MX370102A/MX269902A
TDMA IQproducer™
Operation Manual

15th 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 MG3700A Vector Signal Generator Operation Manual (Mainframe), MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (Mainframe), MS2690A/MS2691A/MS2692A Signal Analyzer Operation Manual (Mainframe Operation), MS2830A Signal Analyzer Operation Manual (Mainframe Operation), or MS2840A Signal Analyzer Operation Manual (Mainframe Operation). Please also refer to them before using the equipment.**
- **Keep this manual with the equipment.**

ANRITSU CORPORATION

Document No.: M-W2916AE-15.0

Safety Symbols

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

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

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Safety Symbols Used on Equipment and in Manual

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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.

MX370102A/MX269902A
TDMA IQproducer™
Operation Manual

25 April 2007 (First Edition)
12 June 2026 (15th Edition)

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1. Anritsu may terminate this EULA immediately if you violate any conditions described herein. This EULA shall also be terminated immediately by Anritsu if there is any good reason that it is deemed difficult to continue this EULA, such as your violation of Anritsu copyrights, patents, etc. or any laws and ordinances, or if it turns out that you belong to an antisocial organization or has a socially inappropriate relationship with members of such organization.
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If Anritsu suffers any damages or loss, financial or otherwise, due to your violation of the terms of this EULA, Anritsu shall have the right to seek proportional damages from you.

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Revision History:

February 29th, 2020
December 17th, 2021
March 11th, 2024

Cautions Against Computer Virus Infection

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

Protection Against Computer Virus Infections

Prior to the software installation

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

When using this software and connecting with the measuring instrument

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

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

Cautions on Proper Operation of Software

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

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

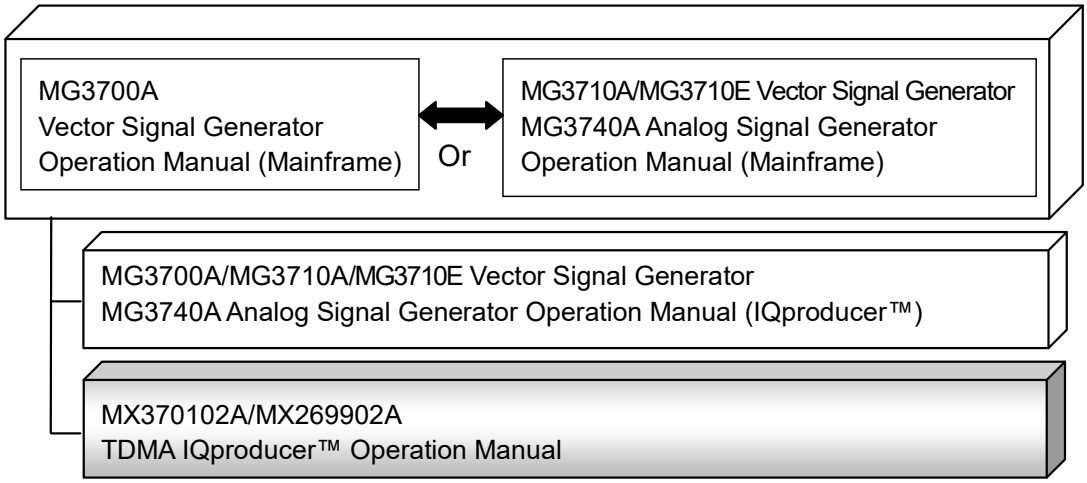
For how to turn off the functions, refer to the operation manual that came with your computer.

About This Manual

■ Associated Documents

The operation manual configuration of the MX370102A/MX269902A TDMA IQproducer™ is shown below.

■ If using MG3700A, MG3710A, MG3710E or MG3740A:



- MG3700A Vector Signal Generator Operation Manual (Mainframe)

This describes basic operations, maintenance procedure, and remote functions of the MG3700A Vector Signal Generator.

Or

- MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (Mainframe)

This describes basic operations, maintenance procedure, and remote functions of the MG3710A, MG3710E Vector Signal Generator and the MG3740A Analog Signal Generator.

- MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™)

This describes the functions and how to use the IQproducer, which is Windows software for the Vector Signal Generator and the Analog Signal Generator.

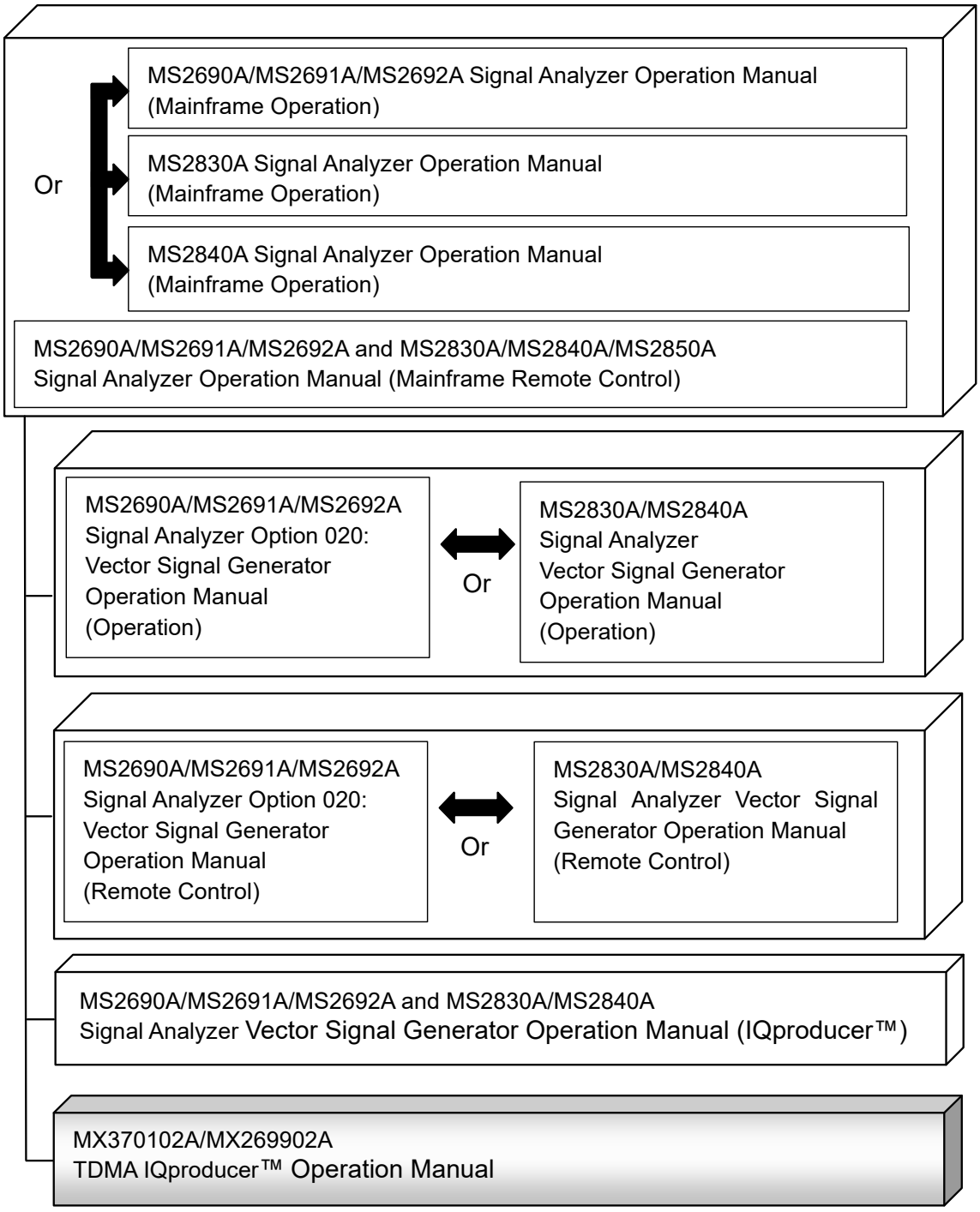
- TDMA IQproducer™ Operation Manual (This document)

This describes basic operations and functions of the TDMA IQproducer™.

Name Used in This Manual

In this manual, it is assumed that you use MG3710A unless otherwise noted. If you use MG3710E, read MG3710A as MG3710E.

■ **If using MS2690A/MS2691A/MS2692A, MS2830A or MS2840A:**



- Signal Analyzer Operation Manual (Mainframe, Operation)

This describes basic operations, maintenance procedure, common functions.

- Signal Analyzer Operation Manual (Mainframe, Remote Control)

These describe common remote functions.

- MS2690A/MS2691A/MS2692A Signal Analyzer Option 020: Vector Signal Generator Operation Manual, Operation

This describes the functions and how to use the Vector Signal Generator option.

- MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual, Operation

This describes the functions and how to use the Vector Signal Generator option.

- MS2690A/MS2691A/MS2692A Signal Analyzer Option 020: Vector Signal Generator Operation Manual, Remote Control

This describes how to remotely control the Vector Signal Generator option.

- MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual, Remote Control

This describes how to remotely control the Vector Signal Generator option.

- MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (IQproducer™)

This describes the functions and how to use the IQproducer, which is Windows software for the Vector Signal Generator option.

- TDMA IQproducer™ Operation Manual (This document)

This describes basic operations and functions of the TDMA IQproducer™.

Table of Contents

Chapter 1 Overview..... 1-1

1.1 Product overview 1-2

1.2 Product Composition..... 1-3

Chapter 2 Preparation..... 2-1

2.1 Operating Environment..... 2-2

2.2 Installation/Uninstallation 2-3

2.3 Starting up and exiting the software 2-4

Chapter 3 Detailed Description of Functions 3-1

3.1 Screen Layout and Composition..... 3-2

3.2 Waveform Pattern Generation Procedure 3-58

Chapter 4 How to Use Waveform Patterns. 4-1

4.1 For MG3700A, MG3710A or MG3740A..... 4-2

4.2 For MS2690A/MS2691A/MS2692A, MS2830A, or MS2840A 4-6

Appendix A Error Messages..... A-1

Appendix B Symbol Points for Each Modulation Type B-1

Appendix C User File Format C-1

Index Index-1

Chapter 1 Overview

This chapter provides an overview of the MX370102A/MX269902A TDMA IQproducer™.

1.1 Product overview 1-2
1.2 Product Composition 1-3

1.1 Product overview

MX370102A/MX269902A TDMA IQproducer™ (hereinafter referred to as "this software") is software used to generate waveform patterns conforming to the TDMA specifications.

This software requires either of the following environment:

- MG3710A Vector Signal Generator
- MG3740A Analog Signal Generator
- MS2690A/MS2691A/MS2692A, MS2830A or MS2840A Signal Analyzer with Vector Signal Generator option mounted
- Personal computer (hereinafter, "PC")

This software generates waveform patterns that support the specifications of TDMA with various characteristics. This is made possible by the editing/customizing of parameters according to its use.

A waveform pattern created by this software can be output using an RF signal after being downloaded into the MG3700A Vector Signal Generator , MG3710A Vector Signal Generator, MG3740A Analog Signal Generator or an MS2690A/MS2691A/MS2692A, MS2830A or MS2840A Signal Analyzer with Vector Signal Generator option installed (collectively referred to as "mainframe", or "this equipment").

1.2 Product Composition

The following table lists the model name and specifications of this software according to the equipment.

Table 1.2-1 Restrictions

Mainframe / Restrictions	MG3700A	MG3710A MG3740A	MS2690A MS2691A MS2692A	MS2830A	MS2840A
Software name	MX370102A		MX269902A		
Maximum Size of Waveform Patterns	256 M sample 512 M sample*1	64 M sample 128 M sample*5 256 M sample*6 512 M sample*7	256 M sample	64 M sample 256 M sample*4	64 M sample 256 M sample*4
Transmission method of Waveform Patterns	LAN, CompactFlash Card	LAN, USB Memory and other external device*2	USB Memory and other external device*2	USB memory and other external device*2	USB memory and other external device*2
Installation of this software to this equipment	N/A	Possible	Possible*3	Possible*3	Possible*3

*1: The ARB memory expansion 512 M sample (optional) must be installed into the MG3700A to use waveform patterns that exceed 256 M samples.

*2: Transferring waveform patterns is not required if the waveform patterns are created on the equipment using this software.

*3: Although this software can be installed and run in the MS2690A/MS2691A/MS2692A, MS2830A or MS2840A, the measurement functions of the MS2690A/MS2691A/MS2692A, MS2830A or MS2840A are not guaranteed while this software runs.

*4: The ARB memory expansion 256 M sample (optional) must be installed into the Vector Signal Generator option to use waveform patterns that exceed 64 M samples.

*5: The Combination of Baseband Signal (optional) must be installed into the MG3710A/MG3740A to use waveform patterns of maximum 128 M samples.

*6: The ARB memory expansion 256M sample (optional) must be installed into the MG3710A/MG3740A to use waveform patterns of maximum 256 M samples.

*7: To use waveform patterns of maximum 512 M samples, either of the following must be installed:

MG3710A

- ARB memory expansion 1024 M sample (optional)
- ARB memory expansion 256 M (optional) and Combination of Baseband Signal (optional)

MG3740A

- ARB memory expansion 256 M (optional) and Combination of Baseband Signal (optional)

■ Notes on waveform pattern conversion

The waveform patterns generated with this software varies according to the main unit type. If using the waveform pattern to the different main unit, you need to convert the waveform pattern.

For details about how to convert a waveform pattern, refer to each one of the following manuals.

- *MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™)*
  4.5 “File Conversion on Convert Screen”
- *MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (IQproducer™)*
  4.5 “File Conversion on Convert Screen”

Chapter 2 Preparation

This chapter describes the operating environment for the MX370102A/MX269902A.

2.1 Operating Environment 2-2
2.2 Installation/Uninstallation 2-3
2.3 Starting up and exiting the software 2-4
2.3.1 Starting Software: When installed on other than MG3710A/MG3740A 2-4
2.3.2 Starting Software: When installed on MG3710A/MG3740A 2-6
2.3.3 Exiting Software 2-7

2.1 Operating Environment

The following environment is required for operating this software.

(1) PC that meets the following conditions

OS	Windows XP/Windows Vista/ Windows 7/Windows 10/Windows 11
CPU	Pentium III 1 GHz equivalent or faster
Memory	512 MB or more
Hard disk space	5 GB or more free space in the drive where this software is to be installed. The free hard disk space necessary to create waveform pattern varies depending on the waveform pattern size. The free disk space of 27 GB or greater is required to create four maximum (512 Msample) waveform patterns.

(2) If viewing on PC, displays with a resolution of 1024 × 768 pixels are best viewed using a small font setting.

2.2 Installation/Uninstallation

This software is included in the IQproducer™ installer. It is automatically installed by installing the IQproducer™ that is supplied with this equipment or this software. When using a waveform pattern created using this software in the equipment, the license file must be installed in advance.

■ Installing/Uninstalling IQproducer™

For how to install and uninstall IQproducer™, refer to each of the following manuals:

- *MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™)*
  Chapter 2 "Installation"
- *MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (IQproducer™)*
  Chapter 2 "Installation"

■ Installing/Uninstalling IQproducer™ license file

For how to install license file to MG3700A/MG3710A/MG3740A, refer to the following manual:

- *MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™)*
  5.1 "Installing License File"

For how to uninstall license file from MG3700A/MG3710A/MG3740A, refer to each one of the following manuals:

- *MG3700A Vector Signal Generator Operation Manual (Mainframe)*
  3.10.10 "Install"
- *MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (Mainframe)*
  9.4.4 "Install"

Refer to the following manual for details of how to install/uninstall license file to MS2690A/MS2691A/MS2692A, MS2830A or MS2840A with Vector Signal Generator option.

- *MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (IQproducer™)*
  2.2 "Installation/Uninstallation"

2.3 Starting up and exiting the software

This section explains how to start and stop this software.

Note:

The following explanation assumes the use of Windows XP. The screen image may differ slightly if not using Windows XP.

2.3.1 Starting Software: When installed on other than MG3710A/MG3740A

Start this software using the following procedure.
The example assumes that it is a PC operation.

<Procedure>

1. Click **Start** on the task bar, and point to **All Programs**. Next, point to **Anritsu Corporation**, point to **IQproducer**, and then click **IQproducer.**

2. When IQproducer™ starts, the **Select instrument** screen is displayed.

   On the **Select instrument** screen, select the model of the main unit that uses the waveform patterns created by IQproducer™.

Note:

To hide this screen and to start with the selected mainframe's screen from the next time, select the Don't show this window next time check box.

3. The common platform screen is displayed when **OK** is clicked in the **Select instrument** screen.

   The common platform screen is a screen used to select each function of the IQproducer™.

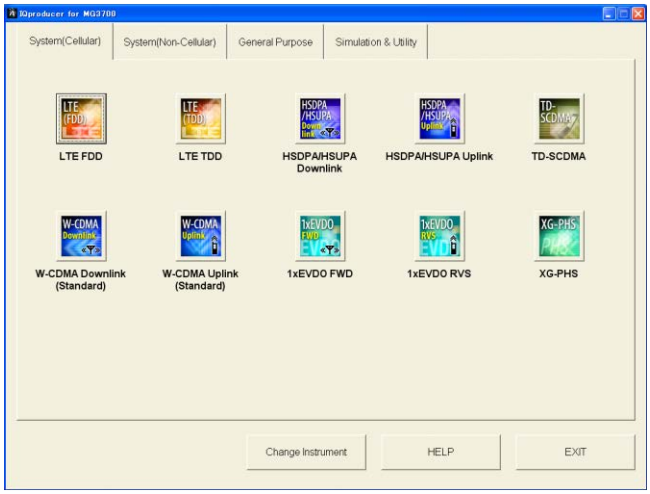


Figure 2.3.1-1 Common Platform Screen

4. Click the **General Purpose** tab on the common platform screen, to show the **General Purpose** selection screen that supports each telecommunication system.

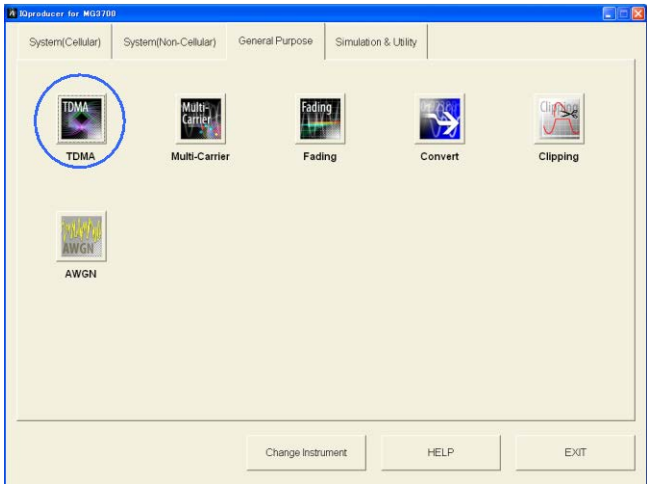


Figure 2.3.1-2 General Purpose Selection Tab

5. Click **TDMA** to display the main screen. For details of the main screen, refer to Chapter 3 “Detailed Description of Functions”.

Note:

If **Change Instrument** is clicked, the **Select instrument** screen will appear each time the software is loaded.

2.3.2 Starting Software: When installed on MG3710A/MG3740A

Start this software using the following procedure.

<Procedure>

1. Press IQpro on the MG3710A/MG3740A front panel to display the common platform screen.

   The common platform screen is a screen used to select each function of the IQproducer™.

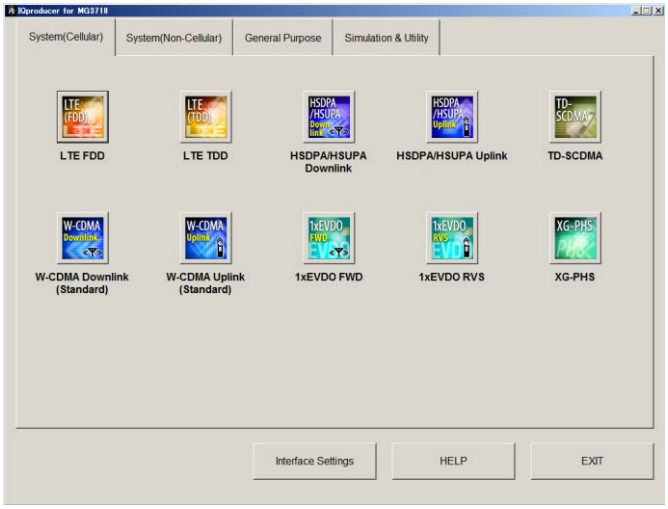


Figure 2.3.2-1 Common Platform Screen

2. Click the General Purpose tab on the common platform screen, to show the General Purpose selection screen that supports each telecommunication system.

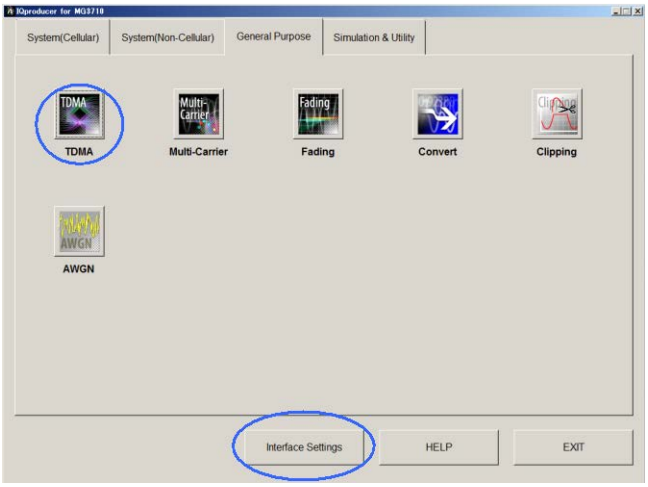


Figure 2.3.2-2 General Purpose Selection Tab

3. Click TDMA to display the main screen. For details of the main screen, refer to Chapter 3 “Detailed Description of Functions”.

Note:

Clicking **Interface Settings** displays the Interface Setting dialog box.

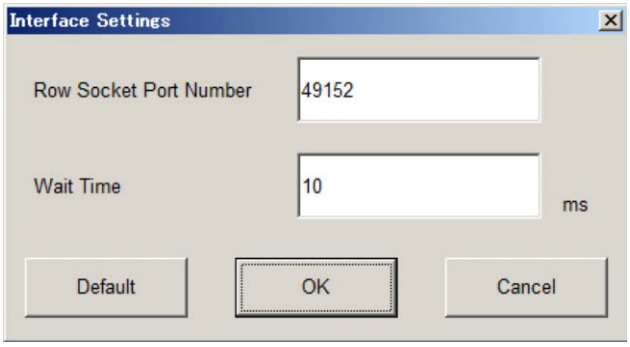


Figure 2.3.2-3 Interface Settings Dialog Box

Here, you can configure interface-related settings of IQproducer and MG3710A/MG3740A. To return to factory defaults, click **Default**.

- Row Socket Port Number

  Sets Row Socket port number. Set the same value as that for MG3710A/MG3740A.

- Wait Time

  Sets the wait time between commands.

2.3.3 Exiting Software

Stop this software using the following procedure.

■ When exiting only this software

To exit only this software without closing the Common Platform screen, or other IQproducer™ tools, do one of these below:

- Click the Exit button ( ) on the tool bar.
- Select Exit from the File menu.
- Click the button on the upper right screen.

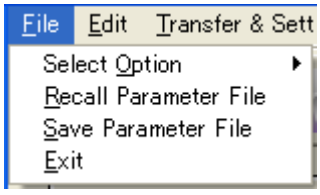


Figure 2.3.3-1 Exiting Software

The operation of the three screen buttons is explained below.

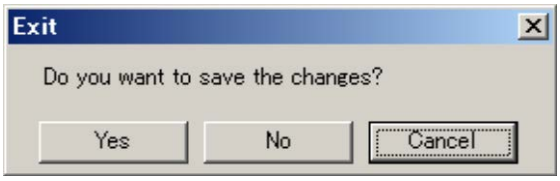


Figure 2.3.3-2 Exit Confirmation Window

- **Yes** Saves current parameters to file and stops this software.
- **No** Stops this software without saving current parameters to file.
- **Cancel** or ☒ Cancels the process and returns to the main screen.

When stopping this software using the **Yes** button, the saved parameters are read at the next start and reset for each parameter.

■ When exiting entire IQproducer™ application

To exit all tools of IQproducer™ that are running, select **Exit** on the Common Platform Screen. In this case, a dialog is displayed to confirm stopping of each running tool.

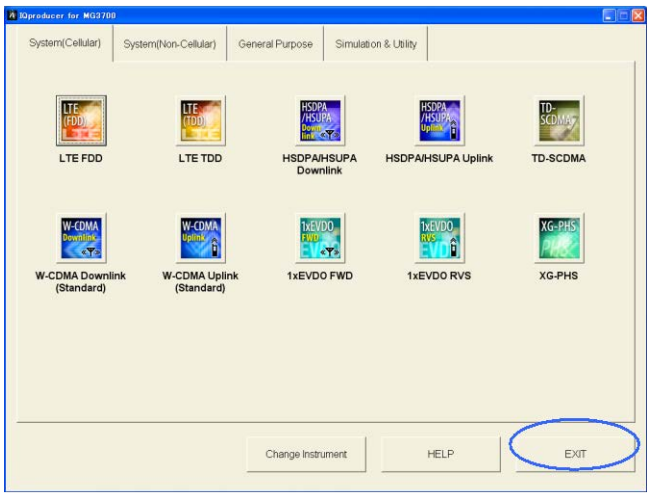


Figure 2.3.3-3 Exiting IQproducer™

Chapter 3 Detailed Description of Functions

This chapter provides detailed descriptions of this software.

Notes:

- The examples and screens used throughout this chapter are based on the assumption that the IQproducer™ is activated with the MG3700A.
- The MG3710A, MG3740A, MS2690A/MS2691A/MS2692A, MS2830A and MS2840A functions are described as notes in each item.

3.1 Screen Layout and Composition 3-2
3.1.1 Main screen 3-2
3.1.2 Parameter setting sheet 3-11
3.1.3 Calculation 3-42
3.1.4 Calculation & Load 3-46
3.1.5 Calculation & Play 3-47
3.1.6 Saving/reading parameters 3-48
3.1.7 Displaying graph 3-51
3.1.8 Auxiliary signal output 3-57
3.2 Waveform Pattern Generation Procedure 3-58

3.1 Screen Layout and Composition

3.1.1 Main screen

On common platform screen, click the **General Purpose** tab, and then click **TDMA** to display the main screen.

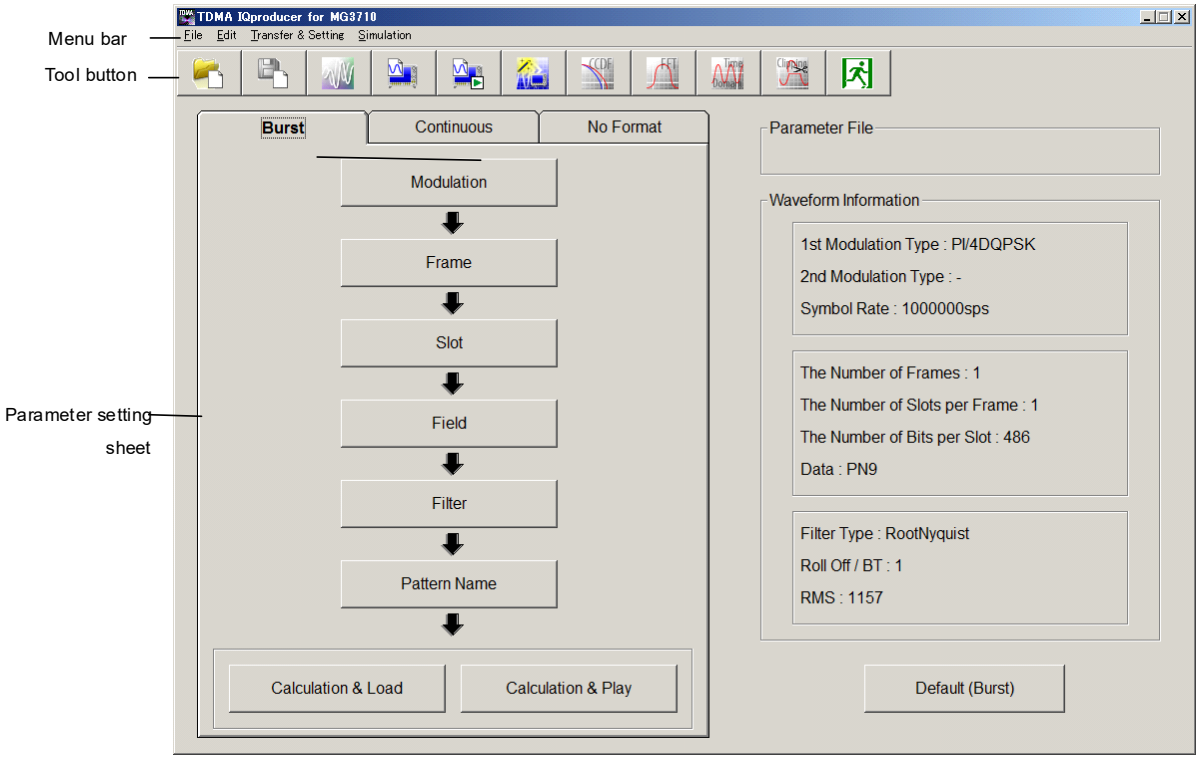


Figure 3.1.1-1 TDMA IQproducer Main Screen (When on MG3710 or MG3740)

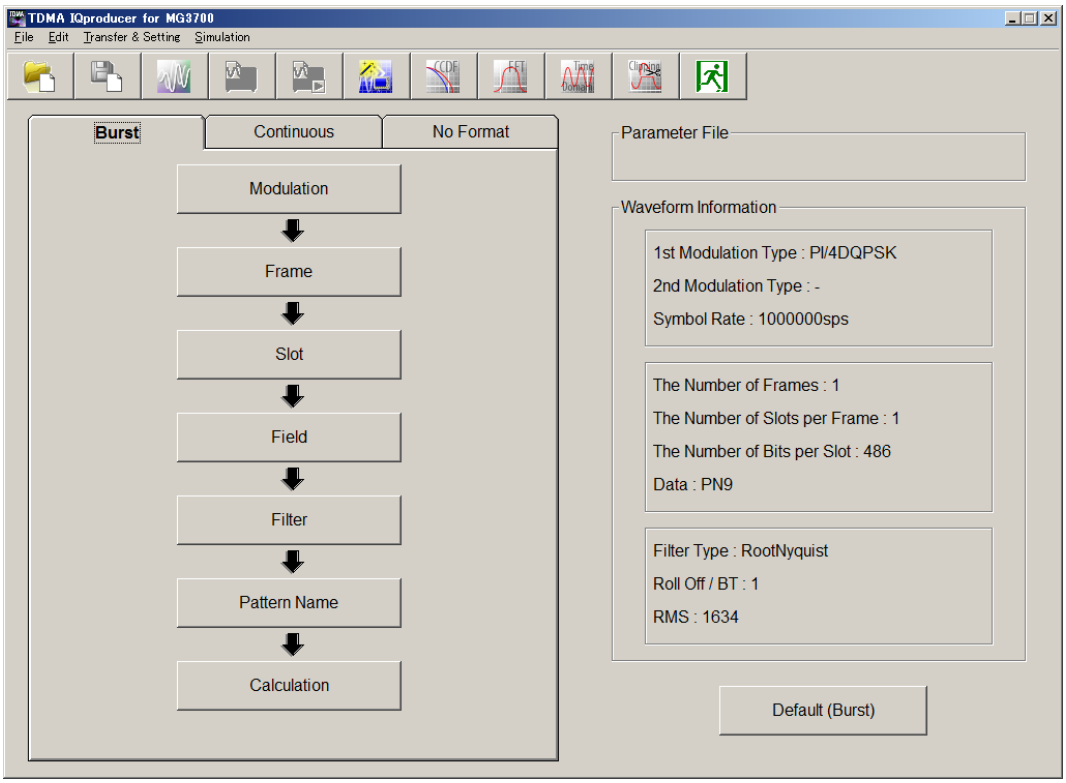


Figure 3.1.1-2 TDMA IQproducer Main Screen (When on PC)

■ **File** menu

The **File** menu contains the following items.

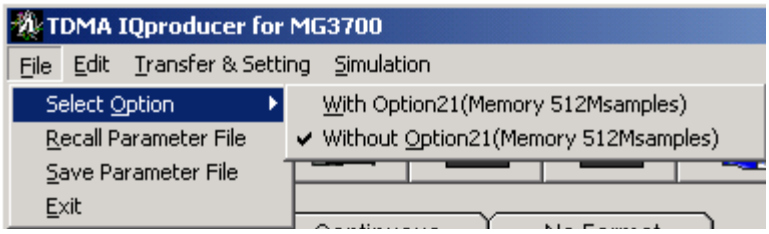


Figure 3.1.1-3 File menu

- **Select Option**

  Notes:

  - This function is available only when **MG3700**, **MG3710**, MG3740, **MS2830** or **MS2840** is selected in the **Select instrument** screen.

  - ARB Memory Expansion (option) is not available for MS269xA. Only Memory 256M samples, 1 GB is available.

■ When using MG3700A, MS2830A or MS2840A

Select whether the ARB memory expansion option 256Msamples is installed. Selecting **With Option21 (Memory 512M samples)/With Option27 (Memory 256M samples)** supports creation of larger waveform patterns. If the ARB memory expansion option is not installed, the generated waveform pattern may not be able to be used. Waveform patterns cannot be created with a size greater than 256Msamples or 64M samples when **Without Option21 (Memory 512M samples)/Without Option27 (Memory 256M samples)** is selected. Select either according to the presence of ARB memory expansion option.

Table 3.1.1-1 Available Options for MG3700A, MS2830A or MS2840A

Model	Items	ARB Memory Expansion
MG3700A	With Option21 (Memory 512M samples)	1 GB × 2 memories
	Without Option21 (Memory 512M samples)	512 MB × 2 memories
MS2830A	With Option27 (Memory 256M samples)	1 GB
	Without Option27 (Memory 256M samples)	256 MB
MS2840A	With Option27 (Memory 256M samples)	1 GB
	Without Option27 (Memory 256M samples)	256 MB

■ When using MG3710A or MG3740A

The presence/absence of the ARB Memory Expansion (option) and Baseband Signal Combination Function (option) is selected. Selecting the ARB Memory Expansion (option) and the Baseband Signal Combination Function (option) generates a bigger waveform pattern, while selecting the Baseband Signal Combination Function (option) generates a waveform pattern. If an uninstalled option is selected, sometimes the created waveform pattern may not be usable.

Set the combination of installed options based on the following setting items.

Table 3.1.1-2 Available Options for MG3710A or MG3740A

Items	Combinations of Options
Memory 64M samples	None
Memory 64M samples × 2	Option48 and Option 78
Memory 256M samples	Option45 or Option 78
Memory 256M samples × 2	Option 45 and Option 48 or Option 75 and Option 78
Memory 1024M samples*	Option46 or Option 76
Memory 1024M samples × 2*	Option 46 and Option 48 or Option 76 and Option 78

*: Option 46 and Option 76 are not available for MG3740A and do not appear on the display.

The maximum size of the generated waveform pattern for each of the setting items is shown below.

Table 3.1.1-3 Waveform Pattern Maximum Size

Items	Maximum Size
Memory 64M samples	64M samples
Memory 64M samples × 2 (With Option48, 78)	128M samples
Memory 256M samples	256M samples
Memory 256M samples × 2 (With Option48, 78)	512M samples
Memory 1024M samples*	512M samples
Memory 1024M samples × 2* (With Option48, 78)	512M samples

*: Does not support MG3740A.

- **Recall Parameter File**
  Loads the parameter files saved by Save Parameter File. Setting can be facilitated by using the loaded parameters.

- **Save Parameter File**
  Saves the setting parameters to a file.

- **Exit**
  Exits this Software.

■ **Edit** menu

The **Edit** menu contains the following item.

Figure 3.1.1-4 Edit menu

- **Calculation Waveform Pattern**

  Starts waveform pattern generation after parameter setting. This is the same operation with clicking the Calculation button on a parameter setting sheet.

- **Calculation & Load**

  Note:

  This function is available only when this software is used on MG3710A or MG3740A.

  After waveform generation is finished, the created waveform pattern is loaded into the MG3710A or MG3740A waveform memory.

- **Calculation & Play**

  Note:

  This function is available only when this software is used on MG3710A or MG3740A.

  After waveform generation is finished, the created waveform pattern is loaded and selected at the MG3710A or MG3740A waveform memory.

- **Clipping**

  Displays the Clipping setting screen. In this screen, clipping and filtering processing can be performed for a generated waveform pattern.

■ **Transfer Setting** Menu

The **Transfer Setting** menu contains the following item.

Figure 3.1.1-5 Transfer Setting menu

- **Transfer & Setting Wizard**

  Note:

  This function is available only when **MG3700**, **MG3710** or **MG3740** is selected in the **Select instrument** screen.

  Displays the Transfer Setting Wizard screen. Every operation ranging from connecting the PC and MG3700A, MG3710A or MG3740A and transferring the waveform pattern to the MG3700A, MG3710A or MG3740A, to loading the waveform pattern into the MG3700A, MG3710A or MG3740A ARB memory is performed at this screen.

■ **Simulation** menu

The **Simulation** menu contains the following items.

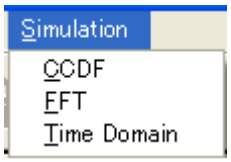


Figure 3.1.1-6 Simulation menu

- **CCDF**

  Displays the CCDF graph display screen. In this screen, the CCDF of the generated waveform pattern is displayed in a graph.

- **FFT**

  Displays the FFT graph display screen. In this screen, the FFT-processed spectrum of the generated waveform pattern is displayed in a graph.

- **Time Domain**

  Displays the Time Domain screen. In this screen, the time domain waveform of a generated waveform pattern is displayed in a graph.

■ Tool buttons

The following tool buttons are provided:

Notes:

- Transfer&Setting Wizard is available only when **MG3700, MG3710** or **MG3740** is selected in the **Select instrument** screen.
- Calculation & Load and Calculation & Play are available only when this software is used on MG3710A or MG3740A.

Recall Parameter File

Save Parameter File

Calculation

Calculation & Load

Calculation & Play

Transfer & Setting Wizard

CCDF

FFT

Time Domain

Clipping

Exit

Clicking a tool button operates the same as the corresponding commands in the menu.

■ Parameter setting sheets

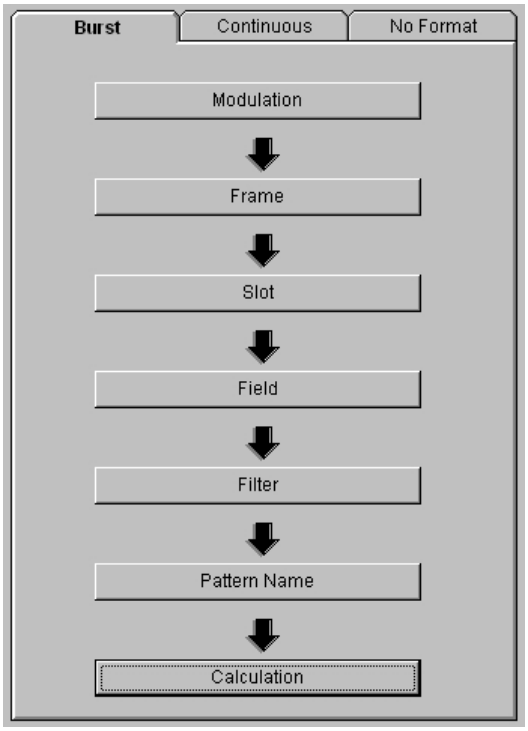


Figure 3.1.1-7 Parameter setting sheets

The parameter setting sheets are provided on the left of the TDMA main screen, consisting of three independent sheets: Burst, Continuous, and No Format. Each parameter setting sheet has setting item buttons. When one of these setting item buttons is clicked, the corresponding setting screen is displayed. Although the setting item buttons are placed sequentially from top down with arrows, it is not necessary to perform parameter settings in this order. Note, however, that some parameters have an effect on the subsequent parameters.

■ Parameter File display

Figure 3.1.1-8 Parameter File display

When reading or saving a parameter file, the target file name is displayed in this area.

■ Waveform Information display

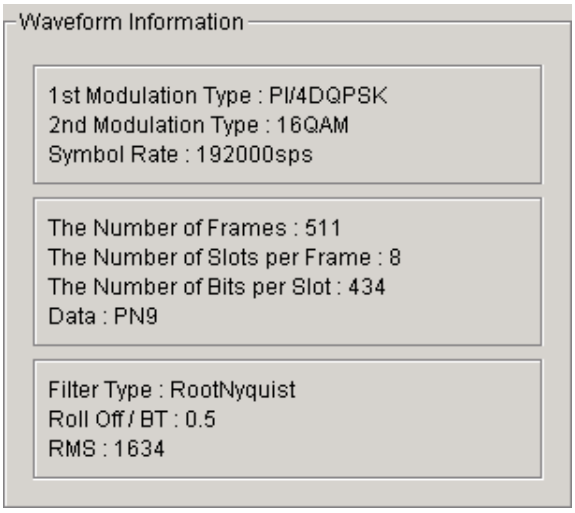


Figure 3.1.1-9 Waveform Information display

The settings of the current parameter are displayed for each parameter setting sheet.

■ Initialization button

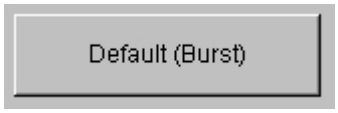


Figure 3.1.1-10 Initialization button

Clicking this button initializes the parameters on the selected parameter setting sheet.

3.1.2 Parameter setting sheet

There are three parameter setting sheets (Burst, Continuous, No Format) on the TDMA main screen, and each sheet is displayed by clicking the tab on the sheet. Each parameter setting sheet has five or seven setting item buttons, and when one of these buttons is clicked, the corresponding setting screen is displayed. Although the setting item buttons are placed sequentially from top down with arrows, it is not necessary to perform parameter settings in this order. Note, however, that some parameters have an effect on the subsequent parameters (refer to Section 3.1.2.8 "Re-setting by changing parameter").

The following setting item buttons are provided:
Modulation, **Frame**, **Slot**, **Field**, **Data**, **Filter**, **Pattern Name**, **Calculation**

The setting item buttons are different among parameter setting sheets. See the table below for what setting item buttons are provided in each parameter setting sheet.

Table 3.1.2-1 Setting item buttons provided on each parameter setting sheet

Setting Item Buttons	Parameter Setting Sheets		
	Burst	Continuous	No Format
Modulation	✓	✓	✓
Frame	✓	✓	–
Slot	✓	✓	–
Field	✓	✓	–
Data	–	–	✓
Filter	✓	✓	✓
Pattern Name	✓	✓	✓
Calculation	✓	✓	✓

- Burst: Used to generate a burst waveform with a slot format.
- Continuous: Used to generate a continuous waveform with a slot format.
- No Format: Used to generate a continuous waveform without a slot format.

When running on MG3710A or MG3740A the **Calculation & Load**, **Calculation & Play buttons display** instead of the **Calculation** button.

The following sections show the setting screens corresponding to each setting item.

3.1.2.1 Modulation

In the "Modulation" setting item, the modulation type, symbol rate, and oversampling rate can be set. The 2nd modulation type can be set only in the Burst parameter setting sheet, and the modulation type can be switched within one slot. Clicking the **Modulation** button on a parameter setting sheet displays the Modulation setting screen.

After setting the parameters, click the **OK** button on the screen to apply the current settings and close the Modulation setting screen. Clicking the **Cancel** button or ☒ button on the upper right of the screen closes the Modulation setting screen canceling the current settings.

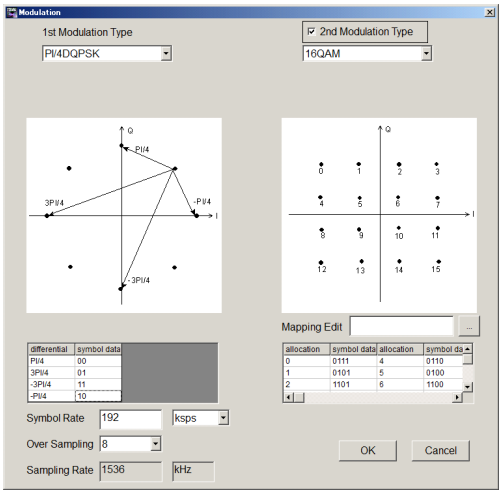


Figure 3.1.2.1-1 Modulation setting screen (When running on PC, MS2690A/MS2691A/MS2692A, MS2830A or MS2840A)

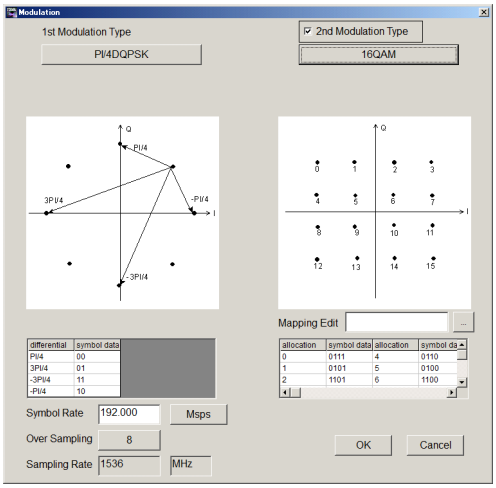


Figure 3.1.2.1-2 Modulation setting screen (When running on MG3710A or MG3740A)

The following parameters can be set in the Modulation setting screen.

Modulation Type (1st Modulation Type)

[Overview] Set the 1st modulation type.

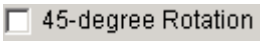
[Default] PI/4DQPSK

[Options] BPSK, DBPSK, PI/2DBPSK,
QPSK, O-QPSK, DQPSK, PI/4DQPSK,
8PSK, D8PSK,
16QAM, 32QAM, 64QAM, 256QAM,
2ASK, 4ASK, 2FSK, 4FSK, User defined

[Remarks] Symbol points on the IQ plane for each modulation type are shown in the Modulation Type list box, and the decimal numbers corresponding to each symbol point are listed in the table in the lower part of the screen. (Similar figures and tables are provided in Appendix B for reference.)

For modulation types 8PSK, D8PSK, 16QAM, 32QAM, 64QAM, and 256QAM, 4FSK, the decimal numbers corresponding to each symbol point can be changed by clicking the referential button

under the IQ plane and selecting a user file for IQ mapping. Refer to Appendix C “User File Format” for details on the user file.

For modulation types BPSK and QPSK, the symbol points can be rotated by 45° by selecting the check box 

under the Modulation Type list box.

When generating Continuous or No Format waveform at 2FSK and 4FSK, the phase may not be continuous between the first and last waveform data.

User defined can be selected only when the parameter setting sheet is No Format.

When User defined is selected, Modulation Mapper is displayed and a user file in which the modulation type is defined can be specified.

Modulation Mapper

When User defined is selected at Modulation Type, Modulation Mapper is dispalyed below the Modulation Type list box.

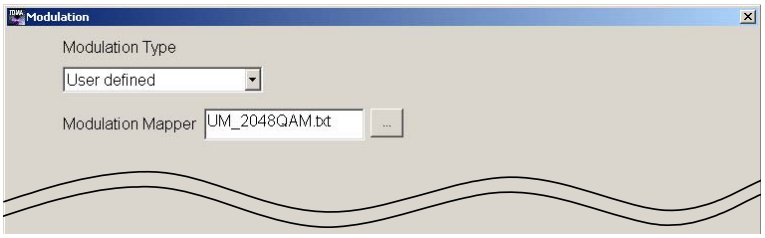


Figure 3.1.2.1-3 Modulation setting screen (When Modulation Type is User defined)

[Overview] This displays the user file for the currently selected user defined modulation. And a user file in which the modulation type is defined can be specified.
Using this function creates the waveforms of the APSK format, such as 16APSK, and the multiple-valued QAM format that is more than 512QAM. Refer to Appendix C "User File Format" for details of the user file for user defined modulation.
When the referential button on the right side of Modulation Mapper (...) is clicked, a new user file for user defined modulation can be selected in the user file selection dialog box.
When User defined is selected while a user file for user defined modulation has not been selected, the user file selection dialog box is automatically displayed.

Modulation Type (2nd Modulation Type)

[Overview] Set the 2nd modulation type.

[Default] PI/4DQPSK

[Options] BPSK, DBPSK, PI/2DBPSK,
QPSK, DQPSK, PI/4DQPSK, 8PSK, D8PSK,
16QAM, 32QAM, 64QAM, 256QAM

[Remarks] The settings for the 2nd modulation type can be configured by selecting the check box 2nd Modulation Type. Note, however, that the 2nd modulation type cannot be set when 2ASK, 4ASK, 2FSK, or 4FSK is set for the 1st modulation type.
The decimal numbers corresponding to each symbol point are displayed in the same manner as for the 1st modulation type.

Symbol Rate, Modulation Index, Maximum Frequency deviation

The display changes according to the setting made for modulation type.

Other than below:	Symbol Rate
2ASK, 4ASK, 2FSK:	Modulation Index
4FSK:	Maximum Frequency deviation

Symbol Rate

[Overview] Set the symbol rate.

[Default] 1 Msps

[Setting range]

1 ksps to 80 Msps	Except for MG3740A
1 ksps to 4 Msps	MG3740A

[Resolution] 1 sps

Over Sampling

[Overview] Set the oversampling rate.

[Default] 2

[Options] 2, 3, 4, 8, 16, 32

[Remarks] The setting range varies depending on the modulation index when 2FSK is set for the modulation type.

Sampling Rate

[Overview] Set the sampling rate.

[Default] 2 MHz

[Setting range]

20 kHz to 160 MHz	Except for MG3740A
20 kHz to 8 MHz	MG3740A

[Remarks] The value of *symbol rate* × *oversampling rate* is automatically set. When the Manchester code setting is enabled, however, the value of *symbol rate* × *oversampling rate* × *2* is automatically set.

GSM

[Overview] Enable/disable the automatic setting in accordance with GSM.
When 8PSK or 2FSK is set for the modulation type, the check box ☐ GSM appears under the Modulation Type list box. When this check box is selected, the automatic setting is performed in accordance with GSM. Note, however, that the 2nd modulation type cannot be set when the GSM check box is selected.
The setting values are as follows.

Symbol data:	8PSK symbol data (Refer to Appendix B)
Symbol rate:	270.833 ksps
Oversampling rate:	12
Number of slots (see 3.1.2.2):	8 slots
Ramp length (see 3.1.2.3)	2 symbols × 2
Guard length (see 3.1.2.3)	4.25 symbols
Filter (see 3.1.2.6)	Specified Filter

Modulation Index

[Overview] Set the modulation index.
[Default] 1
[Setting range] 0.00 to 1.00 (for 2ASK, 4ASK), 0.20 to 10.00 (for 2FSK)
[Remarks] The modulation index can be set in the text box that appears under the Modulation Type list box when 2ASK, 4ASK or 2FSK is set for the modulation type. When the modulation type is 2FSK, the setting range of the oversampling rate varies depending on the modulation index.

Manchester Code

[Overview] Enable/disable Manchester code setting.
When 2ASK is set for the modulation type, the check box ☐ Manchester Code appears under the Modulation Type list box. The Manchester code is selected when this check box is selected, and NRZ is selected when this check box is cleared. NRZ is always selected for modulation types other than 2ASK.

Maximum frequency deviation

[Overview] This sets the maximum frequency deviation.
[Default] 945
[Setting range] 120 to 100000
[Remarks] This is available only when 4FSK is selected for modulation; a text box appears below the Modulation Type list box.

Mapping Edit

Click the referential button on the right hand side of Mapping Edit. Here you can select user file.
Refer to Appendix C.1 "IQ Mapping User File Format" for details.

Keep Phase continuity

[Overview] This function keeps the continuity of phase header and footer of waveform pattern.
[Remarks] This is available when parameter setting sheet is Continuous, No Format, and when modulation method is 2FSK, 4FSK.

Note:

When the **Number of Frames** setting is set to **AUTO**, the number of frames to be generated differs depending on whether the Keep phase continuity check box is selected or not.
If selected, the number of frames is determined by the data frequency set for Data Field. This is because it is no longer necessary to repeat until the header and footer of waveform pattern matches, as previously.

If the check box is selected, offset to applied to the waveform pattern frequency. Its value is displayed as "Frequency Offset" as shown below.

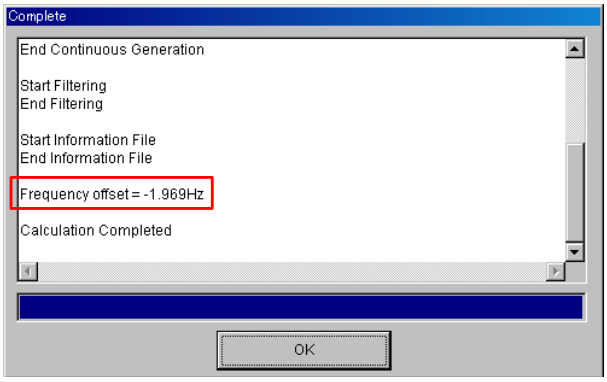


Figure 3.1.2.1-4 Waveform Generation Screen

3.1.2.2 Frame

In the "Frame" setting item, the number of frames, the number of slots per frame, and the transmission status of each slot (ON/OFF) can be set. This setting item is not provided in the No Format parameter setting sheet. Clicking the **Frame** button on the Burst or Continuous parameter setting sheet displays the Frame setting screen shown in Figure 3.1.2.2-1.

After setting the parameters, click the **OK** button on the screen to apply the current settings and close the Frame setting screen. Clicking the **Cancel** button or ✕ button on the upper right of the screen closes the Frame setting screen canceling the current settings.

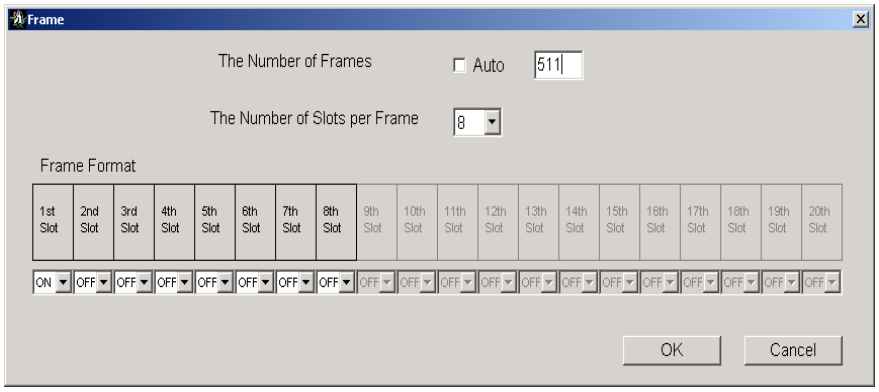


Figure 3.1.2.2-1 Frame setting screen

The following parameters can be set in the Frame setting screen.

The Number of Frames

[Overview] Set the number of frames.

[Default] 1

[Setting range] 1 to 32767

[Remarks] The number of frames is automatically set when the check box Auto is selected. On the Burst parameter setting sheet, the number of frames that retain the continuity of the continuous pattern set in the Data Field area (refer to Section 3.1.2.4 "Field" for details) is automatically set. When the continuous pattern is PN9, for example, the number of frames is automatically set to 511, retaining the PN9 continuity. On the Continuous parameter setting sheet, the number of frames that retains the phase continuity as well as the continuity of the continuous pattern is automatically set. But if the continuous pattern is set to "UserFile" when the check box Auto is selected, the number of frames is automatically set to 1 or a value that retains the phase continuity only.
When the check box Auto is cleared, the number of frames can be set freely within the setting range. Note, however, the continuity of the continuous pattern and phase is not guaranteed in this event.

The Number of Slots per Frame

[Overview] Set the number of slots per frame.

[Default] 1

[Setting range] 1 to 20

[Remarks] The transmission status can be selected for the slots to be used (set by ON/OFF). It is prohibited to set all the slots to OFF. In the Continuous parameter setting sheet, an ALL1 signal is output for the transmission-OFF slots (slots for which the transmission status is set to OFF).
The signal output level when the transmission status is OFF is the same as that when the transmission status is ON.

3.1.2.3 Slot

The slot format can be set in the “Slot” setting item. This setting item is not provided in the No Format parameter setting sheet. The setting items for “Slot” in the Burst parameter setting sheet and that in the Continuous parameter setting sheet are different. Clicking the **Slot** button on the Burst or Continuous parameter setting sheet displays the Slot setting screen.

The slot format set here is commonly applied to all the transmission-ON slots. On slot can be divided into up to 24 fields. The number of bits and field type (Guard, Ramp, Fixed, Data, or CRC) can be set for each field. The fields for which the number of bits is set to 0 are recognized as nonexistent.

When the 2nd modulation type is set in the Burst parameter setting sheet, the setting range for the 1st modulation type is between the first and 12th fields, and that for the 2nd modulation type is between the 13th to 24th fields.

When the **Apply** button on the screen is clicked after setting the parameters, the Slot Format image on the upper of the Frame screen is modified according to the settings. Clicking the **OK** button applies the current settings and closes the Slot setting screen. Clicking the **Cancel** button or button on the upper right of the screen closes the Slot setting screen canceling the current settings.

Setting items for Burst

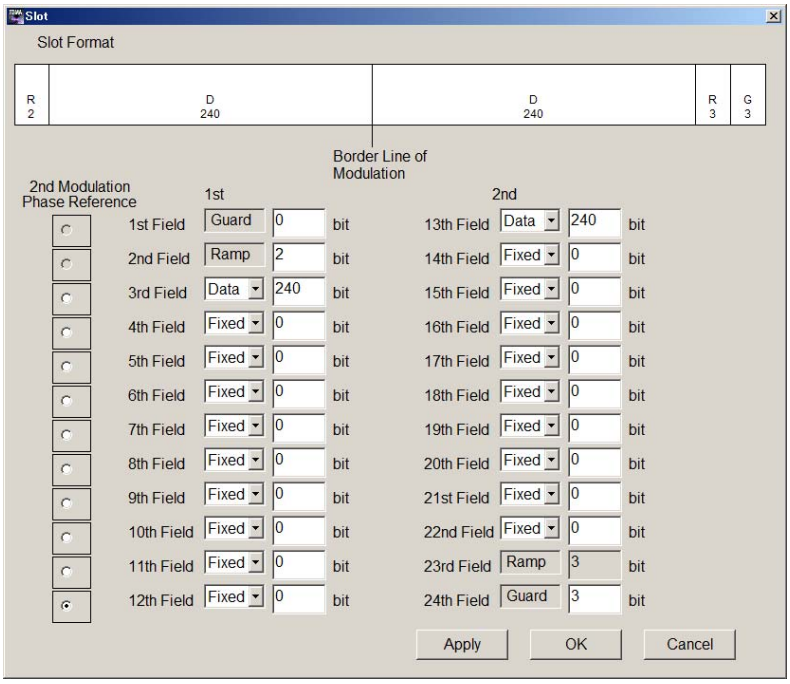


Figure 3.1.2.3-1 Slot setting screen for Burst (When running on PC, MS2690A/MS2691A/MS2692A, MS2830A or MS2840A)

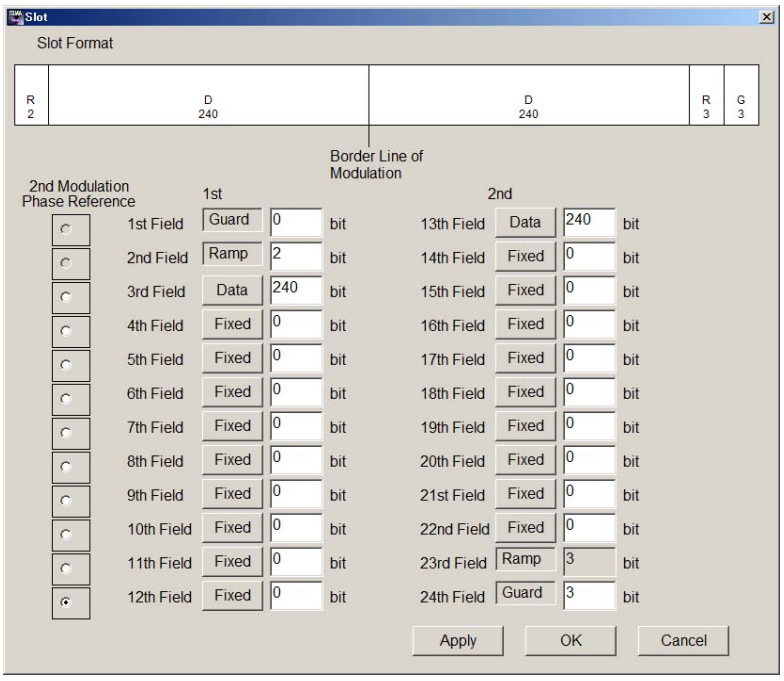


Figure 3.1.2.3-2 Slot setting screen for Burst (When running on MG3710A or MG3740A)

The following parameters can be set in the Slot setting screen for Burst.

Guard

[Overview] Set the number of bits in the Guard field.
The Guard field is fixed to the first and 24th fields.

[Setting range] The setting range for the number of bits is determined as follows according to the set modulation type.

Table 3.1.2.3-1 Setting range for Guard

(1st/2nd) Modulation Type	Number of Bits in 1st Field	Number of Bits in 24th Field
BPSK, DBPSK, PI/2DBPSK, 2ASK, 2FSK	Integer number from 0 to 9960	Integer number from 0 to 9960
QPSK, O-QPSK, DQPSK, PI/4DQPSK, 4ASK, 4FSK	Multiples of 2 from 0 to 9960	Multiples of 2 from 0 to 9960
8PSK, D8PSK	Multiples of 3 from 0 to 9960	Multiples of 3 from 0 to 9960
16QAM	Multiples of 4 from 0 to 9960	Multiples of 4 from 0 to 9960
32QAM	Multiples of 5 from 0 to 9960	Multiples of 5 from 0 to 9960
64QAM	Multiples of 6 from 0 to 9960	Multiples of 6 from 0 to 9960
256QAM	Multiples of 8 from 0 to 9960	Multiples of 8 from 0 to 9960

Ramp

[Overview] Set the number of bits in the Ramp field.
The Ramp field is fixed to the second and 23rd fields.
The number of bits equivalent to the symbol length set in the second field is automatically set to the 23rd field.

[Setting range] The setting range for the number of bits is determined as follows according to the set modulation type.

Table 3.1.2.3-2 Setting range for Ramp

(1st/2nd) Modulation Type	Number of Bits
BPSK, DBPSK, PI/2DBPSK, 2ASK, 2FSK	Integer number from 1 to 16
QPSK, O-QPSK, DQPSK, PI/4DQPSK, 4ASK, 4FSK	Multiples of 2 from 2 to 32
8PSK, D8PSK	Multiples of 3 from 3 to 48
16QAM	Multiples of 4 from 4 to 64
32QAM	Multiples of 5 from 5 to 80
64QAM	Multiples of 6 from 6 to 96
256QAM	Multiples of 8 from 8 to 128

Slot

The following items are available:

Fixed

[Overview] Set the number of bits in the fixed data field.
The fixed data field can be set to the 3rd through 22nd fields.

[Setting range] An integer number from 0 to 128

Data

[Overview] Set the number of bits in the continuous pattern data field, such as a pseudo random pattern (PN9, PN15).
The continuous pattern data field can be set to the 3rd through 22nd fields.

[Setting range] An integer number from 0 to 1024

CRC

[Overview] Set the number of bits in the cyclic redundancy check (CRC) field.
The CRC field can be set to the 4th through 22nd fields.

[Options] 0, 8, 12, 16, 24, 32

[Remarks] The following generation polynomial expressions are used according to the set number of bits:

8 bits: $x^8 + x^7 + x^4 + x^3 + x + 1$

12 bits: $x^{12} + x^{11} + x^3 + x^2 + x + 1$

16 bits: $x^{16} + x^{12} + x^5 + 1$

24 bits: $x^{24} + x^{23} + x^6 + x^5 + x + 1$

32 bits: $x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$

The total number of bits in the left fields of the CRC field (excluding Guard and Ramp fields) must be 1 or more. When setting two or more CRC fields, the total number of bits between the CRC field and the previous CRC field must be 1 or more. The CRC calculation area can be set in the Field setting screen (refer to Section 3.1.2.4 “Field” for details).

The total number of bits in the Fixed, Data, and CRC fields is restricted as follows according to the set modulation type. When the 2nd modulation type is set, the total number of bits for the 1st modulation type should be calculated from the third to 12th fields, and that for the 2nd modulation type should be calculated from the 13th to 22nd fields. Also, note that the total number of bits cannot be set to 0.

Table 3.1.2.3-3 Restrictions on total number of bits for modulation type

(1st/2nd) Modulation Type	Total Number of Bits
BPSK, DBPSK, PI/2DBPSK, 2ASK, 2FSK	–
QPSK, O-QPSK, DQPSK, PI/4DQPSK, 4ASK, 4FSK	Multiples of 2
8PSK, D8PSK	Multiples of 3
16QAM	Multiples of 4
32QAM	Multiples of 5
64QAM	Multiples of 6
256QAM	Multiples of 8

2nd Modulation Phase Reference

[Overview] Set the 0 phase reference symbol.
The optional radio buttons are displayed for the third to 12th fields when the 2nd modulation type is set. When the 1st modulation mode is the differential modulation mode, the 2nd modulation is performed regarding the phase of the last symbol in the field with the selected optional radio button as 0.

Setting items for Continuous

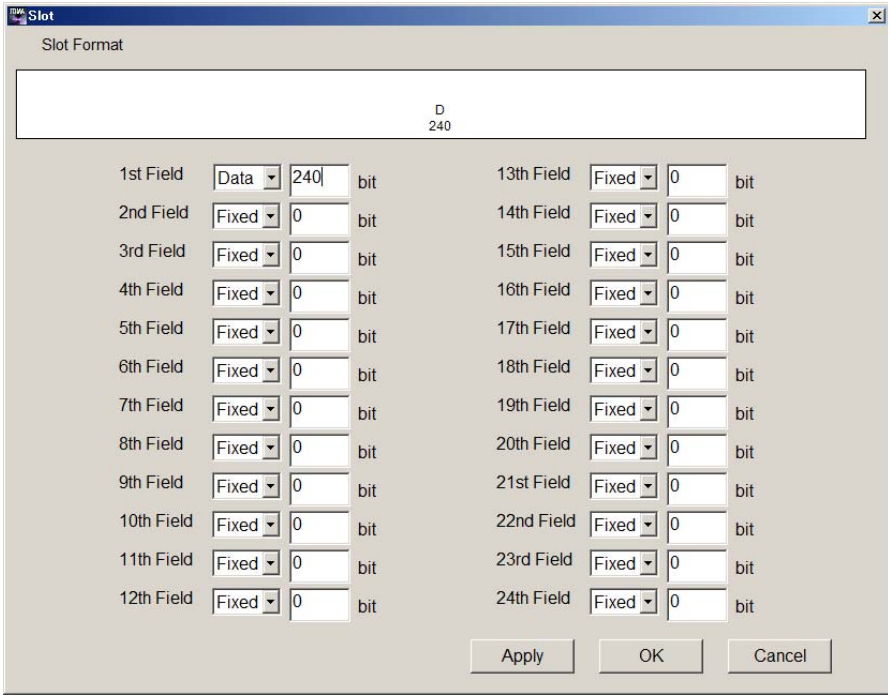


Figure 3.1.2.3-3 Slot setting screen for Continuous (When running on PC, MS2690A/MS2691A/MS2692A, MS2830A or MS2840A)

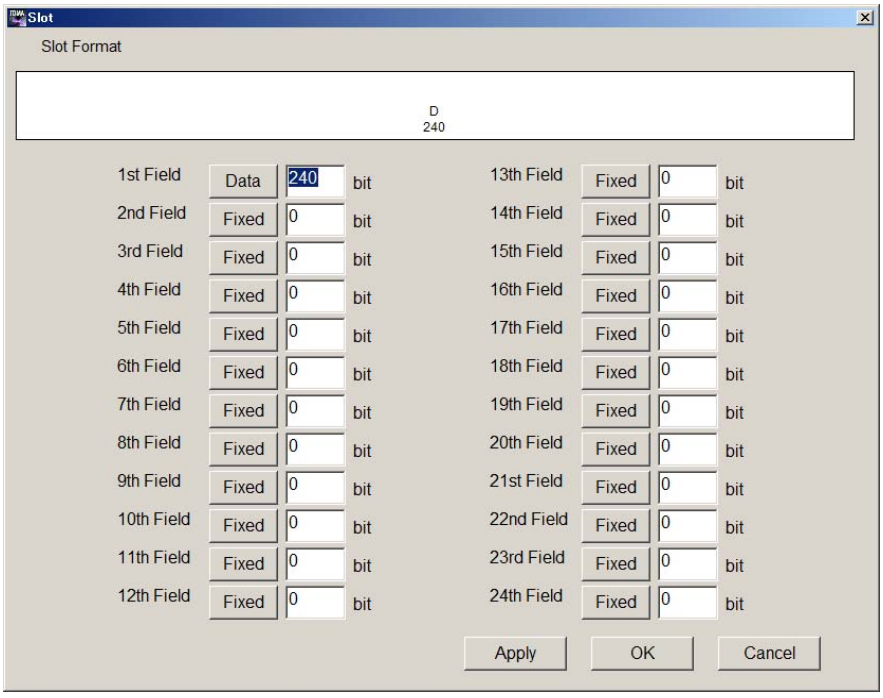


Figure 3.1.2.3-4 Slot setting screen for Continuous (When running on MG3710A or MG3740A)

The following parameters can be set in the Slot setting screen for Continuous.

Fixed

[Overview] Set the number of bits in the fixed data field.
The fixed data field can be set to the first through 24th fields.

[Setting range] An integer number from 0 to 128

Data

[Overview] Set the number of bits in the continuous pattern data field, such as a pseudo random pattern (PN9, PN15).
The continuous pattern data field can be set to the first through 24th fields.

[Setting range] An integer number from 0 to 1024

CRC

[Overview] Set the number of bits in the cyclic redundancy check (CRC) field.
The CRC field can be set to the 2nd through 24th fields.

[Options] 0, 8, 12, 16, 24, 32

[Remarks] The following generation polynomial expressions are used according to the set number of bits:

8 bits: $x^8 + x^7 + x^4 + x^3 + x + 1$

12 bits: $x^{12} + x^{11} + x^3 + x^2 + x + 1$

16 bits: $x^{16} + x^{12} + x^5 + 1$

24 bits: $x^{24} + x^{23} + x^6 + x^5 + x + 1$

32 bits: $x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x^2 + x + 1$

The total number of bits in the left fields of the CRC field must be 1 or more. When setting two or more CRC fields, the total number of bits between the CRC field and the previous CRC field must be 1 or more.
The CRC calculation area can be set in the Field setting screen (refer to Section 3.1.2.4 “Field” for details).

The total number of bits is restricted as follows according to the set modulation type. Also, note that the total number of bits cannot be set to 0.

Table 3.1.2.3-4 Restrictions on total number of bits

Modulation Type	Total Number of Bits
BPSK, DBPSK, PI/2DBPSK, 2ASK, 2FSK	–
QPSK, O-QPSK, DQPSK, PI/4DQPSK, 4ASK, 4FSK	Multiples of 2
8PSK, D8PSK	Multiples of 3
16QAM	Multiples of 4
32QAM	Multiples of 5
64QAM	Multiples of 6
256QAM	Multiples of 8

3.1.2.4 Field

In the "Field" setting item, the contents of each field in a transmission-ON slot can be set. This setting item is not provided in the No Format parameter setting sheet. Clicking the **Field** button on the Burst or Continuous parameter setting sheet displays the Field setting screen.

The slot format image is displayed on the upper of the Field setting screen, like in the Slot setting screen. Select a slot to be set from the Slot Format list box on the upper-left of the screen. The field numbers, field types, and the numbers of bits in each field are displayed in the middle of the screen. For Fixed fields and CRC fields, a text box is displayed on the right. For Data fields, their contents can be set in the Data Field area under the slot format image.
When "ALL" is selected from the Slot Format list box, the field settings on the Field screen commonly apply to all transmission slots.

After setting the parameters, click the **OK** button to apply the current settings and close the Field setting screen. Clicking the **Cancel** button or ✕ button on the upper right of the screen closes the Field setting screen canceling the current settings.

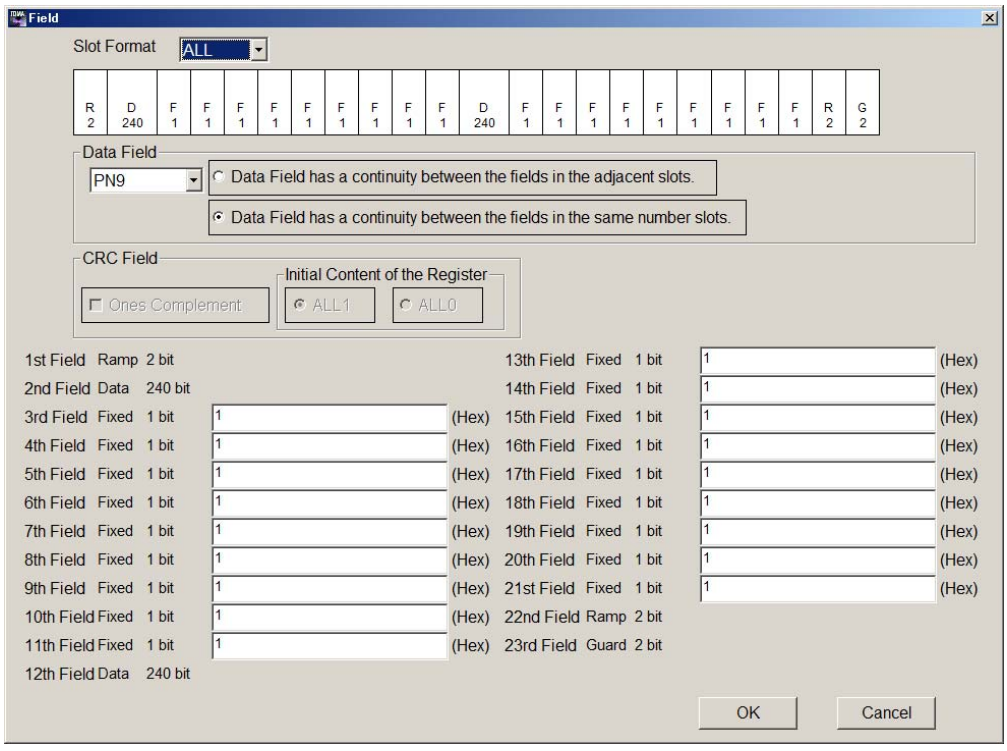


Figure 3.1.2.4-1 Field setting screen (When running on PC, MS2690A/MS2691A/MS2692A, MS2830A or MS2840A)

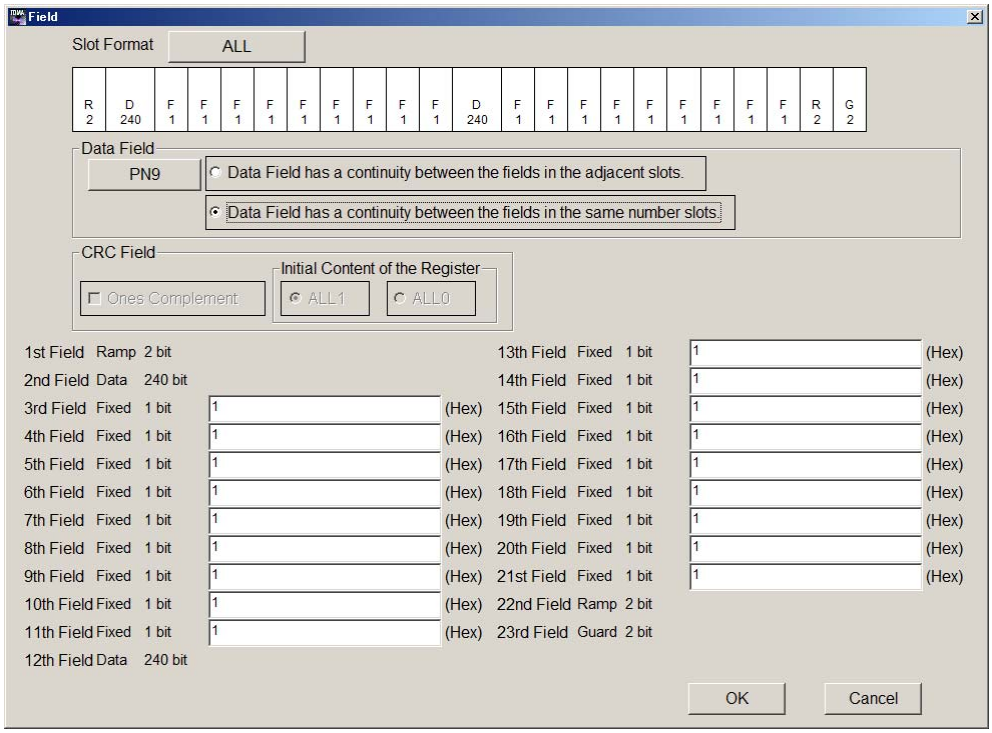


Figure 3.1.2.4-2 Field setting screen (When running on MG3710A or MG3740A)

The following parameters can be set in the Field setting screen.

Slot Format

The slot whose transmission setting is set to ON in 3.1.2.2 “Frame” can be selected.

[Overview] Select from the list box a slot whose field is to be set.
[Default] ALL
[Setting range] Slots whose transmission status is set to ON in the Frame setting screen (transmission-ON slots).
[Remarks] When “ALL” is selected, the set field contents will be applied to all the transmission-ON slots.

Fixed

[Overview] Set fixed data in the text box in hexadecimal.
[Default] 1
[Setting range] 0 to the maximum value within the set number of bits (Ex. 0 to 1F when the set number of bits is 5)

CRC

[Overview] Set a CRC calculation area in the text box by integer number.
[Default] 1
[Setting range] 1 to the total number of bits in the left fields (excluding Guard and Ramp fields) of the CRC field. When there are two or more CRC fields, the maximum value for the second and subsequent CRC fields is the total number of bits between the CRC fields.
[Remarks] The initial value of the CRC register can be set by using the radio buttons in Initial Content of the Register in the CRC Field area. All the initial values are set to 0 when the ALL0 radio button is selected, and are set to 1 when the ALL1 radio button is selected.
The CRC Field area also provides the Ones Complement check box. When this check box is selected, the 1’s complement of the register value after CRC calculation is used for the CRC field. When this check box is cleared, the register value after CRC calculation is used as is.

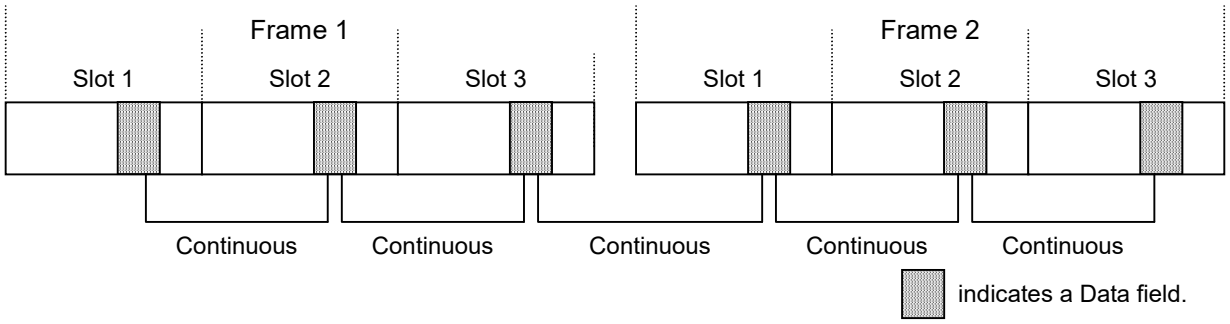
Data

[Overview] Select a continuous pattern from the list box in the Data Field area.
When “16-bit Pattern” is selected, the 16-bit Pattern (Common) text box on the right in this area becomes enabled. Enter an arbitrary “16-bit Pattern” in this text box in hexadecimal. It is also possible to load a user file for setting.

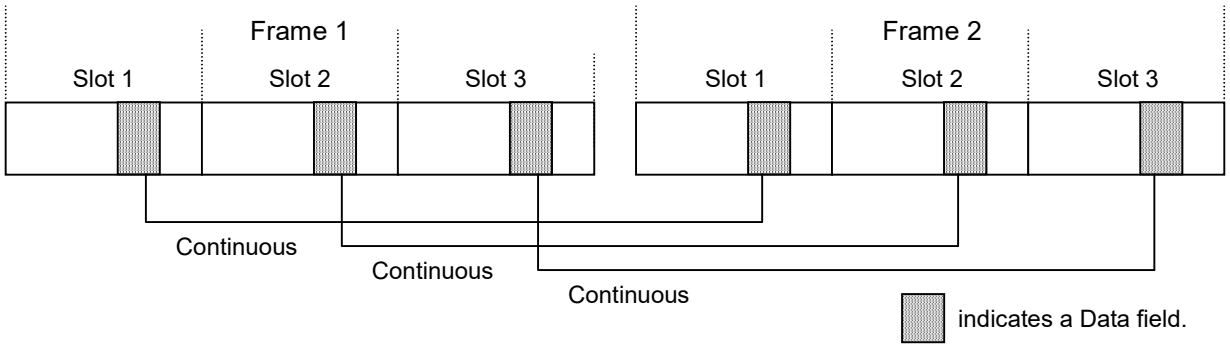
[Default] PN9

[Options] PN9, PN15, 16-bit Pattern, ALL0, ALL1, UserFile

[Remarks] When two or more Data fields exist in one slot, the continuity of the Data fields within the slot is retained. However, the continuity of the Data fields between different slots should be specified by the radio buttons on the right of the list box. When the radio button “Data Field has a continuity between the fields in the adjacent slots.” is selected, the continuity of the Data fields is retained between the transmission-ON slots. In this event, if “16-bit Pattern” is selected for the continuous pattern, the value entered in the text box is commonly applied to all the transmission-ON slots. When the radio button “Data Field has a continuity between the fields in the same number slots.” is selected, the continuity of the Data fields is retained between the transmission-ON slots having the same number in each frame. In this event, if “16-bit Pattern” is selected for the continuous pattern, an individual value can be set in the text box for each transmission-ON slot (see Figure 3.1.2.4-3).
When “UserFile” is selected in the Data Field list box, a screen for selecting a user file for continuous pattern is displayed, enabling to load a user-defined bit string other than the provided selection items. Refer to Appendix C “User File Format” for details on the user file.



When “Data Field has a continuity between the fields in the adjacent slots.” is selected



When “Data Field has a continuity between the fields in the same number slots.” is selected

Figure 3.1.2.4-3 Continuity of Data field when one frame contains three transmission-ON slots

3.1.2.5 Data

In the "Data" setting item, a continuous pattern such as a pseudo random pattern (PN9, PN15) can be set for a No Format waveform pattern. This setting item is not provided in the Burst and Continuous parameter setting sheets. Clicking the **Data** button on the No Frame parameter setting sheet displays the Data setting screen.

After setting the parameters, click the **OK** button to apply the current settings and close the Data setting screen. Clicking the **Cancel** button or ☒ button on the upper right of the screen closes the Data setting screen canceling the current settings.

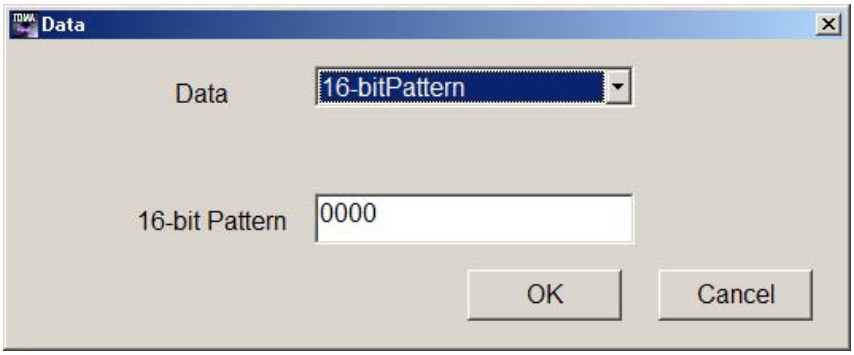


Figure 3.1.2.5-1 Data setting screen (When running on PC, MS2690A/MS2691A/MS2692A, MS2830A or MS2840A)

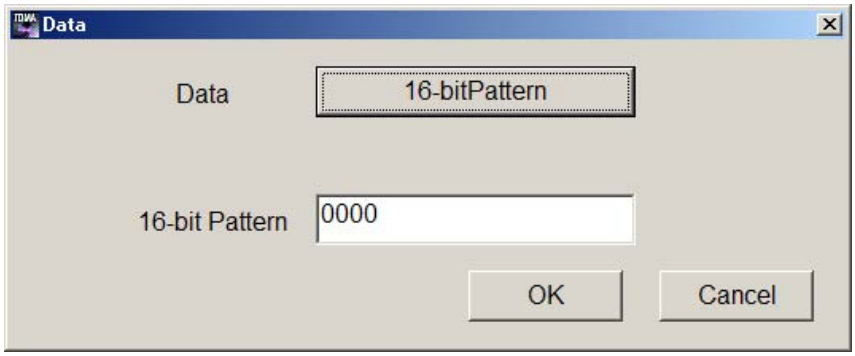


Figure 3.1.2.5-2 Data setting screen (When running on MG3710A or MG3740A)

The following parameter can be set in the Data setting screen.

Data

[Overview] Select a continuous pattern from the Data list box. When “16-bit Pattern” is selected, the 16-bit Pattern text box under the list box becomes enabled. Enter an arbitrary “16-bit Pattern” in this text box in hexadecimal. It is also possible to load a user file for setting.

[Default] PN9

[Options] PN9, PN15, 16-bit Pattern, ALL0, ALL1, UserFile

[Remarks] When “UserFile” is selected in the Data Field list box, a screen for selecting a user file for continuous pattern is displayed, enabling to load a user-defined bit string other than the provided selection items. Refer to Appendix C “User File Format” for details on the user file.

3.1.2.6 Filter

The "Filter" setting item is used for setting a filter. Clicking the **Filter** button on a parameter setting sheet displays the Filter setting screen.

After setting the parameters, click the **OK** button to apply the current settings and close the Filter setting screen. Clicking the **Cancel** button or ✕ button on the upper right of the screen closes the Filter setting screen canceling the current settings.

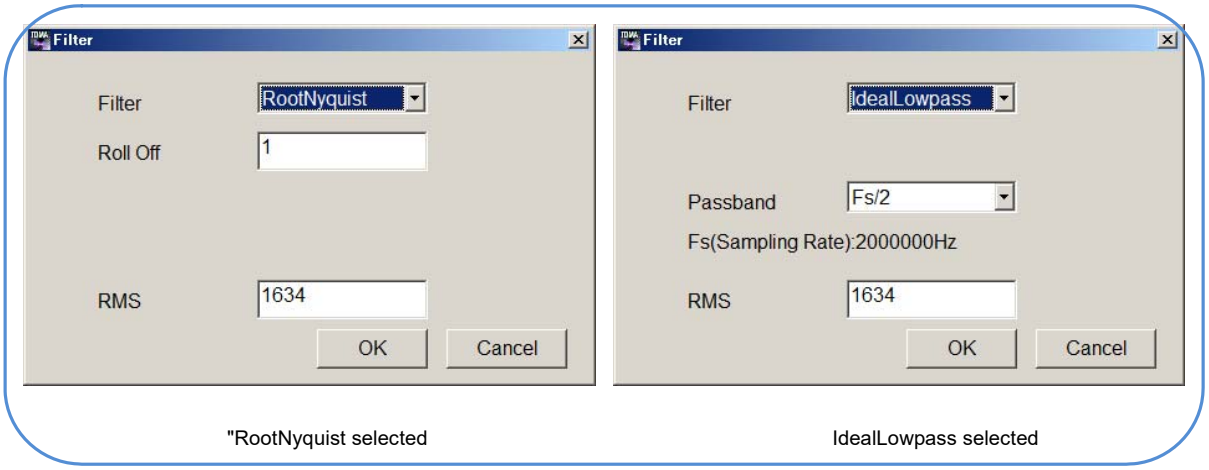


Figure 3.1.2.6-1 Filter setting screen (When running on PC, MS2690A/MS2691A/MS2692A, MS2830A or MS2840A)

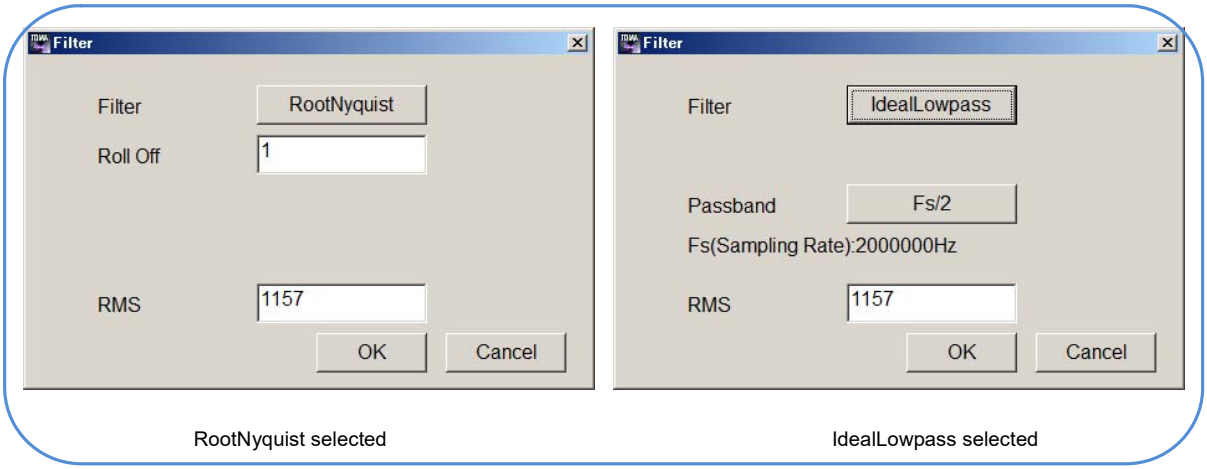


Figure 3.1.2.6-2 Filter setting screen (When running on MG3710A or MG3740A)

The following parameters can be set in the Filter setting screen.

Filter

[Overview] Set the filter type.

[Default] RootNyquist

[Options] Nyquist, RootNyquist, Gaussian, Gaussian2, IdealLowpass, None, ARIB STD-T98, Half-sine, ARIB STD-T102Part1, User Defined Filter

[Remarks] IdealLowpass is a rectangular filter. It is not an ideal filter since the number of filter coefficients is limited.
When the check box ☐ GSM has been selected in the Modulation setting screen to enable the GSM setting, Specified Filter is displayed and a filter that conforms to the GSM specifications is automatically set.
If 2FSK or 4FSK is specified for Modulation Type on the Modulation setting screen, symbols are filtered.
ARIB STD-T98 and ARIB STD-T102Part1 can only be selected if 4FSK is specified for Modulation Type on the Modulation setting screen.
The ARIB STD-T98/T102 filter is specified for the four-frequency shift keying of the ARIB STD-T98/T102 standards and has the configuration shown in the following figure.

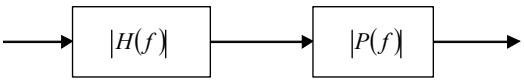


Figure 3.1.2.6-3 ARIB STD-T98/102 filter composition

Here, H(f) is the RootNyquist function, and P(f) is the sinc function (T98) or Gaussian function (T102).
Half-sine can only be selected if O-QPSK is specified for Modulation Type on the Modulation setting screen.
The impulse response is expressed as the formula below when the filter is set to Gaussian.

$$h(t) = \frac{\exp\left(\frac{-t^2}{2\delta^2 T^2}\right)}{\sqrt{(2\pi)}\,.\delta T} * rect\left(\frac{t}{T}\right)$$

It is under the condition below. (T is symbol cycle)

$$rect\left(\frac{t}{T}\right) = \frac{1}{T} \quad for|t| < \frac{T}{2}, \qquad rect\left(\frac{t}{T}\right) = 0 \quad otherwise$$

The impulse response is expressed as the formula below when the filter is set to Gaussian2.

$$h(t) = \frac{\exp\left(\frac{-t^2}{2\delta^2 T^2}\right)}{\sqrt{(2\pi)} \ . \ \delta T}$$

Here δ is a constant expressed as the formula below.

$$\delta = \frac{\sqrt{\ln(2)}}{2\pi BT}$$

The following figure shows the comparison of amplitude characteristics between the filter types (Gaussian and Gaussian2).
(Horizontal axis: Frequency normalized to the symbol rate, BT = 0.5, Over Sampling = 8)

In comparison with Gaussian2, Gaussian has the narrower passband, and its amplitude becomes 0 at an integer multiples of the Symbol Rate frequency, due to the influence of rect(t/T).

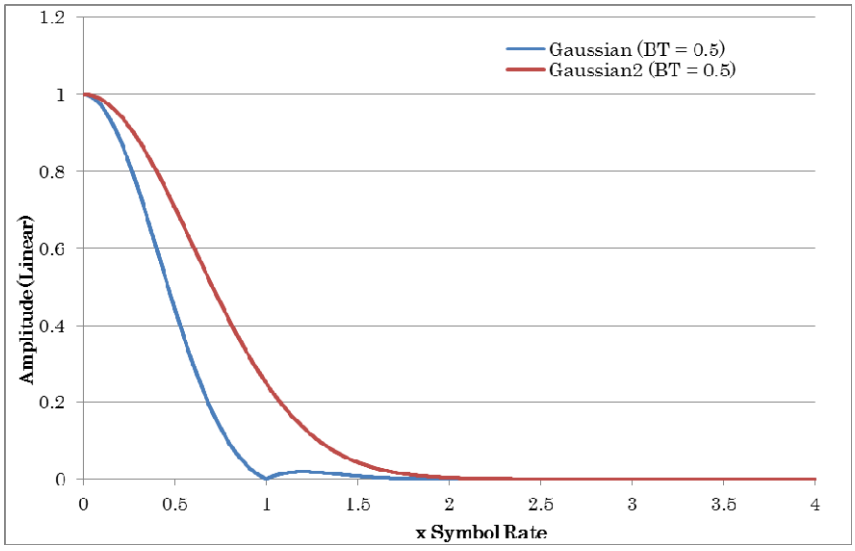


Figure 3.1.2.6-4 Amplitude characteristics of Gaussian and Gaussian2 filters

The user file format when the filter is set to User Defined Filter is as below.
-Each filter coefficient should be separated by return key in ASCII format. (Commas, spaces, and tabs are taken as errors.)
-There must be a FIR filter coefficient string expressed by time response (as real number).

-The filter coefficient tap number must be an odd number in the range from 1 to 1023.

Roll Off/BT

[Overview] Set the roll-off rate for filter (when Nyquist or RootNyquist is set) or BT product (when Gaussian is set).

[Default] 1

[Setting range] 0.10 to 1.00

[Remarks] This item is displayed and can be set only when Nyquist, RootNyquist, or Gaussian is set for the filter type.

Passband

[Overview] Set the passband of filter.

[Default] Fs/oversampling rate (Fs: Sampling rate)

[Options] Fs/2, Fs/3, Fs/4, Fs/8, Fs/16, Fs/32

[Remarks] The setting range varies depending on the oversampling rate.
This item is displayed and can be set only when IdealLowpass is set for the filter type.

RMS

[Overview] Set the RMS value of waveform pattern.

[Default] 1634

[Setting range] 651 to 4104

[Remarks] The RF output level accuracy of the mainframe is specified by an RMS value from 1157 to 1634.

Note:

When started up in MG3710, MG3740, MS2830 or MS2840 mode, the initial value is 1157. RMS value is fixed to 1157 in MS269x mode.

3.1.2.7 Pattern Name

The "Pattern Name" setting item is used to set a waveform pattern file name. Clicking the **Pattern Name** button on a parameter setting sheet displays the Pattern Name setting screen shown in Figure 3.1.2.7-1.

After setting the parameters, click the **OK** button to apply the current settings and close the Pattern Name setting screen. Clicking the **Cancel** button or ✕ button on the upper right of the screen closes the Pattern Name setting screen canceling the current settings.

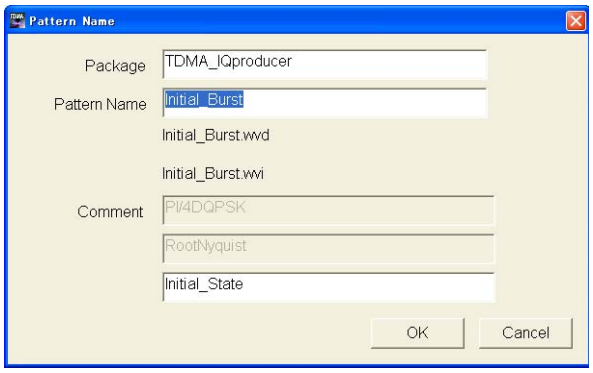


Figure 3.1.2.7-1 Pattern Name setting screen

The following parameters can be set in the Field setting screen.

Package

[Overview] Enter the name of the package that saves waveform patterns to be created.

[Default] TDMA_IQproducer

[Setting range] Within 31 characters, including alphanumeric and the following symbols:
! % & ( ) + = ` { } _ - ^ @ [ ]

Pattern Name

[Overview] Enter a waveform pattern file name.
One waveform pattern consists of a waveform information file with the extension ".wvi" and a waveform data file with the extension ".wvd". These file names are the same except for the extension.

[Default] Initial_Burst/Initial_Continuous/Initial_NoFormat

[Setting range] Within 20 characters, including alphanumeric and the following symbols:
! % & ( ) + = ` { } _ - ^ @ [ ]

Comment

[Overview] Enter comments to be displayed on the screen.
The settings of Modulation Type and Over Sampling are displayed in the first line, and the settings of Filter Type are displayed in the second line.
When **Modulation Type** is **User defined**, "user file name" selected at Modulation Mapper and "Over Sampling" are displayed in the first line.
A comment can be entered by a user in the third line only. This line can be left blank.

[Default] Initial_State

[Setting range] Within 38 characters.

3.1.2.8 Re-setting by changing parameter

Although it is not necessary to perform parameter settings in the order indicated by arrows (see Figure 3.1.1-7 "Parameter setting sheets"), some parameters have an effect on the subsequent parameters when they are set.

Automatic setting when Modulation Type is changed

The parameters on the Slot setting screen are automatically changed depending on the setting of "Modulation Type" in the Modulation setting screen. When "Modulation Type" is changed on the Modulation setting screen after setting the parameters on the Slot setting screen, therefore, be aware that the parameters on the Slot setting screen will be changed automatically. Tables 3.1.2.8-1 and 3.1.2.8-2 show the values automatically set after changing "Modulation Type."

Table 3.1.2.8-1 Automatically set values (Burst)

Field	No. of Bits	Field Type
1st	0	Guard
2nd	Number of bits per symbol for the set modulation type	Ramp
3rd	240	Data
13th	240	Data
23rd	Number of bits per symbol for the set modulation type	Ramp
24th	Number of bits per symbol for the set modulation type	Guard
Other than the above	0	Fixed

Table 3.1.2.8-2 Automatically set values (Continuous)

Field	No. of Bits	Field Type
1st	240	Data
Other than the above	0	Fixed

Automatic setting due to change in Frame or Slot setting item

When the number of transmission-ON slots is increased or a transmission-OFF slot is changed to a transmission-ON slot in the Frame setting screen, all the values of Fixed and CRC fields in the Field setting screen are automatically set to "1" for the slots that are set/changed to transmission-ON.

This automatic setting operation also occurs when the slot format in the Slot setting screen is changed. Care must be taken, therefore, when changing the parameters on the Frame or Slot setting screen after the parameters on the Field setting screen have been set.

3.1.3 Calculation

The "Calculation" button is used to start waveform pattern generation after parameter setting is completed. Click the **Calculation** button on a parameter setting sheet to display the Export Path screen shown in Fig. 3.1.3 -1, and select the waveform pattern output destination on this screen.

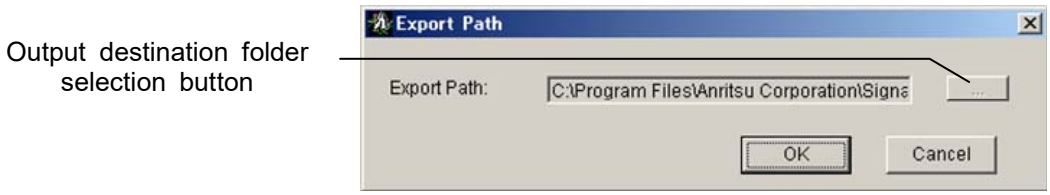


Figure 3.1.3-1 Export Path screen for selecting waveform pattern output destination

Clicking the output destination selection button displays the Browse for Folder screen shown in Figure 3.1.3-2. The output destination folder can be selected from this screen.

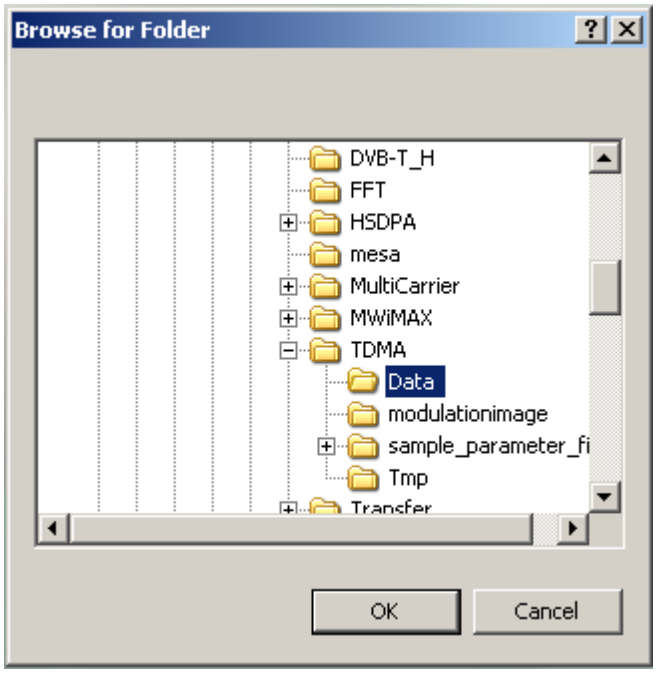


Figure 3.1.3-2 Browse for Folder screen

The default destination folder for waveform patterns in each instrument is shown in the table below.

Table 3.1.3-1 Default export destination folder

Instrument	Operating environment	Export destination folder
MG3700A	**–**	X:\IQproducer\TDMA\Data (X:\ IQproducer is a folder where IQproducer is installed) This can be changed.
MG3710A **MG3740A**	**MG3710A** **MG3740A**	C:\Anritsu\MG3710A\User Data \Waveform\"Package name" This cannot be changed.
	PC	Same as MG3700A
MS269xA, **MS2830A,** **MS2840A**	**MS269xA,** **MS2830A,** **MS2840A,** **PC**	When Installed OS is Windows Embedded Standard 7, Windows 10, or Windows 11. C:\Anritsu\Signal Analyzer\System\Waveform Other than above. C:\Program Files\Anritsu Corporation \Signal Analyzer\System\Waveform\" Package name" This cannot be changed.

After the output destination folder is specified, the Waveform Generation screen shown in Figure 3.1.3-3 is displayed, but if the waveform pattern sample size exceeds the upper limit of the memory, an error screen is displayed and the waveform is not generated. However, when the frame count is set to Auto at the Frame Parameter setting screen, if the waveform pattern sample size exceeds the above-described limit range, the waveform pattern is generated by reducing the frame count; when the directions indicate a Burst waveform, the frame count becomes 1 to generate a waveform. For a Continuous waveform, the waveform is generated with a continuous phase, but even in this case, the waveform is generated with a frame count of 1 if the sample count exceeds the limit range. Furthermore, for a waveform pattern with less than 1000 samples, the frame count is increased to generate the waveform as for a waveform pattern with 1000 or more samples. Table 3.1.3-2 shows the method for calculating the waveform pattern sample count.

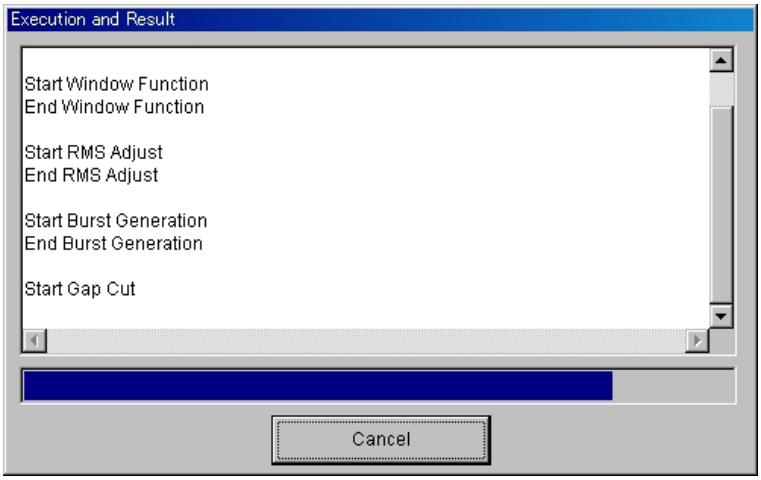


Figure 3.1.3-3 Waveform generation screen (in progress)

Table 3.1.3-2 How to calculate the number of samples of waveform pattern

For Burst:	Symbol × Slot_ON × Frame × OSR [samples]	
For Continuous:	Symbol × Slot × Frame × OSR [samples]	
where;	Symbol:	The number of symbols in a slot
	Slot_ON:	Number of the last transmission-ON slot in a frame
	Slot:	The number of slots in a frame
	Frame:	The number of frames
	OSR:	Oversampling rate

When waveform generation is completed, "Calculation Completed" is displayed on the screen as shown in Fig. 3.1.3-4, and the **Cancel** button changes to the **OK** button.

If the amplitude value of the waveform pattern is out of the range from –8192 to 8191, clipping is processed and "Clipping was done." is displayed on the screen. Clipping is a process to "clip" the part of the amplitude value that exceeds the limitation range. When clipping is processed, a waveform may be distorted, resulting in the degradation in the adjacent channel leakage power ratio and/or waveform quality.

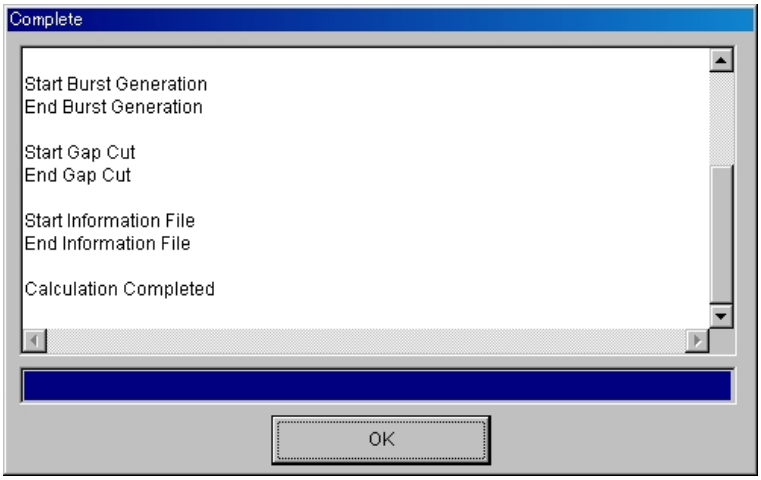


Figure 3.1.3-4 Waveform generation screen (when calculation completed)

When the **Cancel** button is clicked during waveform generation, the waveform generating operation is interrupted, the waveform generation screen is closed, and the TDMA main screen is displayed again. The waveform generating operation is also interrupted if the size of the intermediate file that is created during waveform generation exceeds 4 GB ("Can not read file" is displayed on the screen at this time). In this event, reduce the number of frames, for example, to complete the waveform generating operation.

When the **OK** button is clicked after waveform generation is completed, the waveform generation screen is closed and the TDMA main screen is displayed again.

3.1.4 Calculation & Load

Note:

This function is available only when this software is used on MG3710A or MG3740A.

When **Calculation & Load** is selected, the Load Setting screen will display after waveform generation.

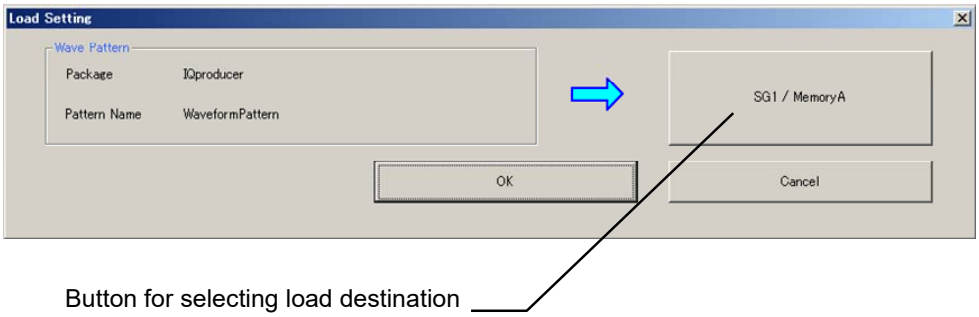


Figure 3.1.4-1 Load Setting Screen

The Select Memory screen will display after clicking the load destination in the Load Setting screen.

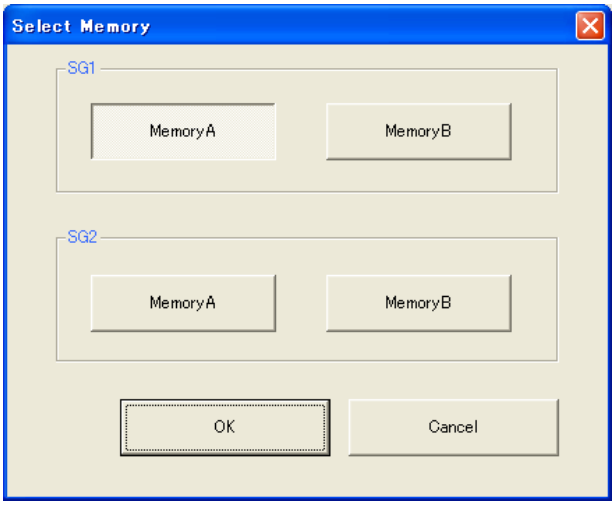


Figure 3.1.4-2 Select Memory Screen

After selecting the load destination of generated waveform in the Select Memory screen and clicking the **OK** button, the Load Setting screen will be shown again. Click the **OK** button in the Load Setting screen, and then the loading of waveform starts.

Note:

To exit this screen without loading the waveform pattern, click the **Cancel** button in the Load Setting screen.

3.1.5 Calculation & Play

Note:

This function is available only when this software is used on MG3710A or MG3740A.

When **Calculation & Play** is selected, after waveform creation is completed, the created waveform is loaded into memory, selected and output.

When the 2nd Vector Signal Generator (option) is installed, the Select SG screen is displayed before the start of waveform generation. This screen is used to select the signal generator for outputting the created waveform pattern.

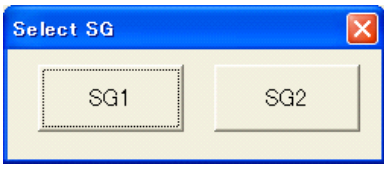


Figure 3.1.5-1 Select SG Screen

3.1.6 Saving/reading parameters

This numeric values and settings for each item can be saved in a parameter file by using this software.

■ Saving parameter file

When running on PC, MS2690A/MS2691A/MS2692A, MS2830A or MS2840A

1. Select **Save Parameter File** from the **File** menu or click the tool button to display the parameter file saving screen shown.

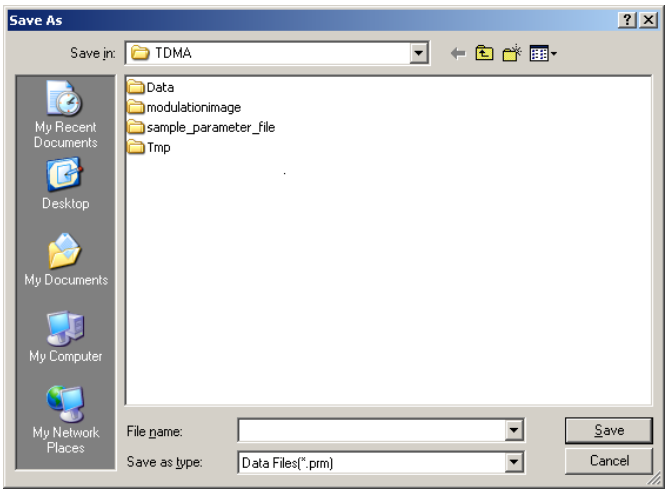


Figure 3.1.6-1 Parameter file saving screen

2. Enter a file name in the **File name** text box and click the **Save** button to save the parameter file.
   When the save destination is not changed in the **Save in** box, the parameter file is saved in the following directory with the entered file name:
   X:\IQproducer\TDMA*Entered file name*.prm
   ("X:\IQproducer" indicates the folder where the IQproducer™ is installed.)

When running on MG3710A or MG3740A

1. Click the **Save Parameter File** button in **File** menu or click the button to display the parameter file saving screen.

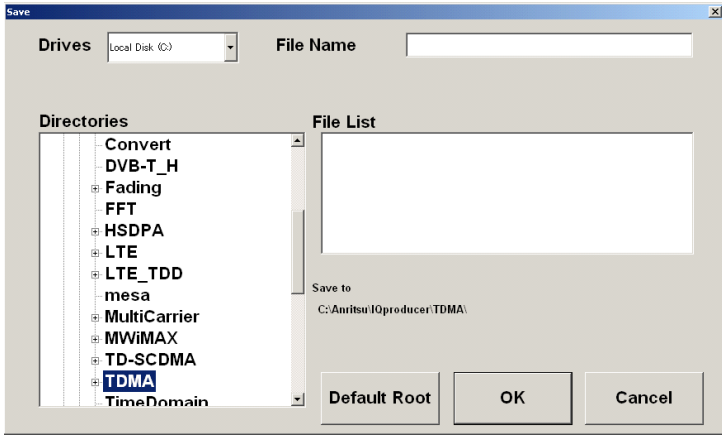


Figure 3.1.6-2 Parameter file saving screen (MG3710A or MG3740A)

2. Select the folder to store the file in the **Directories** field, and then enter the name of the file using the **File Name** box. Click **OK** to save the parameter file. To initialize the setting in the **Directories** field, click the **Default Root** button.

■ Reading parameter file

When running on PC, MS2690A/MS2691A/MS2692A, MS2830A or MS2840A.

1. Select **Recall Parameter File** from the **File** menu or click the tool button to display the parameter file reading screen.

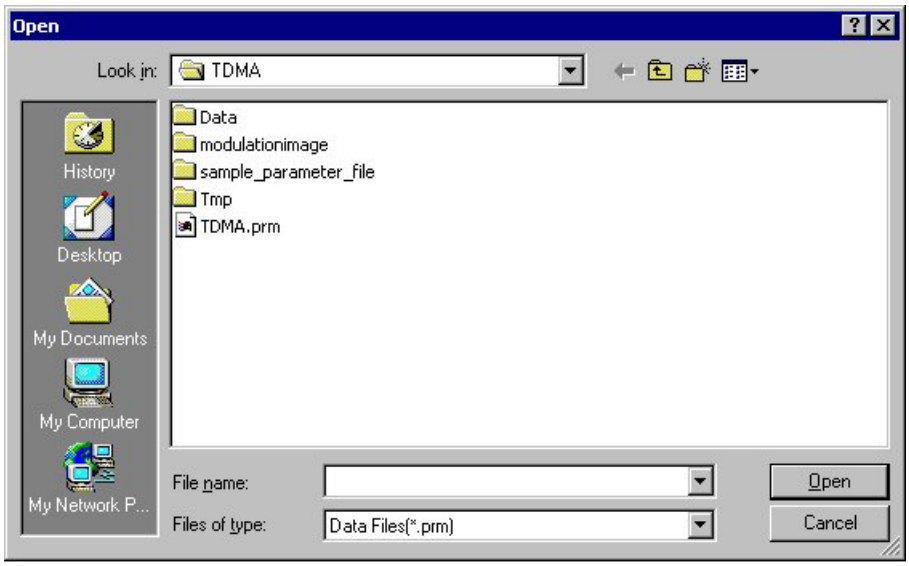


Figure 3.1.6-3 Parameter file reading screen

2. Select a parameter file to be read from the file list, and then click the **Open** button to read the selected parameter file.
3. The parameter files for creating the waveform patterns of PDC, PHS, and User Defined, in which APSK and multi-valued QAM are defined, are stored in the following directories:

   X:\IQproducer\TDMA\sample_parameter_file\PDC
   X:\IQproducer\TDMA\sample_parameter_file\PHS
   X:\IQproducer\TDMA\sample_parameter_file\UserDefined
   ("X:\IQproducer" indicates the folder where the IQproducer™ is installed.)

   Read a parameter file and generate a waveform to create a waveform pattern similar to the standard waveform pattern.

When running on MG3710A or MG3740A.

1. Select **Recall Parameter File** from the **File** menu or click the tool button to display the parameter file reading screen.

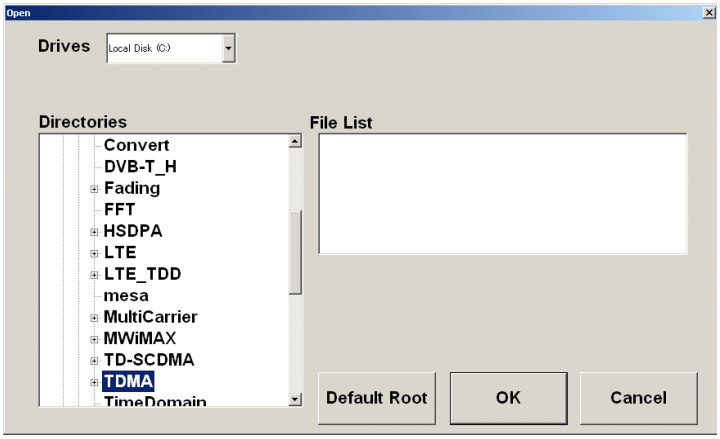


Figure 3.1.6-4 Parameter file reading screen (MG3710A or MG3740A)

2. Select the directory where the files to be loaded is stored in the **Directories** field. Click the desired file from the **File List**, and click **OK**. To initialize the setting in the **Directories** field, click the **Default Root** button.

3.1.7 Displaying graph

The generated waveform pattern can be displayed in a CCDF, FFT, or Time Domain graph by using this software. For details of each graph display, refer to each one of the following:

- *MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™)*
  4.3 "CCDF Graph Display", 4.4 "FFT Graph Display", 4.13 "Time Domain Graph Display"
- *MS2690A/MS2691A/MS2692A and MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (IQproducer™)*
  4.3 "CCDF Graph Display", 4.4 "FFT Graph Display", 4.9 "Time Domain Graph Display"

Displaying CCDF graph

1. Generate a TDMA waveform pattern by executing "Calculation."
2. Select **CCDF** from the **Simulation** menu or click the tool button. The CCDF graph screen shown in Figure 3.1.7-1 is displayed with the trace of the generated waveform pattern.

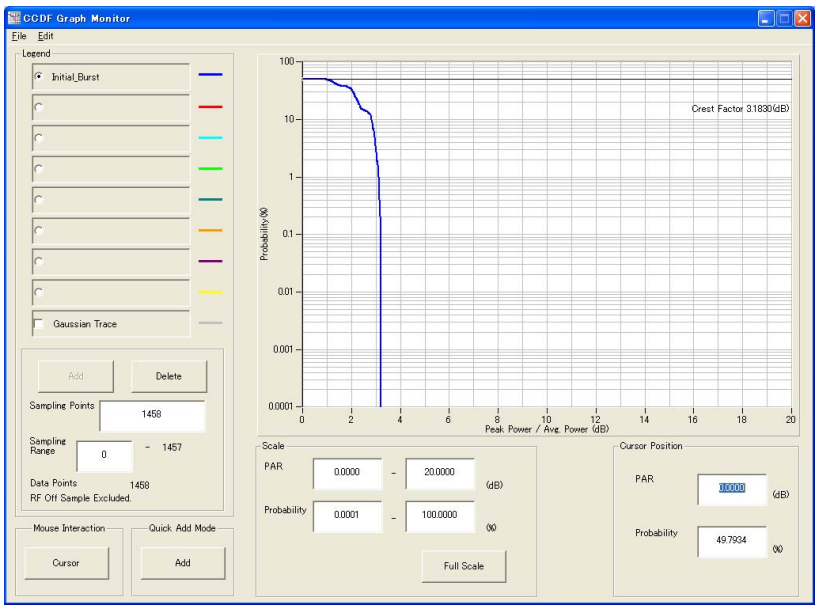


Figure 3.1.7-1 CCDF graph screen

When a waveform pattern is generated by changing parameters and executing "Calculation" while other traces are displayed in the CCDF graph screen, the trace of the waveform pattern newly generated can be displayed in either of the following two methods:

- Displaying the new trace in the same screen with the previous traces
- Deleting the previous traces to display the new trace

Note:

A CCDF graph and an FFT graph cannot be generated at the same time. When displaying a CCDF graph while an FFT graph is displayed, execute the CCDF graph generation after FFT graph generation is completed.

■ When displaying a new trace in the same screen with the previous traces:

1. Set **Add** for **Quick Add Mode** on the lower-left of the CCDF graph screen.
2. Select **CCDF** from the **Simulation** menu or click the tool button. The trace of the waveform pattern newly generated is additionally displayed in the CCDF graph screen.
   Up to eight traces can be displayed by repeating this procedure.

■ When deleting the previous traces to display a new trace:

1. Set **Clear** for **Quick Add Mode** on the lower-left of the CCDF graph screen.
2. Select **CCDF** from the **Simulation** menu or click the tool button. The confirmation message shown in Figure 3.1.7-2 below appears:

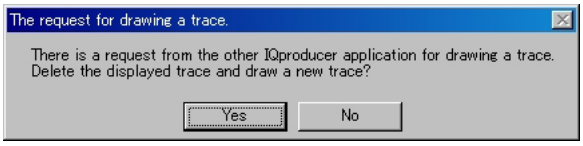


Figure 3.1.7-2 Confirmation message

Click the **Yes** button. The previous traces are deleted from the CCDF graph screen, and the trace of the waveform pattern newly generated is displayed.

Displaying FFT graph

1. Generate a TDMA waveform pattern by executing “Calculation.”
2. Select **FFT** from the **Simulation** menu or click the tool button. The FFT graph screen shown in Figure 3.1.7-3 is displayed with the trace of the generated waveform pattern.

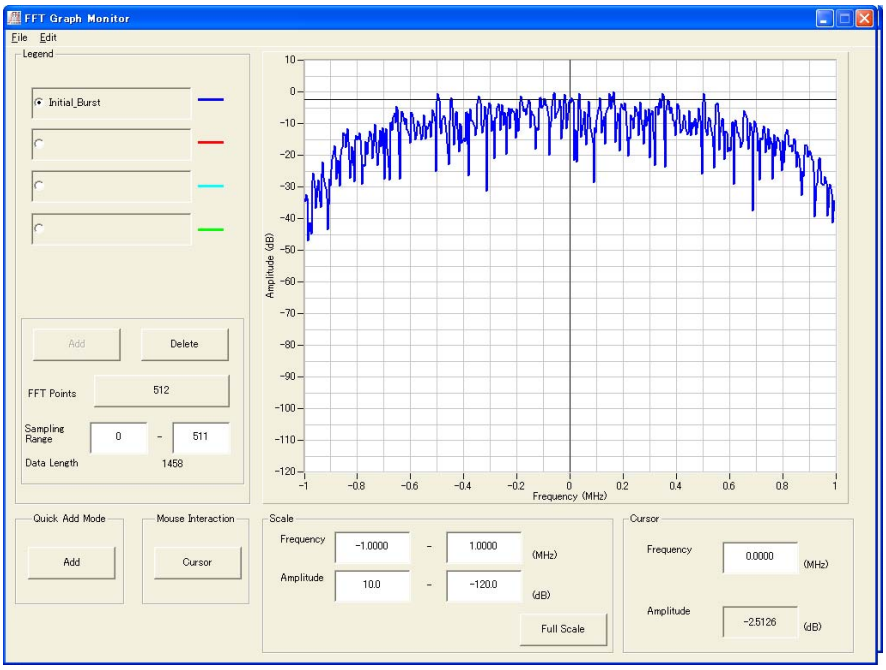


Figure 3.1.7-3 FFT graph screen

When a waveform pattern is generated by changing parameters and executing “Calculation” while other traces are displayed in the FFT graph screen, the trace of the waveform pattern newly generated can be displayed in either of the following two methods:

- Displaying the new trace in the same screen with the previous traces
- Deleting the previous traces to display the new trace

Note:

A CCDF graph and an FFT graph cannot be generated at the same time. When displaying an FFT graph while a CCDF graph is displayed, execute the FFT graph generation after CCDF graph generation is completed.

■ When displaying a new trace in the same screen with the previous traces:

1. Set **Add** for **Quick Add Mode** on the lower-left of the FFT graph screen.
2. Select **FFT** from the **Simulation** menu or click the tool button. The trace of the waveform pattern newly generated is additionally displayed in the FFT graph screen.
   Up to four traces can be displayed by repeating this procedure.

■ When deleting the previous traces to display a new trace:

1. Set **Clear** for **Quick Add Mode** on the lower-left of the FFT graph screen.
2. Select **FFT** from the **Simulation** menu or click the tool button. The confirmation message shown in Figure 3.1.7-4 below appears:

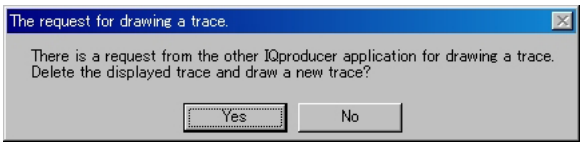


Figure 3.1.7-4 Confirmation message

Click the **Yes** button. The previous traces are deleted from the FFT graph screen, and the trace of the waveform pattern newly generated is displayed.

Displaying the Time Domain graph

1. Generate a waveform pattern by executing “Calculation”.
2. When **Time Domain** is clicked in the **Simulation** menu or is clicked, the Time Domain graph screen shown in Figure 3.1.7-5 is displayed, along with a trace of the generated waveform pattern.

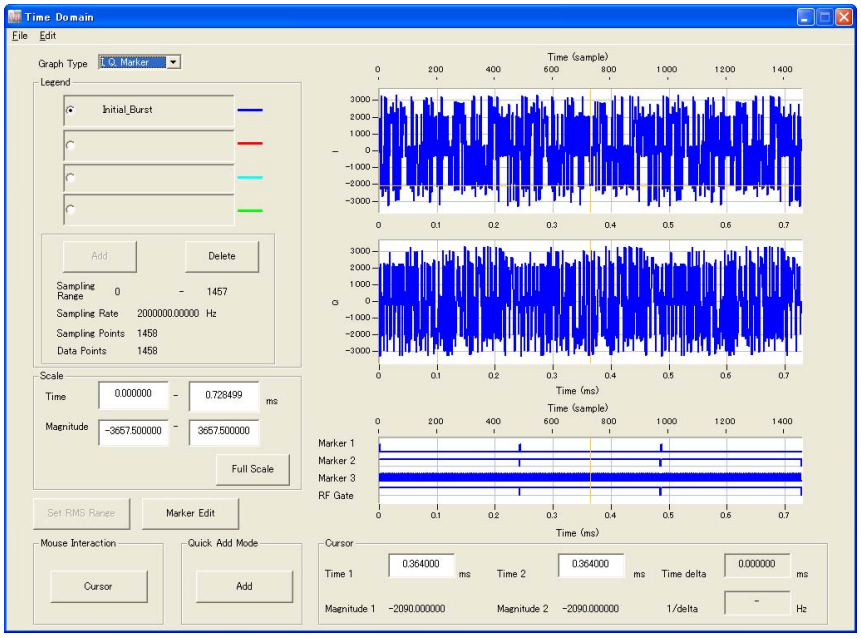


Figure 3.1.7-5 Time Domain graph

When a waveform pattern is generated by changing parameters and executing “Calculation” while other traces are displayed in the Time Domain Graph Monitor screen, the trace of the waveform pattern newly generated can be displayed in either of the following two methods:

- Displaying the new trace in the same screen as the previous traces
- Deleting the previous traces to display the new trace

Note:

CCDF, FFT, and Time Domain graphs cannot be created simultaneously. To display all these graphs, complete creation of each graph and then create a separate graph.

■ Displaying the new trace in the same screen as the previous traces

1. Set **Add** for **Quick Add Mode** on the lower-left of the Time Domain Graph Monitor screen.
2. When **Time Domain** is clicked in the **Simulation** menu or is clicked, a trace of the newly generated waveform pattern is added to the Time Domain graph screen.
   Up to four traces can be displayed by repeating this procedure.

■ When deleting the previous traces to display a new trace:

1. Set **Clear** for **Quick Add Mode** on the lower-left of the Time Domain Graph Monitor screen.
2. When **Time Domain** is clicked in the **Simulation** menu or is clicked, a message such as that shown in Figure 3.1.7-6 is displayed.

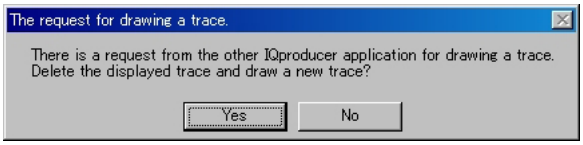


Figure 3.1.7-6 Confirmation screen

Click **Yes**. The previous traces are deleted, and the trace of the waveform pattern newly generated is displayed.

3.1.8 Auxiliary signal output

When a waveform pattern generated by the TDMA IQproducer™ is selected by the Vector Signal Generator, a marker signal synchronized with the RF signal is output from the AUX input/output connector on the rear panel as an auxiliary signal. Frame Trigger (Connector 1), RF Gate (Connector 2) and Symbol Clock (Connector 3) are output.

- Frame Trigger
  A pulse synchronized with the symbol at the beginning of the frame is output from Connector 1. The signal polarity can be changed by changing the polarity of Connector 1.

- RF Gate
  Indicates the RF output burst ON/OFF status of the Vector Signal Generator when a burst wave is used as the waveform pattern. Correspondence between the burst status and output signal status is shown below:
  Burst ON: High level
  Burst OFF: Low level
  (When Polarity for Marker 2 is set to Positive. When Polarity is set to Negative, the above correspondences are reversed.)

- Symbol Clock
  A symbol clock synchronized with the symbol is output from Marker 3. The signal polarity can be changed by changing the polarity of Marker 3.

3.2 Waveform Pattern Generation Procedure

This section provides the waveform pattern generation procedure, taking a PHS downlink waveform pattern as an example.

R	SS	PR	UW	CI	SA	TCH	CRC	R	G
4	2	6	16	4	16	160	16	4	12

R:	Ramp time for transient response	0_H (4 bits)
SS:	Start symbol	2_H (2 bits)
PR:	Preamble	19_H (6 bits)
UW:	Sync word	Uplink line $E149_H$ (16 bits)
		Downlink line $3D4C_H$ (16 bits)
CI:	Channel identification	0_H (4 bits)
SA:	SACCH	8000_H (16 bits)
TCH:	Information channel	PN9 pseudo random pattern
CRC:	Cyclic redundancy check code	CRC bit of CI, SA, TCH
G:	Guard time for transient response	000_H (12 bits)

Figure 3.2-1 PHS Slot Format

<Procedure>

1. Click the tab of Burst parameter setting sheet.
2. Click the **Modulation** button to display the Modulation setting screen.
3. Set “Modulation Type” to PI/4DQPSK and “Symbol Rate” to 192 ksps. Then click the **OK** button to close the Modulation setting screen.
4. Click the **Frame** button to display the Frame setting screen.
5. Set “The Number of Frames” to 511 and “The Number of Slots per Frame” to 8. For the transmission status, set only the 1st Slot to ON. Then click the **OK** button to close the Frame setting screen.
6. Click the **Slot** button to display the Slot setting screen.
7. Set the parameters so that the slot format becomes as shown in Table 3.2-1. Then click the **OK** button to close the Slot setting screen.

Table 3.2-1 Slot setting values

Field	No. of Bits	Field Type
1st	0	Guard
2nd	4	Ramp
3rd	2	Fixed
4th	6	Fixed
5th	16	Fixed
6th	4	Fixed
7th	16	Fixed
8th	160	Data
9th	16	CRC
23rd	4	Ramp
24th	12	Guard
Other than the above	0	Fixed

8. Click the **Field** button to display the Field setting screen.
9. Set each field as shown in Table 3.2-2. Then click the **OK** button to close the Field setting screen.

Table 3.2-2 Field setting values

Field	Field Type	Setting Value
Data Field	–	PN9
CRC Field	–	Clear Ones Complement check box and select ALL1 radio button for register initial value.
1st	Ramp	–
2nd	Fixed	2
3rd	Fixed	19
4th	Fixed	3D4C
5th	Fixed	0
6th	Fixed	8000
7th	Data	–
8th	CRC	180
9th	Ramp	–
10th	Guard	–
Other than the above	Fixed	–

10. Click the **Filter** button to display the Filter setting screen.
11. Set Root Nyquist for Filter Type, 0.5 for Roll Off and 1634 for RMS, and then click the **OK** button to close the Filter setting screen.
12. Click the **Pattern Name** button to display the Pattern Name setting screen.
13. Enter an output file name into the Pattern Name text box. Then click the **OK** button to close the Pattern Name setting screen.
14. Click the **Calculation** button to generate the waveform pattern.

Chapter 4 How to Use Waveform Patterns

The following operations are required to output a modulated signal from this equipment using the waveform pattern generated by this software:

- Transferring waveform pattern to internal HDD/SSD
- Loading waveform patterns from the HDD/SSD to the waveform memory
- Selecting a waveform pattern to be output from this equipment

This chapter explains the details of these operations.

4.1 For MG3700A, MG3710A or MG3740A 4-2
4.1.1 Transferring waveform pattern to internal hard disk 4-2
4.1.2 Loading to Waveform Memory 4-4
4.1.3 Selecting Waveform Pattern 4-5
4.2 For MS2690A/MS2691A/MS2692A, MS2830A or MS2840A 4-6
4.2.1 Transferring waveform pattern to internal HDD/SSD 4-6
4.2.2 Loading to Waveform Memory 4-6
4.2.3 Selecting Waveform Pattern 4-7

4.1 For MG3700A, MG3710A or MG3740A

This section describes how to download a waveform pattern created for the MG3700A/MG3710A/MG3740A to the hard disk of the MG3700A/MG3710A/MG3740A and output the pattern.

4.1.1 Transferring waveform pattern to internal hard disk

The waveform pattern created with this software can be transferred to the internal hard disk in the following ways:

Note:

This operation is not necessary if you are using MG3710A or MG3740A and have generated waveform patterns on MG3710A, MG3740A.

For MG3700A

- LAN
- CompactFlash Card

For MG3710A or MG3740A

- LAN
- External device such as USB Memory

■ Transferring from PC via LAN (MG3700A, MG3710A, MG3740A)

Two IQproducer™ tools can be used to transfer a waveform pattern to the MG3700A/MG3710A/MG3740A via a LAN.

- Transfer & Setting Wizard
  Start this wizard by clicking the **Transfer & Setting Wizard** button of this software or by selecting **Simulation & Utility** tab → **Transfer & Setting Wizard** from the IQproducer™ after creating a waveform pattern. For details, refer to Section 4.7 “File Transfer and Loading to Memory Using Transfer & Setting Wizard” in the *MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™).*
  Transferring a waveform pattern to the internal hard disk of the MG3700A/MG3710A/MG3740A, loading the waveform from the hard disk to the waveform memory, and then outputting the waveform pattern can be done using this wizard.

- Transfer & Setting Panel
  This function is loaded by selecting **Transfer & Setting Panel** in the **Simulation & Utility** tab of the IQproducer™. For details, refer to Section 5.2 "Transferring Waveform Pattern" in the *MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™)*.
  Specify the folder that contains the waveform pattern to transfer to the MG3700A/MG3710A/MG3740A in the PC-side tree of **Transfer & Setting Panel**.

■ Transferring using a CF card (MG3700A)

Copy the waveform pattern (***.wvi and ***.wvd files) to be downloaded to the MG3700A to the root directory of a CF card.

Insert the CF card into the card slot on the front panel of the MG3700A, and then copy the file to the hard disk. For details about how to use a CF card to transfer a waveform pattern, refer to (1) Loading waveform file in memory in Section 3.5.2 of the *MG3700A Vector Signal Generator Operation Manual (Mainframe)*.

■ Transferring via external device such as USB memory (MG3710A, MG3740A)

For details about how to transfer a waveform pattern created using this software to the hard disk of the MG3710A/MG3740A, refer to Section 7.3.6 "Copying external waveform pattern: Copy" in the *MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (Mainframe)*.

4.1.2 Loading to Waveform Memory

To output a modulated signal using a waveform pattern, it is necessary to load the waveform pattern that was transferred to the internal hard disk of the MG3700A/MG3710A/MG3740A (described in Section 4.1.1 "Transferring waveform pattern to internal hard disk") to the waveform memory. A waveform pattern can be loaded into the waveform memory in the following two ways.

■ Configuring using the mainframe

A waveform pattern can be loaded into the waveform memory by using the instruction panel of the MG3700A/MG3710A/MG3740A or by using a remote command.

For operation using the front panel, refer below:

- Section 3.5.2 (1) "Loading waveform file in memory" in the *MG3700A Vector Signal Generator Operation Manual (Mainframe)*
- Section 7.3.4 "Loading waveform pattern: Load" in the *MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (Mainframe)*

For operation using remote commands, refer below:

- Chapter 4 "Remote Control" in the *MG3700A Vector Signal Generator Operation Manual (Mainframe)*
- Section 7.3.4 "Loading waveform pattern: Load" in the *MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (Mainframe)*

■ Using Transfer & Setting Panel of IQproducer™

A waveform pattern can be loaded from the LAN-connected PC to the memory by using **Transfer & Setting Panel**, which can be opened from the **Simulation & Utility** tab. For details, refer to Section 4.6 "File Transfer and Loading to Memory Using Transfer & Setting Panel" in the *MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™)*.

4.1.3 Selecting Waveform Pattern

Select a waveform pattern to use for modulation from the waveform patterns loaded into the waveform memory of the MG3700A/MG3710A according to Section 4.1.2 “Loading to waveform memory”. A waveform pattern can be selected in the following two ways.

■ Configuring using the MG3700A/MG3710A/MG3740A

Waveform patterns to be used for modulation can be selected by operating the equipment panel or by using a remote command.

For operation using the front panel, refer below:

- Section 3.5.2 (4) “Outputting pattern loaded in Memory A for modulation in Edit mode” in the *MG3700A Vector Signal Generator Operation Manual (Mainframe)*
- Section 7.3.5 “Selecting output waveform pattern: Select” in the *MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (Mainframe)*

For operation using remote commands, refer below:

- Chapter 4 “Remote Control” in the *MG3700A Vector Signal Generator Operation Manual (Mainframe)*
- Section 7.3.5 “Selecting output waveform pattern: Select” in the *MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (Mainframe)*

■ Using Transfer & Setting Panel of IQproducer™

A waveform pattern can be loaded from the LAN-connected PC to the memory, and also selected for modulation. This is done by using **Transfer & Setting Panel**, which can be opened from the **Simulation & Utility** tab. For details, refer to Section 4.6 “File Transfer and Loading to Memory Using Transfer & Setting Panel” in the *MG3700A/MG3710A/MG3710E Vector Signal Generator MG3740A Analog Signal Generator Operation Manual (IQproducer™)*.

4.2 For MS2690A/MS2691A/MS2692A, MS2830A or MS2840A

This section describes how to download a waveform pattern created for the MS2690A/MS2691A/MS2692A, MS2830A or MS2840A to the HDD/SSD of the MS2690A/MS2691A/MS2692A, MS2830A or MS2840A and output the pattern.

4.2.1 Transferring waveform pattern to internal HDD/SSD

For details about how to transfer a waveform pattern created using this software to the hard disk of the MS2690A/MS2691A/MS2692A, MS2830A or MS2840A, refer below:

- Section 2.4.4 "Copying waveform file(s) to hard disk" in the *MS2690A/MS2691A/MS2692A Signal Analyzer Option 020: Vector Signal Generator Operation Manual (Operation)*
- Section 2.4.4 "Copying waveform file(s) to HDD/SSD" in the *MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (Operation)*

Note:

Transferring waveform patterns is not required if the patterns are created using this software.

4.2.2 Loading to Waveform Memory

In order to output a modulated signal using the waveform pattern, it is necessary to load the waveform patterns stored in the internal HDD/SSD to the waveform memory.

■ Loading to Waveform Memory

Waveform patterns can be loaded to waveform memories by operating the panel or by using a remote command.

For operation using the front panel, refer below:

- Section 2.4.1 "Loading waveform file in memory" in the *MS2690A/MS2691A/MS2692A Signal Analyzer Option 020: Vector Signal Generator Operation Manual (Operation)*
- Section 2.4.1 "Loading waveform pattern(s) to memory" in the *MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (Operation)*

For operation using remote commands, refer below:

- *MS2690A/MS2691A/MS2692A Signal Analyzer Option 020: Vector Signal Generator Operation Manual (Remote Control)*
- *MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (Remote Control)*

4.2.3 Selecting Waveform Pattern

Select waveform patterns to be used for modulation from those loaded in the waveform memory as described in Section 4.2.1 "Transferring waveform pattern to internal HDD/SSD" above.

■ Selecting waveform pattern

Waveform patterns to be used for modulation can be selected by operating the equipment panel or by using a remote command.

For operation using the front panel, refer below:

- Section 2.4.2 "Loading waveform file in memory" in the *MS2690A/MS2691A/MS2692A Signal Analyzer Option 020: Vector Signal Generator Operation Manual (Operation)*
- Section 2.4.2 "Loading waveform pattern(s) to memory" in the *MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (Operation)*

For operation using remote commands, refer below:

- *MS2690A/MS2691A/MS2692A Signal Analyzer Option 020: Vector Signal Generator Operation Manual (Remote Control)*
- *MS2830A/MS2840A Signal Analyzer Vector Signal Generator Operation Manual (Remote Control)*

Appendix A Error Messages

A list of error messages is shown below. In an error message, n_1 and n_2 indicate a numeric value, and s indicates a character string.

Table A-1 Error messages

Error Message	Description
Can not open file	The file cannot be opened.
Can not open file ("*s*")	The file *s* cannot be opened.
Can not read file	Reading from the file is disabled.
Can not write file	Writing to the file is disabled.
Directory not found ("*s*")	The folder *s* cannot be found.
Disk full ("*s*")	The disk capacity becomes full while creating the file *s*.
Inadequacy: All Off	The statuses of all slots are OFF.
Inadequacy: Blank	The setting is left blank.
Inadequacy: CRC	The CRC setting is invalid.
Inadequacy: Invalid Value	The set numeric value is invalid.
Inadequacy: No Pattern Name	A pattern name is not entered.
Invalid file format	The file format is invalid.
Invalid file format ("*s*")	The format of the file *s* is invalid.
Out of range: *s* (n_1 – n_2)	The value of the parameter *s* is out of the setting range from n_1 to n_2.
Out of range: The number of samples is over 256/512Msamples.	The number of samples of the waveform pattern to be generated exceeds 256/512 Msamples. ***Note:*** This message is available only when **MG3700** is selected in the Select instrument screen at startup.
Out of range: The number of samples is over 64/128/256/512Msamples.	The number of samples of the waveform pattern to be generated exceeds 64/128/256/512 Msamples. ***Note:*** This message is available only when **MG3710, MG3740** is selected in the Select instrument screen at startup.
Out of range: The number of samples is over 256Msamples.	The number of samples of the waveform pattern to be generated exceeds 256 Msamples. ***Note:*** This message is available only when **MS269x, MS2830, MS2840** is selected in the Select instrument screen at startup.

Table A-1 Error messages (Cont'd)

Error Message	Description
Out of Range:Sampling Rate (kHz) (20-8000)	The sampling rate is out of the range of 20 to 8000 kHz.
Out of Range:Sampling Rate (MHz) (0.02-8)	The sampling rate is out of the range of 0.02 to 8 MHz.
The Waveform data file is not generated.	The waveform pattern data file is not generated.
There is no Fixed/Data/CRC field.	There are no Fixed/Data/CRC fields in the slot.
Total bit isn't a multiple of n_1.	The total number of bits in the slot is not a multiple of n_1.
Total bit of the first half of the slot isn't a multiple of n_1.	The total number of bits in the first half of the slot is not a multiple of n_1.
Total bit of the second half of the slot isn't a multiple of n_1.	The total number of bits in the second half of the slot is not a multiple of n_1.
Inadequacy:Maximum frequency deviation isn't a multiple of 3.	Maximum frequency deviation is not a multiple of 3.
Out of range : The number of FIR taps(1 – 1023)	The number of filter coefficient taps is out of the setting range from 1 to 1023.
Inadequacy : The number of FIR taps is not odd numbers	The number of filter coefficient taps is not an odd number.

A list of warning messages is shown below.

Table A-2 Warning messages

Warning Message	Description
All slots shall be the same content of fields.	The field settings will apply to all transmission slots.
Change the number of frames to 1?	Do you want to change the number of frames to 1?
Clipping was done.	Clipping has been executed.
Decrease the number of frames to keep only phase continuous?	Do you want to decrease the number of frames to keep only phases continuous?
Keep phase continuous?	Do you want to keep phases continuous?
There is a possibility that phase is not continuous.	Phase may not be continuous.

Appendix B Symbol Points for Each Modulation Type

B.1 BPSK

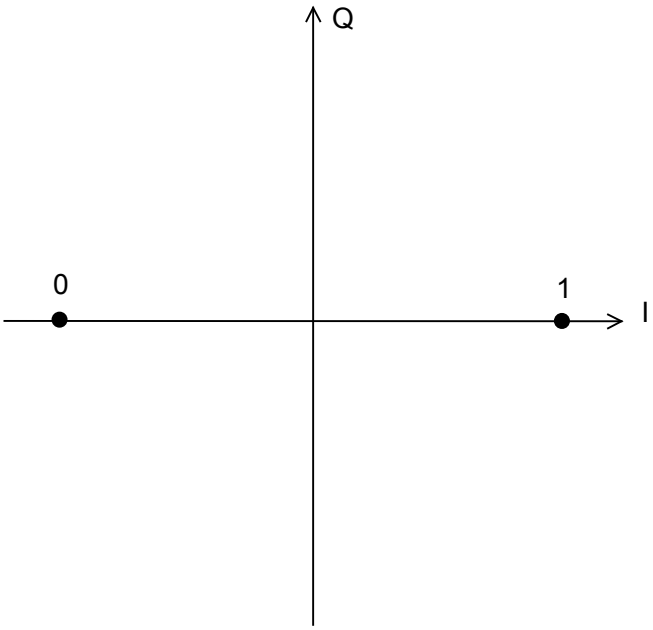


Table B.1-1 BPSK

Allocation	Symbol Data
0	0
1	1

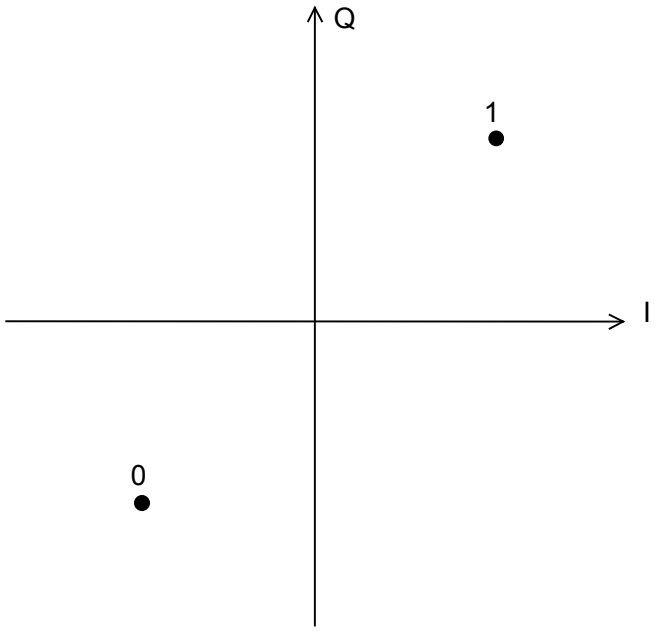


Table B.1-2 BPSK (Rotated 45° counterclockwise)

Allocation	Symbol Data
0	0
1	1

B.2 DBPSK

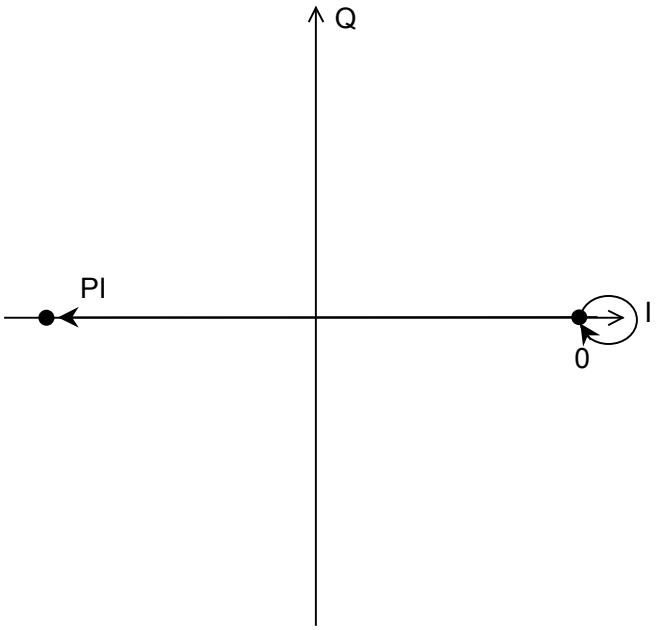


Table B.2-1 DBPSK

Differential	Symbol Data
PI	0
0	1

B.3 PI/2DBPSK

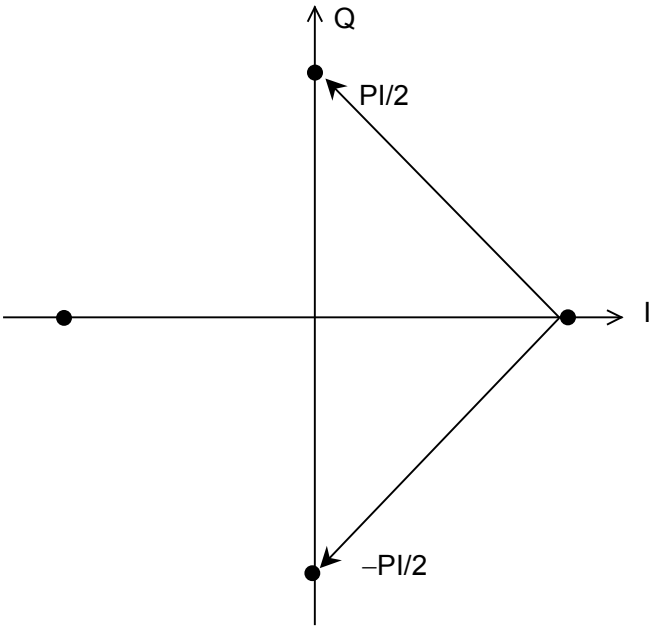


Table B.3-1 PI/2DBPSK

Differential	Symbol Data
PI/2	0
–PI/2	1

B.4 QPSK

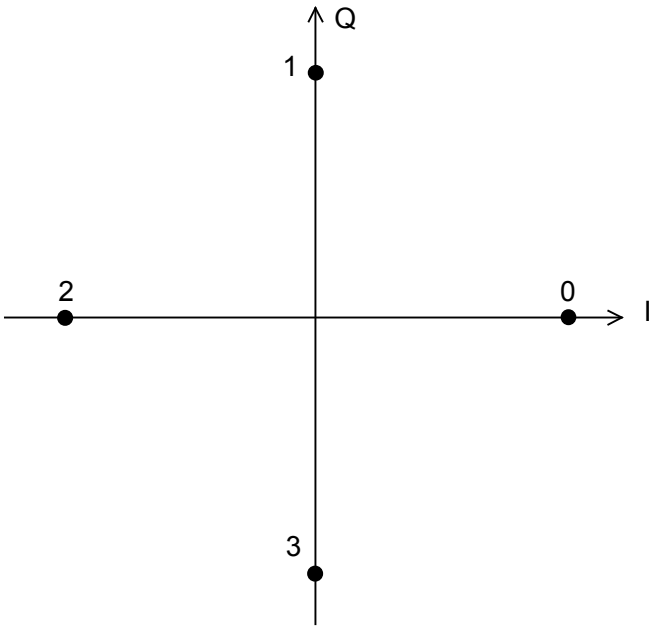


Table B.4-1 QPSK

Allocation	Symbol Data
0	11
1	01
2	00
3	10

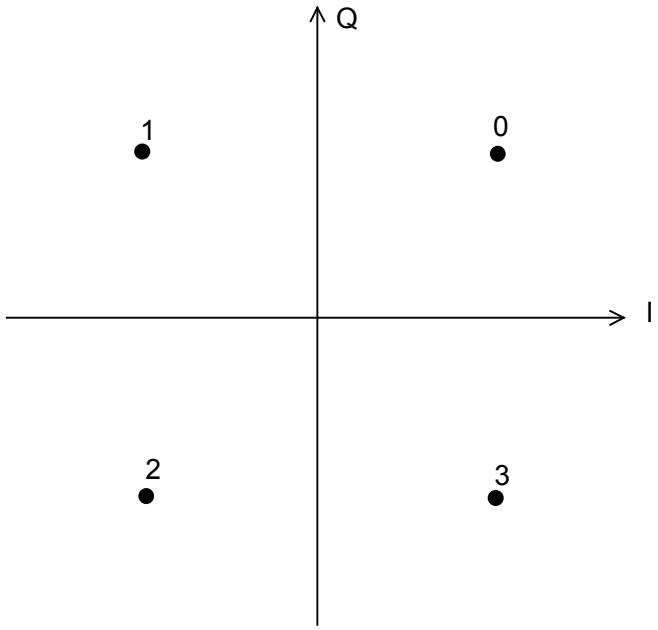


Table B.4-2 QPSK (Rotated 45° counterclockwise)

Allocation	Symbol Data
0	11
1	01
2	00
3	10

B.5 O-QPSK

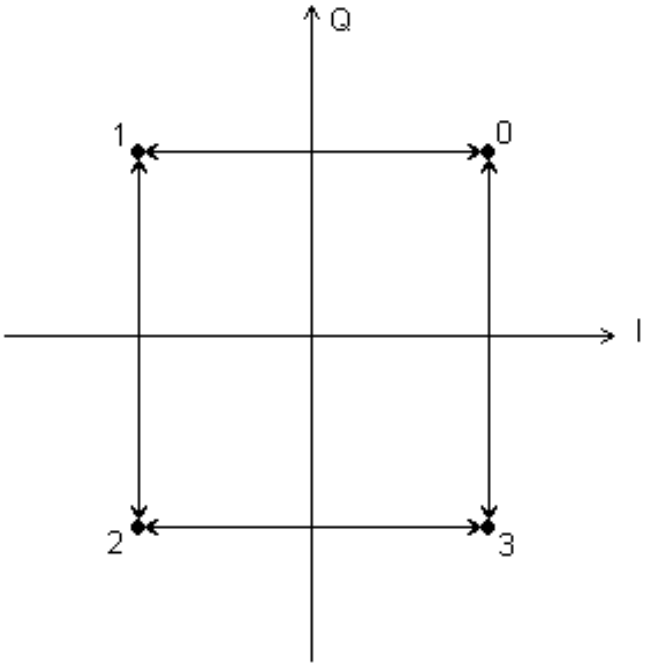


Table B.5-1 QPSK

Allocation	Symbol Data
0	11
1	01
2	00
3	10

B.6 DQPSK

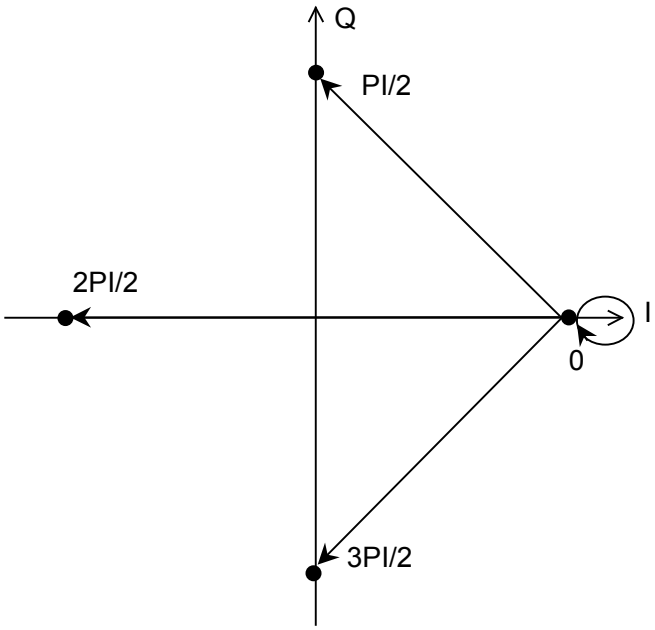


Table B.6-1 DQPSK

Differential	Symbol Data
PI/2	00
2PI/2	01
3PI/2	10
0	11

B.7 PI/4DQPSK

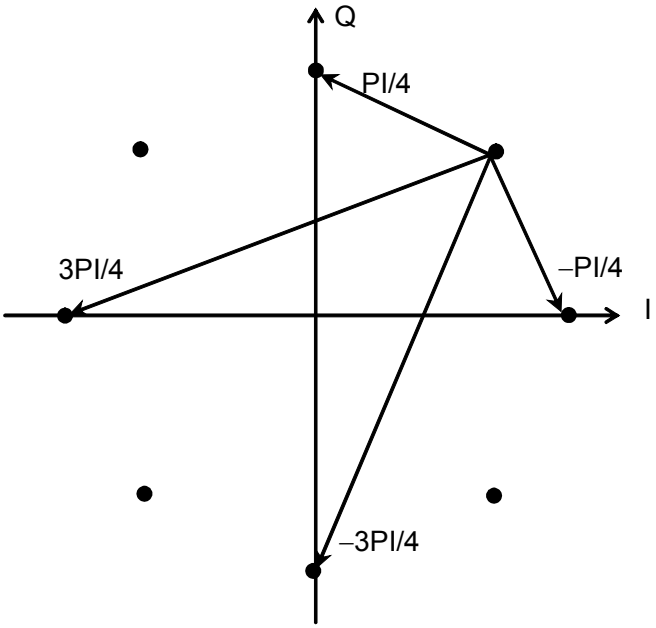


Table B.7-1 PI/4DQPSK

Differential	Symbol Data
PI/4	00
3PI/4	01
–3PI/4	10
–PI/4	11

B.8 8PSK

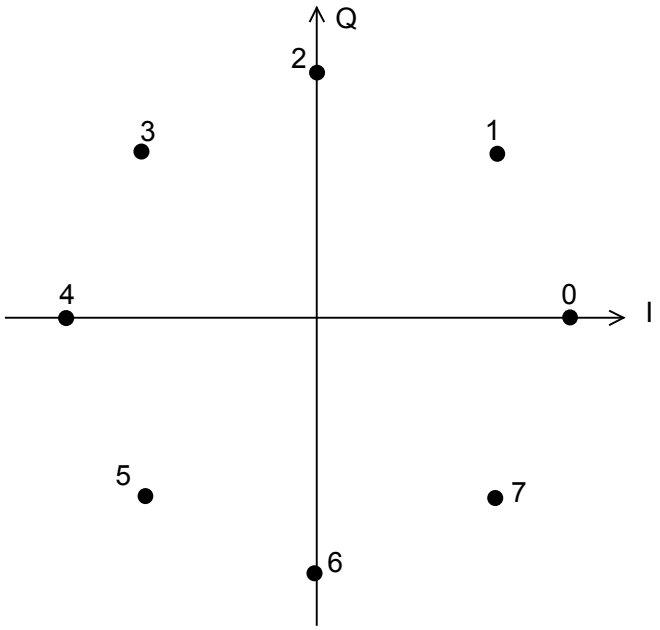


Table B.8-1 8PSK

Allocation	Symbol Data	Allocation	Symbol Data
0	111	4	001
1	110	5	000
2	010	6	100
3	011	7	101

Table B.8-2 8PSK (GSM)

Allocation	Symbol Data	Allocation	Symbol Data
0	111	4	001
1	011	5	101
2	010	6	100
3	000	7	110

B.9 D8PSK

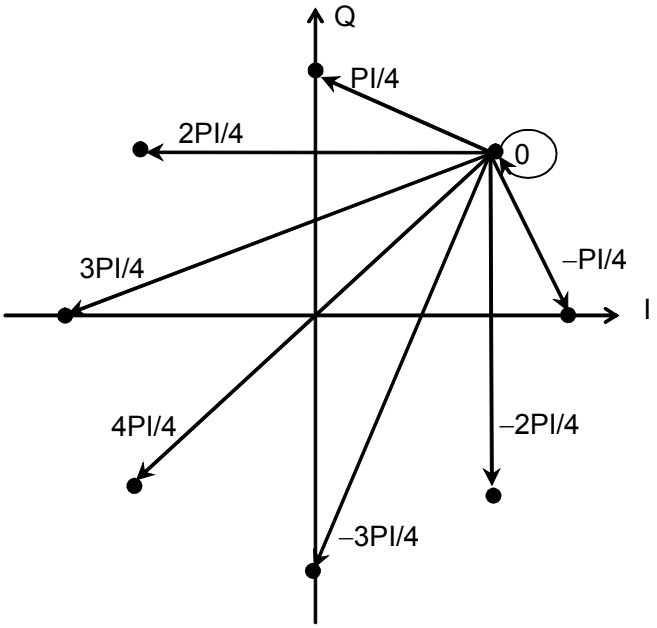


Table B.9-1 D8PSK

Differential	Symbol Data	Differential	Symbol Data
PI/4	110	–3PI/4	000
2PI/4	010	–2PI/4	100
3PI/4	011	–PI/4	101
4PI/4	001	0	111

B.10 16QAM

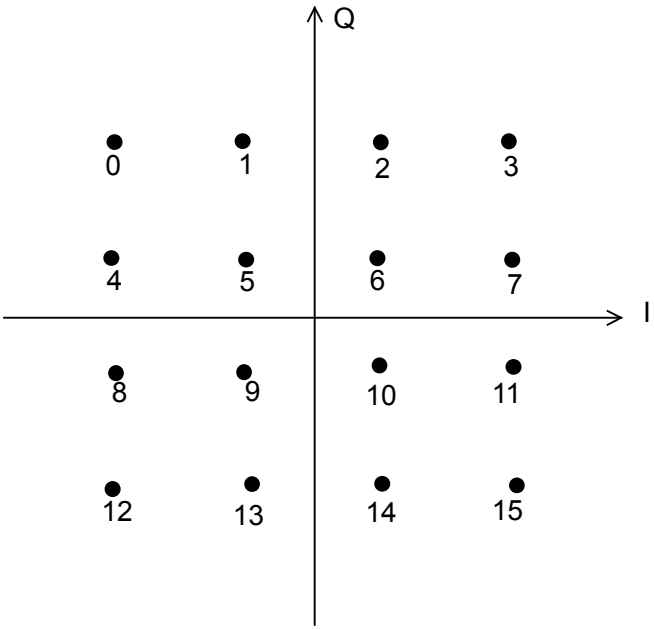


Table B.10-1 16QAM

Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data
0	0111	4	0110	8	0010	12	0011
1	0101	5	0100	9	0000	13	0001
2	1101	6	1100	10	1000	14	1001
3	1111	7	1110	11	1010	15	1011

B.11 32QAM

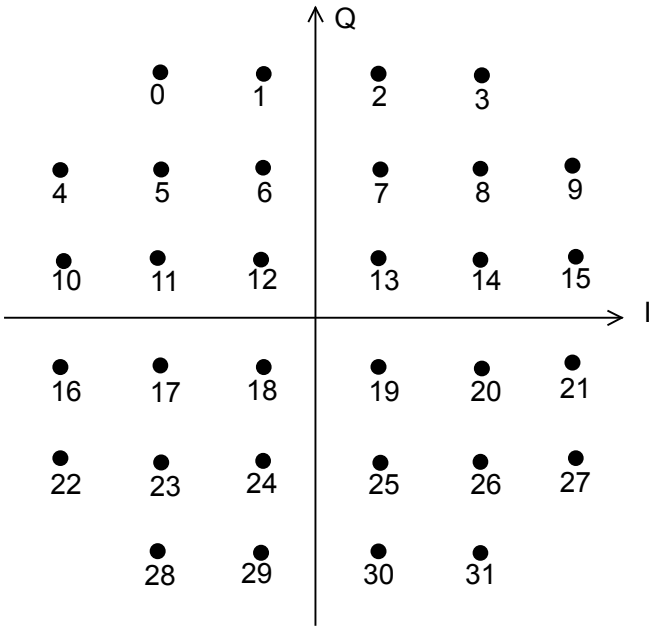


Table B.11-1 32QAM

Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data
0	11101	8	00100	16	00110	24	01001
1	01010	9	10111	17	10011	25	11001
2	11010	10	01110	18	00000	26	01100
3	01101	11	11011	19	10000	27	11111
4	00111	12	01000	20	00011	28	10101
5	10100	13	11000	21	10110	29	00010
6	00001	14	01011	22	01111	30	10010
7	10001	15	11110	23	11100	31	00101

B.12 64QAM

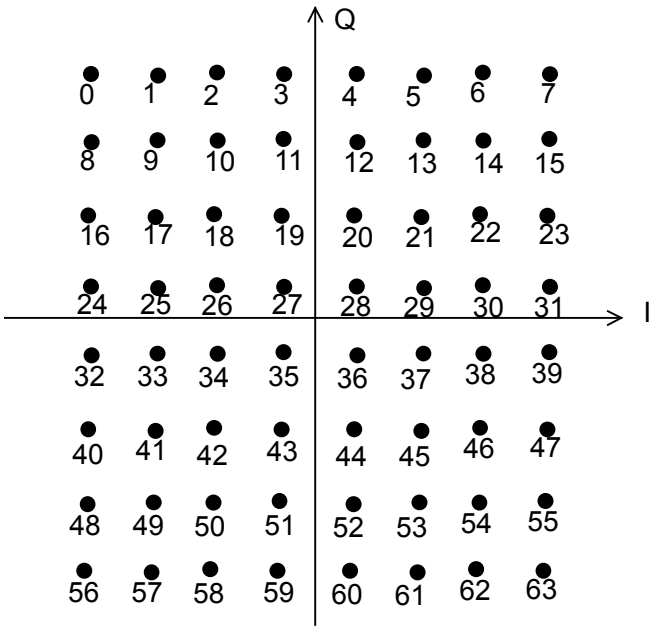


Table B.12-1 64QAM

Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data
0	100010	16	100111	32	110111	48	110010
1	100000	17	100101	33	110101	49	110000
2	101000	18	101101	34	111101	50	111000
3	101010	19	101111	35	111111	51	111010
4	001000	20	001101	36	011101	52	011000
5	001010	21	001111	37	011111	53	011010
6	000010	22	000111	38	010111	54	010010
7	000000	23	000101	39	010101	55	010000
8	100011	24	100110	40	110110	56	110011
9	100001	25	100100	41	110100	57	110001
10	101001	26	101100	42	111100	58	111001
11	101011	27	101110	43	111110	59	111011
12	001001	28	001100	44	011100	60	011001
13	001011	29	001110	45	011110	61	011011
14	000011	30	000110	46	010110	62	010011
15	000001	31	000100	47	010100	63	010001

B.13 256QAM

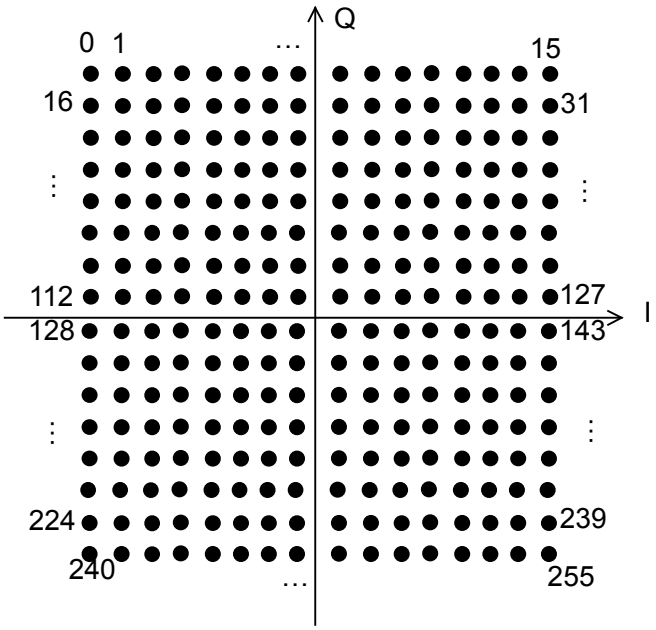


Table B.13-1 256QAM

Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data
0	10001000	30	00000011	60	00001100	90	00111100
1	10001010	31	00000001	61	00001110	91	00111110
2	10000010	32	10001101	62	00000110	92	00011100
3	10000000	33	10001111	63	00000100	93	00011110
4	10100010	34	10000111	64	10011101	94	00010110
5	10100000	35	10000101	65	10011111	95	00010100
6	10101000	36	10100111	66	10010111	96	10011000
7	10101010	37	10100101	67	10010101	97	10011010
8	00100010	38	10101101	68	10110111	98	10010010
9	00100000	39	10101111	69	10110101	99	10010000
10	00101000	40	00100111	70	10111101	100	10110010
11	00101010	41	00100101	71	10111111	101	10110000
12	00001000	42	00101101	72	00110111	102	10111000
13	00001010	43	00101111	73	00110101	103	10111010
14	00000010	44	00001101	74	00111101	104	00110010
15	00000000	45	00001111	75	00111111	105	00110000
16	10001001	46	00000111	76	00011101	106	00111000
17	10001011	47	00000101	77	00011111	107	00111010
18	10000011	48	10001100	78	00010111	108	00011000
19	10000001	49	10001110	79	00010101	109	00011010
20	10100011	50	10000110	80	10011100	110	00010010
21	10100001	51	10000100	81	10011110	111	00010000
22	10101001	52	10100110	82	10010110	112	10011001
23	10101011	53	10100100	83	10010100	113	10011011
24	00100011	54	10101100	84	10110110	114	10010011
25	00100001	55	10101110	85	10110100	115	10010001
26	00101001	56	00100110	86	10111100	116	10110011
27	00101011	57	00100100	87	10111110	117	10110001
28	00001001	58	00101100	88	00110110	118	10111001
29	00001011	59	00101110	89	00110100	119	10111011

Table B.13-1 256QAM (Cont'd)

Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data	Allocation	Symbol Data
120	00110011	154	01111100	188	01011001	222	01000011
121	00110001	155	01111110	189	01011011	223	01000001
122	00111001	156	01011100	190	01010011	224	11001101
123	00111011	157	01011110	191	01010001	225	11001111
124	00011001	158	01010110	192	11001000	226	11000111
125	00011011	159	01010100	193	11001010	227	11000101
126	00010011	160	11011000	194	11000010	228	11100111
127	00010001	161	11011010	195	11000000	229	11100101
128	11011101	162	11010010	196	11100010	230	11101101
129	11011111	163	11010000	197	11100000	231	11101111
130	11010111	164	11110010	198	11101000	232	01100111
131	11010101	165	11110000	199	11101010	233	01100101
132	11110111	166	11111000	200	01100010	234	01101101
133	11110101	167	11111010	201	01100000	235	01101111
134	11111101	168	01110010	202	01101000	236	01001101
135	11111111	169	01110000	203	01101010	237	01001111
136	01110111	170	01111000	204	01001000	238	01000111
137	01110101	171	01111010	205	01001010	239	01000101
138	01111101	172	01011000	206	01000010	240	11001100
139	01111111	173	01011010	207	01000000	241	11001110
140	01011101	174	01010010	208	11001001	242	11000110
141	01011111	175	01010000	209	11001011	243	11000100
142	01010111	176	11011001	210	11000011	244	11100110
143	01010101	177	11011011	211	11000001	245	11100100
144	11011100	178	11010011	212	11100011	246	11101100
145	11011110	179	11010001	213	11100001	247	11101110
146	11010110	180	11110011	214	11101001	248	01100110
147	11010100	181	11110001	215	11101011	249	01100100
148	11110110	182	11111001	216	01100011	250	01101100
149	11110100	183	11111011	217	01100001	251	01101110
150	11111100	184	01110011	218	01101001	252	01001100
151	11111110	185	01110001	219	01101011	253	01001110
152	01110110	186	01111001	220	01001001	254	01000110
153	01110100	187	01111011	221	01001011	255	01000100

B.14 2ASK

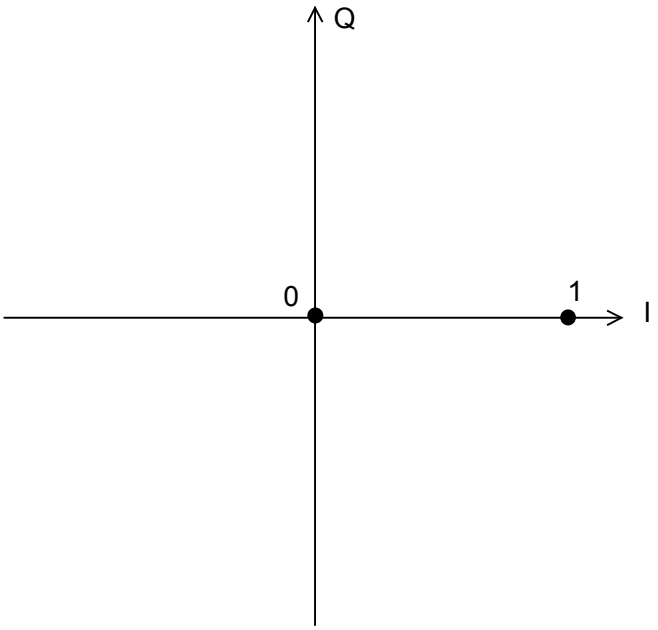


Table B.14-1 2ASK

Allocation	Symbol Data
0	0
1	1

B.15 4ASK

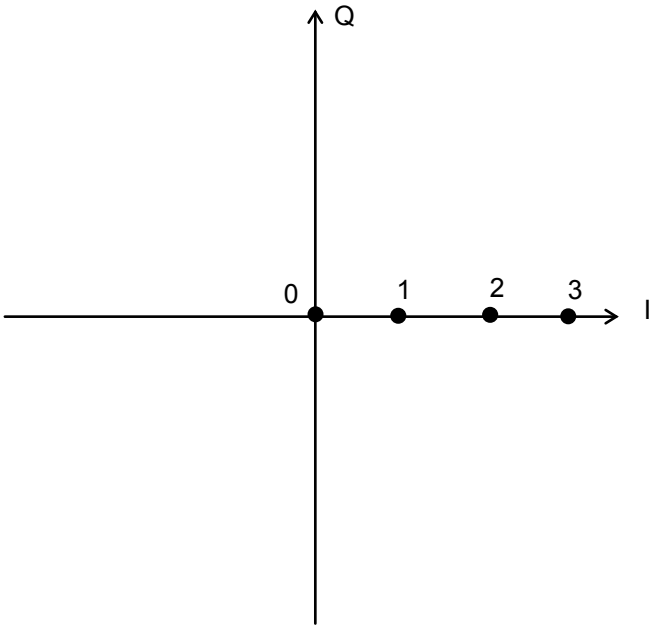


Table B.15-1 4ASK

Allocation	Symbol Data
0	00
1	01
2	11
3	10

B.16 2FSK

Table B.16-1 FSK

Direction	Symbol Data
+	1
–	0

B.17 4FSK

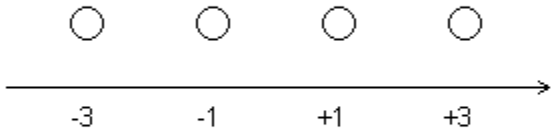


Table B.17-1 4FSK (Maximum frequency deviation = 945 Hz)

Direction	Symbol Data	Deviation
+3	01	945
+1	00	315
–1	10	–315
–3	11	–945

Deviation is calculated by the following:

$$Deviation = Direction \times \frac{Maximum\ frequency\ deviation}{3}$$

C.1 IQ Mapping User File Format

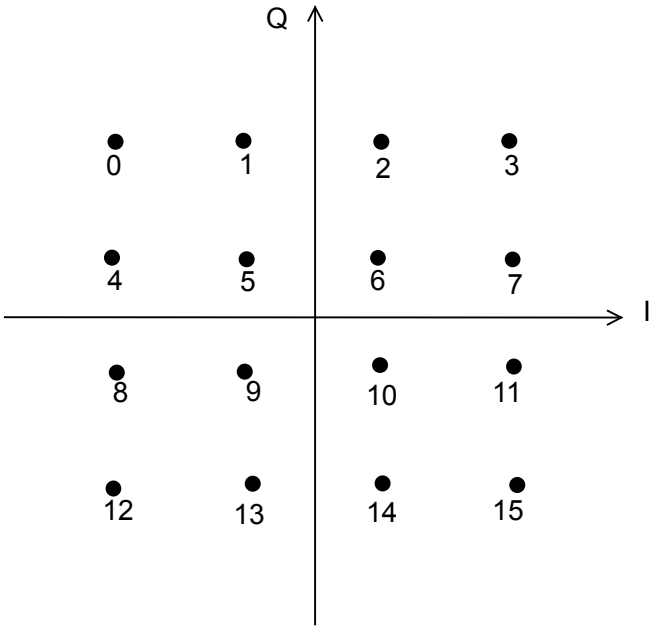
Write binary numbers corresponding to symbol points shown in the figures in Appendix B in the order of numbers assigned for symbol points using text character 0 or 1 in one line per point. For D8PSK, write binary numbers corresponding to phase difference in the order of PI/4, 2PI/4, 3PI/4, 4PI/4, –3PI/4, –2PI/4, –PI/4 and 0 in one line per point.

Any extension can be used as long as the user file is a text file. A loading error occurs with a file in an invalid format. Shortage in binary numbers required for the modulation type or duplication of the same binary numbers also result in an error at loading.

```
1111
1110
1101
1100
1011
1010
1001
1000
0111
0110
0101
0100
0011
0010
0001
0000
```

Figure C.1-1 Example of 16QAM IQ mapping user file

When the user file shown in Fig. C.1-1 is loaded, symbol point allocation is as shown in Fig. C.1-2.



	Symbol Data		Symbol Data		Symbol Data		Symbol Data
0	1111	4	1011	8	0111	12	0011
1	1110	5	1010	9	0110	13	0010
2	1101	6	1001	10	0101	14	0001
3	1100	7	1000	11	0100	15	0000

Figure C.1-2 16QAM IQ mapping and symbol data table when the user file shown in Fig. C.1-1 is loaded

C.2 Continuous Pattern User File Format

Describe binary sequences before modulation. Only 0, 1 and line feed characters can be used and any comma or space causes loading error. Up to 9600000 bits can be loaded.

Example: PN9

```
111111111000001111011111000101110011001000001001010011101101000111100111111001101
100010101001000111000110110101011100010011000100010000000010000100011000010011100
010101011000011011110100110111001000101000010101101001111111011001001001011011111
100100110101001100110000000110001100101000110100101111111010001011000111010110010
011001111000111110111010000011010110110111011000001011010111110101010100000010100
010101111001011101110000001110011101001001111010111010100010010000110011100001010
111011011001101000011101111000
```

The binary sequences are inserted into Data Field one by one starting from the top left. Refer to Fig. 5.1.2.4-3 in Section 5 for the continuity of Data Field for each Slot. When the total number of bits in the Data Field exceeds the number of binary number bits in the user file, the rest are inserted from the top of the user file again, as shown in Fig. C.2-1.
When the checkbox ☐ Auto is selected for the Number of Frames in the Frame setting screen and the continuous pattern is set to “UserFile” in the Data Field area of the Field setting screen, the number of frames is automatically set to 1 or a value that retains the phase continuity only.

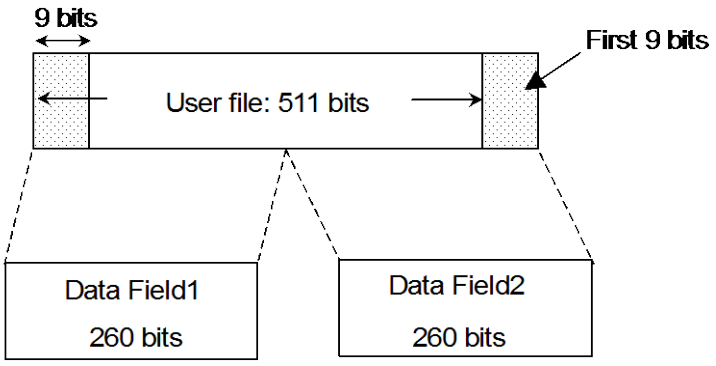


Figure C.2-1 Insertion method to Data Field

C.3 User Defined Modulation User File Format

Describe the user file for user defined modulation as follows:
First row:

Bit length that configures 1 symbol for user defined modulation

Second and subsequent rows:

IQ data used for user defined modulation separated by commas

The total IQ data must be matched with the value in which 2 is raised to the bit length that configures 1 symbol.

The bit strings corresponding to the IQ data for mapping can be inserted optionally. Insert the bit string after the IQ data, separated by a comma. When the bit strings are not inserted, the bit strings are automatically inserted in zero-based ascending order.

```
4
0.707106781,0.707106781,0000
0.707106781,-0.707106781,0001
-0.707106781,0.707106781,0010
-0.707106781,-0.707106781,0011
0.965925826,0.258819045,0100
0.965925826,-0.258819045,0101
-0.965925826,0.258819045,0110
-0.965925826,-0.258819045,0111
0.258819045,0.965925826,1000
0.258819045,-0.965925826,1001
-0.258819045,0.965925826,1010
-0.258819045,-0.965925826,1011
0.224478343,0.224478343,1100
0.224478343,-0.224478343,1101
-0.224478343,0.224478343,1110
-0.224478343,-0.224478343,1111
```

Figure C.3-1 Example of user defined modulation mapping user file (16APSK)

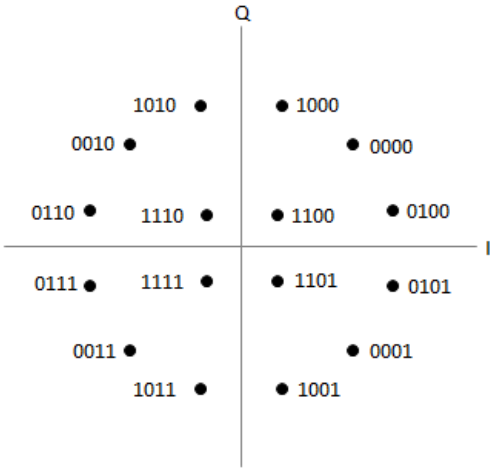


Figure C.3-2 Image of 16APSK IQ mapping when the user file shown in Fig. C.3-1 is loaded

Note:

Any extension can be used when using a text file as the user file. When an invalid format is used in the user file, a read error occurs.

The range of value that can be set to the bit length that configures 1 symbol is 1 to 11, and the range of total IQ data is 2 to 2048. When the values are out of range, a read error occurs.

When the total IQ data is not matched with a value in which 2 is raised to the bit length that configures 1 symbol, a read error occurs.

When there is character other than numerical value, comma, and line feed character in the user file, a read error occurs.

When the user file in which RMS of IQ data is 0 is loaded, an error occurs.

Insert the bit strings to all IQ data. When the bit strings are inserted into part of IQ data, a read error occurs. Also, when the contents of bit strings are overlapped in the user file, a read error occurs.

Index

References are to page numbers.

C

Calculation 3-42
Calculation & Load 3-46
Calculation & Play 3-47
CCDF graph 3-51

D

Data 3-33
Displaying graph 3-51

F

FFT graph 3-53
Field 3-28
Filter 3-35
Frame 3-18

I

Installation 2-3

M

Main screen 3-2
Modulation 3-12

O

Operating Environment 2-2

P

Parameter file
  Reading 3-49
  Saving 3-48
Parameter setting sheet 3-11
Pattern Name 3-39
Product Composition 1-3
Product overview 1-2

R

Re-setting by changing parameter 3-41

S

Slot 3-20

T

Time Domain graph 3-55

U

Uninstallation 2-3

W

Waveform Memory
  Loading to 4-4, 4-6
Waveform pattern 4-1
  Generation Procedure 3-58
  Selecting 4-5, 4-7
  Transferring to internal hard disk 4-2