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ADVANTEST CORPORATION

R3681 Series OPT64 Single-Carrier General-Purpose Modulation Analysis Software User's Guide

MANUAL NUMBER FOE-8440217A00

Applicable Models
R3681
R3671

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1. INTRODUCTION

This chapter describes the outline of this manual and the product overview of the R3681 series signal analyzer option 64 Single-Carrier General-Purpose Modulation Analysis Software.

1.1 Outline of This Manual

The outline of each chapter is shown below:

For basic operating methods, functions and the remote programming method of the signal analyzer, refer to "1.3 Other Manuals Relating to This Instrument."

Chapter 1. INTRODUCTION	Describes the outline of this manual and the product overview.
Chapter 2. BEFORE OPERATING	Provides preliminary tips on using this instrument. Read this chapter before using this instrument.
Chapter 3. SETUP	Describes how to set up this instrument. After installing this instrument in position, switch it on to make sure that it starts successfully.
Chapter 4. MEASUREMENT EXAMPLES	Describes example measurements.
Chapter 5. MENU MAP, FUNCTIONAL EXPLANATION	Describes the menu configuration and functions of the soft keys.
Chapter 6. SCPI COMMAND REFERENCE	SCPI command reference. The command reference describes the commands in order of function. The following items are described: • Command format • Function description • Parameters • Query response
Chapter 7. PERFORMANCE VERIFICATION	Describes the performance verification test procedures for option 64.
Chapter 8. SPECIFICATIONS	Shows the specifications of option 64.
APPENDIX	Describes operation principles and the error code table.

1.2 Product Overview

The single-carrier general-purpose modulation analysis option is software that performs the modulation analysis of the single-carrier modulated signal.

This option includes the following features.

- Analyzing the modulation accuracy such as the phase error, frequency error, and EVM (Error Vector Magnitude) by setting the symbol rate and modulation format.
- Analyzing the frequency characteristics of the transmitter and EVM of the DUT by using the equalizing function.
- Analyzing the quadrature error and the IQ gain imbalance of the quadrature modulator/demodulator.

1.3 Other Manuals Relating to This Instrument

Manuals which relate to this instrument include:

- User's Guide (Part Code: {ER3681SERIES/U}, English)

  Describes how to setup the R3681 Series Signal Analyzer, how to perform procedures such as, basic operations, applied measurements, and maintenance, and describes the functions, specifications of the R3681 Series Signal Analyzer.
- Programming Guide (Part Code: {ER3681SERIES/P}, English)

  Describes how to program the R3681 Series Signal Analyzer to automate measurement sequences and includes a remote control overview, SCPI command references, and sample application programs.
- Performance Test Guide (Part Code: {ER3681SERIES/T}, English)

  Describes how to check the performance of the R3681 Series Signal Analyzer and includes performance test procedures and specifications of the R3681 Series Signal Analyzer.

1.4 Conventions of Notation Used in This Document

In this document, hard keys, touch-screen buttons and menus are represented by the following symbols:

Hard keys
"Hard keys" are hardware keys which are on the panel.

Sample	Indicates a hard key labeled "Sample."
	Example: **START**, **STOP**

Touch-screen system menus

[Sample]	Indicates a touch-screen menu, tab, button or dialog box that is labeled "Sample" and that is selected or executed when touched.
	Example: **[File]** menu, **[Normal]** tab, **[Option]** button

Touch-screen function buttons

{Sample}	Indicates a touch-screen button labeled "Sample."
	Example: **{FREQ}** button, **{SWEEP}** button

Touch-screen side menu

Sample	Indicates a touch-screen side menu labeled "Sample."
	Example: **Center** key, **Span** key

Touch-screen system menu key operation

[File]→[Save As...]	Indicates that you need to touch the **[File]** menu and then select **[Save As...]**.

Sequential key operation

{FREQ}, **Center**	Indicates that you need to touch the **{FREQ}** button and then touch the **Center** key.

Toggle key operation

ΔMarker On/Off (On)	Indicates that you need to touch the **ΔMarker On/Off** key to turn on the ΔMarker.

*NOTE: **Screen displays and diagrams such as external view of the main unit in this manual are those of the R3681 in the R3681 series.***

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2. BEFORE OPERATING

This chapter describes important information on using this instrument. Read this chapter before using this instrument.

2.1 If a Fault Should Occur

If smoke, strange smells, or strange noises are detected, switch off the power, disconnect the power cable and contact either your dealer or Advantest immediately.

2.2 Removing the Case

The case should not be opened except by qualified Advantest service personnel.

WARNING: ***This instrument contains high-voltage and high-temperature parts. Electrical shocks or burns may result if handled incorrectly.***

2.3 Overcurrent Protection

This instrument is protected from overcurrent flow by a power breaker. Located on the rear panel, the power breaker automatically interrupts the power supply when an overcurrent flows through this instrument. When the power breaker has turned off, turn off the power supply and disconnect the power cable from the AC power. Then, call upon your dealer or us for repair services to fix a possible fault that has occurred in this instrument.

2.4 Hard Disk Drive

This instrument has a built-in hard disk drive. When handling the hard disk drive, take notice of these instructions.

- Do not cause impact or vibration damage to the hard disk drive.
  Damaging the disk increasing the chances of the disk malfunctioning or failing during operation.
- Do not switch off this instrument while the HDD access lamp is lit.
  The data being accessed may become corrupt.

CAUTION: ***We do not assume any responsibility for the loss or corruption of data stored on the hard disk drive that might result from the disk becoming damaged.***

2.5 Handling the Touch Screen

This instrument has a touch screen. When handling the touch screen, take notice of these instructions.

- Do not give apply excessive force to the screen. The screen is made from glass and may crack.
- Use the stylus pen included with this instrument to operate the screen. Using a tool with a hard-point (such as a mechanical pencil or ballpoint) may scratch the screen surface.

2.6 Getting the Software Running with Stability

The R3681 Series Signal Analyzer has Microsoft Windows XP pre-installed.

The measuring function of this instrument is dependent on the Windows environment. Do not alter the Windows operating environment in any way other than as described in this manual.
This instrument is not a data processor. Operate it only as described in this manual.

1. Prohibited actions
   - Installing other application programs.
   - Changing or deleting items in the control panel (except as described in "A.2 Installing the Printer Driver" and "A.3 Setting up the Network" of R3681 Series User's Guide).
   - Creating new files or editing existing files on the C drive.
   - Operating other application programs during the measurement.
   - Upgrading the Windows operating system.
   - If this instrument functions incorrectly because of any of the above, re-install the system using the system recovery disk.
     For more information on the system recovery procedure, refer to section 8.7, "System Recovery Procedure" in the R3681 Series User's Guide.
2. Computer viruses

   Depending on the operating environment, the system may become infected by a computer virus. To protect the system, we recommended taking the following countermeasures:
   - Perform a virus check before loading any file or inserting any media from an outside source.
   - Make sure that any network used has safety measures against computer viruses before connecting this instrument.

   [If infected with a computer virus:]
   - Delete all files on the D drive. Re-install the system using the recovery disk.
     For more information on the system recovery procedure, refer to section 8.7, "System Recovery Procedure" of R3681 Series User's Guide.

2.7 Transporting

Extreme care as described below must be taken when carrying this instrument.

- This instrument is heavy and must be carried by two or more persons, or on a transportation cart.
- If using a cart to move this instrument, ensure the instrument is secure.

2.8 Electromagnetic Interference

This instrument may cause electromagnetic interference and affect television and radio reception.
If the electromagnetic interference is reduced when this instrument's is turned off, then this instrument is the cause of the problem.
Electromagnetic interference may be prevented by doing the following:

- Changing the direction of the antenna of the television or radio.
- Placing this instrument on the other side of the television or radio.
- Placing this instrument away from the television or radio.
- Using different lines power outlets for this instrument and the television or radio.

2.9 Before Turning On

Do not connect a DUT to this instrument when turning on.

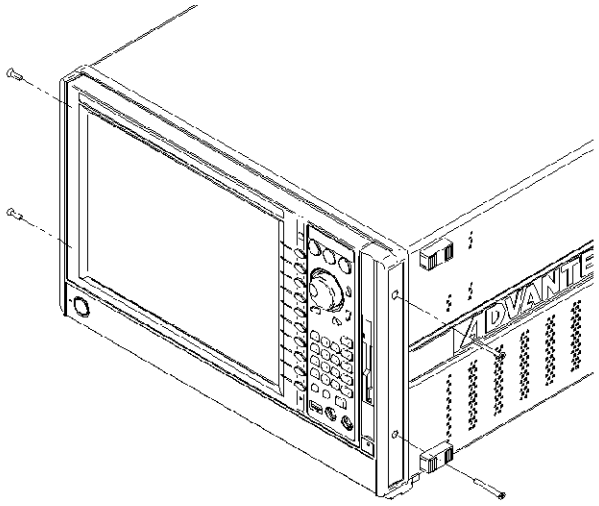
2.10 Removing and Attaching the Front Panel

This instrument can be used separately after removing the panel.
When removing the panel, take notice of these instructions.

MEMO: ***To use this instrument after removing the panel, a connecting cable is required (sold separately).***

- If this instrument's power is turned on, make sure that this instrument has stopped operating, turn off the power, and remove the power cable.
- When removing or attaching the panel, take care not to catch your fingers.
- Place this instrument on a flat and steady table when removing or attaching the panel.
- Remove the four screws that are exposed on the side of the front panel of this instrument.
- When removing the screws, steady the panel so that it will not fall.
- After all four screws have been removed, pull the panel forward.
- Remove the cable connecting the panel to the instrument.
- Replace the cable with an appropriate cable.
- If any screws become lost, use the following types of screw.
  - For the 2 screws on the key side: flat-head Phillips screws M4X35 (steel or stainless steel)
  - For the 2 screws on the liquid-crystal display: flat-head Phillips screws M4X14 (steel or stainless steel)

2.10 Removing and Attaching the Front Panel



2.11 Limitations Imposed when Using Windows XP

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3. SETUP

This chapter describes how to set up this instrument. Topics included in this chapter are:

3.1 Unpacking Inspection

When the product is delivered, check the condition of it and its accessories included by following these steps:

1. Check that the box and the padding in which the product was shipped has not been damaged during transit.

   IMPORTANT: ***If the box or the padding is damaged, leave them in their original condition until the inspection described below is complete.***

2. Check the product surfaces for any damage.

   WARNING: ***Do not supply any power to this instrument if the cover, panels (front and rear), LCD display, power switch, connector or any other key component are damaged. Electrical shocks may result from using damaged components.***

3. Referring to the standard accessory list of the OPT64 in Table 3-1, check that a standard accessory has been supplied and that no accessory is damaged.

   Contact your dealer or Advantest in any of the following situations:

   - The box or the padding in which the product was shipped was damaged during transit.
   - The product surfaces are damaged.
   - Any of the standard accessories are missing or damaged.
   - Faults are detected in any subsequent product verification test.

Table 3-1 Standard Accessory

Name	Model	Quantity	Remarks
R3681 Series OPT64 User's Guide	ER3681OPT64	1	English version

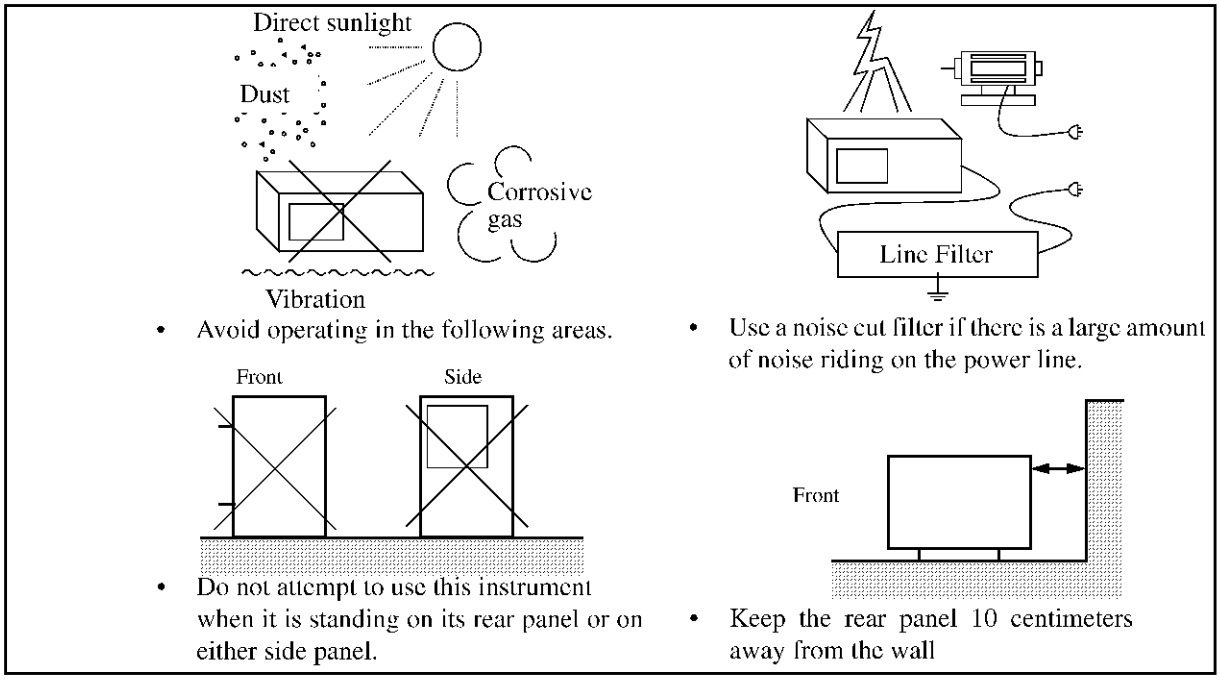
3.2 Locating This Instrument

This section describes the environment in which this instrument should be installed.

3.2.1 Operating Environment

This instrument should only be used in an environment that satisfies the following conditions:

- Ambient temperature: +5 °C to +40 °C (operating temperature)
  -20 °C to +60 °C (Storage temperature range)
- Relative humidity: RH80% or less (no condensation)
- An area free from corrosive gas
- An area away from direct sunlight
- A area free from dust
- An area free from vibrations
- A low noise area
  Although this instrument has been designed to withstand a certain amount of noise riding on the AC power line, it should be used in an area of low noise. Use a noise filter if ambient noise is unavoidable.
- An area allowing unobstructed airflow
  There is an exhaust-cooling fan on the rear panel and exhaust vents on both sides and the bottom (toward the front) of this instrument. Do not block these vents. The resulting internal temperature rise will affect measurement accuracy. Keep the rear panel 10 centimeters away from the wall. In addition, do not attempt to use this instrument when it is standing on its rear panel or lying on either side.



- Avoid operating in the following areas.
- Use a noise cut filter if there is a large amount of noise riding on the power line.
- Do not attempt to use this instrument when it is standing on its rear panel or on either side panel.
- Keep the rear panel 10 centimeters away from the wall

Figure 3-1 Operating Environment

3.2.2 Prevention of Electrostatic Buildup

To prevent electrostatic discharge (ESD) from damaging components in this instrument, the precautions described below should be taken. We recommend that two or more countermeasures are combined to provide adequate protection from ESD.
(Static electricity can easily be generated when a person moves or an insulator is rubbed.)

Table 3-2 ESD Countermeasures

Operator	Use a wrist strap (see Figure 3-2).
Floor in the work area	Install a conductive mat, use conductive shoes, and connect both to ground (see Figure 3-3).
Workbench	Install a conductive mat and connect it to ground (see Figure 3-4).

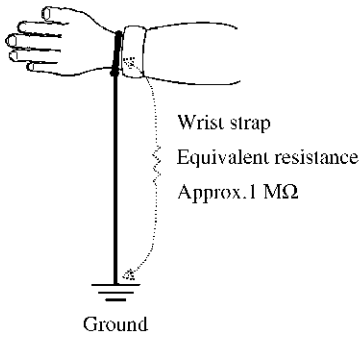


Figure 3-2 Countermeasures against Static Electricity from the Human Body

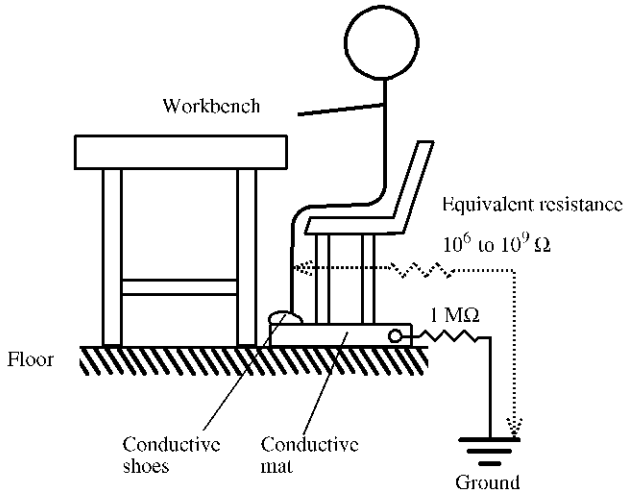


Figure 3-3 Countermeasures against Static Electricity from the Work Floor

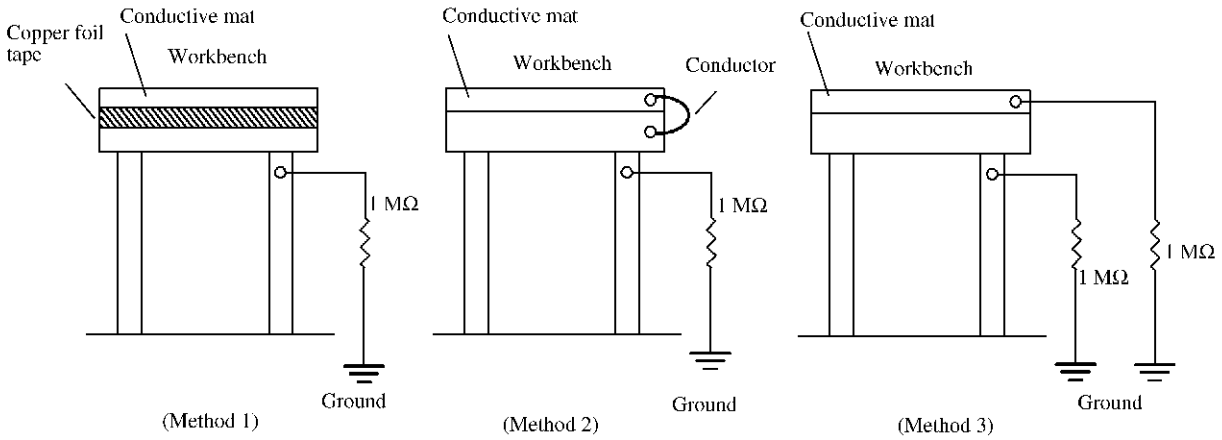


Figure 3-4 Countermeasures against Static Electricity from the Workbench

3.3 Connecting Accessories

This section describes how to connect accessories to this instrument and run it.

3.3.1 Connecting the Keyboard and Mouse

Plug the keyboard and mouse into their respective front-panel connectors before turning on this instrument.

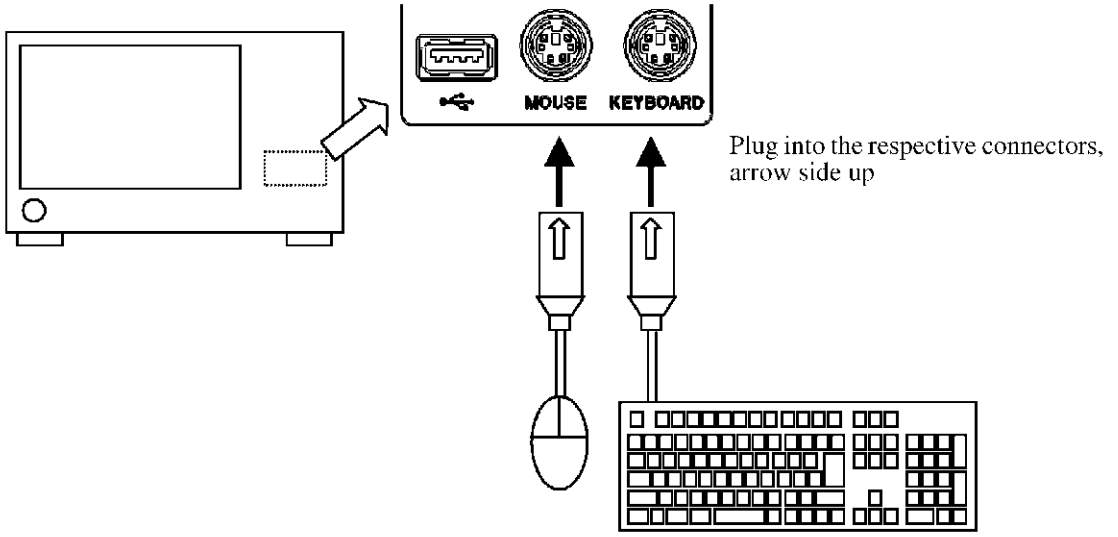


Figure 3-5 Connecting the Keyboard and Mouse

3.4 Supply Description

This section describes how to check the power supply specifications and connect the power cable.

3.4.1 Check the Supply Power

Table 3-3 summarizes the power supply specifications for this instrument. Make sure that the power supply available to this instrument meets these specifications.

Table 3-3 Power Supply Specifications

	100 V AC Operation	200 V AC Operation	Remarks
Input voltage range	90 V to 132 V	198 V to 250 V	Automatically switches between input levels of 100 V AC and 200 V AC.
Frequency range	47 Hz to 63 Hz		
Power consumption	450 VA or below		

WARNING: ***Be sure to provide a power supply that meets the specified power supply specifications for this instrument. Failure to meet the specifications could cause damage to this instrument.***

3.4.2 Connecting the Power Cable

This instrument comes with a three-core power cable with a ground conductor. To prevent electrical shock hazards, ground this instrument by plugging the power cable into a three-pole power outlet.

1. Check the power cable included with this instrument for any damage.

   WARNING: ***Never use a damaged power cable. Electrical shock could result.***

2. Plug one end of the power cable included with this instrument into the AC power connector on this instrument rear panel and the other into a three-pin power outlet that has a ground pin (see Figure 3-6).

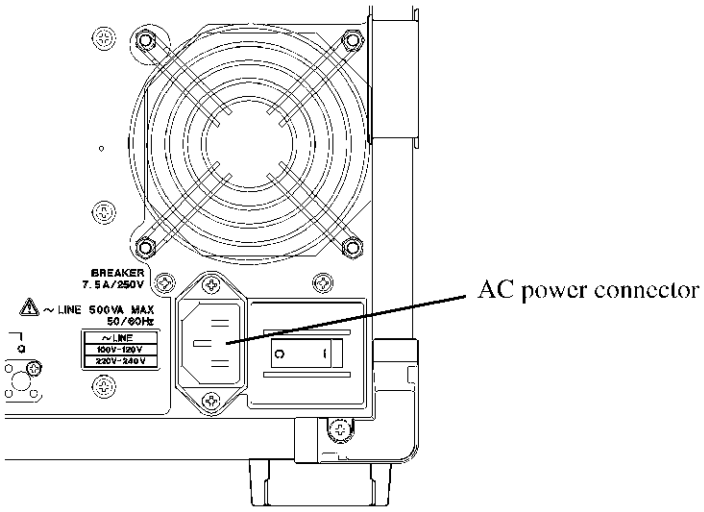


Figure 3-6 Connecting the Power Cable

WARNING:

1. ***Use a power cable rated for the voltage being used. Be sure, however, to use a power cable that conforms to the safety standards of your country when using this instrument (Refer to "Safety Summary").***
2. ***Plug the power cable into a three-pin power outlet that has a ground pin to prevent electrical shocks. Using an extension cable that has no ground pin would negate having a ground.***

3.5 Operation Check

This section describes how to make a simple operation check on this instrument by using its built-in autocalibration feature. To verify that this instrument runs correctly, follow these steps:

Starting up this instrument

1. Connect the power cable as instructed in 3.4.2 "Connecting the Power Cable."
2. Switch on the power breaker on the rear panel and wait for 3 seconds or more.
3. Press the **POWER** switch to switch on the power.

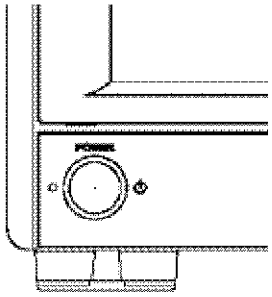


Figure 3-7 **POWER** Switch

CAUTION:

1. ***If the power to this instrument is suddenly interrupted while the unit is in operation, such as is the power cable is disconnected, the hard disk drive could be damaged. Even if the hard disk drive does not fail, Scandisk launches to check for possible data corruption the next time this instrument starts up.***
2. ***About Scandisk***
   If this instrument has been switched off without being shut down, Scandisk will automatically launch to check for any corrupt data. Do not abort Scandisk while it is running. If Scandisk locates any corrupt data, take appropriate action by following the displayed messages. The software in this instrument resumes automatically when Scandisk ends.

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4. The power-on diagnostic program launches to carry out self-diagnostics. The self-diagnostic program take about 1 minute to complete.
5. The initial screen shown in Figure 3-8 is displayed unless this instrument is faulty. The initial screen may give look differently from Figure 3-8, depending on the settings in effect the last time this instrument was switched off.

NOTE: ***Refer to Chapter 8, "MAINTENANCE" of R3681 Series User's Guide if any error messages are displayed as a result of the self-diagnostic program.***

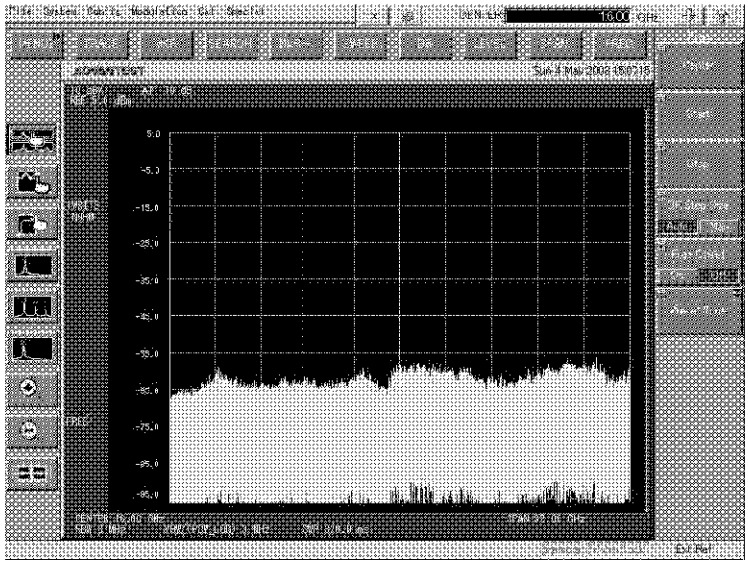


Figure 3-8 Initial Setup Screen

Running autocalibration

6. <R3681>
Install this instrument as shown in Figure 3-9 by using the SMA (f)-SMA (f) adapter, SMA (m)-BNC (f) adapter, and input cable (A01261-30) that come with this instrument as standard.

<R3671>
Hook up this instrument as shown in Figure 3-9 by using the N (m)-BNC (f) adapter, and input cable (A01261-30) that come with this instrument as standard.

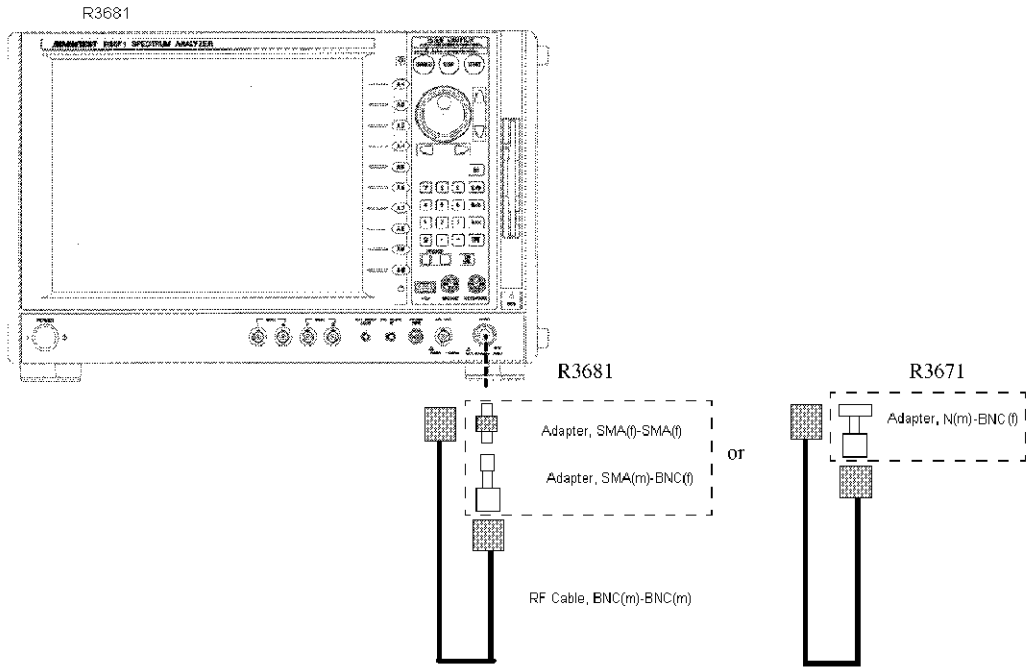


Figure 3-9 Autocalibration

IMPORTANT: ***Allow this instrument to warm up for at least 30 minutes before running the autocalibration. For more information on how to use the autocalibration, refer to Section 4.3.1, "Autocalibration" of the R3681 Series User's Guide.***

7. Touch the **[Cal]** button on this instrument's menu bar to select **[SA Cal]** from the dropdown menu.
8. Autocalibration runs.
   The autocalibration takes about 1 minute to complete.
9. Make sure that no error messages are displayed as a result of the autocalibration.

MEMO: ***Refer to Chapter 8, "MAINTENANCE" of the R3681 Series User's Guide if error messages are displayed as a result of the autocalibration.***

Switching off power

Press **POWER** to switch off this instrument.
The final procedure is complete and the power is automatically turned off.

4. MEASUREMENT EXAMPLES

This chapter describes how to use this option by using specific measurement examples.

4.1 Modulation Accuracy Measurement of the QPSK Signal

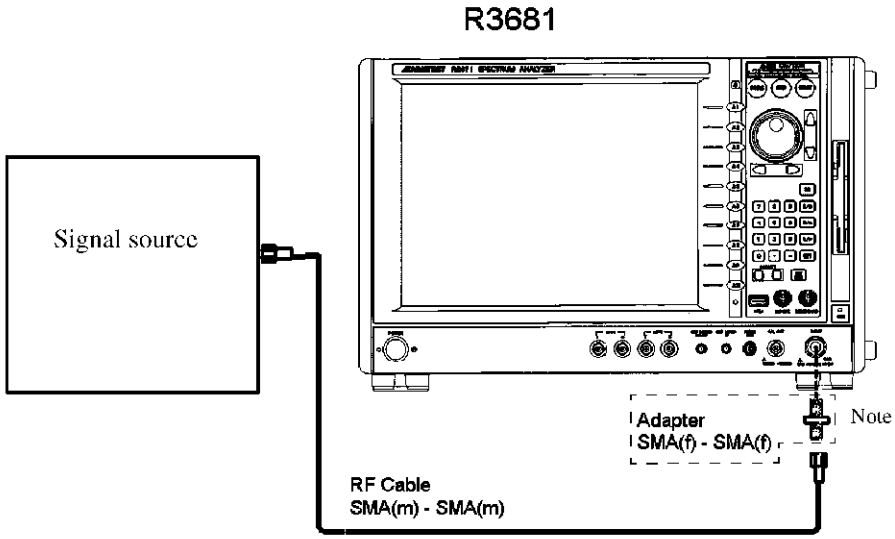
Signal Specifications

Table 4-1 shows the signal specifications.

Table 4-1 Signal Specifications

Symbol rate	1 MHz
Modulation format	QPSK
Signal	Continuous wave
Transmission filter	Nyquist, roll-off factor: 0.5
Center frequency	2 GHz
Output level	-10 dBm

Connections



Note: The R3671 uses the N(m)-SMA(f) adapter.

Figure 4-1 Modulation Accuracy Measurement Connection Diagram

Measurement condition settings

1. Touch **[Config]** on the menu bar and select **[Modulation Analyzer]**.
2. Touch **[Modulation]** on the menu bar and select **[Vector Modulation Analysis]**.
3. Touch the **{FREQ}** button on the function bar.
4. Touch the **Center** key on the soft menu bar.
5. Press **2** and **G/p** on the keypad.
   The center frequency is set to 2 GHz.
6. Touch the **{TRIGGER}** button on the function bar.
7. Touch the **Trigger Source** key on the soft menu bar.
8. Touch the **Free Run** key on the soft menu bar.
   The trigger source is set to the internal trigger.
9. Touch the **{INPUT}** button on the function bar.
10. Touch the **Input Setup** key on the soft menu bar.
    The **[Input Setup]** dialog box is displayed.
11. Set **[Input]** in the **[Input Setup]** dialog box to **[RF]**.
12. Set the **[IQ Inverse]** option button in the **[Input Setup]** dialog box to **[OFF]**.

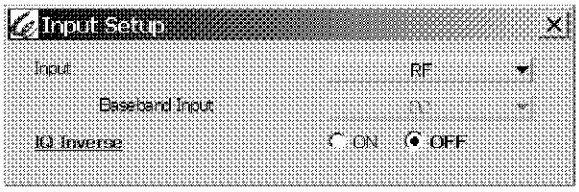


Figure 4-2 **[Input Setup]** Dialog Box

13. Touch the close button **X** in the **[Input Setup]** dialog box to close the dialog box.
14. Touch the **{LEVEL}** button on the function bar.
15. Touch the **Auto Level Set** key on the soft menu bar.
    The Ref Level is automatically set to the optimum value.
16. Touch the **{MEAS SETUP}** button on the function bar.
17. Touch the **Meas Parameters** key on the soft menu bar.
    The **[Measurement Parameters Setup]** dialog box is displayed.
18. Touch the **[Symbol Rate]** text box and press **1** and **M/n** on the keypad.
19. Set **[Modulation Format]** to **[QPSK]**.

20. Set the **[Differential Code]** option button to **[OFF]**.
21. Touch the **[A/D Capture Length]** text box and press [1], [5], [0], [0], and [ENT] on the keypad.
22. Touch the **[Analysis Length]** text box and press [1], [5], [0], [0], and [ENT] on the keypad.
23. Set the **[Burst Search]** option button to **[OFF]**.
24. Set the **[Compensate Origin Offset]** option button to **[ON]**.
25. Set the **[EVM Calculation Method]** option button to **[RMS]**.

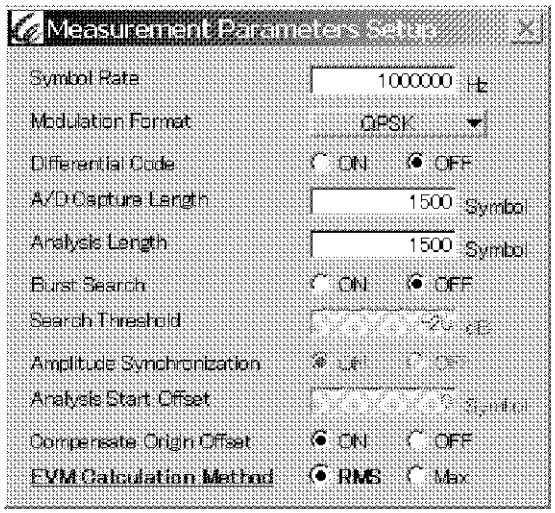


Figure 4-3 **[Measurement Parameters Setup]** Dialog Box

26. Touch the **Return** key on the soft menu bar to close the **[Measurement Parameters Setup]** dialog box.
27. Touch the **Synchronous Parameters** key on the soft menu bar.
    The **[Synchronous Parameters Setup]** dialog box is displayed.
28. Set the **[Synchronization]** option button to **[OFF]**.

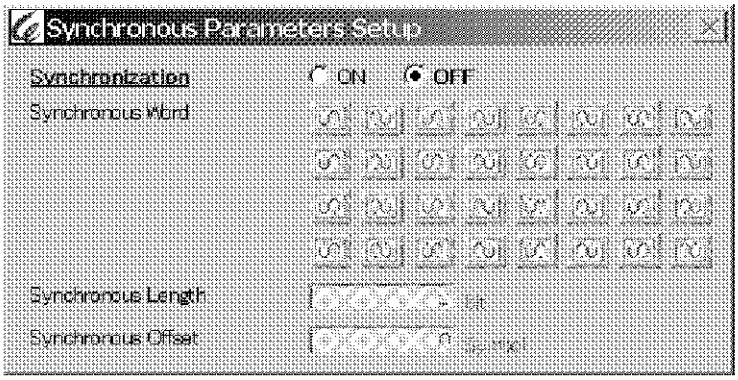


Figure 4-4 **[Synchronous Parameters Setup]** Dialog Box

29. Touch the **Return** key on the soft menu bar to close the **[Synchronous Parameters Setup]** dialog box.

30. Touch the **Filter Parameters** key on the soft menu bar.
    The **[Filter Parameters Setup]** dialog box is displayed.

31. Set **[Filter Type]** in **[Meas Filter]** to **[Sinc]**.

32. Touch the **[Filter Parameter]** text box in **[Meas Filter]** and press **0**, **.**, **5**, and **ENT** on the keypad.

33. Touch the **[Filter Tap]** text box in **[Meas Filter]** and press **2**, **0**, and **ENT** on the keypad.

34. Set **[Filter Type]** in **[Ref Filter]** to **[Nyquist]**.

35. Touch the **[Filter Parameter]** text box in **[Ref Filter]** and press **0**, **.**, **5**, and **ENT** on the keypad.

36. Touch the **[Filter Tap]** text box in **[Ref Filter]** and press **2**, **0**, and **ENT** on the keypad.

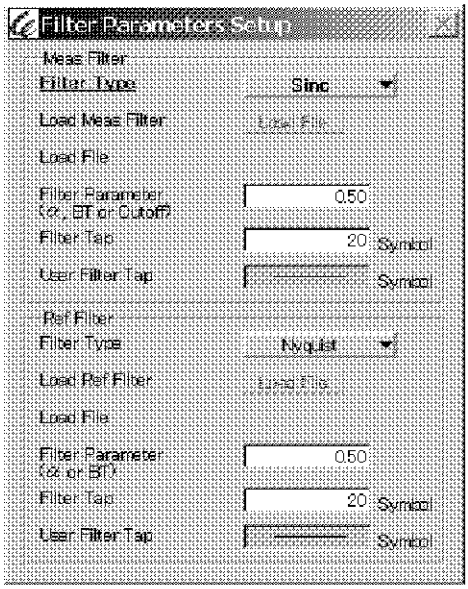


Figure 4-5 **[Filter Parameters Setup]** Dialog Box

37. Touch the **Return** key on the soft menu bar to close the **[Filter Parameters Setup]** dialog box.

38. Press the **SINGLE** button on the front panel.

    The Single measurement is performed and the measurement results are displayed.

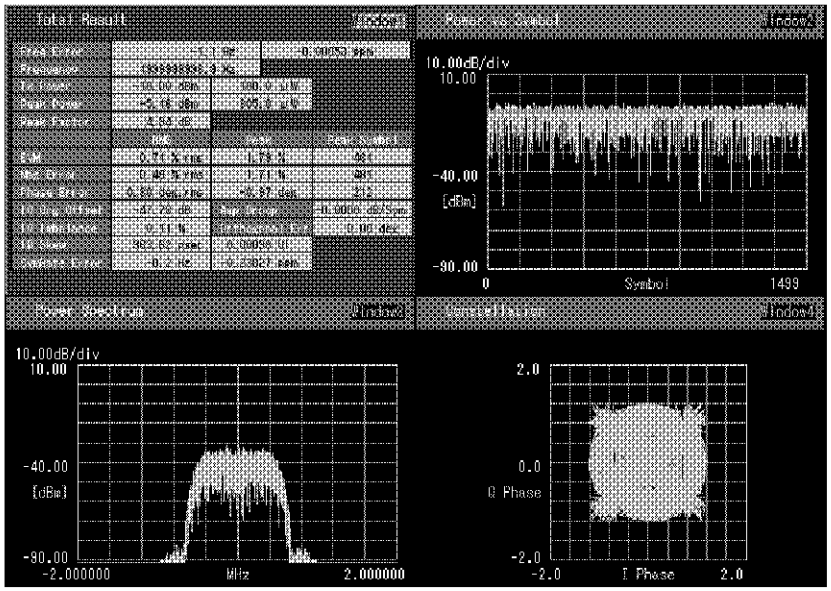


Figure 4-6 Modulation Accuracy Measurement Results

4.2 EVM Measurement of the DUT by Using the Equalizing Filter

By using the Equalizing Filter function, the signal source frequency characteristics are canceled and then EVM of the DUT such as an amplifier or filter can be measured. An example, which is measured by using the Equalizing Filter function, is shown below.

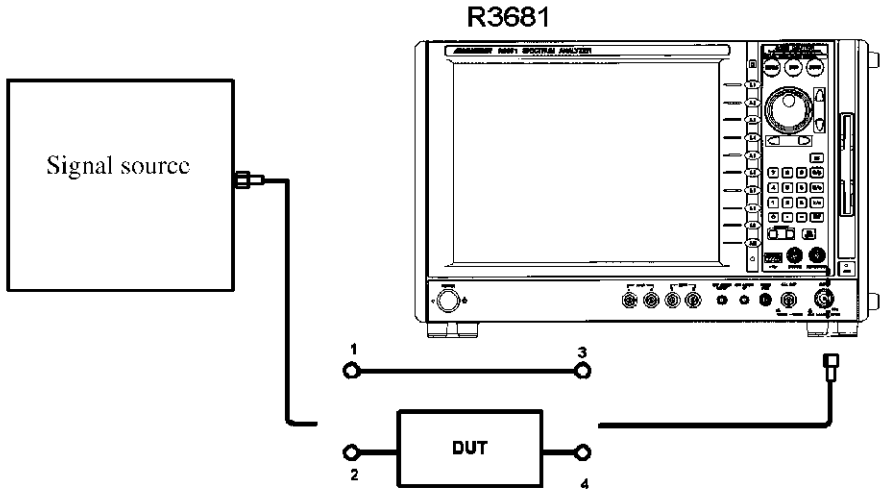


Figure 4-7 Connection Diagram using the Equalizing Filter

[Measurement condition settings]

1. Connect the instruments to the 1-3 path shown in Figure 4-7.
2. Touch **[Config]** on the menu bar and select **[Modulation Analyzer]**.
3. Touch **[Modulation]** on the menu bar and select **[Vector Modulation Analysis]**.
4. Touch the **{FREQ}** button on the function bar.
5. Touch the **Center** key on the soft menu bar.
6. Press **2** and **G/p** on the keypad.
   The center frequency is set to 2 GHz.
7. Touch the **{TRIGGER}** button on the function bar.
8. Touch the **Trigger Source** key on the soft menu bar.
9. Touch the **Free Run** key on the soft menu bar.
   The trigger source is set to the internal trigger.
10. Touch the **{INPUT}** button on the function bar.
11. Touch the **Input Setup** key on the soft menu bar.
    The **[Input Setup]** dialog box is displayed.

12. Set **[Input]** in the **[Input Setup]** dialog box to **[RF]**.
13. Set the **[IQ Inverse]** option button in the **[Input Setup]** dialog box to **[OFF]**.

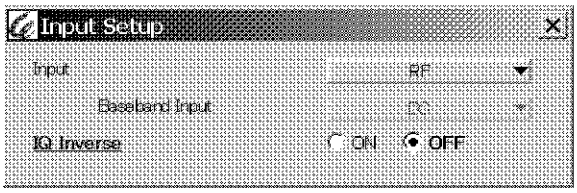


Figure 4-8 **[Input Setup]** Dialog Box

14. Touch the close button ✕ in the **[Input Setup]** dialog box to close the dialog box.
15. Touch the **{LEVEL}** button on the function bar.
16. Touch the **Auto Level Set** key on the soft menu bar.
    The Ref Level is automatically set to the optimum value.
17. Touch the **{MEAS SETUP}** button on the function bar.
18. Touch the **Meas Parameters** key on the soft menu bar.
    The **[Measurement Parameters Setup]** dialog box is displayed.
19. Touch the **[Symbol Rate]** text box and press **1** and **M/n** on the keypad.
20. Set **[Modulation Format]** to **[QPSK]**.
21. Set the **[Differential Code]** option button to **[OFF]**.
22. Touch the **[A/D Capture Length]** text box and press **1**, **5**, **0**, **0**, and **ENT** on the keypad.
23. Touch the **[Analysis Length]** text box and press **1**, **5**, **0**, **0**, and **ENT** on the keypad.
24. Set the **[Burst Search]** option button to **[OFF]**.
25. Set the **[Compensate Origin Offset]** option button to **[ON]**.
26. Set the **[EVM Calculation Method]** option button to **[RMS]**.

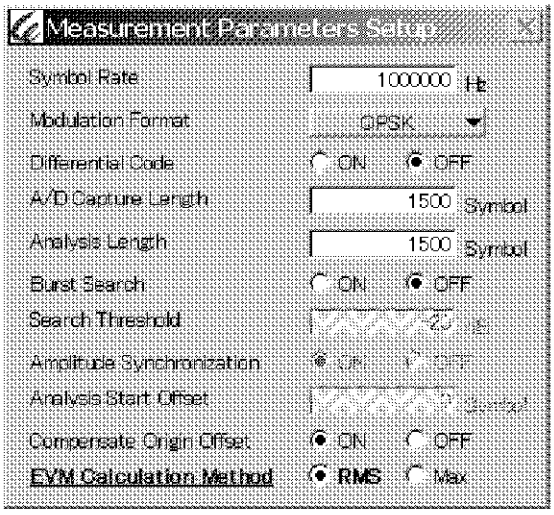


Figure 4-9 **[Measurement Parameters Setup]** Dialog Box

27. Touch the **Return** key on the soft menu bar to close the **[Measurement Parameters Setup]** dialog box.

28. Touch the **Synchronous Parameters** key on the soft menu bar.
    The **[Synchronous Parameters Setup]** dialog box is displayed.

29. Set the **[Synchronization]** option button to **[OFF]**.

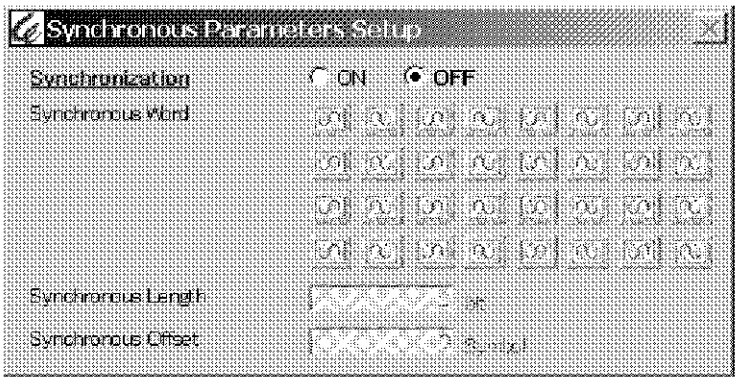


Figure 4-10 **[Synchronous Parameters Setup]** Dialog Box

30. Touch the **Return** key on the soft menu bar to close the **[Synchronous Parameters Setup]** dialog box.

31. Touch the **Filter Parameters** key on the soft menu bar.
    The **[Filter Parameters Setup]** dialog box is displayed.

32. Set **[Filter Type]** in **[Meas Filter]** to **[Sinc]**.

33. Touch the **[Filter Parameter]** text box in **[Meas Filter]** and press [0], [.], [5], and [ENT] on the keypad.

34. Touch the **[Filter Tap]** text box in **[Meas Filter]** and press [2], [0], and [ENT] on the keypad.

35. Set **[Filter Type]** in **[Ref Filter]** to **[Nyquist]**.

36. Touch the **[Filter Parameter]** text box in **[Ref Filter]** and press [0], [.], [5], and [ENT] on the keypad.

37. Touch the **[Filter Tap]** text box in **[Ref Filter]** and press [2], [0], and [ENT] on the keypad.

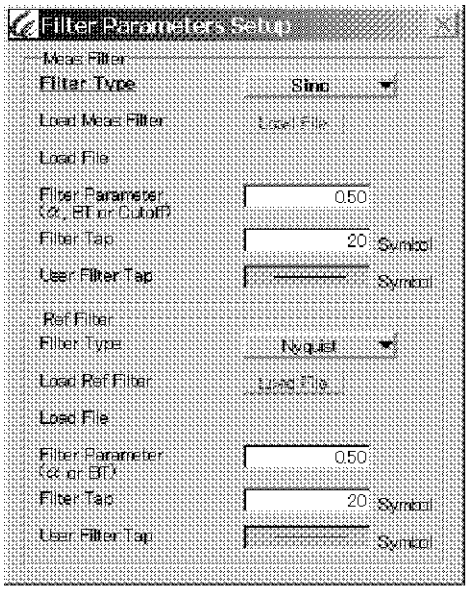


Figure 4-11 **[Filter Parameters Setup]** Dialog Box

38. Touch the **Return** key on the soft menu bar to close the **[Filter Parameters Setup]** dialog box.

39. Press the [SINGLE] button on the front panel.

    The Single measurement is performed and the measurement results are displayed.

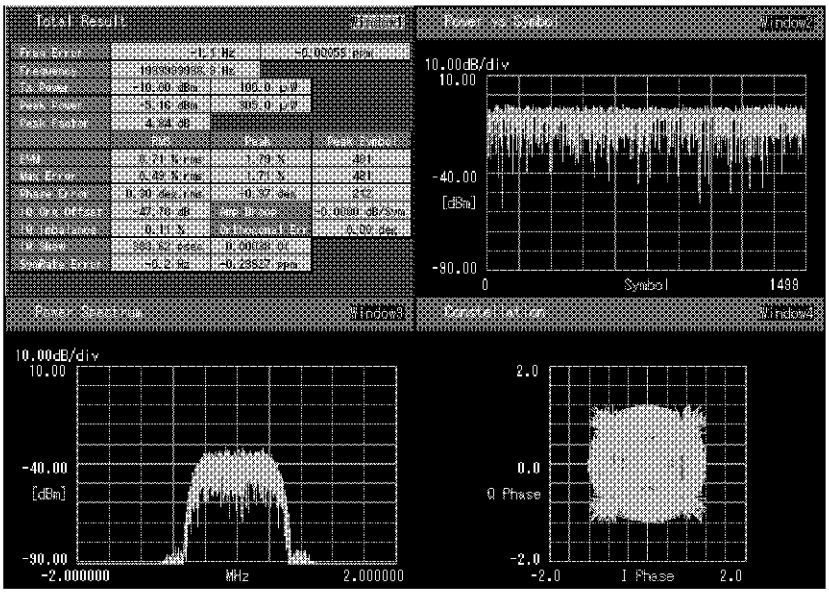


Figure 4-12 Modulation Accuracy Measurement Results

40. Touch the **{MEAS SETUP}** button on the function bar.
41. Touch the **Make Equalizer** key on the soft menu bar.
    The Equalizing Filter coefficient is created.
42. Touch the **{DISPLAY}** button on the function bar.
43. Touch the active window switching icon on the measurement tool bar.
44. Touch **[Window2]** to activate **[Window2]**.
45. Touch the **Window Format** key on the soft menu bar.
    The **[Window Format]** dialog box is displayed.
46. Select **[Transmission Mag Characteristics]**.
47. Touch **[Window4]** to activate **[Window4]**.
48. Select **[Transmission Phase Characteristics]**.
49. Touch the **Return** key on the soft menu bar to close the **[Window Format]** dialog box.
50. Touch **[Window2]** to activate **[Window2]**.
51. Touch the **{SCALE}** button on the function bar.
52. Touch the **Auto Scale** key on the soft menu bar.
    The horizontal-axis and vertical-axis are automatically adjusted to the optimum scale.
53. Touch **[Window4]** to activate **[Window4]**.

54. Touch the **Auto Scale** key on the soft menu bar.

55. Check the transfer characteristics.

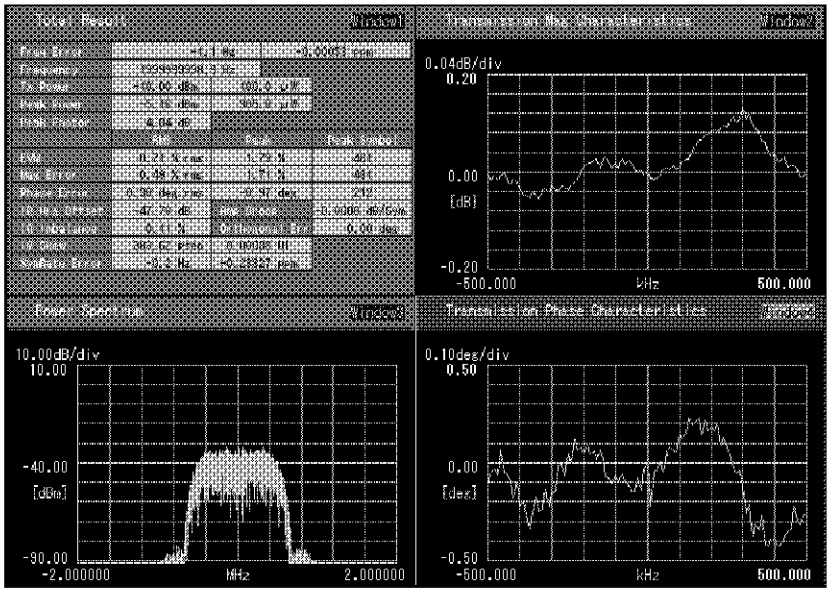


Figure 4-13 Transfer Characteristics Measurement Results

56. Connect the instruments to the 2-4 path shown in Figure 4-7.

57. Touch the **{MEAS SETUP}** button on the function bar.

58. Touch the **Equalizing Filter** key on the soft menu bar.
    Equalizing Filter is set to ON and the mode, which uses the Equalizing Filter, is set.

59. Touch the **{LEVEL}** button on the function bar.

60. Touch the **Auto Level Set** key on the soft menu bar.
    Ref Level is automatically set to the optimum value.

61. Press the **SINGLE** button on the front panel.

    The Single measurement is performed, and the DUT measurement results corrected by the equalizing process are displayed.

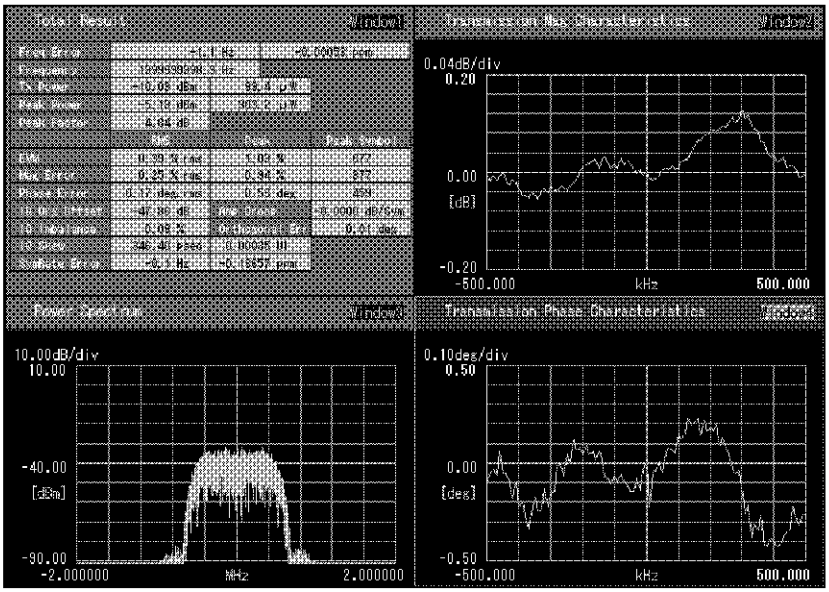


Figure 4-14 DUT Measurement Results

5. MENU MAP, FUNCTIONAL EXPLANATION

This chapter describes the configurations and functions of the soft keys displayed on the touch screen of the single-carrier general-purpose modulation analysis option.

MEMO:

- *|.....| Used to enclose a menu name, key name, item name in the dialog box, button name, or the name of selected items in lists and menus.*
- *{....} Shows a function button on the function bar.*
- *[....] Shows a soft key on the soft menu bar.*
- *A dialog box is surrounded by a broken line.*
- *Operations are supposed to be made through the touch screen and "touch" means to press a button or a key.*

5.1 Menu Index

5.2 Switching Communication Systems

The menu bar of this option is arranged as follows:

[File]	[System]	[Config]	[Modulation]	[Cal]	[Special]

The menu bar consists of the same items as those of Spectrum Analyzer.

Select **[Modulation Analyzer]** from **[Config]** on the menu bar to select a modulation analysis function.

Select **[Vector Modulation Analysis]** from **[Modulation]** on the menu bar to select the single-carrier general-purpose modulation analysis function.

5.3 Function Bar

This section describes the functions of each function button displayed on the function bar. The configuration of the function buttons of this option is as follows:

If you touch a button on the function bar, the relevant soft keys are displayed on the soft menu bar.

5.4 Soft Menu Bar

The area located on the right-hand side of the screen and in which soft keys are displayed is called the soft menu bar.

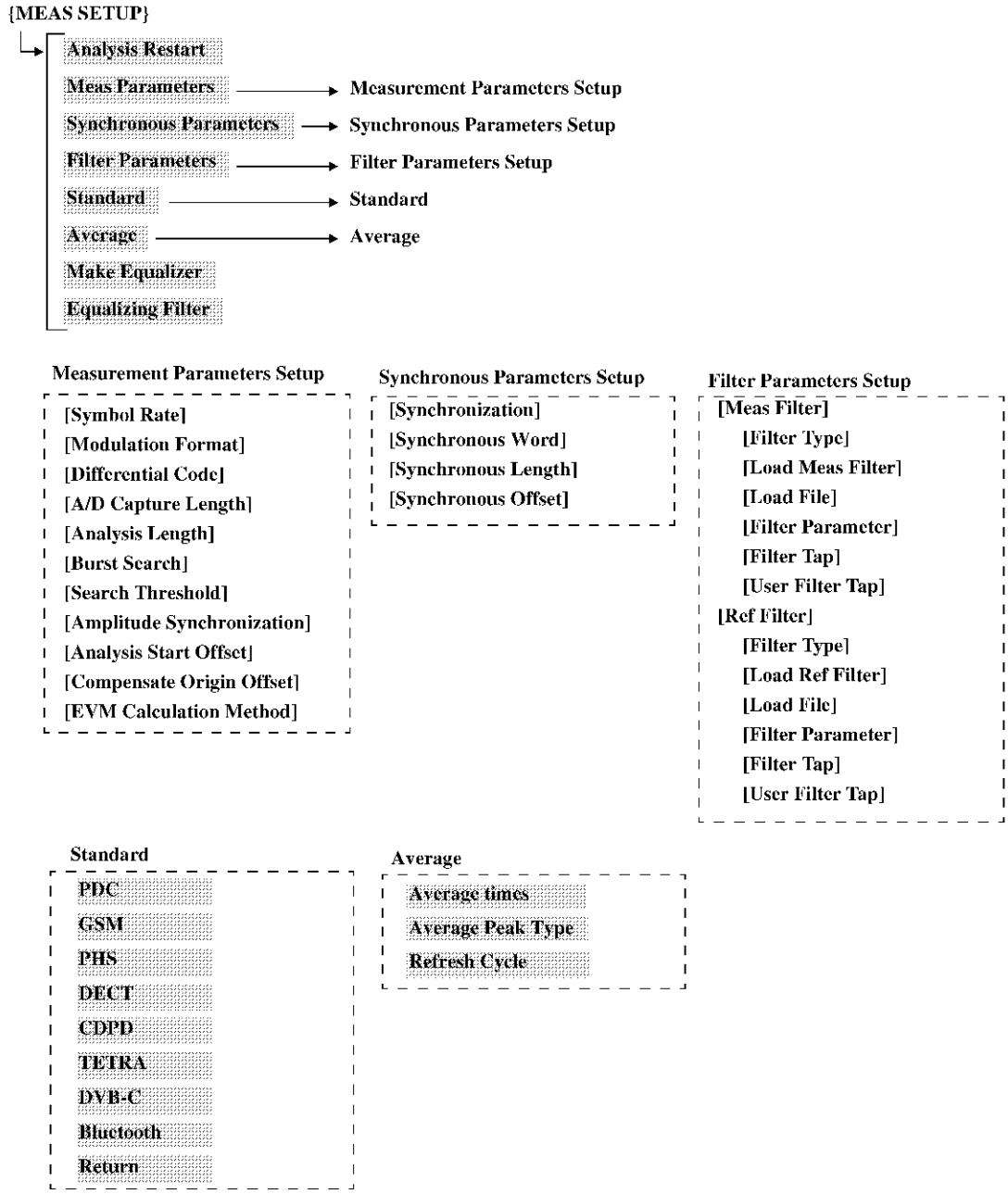
If you touch a button on the function bar, the relevant soft keys are displayed on the soft menu bar.

5.5 Description of the Function of Each Key

This section describes the function of each key.

5.5.1 {MEAS SETUP}

If **{MEAS SETUP}** is touched, soft keys, which relate to analysis parameter settings, are displayed on the soft menu bar.



Analysis Restart

The measurement of AD data, which has already been acquired, restarts by touching the **Analysis Restart** key.

MEMO: Even if Average is set to ON, the analysis is performed without Average.

Meas Parameters

The dialog box, which is used to set the measurement conditions, is displayed by touching the **Meas Parameters** key.

[Symbol Rate]

Sets the symbol rate of the signal.
The setting range is 10 kHz to 20 MHz and the setting resolution is 10 Hz.

MEMO: A symbol rate of 270833 Hz can be set to perform the GSM analysis. Set the symbol rate of hardware to 1625/6 kHz and perform the analysis after setting the symbol rate to 270833 Hz.

[Modulation Format]

Selects the modulation format of the signal.

[Differential Code]

Sets whether the modulation format of the signal is Differential Code. This parameter cannot be set when Modulation Format is set to π/4 DQPSK.

[A/D Capture Length]

Sets the number of symbols of A/D data acquired into memory.

MEMO: Lower limit of the setting
BPSK, QPSK, π/4 DQPSK, 8PSK, FSK,
MSK: 100, 16QAM: 300, 32QAM: 320,
64QAM: 600, 128QAM: 1000, 256QAM: 1200

Upper limit of the setting
Except for FSK: 50000, FSK: 25000

[Analysis Length]

Set the number of symbols to be analyzed.

MEMO: Lower limit of the setting
BPSK, QPSK, π/4 DQPSK, 8PSK, FSK,
MSK: 100, 16QAM: 300, 32QAM: 320,
64QAM: 600, 128QAM: 1000, 256QAM: 1200

Upper limit of the setting
Except for FSK: 10000, FSK: 5000

[Burst Search]

Sets whether to search for the burst in the acquired data by software.

ON: Searches for the burst by software.

OFF: Does not search for the burst by software.

[Search Threshold]

Sets the threshold that is used when the software searches for the burst. This parameter cannot be set when Burst Search is set to OFF.

[Amplitude Synchronization] Sets whether to synchronize with amplitude when searching for the burst. This parameter cannot be set when Burst Search is set to OFF.

ON: Synchronizes with amplitude.

OFF: Does not synchronize with amplitude.

[Analysis Start Offset] Specifies the number of offset symbols of the analysis start point against the rising edge of the burst when the burst signal is measured. This parameter cannot be set when Burst Search is set to OFF or Amplitude Synchronization is set to ON.

[Compensate Origin Offset] Sets whether to compensate the origin offset when the modulation accuracy is calculated.

ON: Compensates the origin offset.

OFF: Does not compensate the origin offset.

[EVM Calculation Method] Sets the calculation method of the reference level when the modulation accuracy is calculated.

RMS: Sets the reference level to the RMS value of the amplitude of the ideal signal.

Max: Sets the reference level to the maximum value of the amplitude of the ideal signal.

Return When the **Return** key is touched, the dialog box closes and the soft key array on the soft menu bar returns to the previous menu.

Synchronous Parameters The dialog box, which is used to set the synchronous conditions, is displayed by touching the **Synchronous Parameters** key.

[Synchronization] Sets whether to perform a measurement synchronized with Sync Word.

[Synchronous Word] Sets the user-defined Sync Word. This parameter cannot be set when Synchronize is set to OFF.

[Synchronous Length] Sets the bit length of Sync Word. The setting resolution is the number of bits per symbol in the modulation format set in **[Modulation Format]**. This parameter cannot be set when Synchronize is set to OFF.

[Synchronous Offset] Sets the number of offset symbols of Sync Word. This parameter cannot be set when Synchronize is set to OFF.

Return When the **Return** key is touched, the dialog box closes and the soft key array on the soft menu bar returns to the previous menu.

Filter Parameters The dialog box, which is used to set the receiving filter and the reference filter, is displayed by touching the **Filter Parameters** key.

[Meas Filter] Set the receiving filter.

[Filter Type] Set the type of the receiving filter.

[Load Meas Filter] Loads the user filter. The user filter can be loaded only when Filter Type is set to User.

[Load File] Displays the file name of the user filter to be loaded.

[Filter Parameter] Sets the filter parameter. Filter Parameter cannot be set when Filter Type is set to User.

MEMO: ***In Filter Parameter, the roll-off is set when Filter Type is set to Nyquist or Root Nyquist, BT is set when Filter Type is set to Gauss, and the cutoff ratio to the oversampling (FSK: 8, except for FSK: 4) is set when Filter Type is set to Sinc.***

[Filter Tap] Sets the number of taps of the filter in units of symbol. This parameter cannot be set when Filter Type is set to User.

[User Filter Tap] Displays the number of taps of the user filter to be loaded.

[Ref Filter] Sets the reference filter.

MEMO: ***Set the reference filter correctly when Modulation Format is set to FSK or MSK. Inaccurate measurements may be performed.***

[Filter Type] Set the type of the reference filter.

MEMO: ***When Modulation Format is set to any format except for FSK and MSK, the signal is interpolated by Dirac Pulse and then filtered by the reference filter. When Modulation Format is set to FSK or MSK, the phase is interpolated by Rectangular and then filtered by the reference filter.***

[Load Ref Filter] Loads the user filter. The user filter can be loaded only when Filter Type is set to User.

[Load File] Displays the file name of the user filter to be loaded.

[Filter Parameter] Sets the filter parameter. This parameter cannot be set when Filter Type is set to User or Rect.

MEMO: ***In Filter Parameter, the roll-off is set when Filter Type is set to Nyquist or Root Nyquist and BT is set when Filter Type is set to Gauss.***

[Filter Tap] Sets the number of taps of the filter in units of symbol. This parameter cannot be set when Filter Type is set to User or Rect.

[User Filter Tap] Displays the number of taps of the user filter to be loaded.

Return When the **Return** key is touched, the dialog box closes and the soft key array on the soft menu bar returns to the previous menu.

Standard If the **Standard** key is touched, the standards are displayed on the soft menu bar.

PDC Sets Meas Parameters and Filter Parameters to the PDC measurement conditions.

GSM Sets Meas Parameters and Filter Parameters to the GSM measurement conditions.

PHS — Sets Meas Parameters and Filter Parameters to the PHS measurement conditions.

DECT — Sets Meas Parameters and Filter Parameters to the DECT measurement conditions.

CDPD — Sets Meas Parameters and Filter Parameters to the CDPD measurement conditions.

TETRA — Sets Meas Parameters and Filter Parameters to the TETRA measurement conditions.

DVB-C — Sets Meas Parameters and Filter Parameters to the DVB-C measurement conditions.

Bluetooth — Sets Meas Parameters and Filter Parameters to the Bluetooth measurement conditions.

Return — When the **Return** key is touched, the soft key array on the soft menu bar returns to the previous menu.

Average — If the **Average** key is touched, the setting menu in the average measurement is displayed on the soft menu bar.

Average times — Sets Average to ON or OFF. If Average is set to ON, the dialog box used to set the number of times that averaging is performed is displayed.

Average Peak Type — Sets how to calculate the Peak value in the Average measurement. Calculates the Peak value in all measurements when Average Peak Type is set to Hold. Averages the Peak value of each measurement when Average Peak Type is set to Avg. This parameter cannot be set when Average times is set to OFF.

*MEMO: **Absolute values of Peak Phase Error and Peak Mag Error are displayed when Average Peak Type is set to Avg.***

Refresh Cycle — Sets the number of refresh cycles of the measurement result in the Average measurement. Refreshes the measurement result every set number of times averaging is performed. This parameter cannot be set when Average times is set to OFF.

*MEMO: **The measurement result continues to refresh after Average has been completed.***

Return — When the **Return** key is touched, the soft key array on the soft menu bar returns to the previous menu.

Make Equalizer — The Equalizing filter is created by touching the **Make Equalizer** key. If no measurement is performed after hardware settings are changed, the Equalizing filter cannot be created. The Equalizing filter cannot be created when Modulation Format is set to FSK.

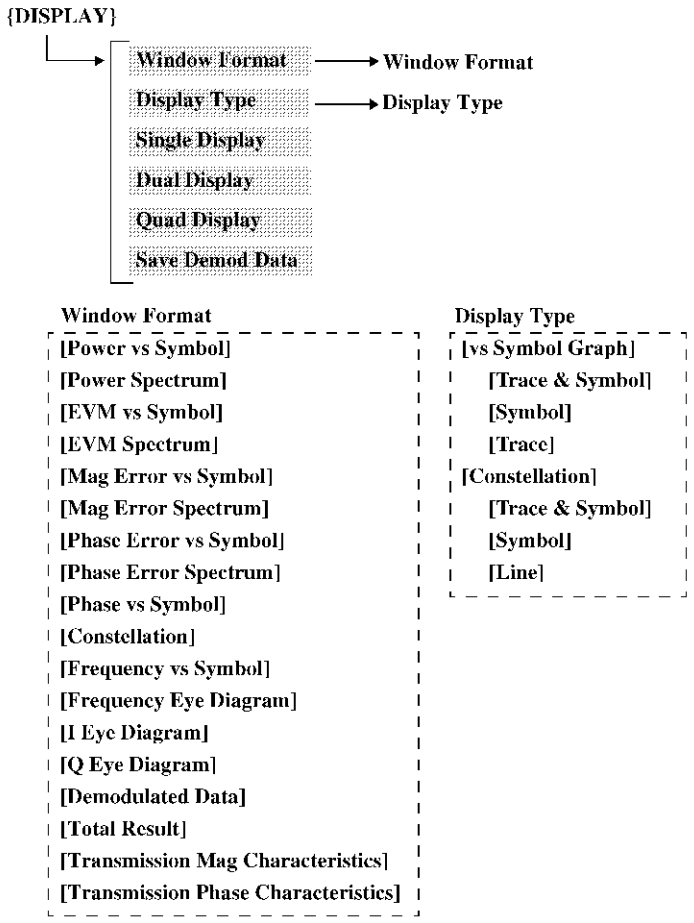
*MEMO: **After Analysis Length is set to 300 or more and the measurement is performed, the Equalizing filter can be created.***

Equalizing Filter

Sets Equalizing Filter to ON or OFF. This parameter cannot be set before Equalizing Filter is created.

5.5.2 {DISPLAY}

If the **{DISPLAY}** button is touched, soft keys, which relate to the active window format, active window display type, the number of divided windows, and demodulation data saving, are displayed on the soft menu bar.



Window Format The dialog box, which is used to set the display data, is displayed by touching the **Window Format** key.

[Power vs Symbol] Displays the power for each symbol on a graph.

[Power Spectrum] Displays the power spectrum on a graph.

[EVM vs Symbol] Displays EVM for each symbol on a graph.

[EVM Spectrum] Displays the EVM spectrum on a graph.

[Mag Error vs Symbol] Displays the magnitude error for each symbol on a graph.

[Mag Error Spectrum] Displays the magnitude error spectrum on a graph.

[Phase Error vs Symbol] Displays the phase error for each symbol on a graph.

[Phase Error Spectrum] Displays the phase error spectrum on a graph.

MEMO: ***EVM vs Symbol, EVM Spectrum, Mag Error vs Symbol, Mag Error Spectrum, Phase Error vs Symbol, and Phase Error Spectrum are enabled when Modulation is set to any modulation format except for FSK.***

[Phase vs Symbol] Displays the phase for each symbol on a graph.

[Constellation] Displays the constellation.

[Frequency vs Symbol] Displays the frequency for each symbol on a graph.

[Frequency Eye Diagram] Displays the frequency on an EYE diagram.

[I Eye Diagram] Displays the I signal on an EYE diagram.

[Q Eye Diagram] Displays the Q signal on an EYE diagram.

[Demodulated Data] Displays the demodulated data from the LSB in units of symbol.

[Total Result] Displays the numerical results.

Except for FSK

Freq Error	Carrier frequency error
Frequency	Carrier frequency
Tx Power	Power through a receiving filter
Peak Power	Peak power through a receiving filter
Peak Factor	Ratio between Tx Power and Peak Power
EVM	Error vector magnitude
Mag Error	Magnitude error
Phase Error	Phase error
IQ Org Offset	Origin offset
Amp Droop	Amplitude droop
IQ Imbalance	IQ magnitude imbalance
Orthogonal Err	IQ orthogonal error
IQ Skew	IQ skew
SymRate Error	Symbol rate error

MEMO: ***IQ Imbalance, Orthogonal Err, IQ Skew, and SymRate Error can be analyzed when Modulation Format is set to any modulation format except for BPSK and MSK, and Filter Type of Ref Filter is set to any filter type except for Rect.***

FSK

Freq Error	Carrier frequency error
Frequency	Carrier frequency
Tx Power	Power through the receiving filter
Peak Power	Peak power through the receiving filter

Peak Factor	Ratio between Tx Power and Peak Power
IQ Org Offset	Origin offset
Amp Droop	Amplitude droop
Max Deviation	Maximum frequency deviation
Min Deviation	Minimum frequency deviation
Min/Max Deviation	Ratio between Max Deviation and Min Deviation

[Transmission Mag Characteristics]
Displays the magnitude transfer characteristics of the transmitter on a graph.

[Transmission Phase Characteristics]
Displays the phase transfer characteristics of the transmitter on a graph.

MEMO: ***Transmission Mag Characteristics and Transmission Phase Characteristics are enabled after Equalizing Filter is created.***

Return When the **Return** key is touched, the dialog box closes and the soft key array on the soft menu bar returns to the previous menu.

Display Type The dialog box, which is used to set the display type, is displayed by touching the **Display Type** key.

[vs Symbol Graph] Sets the display type of the symbol-axis graph.

[Trace & Symbol] Displays both symbol points and their loci.

[Symbol] Displays symbol points only.

[Trace] Displays loci only.

[Constellation] Sets the constellation display type.

[Trace & Symbol] Displays both symbol points and their loci.

[Symbol] Displays symbol points only.

[Line] Displays symbol points which are connected by straight line.

Return When the **Return** key is touched, the dialog box closes and the soft key array on the soft menu bar returns to the previous menu.

Single Display Zooms into the window set to the active display when the display is split into quarters.

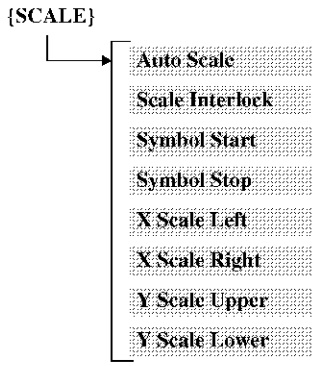
Dual Display Zooms into the window set to the active display and the following window when the display is split into quarters.

Quad Display Splits the display into quarters.

Save Demod Data Saves the demodulated data.

5.5.3 {SCALE}

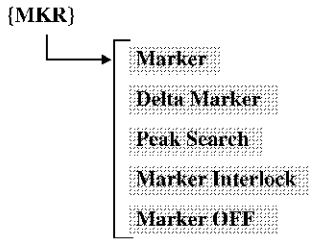
If the **{SCALE}** button is touched, soft keys, which relate to the Symbol-axis, X-axis, and Y-axis scale settings on the active window, are displayed on the soft menu bar.



Auto Scale	Sets the horizontal axis and vertical axis automatically.
Scale Interlock	Synchronizes the scale with the Symbol-axis on the displayed graph.
Symbol Start	Sets the minimum value on the Symbol-axis.
Symbol Stop	Sets the maximum value on the Symbol-axis.
X Scale Left	Sets the minimum value on the X-axis.
X Scale Right	Sets the maximum value on the X-axis.
Y Scale Upper	Sets the maximum value on the Y-axis.
Y Scale Lower	Sets the minimum value on the Y-axis.

5.5.4 {MKR}

If you touch the **{MKR}** button, the soft keys related to the marker setup are displayed on the side menu bar. Functions, which are enabled, depend on the type of the graph in an active window. If a window except for graph is active or if no graph data is given because the measurement has not been performed, these functions are unavailable.



Marker Sets the X-axis position of the normal marker.

Delta Marker Switches the delta marker display function ON and OFF.

ON: Displays a delta marker at the same position as a normal marker. Displays the relative value between a delta marker and a normal marker (measurement value such as EVM) in the marker area.

OFF: Hides a delta marker display.

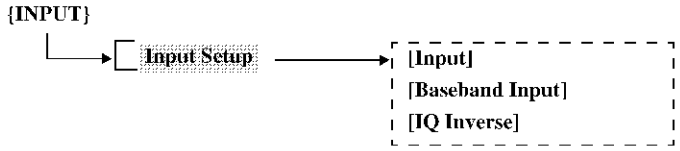
Peak Search Performs a peak search.

Marker Interlock Synchronizes with the Symbol-axis marker on the displayed graph.

Marker OFF Hides marker display.

5.5.5 {INPUT}

If the **{INPUT}** key is touched, the soft keys related to the setup of the input format to the instrument are displayed on the soft menu bar.



Input Setup

If you touch the **Input Setup** key, the dialog box used to set the input format to the instrument appears. Set the input format in accordance with the measured signal.

[Input]

Sets the input path of the signal.

RF: Sets the input path to the RF signal input.

Baseband(I&Q):
Sets the input path to the IQ signal (baseband) input.

[Baseband Input]

Sets the coupling when the IQ signal is input.

AC: Selects the AC coupling.

DC: Selects the DC coupling.

[IQ Inverse]

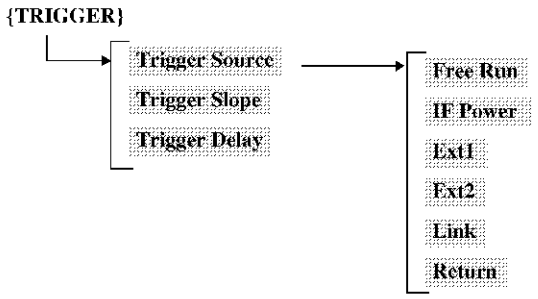
Selects whether to invert the phase of the measured signal.

ON: Inverts.

OFF: Does not invert.

5.5.6 {TRIGGER}

If the **{TRIGGER}** button is touched, the soft keys related to the trigger setup are displayed on the soft menu bar.



Trigger Source

If the **Trigger Source** key is touched, the soft keys related to the trigger setup are displayed on the soft menu bar.

Free Run

Acquires data according to the internal timing of the instrument and analyzes.

IF Power

Acquires data in synchronization with the IF signal and analyzes.

Ext1

Acquires data in synchronization with the external signal entered into the EXT TRIG IN 1 connector and analyzes. The threshold level for Ext1 is fixed to the TTL level.

Ext2

Acquires data in synchronization with the external signal entered into the EXT TRIG IN 2 connector and analyzes. The threshold level for Ext2 can be set.

Link

Acquires data in synchronization with the trigger of an optional function and analyzes.

---

*MEMO: **For information on how to use the link trigger, refer to the manual of the option in which the link trigger is used.***

Return

Returns to the previous soft key array on the soft menu bar.

Trigger Slope

Switches the trigger slope polarity + and -.

Available only for IF Power, Ext1, Ext2, and Link.

+: Starts the sweep at the rising edge of a trigger.

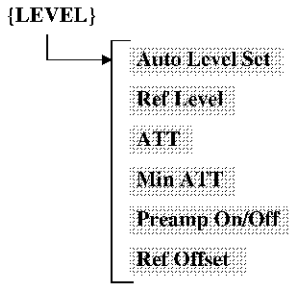
-: Starts the sweep at the falling edge of a trigger.

Trigger Delay

Sets the delay time from a trigger point. When analyzing, the start position of AD data acquisition is shifted to the delay time. This setting is enabled only when Trigger Source is set to IF Power, Ext1, Ext2, and Link.

5.5.7 {LEVEL}

If the **{LEVEL}** button is touched, the soft keys related to the setup of the attenuator and reference level are displayed on the soft menu bar.



Auto Level Set

Sets the reference level to the optimum value according to the measured signal. When the key is pressed, Auto Level Set is executed.

IMPORTANT: While Auto Level Set is being executed, the level of the measured signal must remain constant. Auto Level Set is executed for data acquisition time which depends on Symbol Rate and A/D Capture Length. When Symbol Rate is set to 10 kHz and A/D Capture Length is set to 50000, Auto Level Set acquires data for five seconds every time ATT is changed. If the reference level changes a lot, it takes a long time to complete Auto Level Set.

Ref Level

Sets the reference level.

ATT

Sets the attenuator.

Auto: Automatically sets the attenuator value based on the reference level.

Man: Sets the attenuator value.

Min ATT

Sets the Min ATT function to ON or OFF.

On: Sets the minimum attenuator value and restricts the attenuator regardless of whether ATT is Auto or Manual.

Off: Cancels the Min ATT restriction.

Preamp On/Off

Sets the preamplifier function to ON or OFF.

Ref Offset

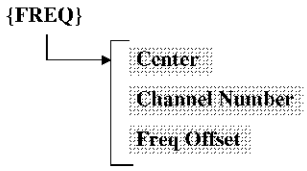
Switches the reference level offset function ON and OFF.

On: Sets the offset value and changes only the display of the reference level by the offset value.
(Displayed reference level = Set value + Offset value)

Off: Cancels the offset function.

5.5.8 {FREQ}

If the **{FREQ}** button is touched, the soft keys related to the measurement frequency setup are displayed on the soft menu bar.



Center

Sets the center frequency of the measured signal.

IMPORTANT: ***Set the center frequency correctly. If it is set incorrectly, an error may occur in the center frequency error measurement and the measurement may be incorrect.***

Channel Number

If the channel number is set, the center frequency is automatically set by using the following formula.

(Center frequency) = (Channel interval) × (Channel number + Channel offset) + (Start frequency)

The parameters such as the channel interval, and the channel number setting range depend on the Standard selected by **[Special]→[STD**...**]**. For more information, refer to the R3681 Series User's Guide.

Freq Offset

Switches the center frequency offset function ON and OFF.

On: Sets the offset value and changes only the display of the center frequency by the offset value.
(Displayed center frequency = Set value + Offset value)

Off: Cancels the offset function.

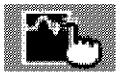
5.5.9 Measurement Tool Bar

Functions such as waveform range selection and active window selection are displayed as icons.

The following functions can be used by touching the icons.

 :Active window switching icon

Used to make one of the split windows active.

 :Range specification icon (X-axis mode)

Used to specify a range in the window in which the waveform is displayed. After touching the icon, touch both sides of the range to be specified.

 :Range specification icon (range mode)

Used to specify a range in the window in which the waveform is displayed. After touching the icon, touch the upper left corner and the lower right corner of the range to be specified.

 :Peak search icon

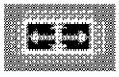
Used to place a marker on the peak after searching for the peak of the waveform.

 :Zoom in icon

Used to zoom in on the waveform displayed in the window. If you touch this icon after specifying the range by using the range specification icon, the range zooms in.

 :Zoom out icon

Used to zoom out from the waveform displayed in the window.

 :Range shift icon

Used to scroll the display without changing the scale.

6. SCPI COMMAND REFERENCE

This chapter describes the SCPI command reference for this instrument.

6.1 Command Reference Format

This section describes the format and layout used to describe commands in this chapter.

Each description includes the following items:

Function description

SCPI command

Parameter

Query reply

- |Function description|

  The usage of commands and operations in this instrument.

- |SCPI command|

  The SCPI command displays the syntax of a command sent from the external controller to this instrument. The syntax consists of a command and a number of parameters. The command and the parameters are separated by a space.

  If a command has multiple parameters, they are separated by commas (,). The three points (...) displayed between commas represent the parameter(s) omitted at that position.

  For example, the description <numeric value 1>,..., <numeric value 4> shows that four parameters, <numeric value 1>, <numeric value 2>, <numeric value 3>, and <numeric value 4>, are required.

  If the parameter is a character string type such as <character string>, <character string 1>, the parameter must be enclosed in double quotation marks (" "). If the parameter is <block>, it shows the block format data.

  Text written in lowercase alphabetic characters in the syntax can be omitted.

  For example, ":CALibration:CABLe" can be abbreviated to ":CAL:CABL."

  The marks used in the syntax are defined as follows:

< >:	Shows a parameter required for sending a command
[ ]:	Shows that the command is optional It can be omitted
{ }:	Shows that only one item is required to be selected from multiple items
|:	Used as a delimiter for multiple items written in curly brackets {..}
<ch>:	Written in the command header and shows the target input channel number of the command The channel number can be omitted. However, when it is written, channel number 1 is selected
<screen>:	Written in the command header and shows the target screen number of the command The screen number can be omitted. However, when it is written, a value from 1 to 4 can be selected [{1|2|3|4}]

For example, If the syntax below is specified, :CALC:CORR:EDEL:TIME 0.1 and : CALCULATE1:SELECTED:CORR:EDEL:TIME 25E-3 are valid.

Syntax: CALCulate{[1|2|3|4]}:SELected]:CORRection:EDELay:TIME <numeric value>

- [Parameter]

  Describes a parameter required for sending a command.

  If the parameter is numeric type or alphabetic, it is enclosed in angle brackets (< >).

  If the parameter is optional, it is enclosed in curly brackets ({ }).

  In this manual, parameter types are described in the following formats:

  < int >: A numeric value that can be input in the format NR1, NR2, or NR3 and rounded to an integer in this instrument

  < real >: A numeric value that can be input in the format NR1, NR2, or NR3 and rounded to a valid-digit real number in this instrument

  < bool >: Either OFF or ON can be entered.

  < str >: A character string enclosed in quotation (' ') or double quotation (" ") marks.

  <block>: Block data type
  The data content is an 8-bit binary data array

  < type >: Character data selected from multiple types

- [Query reply]

  When there is a query reply to the command, the data format used for reading the query is described.

  Each parameter to be read is enclosed in curly brackets ({ }). If multiple items, which are delimited by a vertical bar (|), exist in curly brackets ({ }), only one of those items is read out. If parameters are delimited by commas (,) multiple parameters can be read out. The three points (...) displayed between commas represent data omitted from that position. For example, the description {numeric value 1},...., {numeric value 4} shows that four parameters {numeric value 1}, {numeric value 2}, {numeric value 3}, and {numeric value 4} are read.

  If the parameter to be read is enclosed in square brackets ([ ]), the parameter may be omitted, depending on the measurement result, etc.

  If the parameter to be read is a value in a unit, a description such as "Unit: dBm" is added to display the unit of the parameter value. However, only when the parameter is described in a level unit "dBm", the level unit selected at that time will be applied to the parameter.

6.2 Common Commands

This section describes common IEEE commands.

Function description	SCPI Command	Parameter	Query reply	Remarks
Clears the status byte and related data	*CLS	-	-	
Macro definition for GET	*DDT	<block>	<block>	*1
Sets the standard event status enable register	*ESE	<int>	<int>	
Reads the standard event status register	*ESR?	-	<int>	
Device inquiry	*IDN?	-	<str>	*2
Notifies when all running operations are complete	*OPC	-	1	
Loads the device settings	*RCL	<int> | POFF	-	*3
Resets the device	*RST	-	-	
Saves the device settings	*SAV	<int>	<int>	
Sets the service request enable register	*SRE	<int>	<int>	
Reads the status byte register	*STB?	-	<int>	
Triggers the device	*TRG	-	-	
Waits until all running operations are complete	*WAI	-	-	

*1: If the *DDT? command is executed when the macro is undefined, a zero-length block data (#10) is returned.
*2: <str> is output in the following format: maker name, model name, serial number and version number.
*3: POFF indicates the parameter settings when the power was last switched off.

6.3 List of Commands

6.3.1 Subsystem-SYSTem

Function description	SCPI command	Parameter	Query reply	Remarks
Config				
Measurement system selection	:SYSTem:SELect	SANalyzer|MANalyzer	SAN|MAN	
Modulation				
Modulation analysis system selection	:SYSTem:SELect:MODulation	VMANalysis	VMAN	
Preset				
Each measurement system parameter initialization	:SYSTem:PRESet	-	-	
All measurement systems initialization	:SYSTem:PRESet:ALL	-	-	
Log				
Inquiry about the error that occurred last	:SYSTem:ERRor	-	<int>,<str>	
Inquiry about the details of the error log	:SYSTem:ERRor:ALL	-	<int>,<str>	

6.3.2 Subsystem-INPut

Function description	SCPI command	Parameter	Query reply	Remarks
ATT/Preamp				
ATT setting (Manual)	:INPut:ATTenuation	<real>	<real>	
ATT(Auto/Manual)	:INPut:ATTenuation:AUTO	OFF|ON	OFF|ON	
Min ATT setting	:INPut:ATTenuation:MINimum	<real>	<real>	
Min ATT ON/OFF	:INPut:ATTenuation:MINimum:STATe	OFF|ON	OFF|ON	
Preamp ON/OFF	:INPut:GAIN:STATe	OFF|ON	OFF|ON	
Input Setup				
Input Signal RF/Baseband	:INPut:SIGNal	RF|BASeband	RF|BAS	
Baseband Input AC/DC	:INPut:BASeband	AC|DC	AC|DC	
IQ Inverse ON/OFF	:INPut:IQ:INVerse	OFF|ON	OFF|ON	

6.3.3 Subsystem-SENSe

Function description	SCPI command	Parameter	Query reply	Remarks
Frequency				
Center Freq setting	[:SENSe]:FREQuency:CENTer	<real>	<real>	
Freq Offset setting	[:SENSe]:FREQuency:OFFSet	<real>	<real>	
Freq Offset ON/OFF	[:SENSe]:FREQuency:OFFSet:STATe	OFF|ON	OFF|ON	
Channel Number setting	[:SENSe]:FREQuency:CHANnel:NUMBer	<int>	<int>	
Auto Level Set				
Auto Level Set execution	[:SENSe]:POWer:LEVel:AUTO	-	-	
Measurement Parameters				
Symbol Rate setting	[:SENSe]:CONDition:SRATe	<real>	<real>	
Modulation Format selection	[:SENSe]:CONDition:MFORmat	BPSK|QPSK| P4DQPSK|PSK8| QAM16|QAM32| QAM64| QAM128| QAM256|FSK| MSK	BPSK|QPSK| P4DQPSK| PSK8|QAM16| QAM32|QAM64| QAM128| QAM256|FSK| MSK	
Differencial Code ON/OFF	[:SENSe]:CONDition:DCODe	OFF|ON	OFF|ON	
A/D Capture Length setting	[:SENSe]:CONDition:CAPTure:LENGth	<int>	<int>	
Analysis Length setting	[:SENSe]:CONDition:ANALysis:LENGth	<int>	<int>	
Burst Search ON/OFF	[:SENSe]:CONDition:BSEarch	OFF|ON	OFF|ON	
Search Threshold setting	[:SENSe]:CONDition:STHReshold	<real>	<real>	
Amplitude Synchronization ON/OFF	[:SENSe]:CONDition:ASYNchronization	OFF|ON	OFF|ON	
Analysis Start Offset setting	[:SENSe]:CONDition:ASOFfset	<int>	<int>	
Compensate Origin Offset setting	[:SENSe]:CONDition:COOFfset	OFF|ON	OFF|ON	
EVM Calculation Method RMS/Max	[:SENSe]:CONDition:ECMethod	RMS|MAXimum	RMS|MAX	
Synchronous Parameters				
Synchronization ON/OFF	[:SENSe]:CONDition:SYNChronization	OFF|ON	OFF|ON	
Synchronous Word setting	[:SENSe]:CONDition:SYNChronous:WORD	<str>	<str>	Hexadecimal character string
Synchronous Length setting	[:SENSe]:CONDition:SYNChronous:LENGth	<int>	<int>	
Synchronous Offset setting	[:SENSe]:CONDition:SYNChronous:OFFSet	<int>	<int>	

6.3.3 Subsystem-SENSe

Function description	SCPI command	Parameter	Query reply	Remarks
Filter Parameters				
Meas Filter Type Nyquist/ Root Nyquist/Gauss/Sinc/ User	[:SENSe]:CONDition:MFILter:TYPE	NYQuist| RNYQuist| GAUSs|SINC| USER	NYQ|RNYQ| GAUS|SINC| USER	
Load Meas Filter execution	[:SENSe]:CONDition:MFILter:LOAD	<str>	-	Absolute path to the file
Meas Filter Parameter setting	[:SENSe]:CONDition:MFILter:PARameter	<real>	<real>	
Meas Filter Tap setting	[:SENSe]:CONDition:MFILter:TAP	<int>	<int>	
Ref Filter Type Nyquist/Root Nyquist/Gauss/Rect/User	[:SENSe]:CONDition:RFILter:TYPE	NYQuist| RNYQuist| GAUSs|RECT| USER	NYQ|RNYQ| GAUS|RECT| USER	
Load Ref Filter execution	[:SENSe]:CONDition:RFILter:LOAD	<str>	-	Absolute path to the file
Ref Filter Parameter setting	[:SENSe]:CONDition:RFILter:PARameter	<real>	<real>	
Ref Filter Tap setting	[:SENSe]:CONDition:RFILter:TAP	<int>	<int>	
Standard				
Standard setting (PDC)	[:SENSe]:CONDition:STANdard:PDC	-	-	
Standard setting (GSM)	[:SENSe]:CONDition:STANdard:GSM	-	-	
Standard setting (PHS)	[:SENSe]:CONDition:STANdard:PHS	-	-	
Standard setting (DECT)	[:SENSe]:CONDition:STANdard:DECT	-	-	
Standard setting (CDPD)	[:SENSe]:CONDition:STANdard:CDPD	-	-	
Standard setting (TETRA)	[:SENSe]:CONDition:STANdard:TETRA	-	-	
Standard setting (DVB-C)	[:SENSe]:CONDition:STANdard:DVBC	-	-	
Standard setting (Bluetooth)	[:SENSe]:CONDition:STANdard:BLUETOOTH	-	-	
Average				
Average ON/OFF	[:SENSe]:CONDition:AVERage[:STATe]	OFF|ON	OFF|ON	
Average setting	[:SENSe]:CONDition:AVERage:COUNt	<int>	<int>	
Average Peak Type Hold/ Average	[:SENSe]:CONDition:AVERage:PTYPe	HOLD|AVERage	HOLD|AVER	
Average Refresh Cycle setting	[:SENSe]:CONDition:AVERage:RCYCle	<int>	<int>	
Equalizing Filter				
Equalizing Filter creation	[:SENSe]:CONDition:EQUAlizer:MAKE	-	-	
Equalizing Filter ON/OFF	[:SENSe]:CONDition:EQUAlizer	OFF|ON	OFF|ON	

6.3.4 Subsystem-TRIGger

Function description	SCPI command	Parameter	Query reply	Remarks
Sequence				
Trigger Source	:TRIGger[:SEQuence]:SOURce	IMMediate|IF| EXTernal1| EXTernal2|LINK	IMM|IF|EXT1| EXT2|LINK	
Trigger Slope	:TRIGger[:SEQuence]:SLOPe	POSitive| NEGative	POS|NEG	
IF Power setting	:TRIGger[:SEQuence]:LEVel:IF	<real>	<real>	
Ext2 Trigger Level setting	:TRIGger[:SEQuence]:LEVel:EXTernal	<real>	<real>	
Trigger Delay setting	:TRIGger[:SEQuence]:DELay	<real>	<real>	

6.3.5 Subsystem-INITiate

Function description	SCPI command	Parameter	Query reply	Remarks
Initiate				
Single measurement execution	:INITiate:MEASure:SINGle	-	-	
Repeat measurement execution	:INITiate:MEASure:REPeat	-	-	
Analysis execution	:INITiate:RESTart	-	-	
Stop execution	:INITiate:ABORt	-	-	

6.3.6 Subsystem-CALCulate

Function description	SCPI command	Parameter	Query reply	Remarks
Marker				
Marker ON/OFF	:CALCulate:MARKer<scrn=1|2|3|4>[:STATe]	OFF|ON	OFF|ON	
Marker X setting	:CALCulate:MARKer<scrn=1|2|3|4>:X	<real>	<real>	
Marker Y reading	:CALCulate:MARKer<scrn=1|2|3|4>:Y	-	<real>	
Marker setting on the Constellation and Eye displays	:CALCulate:MARKer<scrn=1|2|3|4>:SYMBol	<real>	<real>	
I reading on the Constellation and Eye displays	:CALCulate:MARKer<scrn=1|2|3|4>:I	-	<real>	<I>
Q reading on the Constellation and Eye displays	:CALCulate:MARKer<scrn=1|2|3|4>:Q	-	<real>	<Q>
Marker Interlock ON/OFF	:CALCulate:MARKer:ILOCk	OFF|ON	OFF|ON	
ΔMarker ON/OFF	:CALCulate:DELTamarker<scrn=1|2|3|4> [:STATe]	OFF|ON	OFF|ON	
Peak Search execution	:CALCulate:MARKer<scrn=1|2|3|4>:MAXimum	-	-	

6.3.7 Subsystem-DISPlay

Function description	SCPI command	Parameter	Query reply	Remarks
Level				
Ref Level setting	:DISPlay:TRACe:Y[:SCALe]:RLEVel	<real>	<real>	
Level Offset setting	:DISPlay:TRACe:Y[:SCALe]:RLEVel:OFFSet	<real>	<real>	
Level Offset ON/OFF	:DISPlay:TRACe:Y[:SCALe]:RLEVel:OFFSet :STATe	OFF|ON	OFF|ON	
Display				
Multi Screen setting	:DISPlay	SINGle|DUAL| QUAD	SING|DUAL| QUAD	
Window Format selection	:DISPlay[:WINDow<scrn=1|2|3|4>]:FORMat	PSYMbol| PSPectrum| ESYMbol| ESPectrum| MESYmbol| MESPectrum| PESYmbol| PESPectrum| PHSYmbol| FSYMbol| FEYE| CONStellation| IEYE|QEYE| TMCHaracteris-tics| TPCHaracteris-tics| DDATa|TRESult	PSYM|PSP| ESYM|ESP| MESY|MESP| PESY|PESP| PHSY|FSYM| FEYE|CONS| IEYE|QEYE| TMCH|TPCH| DDAT|TRES	
Display Type vs Symbol setting	:DISPlay[:WINDow<scrn=1|2|3|4>]:SYMBol :TRACe:TYPE	TSYMbol| SYMBol| TRACe	TSYM|SYMB| TRAC	
Display Type Constellation setting	:DISPlay[:WINDow<scrn=1|2|3|4>] :CONStellation:TRACe:TYPE	TSYMbol| SYMBol|LINE	TSYM|SYMB| LINE	
Scale				
Scale Interlock ON/OFF	:DISPlay:SCALe:ILOCk	OFF|ON	OFF|ON	
Auto Scale execution	:DISPlay[:WINDow<scrn=1|2|3|4>]:SCALe :AUTO	-	-	
Symbol Start setting	:DISPlay[:WINDow<scrn=1|2|3|4>]:TRACe :SYMBol:STARt	<int>	<int>	
Symbol Stop setting	:DISPlay[:WINDow<scrn=1|2|3|4>]:TRACe :SYMBol:STOP	<int>	<int>	
X Scale Left setting	:DISPlay[:WINDow<scrn=1|2|3|4>]:TRACe :X[:SCALe]:LEFT	<real>	<real>	
X Scale Right setting	:DISPlay[:WINDow<scrn=1|2|3|4>]:TRACe :X[:SCALe]:RIGHt	<real>	<real>	
Y Scale Upper setting	:DISPlay[:WINDow<scrn=1|2|3|4>]:TRACe :Y[:SCALe]:UPPer	<real>	<real>	
Y Scale Lower setting	:DISPlay[:WINDow<scrn=1|2|3|4>]:TRACe :Y[:SCALe]:LOWer	<real>	<real>	

6.3.8 Subsystem-MMEMory

Function description	SCPI command	Parameter	Query reply	Remarks
Save/Recall				
Saving the settings of this instrument	:MMEMory:STORe:STATe	<int>	-	*1
Loading the settings of this instrument	:MMEMory:LOAD:STATe	<int>	-	*1
Measurement condition Save selection	:MMEMory:SELect:ITEM:VMANalysis:SETup	OFF|ON	OFF|ON	
Save Demod Data execution	:MMEMory:STORe:DDATa:STATe	<int>	-	*1

*1: A number, which is a maximum of 4-digit and is added to the file name of the data to be saved or loaded, must be specified in <int>.

6.3.9 Subsystem-MEASure

Function description	SCPI command	Parameter	Query reply	Remarks
Total Result(Common)				
Frequency Error reading	:MEASure:TRESult:FERRor	-	<real>,<real>	<Hz>, <ppm>
Frequency reading	:MEASure:TRESult:FREQuency	-	<real>	
Tx Power reading	:MEASure:TRESult:POWer	-	<real>,<real>	<dBm>, <W>
Peak Power reading	:MEASure:TRESult:PEAK:POWer	-	<real>,<real>	<dBm>, <W>
Peak Factor reading	:MEASure:TRESult:PEAK:FACTor	-	<real>	
IQ Origin Offset reading	:MEASure:TRESult:IQOFfset	-	<real>	
Amp Droop reading	:MEASure:TRESult:ADRoop	-	<real>	
Total Result(Not FSK)				
EVM reading	:MEASure:TRESult:EVM	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
Mag Error reading	:MEASure:TRESult:MERRor	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
Phase Error reading	:MEASure:TRESult:PERRor	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
IQ Imbalance reading	:MEASure:TRESult:IQIMbalance	-	<real>	
Orthogonal Error reading	:MEASure:TRESult:OERRor	-	<real>	
IQ Skew reading	:MEASure:TRESult:IQSKew	-	<real>,<real>	<sec>,<UI>
Symbol Rate Error reading	:MEASure:TRESult:SRERror	-	<real>,<real>	<Hz>,<ppm>
Total Result(FSK)				
Max Deviation reading	:MEASure:TRESult:DEViation:MAXimum	-	<real>,<int>	<Hz>,<Symbol>
Min Deviation reading	:MEASure:TRESult:DEViation:MINimum	-	<real>,<int>	<Hz>,<Symbol>
Min/Max Deviation reading	:MEASure:TRESult:DEViation:RATE	-	<real>	

6.3.9 Subsystem-MEASure

Function description	SCPI command	Parameter	Query reply	Remarks
Trace Data				
Power vs Symbol X data reading	:MEASure:PSYMbol:X	-	<block> or <ASCII>	*2
Power vs Symbol Y data reading	:MEASure:PSYMbol:Y	-	<block> or <ASCII>	*2
Power Spectrum X data reading	:MEASure:PSPectrum:X	-	<block> or <ASCII>	*2
Power Spectrum Y data reading	:MEASure:PSPectrum:Y	-	<block> or <ASCII>	*2
EVM vs Symbol X data reading	:MEASure:ESYMbol:X	-	<block> or <ASCII>	*2
EVM vs Symbol Y data reading	:MEASure:ESYMbol:Y	-	<block> or <ASCII>	*2
EVM Spectrum X data reading	:MEASure:ESPectrum:X	-	<block> or <ASCII>	*2
EVM Spectrum Y data reading	:MEASure:ESPectrum:Y	-	<block> or <ASCII>	*2
Mag Error vs Symbol X data reading	:MEASure:MESYmbol:X	-	<block> or <ASCII>	*2
Mag Error vs Symbol Y data reading	:MEASure:MESYmbol:Y	-	<block> or <ASCII>	*2
Mag Error Spectrum X data reading	:MEASure:MESPectrum:X	-	<block> or <ASCII>	*2
Mag Error Spectrum Y data reading	:MEASure:MESPectrum:Y	-	<block> or <ASCII>	*2
Phase Error vs Symbol X data reading	:MEASure:PESYmbol:X	-	<block> or <ASCII>	*2
Phase Error vs Symbol Y data reading	:MEASure:PESYmbol:Y	-	<block> or <ASCII>	*2
Phase Error Spectrum X data reading	:MEASure:PESPectrum:X	-	<block> or <ASCII>	*2
Phase Error Spectrum Y data reading	:MEASure:PESPectrum:Y	-	<block> or <ASCII>	*2
Phase vs Symbol X data reading	:MEASure:PHSYmbol:X	-	<block> or <ASCII>	*2
Phase vs Symbol Y data reading	:MEASure:PHSYmbol:Y	-	<block> or <ASCII>	*2
Frequency vs Symbol X data reading	:MEASure:FSYMbol:X	-	<block> or <ASCII>	*2
Frequency vs Symbol Y data reading	:MEASure:FSYMbol:Y	-	<block> or <ASCII>	*2
Frequency Eye Diagram data reading	:MEASure:FEYE	-	<block> or <ASCII>	*2
Constellation I data reading	:MEASure:CONStellation:I	-	<block> or <ASCII>	*2
Constellation Q data reading	:MEASure:CONStellation:Q	-	<block> or <ASCII>	*2

Function description	SCPI command	Parameter	Query reply	Remarks
Transmission Mag Characteristics X data reading	:MEASure:TMCHaracteristics:X	-	<block> or <ASCII>	*2
Transmission Mag Characteristics Y data reading	:MEASure:TMCHaracteristics:Y	-	<block> or <ASCII>	*2
Transmission Phase Characteristics X data reading	:MEASure:TPCHaracteristics:X	-	<block> or <ASCII>	*2
Transmission Phase Characteristics Y data reading	:MEASure:TPCHaracteristics:Y	-	<block> or <ASCII>	*2
Demodulated Data				
Synchronous Judgment reading	:MEASure:DDATa:SYNChronous :JUDGment	-	NSYN|SYNC	
Demodulated Data reading	:MEASure:DDATa	-	<ASCII>	*2

*2: Data of the measurement length is output.

6.3.10 Subsystem-READ

Function description	SCPI command	Parameter	Query reply	Remarks
Total Result(Common)				
Frequency Error reading	:READ:TRESult:FERRor	-	<real>,<real>	<Hz>,<ppm>
Frequency reading	:READ:TRESult:FREQuency	-	<real>	
Tx Power reading	:READ:TRESult:POWer	-	<real>,<real>	<dBm>,<W>
Peak Power reading	:READ:TRESult:PEAK:POWer	-	<real>,<real>	<dBm>,<W>
Peak Factor reading	:READ:TRESult:PEAK:FACTor	-	<real>	
IQ Origin Offset reading	:READ:TRESult:IQOFfset	-	<real>	
Amp Droop reading	:READ:TRESult:ADRoop	-	<real>	
Total Result(Not FSK)				
EVM reading	:READ:TRESult:EVM	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
Mag Error reading	:READ:TRESult:MERRor	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
Phase Error reading	:READ:TRESult:PERRor	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
IQ Imbalance reading	:READ:TRESult:IQIMbalance	-	<real>	
Orthogonal Error reading	:READ:TRESult:OERRor	-	<real>	
IQ Skew reading	:READ:TRESult:IQSKew	-	<real>,<real>	<sec>,<UI>
Symbol Rate Error reading	:READ:TRESult:SRERror	-	<real>,<real>	<Hz>,<ppm>
Total Result(FSK)				
Max Deviation reading	:READ:TRESult:DEViation:MAXimum	-	<real>,<int>	<Hz>,<Symbol>
Min Deviation reading	:READ:TRESult:DEViation:MINimum	-	<real>,<int>	<Hz>,<Symbol>
Min/Max Deviation reading	:READ:TRESult:DEViation:RATE	-	<real>	
Trace Data				
Power vs Symbol X data reading	:READ:PSYMbol:X	-	<block> or <ASCII>	*2
Power vs Symbol Y data reading	:READ:PSYMbol:Y	-	<block> or <ASCII>	*2
Power Spectrum X data reading	:READ:PSPectrum:X	-	<block> or <ASCII>	*2
Power Spectrum Y data reading	:READ:PSPectrum:Y	-	<block> or <ASCII>	*2
EVM vs Symbol X data reading	:READ:ESYMbol:X	-	<block> or <ASCII>	*2
EVM vs Symbol Y data reading	:READ:ESYMbol:Y	-	<block> or <ASCII>	*2
EVM Spectrum X data reading	:READ:ESPectrum:X	-	<block> or <ASCII>	*2
EVM Spectrum Y data reading	:READ:ESPectrum:Y	-	<block> or <ASCII>	*2

Function description	SCPI command	Parameter	Query reply	Remarks
Mag Error vs Symbol X data reading	:READ:MESYmbol:X	-	<block> or <ASCII>	*2
Mag Error vs Symbol Y data reading	:READ:MESYmbol:Y	-	<block> or <ASCII>	*2
Mag Error Spectrum X data reading	:READ:MESPectrum:X	-	<block> or <ASCII>	*2
Mag Error Spectrum Y data reading	:READ:MESPectrum:Y	-	<block> or <ASCII>	*2
Phase Error vs Symbol X data reading	:READ:PESYmbol:X	-	<block> or <ASCII>	*2
Phase Error vs Symbol Y data reading	:READ:PESYmbol:Y	-	<block> or <ASCII>	*2
Phase Error Spectrum X data reading	:READ:PESPectrum:X	-	<block> or <ASCII>	*2
Phase Error Spectrum Y data reading	:READ:PESPectrum:Y	-	<block> or <ASCII>	*2
Phase vs Symbol X data reading	:READ:PHSYmbol:X	-	<block> or <ASCII>	*2
Phase vs Symbol Y data reading	:READ:PHSYmbol:Y	-	<block> or <ASCII>	*2
Frequency vs Symbol X data reading	:READ:FSYMbol:X	-	<block> or <ASCII>	*2
Frequency vs Symbol Y data reading	:READ:FSYMbol:Y	-	<block> or <ASCII>	*2
Frequency Eye Diagram data reading	:READ:FEYE	-	<block> or <ASCII>	*2
Constellation I data reading	:READ:CONStellation:I	-	<block> or <ASCII>	*2
Constellation Q data reading	:READ:CONStellation:Q	-	<block> or <ASCII>	*2
Transmission Mag Characteristics X data reading	:READ:TMCHaracteristics:X	-	<block> or <ASCII>	*2
Transmission Mag Characteristics Y data reading	:READ:TMCHaracteristics:Y	-	<block> or <ASCII>	*2
Transmission Phase Characteristics X data reading	:READ:TPCHaracteristics:X	-	<block> or <ASCII>	*2
Transmission Phase Characteristics Y data reading	:READ:TPCHaracteristics:Y	-	<block> or <ASCII>	*2
Demodulated Data Synchronous Judgment reading	:READ:DDATa:SYNChronous:JUDGment	-	NSYN|SYNC	
Demodulated Data reading	:READ:DDATa	-	<ASCII>	*2

*2: Data of the measurement length is output.

6.3.11 Subsystem-FETCh

Function description	SCPI command	Parameter	Query reply	Remarks
Total Result(Common)				
Frequency Error reading	:FETCh:TRESult:FERRor	-	<real>,<real>	<Hz>,<ppm>
Frequency reading	:FETCh:TRESult:FREQuency	-	<real>	
Tx Power reading	:FETCh:TRESult:POWer	-	<real>,<real>	<dBm>,<W>
Peak Power reading	:FETCh:TRESult:PEAK:POWer	-	<real>,<real>	<dBm>,<W>
Peak Factor reading	:FETCh:TRESult:PEAK:FACTor	-	<real>	
IQ Origin Offset reading	:FETCh:TRESult:IQOFfset	-	<real>	
Amp Droop reading	:FETCh:TRESult:ADRoop	-	<real>	
Total Result(Not FSK)				
EVM reading	:FETCh:TRESult:EVM	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
Mag Error reading	:FETCh:TRESult:MERRor	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
Phase Error reading	:FETCh:TRESult:PERRor	-	<real>,<real>, <int>	<RMS>,<Peak>, <Peak Symbol>
IQ Imbalance reading	:FETCh:TRESult:IQIMbalance	-	<real>	
Orthogonal Error reading	:FETCh:TRESult:OERRor	-	<real>	
IQ Skew reading	:FETCh:TRESult:IQSKew	-	<real>,<real>	<sec>,<UI>
Symbol Rate Error reading	:FETCh:TRESult:SRERror	-	<real>,<real>	<Hz>,<ppm>
Total Result(FSK)				
Max Deviation reading	:FETCh:TRESult:DEViation:MAXimum	-	<real>,<int>	<Hz>,<Symbol>
Min Deviation reading	:FETCh:TRESult:DEViation:MINimum	-	<real>,<int>	<Hz>,<Symbol>
Min/Max Deviation reading	:FETCh:TRESult:DEViation:RATE	-	<real>	
Trace Data				
Power vs Symbol X data reading	:FETCh:PSYMbol:X	-	<block> or <ASCII>	*2
Power vs Symbol Y data reading	:FETCh:PSYMbol:Y	-	<block> or <ASCII>	*2
Power Spectrum X data reading	:FETCh:PSPectrum:X	-	<block> or <ASCII>	*2
Power Spectrum Y data reading	:FETCh:PSPectrum:Y	-	<block> or <ASCII>	*2
EVM vs Symbol X data reading	:FETCh:ESYMbol:X	-	<block> or <ASCII>	*2
EVM vs Symbol Y data reading	:FETCh:ESYMbol:Y	-	<block> or <ASCII>	*2
EVM Spectrum X data reading	:FETCh:ESPectrum:X	-	<block> or <ASCII>	*2
EVM Spectrum Y data reading	:FETCh:ESPectrum:Y	-	<block> or <ASCII>	*2

Function description	SCPI command	Parameter	Query reply	Remarks
Mag Error vs Symbol X data reading	:FETCh:MESYmbol:X	-	<block> or <ASCII>	*2
Mag Error vs Symbol Y data reading	:FETCh:MESYmbol:Y	-	<block> or <ASCII>	*2
Mag Error Spectrum X data reading	:FETCh:MESPectrum:X	-	<block> or <ASCII>	*2
Mag Error Spectrum Y data reading	:FETCh:MESPectrum:Y	-	<block> or <ASCII>	*2
Phase Error vs Symbol X data reading	:FETCh:PESYmbol:X	-	<block> or <ASCII>	*2
Phase Error vs Symbol Y data reading	:FETCh:PESYmbol:Y	-	<block> or <ASCII>	*2
Phase Error Spectrum X data reading	:FETCh:PESPectrum:X	-	<block> or <ASCII>	*2
Phase Error Spectrum Y data reading	:FETCh:PESPectrum:Y	-	<block> or <ASCII>	*2
Phase vs Symbol X data reading	:FETCh:PHSYmbol:X	-	<block> or <ASCII>	*2
Phase vs Symbol Y data reading	:FETCh:PHSYmbol:Y	-	<block> or <ASCII>	*2
Frequency vs Symbol X data reading	:FETCh:FSYMbol:X	-	<block> or <ASCII>	*2
Frequency vs Symbol Y data reading	:FETCh:FSYMbol:Y	-	<block> or <ASCII>	*2
Frequency Eye Diagram data reading	:FETCh:FEYE	-	<block> or <ASCII>	*2
Constellation I data reading	:FETCh:CONStellation:I	-	<block> or <ASCII>	*2
Constellation Q data reading	:FETCh:CONStellation:Q	-	<block> or <ASCII>	*2
Transmission Mag Characteristics X data reading	:FETCh:TMCHaracteristics:X	-	<block> or <ASCII>	*2
Transmission Mag Characteristics Y data reading	:FETCh:TMCHaracteristics:Y	-	<block> or <ASCII>	*2
Transmission Phase Characteristics X data reading	:FETCh:TPCHaracteristics:X	-	<block> or <ASCII>	*2
Transmission Phase Characteristics Y data reading	:FETCh:TPCHaracteristics:Y	-	<block> or <ASCII>	*2
Demodulated Data Synchronous Judgment reading	:FETCh:DDATa:SYNChronous:JUDGment	-	NSYN|SYNC	
Demodulated Data reading	:FETCh:DDATa	-	<ASCII>	*2

*2: Data of the measurement length is output.

6.3.12 Subsystem-FORMat

Function description	SCPI command	Parameter	Query reply	Remarks
FORMat				
Trace data output byte order setting	:FORMat:BORDer[:DATA]	NORMal|SWAPped	NORM|SWAP	
Trace data output format setting	:FORMat:TRACe[:DATA]	REAL|ASCii, <int>	REAL|ASC,<int>	*3

*3: <int> is selected from {32|64} for REAL and {8|9|10|...|21|22} for ASCii.

6.3.13 Subsystem-STATus

Function description	SCPI command	Parameter	Query reply	Remarks
Status				
Standard Operation Enable Register setting	:STATus:OPERation:ENABle	<int>	<int>	
Standard Operation Event Register setting	:STATus:OPERation:EVENt	-	<int>	
Questionable Enable Register setting	:STATus:QUEStionable:ENABle	<int>	<int>	
Questionable Event Register setting	:STATus:QUEStionable:EVENt	-	<int>	
Measuring Enable Register setting	:STATus:OPERation:MEASure:ENABle	<int>	<int>	
Measuring Operation Event Register setting	:STATus:OPERation:MEASure:EVENt	-	<int>	

6.3.14 Subsystem-HCOPy

Function description	SCPI command	Parameter	Query reply	Remarks
Hcopy				
Copy output to the file or printer	:HCOPy[:IMMediate]	-	-	
Specification of the output destination (file or printer)	:HCOPy:DESTination	MMEMory|PRINt	MMEM|PRIN	
Specification of the output file number	:HCOPy:MMEMory:FILE:NUMBer	<int>	<int>	
Specification of the output file type	:HCOPy:MMEMory:FILE:TYPE	BITMap|PNGraphic	BITM|PNG	

6.4 Status Register

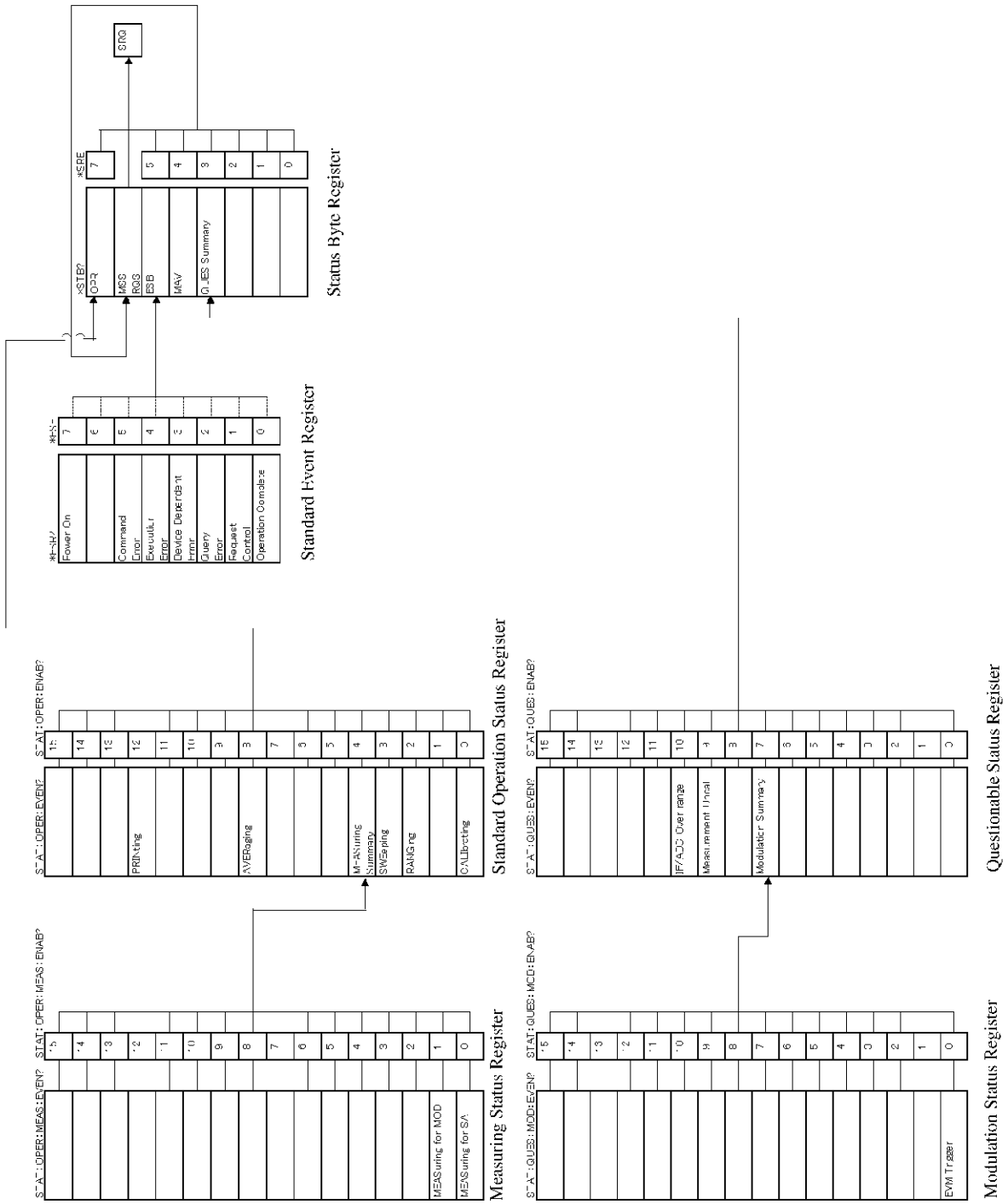


Figure 6-1 Status Registers

7. PERFORMANCE VERIFICATION

This chapter describes how to verify whether this instrument meets the specified performance.

It is recommended that you copy the test data record sheet included in the last of this chapter and save it as a record of the performance test.

IMPORTANT: Before executing the performance verification, execute warm-up and all calibrations.

7.1 Test Signal Specifications

The test signals used for performance verification are shown below:

Table 7-1 Test Signal Specifications (1 of 2)

No.	Test signal name	Signal specifications		Test item
1	8PSK Signal	Carrier frequency :	2 GHz (only RF input)	Power measurement (only RF input) Carrier frequency error measurement EVM measurement
		Power :	-10 dBm (only RF input)	
		Input voltage :	1 Vpp (only IQ input)	
		Symbol rate :	1 MHz	
		Modulation format :	8PSK	
		Transmission filter :	Nyquist, α=0.5	
2	256QAM Signal	Carrier frequency :	2 GHz (only RF input)	Power measurement (only RF input) Carrier frequency error measurement EVM measurement
		Power :	-10 dBm (only RF input)	
		Input voltage :	1 Vpp (only IQ input)	
		Symbol rate :	1 MHz	
		Modulation format :	256QAM	
		Transmission filter :	Nyquist, α=0.5	
		EVM Calculation Method :	RMS	
3	MSK Signal	Carrier frequency :	2 GHz (only RF input)	Power measurement (only RF input) Carrier frequency error measurement EVM measurement
		Power :	-10 dBm (only RF input)	
		Input voltage :	1 Vpp (only IQ input)	
		Symbol rate :	1 MHz	
		Modulation format :	MSK	
		Transmission filter :	Gauss, BT=0.3	

Table 7-1 Test Signal Specifications (2 of 2)

No.	Test signal name	Signal specifications		Test item
4	FSK Signal	Carrier frequency : Power : Input voltage : Symbol rate : Modulation format : Modulation index : Transmission filter :	2 GHz (only RF input) -10 dBm (only RF input) 1 Vpp (only IQ input) 1 MHz FSK 0.32 Gauss, BT=0.5	Power measurement (only RF input) Carrier frequency error measurement Max Deviation measurement

7.2 Test Procedures

This section describes the procedures of each test item.

7.2.1 RF Input Test Signal Measurement

Connect the signal source as shown below.

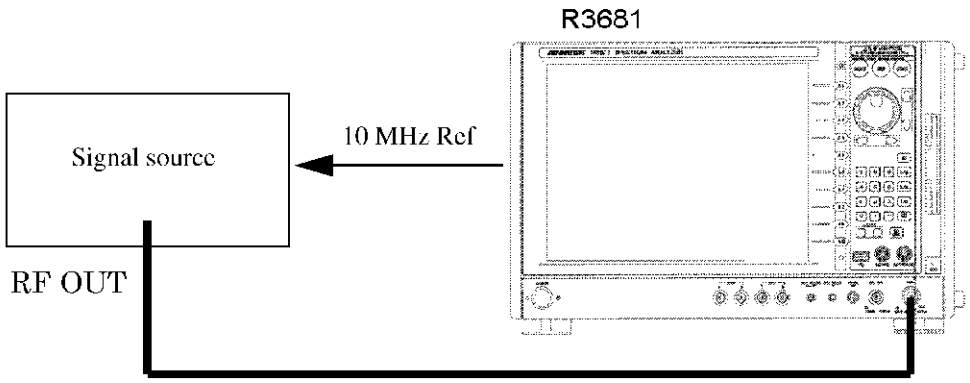


Figure 7-1 Connection Diagram of Signal Source (RF Input)

7.2.1.1 8PSK Measurement

1. Output the 8PSK signal, which has a carrier frequency of 2 GHz and a level of -10 dBm, form the signal source.
2. Set this instrument as follows:

{MEAS SETUP}: **Meas Parameters**

[Symbol Rate]	1000000
[Modulation Format]	8PSK
[Differential Code]	OFF
[A/D Capture Length]	1500
[Analysis Length]	1500
[Burst Search]	OFF
[Compensate Origin Offset]	ON
[EVM Calculation Method]	RMS

Synchronous Parameters

[Synchronization]	OFF

Filter Parameters

[Meas Filter]

[Filter Type]	Sinc

	[Filter Parameter]	0.5
	[Filter Tap]	20
	[Ref Filter]	
	[Filter Type]	Nyqusit
	[Filter Parameter]	0.5
	[Filter Tap]	20
	Average	
	[Average times]	OFF
	Equalizing Filter	OFF
{INPUT}:	**Input**	RF
	IQ Inverse	OFF
{TRIGGER}:	**Trigger Source**	Free Run
{FREQ}:	**Center**	2 GHz
{LEVEL}:	Execute **Auto Level Set**	

3. Press the **SINGLE** button on this unit to perform measurements.
4. Write the measurement results in the test data record sheet.

7.2.1.2 256QAM Measurement

1. Output the 256QAM signal, which has a carrier frequency of 2 GHz and a level of -10 dBm, form the signal source.
2. Set this instrument as follows:

{MEAS SETUP}:	**Meas Parameters**	
	[Symbol Rate]	1000000
	[Modulation Format]	256QAM
	[Differential Code]	OFF
	[A/D Capture Length]	1500
	[Analysis Length]	1500
	[Burst Search]	OFF
	[Compensate Origin Offset]	ON
	[EVM Calculation Method]	RMS
	Synchronous Parameters	
	[Synchronization]	OFF
	Filter Parameters	
	[Meas Filter]	
	[Filter Type]	Sinc
	[Filter Parameter]	0.5
	[Filter Tap]	20

	[Ref Filter]	
	[Filter Type]	Nyqusit
	[Filter Parameter]	0.5
	[Filter Tap]	20
	Average	
	[Average times]	OFF
	Equalizing Filter	OFF
{INPUT}:	**Input**	RF
	IQ Inverse	OFF
{TRIGGER}:	**Trigger Source**	Free Run
{FREQ}:	**Center**	2 GHz
{LEVEL}:	Execute **Auto Level Set**	

3. Press the **SINGLE** button on this unit to perform measurements.
4. Write the measurement results in the test data record sheet.

7.2.1.3 MSK Measurement

1. Output the MSK signal, which has a carrier frequency of 2 GHz and a level of -10 dBm, form the signal source.
2. Set this instrument as follows:

{MEAS SETUP}:	**Meas Parameters**	
	[Symbol Rate]	1000000
	[Modulation Format]	MSK
	[Differential Code]	OFF
	[A/D Capture Length]	1500
	[Analysis Length]	1500
	[Burst Search]	OFF
	[Compensate Origin Offset]	ON
	[EVM Calculation Method]	RMS
	Synchronous Parameters	
	[Synchronization]	OFF
	Filter Parameters	
	[Meas Filter]	
	[Filter Type]	Sinc
	[Filter Parameter]	0.5
	[Filter Tap]	20
	[Ref Filter]	
	[Filter Type]	Gauss

	[Filter Parameter]	0.3
	[Filter Tap]	20
	Average	
	[Average times]	OFF
	Equalizing Filter	OFF
{INPUT}:	**Input**	RF
	IQ Inverse	OFF
{TRIGGER}:	**Trigger Source**	Free Run
{FREQ}:	**Center**	2 GHz
{LEVEL}:	Execute **Auto Level Set**	

3. Press the **SINGLE** button on this unit to perform measurements.
4. Write the measurement results in the test data record sheet.

7.2.1.4 FSK Measurement

1. Output the FSK signal, which has a carrier frequency of 2 GHz and a level of -10 dBm, form the signal source.
2. Set this instrument as follows:

{MEAS SETUP}:	**Meas Parameters**	
	[Symbol Rate]	1000000
	[Modulation Format]	FSK
	[Differential Code]	OFF
	[A/D Capture Length]	1500
	[Analysis Length]	1500
	[Burst Search]	OFF
	[Compensate Origin Offset]	ON
	Synchronous Parameters	
	[Synchronization]	OFF
	Filter Parameters	
	[Meas Filter]	
	[Filter Type]	Sinc
	[Filter Parameter]	0.5
	[Filter Tap]	20
	[Ref Filter]	
	[Filter Type]	Gauss
	[Filter Parameter]	0.5
	[Filter Tap]	20

	Average	
	[Average times]	OFF
{INPUT}:	**Input**	RF
	IQ Inverse	OFF
{TRIGGER}:	**Trigger Source**	Free Run
{FREQ}:	**Center**	2 GHz
{LEVEL}:	Execute **Auto Level Set**	

3. Press the **SINGLE** button on this unit to perform measurements.
4. Write the measurement results in the test data record sheet.

7.2.2 IQ Input Test Signal Measurement

Connect the signal source as shown below.

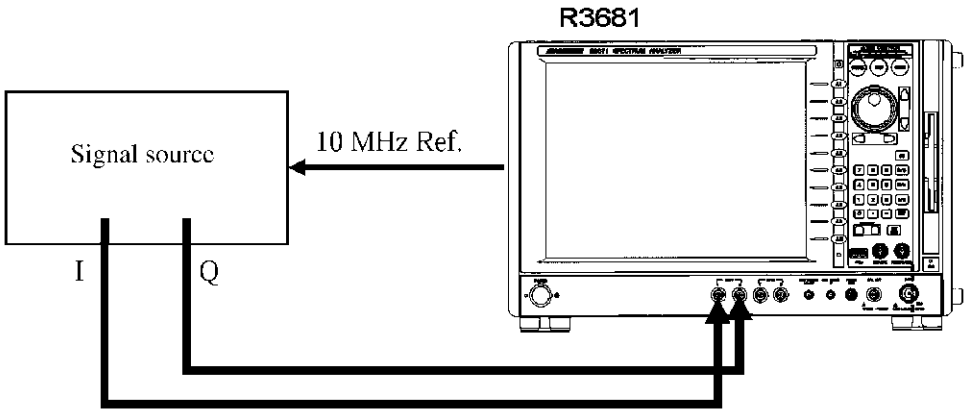


Figure 7-2 Connection Diagram of Signal Source (IQ Input)

7.2.2.1 8PSK Measurement

1. Output the 8PSK signal that has a voltage of 1 Vpp form the signal source.
2. Set this instrument as follows:

{MEAS SETUP}: **Meas Parameters**

[Symbol Rate]	1000000
[Modulation Format]	8PSK
[Differential Code]	OFF
[A/D Capture Length]	1500
[Analysis Length]	1500
[Burst Search]	OFF
[Compensate Origin Offset]	ON
[EVM Calculation Method]	RMS

Synchronous Parameters

[Synchronization]	OFF

Filter Parameters

[Meas Filter]	
[Filter Type]	Sinc
[Filter Parameter]	0.5
[Filter Tap]	20
[Ref Filter]	
[Filter Type]	Nyqusit
[Filter Parameter]	0.5

	[Filter Tap]	20
	Average	
	[Average times]	OFF
	Equalizing Filter	OFF
{INPUT}:	**Input**	Baseband(I&Q)
	Baseband Input	DC
	IQ Inverse	OFF
{TRIGGER}:	**Trigger Source**	Free Run

3. Press the **SINGLE** button on this unit to perform measurements.
4. Write the measurement results in the test data record sheet.

7.2.2.2 256QAM Measurement

1. Output the 256QAM signal that has a voltage of 1 Vpp form the signal source.
2. Set this instrument as follows:

{MEAS SETUP}:	**Meas Parameters**	
	[Symbol Rate]	1000000
	[Modulation Format]	256QAM
	[Differential Code]	OFF
	[A/D Capture Length]	1500
	[Analysis Length]	1500
	[Burst Search]	OFF
	[Compensate Origin Offset]	ON
	[EVM Calculation Method]	RMS
	Synchronous Parameters	
	[Synchronization]	OFF
	Filter Parameters	
	[Meas Filter]	
	[Filter Type]	Sinc
	[Filter Parameter]	0.5
	[Filter Tap]	20
	[Ref Filter]	
	[Filter Type]	Nyqusit
	[Filter Parameter]	0.5
	[Filter Tap]	20
	Average	
	[Average times]	OFF
	Equalizing Filter	OFF

{INPUT}:	**Input**	Baseband(I&Q)
	Baseband Input	DC
	IQ Inverse	OFF
{TRIGGER}:	**Trigger Source**	Free Run

3. Press the SINGLE button on this unit to perform measurements.
4. Write the measurement results in the test data record sheet.

7.2.2.3 MSK Measurement

1. Output the MSK signal that has a voltage of 1 Vpp form the signal source.
2. Set this instrument as follows:

{MEAS SETUP}:	**Meas Parameters**	
	[Symbol Rate]	1000000
	[Modulation Format]	MSK
	[Differential Code]	OFF
	[A/D Capture Length]	1500
	[Analysis Length]	1500
	[Burst Search]	OFF
	[Compensate Origin Offset]	ON
	[EVM Calculation Method]	RMS
	Synchronous Parameters	
	[Synchronization]	OFF
	Filter Parameters	
	[Meas Filter]	
	[Filter Type]	Sinc
	[Filter Parameter]	0.5
	[Filter Tap]	20
	[Ref Filter]	
	[Filter Type]	Gauss
	[Filter Parameter]	0.3
	[Filter Tap]	20
	Average	
	[Average times]	OFF
	Equalizing Filter	OFF
{INPUT}:	**Input**	Baseband(I&Q)
	Baseband Input	DC
	IQ Inverse	OFF

{TRIGGER}:	**Trigger Source**	Free Run

3. Press the **SINGLE** button on this unit to perform measurements.
4. Write the measurement results in the test data record sheet.

7.2.2.4 FSK Measurement

1. Output the FSK signal that has a voltage of 1 Vpp form the signal source.
2. Set this instrument as follows:

{MEAS SETUP}:	**Meas Parameters**	
	[Symbol Rate]	1000000
	[Modulation Format]	FSK
	[Differential Code]	OFF
	[A/D Capture Length]	1500
	[Analysis Length]	1500
	[Burst Search]	OFF
	[Compensate Origin Offset]	ON
	Synchronous Parameters	
	[Synchronization]	OFF
	Filter Parameters	
	[Meas Filter]	
	[Filter Type]	Sinc
	[Filter Parameter]	0.5
	[Filter Tap]	20
	[Ref Filter]	
	[Filter Type]	Gauss
	[Filter Parameter]	0.5
	[Filter Tap]	20
	Average	
	[Average times]	OFF
	Equalizing Filter	OFF
{INPUT}:	**Input**	Baseband(I&Q)
	Baseband Input	DC
	IQ Inverse	OFF
{TRIGGER}:	**Trigger Source**	Free Run

3. Press the **SINGLE** button on this unit to perform measurements.
4. Write the measurement results in the test data record sheet.

7.3 Test Data Record Sheet

Test data record sheet

Model name:

Serial number:

7.3.1 RF Input

7.3.1.1 8PSK Signal

Test item	Specifications			Determination Pass / Fail
	Minimum value	Measured value	Maximum value	
Carrier frequency error	-20 Hz		20 Hz	
EVM (RMS)	None		2.0%rms	
Transmission power	-10.9 dBm		-9.1 dBm	

7.3.1.2 256QAM Signal

Test item	Specifications			Determination Pass / Fail
	Minimum value	Measured value	Maximum value	
Carrier frequency error	-20 Hz		20 Hz	
EVM (RMS)	None		2.0%rms	
Transmission power	-10.9 dBm		-9.1 dBm	

7.3.1.3 MSK Signal

Test item	Specifications			Determination Pass / Fail
	Minimum value	Measured value	Maximum value	
Carrier frequency error	-20 Hz		20 Hz	
EVM (RMS)	None		2.5%rms	
Transmission power	-10.9 dBm		-9.1 dBm	

7.3.1.4 FSK Signal

Test item	Specifications			Determination Pass / Fail
	Minimum value	Measured value	Maximum value	
Carrier frequency error	-200 Hz		200 Hz	
Max Deviation	130 kHz		190 kHz	
Transmission power	-10.9 dBm		-9.1 dBm	

7.3.2 IQ Input

7.3.2.1 8PSK Signal

Test item	Specifications			Determination Pass / Fail
	Minimum value	Measured value	Maximum value	
Carrier frequency error	-5 Hz		5 Hz	
EVM (RMS)	None		1.5%rms	

7.3.2.2 256QAM Signal

Test item	Specifications			Determination Pass / Fail
	Minimum value	Measured value	Maximum value	
Carrier frequency error	-5 Hz		5 Hz	
EVM (RMS)	None		1.5%rms	

7.3.2.3 MSK Signal

Test item	Specifications			Determination Pass / Fail
	Minimum value	Measured value	Maximum value	
Carrier frequency error	-5 Hz		5 Hz	
EVM (RMS)	None		2.0%rms	

7.3.2.4 FSK Signal

Test item	Specifications			Determination Pass / Fail
	Minimum value	Measured value	Maximum value	
Carrier frequency error	-50 Hz		50 Hz	
Max Deviation	130 kHz		190 kHz	

8. SPECIFICATIONS

8.1 Conditions

8.1.1 Instrument Conditions

Item	Specifications
Ambient temperature range	+20°C to +30°C
Input frequency range	
RF input	50 MHz to 6 GHz
Input level range	
RF input	For Preamp OFF After Auto Level Set is complete.
IQ input	<1 Vpp
Measurement Parameters	
Analysis Length	1500 Symbol
Compensate Origin Offset	ON
EVM Calculation Mathod	RMS
Filter Parameters	
Meas Filter	
Filter Type	Sinc
Filter Parameter	0.5
Filter Tap	20

8.1.2 Conditions of Signal to Be Measured

Item	Specifications
Modulation format	8PSK, 256QAM, MSK, FSK
Carrier frequency error	0 Hz
EVM	0%rms
Level	
RF input	-10 dBm
IQ input	1 Vpp
Transmission filter	
8PSK, 256QAM	Nyquist, α=0.5
MSK	Gauss, BT=0.3
FSK	Gauss, BT=0.5
Modulation index	
FSK	0.32

8.2 Single-Carrier General-Purpose Modulation Analysis Performance

8.2.1 RF Input

The reference frequency accuracy, frequency response, and calibration signal level accuracy depend on the specifications of the R3681 series. All specifications are specified after Auto Level Set is executed.

8.2.1.1 8PSK Signal

Item	Specifications
Carrier frequency error	
Measurement accuracy	
Symbol Rate 10 kHz to 5 MHz	<±(Reference frequency accuracy × Carrier frequency + 20) Hz
Symbol Rate 5 MHz to 20 MHz	<±(Reference frequency accuracy × Carrier frequency + 50) Hz
EVM	
Residual EVM	
Symbol Rate 10 kHz to 300 kHz	≤5.0%rms
Symbol Rate 300 kHz to 5 MHz	≤2.0%rms
Symbol Rate 5 MHz to 20 MHz	≤4.0%rms
Power measurement	
Accuracy	
Symbol Rate 10 kHz to 20 MHz	<±(0.3+Frequency response + Calibration signal level accuracy) dB

8.2.1.2 256QAM Signal

Item	Specifications
Carrier frequency error	
Measurement accuracy	
Symbol Rate 10 kHz to 5 MHz	<±(Reference frequency accuracy × Carrier frequency + 20) Hz
Symbol Rate 5 MHz to 20 MHz	<±(Reference frequency accuracy × Carrier frequency + 50) Hz
EVM	
Residual EVM	
Symbol Rate 10 kHz to 300 kHz	≤5.0%rms
Symbol Rate 300 kHz to 5 MHz	≤2.0%rms
Symbol Rate 5 MHz to 20 MHz	≤4.0%rms
Power measurement	
Accuracy	
Symbol Rate 10 kHz to 20 MHz	<±(0.3 + Frequency response + Calibration signal level accuracy) dB

8.2.1.3 MSK Signal

Item	Specifications
Carrier frequency error	
Measurement accuracy	
Symbol Rate 10 kHz to 5 MHz	<±(Reference frequency accuracy × Carrier frequency + 20) Hz
Symbol Rate 5 MHz to 20 MHz	<±(Reference frequency accuracy × Carrier frequency + 50) Hz
EVM	
Residual EVM	
Symbol Rate 10 kHz to 300 kHz	≤5.0%rms
Symbol Rate 300 kHz to 5 MHz	≤2.5%rms
Symbol Rate 5 MHz to 20 MHz	≤4.5%rms
Power measurement	
Accuracy	
Symbol Rate 10 kHz to 20 MHz	<±(0.3+Frequency response + Calibration signal level accuracy) dB

8.2.1.4 FSK Signal

Item	Specifications
Carrier frequency error	
Measurement accuracy	
Symbol Rate 10 kHz to 40 kHz	<±(Reference frequency accuracy × Carrier frequency + 8) Hz
Symbol Rate 40 kHz to 20 MHz	<±(Reference frequency accuracy × Carrier frequency+ 2.0×10^{-4} × Symbol Rate) Hz
Max Deviation	
Measurement accuracy	
Symbol Rate 10 kHz to 20 MHz	<± (0.03 × Symbol Rate) Hz
Power measurement	
Accuracy	
Symbol Rate 10 kHz to 20 MHz	<±(0.3 +Frequency response + Calibration signal level accuracy) dB

8.2.2 IQ Input

8.2.2.1 8PSK Signal

Item	Specifications
Carrier frequency error	
Measurement accuracy	
Symbol Rate 10 kHz to 20 MHz	<±5 Hz
EVM	
Residual EVM	
Symbol Rate 10 kHz to 20 MHz	<1.5%rms

8.2.2.2 256QAM Signal

Item	Specifications
Carrier frequency error	
Measurement accuracy	
Symbol Rate 10 kHz to 20 MHz	<±5 Hz
EVM	
Residual EVM	
Symbol Rate 10 kHz to 20 MHz	<1.5%rms

8.2.2.3 MSK Signal

Item	Specifications
Carrier frequency error	
Measurement accuracy	
Symbol Rate 10 kHz to 20 MHz	<±5 Hz
EVM	
Residual EVM	
Symbol Rate 10 kHz to 20 MHz	<2.0%rms

8.2.2.4 FSK Signal

Item	Specifications
Carrier frequency error	
Measurement accuracy	
Symbol Rate 10 kHz to 100 kHz	<±5 Hz
Symbol Rate 100 kHz to 20 MHz	<±(5.0 × 10^{-5} × Symbol Rate) Hz
Max Deviation	
Measurement accuracy	
Symbol Rate 10 kHz to 20 MHz	<±(0.03 × Symbol Rate) Hz

APPENDIX

This section describes the following supplemental information.

A.1 Technical Notes

A.2 Error Message List

A.3 Warning Message List

A.1 Technical Notes

A.1.1 How to Calculate Measurement Values

EVM, Mag Error, and Phase Error are calculated by using the following equation after the frequency error, magnitude, origin offset (when Compensate Origin Offset is set to ON), and droop are corrected.

Error Vector Magnitude (EVM)

EVM is defined by Figure A-1 and calculated by using the following equations.

When EVM Calculate Method is set to RMS:

$$EVM = \sqrt{\frac{\sum_{i}^{K}\left\{\left(Im(i)-Ir(i)\right)^2+\left(Qm(i)-Qr(i)\right)^2\right\}}{\sum_{i}^{K}\left\{Ir(i)^2+Qr(i)^2\right\}}} \times 100\ [\%]$$

When EVM Calculate Method is set to Max:

$$EVM = \sqrt{\frac{\left[\sum_{i}^{K}\left\{\left(Im(i)-Ir(i)\right)^2+\left(Qm(i)-Qr(i)\right)^2\right\}\right] \Big/ K}{Max\left\{Ir(i)^2+Qr(i)^2\right\}}} \times 100\ [\%]$$

Im(i),Qm(i):	Measurement value
Ir(i),Qr(i):	Reference value
i:	Symbol number
K:	Measurement length

Mag Error

Mag Error is defined by Figure A-1 and calculated by using the following equation.

When EVM Calculate Method is set to RMS:

$$MagError = \sqrt{\frac{\sum_{i}^{K}\left\{\sqrt{Im(i)^2 + Qm(i)^2} - \sqrt{Ir(i)^2 + Qr(i)^2}\right\}}{\sum_{i}^{K}\left\{Ir(i)^2 + Qr(i)^2\right\}}} \times 100\ [\%]$$

When EVM Calculate Method is set to Max:

$$MagError = \sqrt{\frac{\left[\sum_{i}^{K}\left\{\sqrt{Im(i)^2 + Qm(i)^2} - \sqrt{Ir(i)^2 + Qr(i)^2}\right\}\right] \Big/ K}{Max\left\{Ir(i)^2 + Qr(i)^2\right\}}} \times 100\ [\%]$$

Im(i),Qm(i):	Measurement value
Ir(i),Qr(i):	Reference value
i:	Symbol number
K:	Measurement length

Phase Error

Phase Error is defined by Figure A-1 and calculated by using the following equation.

$$PhaseError = \sqrt{\frac{\sum_{i}^{K}\left\{\tan^{-1}(Qm(i)/Im(i)) - \tan^{-1}(Qr(i)/Ir(i))\right\}^2}{K}} \times 180/\pi\ [\text{deg}]$$

Im(i),Qm(i):	Measurement value
Ir(i),Qr(i):	Reference value
i:	Chip number
K:	Measurement length

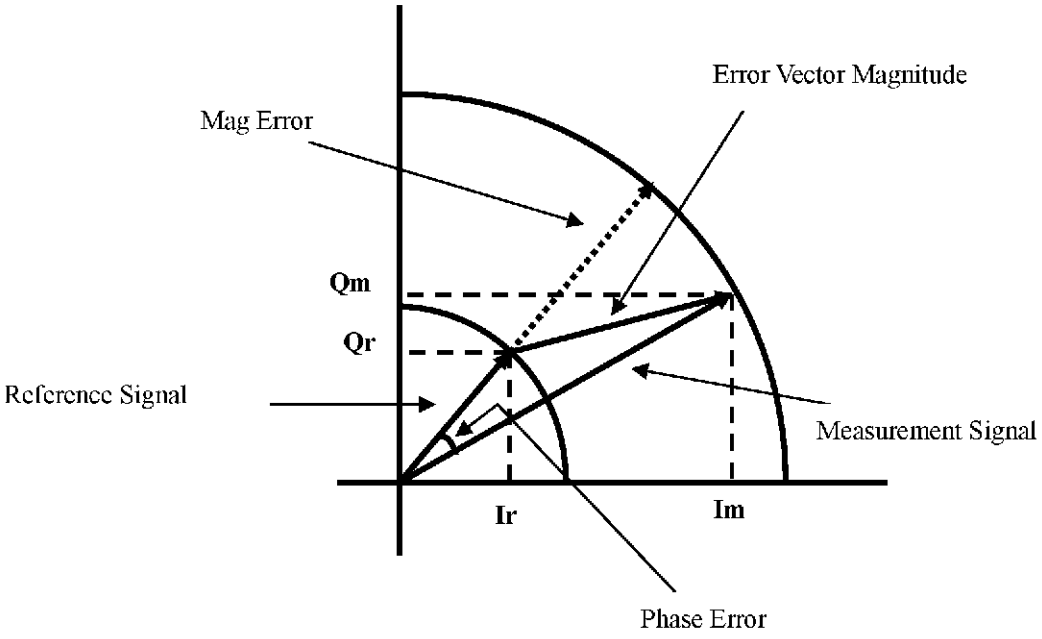


Figure A-1 Error Vector Magnitude, Magnitude Error, Phase Error

A.1.2 Symbol Mapping

The mapping of each Modulation Format is shown in the following. When Differential Code is set to ON, the mapping shows the amount of phase variation. The MSB is shown at the left in the mapping and LSB is shown at the right.

MEMO: ***Because Demodulated Data of Window Format is displayed from the LSB, the left and right of the display are reversed to the mapping bit display.***

A.1.2.1 BPSK

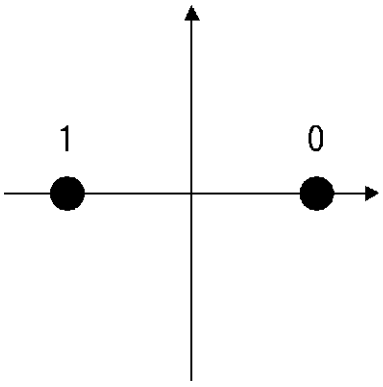


Figure A-2 BPSK Mapping

A.1.2.2 QPSK(π/4 DQPSK)

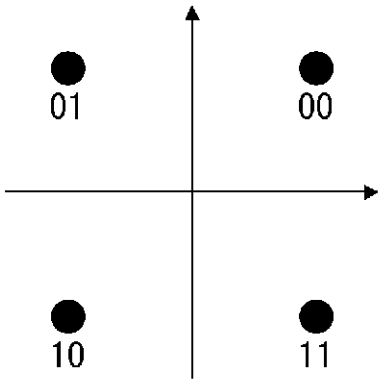


Figure A-3 QPSK Mapping

The phase of 00 is 0 degree in Differential. The phase of 00 is 45 degrees in π/4 DQPSK.

A.1.2.3 8PSK

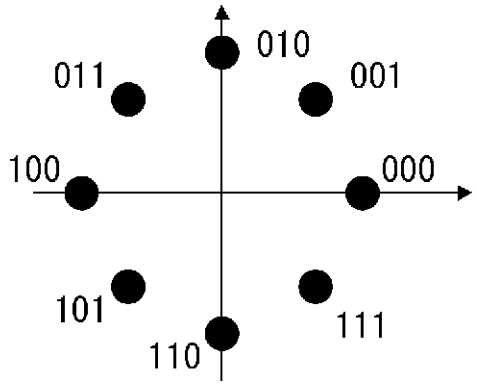


Figure A-4 8PSK Mapping

A.1.2.4 16QAM (Differential Code OFF)

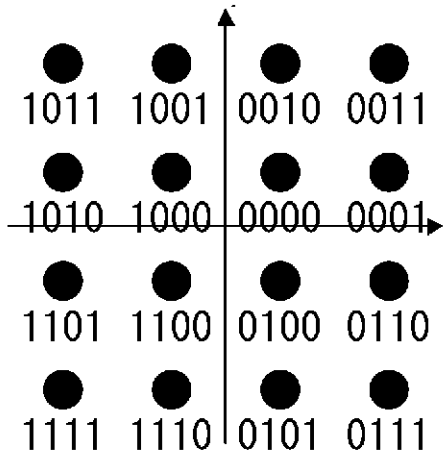


Figure A-5 16QAM Mapping (Differential Code OFF)

A.1.2.5 16QAM (Differential Code ON)

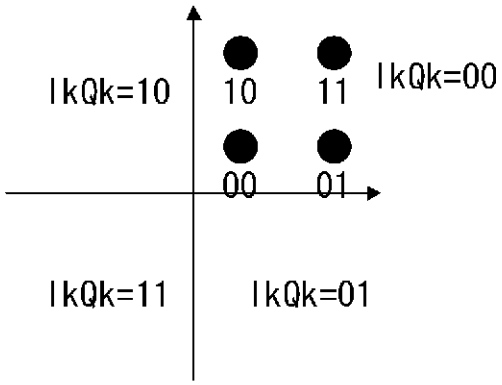


Figure A-6 16QAM Mapping (Differential Code ON)

A quadrant is coded by using the following equations in which A_k represents MSB and B_k represents MSB-1.

$$I_k = \left(\overline{A_k \oplus B_k}\right) \cdot \left(A_k \oplus I_{k-1}\right) + \left(A_k \oplus B_k\right) \cdot \left(A_k \oplus Q_{k-1}\right)$$
$$Q_k = \left(\overline{A_k \oplus B_k}\right) \cdot \left(B_k \oplus Q_{k-1}\right) + \left(A_k \oplus B_k\right) \cdot \left(B_k \oplus I_{k-1}\right)$$

The above equations are also used for the following QAM signals.

A.1.2.6 32QAM (Differential Code OFF)

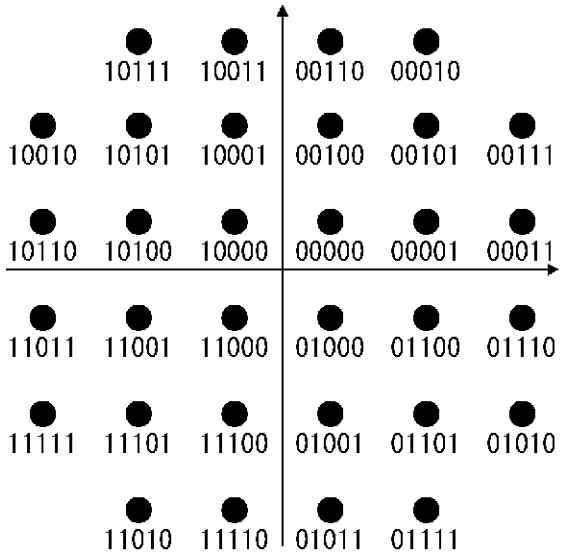


Figure A-7 32QAM Mapping (Differential Code OFF)

A.1.2.7 32QAM (Differential Code ON)

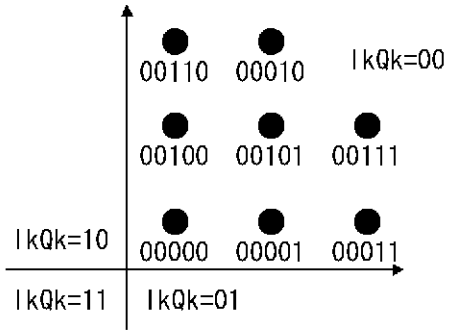


Figure A-8 32QAM Mapping (Differential Code ON)

A.1.2.8 64QAM (Differential Code OFF)

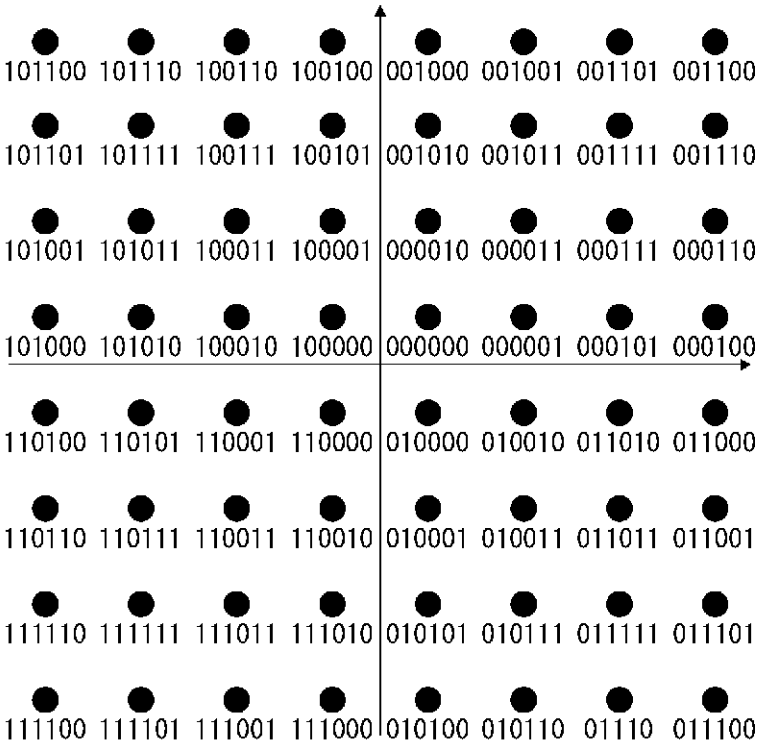


Figure A-9 64QAM Mapping (Differential Code OFF)

A.1.2.9 64QAM (Differential Code ON)

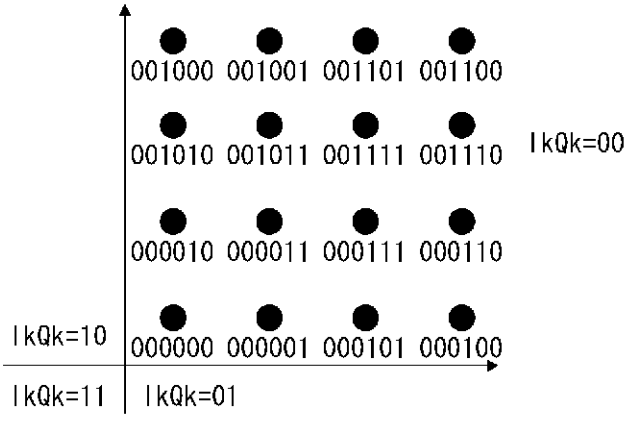


Figure A-10 64QAM Mapping (Differential Code ON)

A.1.2.10 128QAM (Differential Code OFF)

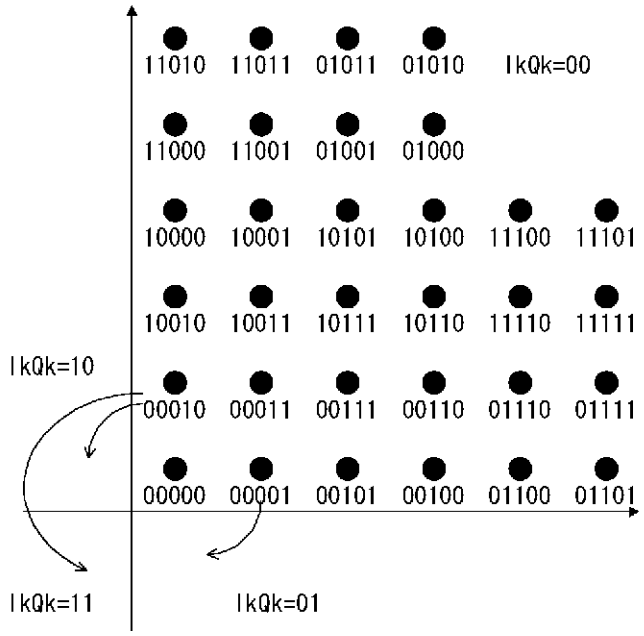


Figure A-11 128QAM Mapping (Differential Code OFF)

Figure A-11 shows the mapping of the Bit value, which excludes MSB and MSB-1, in the first quadrant. Each Bit value mapping in the second, third, and forth quadrants rotates by 90, 180, and 270 degrees respectively with respect to the Bit value mapping in the first quadrant. The values of MSB and MSB-1are represented by IkQk and each symbol is represented by 7 bits.

A.1.2.11 128QAM (Differential Code ON)

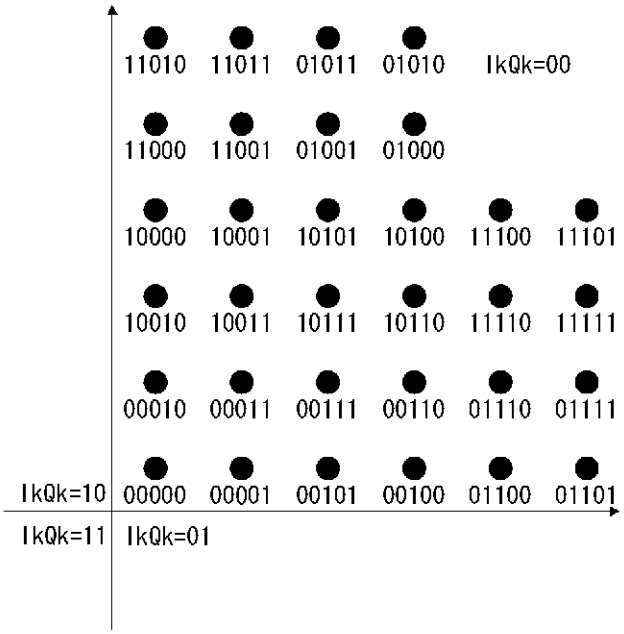


Figure A-12 128QAM Mapping (Differential Code ON)

A.1.2.12 256QAM (Differential Code OFF)

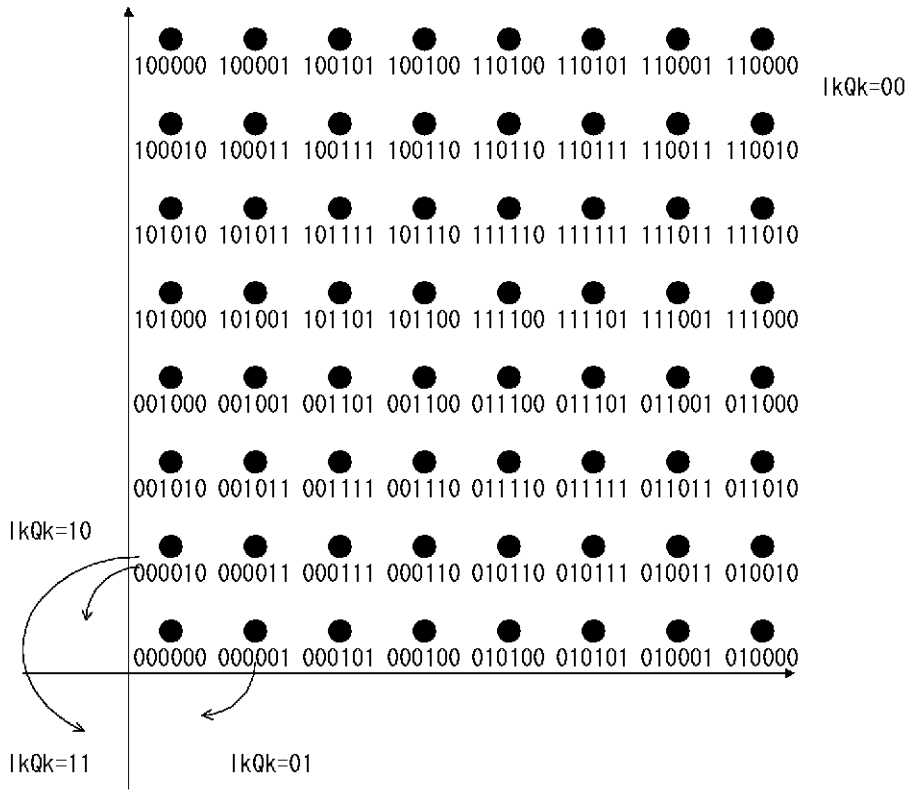


Figure A-13 125QAM Mapping (Differential Code OFF)

Figure A-13 shows the mapping of the Bit value, which excludes MSB and MSB-1, in the first quadrant. Each Bit value mapping in the second, third, and forth quadrants rotates by 90, 180, and 270 degrees respectively with respect to the Bit value mapping in the first quadrant. The values of MSB and MSB-1are represented by IkQk and each symbol is represented by 8 bits.

A.1.2.13 256QAM (Differential Code ON)

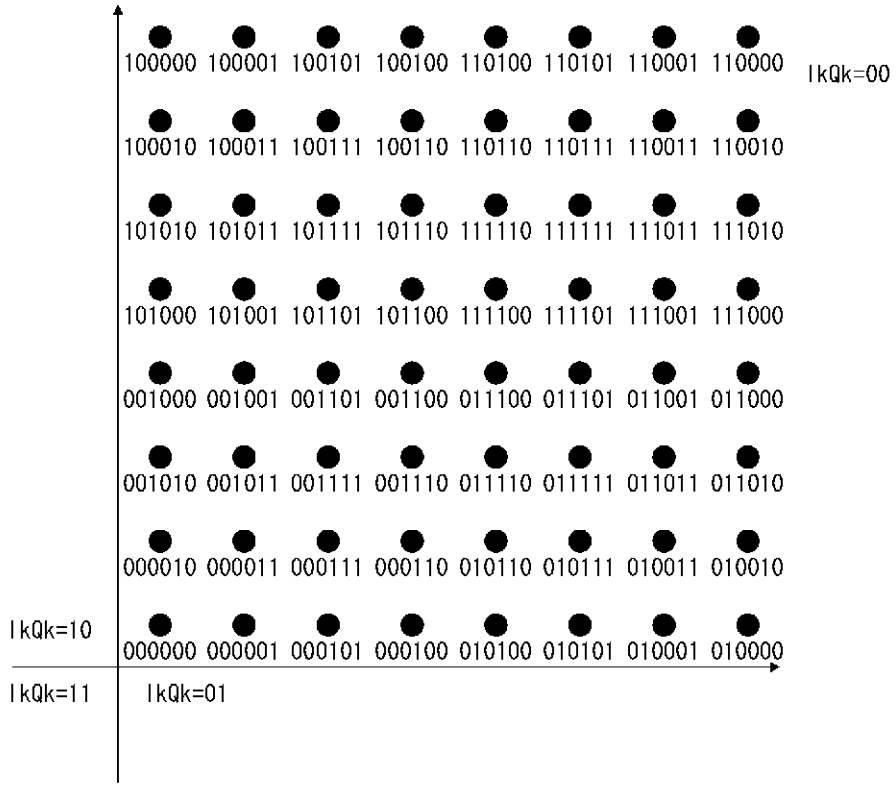


Figure A-14 256QAM Mapping (Differential Code ON)

A.1.2.14 MSK, FSK

Table A-1 MSK and FSK Mapping

Bit value	0	1
Frequency	+	-

The Differential coding is performed according to the following equation.

$\hat{d}_i = d_i \oplus d_{i-1}$ where $\oplus$ denotes modulo 2 addition.

A.1.3 Synchronous Word Setting

Synchronous Word is set by writing it from the LSB and converting it to hexadecimal in units of 8 bits. If a unit contains less than 8 bits, zeros are added at the end.

For example, GSM TSC0 is shown below. The Synchronous Word in GSM TSC0 is provided as shown below.

00100101110000100010010111(26 bit)

Delimit this by units of 8 bits and convert it to hexadecimal.

25 C2 25 C0

The Synchronous Offset in GSM is 61 symbols. After these settings are complete, the Synchronous Parameters Setup dialog box is shown below.

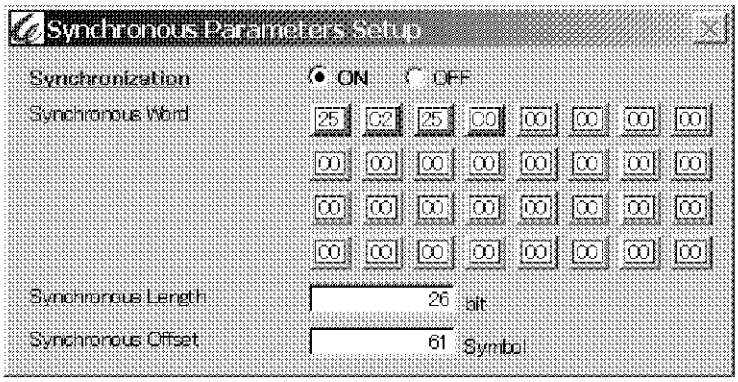


Figure A-15 Synchronous Parameters Setup Dialog Box

A.1.4 Cutoff of Filter Type Sinc

The cutoff is set in Filter Parameter when Filter Type is set to Sinc. Set the cutoff by the ratio of the cutoff frequency to the Nyquist frequency that is used when Oversampling is set to 4 in any modulation format except for FSK and is set to 8 in FSK. Figure A-16 shows examples of the power spectrum measured under the following conditions: Symbol rate; 1 MHz, QPSK signal, Meas Filter; Sinc filter, and Filter Parameter; 1.0, 0.75, and 0.5

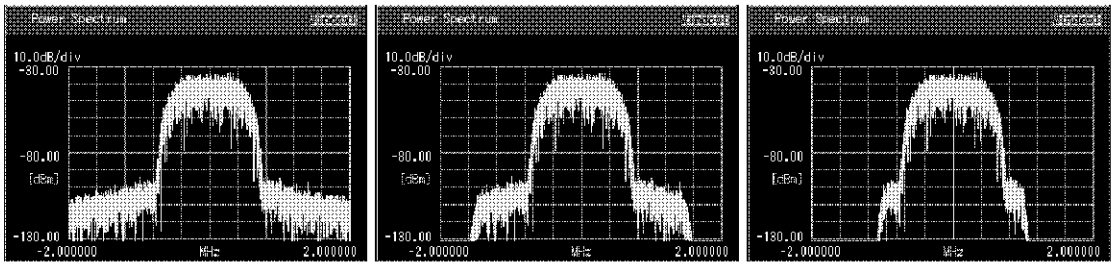


Figure A-16 QPSK Signal Power Spectrum for each Cutoff

For the Nyquist frequency of 2 MHz, each spectrum is analyzed by using the filters that have cutoff frequencies of 2 MHz, 1.5 MHz, and 1 MHz. If adjacent channels or noise are close to the signal to be measured, reduce the cutoff to prevent the modulation accuracy from deteriorating and measure the signal. The longer the Tap size of the filter, the sharper the cutoff characteristic and the more accurate the modulation accuracy.

A.1.5 Tx Power and Peak Power in Total Result

Tx Power and Peak Power displayed in Total Result are measurement results of power through Meas Filter. For example, when Meas Filter is set to the Root Nyquist filter ($\alpha = 0.22$), the displayed Tx Power is lower by 0.24 dB than the actual transmission power.

A.1.6 A/D Capture Length and Analysis Length

The number of symbols of A/D data acquired into memory is set in A/D Capture Length. The number of symbols of data to be actually analyzed is set in Analysis Length. The A/D data acquired in the memory is searched for the burst signal or Synchronous Word in the burst signal analysis or synchronous analysis by using Synchronous Word.

When the burst signal is measured, the burst signal must be included in the acquired A/D data. When the TDMA signal is measured, A/D Capture Length must be set to 2-frame length. As a concrete example, the GSM signal measurement is shown below. The GSM signal includes 1250 symbols in one frame. When 1-slot communication signal exists in one frame, A/D Capture Length must be set to 2500 because 2-frame A/D data must be acquired to acquire the 1-slot communication signal surely in the A/D memory. Figure A-17 shows an example of acquiring the burst signal into the A/D memory.

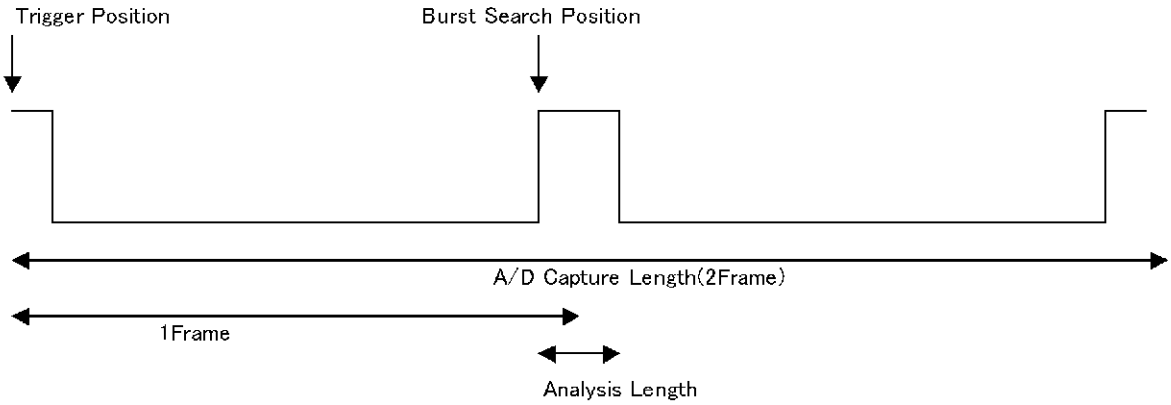


Figure A-17 Example of Acquiring the Burst Signal into the A/D Memory

When a signal is measured by synchronizing with Synchronous Word, Synchronous Word must be included in the acquired A/D data. Set A/D Capture Length to 2-frame length as when measuring the burst signal.

When a CW signal is measured by not synchronizing with Synchronous Word, set the same value to both A/D Capture Length and Analysis Length.

A.1.7 Standard Setting parameter

Table A-2 shows each standard setting parameter that can be set by touching the **Standard** key.

Table A-2 Standard Setting Parameter

Standard	Symbol Rate	Modulation Format	Differential Code	A/D Capture Length	Analysis Length
PDC	21 k	π/4 DQPSK	ON	400	135
GSM	270.833 k	MSK	ON	2500	148
PHS (PHP)	192 k	π/4 DQPSK	ON	1100	111
DECT	1152 k	FSK	OFF	11200	424
CDPD	19.2 k	MSK	OFF	378	378
TETRA	18 k	π/4 DQPSK	ON	1300	231
DVB-C	5.274 M	64QAM	ON	1088	1088
Bluetooth	1 M	FSK	OFF	1464	366

Standard	Burst Search	Search Threshold	Amplitude Synchronization	Analysis Start Offset	Compensate Orgin Offset	EVM Calculation Method
PDC	ON	-20	ON	---	ON	RMS
GSM	ON	-20	ON	---	OFF	RMS
PHS (PHP)	ON	-20	ON	---	ON	RMS
DECT	ON	-20	ON	---	OFF	RMS
CDPD	OFF	---	---	---	ON	RMS
TETRA	ON	-20	ON	---	ON	RMS
DVB-C	OFF	---	---	---	ON	MAX
Bluetooth	ON	-20	ON	---	OFF	RMS

Standard	Meas Filter Type	Meas Filter Parameter	Meas Filter Tap	Ref Filter Type	Ref Filter Parameter	Ref Filter Tap
PDC	Root Nyquist	0.5	8	Nyquist	0.5	8
GSM	Sinc	0.5	8	Gauss	0.3	8
PHS (PHP)	Root Nyquist	0.5	8	Nyquist	0.5	8
DECT	Sinc	0.5	8	Gauss	0.5	8
CDPD	Sinc	0.75	8	Gauss	0.5	8
TETRA	Root Nyquist	0.35	8	Nyquist	0.35	8
DVB-C	Root Nyquist	0.13	20	Nyquist	0.13	20
Bluetooth	Sinc	0.5	8	Gauss	0.5	8

A.1.8 File Format of the User Filter

Create the user filter by setting Oversampling to 4 when Modulation Format is set to any format except for FSK, and by setting Oversampling to 8 when Modulation Format is set to FSK. Set the number of data points to "the number of filter symbols × Oversampling + 1".

The ASCII format is used as the file format and LF is used as the data delimiter.

An example of the user filter (10 symbols)

2.70472e-034

-3.75317e-005

1.7917e-019

0.000402921

-7.83731e-019

-0.00140999

1.97597e-018

0.0035743

-3.91292e-018

-0.00768832

6.62645e-018

0.0149294

-9.93553e-018

-0.0272815

1.34316e-017

0.0492443

-1.65511e-017

-0.0968188

1.87148e-017

0.315094

0.499983

0.315094

1.87148e-017

-0.0968188

-1.65511e-017

0.0492443

1.34316e-017

-0.0272815

-9.93553e-018

0.0149294

6.62645c-018
-0.00768832
-3.91292e-018
0.0035743
1.97597c-018
-0.00140999
-7.83731e-019
0.000402921
1.7917e-019
-3.75317c-005
2.70472e-034

Create the file with extension ".flt".

A.1.9 Demodulated Data Saving Function

The demodulated data can be saved by touching the **Save Demod Data** key. When Synchronization is set to ON and the measurement signal is synchronized with the synchronous signal, "Sync" is displayed to the right of Synchronous Word.

The format is as follows:

```
*****Parameters*****
setting
***** Results *****
Synchronous Judgment
<<< Demodulated Data >>>
Title line
Symbol number, b0, b1, ..., bn, Sync
```

Example 1 QPSK measurement

```
***** Parameters *****
2005/07/21  16:42:00
Input,RF
Center Freq[Hz],2000000000
Ref Level[dBm],5.0
ATT[dB],0
Preamp,OFF
Baseband,DC
IQ Inverse,OFF
Symbol Rate[Hz],1000000
Modulation Format,QPSK
Differential Code,OFF
A/D Capture Length[Symbol],20000
Analysis Length[Symbol],1500
Burst Search,OFF
Search Threshold[dB],-20
Amplitude Synchronization,ON
Analysis Start Offset[Symbol],0
Compensate Origin Offset,ON
EVM Calculation Method,RMS
Synchronoization,ON
Synchronous Word,ABCD00000000000000000000000000000000000000000000000000000000000000000000
Synchronous Length[bit],16
Synchronous Offset[Symbol],2
Meas Filter Type,Sinc
Meas Filter Parameter,0.50
Meas Filter Tap[Symbol],20
Ref Filter Type,Nyquist
Ref Filter Parameter,0.50
Ref Filter Tap[Symbol],20
Average,OFF
Average Times,1/1
Average Peak Type,Hold
Equalizing Filter,OFF
***** Results *****
Synchronous Judgment,Synchronous
<<< Demodulated Data >>>
Symbol,b0,b1,Sync
0,1,0,****
```

A.1.9 Demodulated Data Saving Function

```
1,0,1,****
2,1,0,Sync
3,1,0,Sync
4,1,0,Sync
5,1,1,Sync
6,1,1,Sync
7,0,0,Sync
8,1,1,Sync
9,0,1,Sync
10,0,0,****
11,0,0,****
12,1,0,****
13,1,0,****
14,0,1,****
15,1,1,****
   :
```

A.2 Error Message List

This section describes error messages displayed on this instrument.

The following information is included.

- Error number
- Displayed message
- Cause of the error and action to be taken

Table A-3 Error Message List

Error number	Displayed message	Description
-1250	No such file or directory.	The file or directory does not exist. Check the file name or directory name.
-1251	Permission denied.	File operation is forbidden. Check the drive name, file name, or directory name.
-1252	Not enough space on the disk.	Not enough space is available. Delete all unnecessary files.
-1253	File read/write error.	A file I/O error occurred. Check if there is sufficient disk space or the disk is write-protected.
-1300	Device is not ready.	No disk is inserted.
-1500	Option required.	The appropriate option function is required.
-3210	Input Level is out of range. Check the Ref. Level.	The input signal level is outside the permitted range. Check the reference level or input signal level.
-3211	Auto Level Set cannot be succeed. Signal level is not stable.	Auto Level Set is not complete. Check to see if the input signal level is not constant or if the attenuator is set to manual
-3228	Not available in I/Q input mode.	Cannot be set when the Baseband input is specified.
-3242	Cannot find out Burst.	Burst cannot be detected in A/D data.
-3264	Wrong data size.	The data size is not correct.
-3265	Empty user filter.	No user filter data is loaded.

A.3 Warning Message List

This section describes the warning messages displayed on this instrument.

The following information is included.

- Displayed message
- Description

Table A-4 Warning Message List

Displayed message	Description
The result is not corresponding to the setting.	This message is displayed when Modulation Format is set to FSK while the graph, on which the results cannot be displayed when Modulation Format is set to FSK, is displayed.
Equalizing Filter is void.	This message is displayed when Equalizing Filter cannot be used (when Transmission Mag/Phase Characteristics graph is displayed).
Some settings are changed. Do you execute it?	This message is displayed when the Standard setting is changed.
The scale setting is changed. Do you execute it?	This message is displayed when the Marker Interlock function and the Scale Interlock function are followed.

ALPHABETICAL INDEX

[Symbol]

[Numerics]

[A]

[B]

[C]

[D]

[E]

[F]

[G]

[H]

[I]

[L]

[M]

[O]

[P]

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