	hannel Calibra		20.000 00	Jo Badd
	Global	Delay Calibrati	on		
	Initializ	e	te		Max: 64.200G
0	peration	Baud Rate 2.	40 - 30.0	00 -	Baud 1.20

 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.

				ation Setting
Unit Sync ON/OFF OFF	-		Slot	None
nter module combination				
Sync ON/OFF Channel Synchron	ization			
Synced Module(s) Settings		-		
Sync Type	I Synchronization			
<ul> <li>Slot-1 Master MU196020A</li> </ul>	Offset Delay			
Slot-2 Slave MU196020A	0	ps		
Slot-3 Slave MU196020A	0	ps		
Slot-4 Slave MU196020A	0	ps		

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

Unit Sync	·	<b>1</b>		nation Setting			×
✓ Slot-	bination Channel Synchronizations) Settings	chronization Offset Delay 0	Slot	None	<b>*</b>		
						Cance	Ø

- 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: IB Address: 102 162 2 100

IP Address.	192.168.2.100
Port No.:	5001
Synthesizer slot No.:	8

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

Multi Channel Calibration (2/4)
Connect this MP1900A to the MP1900A in which MU181000A/B is installed, with an Ethernet cable. Then, in the Multi Channel Calibration dialog box, fill in the following information about the connected MP1900A: - IP Address - Port No. - Slot No.
Use an external synthesizer Use MUI81000A/B installed in a separate MP1900A IP Address Port No. 5001 Synthesizer slot No. 8 < BACK NEKT > CANCEL

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.

	Multi Channel Calibra	ation (2/4)	
Input a Clock signal to the PPGs in SI Use cables of the same length for all After connecting the Clock signals co	ot 1 to 4. the connections to the PPGs. rrectly, press the [Next] button.		
	< BACK	NEXT >	CANCEL

 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.

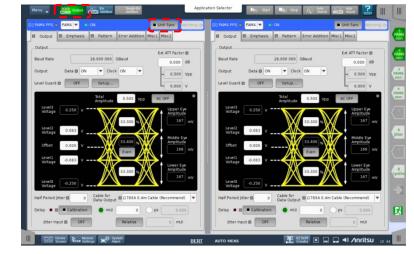
- (a) On the Misc2 tab for MU196020A in Slot 1 of each of Master and Slave, set as follows:
  Clock Source: MU181500B
  Output Clock Rate: Fullrate
  Operation Baud Rate: 25.00-32.10 GBaud
- (b) Set MU181000B in Slot 8 of Master as follows:
   Center Frequency: 6.640625 GHz (1/4 of 26.5625G)

	Operation	Variable 💌 🖬 PLL Unlock	
Unit1:Slot6:MU181500B	Center Frequency	6 390 625 kHz 💌	
28.000 000 GBaud	Offset	0 ppm	
	Reference Clock		
Fullrate Wax 32.100G	Source	Internal 💌	
	Spectrum Spread		
25.00 - 32.10 V GBaud 6.250 - 8.025 GHz (1/4 Clock)	SSC	OFF w	
	Spread Method	Center V	
	Jitter		
	jitter	OFF	
	Modulation Source	External I/Q	
	Trigger St	ource f/64	
-	28.000 000 GBaud ulrate V Max 32.100G input Clock Freq	28.000 000 GBaud Ulrate ♥ Max: 32,1000 mput Clock Preq 15.00 - 32,10 ♥ GBaud 6.250 - 8.025 GHz (1/4 Clock) Spread Method Jtter jtter	28.000 000 GBaud Ulrate ♥ Max: 32,1000 Input Clock Freq 55.00 - 32.10 ♥ GBaud 6.250 - 8.025 GHz (1/4 Clock) Spectrum Spread Spectrum Spread Spectrum Spread Spectrum Spread Spectrum Spread Spectrum Clock Freq Spread Method Center ♥ Jtter Jtter OFF

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

[1] PAM4 PPG G PAM4 🔻 C: ON	Unit Sync Marming	y Up
Output G Emphasis O Patter	rn Error Addition Misc1 Misc2	
Test Pattern 🛛 🛛 All List 🖉 🔻		
PRBS13Q	<b>•</b>	
Conformance to Standard: Conformed		
-		G
g(X)= + 1:2 LSB PRBS Inv -		
Logic 201 Pos MSB 700. Pos Logic 201 Pos LSB 700. Pos	Shift -	→
Summary		
The PRBS13Q test pattern is defined in IE Each cycle of PRBS13Q is 8,191 symbols A PMA Precoding block is. when using the PMD service interface of when using the PMD service interface of	a 50GBASE or 100GBASE is mandatory	
		_

- 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  $\pm 1024$  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

## 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 **EZ SCPI** on Figure 3.7-1 to start using this function.

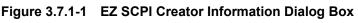
Menu Utput Output	plication Selector	Start Stop 🔊	Auto Search Onor Adjust	
[7] 21G/32G SI PPG     Data1     C: ON       Output     Emphasis     Pattern     Error Addition     Pre-Code     Misc1	[6] 21G/32G SI ED Result Measure		▶ Start ■ Stop C: ON	1
Output Bitrate Variable Variable 12.500 000 Gbit/s	Gating Cycle Repea	t Vnit Time	0 day 00:00:01	2 Synthe
Output Data © ON V Clock ON V Level Guard © OFF Setup Ext ATT Factor ©	Current Calculatio	n Progressive	Interval 100 V ms	3 4 Jitter
Defined Interface @     Variable      0     dB       Amplitude @     0.438     Vpp      0.438     Vpp       Offset @     AC OFF     0.000     V     Vth      0.000	Zoom Total ER	History Reset INS	2017/09/19 18:59:14 OMI /nritsu	5
Half Period Jitter @ 0	EC			6 SIED 7 SIPPG
Delay	Frequency(kHz Clock Loss Sync Loss		ount	8 Noise
Jitter Input @ ON Relative 0 mUl	Error Data Threshold	• • • • • • • • • • • • • • • • • • •	Delay mU	1
	XData Thresho Gating	(0%)	All Channel	
Divide Koreen Kodule Settings	T AUTO MEAS	Cryber	🗵 🗖 🗖 🕪 Anritsu 💡	18:59

EZ SCPI Creator Button

Figure 3.7-1 EZ SCPI Creator Button

## 3.7.1 EZ SCPI Creator Operation





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.

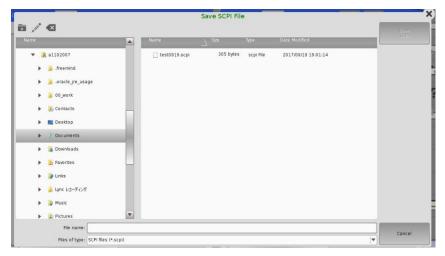


Figure 3.7.1-2 Save SCPI File Dialog Box

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:

REC Creator Touch and the button color changes to blue EZ SCPI Creator REC ) 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. changes to Cocal. The GUI

EZ SCPI REC Creator In this case 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	Standa	ard BERT Application	
	4.1.1	Standard BERT for SI Application	4-2
	4.1.2	Standard BERT for PAM4 Application	n 4-4
4.2	Expert	BERT Application	
4.3	Module	e Application	
	4.3.1	MU181000A/B	4-8
	4.3.2	MU181500B	
	4.3.3	MU195020A	
	4.3.4	MU195040A	
	4.3.5	MU195050A	
	4.3.6	MU196020A	
	4.3.7	MU196040A	
	4.3.8	MU196040B	
4.4	Auto M	leasurement	
	4.4.1	Eye Contour Measurement	
	4.4.2	Bathtub Measurement	
	4.4.3	Eye Margin Measurement	
	4.4.4	PAM BER Measurement	

## 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.

Slot Number	Module Name
1	MU181000A 12.5GHz Synthesizer
2	or MU181000B 12.5GHz 4port Synthesizer
3	MU181500B Jitter Modulation Source
4	Me 101900D Sitter Modulation Source
5	Blank or MU196020A PAM4 PPG
6	MU195040A 21G/32G bit/s SI ED
7	MU195020A 21G/32G bit/s SI PPG
8	Blank or MU195050A Noise Generator

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

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

## 4.1 Standard BERT Application



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.

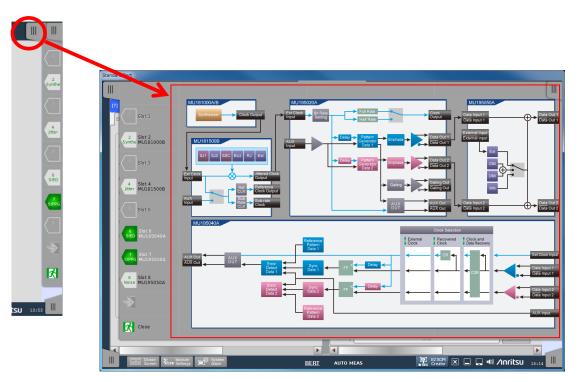


Figure 4.1.1-2 How to Display Overall Block Diagram

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 under the following conditions.
  - 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
2	or MU181000B 12.5GHz 4port Synthesizer
3	MU181500B Jitter Modulation Source
4	MO181300D Sitter Modulation Source
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.





How to Display Overall Block Diagram

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

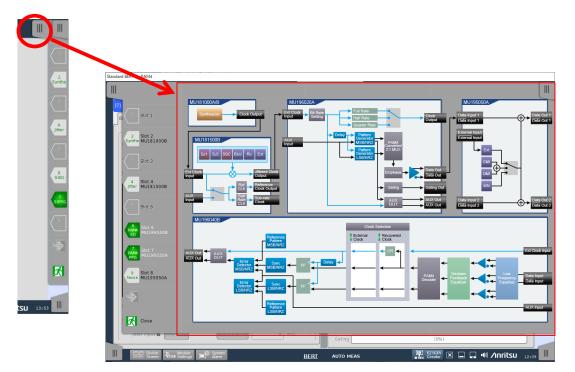


Figure 4.1.2-2 How to Display Overall Block Diagram

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.

## 4.2 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.

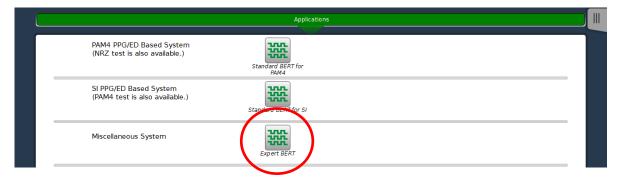


Figure 4.2-1 How to Start Expert BERT Application

#### 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

### 4.3.1 MU181000A/B

The MU181000A/B is a plug-in module 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.

[6] 12.5GHz 4port	Synthesizer	
_Operating Freq	uency	
Operation		Variable 🔽 🗖 PLL Unlock
Center Freque	ncy	12 500 MHz 💌
Offset		0 ppm
_Reference Cloc	k	
Source		Internal
_Spectrum Sprea	ad	
SSC		OFF V
Spread Metho	d	Down
_Jitter		
Jitter		OFF
Modulation	Source	Internal
	Frequency	10.000 Hz 🔽
	Amplitude	10.000 Ulp-p
	Trigger Source (f0 > 0.865GH	1/64

• 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 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.

#### Chapter 4 Operation of Applications

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

ltem	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.

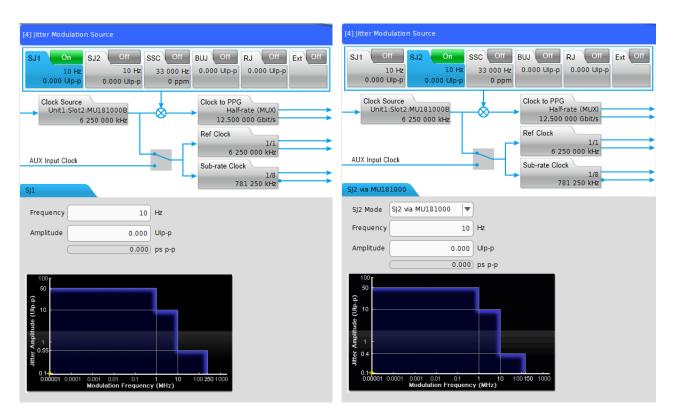


Figure 4.3.2-1 MU181500B Setting Window SJ1 (Left), SJ2 (Right)

#### 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

ltem	Function	
Туре	Sets spread method.	
Frequency	Sets modulation frequency.	
Deviation	Sets frequency deviation.	

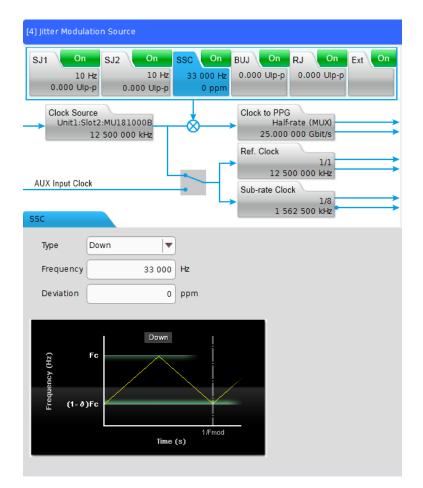


Figure 4.3.2-2 MU181500B SSC Setting Screen

#### 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

ltem	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.

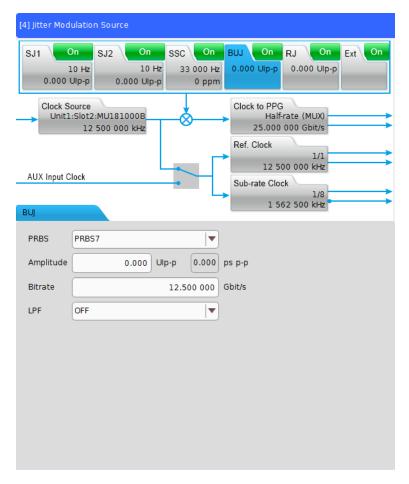


Figure 4.3.2-3 MU181500B BUJ Setting Window

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.

ltem	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.

Table 4.3.2-4 MU181500B RJ Setting Items

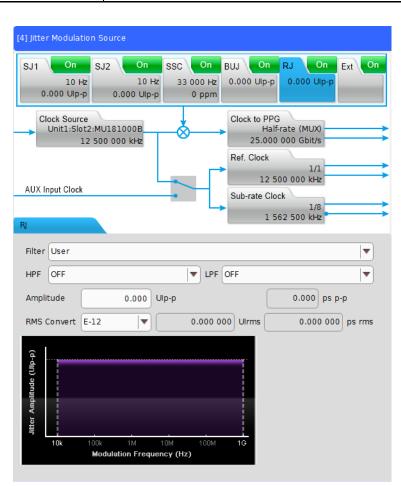


Figure 4.3.2-4 MU181500B RJ Setting Window

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	<b>Clock Source</b>	Setting Items
			ootting itoma

ltem	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.

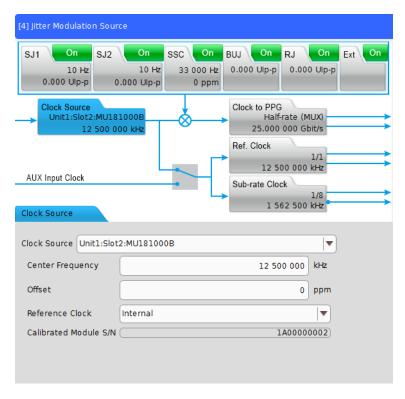


Figure 4.3.2-5 MU181500B Clock Source Setting Window

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.

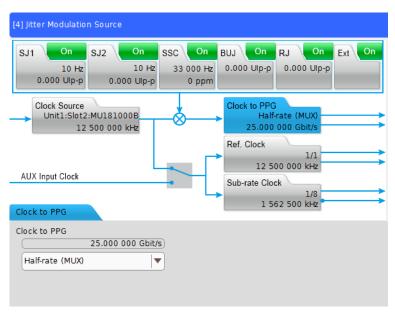


Figure 4.3.2-6 MU181500B Clock to PPG Setting Window

#### 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

ltem	Function	
Divider	Sets clock division rate.	

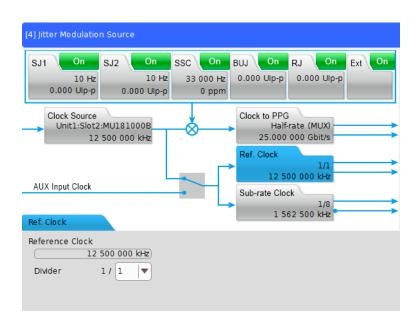


Figure 4.3.2-7 MU181500B Ref .Clock Setting Window

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

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

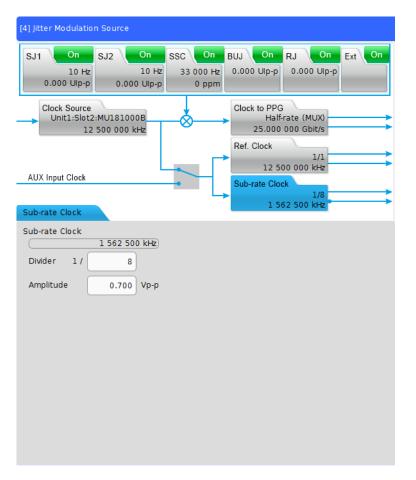


Figure 4.3.2-8 MU181500B Sub-Rate Clock Setting Window

# 4.3.3 MU195020A

The MU195020A 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 and Mixed 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 **[11]**, 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 **G Output** tab is shown in Figure 4.3.3.1-1.

17	7] 21G/32G SI	PPG Datal	C: OFF				
	Output	Emphasis	Pattern	Error Addition	Pre-Code	Miscl	Misc2
	_Output						
	Bitrate		28.000 000	Gbit/s			
	Output	Data 🖸	ON 🔻	Clock ON	-		
	Level Guard	i C	OFF	Setup	Ext	ATT Fact	or 🖻
	Defined Inte	erface 🖻	Variable			0	dB
	Amplitude (	Ð	1.000	Vpp	ļ	1.000	Vpp
	Offset 🖻	AC OFF	0.000	V Vth		0.000	V
	Half Period	Jitter 🖸	0				
	,	Calibration	n 🔵 mUl		⊖ ps (		.000
	Jitter Ir	nput 🖻 🛛 OFF		Relative		0 r	nUI

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

[7] 21G/32G SI PPG Data1	e: OFF
🕼 Output 🖻 Emphasi	s 🛛 Pattern Error Addition Pre-Code Misc1 Misc2
Preset	
File Operation	Recall Store Initialize
Standard 🖻	JSER V Preset0 V
Output	
Emphasis Function 🖻 🛛	DFF 🛛 De-Emphasis
Amplitude	1.000 Vpp
	utput Monitor
Pre dB 🖸	
Cursor3 0.000	Simulated Pulse[Vpp]
Cursor2 0.000	a 1.000
Cursor1 0.000	b 1.000
Post	
Cursor1 0.000	
Cursor2 0.000	Va Vb Vc Vd Ve Vf Vg Vh Vi Vj
Cursor3 0.000	
Cursor4 0.000 V	
Cursor5 0.000 V	i 1.000
Cursor6 0.000	j [1.000]

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 four test patterns are available.

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

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

[7] 21G/32G SI PPG Data1 🔻 🖻: OFF	
© Output © Emphasis © Pattern Error Addition Pre-Code	Miscl Misc2
Test Pattern © PRBS V Logic © POS V Bit	Shift Ibit
Length 🗉 2^15-1 💌 bits	
Mark Ratio 🖸 1/2	

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.

[7] 2	1G/32G SI P	PG Datal 🔻	C: OFF	:			
C	Output	) Emphasis	© Patt	ern Error A	Addition Pre-Code	Miscl M	lisc2
E	rror Additior	OFF					
S	ource	Internal		<b>\</b>	Variation	Repeat	
R	oute	Select		1	=	Sing	le
R	ate		E	-3			

Figure 4.3.3.4-1 MU195020A Error Addition Tab

4

#### 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**.

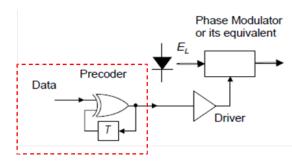


Figure 4.3.3.5-1 Pre-Code Logical Diagram (DQPSK)

7] 21G/32G SI I	PPG Datal 🔻	⊏: ON				
🛛 Output	🖻 Emphasis	© Pattern	Error Addition	Pre-Code	Miscl	Misc2
Pre-Code	OFF					
Туре	DQPSK					
Initialize Dat	a 1					

Figure 4.3.3.5-2 MU195020A Pre-Code Tab

### 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
-----------------	---------------

ltem	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.

[7] 21G/32G SI PPG Data	al 🔻 🖻: OFF				
G Output G Emph	asis 🖸 Pattern	Error Addition	Pre-Code	Misc1	Misc2
Pattern Sequence	Repeat 💌				
Pulse Width		128 bits			
Delay		128 bits			
_AUX Input					
AUX Input	Error Injection		Vth OV		
_AUX Output					
AUX Output	1/N Clock				
	1 / 64 Clock				
_Gating Output					
Gating Output	ON <b></b>				

Figure 4.3.3.6-1 MU195020A Misc1 Tab

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## 4.3.3.7 Misc2 tab

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

[7] 21G/32G SI PPG Data	I 💌 🛛 OFF
Output     G Empha	asis 🖸 Pattern Error Addition Pre-Code Misc1 Misc2
_Clock Setting	
Clock Source	External
Bit Rate	28.000 000 Gbit/s
Output Clock Rate	Halfrate 🔽 Input Clock Freq
Operation Bitrate	2.4 - 32.1 💌 Gbit/s 1.200 - 16.05 GHz(1/2 Clock)

Figure 4.3.3.7-1 MU195020A Misc2 Tab

# 4.3.4 MU195040A

The 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 and Mixed 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.

ltem	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.

Table 4.3.4.1-1 Setting Items in Result Tab

[6] 21G/32G SI ED Data1 ▼ C ④ S ④ E ④ ► Start ■ Stop ©: OFF
Result Measurement 🖾 Pattern 🖾 Input Capture Miscl
Gating
Cycle Repeat VIII Time V 0 day 00:00:01
Current
Calculation Progressive ▼ − Interval 100 ▼ ms
Error/Alarm V Independent V Date&Time V
Zoom History Reset 2017/06/14 12:08:55
Total INS OMI /Inritsu
ER
EC
%EFI
EI
Frequency(kHz) Clock Count
Clock Loss 🔘 🔘
Sync Loss
Error
Data Threshold V Data Delay mU
XData Threshold v ps
Gating (0%) All Channel

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.

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.

Table 4.3.4.2-1 Setting/Display Items in Measurement Tab

[6] 21G/32G SI ED Data1 ▼ C O S O E O ► Start ■ Stop ©: OFF		
Result Measurement © Pattern © Input Capture Misc1		
Gating		
Cycle Repeat VIII Time O day 00:00:01		
Current ON		
Calculation Progressive  Interval 100 I ms		
Auto Sync		
Auto Sync ON Threshold INT		
SKP Ordered Set		
Filtering OFF		
L Specification PCIe Gen5		
_Sync Control		
Control		
Frame Length 64 bits — Frame Position 1 bit		
Mask 00 00 00 00 00 00 00 00 00 Edit		
Error/Alarm Condition		
Error Detection Insertion/Omission		
EI/EFI Interval		

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 four 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**)

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

[6] 21G/32G SI ED	Datal 🔻 C	🔘 S 🔘 E	🌑 🕨 🕨 Sta	art 📕 Stop	C: OFF
Result Measurem	ent 🖻 Patter	n 🖻 Input	Capture	Aiscl	
Test Pattern 🖻 Pf	RBS		jic 🛛 POS 🛛	Bit Shift	lbit 💌
Length 🖸	2^15-1	<b>▼</b> bits		G	Edit
Mark Ratio 🖻	1/2				
_Mask					)
Block Window	OFF	Bit Window	OFF	External Mask	OFF

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 4.0.4.4-1 Octaing 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	

Table 4.3.4.4-1 Setting Items in Input Tab

[6] 21G/32G SI ED Data1 🔻 C 🕥 S 🔕 E 🔕 🕨 Start 🔳 Stop 📴 OFF		
Result Measurement 🖻 Pattern 🖻 Input Capture Misc1		
_Data		
Input Condition 🖸 Single-Ended		
Data Threshold 🖸 0.000 V		
Termination C GND - 0.000 V		
XData Threshold © V CTLE © OFF 🛛 🔻		
Cata-XData V C 0 dB		
_Clock		
Selection External Clock		
Delay  Omul Onu		
Relative 0 mUl Jitter Input © OFF		
Measurement Restart		
Data Threshold Clock Delay		

Figure 4.3.4.4-1 MU195040A Input Tab

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## 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.

[6] 21G/32G SI ED Data1 ▼ C 🔘 S 🌑 E 🔘 🕨 Start 🔳 Stop 🖻: OFF
Result Measurement @ Pattern @ Input Capture Misc1
Capture Trigger
Acquisition Bit Pattern
_ Condition
Number of Block 128 Condition
Trigger Match Pattern Position Top
Match Pattern Length 4 bits
Format HEX
Match Pattern
0
Mask Pattern
0

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 Misc 1 Tab

ltem	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.

[6] 21G/32G SI ED Data1	C 🕥 S 🔘 E 🕥 🕨 Start 🔳 Stop 📴 OFF
Result Measurement 🖸	Pattern 🖾 Input Capture Miscl
_Pattern Sequence	
Pattern Sequence	Repeat         Source         External-Enable         Image: The second
_AUX Input	
AUX Input	External Mask Vth OV
_AUX Output	
AUX Output	1/N Clock
1/	64 Clock

Figure 4.3.4.6-1 MU195040A Misc 1 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 **[11]**, and then touch the screen item you need help with.
- For mouse operation, right-click the screen item you need help with.

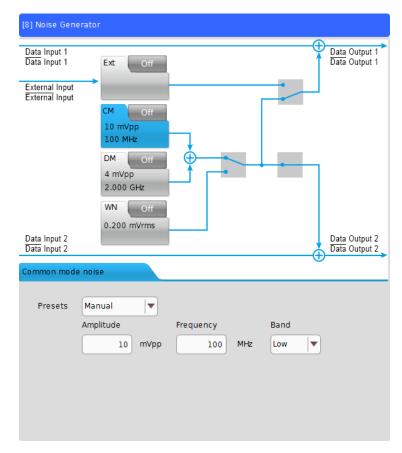


Figure 4.3.5-1 MU195050A Control Window

## 4.3.6 MU196020A

The MU196020A 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 **Figure**, 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

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#### 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.

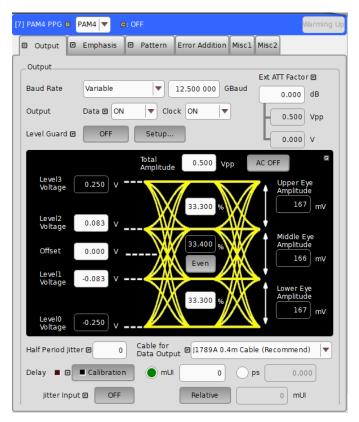


Figure 4.3.6.1-1 MU196020A Output Tab (PAM4 Mode)

### 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.

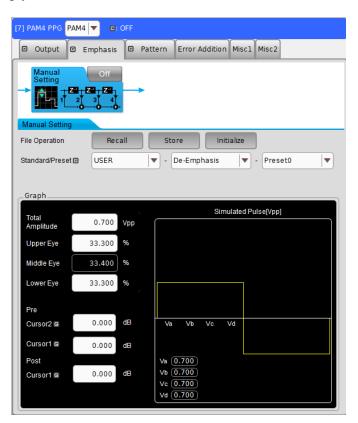


Figure 4.3.6.2-1 MU196020A Emphasis Tab (PAM4 Mode)

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[7] PAM4 PPG 🖬 PAM4 🔻 Output I Emphasis I Pattern Error Addition Misc1 Misc2 Channel Emulator Manual Setting On ISI On Оп Z-1 **Z**-1 Initialize Recall Store File Operation Standard / Interface© USER ▼ - Preset  $|\bullet|$ Loss Channel 🖻 Not Specified ▼ Graph Frequency vs InsertionLoss Graph Mode Freq. Domain 🔻 16.050 000 GHz 🚝 Nyquist Freq. 8.025 000 GHz 1/2 Nyquist Freq. Multi Point Mode 🖻 1point 🔻 Tuning NF Insertion Loss © 4.000 dB E NF Insertion 4.000 dB 055 Tuning 1/2 NF Insertion Loss 🖻 5 10 Frequency[GHz] 2.000 dB 15 1/2 NF Insertion 2.000 dB Ideal Insertion Loss 🖉 Actual Insertion Loss

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

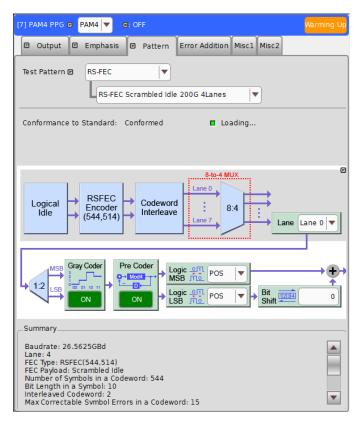
On the **Pattern** tab, you can select a test pattern and can configure the settings for it. The following four test patterns are available.

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

[7] PAM4 PPG @ PAM4 💌 @: OFF	Warming Up
Output C Emphasis Pattern Error Addition Misc1 Misc2	
Test Pattern 🗃 All List	
Length 🖸 2^15-1 💌	
	e
PRBS Generator + 1:2 LSB PRBS Inv OIL ON	Pre Coder
Logic off POS Logic off POS LSB no POS	
_Summary	
A Pseudo-Random Binary Sequence(PRBS) pattern is expressed in an n-th ( generating polynomial, with one cycle of (2^n)-1. For a PRBS pattern with a cycle of (2^n)-1, a pattern of consecutive 1s* for n is generated once in a cycle. Note *: When assumed that PRBS Inv MSB and PRBS Inv LSB are OFF.	-

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)

# 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.

[7] PAM4 PPG 🛛 PAM4 🔻 🖻: OFF	Warming Up
G Output G Emphasis G F	Pattern Error Addition Misc1 Misc2
Error Addition OFF	
Symbol/Burst Symbol	Burst Length 1 symbols
Source	▼         Variation         Repeat         ▼
Rate 1 E	-3 Single
Error Addition Method	Type 1
Level <b>0</b> to <b>1</b>	2 2 2 3 2 3 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1 1 2 1
Level 1 to 2	3 2 <sup>3</sup> 3 22 <sup>3</sup> 1 3 22 0 0
Level 2 to 3	
Level 3 to 2	2 1 0 1 0 1 0 1 0

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

[7] PAM4 PPG 🖻 PAM4 🔽 🖻: OFF Warming Up
Output Emphasis Pattern Error Addition Misc1 Misc2
Error Addition OFF
RS-FEC Symbol Error
Source Internal Variation Repeat V
Total SER for All Lane 1 E -4 Single
Symbol Error per Codeword
Max Correctable Symbol Error 15
Error Addition Method Type 1
Level 0 to 1 $2^{3}$ $2^{2}$ $2^{3}$
Level 2 to 3 $\begin{array}{c} 3 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0$
_Summary
Baudrate: 26.5625GBd Lane: 4 FEC Type: RSFEC(544,514) Number of Symbols in a Codeword: 544 Bit Length in a Symbol: 10 Codeword Interleave: Yes Max Correctable Symbol Errors in a Codeword: 15 Standard:

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.

	0
ltem	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.

Table 4.3.6.5-1 Setting Items

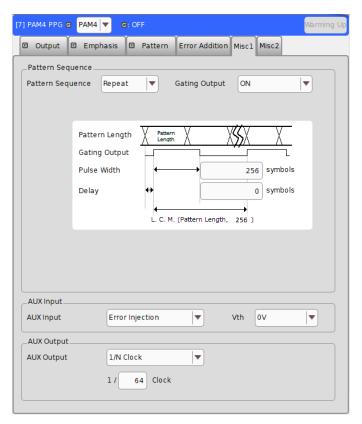


Figure 4.3.6.5-1 MU196020A Misc1 Tab (PAM4 Mode)

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#### 4.3.6.6 Misc2 tab

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

[7	] PAM4 PPG 🖻 PAM4	C: OFF	Warming Up
	🖻 Output 📴 Empha	asis De Pattern Error Addition Misc1 Misc2	
	_Clock Setting		]
	Clock Source	Unit1:Slot4:MU181500B	
	Baud Rate	Variable    12.500 000	GBaud
		Offset 0	ppm
	Output Clock Rate	Halfrate 🔽 Max: 64.200G	
		<u>'</u>	
	Reference Clock	Internal	

Figure 4.3.6.6-1 MU196020A Misc2 Tab (PAM4 Mode)

## 4.3.7 MU196040A

The 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 **Figure**, 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.

ltem	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.

Table 4.3.7.1-1 Setting Items in Result Tab

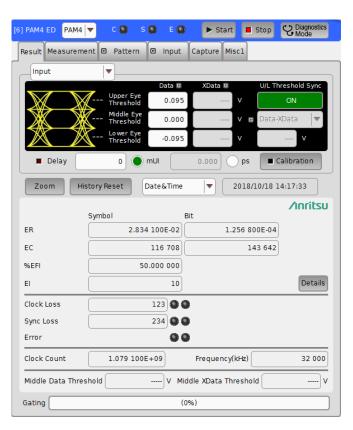


Figure 4.3.7.1-1 MU196040A Result Tab (PAM4 Mode)

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.

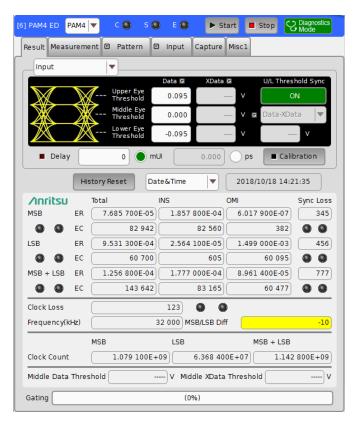


Figure 4.3.7.1-3 MU196040A Result Tab (PAM4 Diagnostics Mode)

#### Note:

To perform accurate SER measurement, observe the signal input to the PAM4 ED with the oscilloscope, and make sure the Lower Eye Threshold and Upper Eye Threshold are appropriate.

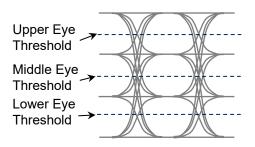


Figure 4.3.7.1-4 Example of Signal with Appropriate Upper Eye Threshold and Lower Eye Threshold

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).

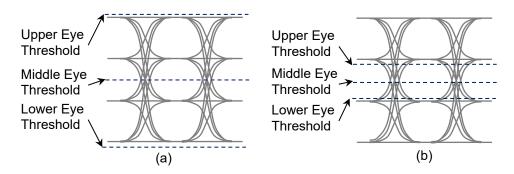


Figure 4.3.7.1-5 Example of Signal with Inappropriate Upper Eye Threshold and Lower Eye Threshold

**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.

### 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.

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.

Table 4.3.7.2-1 Setting/Display Items in Measurement Tab

Gating Cycle Repeat Vunit Time O day 00:00:01 Current ON Calculation Progressive I Interval 100 Mms Auto Sync Auto Sync ON Threshold INT Sync Control Control Frame Length 64 symbols Frame Position 1 symbol Mask 00 00 00 00 00 00 00 Edit Error/Alarm Condition	Cycle Repeat Vinit Time V 0 day 00:00:01 Current ON Current ON Calculation Progressive V — Interval 100 V ms Auto Sync Auto Sync ON — Threshold INT V Sync Control Control Control Mask 00 00 00 00 00 00 00 00 Edit	] PAM4 ED Result Me	PAM4 ▼ C S S C E S ► Start ■ Stop C Mode easurement © Pattern © Input Capture Misc1
Current ON Calculation Progressive  Interval 100  Mask OON Threshold INT Sync Control Control Mask OO 00 00 00 00 00 00 00 00 00 00 00 00 0	Current ON Calculation Progressive  Interval 100  Mask OO 00 00 00 00 00 00 00 00 00 00 00 00	_Gating_	
Auto Sync Auto Sync Auto Sync ON Threshold NT Sync Control Control Frame Length 64 symbols Frame Position 1 symbol Edit	Calculation Progressive   Auto Sync   Auto Sync   ON Threshold INT    Sync Control   Control   Control   Frame Length 64 symbols = Frame Position 1 symbol   Mask   Error/Alarm Condition	Cycle	Repeat VIII Time O day 00:00:01
Auto Sync Auto Sync Auto Sync ON Threshold NT Sync Control Control Frame Length 64 symbols Frame Position 1 symbol Edit	Calculation Progressive   Auto Sync   Auto Sync   ON Threshold INT    Sync Control   Control   Control   Frame Length 64 symbols = Frame Position 1 symbol   Mask   Error/Alarm Condition	Curren	
Auto Sync ON Threshold NT Sync Control	Auto SyncAuto Sync		
Auto Sync ON Threshold INT Sync Control Control Frame Length 64 symbols - Frame Position 1 symbol Mask 00 00 00 00 00 00 00 00 Edit	Auto Sync ON Threshold INT Sync Control Control Frame Length 64 symbols = Frame Position 1 symbol Mask 00 00 00 00 00 00 00 00 Edit Error/Alarm Condition	L	Calculation Progressive V Interval 100 V ms
Sync Control	_Sync Control Control Frame Length 64 symbols — Frame Position 1 symbol Mask 00 00 00 00 00 00 00 00 00 Edit	_Auto Syr	IC
Control Frame Length 64 symbols — Frame Position 1 symbol Mask 00 00 00 00 00 00 00 00 00 00 00 00 00	Control Frame Length 64 symbols = Frame Position 1 symbol Mask 00 00 00 00 00 00 00 00 Edit Error/Alarm Condition	Auto S	ync ON — Threshold INT 💌
Error/Alarm Condition		Γ	ask 00 00 00 00 00 00 00 00
EI/EFI Interval			

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.

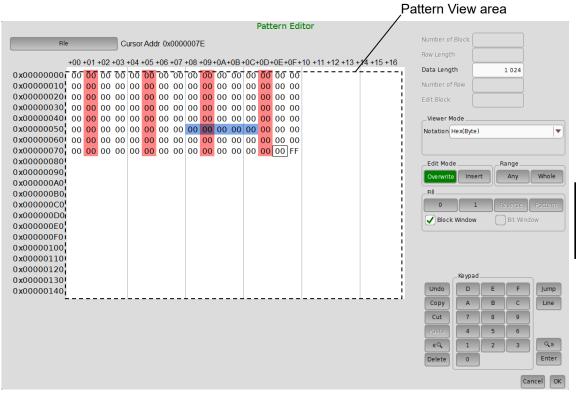
If you select  $\ensuremath{\textbf{Data}}$  , you can edit the test pattern with Patten Editor.

- 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.

[6] PAM4 ED PAM4 ▼ C S S E S ► Start Stop Clagnostics
Result Measurement 🖸 Pattern 🖾 Input Capture Miscl
Test Pattern  All List PRBS
Length 2^15-1 v bits
PRBS Generator + 1:2 LSB PRBS Inv OTION + Gray Coder MSB Inv ON SB
Input Signal → PAM4 Decoder LSB Logic OT POS ▼ → Error LSB TO POS ▼ → Error LSB TO POS ▼ →
_ Summary
A Pseudo-Random Binary Sequence (PRBS) pattern is expressed in an n-th degree generating polynomial, with one cycle of (2^n)-1. For a PRBS pattern with a cycle of (2^n)-1, a pattern of consecutive 1s* for the mumber of consecutive 1s* for the mumber of consecutive 1s* for the mask.
Bit Mask OFF External Mask OFF

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	or Pattern Editor
-----------------	-------------------	-------------------

ltem	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* <sup>2</sup> <i>Note:</i>
	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

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# Chapter 4 Operation of Applications

ltem	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	
	$Symbol(PAM4)^{*2} \qquad 0,1,2,3$	
	Coding	
	This is available when <b>Notation</b> is set to <b>Symbol(PAM4)</b> . Options are <b>No Coding</b> and <b>Gray</b> . When <b>Gray</b> 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 <b>Gray</b> <b>Coder</b> on the <b>Pattern</b> 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 <b>Input Range</b> 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 <b>1</b> , 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 <b>0</b> .	
	Bit Window*3:	
	This check box is available when the modulation mode is NRZ. If you select the check box and click <b>1</b> , 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 <b>0</b> .	
Undo	Cancels the previous operation and restores the previous state.	

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

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

# 4.3 Module Application

ltem	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.
Сору	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 <b>Input Address</b> 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 AllSets all the bits selected by Length to "1".Reset ALLSets all the bits selected by Length to "0".ALL XSets 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 <b>Input</b> <b>Pattern</b> 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 <b>Input</b> <b>Pattern</b> 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.
(«۹) (۹)	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.

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

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# 4.3.7.4 Input tab

On the **Input** tab, you can configure the settings for the input interface. The **G 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.

ltem	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

Table 4.3.7.4-1 Setting Items in Input Tab

[6] PAM4 ED PAM4 ▼ C S S E C ► Start Stop C Mode		
Result Measurement 🛛 Pattern 🖾 Input Capture Miscl		
Data		
Input Condition 🖸 Single-Ended 🔍 Data 🔍		
Termination © GND 🔻 0.000 V		
Data III XData III V/L Threshold Sync Upper Eye Threshold 0.000 v ON Middle Eye 0.000 v III Data-XData V Lower Eye 0.000 v III Data-XData V		
Clock Selection External Clock		
Operation Baud Rate 2.40 - 16.05 GBaud		
Input Clock Freq 2.40-16.05 GHz (1/1 Clock)		
Delay   0 mUl 0.000 ps Calibration Relative 0 mUl Jitter Input © OFF		
Measurement Restart Data Threshold Clock Delay		

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.

	M4 🔻	C 🔘 S 🔘	) E 🔘	► Start	E Stop	C Diagnostics Mode
Result Measur	rement G	Pattern	I Input	Capture Misc	1	
Captu	e	Trigger				
Acquisitio	n	Bit Pattern				
_Condition						
Number	ofBlock	128			Cone	lition
Trigger		Match F	Pattern	Position	Тор	
Match Pa	att <mark>e</mark> rn Leng	th 4	bits			
Format		HEX				
Match Pa	ittern					
0						
Mask Pat	tern:					
0						

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 Misc 1 Tab

ltem	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.

6] PAM4 ED PAM4 🔻	C S S E B FStart Stop C Mode
Result Measurement G	Pattern 🖸 Input Capture Miscl
Pattern Sequence	
Pattern Sequence	Repeat         Source         External-Enable         Image: The second
AUX Input	
AUX Input	External Mask Vth OV V
AUX Output	
AUX Output	1/N Clock
1/	64 Clock

Figure 4.3.7.6-1 MU196040A Misc1 Tab (PAM4 Mode)

# 4.3.8 MU196040B

The 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.

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 **Figure**, 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.



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

**Operation of Applications** 

### 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.

ltem	Description
Input	Select to configure the settings related to the
	input signal interface.
	When the MU196040B-x11 Equalizer is
	installed, set the <b>Low Frequency Equalizer</b> and <b>DFE</b> (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.

Table 4.3.8.1-1 Setting Items in Result Tab

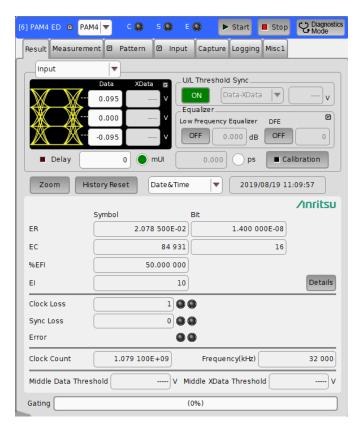


Figure 4.3.8.1-1 MU196040B Result Tab (PAM4 Mode)

### 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.

ltem	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

Table 4.3.8.2-1 Setting/Display Items in Measurement Tab

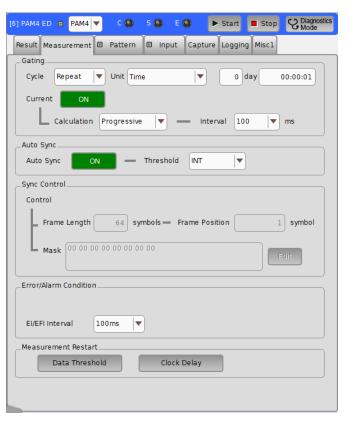


Figure 4.3.8.2-1 MU196040B Measurement Tab (PAM4 Mode)

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# Chapter 4 Operation of Applications

### 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.

[6] PAM4 ED 🖪 🖪	РАМ4 🔻 С 🔘	) S 🔘 E 🔘	) 🕨 Start	E Stop	C Diagnostics Mode
Result Measure	ment 🖸 Patter	n 🖾 Input 🕻	Capture Loggin	g Miscl	
Test Pattern 🖸	All List PRBS			•	
Length	2^15-1	▼ bits			
PRBS Generator	1:2 LSB, PF			Coder	Pre Coder
Input Signal	PAM4 Decoder	MSB LSB LSB LSB			Error Detector
_Summary					
generating poly For a PRBS patt	om Binary Sequer nomial, with one ern with a cycle o	cycle of (2^n)-1. of (2^n)-1, a patt			· _
Bit Mask (Block Window			Ext	ernal Mask	OFF

Figure 4.3.8.3-1 MU196040B Pattern Tab (PAM4 Mode)

### 4.3.8.4 Input tab

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

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

Table 4.3.8.4-1 Setting Items in Input Tab

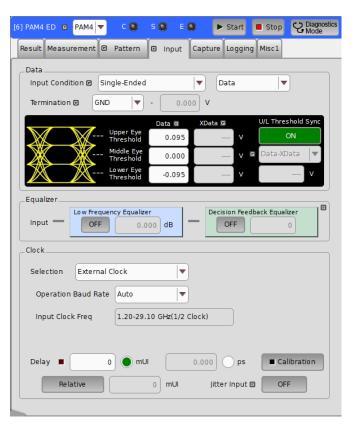


Figure 4.3.8.4-1 MU196040B Input Tab (PAM4 Mode)

### 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

ltem	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.

[6] PAM4 ED 🖸 PAM4 💌 C 🔕 S 🔕 E 🜑 🕨 Start 🔳 Stop 😲 Diagnostics
Result Measurement 🛛 Pattern 🖾 Input Capture Logging Miscl
Capture Mode
Capture Trigger
_Capture Result Display
Auto Launch Capture Data
Condition
Number of Blocks
Capture Area After The Trigger 🔻
Trigger Match Pattern V
Match Pattern / Mask Edit
Match Pattern
00 00
Mask
00 00

Figure 4.3.8.5-1 MU196040B Capture Tab (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

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 values (0, 1, 2, 3) 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.

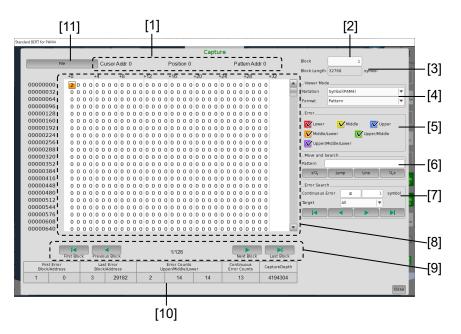
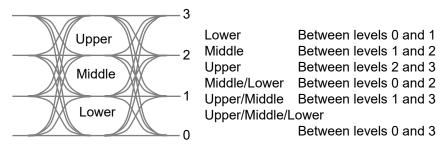


Figure 4.3.8.5-2 Capture Data Screen (PAM4 Mode)

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





# Chapter 4 Operation of Applications

No.	ltem	Description		
[1]	Cursor Addr/	Cursor Addr:	Displays the cursor po	sition within the current block.
	Position/ Pattern Addr	Position:	Displays the position v (all blocks).	vithin the entire captured data
		Pattern Addr:	Displays the position i	n the pattern.
		Data pattern:	Displays the position f pattern.	rom the first symbol of the
		PRBS pattern	: Displays the position f	rom the consecutive 0 bits.
		Note:		
		For the dat	a captured when <b>Captu</b>	re Mode is Raw Data Capture,
		"" is disp	layed at <b>Pattern Addr</b> .	
[2]	Block	Sets the block n	umber to display.	
		The maximum v 4.3.8.5-1.	alue is the value in the	Number of Blocks list in Figure
[3]	Block Length	Displays the block length.		
		Block Length = 4M symbols/ Number of Blocks		
[4]	Viewer Mode	Notation:	Symbol (PAM4), fixed	
		Format:	Select the view mode of	f the Capture Data display area.
		Pattern:	Displays symbols 0, 1,	2 and 3.
		Pattern + Way		
			Displays "symbols" + " values".	image of PAM4 signal of four
[5]	Error*	Displays the leg	end (color sample) for ea	ach of error symbols.
		Lower Eye Error	$r (0 \leftrightarrow 1)$ :	Red
		Middle Eye Erro	or $(1\leftrightarrow 2)$ :	Yellow
		Upper Eye Error	r (2↔3):	Blue
		Middle/Lower E		Orange
		Upper/Middle E	-	Green
			ower Eye Error (0↔3):	Purple
		To show/hide each error in the Capture Data display area, select/cle its check box.		Data display area, select/clear

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

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

# 4.3 Module Application

No.	ltem	Description			
[6]	Move and Search	Searches the cap	Searches the captured data for the string.		
		Pattern:	Searches any pattern of the string specified with symbols $(0, 1, 2 \text{ and } 3)$ by using « $\mathfrak{Q}$ and $\mathfrak{Q}$ ».		
		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.		
		Forward Next:	Searches forward for a pattern that matches the pattern set in the <b>Pattern</b> box. If found, the cursor is placed at the position.		
		Backward Nex	t:		
			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			
[7]	Error Search*	Performs an erro errors.	r search, specifying the number and type of continuous		
		Continuous Erro	r:		
			Specifies the number of continuous errors to search for.		
			1 to 256 symbols, 1 symbol step		
			In the <b>Search Condition</b> box, select = (Exact match) or $\geq$ (Greater than or equal to).		
		Target:	Select the type of errors to search, from the following: Upper Eye, Middle Eye, Lower Eye, All		
[8]	Capture Data display area	Displays the captured data (including error information) by symbols (0, 1, 2 and 3). The background color of each symbol where an error occurred is different depending on the error type. When in the <b>Viewer Mode</b> area, <b>Pattern + Waveform</b> is selected in the			
			M4 pattern image is displayed.		
		Note:			
		For the resu	lts captured when <b>Capture Mode</b> is <b>Raw Data</b>		
		Capture, er	ror information is not displayed.		
[9]	Block scroll buttons	Scrolls the block	view.		

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

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No.	ltem		Description
[10]	Capture result display*	First Error:	or detection results of the entire captured data. 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 (Upper / Middle / Lower), separately.
		Note:	
		One error n	nay be counted in multiple eyes.
		Example:	
		Middle /	Lower $(0\leftrightarrow 2)$ errors are counted as both Middle Eye
		Error an	d Lower Eye Error.
		Continuous Erro	or Counts:
			Displays the number of times an error search detected continuous errors that match the number of symbols set in the <b>Continuous Error</b> box of the <b>Error Search</b> area.
		Capture Depth:	Displays the number of symbols in the entire captured data.
[11]	File	Saves captured result file.	results and pattern to a file and loads the captured
		Save:	Saves the captured results and pattern to a file. The types of saved files are as follows:
		Symbol(PAM4	l) Capture File (*.scap): Select when redisplaying the results in the Capture
			Data screen.
		Symbol(PAM4	I) Capture File (export) (*.txt): Select when saving a pattern file including error information. The saved file can be loaded by Pattern Editor of the PAM4 PPG and PAM4 ED.
		Open:	Loads a result file with the scap extension to display the captured results.
		Note:	
		If Capture	Mode is Sync Mode Capture, the error information
		cannot be d	lisplayed correctly when you open the file of the pattern
		captured ir	n Raw Data Capture mode.

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

# 4.3 Module Application

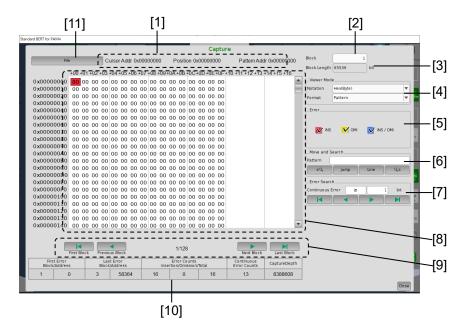


Figure 4.3.8.5-4 Capture Data Screen (NRZ Mode)

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

No.	ltem	Description		
[1]	Cursor Addr/ Position/ Pattern Addr	Cursor Addr: Position:	Displays the cursor position within the current block. 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 <b>Capture Mode</b> is <b>Raw Data Capture</b> ,		
		"" is disp	layed at <b>Pattern Addr</b> .	
[2]	Block	Sets the block number to display. The maximum value is the value in the <b>Number of Blocks</b> list in Figure 4.3.8.5-1.		
[3]	Block Length	Displays the blo	ck length.	
		Block Length = $8$	3M bits/ Number of Blocks	
[4]	Viewer Mode	Notation:		
		Bin		
		Hex(Byte)		
		Format:	Select the view mode of the Capture Data display area.	
			ng of binary (0, 1) or hexadecimal (0-9, A-F) numbers veform: String of binary (0, 1) numbers and image of	

# Chapter 4 Operation of Applications

No.	ltem	Description
[5]	Error*	Displays the legend (color sample) for each of error bits. INS: Insertion Error $(0 \rightarrow 1)$ Red OMI: Omission Error $(1 \rightarrow 0)$ Yellow INS / OMI: Insertion and Omission Error Blue <b>Note:</b> If <b>Hex (Byte)</b> is selected in the <b>Notation</b> list of the <b>Viewer Mode</b> area, bits where both INS and OMI occurred are displayed on blue background. To show/hide each error in the Capture Data display area,
[6]	Move and Search	select/clear its check box.Searches the captured data for the string specified by binary (0, 1) orhexadecimal (0-to 9, A-to F) numbers.Pattern:Searches any pattern using «A and A».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.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.
[7]	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).

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

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

# 4.3 Module Application

No.	ltem	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 <b>Pattern + Waveform</b> in the <b>Notation</b> list of the <b>Viewer Mode</b> area, and you will view a pattern image. <b>Note:</b> For the results captured when <b>Capture Mode</b> is <b>Raw Data</b> <b>Capture</b> , error information is not displayed.		
[9]	Block scroll buttons	Scrolls the block view.		
[10]	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 <b>Continuous Error</b> box of the <b>Error Search</b> area.Capture Depth:Displays the number of bits in the entire captured data.		
[11]	File	<ul> <li>Saves the captured results and pattern data to a file. Also, opens the saved pattern data file.</li> <li>Save: Saves the captured results and pattern to a file. The types of saved files are as follows: <ul> <li>BIN(NRZ) Capture File, HEX(NRZ) Capture File (*.ncap):</li> <li>Select when redisplaying the results in the Capture Data screen.</li> <li>BIN(NRZ) Capture File (export), HEX(NRZ) Capture File (export) (*.txt):</li> <li>Select when saving a pattern file including error information. The saved file can be loaded by Pattern Editor of the PPG and ED.</li> </ul> </li> <li>Open: Loads a result file to redisplay the captured results. The results are displayed by loading the captured data from the ncap file.</li> <li>Note:</li> <li>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.</li> </ul>		

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

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**.

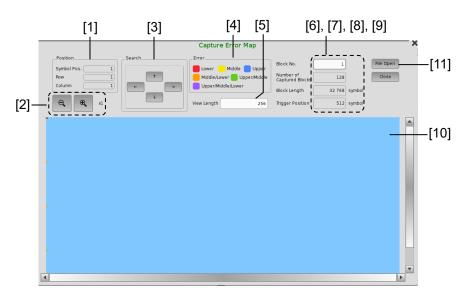


Figure 4.3.8.5-5 Error Mapping Screen (PAM4 Mode)

Table 4.3.8.5-4	Description	of Error Mapping	Screen Items	(PAM4 Mode)
-----------------	-------------	------------------	--------------	-------------

No.	ltem	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 ou	t the result display screen.		
		Zoom in 🔍 ):	2x, 4x, 8x magnification		
		Zoom out (Q):	1/2, 1/4, 1/8		
		Note:			
		In 1x view, each dot represents 1 symbol. In 1/2 view, each dot			
		represents	2 symbols.		

No.	ltem	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 $(0 \leftrightarrow 1)$ : Red						
		Middle Eye Error $(1\leftrightarrow 2)$ : Yellow						
		Upper Eye Error $(2\leftrightarrow 3)$ : Blue						
		Middle/Lower Eye Error $(0\leftrightarrow 2)$ :DiacOrange						
		Upper/Middle Eye Error( $1 \leftrightarrow 3$ ): Green						
		Upper/Middle/Lower Eye Error $(0\leftrightarrow 3)$ : Purple						
		Note:						
		When the Error Mapping display area is displayed with zoomed						
		out, each dot containing two or more types of errors is displayed i						
		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 <b>Number of Blocks</b> 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.						
		Block Length = $\frac{4M}{\text{Number of Blocks}}$						
[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 <b>Capture Mode</b> is <b>Sync Mode Capture</b> , the error information						
		cannot be displayed correctly when you open the file of the pattern						
		captured in <b>Raw Data Capture</b> mode.						

# Table 4.3.8.5-4 Description of Error Mapping Screen Items (PAM4 Mode) (Cont'd)

4



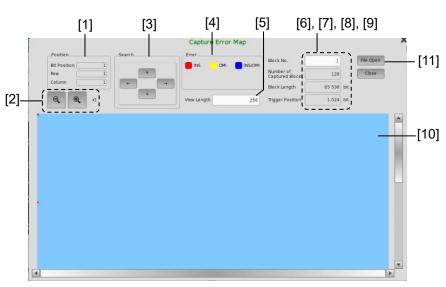


Figure 4.3.8.5-6 Error Mapping Screen (NRZ Mode)

Table 4.3.8.5-5	Description of Error Mapping Screen Items (NRZ Mode)
-----------------	--

No.	ltem	Description				
[1]	Position	Displays the curs	sor 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 pos	ition 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.			

No.	ltem	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 $(0 \rightarrow 1)$ RedOMI:Omission Error $(1 \rightarrow 0)$ YellowINS / OMI:Insertion and Omission Error: BlueNote: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	ets where to wrap (view length) in the Error Mapping display area. 56 bits to Block Length, 8 bits step					
[6]	Block No.	Sets the block number to display. The maximum value is the value in the <b>Number of Blocks</b> list in Figure 4.3.8.5 <sup>-</sup> 1.					
[7]	Number of Captured Blocks	Displays the number of captured blocks.					
[8]	Block Length	Displays the block length. Block Length = $\frac{8M}{\text{Number of Blocks}}$					
[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. <b>Note:</b> If <b>Capture Mode</b> is <b>Sync Mode Capture</b> , the error information cannot be displayed correctly when you open the file of the pattern captured in <b>Raw Data Capture</b> mode.					

# Table 4.3.8.5-5 Description of Error Mapping Screen Items (NRZ Mode) (Cont'd)

4

# 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**.

ltem	Description					
Logging	OFF, ON: Starts logging when set to <b>ON</b> .					
	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	Turn on and off logging of the measurement items.					
items	You can check the remaining logging time calculated					
	rom 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.					

Table 4.3.8.6-1 Setting Items on the Logging Tab

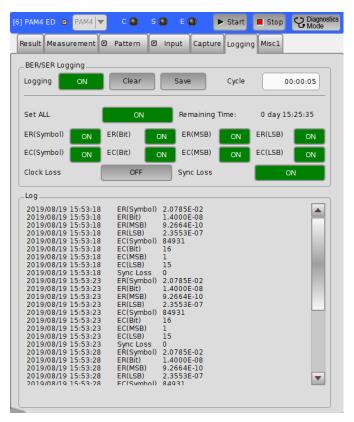


Figure 4.3.8.6-1 MU196040B Logging Tab (PAM4 Mode)

# 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.

[6] PAN	14 ED 🕻	B PAM4		C 🔘	S 🔘	E 🔘	▶ Start	E Stop	C Diagnostics Mode
Resu	t Meas	uremen	t 🖸	Pattern	🖾 Input	t Captu	ire Loggi	ing Miscl	
Pat	tern Se	quence.							
Patt	ern Seo	quence		Repeat	<b></b>	Source	Exterr	nal-Enable	
									J
	(Input_								
AUX	Input			External	Mask		<b> </b> ▼ <b>V</b>	th OV	
	Output	t							
AUX	Output	:		1/N Cloc	k	<b>_</b>			
			1/	6	4 Clock				

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.

- $\bullet\,$  When the module being used is MU196040A/B
- $\bullet$  When Burst is selected for  $Pattern\ Sequence$  on the Misc1 tab
- $\bullet\,$  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



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.

# 4.4 Auto Measurement

Standard Bert		
Eye Contour 🕞 Start 📲 Stop File 🖵 Display	Application Selector	
Eye Contour Mask Edit		
Eye Contour		Condition Mask Judge Result Contour
Slot6-1 ED V Mask Edit1 V	Auto Scale	
Scale Max: 4.000V Step: 800mV		Input Signal NRZ  Bothtub
	∕nritsu	Eye Contour Set All
		Reset All Margin
		Slot6-2 ED OFF
		PAA+BEN
		Auto Search Coarse
		Measurement Point 8
		Lower Measurement Ratio
		Highlight Error Threshold 5.500 E- 10
Frequency: 12 430 000 kHz	Max: 1000mUI Step: 200mUI Scale	Mask OFF Mask Adjust
	Status	
OFF Marker1 mUI mV	Cursor Free	
OFF Marker2 mUI mV	î	
δMarker: mUI mV		
		0% Date&Time 🔻 2017/06/14 13:16:43
	BERT AUTO MEAS	REC Creator

Figure 4.4.1-1 Eye Contour tab

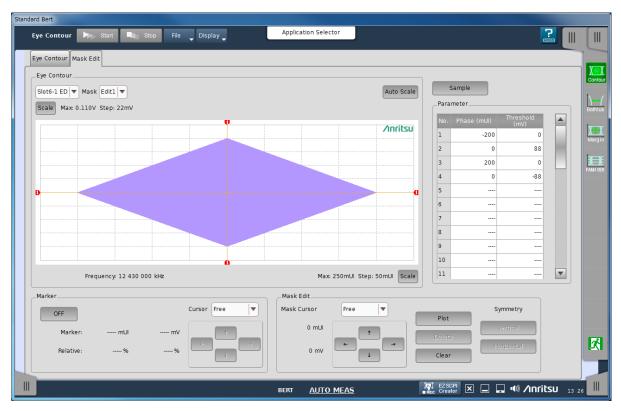


Figure 4.4.1-2 Mask Edit Tab

4

# 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/B
  - When **Burst** is selected for **Pattern Sequence on** the **Misc1** tab
  - When Auto Adjust is set to ON
  - When  $\mathbf{OFF}$  is selected for  $\mathbf{Auto}\ \mathbf{Sync}$  on the  $\mathbf{Result}\ \mathrm{tab}$
  - When the **Input** tab is grouped together with the other tab
- For accuracy, start Bathtub measurement after the operations below.
  - Execute **G** Output tab / Delay / Calibration of PPG.
  - Turn off **G** Output tab / Delay / Jitter Input of PPG.



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.

Standard Bert			
Bathtub 🕞 Start 💷 Stop File		Application Selector	
	1		
Condition Measurement Display			
Measurement Target	_ Condition		
Set All Reset All	Measurement Mode	Single 🔻	Contour
	Times	2 Interval 1 s	
Slot ON/OFF			Bathtub
Slot6-1 ED ON	Auto Search	Threshold&Phase(Coarse)	X+X
Slot6-2 ED ON			Margin
	Fine/Coarse	Coarse	PAMA BER
	Lower Error Threshold	E-8	PAM4 BER
	J2 Measurement	Estimate	

Figure 4.4.2-1 Condition Tab

# 4.4 Auto Measurement

Bathtub Start Stop File	ion Selector		
Condition Measurement Display			
Result Display Slot6-1 ED		Immediate Statistic Marker	
Phase vs BER(Y = Log) Current No. 0 Auto	) Scale	Opt Phase	
Scale Max: 1.0E-3 Min: 1.0E-9		Opt BER	
	Anritsu	TJ(E-12)	
	ZINNUSU	DJ(E-12)	
		RJ(E-12)	
		J2(2.5E-3)	
		J9(2.5E-10)	
		_Status	
Max: 1000mUI Step: :	200mUl Scale		
_ Condition			
Threshold (0.000V) Reload 0.000 V Phase Unit mUI			
Phase Resolution 2 mUI jitter Calculation E	-12	Date&Time	2017/06/14 13:29:27
Calculation Error Threshold E-5 v to E-8 v		0%	
		EZSCPI	

Figure 4.4.2-2 Measurement tab

Standard Bert				
Bathtub 🛼 Start 🖣 Stop File 🖕	Applica	ation Selector		
Condition Measurement Display				i verv
_Overlapping	Current	ON		Contour
Overlapping OFF	History			
		0		Bathtub
	Best Fit Line	ON		Margin
				PAM4 BER
	BERT	<u>AUTO MEAS</u>	🙀 EZSCPI 🗵 🗖 🗐 /nritsu	13 30

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.

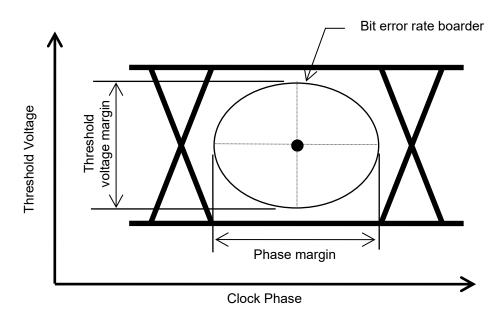


Figure 4.4.3-1 Schematic diagram of Eye Margin measurement

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.

- $\bullet\,$  When the module being used is MU196040A/B
- $\bullet$  When Burst is selected for  $Pattern\ Sequence$  on the Misc1 tab
- $\bullet\,$  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



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.

Eye Margin	Start Start	Stop	File 🖕		Application Selector				III	
Result	Rese	t All				Display Phase Unit	mUI 💌		(O) Contour	
Slot	ON/OFF	Phase Margin	Threshold Margin	Period			Period			
Slot6-1 ED	ON	912 mUI p-p	5247 mV p-p	1000 mUI			~ 7		<b>∖⊷/</b> lathtub	
Slot6-2 ED	ON	912 mUl p-p	5247 mV p-p	1000 mUI		Amplitude	Phase Margin		XXX Margin KM4 BER	1
						Condition				
						Input Signal	NRZ		C	>
						Error Threshold	1.0E-3		pe	
						Fine/Coarse	Fine		rat	_
						Auto Search	OFF 🗸		101	•
						Status			0 1	
						Slot6-1 ED:Measuring Slot6-1 ED:Measuremei Slot6-2 ED:Measuring Slot6-2 ED:Measuremei	nt Completion		Operation of Applications	
						Date & Time	▼ 2018/08/28 19:37:46		🛃 🕄	
							0%			•
					BERT <u>AUTO ME</u>	AS		ritsu 19:37	sc st	

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.

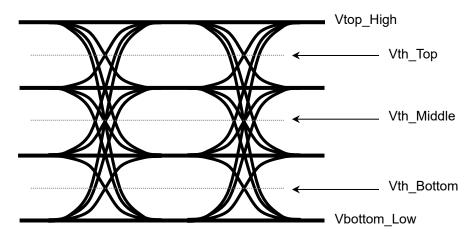


Figure 4.4.4-1 PAM BER Measurement

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.

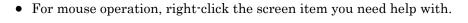
- When the module being used is MU196040A/B
- $\bullet$  When  $Auto\ Adjust$  is set to ON
- When **OFF** is selected for **Auto Sync** on the **Result** tab
- When the **Input** tab is grouped together with the other tab



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 **[11]**, and then touch the screen item you need help with.



	Condition				Change the PPG Combination	n settting to	Contour
Time	Single	▼ 00:00:01			Operation: Combination	on	1)(
Pattern	PRBS15				Combination: 2ch		Bathtub
Auto Search	PAM Coarse	<b>T</b>			Change the ED Combination	settting to	XII
Module	Unit1-Slot6-Data1				Operation: Independe	ent	Margin
Result							Ħ
nesuic	Threshold	Phase		Error Rate	Error Count	Alarm	PAM4 BER
	Data XData						
Upper ON	-0.600 V	V 600 mUI		3.1288E-0	9 2816		
Middle ON	0.060 V	V 600 mUI		5.6320E-0	9 2816		
Lower ON	-1.000 V	V 600 mUI		6.4000E-0	9 2560		
			Total	8.1920E-0	9 8192		
Middle Eye Ph	ase Tracking ON		Frequency(	MHz)	12430		
				Date&T	ime 🗸		
		0%					

Figure 4.4.4-2 PAM BER Screen

# Chapter 5 Remote Commands

This chapter describes remote control of MX190000A.

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	5.5.4	How to Read and Write Status Register	. 5-62			
	5.5.5	How to Clear and Reset Status Register	. 5-63			
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# 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.

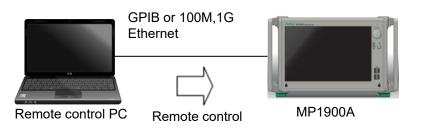


Figure 5.2.1-1 Configuration for remote control of MP1900A from the remote control PC

# 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.

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	
Т5	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	

Table 5.2.2.1-1 Interface Function

\*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.

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

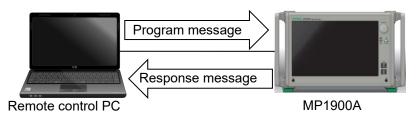


Figure 5.2.2.2-1 Device message

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

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.

Table 5.2.2.3-1 Bus commands

# 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 $\leq 15$  unitsTotal cable length $\leq 2 \text{ m} \times \text{Number of devices (20 m, max.)}$ 

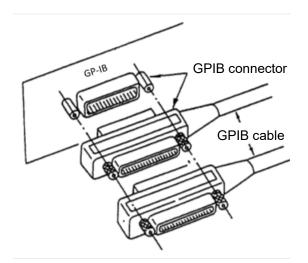


Figure 5.2.2.4-1 GPIB cable connection

# 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**.

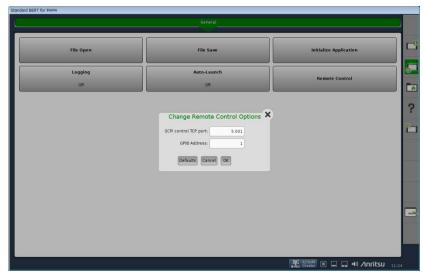


Figure 5.2.2.5-1 Remote Control Setting Example

## 5.2.2.6 System initialization

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

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.

Table 5.2.2.6-1 Device initialization

#### 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

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

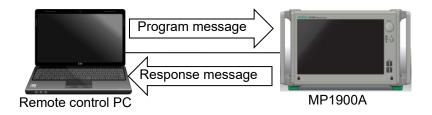


Figure 5.2.3.1-1 Device messages

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

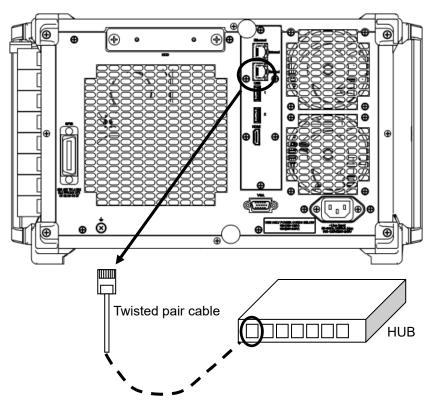


Figure 5.2.3.2-1 Connection via Ethernet Cable

# 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.

Class	Network part length	Host part length	Number of hosts that can be assigned
А	8 bits	24 bits	16 777 214 units
В	16 bits	16 bits	65 534 units
С	24 bits	8 bits	254 units

Table 5.2.3.3-1 IP address

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.

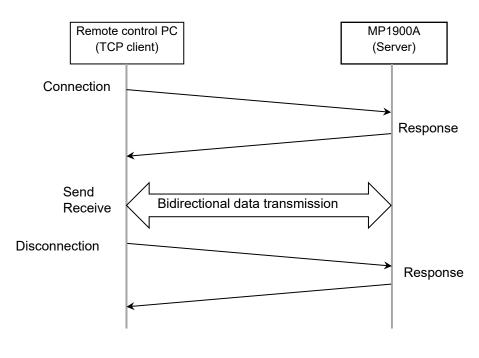


Figure 5.2.3.4-1 Data flow

#### 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.

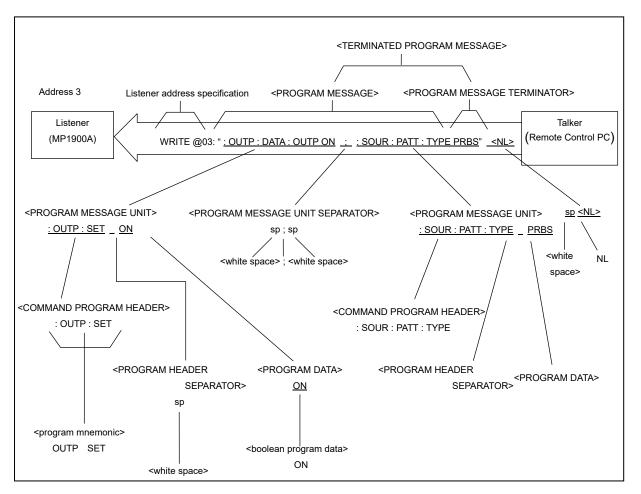


Figure 5.3.1.1-1 SCPI listener input program message

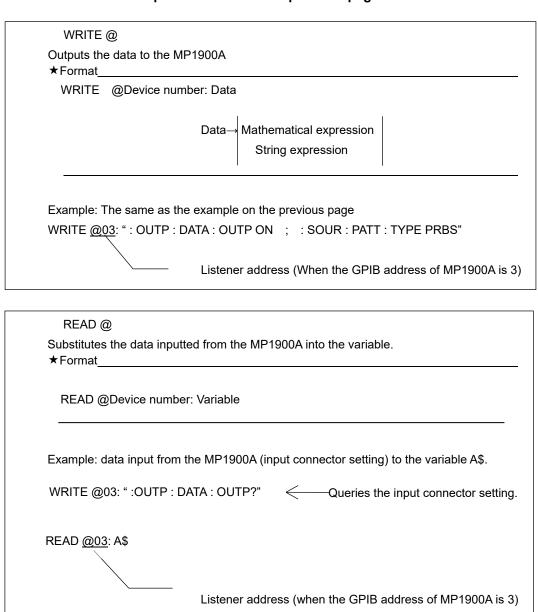
The program message format consists of a sequence of functional elements, which are the minimum level units to indicate a function. In the figure above, the words written in uppercase alphabetical characters enclosed within brackets (< >) indicate examples of functional elements.

The WRITE and READ commands have the following formats.

WRITE @ Outputs data to the MP1900A. ★Format\_\_\_\_\_

WRITE @Device number: Data

 $Data \rightarrow |$  Mathematical expression String expression



#### Example: The same as the previous page

## 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.

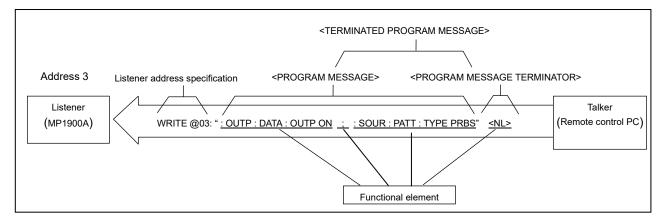
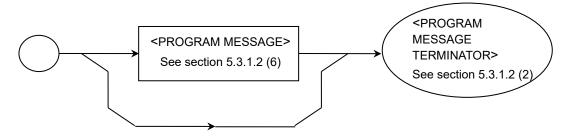


Figure 5.3.1.2-1 <TERMINATED PROGRAM MESSAGE>

<TERMINATED PROGRAM MESSAGE> is defined as follows:

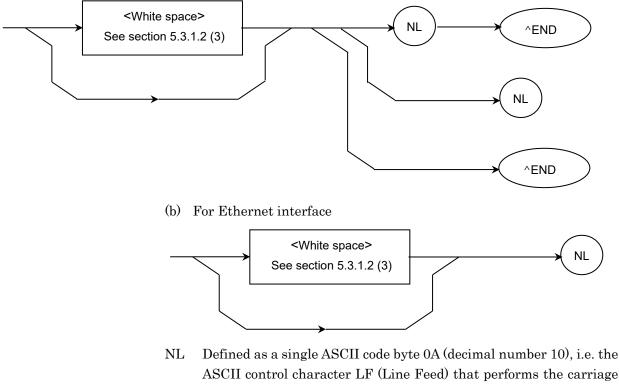


<TERMINATED PROGRAM MESSAGE> is a data message containing all the functional elements required for transmitting the message from the remote control PC to the MP1900A. A <PROGRAM MESSAGE TERMINATOR> is added to the end of a <PROGRAM MESSAGE> to complete transmission of the <PROGRAM MESSAGE>.

#### (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



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.

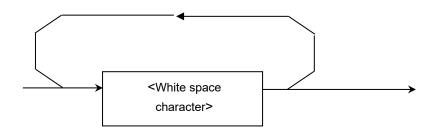
If the remote control PC runs on MS-DOS or Windows, line feed is done with "CR + LF", while it is done with only "LF" for UNIX.

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

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(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.

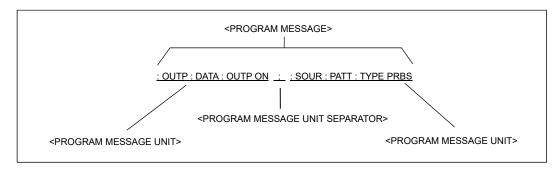
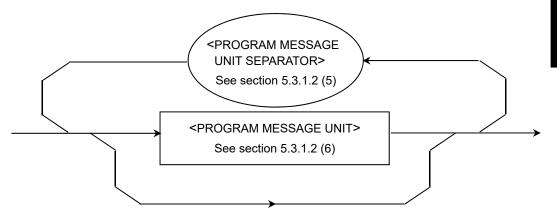


Figure 5.3.1.2-2 <PROGRAM MESSAGE>

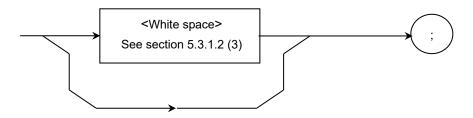
#### <PROGRAM MESSAGE> is defined as follows:



<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>

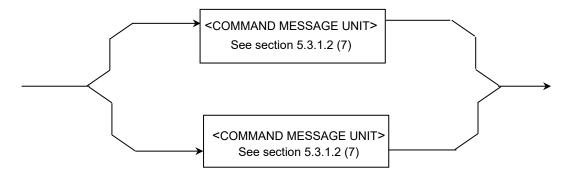
#### <PROGRAM MESSAGE UNIT SEPARATOR> is defined as follows:



<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>

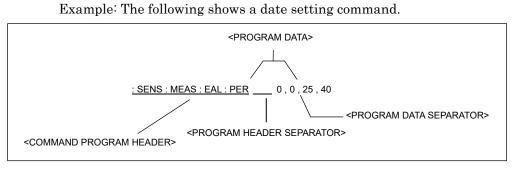
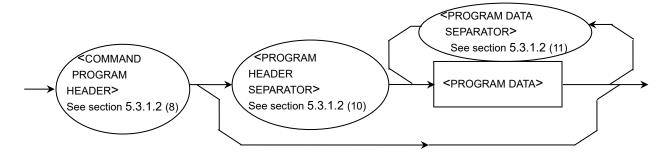


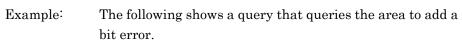
Figure 5.3.1.2-2 <COMMAND MESSAGE UNIT>

#### <COMMAND MESSAGE UNIT> is defined as follows:



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## (b) <QUERY MESSAGE UNIT>



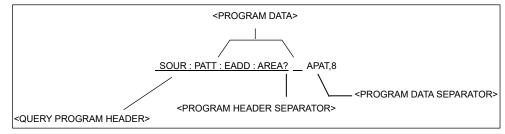
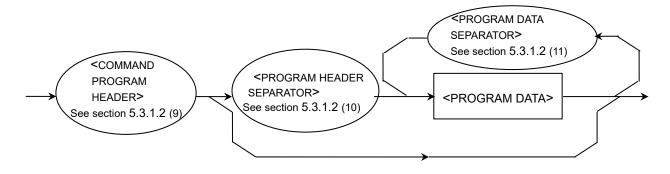


Figure 5.3.1.2-3 <QUERY MESSAGE UNIT>

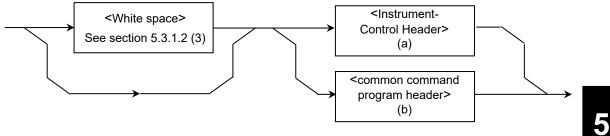
<QUERY MESSAGE UNIT> is defined as follows:



#### (8) <COMMAND PROGRAM HEADER>

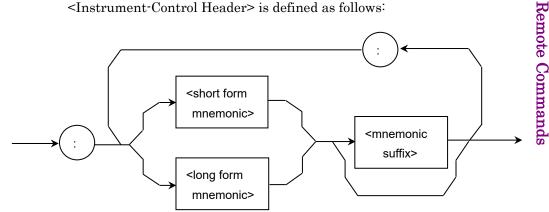
<COMMAND PROGRAM HEADER> indicates the application, function, and operation of the program data executed by the MP1900A. If no program data is added, the header alone indicates the application, function, and operation for the MP1900A. <program mnemonic> expresses the meaning in ASCII code characters,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

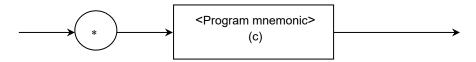
Correspond to the short form and long form of the SCPI commands, respectively. For the specifications of mnemonics, the specifications of <program mnemonic> described earlier are applied as they are.

#### <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).

(b) <common command program header>

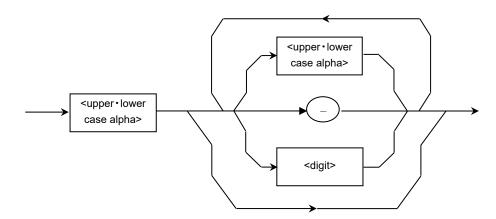
<common command program header> is defined as follows:



<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.

#### <up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><up><l

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).

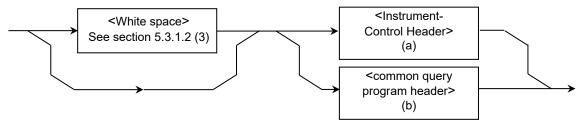
#### (\_)

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.)

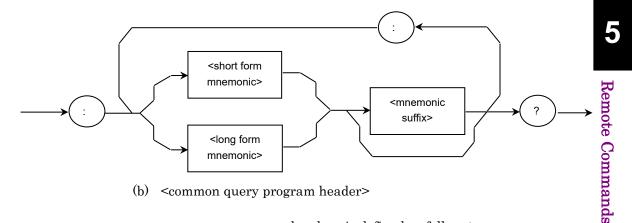
#### (9) <QUERY PROGRAM HEADER>

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

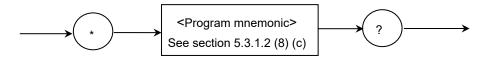


(a) <Instrument-Control Headers>

<Instrument-Control Headers> is defined as follows:



<common query program header> is defined as follows:



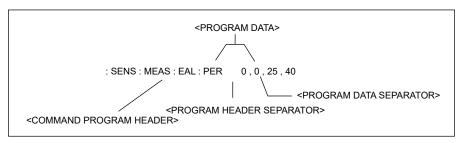
<QUERY PROGRAM HEADER> is a query command transmitted from the remote control PC to the MP1900A in advance for the remote control PC to receive response messages from the MP1900A. A query indicator (?) must be added to the end of the header.

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>.

#### Chapter 5 Remote Commands

#### (10) <PROGRAM HEADER SEPARATOR>



#### Figure 5.3.1.2-4 <PROGRAM HEADER SEPARATOR >

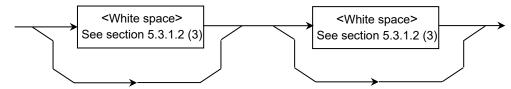
<PROGRAM HEADER SEPARATOR> is defined as follows.



<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".

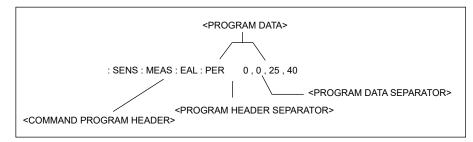


Figure 5.3.1.3-1 <PROGRAM DATA>

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.

<program data=""></program>	Туре
<character data="" program=""></character>	Indicates short alphabetic or alphanumeric data.
<decimal data="" numeric="" program=""></decimal>	Indicates a decimal numerical constant.
<non-decimal data="" numeric="" program=""></non-decimal>	Indicates an alphanumeric character other than a decimal.
<boolean data="" program=""></boolean>	Indicates a theoretical value (defined in SCPI).
<string data="" program=""></string>	Indicates a string enclosed within double quotation marks (" ") or single quotation marks (' ').

5

#### (1) <CHARACTER PROGRAM DATA>

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

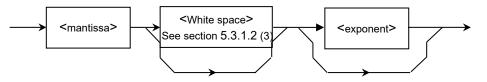
Example: :SENSe:PATTern:TYPE PRBS (Mnemonic data indicating PRBS) :SENSe:MEASure:EALarm:UNIT CLOCk (Mnemonic data indicating the measurement cycle in Clock Count units.)

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

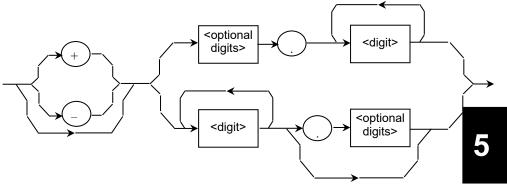


#### (2) <DECIMAL NUMERIC PROGRAM DATA>

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



<mantissa> is defined as follows:



005

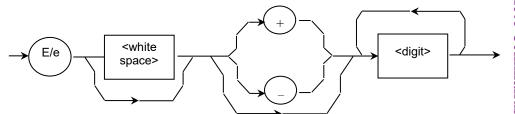
 $+5\Delta\Delta$ 

+5, 5

+5 (applicable),

 $+\Delta 5$  (not applicable)

<exponent> is defined as follows:



The MP1900A uses the decimal integer format.

#### Integer format

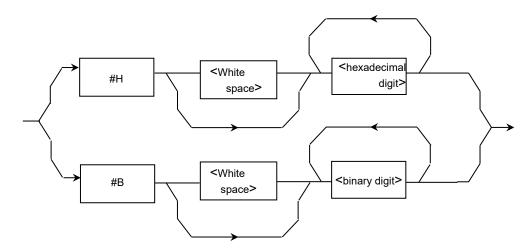
 $\Delta$  represents a space.

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

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).  $\Delta$  represents a space.

- Spaces can be inserted following #H. #H1234 → #H∆1234 #H00AF → #H∆∆∆00AF
- Zeros can be omitted. #H00FF  $\rightarrow$  #HFF #H0000  $\rightarrow$  #H0

Example: :SOURce:PATTern:DREVerse:ADDRess #H0,#H1F

<br/>
<br/>
hinary digit>: Binary format

The binary format consists of #B and the subsequent 0s and/or 1s.  $\Delta$  represents a space.

Spaces can be inserted following #B.
 #B11011011 → #BΔ11011011
 #B00100100 → #BΔΔΔ00100100

#### (4) <BOOLEAN PROGRAM DATA>

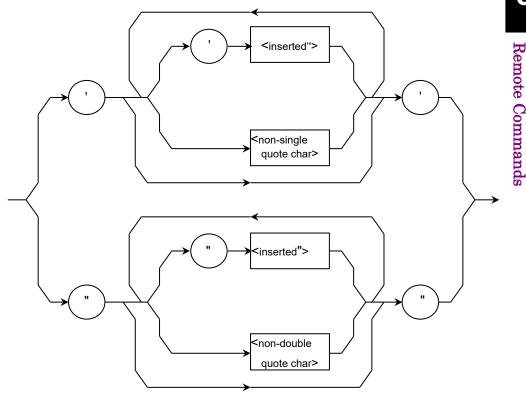
<BOOLEAN PROGRAM DATA> is the program data that is defined in the SCPI, and indicates a theoretical value. As the values corresponding to True and False, ON and OFF of <CHARACTER PROGRAM DATA> and 1 and 0 of <DECIMAL NUMREIC PROGRAM DATA> are defined.

Example:	SOURce:PATTern:EADDition:SET ON	
	SOURce:PATTern:EADDitionSET 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 = ").

		quote char> is defined as a single ASCII symbol of a han 22 (decimal number, 34 = ").	
	<example description="" of=""></example>		
		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	s 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.

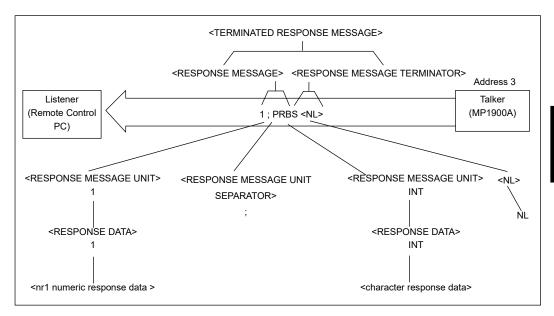


Figure 5.3.2.1-1 <TERMINATED RESPONSE MESSAGE>

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.

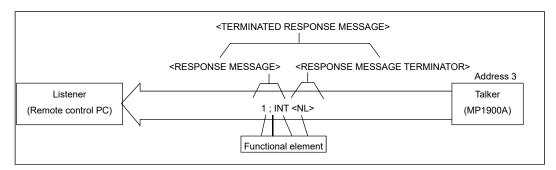
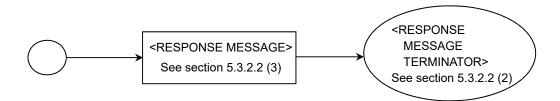


Figure 5.3.2.2-1 <TERMINATED RESPONSE MESSAGE>

<TERMINATED RESPONSE MESSAGE> is defined as follows:

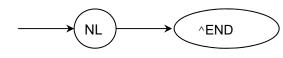


<TERMINATED RESPONSE MESSAGE> is a data message containing all the functional elements required for transmitting the message from the talker (MP1900A) to the remote control PC. A <RESPONSE MESSAGE TERMINATOR> is added to the end of a <RESPONSE MESSAGE> to complete transmission of <RESPONSE MESSAGE>.

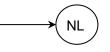
#### (2) <RESPONSE MESSAGE TERMINATOR>

<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.

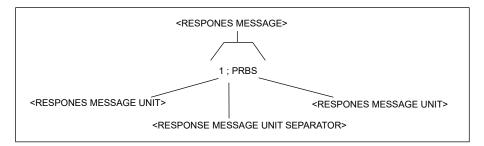
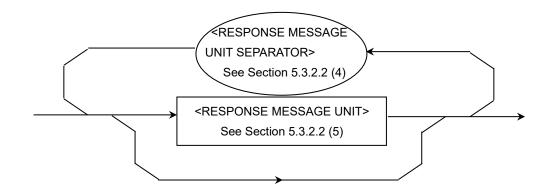


Figure 5.3.2.2-2 <TERMINATED RESPONSE MESSAGE>

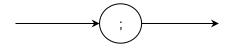
#### <RESPONSE MESSAGE> is defined as follows:



<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>

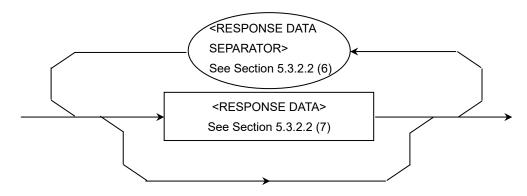
<RESPONSE MESSAGE UNIT SEPARATOR> is defined as follows:



<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>

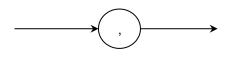
<RESPONSE MESSAGE UNIT> of the MP1900A is a response message unit with no header, and returns only the measurement result data. <RESPONSE MESSAGE UNIT> is defined as follows:



#### (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.
<ul> <li>(3) NR2 NUMERIC RESPONSE DATA Example:</li> <li>12.3</li> <li>+12.34</li> <li>-12.345</li> </ul>	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.

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&gt;NL^END</ascii </ascii>	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 (c) (c) For Ethernet interface (c) (c) (c) (c) (c) (c) (c) (c) (c) (c)	

 Table 5.3.2.2-1
 Response data (Cont'd)

#### 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.

ltem	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	$\Delta$ +E, e+ $\Delta$ ( $\Delta$ is 0 or more)	Uppercase E only
Positive sign (+) of the NR3 exponent part	Can be omitted	Cannot be omitted
$<$ white space> ( : $\Delta$ )*1	Two or more <white space=""> can be added before and after the separator and before the terminator.</white>	Not used
Unit separator	$\Delta$ + semicolon ( $\Delta$ is 0 or more)	Semicolon only
Blank before header	ank before header $\Delta$ + header ( $\Delta$ is 0 or more)	
Header separator	Header + $\Delta$ ( $\Delta$ is 1 or more)	Header + one $20^{2}$
Data separator	$\Delta$ + comma + $\Delta$ ( $\Delta$ is 0 or more)	Comma only
Terminator	rminator $\Delta + \{NL, EOI, or NL+EOI\} (\Delta is 0 or more)$ NL+EOI*3	

#### Table 5.3.2.3-1 Syntax difference

\*1:  $\Delta$  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.

:INPut	:CLOCk	:SELection	<clock></clock>
		SELection?	
		RECovery	<string></string>
		RECovery?	

Table 5.3.3-1 Example of SCPI command tree

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></clock>	
:INPut:CLOCk:SELection?	
:INPut:CLOCk:RECovery <string></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.

Parameter Type	Description
<numeric> <decimal data="" numeric="" program=""></decimal></numeric>	Indicates a decimal integer.
<numeric> <non-decimal data="" numeric="" program=""></non-decimal></numeric>	Indicates a numeric value other than a decimal (binary, octal, etc.).
<boolean> <boolean data="" program=""></boolean></boolean>	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 data="" program=""></string></display></string>	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"
  character =                               	Indicates character data. It is expressed as a short string corresponding to the setting details.
   	Used to transmit 8-bit binary data.

Table 5.3.6-1 Description of parameter types

## 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.

Response Type	Description
<numeric> <nr1 data="" numeric="" response=""></nr1></numeric>	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 data="" numeric="" response=""></nr2></numeric>	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
   	Returns the short form of the character. > :SOURce:SYNThesizer:JITTer:MODulation:SELect? < INT
<string>,<display>etc <string data="" response=""></string></display></string>	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<br="">DATA&gt;</arbitrary>	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,

Table 5.3.7-1 Description of response types

## 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.

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

Table 5.4-1 IEEE 488.2 Common Commands List

*IDN?	Identification Query
Parameter	None
Response	<manufacturer>, <model>, <serial no.=""></serial></model></manufacturer>
	<manufacturer>,</manufacturer>
	ANRITSU
	<model> = <character data="" response=""></character></model>
	MP1900A
	<serial no.=""> = <nr1 data="" numeric="" response=""></nr1></serial>
	000000000 to 999999999
	Main frame Serial number
Function	Reports manufacture name, model, etc.
Example	

*RST	Reset Command	
Parameter	None	e
Function	Initializes entire system.	
	Cancels the measurement and clear the contents.	ਲੂ
	To reset to the factory default, perform SCPI command	em
	SYSTem:MEMory:INITialize	emote
Example		Õ
		omman
		m
*OPC	Operation Complete Command	ands
		•=

*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?	Operation Complete Query	
Parameter	None	
Response	<nr1 data="" numeric="" response=""></nr1>	
	1	
Function	Returns 1 when preceding command is completed.	
Example		

*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		
*CLS	Clear Status Command	

020	
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.</query></program>
Example	

*ESE	Standard Event	Status Enable Command
Parameter	<decimal nume<="" td=""><td>CRIC PROGRAM DATA&gt;</td></decimal>	CRIC 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:	

5

*ESE?	Standard Event Status Enable Query	
Parameter	None	
Response	<nr1 data="" numeric="" response=""></nr1>	
	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 comm	
Function	Queries current value of standard event status enable register.	
Example		

*ESR?	Standard Event Status Register Query		
Parameter	None		
Response	<nr1 data="" numeric="" response=""></nr1>		
		tal of digit values of standard event status gister 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 exi	sts:	

*SRE	Service Reques	t Enable Command	
Parameter	<decimal data="" numeric="" program=""></decimal>		
	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?	Service Request Enable Query	
Parameter	None	
Response	<nr1 numerio<="" td=""><td>C RESPONSE DATA&gt;</td></nr1>	C 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 Example	Function Queries	s current value of service request enable register.

*STB?	Read Status Byte Query	
Parameter	None	
Response	<nr1 f<="" numeric="" td=""><td>RESPONSE DATA&gt;</td></nr1>	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		tus register summary is true:

*TRG	Trigger Command None	
Parameter		
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		
*OPT2	Ontion Identification Query	

*OPT?	Option Identification Query
Parameter	None
Response	<arbitrary ascii="" data="" response=""></arbitrary>
	Characters (refer to Table below) corresponding to the name of an option
	or module installed.
Function	Reports a list of the installed options/modules (see Table 5.4-2).
	All installed options and modules are reported, separated by commas (,).
Example	

**Remote Commands** 

Model/Name	Option No.	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	OPT001	32G bit/s Extension
21G/32G bit/s SI PPG	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
MU195040A	OPT001	32Gbit/s Extension
21G/32G bit/s SI ED	OPT010	1ch ED
	OPT020	2ch ED
	OPT011	1ch CTLE
	OPT021	2ch CTLE
	OPT022	Clock Recovery
MU195050A Noise Generator	OPT001	White Noise
MU196020A	OPT001	32G baud
PAM4 PPG	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

Table 5.4-2	Option Character List (MP1900A)
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5.4 IEEE 488.2 Common Commands

Model/Name	Option No.	Option Name
MU196040A	OPT001	32.1G baud Decoder
PAM4 ED	OPTx22	25.5G to 32.1G baud Clock Recovery
	OPTx41	SER Measurement
MU196040B	OPT001	32.1G baud
PAM4 ED	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
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	OPTx01	32G bit/s Extension
Sensitivity ED	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	OPTx01	32G bit/s Extension
Sensitivity ED	OPTx22	2.4G to 28.1G bit/s Clock Recovery
	OPTx23	25.5G to 32.1G bit/s Clock Recovery

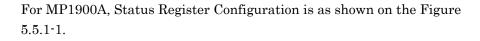
Table 5.4-2 Option Character List (MP1900A) (Cont'd)

# 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



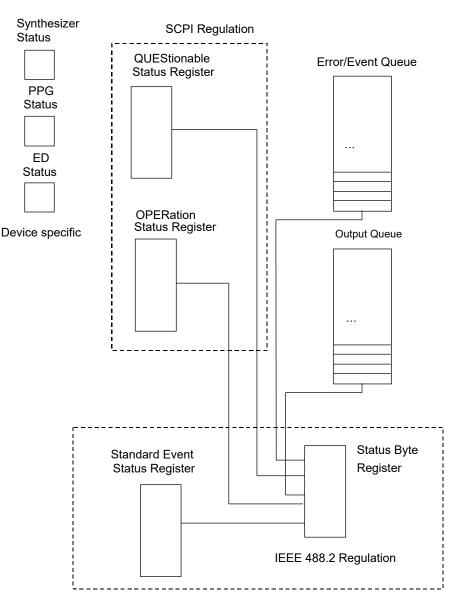


Figure 5.5.1-1 Status Register Configuration

### 5.5.2 IEEE 488.2 Regulated Register

The bits of the following two IEEE 488.2 regulated registers are defined as follows,

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.

Table 5.5.2-1 IEEE 488.2 Regulated Register

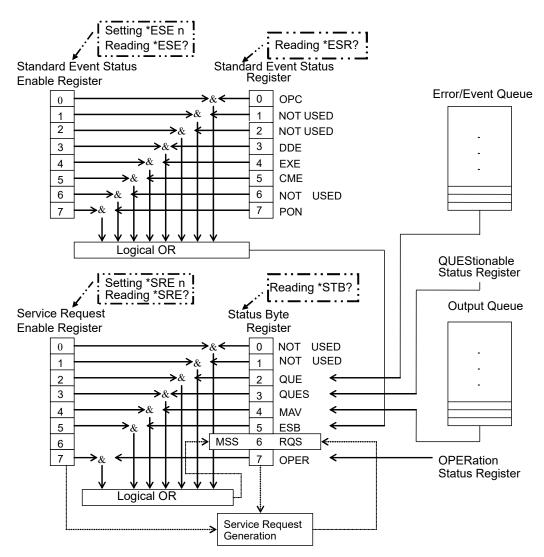


Figure 5.5.2-1 Status Register Configuration

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 5.5.2-2 Status Byte Register Bit Definition

#### 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.

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.

Table 5.5.3-1 SCPI-regulated Status Registers

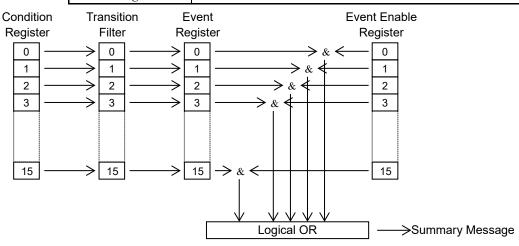


Figure 5.5.3-1 OPERation Status Register

D:4	Maranaatia	Description
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.

 Table 5.5.3-2
 OPERation Status Register Bit Definition

\*: 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.

**Remote Commands** 

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## 5.5.4 How to Read and Write Status Register

Table 5.5.4-1 shows how to read and write status register.

Register	Reading	Writing
Status byte register	<ul> <li>Read the register bits using the serial pole.</li> <li>A 7-bit status byte and a RQS message bit are returned. The status byte value does not change.</li> <li>*STB? Common query</li> <li>A numeric value composed of the statusbyte register value and the MSS summary message is returned.</li> <li>The Status register does not change at this time.</li> </ul>	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	<ul> <li>STATus::PTRansition?</li> <li>STATus::NTRansition?</li> <li>Device-unique command</li> <li>The contents of register bits do not change.</li> </ul>	Device-unique command STATus::PTRansition STATus::NTRansition
Error/event queue	SYSTem:ERRor?	Disabled

Table 5.5.4-1	Reading and Writing the Status Register
---------------	---

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.

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	$\operatorname{Reset}^{*_1}$	Reset	Executing :STATus::EN ABle 0
SCPI Transition filter	No change	Reset	$\operatorname{Reset}^{*1}$	Reset	Executing STATus::PTRansition 0 and STATus::NTRansition 0
Error/event queue	No change	Clear	Clear	No change	Reading all events by :SYSTem:ERRor?

 Table 5.5.5-1
 Clearing and Resetting the Status Registers

\*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	d
--	---

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.

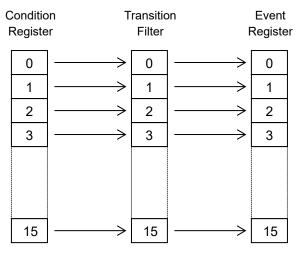


Figure 5.5.6-1 Each Status Configuration

#### 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 Example

Initializes the event status register and filter.

### 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 data="" numeric="" response=""></nr1></numeric>	
	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 reg	rister at OPERation Status Register.
Example		
	or	

## :STATus:OPERation:CONDition?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	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 reg	ister at OPERation Status Register.
Example		

## :STATus:OPERation:ENABle <numeric>

Parameter	<numeric> = <decimal data="" numeric="" program=""></decimal></numeric>		
	$0  ext{ to } 8184$	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 a	are masked.	
Function	Sets mask value of	f event enable register at OPERation status register	
Example	To set event enable	e register to 16 at OPERation status register.	

## :STATus:OPERation:ENABle?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 8184	Sum of all bits set in the event enable register
		(DECIMAL)
Function	Queries enable register	at OPERation status register.
Example		

Parameter	<numeric> = <de< th=""><th colspan="2"><numeric> = <decimal data="" numeric="" program=""></decimal></numeric></th></de<></numeric>	<numeric> = <decimal data="" numeric="" program=""></decimal></numeric>	
	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	on filter (positive direction change) of the OPERation	
	status register to 1	6.	

## :STATus:OPERation:PTRansition < numeric>

## :STATus:OPERation:PTRansition?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 8184	Sum of all bits set in the transition filter (DECIMAL)
Function	Queries the transition	n filter (positive direction change) of the OPERation
	status register.	
Example		

:STATus:OPERation:NTRansition <numeric></numeric>
---

Parameter	<numeric> = <decim< th=""><th>AL NUMERIC PROGRAM DATA&gt;</th></decim<></numeric>	AL 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 filte	er (negative direction change) of the OPERation
	status register.	
Example	To set the transition fi	lter (negative direction change) of the OPERation
	status register to 16.	

## :STATus:OPERation:NTRansition?

Response	<numeric> = <ni< th=""><th colspan="2"><numeric> = <nr1 data="" numeric="" response=""></nr1></numeric></th></ni<></numeric>	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	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			

### 5.5.7.3 Synthesizer Status

Synthesizer Status displays faults at the MU181000A/B.

## :INSTrument:SYG125[:EVENt]?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	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		
	or	

## :INSTrument:SYG125:CONDition?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 1	Sum of all bits set in the condition register
		(DECIMAL)
	Available bit	
	1 (Bit 0)	PLL Unlock occurs
Function Example	Queries condition at Sy	nthesizer.

## :INSTrument:SYG125:PTRansition <numeric>

Parameter	<numeric> = <decimal data="" numeric="" program=""></decimal></numeric>	
	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 filt	er (positive direction change) of the Synthesizer
	Status.	
Example	To set the transition fi	lter (positive direction change) of the Synthesizer
	Status to 1.	

:INSTrument:SYG125:PTRansition?			
Response	<numeric> = &lt;</numeric>	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 1	Sum of all bits set in the transition filter	
		(DECIMAL)	
Function	Queries the tra	insition filter (positive direction change) of the Synthesizer	
	Status.		
Example			

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## :INSTrument:SYG125:NTRansition <numeric>

Parameter	<numeric> = <decimal data="" numeric="" program=""></decimal></numeric>	
	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 filte	er (negative direction change) of the Synthesizer
	Status.	
Example	To set the transition fi	lter (negative direction change) of the Synthesizer
	Status to 1.	

## :INSTrument:SYG125:NTRansition?

Response	<numeric> = &lt;]</numeric>	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 1	Sum of all bits set in the transition filter	
		(DECIMAL)	
Function	Queries the tra	Queries the transition filter (negative direction change) of the	
	Synthesizer Sta	atus.	
Example			

## :INSTrument:SYG125:RESet

Function Example

Initializes event at Synthesizer.

### 5.5.7.4 ED Status

ED Status is used to indicate an alarm and error of MU195040A (SI ED), MU196040A and MU196040B (PAM4 ED). It is compatible with the MU183040A, MU183040B, MU183041A and MU183041B.

## :INSTrument:EDG32[:EVENt]?

Response	<numeric>=<nr1< th=""><th colspan="2"><numeric>=<nr1 data="" numeric="" response=""></nr1></numeric></th></nr1<></numeric>	<numeric>=<nr1 data="" numeric="" response=""></nr1></numeric>	
	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 S	SI ED and PAM4 ED status	
Example			
	or		

## :INSTrument:EDG32:CONDition?

Response	<numeric>=<nr1 data="" numeric="" response=""></nr1></numeric>	
	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 SI ED and PAM4 ED status.	
Example		

## :INSTrument:EDG32:PTRansition <numeric>

Parameter	<numeric>=<decima< td=""><td>L NUMERIC PROGRAM DATA&gt;</td></decima<></numeric>	L 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 SI ED and PAM4	
	ED status.	
Example	To set the transition filter (positive direction transition) at SI ED and	
	PAM4 ED status to 1:	

## :INSTrument:EDG32:PTRansition?

Response	<numeric>=<nr1< th=""><th colspan="2"><numeric>=<nr1 data="" numeric="" response=""></nr1></numeric></th></nr1<></numeric>	<numeric>=<nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 16383	Sum of all bits set in the transition filter	
		(DECIMAL)	
Function	Queries contents of	Queries contents of transition filter (positive direction transition) at SI	
	ED and PAM4 ED	status.	
Example			

Parameter	<numeric>=<decimal data="" numeric="" program=""></decimal></numeric>	
	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 filt	er (negative direction transition) at SI ED and PAM4
	ED status.	
Example	To set the transition	on filter (negative direction transition) at SI ED and
	PAM4 ED status to	o 1:

### :INSTrument:EDG32:NTRansition <numeric>

### :INSTrument:EDG32:NTRansition?

Response	<numeric>=<nr1< td=""><td colspan="2"><numeric>=<nr1 data="" numeric="" response=""></nr1></numeric></td></nr1<></numeric>	<numeric>=<nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 16383	Sum of all bits set in the transition filter	
		(DECIMAL)	
Function	Queries contents or	f transition filter (negative direction transition) at SI	
	ED and PAM4 ED	status.	
Example			

### :INSTrument:EDG32:RESet

Function Example Initializes event at SI ED and PAM4 ED status.

#### 5.5.7.5 PPG Status

The PPG Status is used to indicate an alarm and error of the MU195020A (SI PPG) and MU196020A (PAM4 PPG). It is compatible with the MU183020A and MU183021A.

### :INSTrument:PPGG32[:EVENt]?

Response	<numeric>=<nr1 data="" numeric="" response=""></nr1></numeric>	
	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 SI P	PG and PAM4 PPG status.
Example		
	or	

### :INSTrument:PPGG32:CONDition?

Response	<numeric>=<nr1 data="" numeric="" response=""></nr1></numeric>	
	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 SI	PPG and PAM4 PPG status.
Example		

## :INSTrument:PPGG32:PTRansition <numeric>

Parameter	<numeric>=<decimal data="" numeric="" program=""></decimal></numeric>	
	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 fi	lter (positive direction transition) at SI PPG and PAM4
	PPG status.	
Example	To set the transit	tion filter (positive direction transition) at SI PPG and
	PAM4 PPG statu	us to 1:

## :INSTrument:PPGG32:PTRansition?

Response	<numeric>=<nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 15	Sum of all bits set in the transition filter
		(DECIMAL)
Function	Queries contents	of transition filter (positive direction transition) at SI
	PPG and PAM4	PPG status.
Example		

### :INSTrument:PPGG32:NTRansition <numeric>

Parameter	<numeric>=<de< th=""><th colspan="2"><numeric>=<decimal data="" numeric="" program=""></decimal></numeric></th></de<></numeric>	<numeric>=<decimal data="" numeric="" program=""></decimal></numeric>	
	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 fi	lter (negative direction transition) at SI PPG and PAM4	
	PPG status.		
Example	To set the transi	tion filter (negative direction transition) at SI PPG and	
	PAM4 PPG statu	as to 1:	

# :INSTrument:PPGG32:NTRansition?

Response	<numeric>=<ni< th=""><th colspan="2"><numeric>=<nr1 data="" numeric="" response=""></nr1></numeric></th></ni<></numeric>	<numeric>=<nr1 data="" numeric="" response=""></nr1></numeric>	
	0 to 15	Sum of all bits set in the transition filter	
		(DECIMAL)	
Function	Queries contents	s of transition filter (negative direction transition) at SI	
	PPG and PAM4	PPG status.	
Example			

### :INSTrument:PPGG32:RESet

Function Example Initializes event at SI PPG and PAM4 PPG status.

5

# 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> <type>=<CHARACTER PROGRAM DATA> Parameter PRBS **PRBS** pattern ZSUBstitution Zero-substitution pattern DATA Data pattern **ALTernate** Alternate pattern MIXData Mixed Data pattern Mixed Alternate pattern MIXalt Sequence pattern SEQuence Function Sets the type of the test pattern. To set the test pattern type to the Mixed Data pattern: Example > :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) Parameter Type (IEEE 488.2, SCPI) **Program Command** :SOURce:PATTern:TYPE2 Response <type>=<CHARACTER RESPONSE DATA> PRBS,ZSUB,DATA,ALT,MIXD,MIX,SEQ Function Queries the type of the test pattern. > :SOURce:PATTern:TYPE? Example < 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

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></unit_number>		
Parameter	<unit_number> = <decimal data="" numeric="" program=""></decimal></unit_number>	
	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:	
Compatibility	Compatible with MP1800A.	

## :UENTry:ID?

Response	<unit_number> = <nr1 data="" numeric="" response=""></nr1></unit_number>
	1 to 4
Function Example	Queries the number of the unit being operated.
Compatibility	Compatible with MP1800A.

## :MODule:ID <module\_number>

Parameter	<module_number> = <decimal data="" numeric="" program=""></decimal></module_number>	
	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:	
Compatibility	Compatible with MP1800A.	

## :MODule:ID?

Response	<module_number> = <nr1 data="" numeric="" response=""></nr1></module_number>
	1 to 8
Function Example	Queries the number of the module being operated (slot position).
Compatibility	Compatible with MP1800A.

Parameter	<function> = <c< td=""><td colspan="2"><function> = <character data="" program=""></character></function></td></c<></function>	<function> = <character data="" program=""></character></function>	
	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 automat	Sets the automatic measurement function to be performed.	
Example	To set the commo	To set the common function to be performed to Auto Search:	
Compatibility	Compatible with	Compatible with MP1800A.	

### :SYSTem:CFUNction <function>

## :SYSTem:CFUNction?

Response	<function> = <character data="" response=""></character></function>	
	ASE32	Auto Search
	EMAR32	Eye Margin measurement
	ECT	Eye Contour measurement
	BTUB32	Bathtub measurement
	AADJ32	Auto Adjust
	PAMB	PAM4 BER measurement
	OFF	Off
Function Example	Queries the automatic measurement function being performed.	
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 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> = <ni< th=""><th colspan="3"><version> = <nr2 data="" numeric="" response=""></nr2></version></th></ni<></version>	<version> = <nr2 data="" numeric="" response=""></nr2></version>		
	YYYY.V	YYYY:	Year	
		V:	Revision number	
Function Example	Queries the SCF	Queries the SCPI version to which the MP1900A conforms.		
Compatibility	Compatible with	the MP1632C,	MP1776A and MP1800A.	

#### :SYSTem:CONDition?

Response	<mainframe>,<slot< td=""><td>t1&gt;,,<slot64></slot64></td></slot<></mainframe>	t1>,, <slot64></slot64>
	<mainframe> = <se< td=""><td>erial&gt;,<mver>,<hver>,<opt1>,<sbver>,<saver>,<opt2></opt2></saver></sbver></opt1></hver></mver></td></se<></mainframe>	erial>, <mver>,<hver>,<opt1>,<sbver>,<saver>,<opt2></opt2></saver></sbver></opt1></hver></mver>
	<serial> = <strin< td=""><td>G RESPONSE DATA&gt;</td></strin<></serial>	G RESPONSE DATA>
	XXXXXXXXXX	0000000000 to 9999999999
		MP1900A serial number
	Note:	
	Alphabetic cl	haracters may be included.
	<mver> = <strin< td=""><td>G RESPONSE DATA&gt;</td></strin<></mver>	G RESPONSE DATA>
	XXXX.XX.XX	1.00.00 to 9999.99.99
		MX190000A software version
	<hver> = <string< td=""><td>G RESPONSE DATA&gt;</td></string<></hver>	G RESPONSE DATA>

XXXX.XX.XX	1.00.00 to 9999.99.99
	MP1900A hardware version
<pre><opt1> = <string pre="" r<=""></string></opt1></pre>	RESPONSE DATA>
OPTXXX	Option number (MP1900A)
	See "Table 5.6.1.1-2 Option character
	correspondence table".
Note:	
Outputs the nu	mbers for all installed options.
NONE is outpu	t if no option is installed.
<sbver> = <string< td=""><td>RESPONSE DATA&gt;</td></string<></sbver>	RESPONSE DATA>
XXXX.XX.XX	1.00.00 to 9999.99.99
	Sub application software version (Boot part)
<saver> = <string< td=""><td>RESPONSE DATA&gt;</td></string<></saver>	RESPONSE DATA>
XXXX.XX.XX	1.00.00 to 9999.99.99
	Sub application software version (Application
	part)
<pre><opt2> = <string pre="" r<=""></string></opt2></pre>	
<slot x> = <module>,</module>	<serial>,<fpga1>[,<fpga2>],<boot>,</boot></fpga2></fpga1></serial>
<application>,<opt></opt></application>	
x indicates a slot nun	nber. 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< td=""><td>G RESPONSE DATA&gt;</td></string<></module>	G RESPONSE DATA>
XXXXXXXXX	Module model name (e.g.: MU195020A)
	See "Table 5.6.1.1-2 Option character
	correspondence table".
Note:	
NONE is outpu	t if no module is installed.
For a module th	hat uses two slots, only the slot with the greater
number is valid	1.
<serial> = <string< td=""><td>RESPONSE DATA&gt;</td></string<></serial>	RESPONSE DATA>
XXXXXXXXXX	000000000 to 999999999
	Serial number
Note:	
	utput if no module is installed.
	hat 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 r<="" td=""><td>ESPONSE DATA&gt;</td></string></boot>	ESPONSE DATA>
XXXX.XX.XX	1.00.00 to 9999.99.99
	Logic Boot version
Note:	20910 2000 1010101
	utput if Logic boot is not installed.
	hat uses two slots, only the slot with the greater
number is valid	ι.
<application> = <stf< td=""><td>RING RESPONSE DATA&gt;</td></stf<></application>	RING RESPONSE DATA>
XXXX.XX.XX	1.00.00 to 9999.99.99
	Logic Application version
Note:	
"" is o	utput if Logic Application is not installed.
	hat uses two slots, only the slot with the greater
number is valid	
<opt> = <string ri<="" td=""><td>ESPONSE DATA&gt;</td></string></opt>	ESPONSE DATA>
XXXXXX/XXXXX	Option number
	OPTXXX: For MP1900A
Note:	
Outputs the nu module is insta	mbers for all installed options. NONE is output if no lled.
For a module th	nat uses two slots, only the slot with the greater
number is valid	l.
Queries the software	status of the MP1900A.

Function Example

Compatibility

#### Compatible with MP1800A.

Model/Name	Option Number	Option Name
MX190000A Signal Quality Analyzer-R Control Software	-	-
MU181000A 12.5GHz Synthesizer	OPTx01	Jitter Modulation
MU181000B	OPTx01	Jitter Modulation
12.5GHz 4port Synthesizer	OPTx02	SSC Extension
MU195020A	OPT001	32G bit/s Extension
21G/32G bit/s SI PPG	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
MU195040A	OPT001	32Gbit/s Extension
21G/32G bit/s SI ED	OPT010	1ch ED
	OPT020	2ch ED
	OPT011	1ch CTLE
	OPT021	2ch CTLE
	OPT022	Clock Recovery
MU195050A Noise Generator	OPT001	White Noise
MU196020A	OPT001	32G baud
PAM4 PPG	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

#### Table 5.6.1.1-2 Option character correspondence table

#### 5.6 SCPI Commands

Model/Name	Option Number	Option Name
MU196040A	OPT001	32.1G baud Decoder
PAM4 ED	OPTx22	25.5G to 32.1G baud Clock Recovery
	OPTx41	SER Measurement
MU196040B	OPT001	32.1G baud
PAM4 ED	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
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	OPTx01	32G bit/s Extension
Sensitivity ED	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	OPTx01	32G bit/s Extension
Sensitivity ED	OPTx22	2.4G to 28.1G bit/s Clock Recovery
	OPTx23	25.5G to 32.1G bit/s Clock Recovery

 Table 5.6.1.1-2
 Option character correspondence table (Cont'd)

# :SYSTem:ORGanization:HARDware?

Response	<slot1>,,<slot64></slot64></slot1>	<slot1>,,<slot64></slot64></slot1>		
	<slotx>=</slotx>			
	<module>,<serial>,</serial></module>	<fpga1>[,<fpga2>],<boot>,<application>,<opt></opt></application></boot></fpga2></fpga1>		
	x indicates a slot n	umber. 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	Unit 4: 49 to 64		
	<module> = <stri< td=""><td colspan="3"><module> = <string data="" response=""></string></module></td></stri<></module>	<module> = <string data="" response=""></string></module>		
	XXXXXXXXX	Module model name (e.g.,: MU195020A)		
		See "Table 5.6.1.1-2 Option character		
		correspondence table".		
	Note:			
	NONE is out	NONE is output if no module is installed.		
	For a module	that uses two slots, only the slot with the greater		
	number is va	lid.		
	<serial> = <strin< td=""><td colspan="3"><serial> = <string data="" response=""></string></serial></td></strin<></serial>	<serial> = <string data="" response=""></string></serial>		
	XXXXXXXXXX	0000000000 to 9999999999		
		Serial number		
	Note:	Note:		
	"" is ou	"" is output if no module is installed.		
	For a module number is va	that uses two slots, only the slot with the greater lid.		
	<fpga1>[,<fpga2>,</fpga2></fpga1>	<fpga1>[,<fpga2>,] = <string data="" response=""></string></fpga2></fpga1>		
	XXXX.XX.XX	1.00.00 to 9999.99.99		
		FPGA version		
	<boot> = <string< td=""><td colspan="3"><boot> = <string data="" response=""></string></boot></td></string<></boot>	<boot> = <string data="" response=""></string></boot>		
	XXXX.XX.XX	1.00.00 to 9999.99.99		
		Logic Boot version		
	Note:			
	"" is ou	tput if Logic Boot is not installed.		
		that uses two slots, only the slot with the greater		
	number is va	lid.		

	XXXX.XX.XX Note: "" is outpu	NG RESPONSE DATA> 1.00.00 to 9999.99.99 Logic Application version It if Logic Application is not installed. at uses two slots, only the slot with the greater
	number is valid. <opt> = <string res<="" th=""><th>SPONSE DATA&gt;</th></string></opt>	SPONSE DATA>
	XXXXXX/XXXXX	Option number OPTXXX
	-	if no module is installed. at uses two slots, only the slot with the greater
Function Example	Queries the hardware	system configuration of the MP1900A.
Compatibility	Partially compatible w	ith the MP1632C and MP1776A. Compatible with

the N

the MP1800A.

## :SYSTem:INFormation:ERRor? <unit>

Parameter	<unit> = <decimal data="" numeric="" program=""></decimal></unit>	
	1 to 4	1 to 4, 1 step
Response	<numeric> = <nr1 nu<="" td=""><td>JMERIC RESPONSE DATA&gt;</td></nr1></numeric>	JMERIC RESPONSE DATA>
	0	NONE
	1	PLL Unlock
	2	Temperature
	3	Fan
	All the system errors t	hat have currently occurred are displayed,
	delimited with a comm	na (,).
Function	Queries the System Er	rror contents.
Example		
	(when a syste	m error has occurred for PLL Unlock, Temperature,
	or Fan)	
	(when no system	error has occurred)
Compatibility	Compatible with MP18	800A.

## :SYSTem:TERMination <numeric>

Parameter	<numeric> = <decimal data="" numeric="" program=""></decimal></numeric>	
	0	LF + EOI
	1	CR + LF + EOI
Function	Sets the terminator typ	e of the response data.
Example	To set the terminator ty	ype to LF + EOI:
Compatibility	Compatible with the M	P1632C and MP1800A.

# :SYSTem:TERMination?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0	LF + EOI
	1	CR + LF + EOI
Function	Queries the terminator type of the response data.	
Example		
Compatibility	Compatible with the M	P1632C and MP1800A.

Response	<unit1>,,<unit4></unit4></unit1>	, <slot1>,,<slot8></slot8></slot1>		
	=" <mainframe1>,</mainframe1>	., <mainframe4>,<module1>,,<module6>"</module6></module1></mainframe4>		
	<mainframe1> to &lt;</mainframe1>	<mainframe1> to <mainframe4> = <string data="" response=""></string></mainframe4></mainframe1>		
	XXXXXXXXX	Mainframe model name (e.g.,: MP1900A)		
		See"Table 5.6.1.1-2 Option character		
		correspondence table".		
	Note:			
	NONE is out	put for mainframe2 to mainframe4, if no MP1900A is		
	connected.			
	<module1> to <mod< td=""><td colspan="3"><module1> to <module64> = <string data="" response=""></string></module64></module1></td></mod<></module1>	<module1> to <module64> = <string data="" response=""></string></module64></module1>		
	XXXXXXXXX	Module model name (e.g.,: MU195020A)		
		See"Table 5.6.1.1-2 Option character		
		correspondence table".		
	Note:			
	NONE is out	NONE is output if no module is installed.		
	For a module	e that uses two slots, only the slot with the greater		
	number is va	lid.		
Function Example	Queries the model	name of the MP1900A and module.		
Compatibility	Compatible with M	P1800A.		

Parameter	<numeric> = <nr1< th=""><th>NUMERIC PROGRAM DATA&gt;</th></nr1<></numeric>	NUMERIC PROGRAM DATA>		
	1 to 4	MP1900A number		
	"1" for the $MP1900A$	Α.		
Response	<mainframe> =</mainframe>			
	<unit>,<serial>,<m< td=""><td>ver&gt;,<hver>,<opt1>,<sbver>,<saver>,<opt2></opt2></saver></sbver></opt1></hver></td></m<></serial></unit>	ver>, <hver>,<opt1>,<sbver>,<saver>,<opt2></opt2></saver></sbver></opt1></hver>		
	<unit> = <string< td=""><td colspan="3"><unit> = <string data="" response=""></string></unit></td></string<></unit>	<unit> = <string data="" response=""></string></unit>		
	XXXXXXXXX	Mainframe model name (e.g., : MP1900A)		
		See "Table 5.6.1.1-2 Option character		
		correspondence table".		
	Note:			
	NONE is outp	put if no module is installed.		
	For a unit that	at uses two slots, only the slot with the lower numbe		
	is valid.			
	<serial> = <string< td=""><td>G RESPONSE DATA&gt;</td></string<></serial>	G RESPONSE DATA>		
	XXXXXXXXXX	0000000000 to 9999999999		
		MP1900A serial number		
	Note:			
	Alphabetic ch	aracters may be included.		
	<mver> = <string< td=""><td>RESPONSE DATA&gt;</td></string<></mver>	RESPONSE DATA>		
	XXXX.XX.XX	1.00.00 to 9999.99.99		
		MX190000A software version		
	<hver> = <string< td=""><td>RESPONSE DATA&gt;</td></string<></hver>	RESPONSE DATA>		
	XXXX.XX.XX	1.00.00 to 9999.99.99		
		MP1900A hardware version		
	<pre><opt1> = <string< pre=""></string<></opt1></pre>	RESPONSE DATA>		
	OPTXXX	Option number (MP1900A)		
		See "Table 5.6.1.1-2 Option character		
		correspondence table".		
	Note:			
	Outputs the r	numbers for all installed options.		
	NONE is outp	put if no option is installed.		
	<sbver> = <string< td=""><td>G RESPONSE DATA&gt;</td></string<></sbver>	G RESPONSE DATA>		
	XXXX.XX.XX	1.00.00 to 9999.99.99		
		Sub application software version (Boot part)		
		G RESPONSE DATA>		
	XXXX.XX.XX	1.00.00 to 9999.999		
		Sub application software version (Application part)		

## :SYSTem:UNIT? <numeric>

<opt2> = <STRING RESPONSE DATA>FunctionQueries the MP1900A information including model and serial number.Example

Compatibility

Compatible with MP1800A.

Parameter	<numeric> = <nr1< th=""><th colspan="2"><numeric> = <nr1 data="" numeric="" program=""></nr1></numeric></th></nr1<></numeric>	<numeric> = <nr1 data="" numeric="" program=""></nr1></numeric>	
	1 to 8	Slot	
	1 to 8 when using t	he MP1900A.	
Response	<slot> = <module></module></slot>	, <serial>,<fpga1>,<fpga2>,<boot>,<application>,</application></boot></fpga2></fpga1></serial>	
	<opt></opt>		
	<module> = <stri< td=""><td>NG RESPONSE DATA&gt;</td></stri<></module>	NG RESPONSE DATA>	
	XXXXXXXXX	Module model name (e.g.,: MU195020A)	
		See "Table 5.6.1.1-2 Option character	
		correspondence table".	
	Note:		
	NONE is out	put if no module is installed.	
	For a module number is va	e that uses two slots, only the slot with the greater lid.	
	<serial> = <strin< td=""><td>G RESPONSE DATA&gt;</td></strin<></serial>	G RESPONSE DATA>	
	XXXXXXXXXX	0000000000 to 9999999999	
		Serial number	
	Note:		
	"" is output if no module is installed.		
	For a module number is va	e that uses two slots, only the slot with the greater lid.	
	<fpga1>,<fpga2> =</fpga2></fpga1>	<string data="" response=""></string>	
	XXXX.XX.XX	1.00.00 to 9999.99.99	
		FPGA version	
	<boot> = <string< td=""><td>RESPONSE DATA&gt;</td></string<></boot>	RESPONSE DATA>	
	XXXX.XX.XX	1.00.00 to 9999.99.99	
		Logic Boot version	
	Note:		
	"" is ou	atput if Logic Boot is not installed.	
	For a module number is va	e that uses two slots, only the slot with the greater lid.	

### :SYSTem:MODule? <numeric>

	<application> = <stri< th=""><th>NG RESPONSE DATA&gt;</th></stri<></application>	NG RESPONSE DATA>
	XXXX.XX.XX	1.00.00 to 9999.99.99
		Logic Application version
	Note:	
	"" is outpu	t if Logic Application is not installed.
	For a module tha number is valid.	t uses two slots, only the slot with the greater
	<opt> = <string res<="" td=""><td>SPONSE DATA&gt;</td></string></opt>	SPONSE DATA>
	XXXXXX/XXXXX	Option number
		OPTXXX: For MP1900A
	Note:	
	Outputs the num	bers for all installed options.
	NONE is output	if no option is installed.
	For a module tha number is valid.	t uses two slots, only the slot with the greater
Function	Queries the module inf	ormation on the specified slot.
Example	To query the module in	formation on Slot 3:

Compatibility

Compatible with MP1800A.

# :SYSTem:DISPlay:RESult <boolean>

Parameter	<boolean> = <boolean data="" program=""></boolean></boolean>	
	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	
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 con	nmand
	to set drawing processing to ON or Touch the <b>Remote</b> to restart me	asured
	results drawing processing.	

## :SYSTem:DISPlay:RESult?

Response	<numeric> = <nf< th=""><th colspan="2"><numeric> = <nr1 data="" numeric="" response=""></nr1></numeric></th></nf<></numeric>	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0	Drawing Processing OFF	
	1	Drawing Processing ON (default)	
Function	Sets drawing proc	cessing ON/OFF	
Example			
Compatibility	Compatible with	MP1800A.	

# :DISPlay:ACTive <unit>,<slot>[,<tab>]

Parameter	<unit> = <decimal data="" numeric="" program=""></decimal></unit>
	1 to 4 MP1900A No.1 to 4
	<slot> = <decimal data="" numeric="" program=""></decimal></slot>
	1 to 8 Slot No.1 to 8
	[ <tab>] = <decimal data="" numeric="" program=""></decimal></tab>
	1 to X Tab ID No.1 to X
	When [, <tab>] is omitted, 1 is specified.</tab>
	Tab ID is set to No.1 at the left side dialog, and then the tab ID No. is set
	to 2, 3, 4toward 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)
Compatibility	Compatible with MP1800A.

#### 5.6.1.2 Common Functions



Figure 5.6.1.2-1 Common Functions

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	SOURce:PATTern:EADDition:ASET
On/Off	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	:SYSTem:BEEPer:SYSTem:SET
ON/OFF	SYSTem:BEEPer:SYSTem:SET?
System Error	:SYSTem:BEEPer:SYSTem:TYPE
	:SYSTem:BEEPer:SYSTem:TYPE?

#### Table 5.6.1.2-1 Common Functions Commands

# :SYSTem:MMEMory:QRECall <file\_name>

Parameter	<file_name> = <string data="" program=""></string></file_name>
	" <drv>:\[<dir>]<file>"</file></dir></drv>
	$\langle drv \rangle = C, D, E, F$
	<dir> = <dir1>\<dir2>\ (Omitted for the root directory)</dir2></dir1></dir>
	<file> = File name</file>
Function	Opens all setting data.
Example	To read all setting files from the specified save destination.
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 data="" program=""></string></file_name>		
	" <drv>: \[<dir>]<file></file></dir></drv>	" <drv>:\[<dir>]<file>"</file></dir></drv>	
	$\langle drv \rangle = C, D, E, F$		
	<dir> = <dir1>\<dir2< td=""><td colspan="2"><dir> = <dir1>\<dir2>\(Omitted for the root directory)</dir2></dir1></dir></td></dir2<></dir1></dir>	<dir> = <dir1>\<dir2>\(Omitted for the root directory)</dir2></dir1></dir>	
	<file> = File name</file>		
	<comment> = <string data="" program=""></string></comment>		
	"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		
	changed.		
Example	To specify save destination for all setting files and save them with a		
	comment and measur	ement result data:	
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> = &lt;</file_name>	<file_name> = <string data="" program=""></string></file_name>		
	" <drv>:\[<dir>]&lt;</dir></drv>	<file>"</file>		
	<drv> = C, D, E,</drv>	<drv> = C, D, E, F</drv>		
	<dir> = <dir1>\-</dir1></dir>	<dir> = <dir1>\<dir2>\ (Omitted for the root directory)</dir2></dir1></dir>		
	<file> = File nan</file>	<file> = File name</file>		
	<module> = <st< td=""><td colspan="2"><module> = <string data="" program=""></string></module></td></st<></module>	<module> = <string data="" program=""></string></module>		
	" <unit>:<slot>:&lt;</slot></unit>	" <unit>:<slot>:<port>:<module>"</module></port></slot></unit>		
	<unit> = 1, 2, 3,</unit>	<unit> = 1, 2, 3, 4</unit>		
	<slot> = 1, 2, 3,</slot>	<slot> = 1, 2, 3, 4,, 8</slot>		
	<port> = 1</port>	<pre><port> = 1</port></pre>		
	<module> = Mod</module>	<module> = Module model name</module>		
	<data_type> = &lt;</data_type>	<data_type> = <character data="" program=""></character></data_type>		
	CAP	Saves the captured data.		
	CEX	Saves the captured pattern file.		
	<file_type> = <c< td=""><td colspan="2"><file_type> = <character data="" program=""></character></file_type></td></c<></file_type>	<file_type> = <character data="" program=""></character></file_type>		
	TXT	Text File (Binary)		
	HEX	Text File (Hexadecimal)		
Function	Saves the captur	Saves the captured data and captured pattern file.		
Example	To save the capt	ured data to a text file in a binary format::		
Compatibility	Compatible with	the MP1800A commands. Parameters are incompatible.		

## :SYSTem:PRINt:COPY

Function	Takes a screen shot.
Example	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.

[ <unit>] = <decim< th=""><th>AL NUMERIC PROGRAM DATA&gt;</th></decim<></unit>	AL NUMERIC PROGRAM DATA>	
1 to 4	MP1900A No. 1 to 4	
Can be omitted. MP	1900A No. 1 is specified when omitted.	
<numeric> = <nr1< td=""><td>NUMERIC RESPONSE DATA&gt;</td></nr1<></numeric>	NUMERIC RESPONSE DATA>	
0 to 255	Total number of PPGs that can configure channel	
	synchronization (decimal)	
Available bits:		
0 No PPG that o	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	
Queries the slot whe	ere PPG that can configure channel synchronization	
combination is inser	ted.	
To query the slot in	To query the slot in Unit 3 where PPG that can configure channel	
synchronization is in	nserted:	
Compatible with MI	21800A.	
	1 to 4 Can be omitted. MP <numeric> = <nr1 1<br="">0 to 255 Available bits: 0 No PPG that of 1 (Bit 0) 2 (Bit 1) 4 (Bit 2) 8 (Bit 3) 16 (Bit 4) 32 (Bit 5) 64 (Bit 6) 128 (Bit 7) Queries the slot whe combination is inser</nr1></numeric>	

# :COMBination:OPERation:CHSetting <configuration>[,<unit>]

Parameter	<configuration> =</configuration>	<configuration> = <nr1 data="" numeric="" response=""></nr1></configuration>		
	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>] = <dec< td=""><td colspan="3">[<unit>] = <decimal data="" numeric="" program=""></decimal></unit></td></dec<></unit>	[ <unit>] = <decimal data="" numeric="" program=""></decimal></unit>		
	1 to 4	MP1900A No. 1 to 4		
	Can be omitted. N	Can be omitted. MP1900A No. 1 is specified when omitted.		
Function	Specify the slot w	where the PPG for which channel synchronization is to be		
	set is inserted.			
Example	To set channel sy	nchronization for the PPGs in Slots 1 through 4 of Unit		
	3:			
Compatibility	Compatible with	MP1800A.		

:SYSTem:MEMory:INITialize		
Function	Initializes the internal setting data to the initial settings at factory shipment.	
Example Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

### :SOURce:OUTPut:ASET <boolean>

Parameter	<boolean> = <boolean data="" program=""></boolean></boolean>	
	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:	
Compatibility	Compatible with MP18	300A.

## :SOURce:OUTPut:ASET?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0	Output OFF
	1	Output ON
Function	Queries the ON/OFF state for Data and Clock outputs of optical output and PPG.	
Example		
Compatibility	Compatible with MP18	00A.

### :SOURce:PATTern:EADDition:ASET <boolean>

Parameter	<boolean> = <boolean data="" program=""></boolean></boolean>	
	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:	
Compatibility	Compatible with MP18	00A.

### :SOURce:PATTern:EADDition:ASET?

Response	<numeric> = <ni< th=""><th colspan="2"><numeric> = <nr1 data="" numeric="" response=""></nr1></numeric></th></ni<></numeric>	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0	Error addition OFF	
	1	Error addition ON	
Function Example	Queries the error	addition ON/OFF state for all valid modules.	
Compatibility	Compatible with	MP1800A.	

## :SOURce:PATTern:EADDition:ASINgle

Function	Adds a single error for all valid modules.
Example	
Compatibility	Compatible with MP1800A.

#### :SENSe:MEASure:ASTRt

Function	Starts measurement for all modules.
Example	
Compatibility	Compatible with MP1800A.

#### :SENSe:MEASure:ASTP

Function	Stops measurement for all modules.
Example	
Compatibility	Compatible with MP1800A.

### :SENSe:MEASure:ASTate?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0 Measurement stops for all modules.	
	1 During measurement	
	Note:	
	If any module is being measured, "1 (During measurement)" is returned.	
Function Example	Queries the measurement state for all modules.	
Compatibility	Compatible with MP1800A.	

#### :SYSTem:BEEPer:ERRor:SET <boolean>

Parameter	<boolean> = <boolean data="" program=""></boolean></boolean>	
	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:	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

### :SYSTem:BEEPer:ERRor:SET?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	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:	

Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.
---------------	---

### :SYSTem:BEEPer:ALARm:SET <boolean>

Parameter	<boolean> = <boolean data="" program=""></boolean></boolean>	
	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:	
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

## :SYSTem:BEEPer:ALARm:SET?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0	Buzzer OFF
	1	Buzzer ON
Function Example	Queries the buzzer ON/OFF state at alarm occurrence.	
Compatibility	Compatible with the M	P1632C, MP1776A and MP1800A.

## :SYSTem:BEEPer:SYSTem:SET <boolean>

Parameter	<boolean> = <boolean data="" program=""></boolean></boolean>	
	OFF or 0	Buzzer OFF
	ON or 1	Buzzer ON
Function	Sets buzzer at system e	error occurrence ON/OFF.
Example	To set buzzer at system	n error occurrence ON:
Compatibility	Compatible with the M	P1632C, MP1776A and MP1800A.

### :SYSTem:BEEPer:SYSTem:SET?

Response	<numeric> = <nr1 data="" numeric="" response=""></nr1></numeric>	
	0	Buzzer OFF
	1	Buzzer ON
Function	Queries the buzzer ON/OFF state at system error occurrence.	
Example		
Compatibility	Compatible with the MP1632C, MP1776A and MP1800A.	

## :SYSTem:BEEPer:SYSTem:TYPE <type>,<boolean>

Parameter	<type> = <character data="" program=""></character></type>	
	PUNLock	PLL unlock
	FAN	FAN
	TEMPerature	Temperature
	ALL	Selects all system errors
	<boolean> = <boolea< td=""><td>N PROGRAM DATA&gt;</td></boolea<></boolean>	N PROGRAM DATA>
	OFF or 0	
	ON or 1	
Function	Sets system error buzze	er for the target item ON/OFF.
Example	To set system error buz	zer for "Temperature" ON:
Compatibility	Partially compatible wi	th the MP1632C.
	Compatible with the M	P1800A.

### :SYSTem:BEEPer:SYSTem:TYPE?

Peeperee	$\langle t_{\rm max} \rangle = \langle C     A D \rangle$	<type> = <character data="" response=""></character></type>	
Response			
	PUNL, FAN, TEN	IP, 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/O	Queries the ON/OFF state of system error buzzer for target items.	
Example	To query the ON/	To query the ON/OFF state of system error buzzer for target items:	
Compatibility	Compatible with t	Compatible with the MP1632C and MP1800A.	

#### 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.

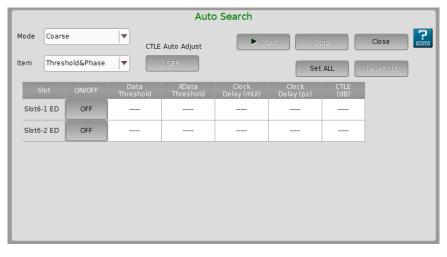


Figure 5.6.1.3-1 Auto Search setting screen

#### 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

Setting Items	Commands	
Open	:SYSTem:MMEMory:PATTern:RECall	
Save	:SYSTem:MMEMory:PATTern:STORe	

Table 5.6.1.5-1	Pattern	<b>Editor setting</b>	commands
-----------------	---------	-----------------------	----------

# :SYSTem:MMEMory:PATTern:RECall <file\_name>,<file\_type>

Parameter	<file_name> = <string data="" program=""></string></file_name>		
	$\operatorname{drv}: [\operatorname{dir}] = \operatorname{file}$		
	<drv> = C, D, E, F</drv>		
	<dir> = <dir1>\<dir2>\ (Omitted for the root directory)</dir2></dir1></dir>		
	<file> = File name <file_type> = <character data="" program=""></character></file_type></file>		
	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:		
Compatibility	Compatible with MP18	800A.	

## :SYSTem:MMEMory:PATTern:STORe <file\_name>,<file\_type>

<file_name> = <string data="" program=""></string></file_name>		
" <drv>:\[<dir>]<file>"</file></dir></drv>		
<drv> = C, D, E, F</drv>		
<dir> = <dir1>\<dir2>\ (Omitted for the root directory)</dir2></dir1></dir>		
<file> = File name</file>		
<file_type> = <character data="" program=""></character></file_type>		
BIN Binary file		
TXT Text file		
Saves a pattern file.		
Note:		
The settings will not be read from the saved file if the file name is		
changed.		
To save a pattern file to the specified destination in the specified file		
format:		
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

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

Table 5.6.3.1-1 MU181500B Command List

## 5.6 SCPI Commands

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	С	
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		С	
39			STORe		С	

Table 5.6.3.1-1 MU181500B Command List (Cont'd)

# 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.

Ty 200720 08 0400 Detail       0.000         Output       B       Help         Output       SCPI Command         Brane	Menu 🚽 🏨	Output	Err. Addition Single Err. On/Off Addition	Application Selector	Start Stop	Auto Auto Adjust	
0 Output       B       SCPI Command         Bitrate       :OUTPut:DATA:OUTPut         Output       :OUTPut:DATA:OUTPut         Output       :OUTPut:DATA:OUTPut         Output       :OUTPut:DATA:OUTPut         Output       :OUTPut:DATA:OUTPut         Output       :OUTPut:DATA:OUTPut         Output       :Output:ON         Defined interfs       *Oboleans = <=COLEAN PROGRAM DATA>         Amplitude @       :Sample b: out OFF: The setting commonly apples to Defined interfs         Amplitude @       :Sample b: outPut:ON or OFF: The setting commonly apples to Defined interfs         Response       :Full TVL CATA:OUTPut?         Response       :Full TVL CATA:OUTPut?         Response       :Full TVL CATA:OUTPut?         Output ON       :Output ON         Output ON       :Output ON         Output ON       :Output ON         Output ON       :Output ON         :Output ON		Datal 🔻 🖸					
Other     SC-F Command       Braze     :OUTPut:DATA:OUTPut       Output     OutPut:DatA:COUTPut       Output     OutPut:DatA:COUTPut       Defined Interfs     Compatibility       Printmeter     Compatibility       Defined Interfs     Function       Printmeter     Stample       Defined Interfs     Function       Compatibility     Compatibility       Compatibility     Compatibility       Offset B     Output OFF       Delixy     Interfset       Function     Set All so output ON       Output OF     Output ON       Offset B     Output OFF       Delixy     Interfset       Function     Output ON       Output ON     Output ON       Utter Input     Compatibility       Interfinput     Compatibility       Utter Input     Compatibility       Utter Input     Compatibility       Utter Input     Compatibility	🛛 Output 🖾			Help		×	
Output:         COLTPUT.DATA.CUTP.ut -Roolean>           Output:         Parameter           Defined Interfs         CFG of 0 Output OFF Output OFF Output OFF Output OFF           Defined Interfs         Function           Amplitude B         Fact data output OFF Output OFF           Offset B         Compatibility           Output OFF Output OFF         Output OFF           Offset B         Compatibility           Deline Interfs         Function           Parameter         Compatibility           Deline Interfs         For output OFA           Offset B         Compatibility           Deline Interfs         Compatibility           Parameter	_Output	SCPI Co	ommand				
Output:     Parameter     booleans = <800LEAN PROGRAM DATA>       Output:     OFF or 0 Output OFF Output OFF Defined Interfe     OFF or 0 Defined Interfe       Parameter     booleans = <800LEAN PROGRAM DATA>       Offset 0     Example The setting commonly apples to Data and Data.       Example The set data output ON or OFF. The setting commonly apples to Data and Data.       Compatibility     Compatibility       Compatibility     Compatibility       Compatibility     Compatibility       Offset 0     Output OFF Define data output ONCFF.       Define data     Function       Queries data output ONCFF.       Sample The setting commonly apples to Output ONCFF.       Sample South Output ONCFF.       Sample	Bitrate						
Level Guard B     Output OFF Output OFF Output OFF Output OFF Amplitude B     Sets data output OV or OFF. The setting commonly applies to Sets data output ON Post data output ON Compatibility       Amplitude B     Post Oata output ON Compatibility     Compatibility       Offset B     Compatibility     Compatibility       Delsy B     B       Finction     Duelsis data output ON/ 0       Jitter Input     Compatibility       List of All SCPL compatibility MI MULB302A.	Output						
Defined interfe     Function     Sets data output ON or OFF. The setting commonly applies to       Amplitude B     Example     B set data output ON       Offset B     Compatibility     Compatibility       Compatibility     Compatibility     Compatibility       OUTF-ULDATACOUTF-UC?     Period jtts       OUTF-ULDATACOUTF-UC?     Compatibility       Period jtts     Output OA       Output OFF     Output OA       Output OFF     Output OA       Output OFF     Output OA       Output OFF     Output OA       Inter input     Compatibility       List of All SCPL command for MU19302A     V	Level Guard 🗃		Output OFF ON or 1				
Diffset ID         > -0.0TPULDATA-OUTPut ON           Half Pendd Jité         Compatibile with MUI8302xA.           Half Pendd Jité         Output CDATA-OUTPut?           Pesponse	Defined Interfa	Function	Sets data output ON or OFF. The setting comm	nonly applies to			
Offset @     Image: Comparison of the second s	Amplitude 🖻	Example	> :OUTPut:DATA:OUTPut ON				
Pesponse <numeric> = <nr1 data="" numeric="" response="">           0         Output OFF           1         Output OFF           1         Output OFF           2         Output OFF           1         Output OFF           2         Output ON           Example         &gt; Output ON/OUPER           2         Output ON/OUPER           3         Compatibility           Compatibility         Compatibility           List of All SCPI command for MU19502x         V</nr1></numeric>	Offset 🖸 🛛	Compatibility	Compatible with MU18302xA.				
Delay         0         Output OFF           Juster Input         Function         Oueries data output ON/OFF.           Jitter Input         Compatibility         Compatibility           List of All SCPL command for MU19902x         T	Half Period Jitte						
Example     >: 00/TP ut:DATA-00/TP ut?       jitter input     Compatibility       List of All SCPI command for MU19502x		Response	0 Output OFF	>			
Jitter Input Compatibility Compatibility List of All SCPL command for MU19502xA.	Delay 🔳 🛛						
	Jitter Input		< 1				
< Back Tomorolo Close		List of All SCPL	command for MU19502x				
		< Back	Forward >			Close	
E Dinde 🛣 Module 🚽 System BERT AUTO MEAS 🛛 🖵 📢 Alam	_						

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.

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 Table A-1
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