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R3681 Series OPT68

OFDM Modulation Analysis Software

User's Guide

MANUAL NUMBER FOE-8440096D00

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 68 OFDM (Orthogonal Frequency Deviation Multiplexing) Modulation Analysis for effective use of this manual.

1.1 Outline of This Manual

The outline of each chapter is shown below:

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

Chapter 1	INTRODUCTION	Describes the outline of this manual and the product overview for effective use of this manual.
Chapter 2	PRE-OPERATION TIPS	Describes cautions for the use of this instrument. Read them carefully before using.
Chapter 3	SETUP	Describes the setup procedures after you receive this instrument. After ensuring a proper environment for installation, turn on the power supply and make sure that this instrument starts up normally.
Chapter 4	EXAMPLES OF MEASUREMENTS	Describes representative examples of measurements.
Chapter 5	MENU MAP, FUNCTIONAL EXPLANATION	Explains the menu configuration and function of the soft keys.
Chapter 6	SCPI COMMAND REFERENCE	SCPI command reference. The command reference explains the commands in order of function. In explanation, the following items are explained: • Command format • Function explanation • Parameters • Query response • Use example • Related commands Sample programs are also provided.
Chapter 7	SPECIFICATIONS	Shows the specifications of option 68.
Chapter 8	PERFORMANCE VERIFICATION	Describes the performance verification test procedures for option 68.
APPENDIX		Describes operation principles and the error code table.

1.2 Product Overview

OFDM analysis option (OPT68) is software for measuring OFDM analysis.

This option has the following features:

- Frequency error and error vector magnitude specified by the standards can be measured with respect to the standard signal of IEEE802.11a, HiperLanType2, and HiSWAN.
- OFDM signal frequency error and error vector magnitude can be measured without depending on the standards by setting the FFT length and sampling frequency.
- This instrument has two measurement modes, Single Frame mode and Multi Frame mode. In Single Frame mode, time waveform of 40 msec at the maximum is obtained and modulation analysis can be performed for the frame specified by the user. In Multi Frame mode, modulation analysis is performed for the number of frames specified by the user and their maximum, minimum and average values are displayed.

1.3 Other Manuals Pertaining to This Instrument

Available manuals pertaining to this instrument include:

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

  Contains information prerequisite to using the R3681 Series Signal Analyzer, ranging from setup to basic operation, applied measurement, functionality, specifications, and maintenance.
- Programming Guide (Part Code: {ER3681SERIES/P}, English)

  Covers programming information to use the R3681 Series Signal Analyzer to automate measurement sequences, including a remote control overview, SCPI command references, and sample application programs.
- Performance Verification Guide (Part Code: {ER3681/SERIES/T}, English)

  Covers information necessary to verify the performance of the R3681 Series Signal Analyzer, including performance test procedures and specifications.

1.4 Conventions of Notation Used in This Document

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

On-panel hard keys

Sample	Represents an on-panel hard key labeled "Sample."
	Example: **START**, **STOP**

On-screen system menus

[Sample]	Represents an on-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

On-screen function buttons

{Sample}	Represents an on-screen function button labeled "Sample."
	Example: **{FREQ}** button, **{SWEEP}** button

On-screen soft menu bar

Sample	Represents an on-screen soft menu bar key labeled "Sample."
	Example: **Center** key, **Span** key

On-screen system menu key operation

[File]→[Save As...]	Indicates a touch on the **[File]** menu followed by a choice of **[Save As...]**.

Sequential key operation

{FREQ}, **Center**	Indicates a touch on the **{FREQ}** button followed by a touch on the **Center** key.

Toggle key operation

ΔMarker On/Off (On)	Indicates a touch on 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. PRE-OPERATION TIPS

This chapter provides preliminary tips on using this instrument. Read this chapter before using this instrument.

2.1 If Faults Should Occur

If this instrument is found to smoke or deliver offensive odors or abnormal noises, switch off the power breaker and remove the power cable from the AC power connector to power off this instrument. Then, contact your dealer or us immediately.

2.2 Removing of Case

The case should not be opened except by service personnel of our company.

WARNING: ***High-voltage and high-temperature parts inside. You may get electrical shocks or burnt if you touch them.***

2.3 Overcurrent Protection

This instrument is protected from overcurrent flow by a power breaker. Located on the rear panel, the power breaker automatically forces an interruption of the power supply when an overcurrent flows through this instrument. When the power breaker has turned off, remove the power cable from the AC power connector to power off this instrument. 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 impact or vibrate the hard disk drive.

  Damage to the disk on which data is stored could result, increasing the chances of malfunctioning or failing during operations.
- Do not switch off this instrument while the HDD access lamp is lit.

  The data being accessed might be damaged.

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

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 strong impacts or apply undue force to the screen. The glass could be cracked.
- Use the stylus pen included with this instrument to operate the screen. Use of a hard-pointed material (such as a mechanical pencil or ballpoint) could 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.

Furthermore, this instrument is not a data processor. Operate it only as described in this manual.

1. Non-permitted actions:
   - Installing other application programs.
   - Changing or deleting items in the control panel (except for "A.2 Installing the Printer Driver" and "A.3 Setting up the Network" of R3681 Series User's Guide).
   - Opening or operating the existing files on the C drive.
   - Operating other application programs during the measurement.
   - Upgrading the Windows operating system.
   - If this instrument does not function correctly due to any of the above, re-install the system using the system recovery disk.
     For more information on the system recovery method, refer to section 8.7, "System Recovery Procedure" of R3681 Series User's Guide.
2. Computer viruses

   Depending on the operating environment and method, the system can be contaminated by a computer virus. To use the system securely, it is recommended to take the following countermeasures:
   - Run a virus check before loading a file or media from an outside source.
   - Make sure that any network has safety measures against computer viruses before connecting.

NOTE:

- ***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 method, refer to section 8.7, "System Recovery Procedure" of R3681 Series User's Guide.

2.7 Tip on Transportation

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

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

2.8 Electromagnetic Interference

This instrument may cause electromagnetic interference and affect television and radio reception.

If this instrument's power is turned off and the electromagnetic interference is reduced, then this instrument has caused the problem.

Electromagnetic interference may be prevented by doing the following:

- Change the direction of the antenna of the television or radio.
- Place this instrument on the other side of the television or radio.
- Place this instrument away from the television or radio.
- Use different lines for the power sources for the television or radio and this instrument.

2.9 Note for Power-on

At power-on, do not connect the DUT to this instrument.

2.10 Notes for Removing and Attaching the Panel

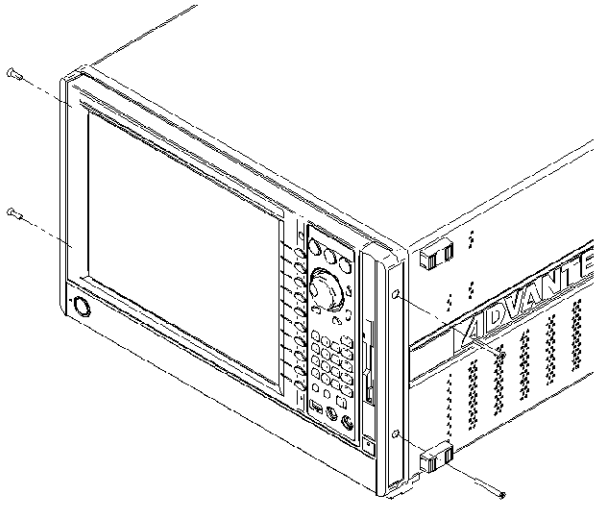
This instrument can be used separately after removing the panel.

When removing the panel, take notice of these instructions.

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

- If this instrument's power is turned on, turn off the power, remove the power cable, and then make sure that the operation of this instrument is terminated.
- When removing or attaching the panel, take care not to jam your finger.
- Place this instrument on a level and steady table when removing or attaching the panel.
- Take out the four screws that are exposed on the side of the front panel of this instrument.
- When taking out the screws, put a hand on the panel so that the panel will not unexpectedly fall off.
- After all four screws have been taken out, pull the panel forward.
- Remove the cable connecting the panel and the body of this instrument.
- Replace the cable with another one that is suitable for your use condition.

- If you have lost screws, use the following screws.
  - 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)



2.11 Limitations Imposed when Using Windows XP

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3. SETUP

This chapter explains how to set up this instrument on delivery. Topics covered in this chapter are:

3.1 Unpacking Inspection

3.2 Locating This Instrument

3.3 Connecting Accessories

3.4 Supply Description

3.5 Operation Check

3.1 Unpacking Inspection

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

1. Check to see if the box or the cushioning material in which the product was shipped has been damaged during transit.

IMPORTANT: ***If the box or the cushioning material is found damaged, leave them in their original condition until the inspection described below completes.***

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2. Check the product surfaces for any damage.

WARNING: ***Do not power on this instrument if the cover, panels (front and rear), LCD display, power switch, connector or any other key component is found damaged. Electrical shock hazards could result from using damaged components.***

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3. Referring to the standard accessory list of the OPT68 in Table 3-1, please check whether all standard accessories exist and make sure that no accessories are damaged.

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

- The box or the cushioning material in which the product was shipped was damaged during transit, or there is evidence of a massive force having been applied to the cushioning material.
- The product surfaces are damaged.
- One or more standard accessories are missing or damaged.
- Defects have been detected in a subsequent product verification test.

Table 3-1 Standard Accessories

Name	Model	Quantity	Remarks
R3681 Series OPT 68 User's Guide	ER3681OPT68	1	English version

3.2 Locating This Instrument

This section describes the installation environment in which this instrument runs successfully.

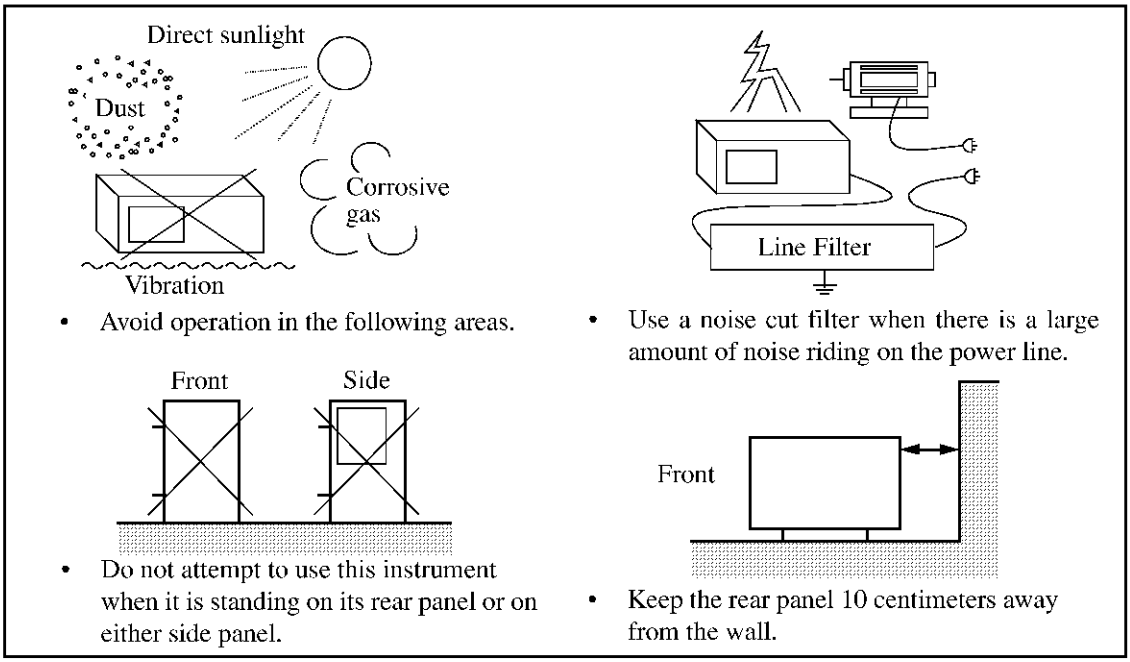
3.2.1 Operating Environment

This instrument should only be used in a place 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 dust-free area
- 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 when 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. Never 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 on either side panel.



- Avoid operation in the following areas.
- Use a noise cut filter when 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 damage to semiconductor parts from electrostatic discharge (ESD), the precautions shown below should be taken. We recommend that two or more countermeasures be combined to provide adequate protection from ESD.

(Static electricity can easily be built up 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	Installation of a conductive mat, the use of conductive shoes, and grounding (see Figure 3-3).
Workbench	Installation of a conductive mat and grounding (see Figure 3-4).

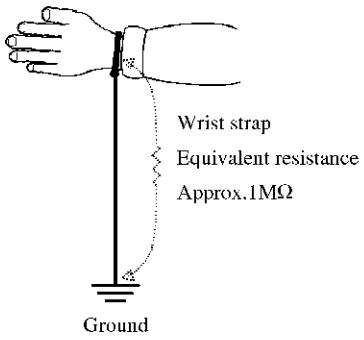


Figure 3-2 Countermeasures for Static Electricity of Human Body

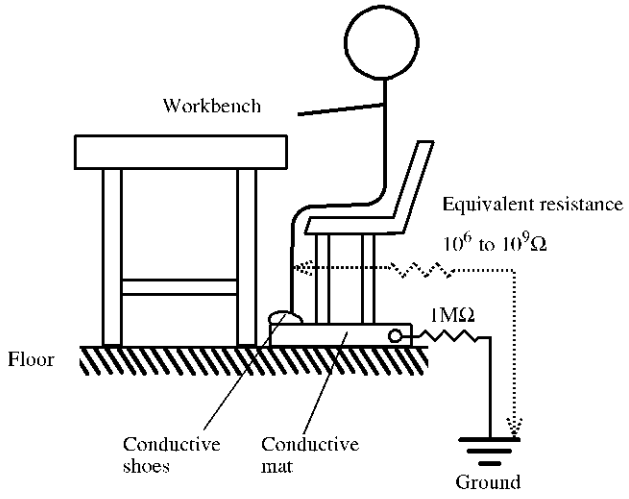


Figure 3-3 Countermeasures for Static Electricity on Work Floor

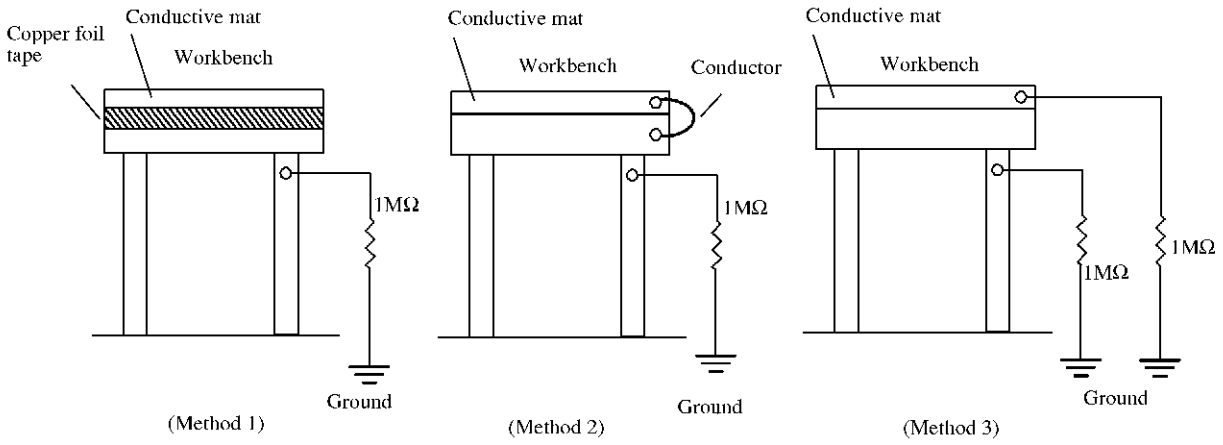


Figure 3-4 Countermeasures for Static Electricity on Workbench

3.3 Connecting Accessories

This section explains how to connect accessories to this instrument to run it.

3.3.1 Connecting the Keyboard and Mouse

Plug the keyboard and mouse into their respective front-panel connectors (KEYBOARD and MOUSE connectors). The keyboard and mouse must be plugged before turning on this instrument.

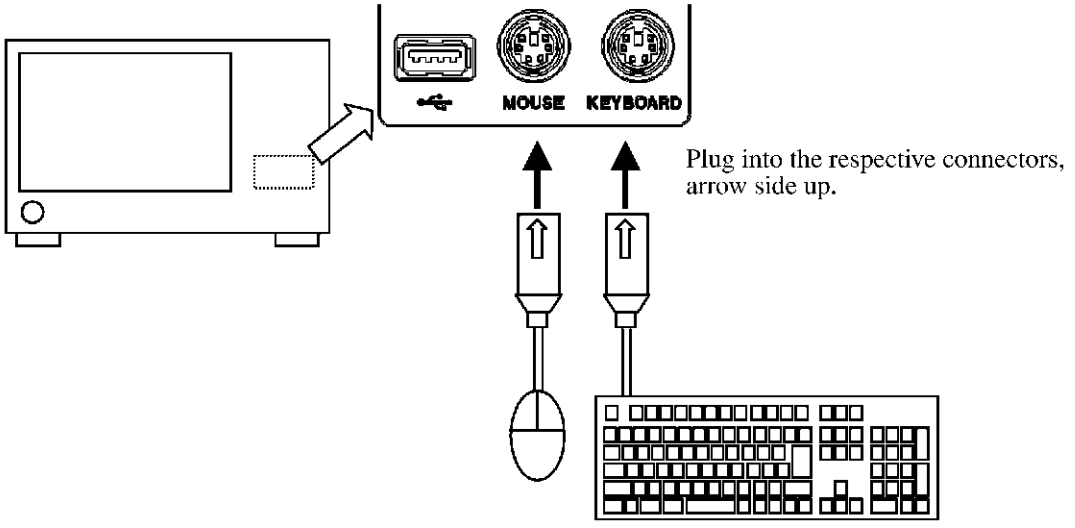


Figure 3-5 Connecting the Keyboard and Mouse

3.4 Supply Description

This section explains 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 VAC operation	200 VAC operation	Remarks
Input voltage range	90 V to 132 V	198 V to 250 V	Automatically switches between input levels of 100 VAC and 200 VAC.
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 grounding conductor. To guard against 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 hazards 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-pole power outlet having a protecting grounding terminal (see Figure 3-6).

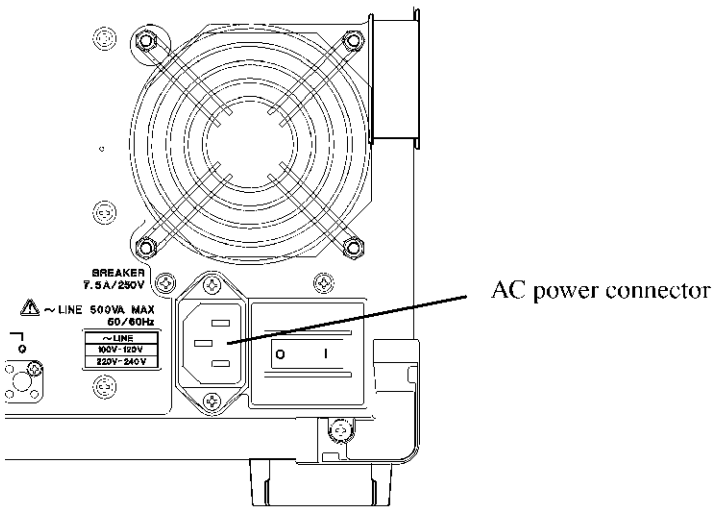


Figure 3-6 Connecting the Power Cable

WARNING:

1. ***Use a power cable rated for the voltage being used. Be sure however to use a power cable conforming to the safety standards of your country when using this instrument overseas (Refer to "Safety Summary").***
2. ***Plug the power cable into a three-pole power outlet having a protecting grounding terminal to guard against electrical shock hazards. Use of an extension cord without a protecting grounding terminal would override the protective grounding.***

3.5 Operation Check

This section explains 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.
   Then wait for 3 seconds or more.
3. Press the **POWER** switch to switch on the power.

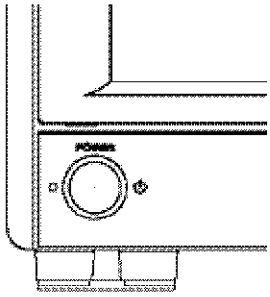


Figure 3-7 **POWER** Switch

CAUTION:

1. ***If this instrument is abruptly powered off while in operation, such as by pulling the power cable out of position, the hard disk drive could fail. Even when the hard disk drive does not fail, Scandisk launches to check for possible corruptions in the data stored on it the next time this instrument starts up.***
2. ***About Scandisk***
   If this instrument has been powered off without being shut down, Scandisk will launch to check for corruptions automatically. Do not abort Scandisk while it is running. If Scandisk locates corruptions, take appropriate remedial action as recommended by the display 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-diagnostics take about 1 minute to complete.
5. The initial screen shown in Figure 3-8 is displayed unless this instrument is tested faulty. The initial screen may give a different look from Figure 3-8, depending on the settings in effect the last time this instrument was powered off.

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

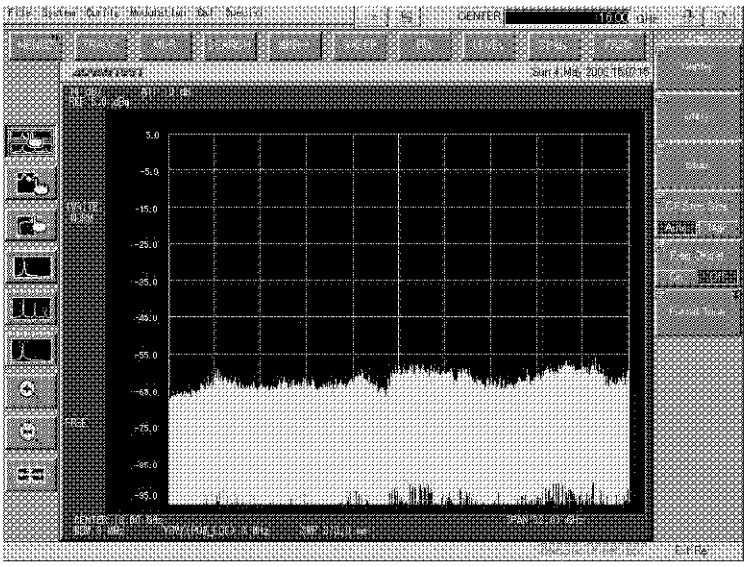


Figure 3-8 Initial Setup Screen

Running autocalibration

6. <R3681>
Hook up 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.

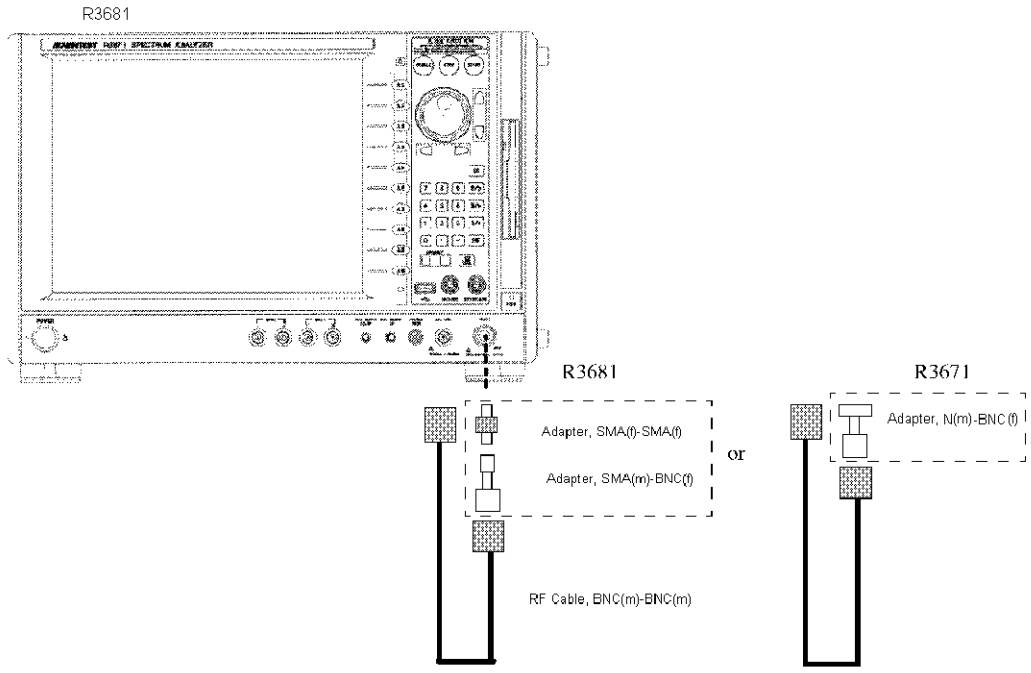


Figure 3-9 Autocalibration

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 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 R3681 Series User's Guide if error messages are displayed as a result of the autocalibration.***

Switching off power

10. Press the **POWER** switch of this instrument.
    The final processing of the system is performed and the power is automatically turned off.

4. EXAMPLES OF MEASUREMENTS

This chapter describes the way to use this option, with the following concrete examples of measurements.

4.1 Measurements Using Multi Frame Mode

4.2 Measurements Using Single Frame Mode

4.3 DUT Frequency Characteristics Measurement Using Equalizer

4.1 Measurements Using Multi Frame Mode

You can repeat measurement of various frames and OFDM symbols by using Multi Frame Mode. This mode is suitable for measurements based on the standards.

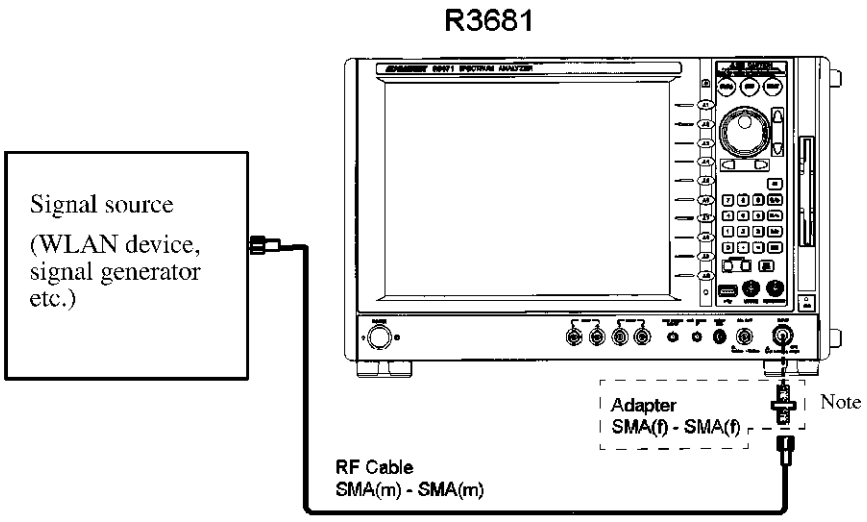
[Specifications of signal to be measured]

Conforming standards:	IEEE802.11a signal
Center frequency:	5170 MHz
Level:	-10 dBm
Data rate:	36 Mbps (Modulation system 16 QAM)
Number of OFDM symbols	100 (excluding SIGNAL)

[Measuring conditions]

A/D Capture Length:	10 ms
Threshold Level:	Auto
Symbol Timing:	0
Pilot Track(Phase):	ON
Pilot Track(Amplitude):	OFF
CH Estimation(Preamble):	ON
Meas Condition:	Frame & Min Symbol
Meas Frame Number:	20
Meas Min Symbol Length:	16
EVM Trigger:	ON
EVM Threshold:	-25 dB
Trigger Source:	Free Run
Single Measurement	

[Device connection]



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

Figure 4-1 Connection Diagram for Measurement Using Multi Frame Mode

[Setting the Measuring Conditions]

1. Touch **[Config]** on the menu bar and select **[Modulation Analyzer]**.
2. Touch **[Modulation]** on the menu bar and select **[OFDM]**.
3. Touch the **{FREQ}** button on the function bar.
4. Touch the **Center** key on the soft menu bar.
5. Press **5**, **1**, **7**, **0** and **M/n** in this order on the ten-key pad.
   The center frequency will be set at 5170 MHz.
6. Touch the **{LEVEL}** button on the function bar.
7. Touch the **Auto Level Set** key on the soft menu bar.
   The Ref Level will be set automatically at the optimum value.
8. Touch the **{STD}** button on the function bar.
9. Touch the **IEEE802.11a** key on the soft menu bar.
   The measuring parameters will be set to the IEEE802.11a standard.
10. Touch the **{TRIGGER}** button on the function bar.
11. Touch the **Trigger Source** key on the soft menu bar.
12. Touch the **Free Run** key on the soft menu bar.

13. Touch the **{INPUT}** button on the function bar.
14. Touch the **Input Setup** button on the soft menu bar.
    The **[Input Setup]** dialog box will be displayed.
15. Set the **[Input]** of the **[Input Setup]** dialog box to **[RF]**.
16. Touch the close button ✕ in the **[Input Setup]** dialog box to close the dialog box.

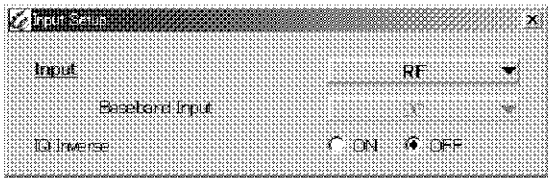


Figure 4-2 **[Input Setup]** Dialog Box

17. Touch the **{MEAS CONTROL}** button on the function bar.
18. Touch the **Multi Frame** key on the soft menu bar and select the multi frame mode.
19. Touch the **Meas Parameters** button on the soft menu bar.
    The **[Measurement Parameters Setup]** dialog box will be displayed.
20. Touch the **[AD Capture]** tab in the **[Measurement Parameters Setup]** dialog box. The screen is switched to the AD Capture Setup screen.

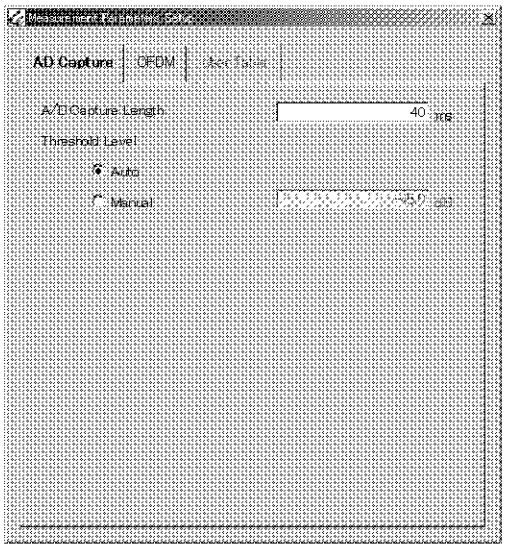


Figure 4-3 **[Measurement Parameters Setup]** Dialog Box - **AD Capture** Setup Tab

21. Set the length of the data to be taken into the memory for one data acquisition.

    Touch the **[A/D Capture Length]** text box in the **[AD Capture]** tab.

    The set value is displayed in a black/white inverted state. Input the numerical value either by pressing **1**, **0** and **ENT** on the ten-key pad or by turning the data knob until the numerical value 10 is displayed.

22. Touch **[Auto]** under **[Threshold Level]** in the **[AD Capture]** tab.

    The setting of the threshold level to search for the frame signal (burst signal) is set to Auto.

    (Set the threshold level when the measuring instrument searches for the frame signal (burst signal) to Auto. If the signal level is unstable, select **[Manual]**.)

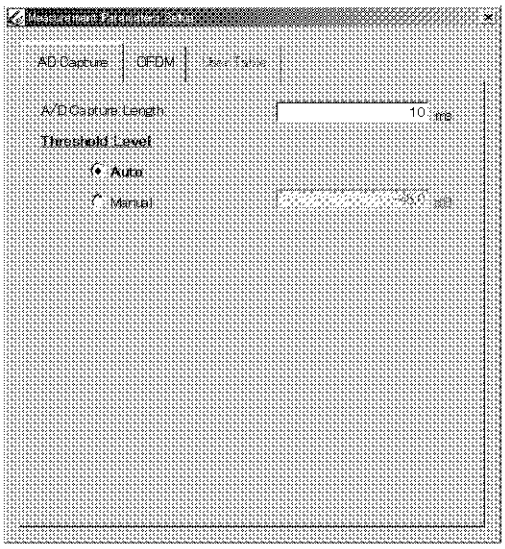


Figure 4-4 **[Measurement Parameters Setup]** Dialog Box - **AD Capture** Setup Tab

23. Touch the **[OFDM]** tab in the **[Measurement Parameters Setup]** dialog box. The screen is switched to the OFDM Setup screen.

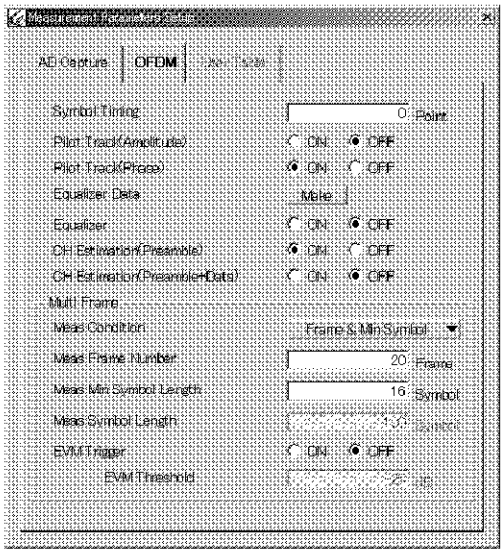


Figure 4-5 **[Measurement Parameters Setup]** Dialog Box - **OFDM** Setup Tab

24. Touch the **[Symbol Timing]** text box in the **[OFDM]** tab.

    The set value is displayed in a black/white inverted state. Input the numerical value either by pressing **0**, **ENT** on the ten-key pad or by turning the data knob until the numerical value 0 is displayed. (Symbol Timing is set to the FFT process start position at the time of demodulation. The center of the guard interval is taken as 0.)

25. Touch the **[OFF]** option button of **[Pilot Track(Amplitude)]** in the **[OFDM]** tab.

    (Pilot Track (Amplitude) is a function which corrects the amplitude for each symbol by referring to the pilot signal of the signal to be measured.)

26. Touch the **[ON]** option button of **[Pilot Track(Phase)]** in the **[OFDM]** tab.

    (Pilot Track (Phase) is a function which synchronizes the phase for each symbol by referring to the pilot signal of the signal to be measured.)

27. Touch **[ON]** of the **[CH Estimation(Preamble)]** option button in the **[OFDM]** tab.

    The CH Estimation(Preamble) function is a function to estimate and correct the frequency characteristics of the signal to be measured using the preamble portion.

28. Set **[Meas Condition]** in the **[OFDM]** tab to **[Frame & Min Symbol]**.

29. Set the number of frames to be measured to 20.

    Touch the **[Meas Frame Number]** text box in the **[OFDM]** tab.

    The set value is displayed in a black/white inverted state. Input the numerical value either by pressing **2**, **0** and **ENT** on the ten-key pad or by turning the data knob until the numerical value 20 is displayed.

    (The measuring instruments analyze frames until reaching the number of frames set here. The number of frames analyzed will be the number of frames set here.)

30. Make the setting so that frames containing 16 symbols or more are analyzed.

    Touch the **[Meas Min Symbol Length]** text box in the **[OFDM]** tab.

    The set value is displayed in a black/white inverted state. Input the numerical value either by pressing [1], [6] and [ENT] on the ten-key pad or by turning the data knob until the numerical value 16 is displayed.

    (The measuring instruments will not analyze frames containing less than the number of symbols set here.)

31. Touch **[ON]** of the **[EVM Trigger]** option button in the **[OFDM]** tab.

32. Touch the **[EVM Threshold]** text box in the **[OFDM]** tab.

    The set value is displayed in a black/white inverted state. Input the numerical value either by pressing [-], [2], [5] and [ENT] on the ten-key pad or by turning the data knob until the numerical value -25 is displayed.

    (If a frame exceeding the EVM set here is analyzed, the measuring instruments will end measurements at that frame.)

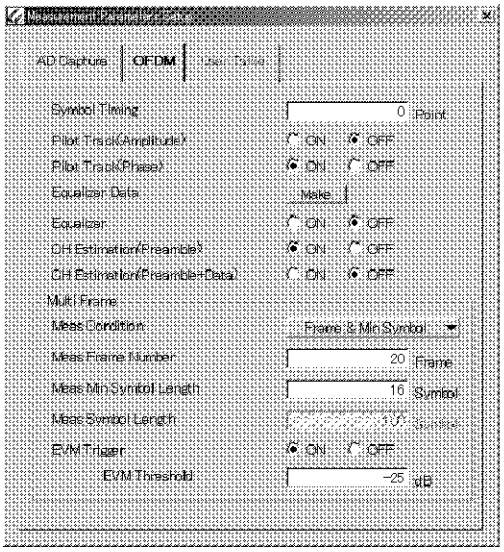


Figure 4-6 **[Measurement Parameters Setup]** Dialog Box - **OFDM** Setup Tab

33. Touch the close button [X] in the **[Measurement Parameters Setup]** dialog box to close the dialog box.

34. Press the **SINGLE** button on the front panel.
    Single measurement is executed, and the measurement results are displayed.

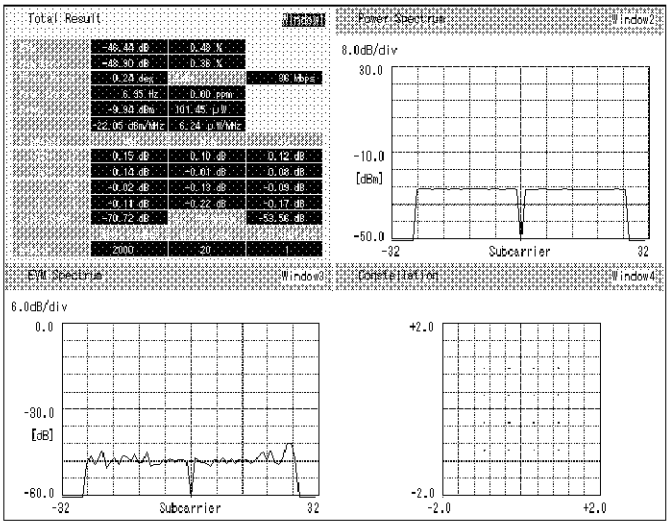


Figure 4-7 Measurement Results of Multi Frame Mode

4.2 Measurements Using Single Frame Mode

You can select and measure any one frame by using Single Frame Mode. This mode is suitable for detailed verification.

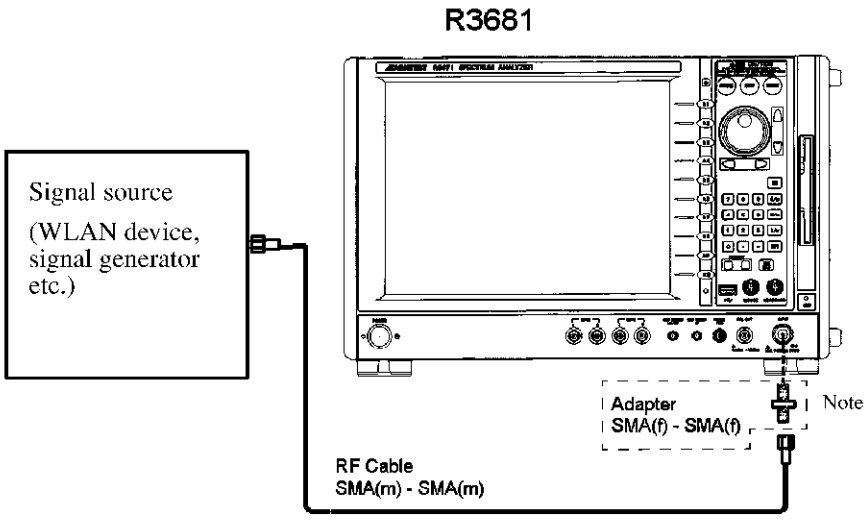
[Specifications of signal to be measured]

Conforming standards:	IEEE802.11a signal
Center frequency:	5170 MHz
Level:	-10 dBm
Data rate:	36 Mbps (Modulation system 16 QAM)
Number of OFDM symbols:	100 (excluding SIGNAL)

[Measuring conditions]

A/D Capture Length:	10 ms
Threshold Level:	Auto
Symbol Timing:	0
Pilot Track(Phase):	ON
Pilot Track(Amplitude):	OFF
CH Estimation(Preamble):	ON
Trigger Source:	Free Run

[Device connection]



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

Figure 4-8 Connection Diagram for Measurement Using Single Frame Mode

[Setting the Measuring Conditions]

1. Touch **[Config]** on the menu bar and select [**Modulation Analyzer**].
2. Touch **[Modulation]** on the menu bar and select **[OFDM]**.
3. Touch the **{FREQ}** button on the function bar.
4. Touch the **Center** key on the soft menu bar.
5. Press **5**, **1**, **7**, **0** and **M/n** in this order on the ten-key pad.
   The center frequency will be set at 5170 MHz.
6. Touch the **{LEVEL}** button on the function bar.
7. Touch the **Auto Level Set** key on the soft menu bar.
   The Ref Level will be set automatically at the optimum value.
8. Touch the **{STD}** button on the function bar.
9. Touch the **IEEE802.11a** key on the soft menu bar.
   The measuring parameters will be set to the IEEE802.11a standard.
10. Touch the **{TRIGGER}** button on the function bar.
11. Touch the **Trigger Source** key on the soft menu bar.
12. Touch the **Free Run** key on the soft menu bar.
13. Touch the **{INPUT}** button on the function bar.
14. Touch the **Input Setup** button on the soft menu bar.
    The [**Input Setup**] dialog box will be displayed.
15. Set the **[Input]** of the [**Input Setup**] dialog box to [**RF**].
16. Touch the close button ☒ in the **[Input Setup]** dialog box to close the dialog box.

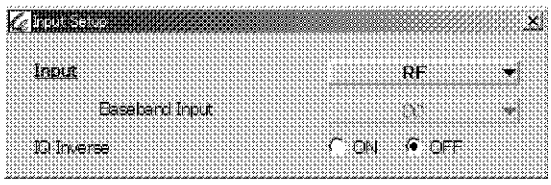


Figure 4-9 **[Input Setup]** Dialog Box

17. Touch the **{MEAS CONTROL}** button on the function bar.
18. Touch the **Single Frame** key on the soft menu bar and select the single frame mode.

19. Touch the **Meas Parameters** button on the soft menu bar.
    The **[Measurement Parameters Setup]** dialog box will be displayed.

20. Touch the **[AD Capture]** tab in the **[Measurement Parameters Setup]** dialog box. The screen is switched to the AD Capture Setup screen.

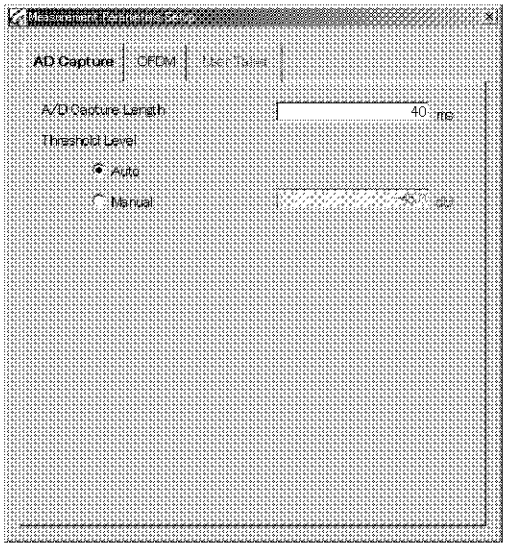


Figure 4-10 **[Measurement Parameters Setup]** Dialog Box - **AD Capture** Setup Tab

21. Set the length of the data to be taken into the memory for one data acquisition.
    Touch the **[A/D Capture Length]** text box in the **[AD Capture]** tab.
    The set value is displayed in a black/white inverted state. Input the numerical value either by pressing **1**, **0** and **ENT** on the ten-key pad or by turning the data knob until the numerical value 10 is displayed.

22. Touch **[Auto]** under **[Threshold Level]** in the **[AD Capture]** tab.
    The setting of the threshold level to search for the frame signal (burst signal) is set to Auto.
    (Set the threshold level when the measuring instrument searches for the frame signal (burst signal) to Auto. If the signal level is unstable, select **[Manual]**.)

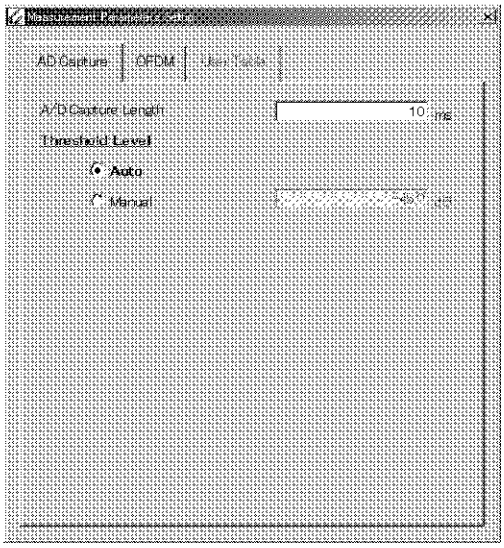


Figure 4-11 [**Measurement Parameters Setup**] Dialog Box - **AD Capture** Setup Tab

23. Touch the **[OFDM]** tab in the [**Measurement Parameters Setup**] dialog box. The screen is switched to the OFDM Setup screen.

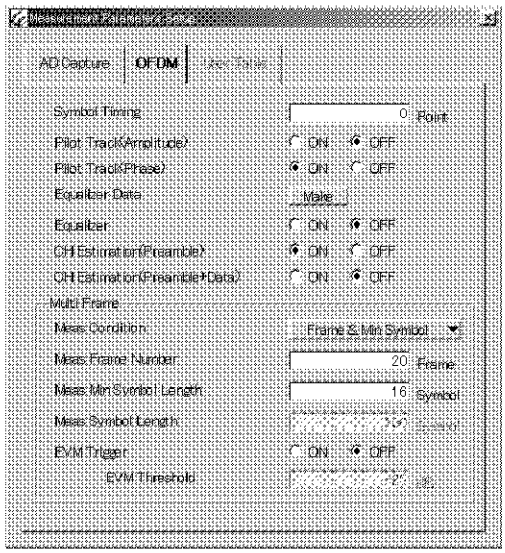


Figure 4-12 [**Measurement Parameters Setup**] Dialog Box - **OFDM** Setup Tab

24. Touch the [**Symbol Timing**] text box in the [**OFDM**] tab.

The set value is displayed in a black/white inverted state. Input the numerical value either by pressing **0**, **ENT** on the ten-key pad or by turning the data knob until the numerical value 0 is displayed. (Symbol Timing is set to the FFT process start position at the time of demodulation. The center of the guard interval is taken as 0.)

25. Touch the **[OFF]** option button of **[Pilot Track(Amplitude)]** in the **[OFDM]** tab.

    (Pilot Track (Amplitude) is a function which corrects the amplitude for each symbol by referring to the pilot signal of the signal to be measured.)

26. Touch the **[ON]** option button of **[Pilot Track(Phase)]** in the **[OFDM]** tab.

    (Pilot Track (Phase) is a function which synchronizes the phase for each symbol by referring to the pilot signal of the signal to be measured.)

27. Touch **[ON]** of the **[CH Estimation(Preamble)]** option button in the **[OFDM]** tab.

    The CH Estimation(Preamble) function is a function to estimate and correct the frequency characteristics of the signal to be measured using the preamble portion.

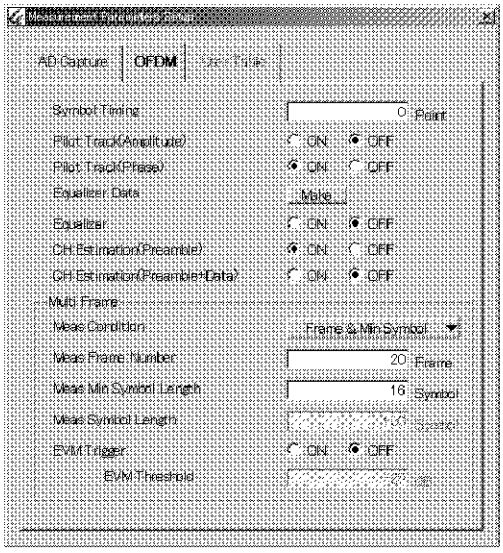


Figure 4-13 [**Measurement Parameters Setup**] Dialog Box - **OFDM** Setup Tab

28. Touch the close button ✕ in the [**Measurement Parameters Setup**] dialog box to close the dialog box.

29. Touch the **A/D Capture** key on the soft menu bar.

    A/D data of the signal under test is taken in, and upon completion the waveform of the signal under test is displayed in the Frame Selection display.

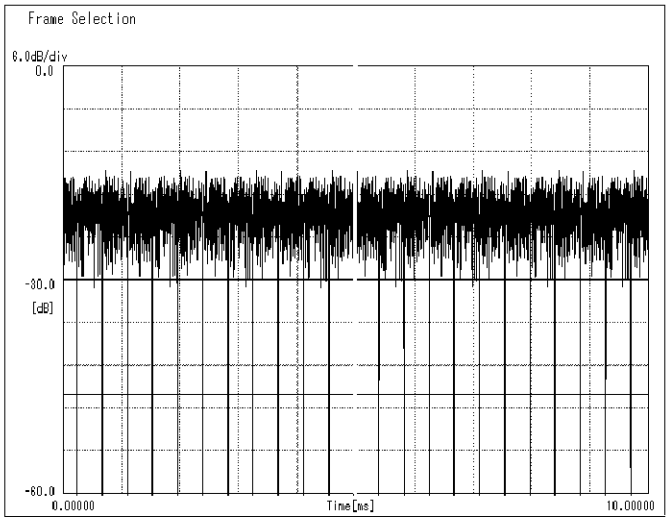


Figure 4-14 Frame Selection Display

30. Touch the Specify Cursor button  on the measurement tool bar.

31. In the waveform of the signal under test in the Frame Selection display, touch near a frame to measure it. The cursor is placed within the frame.

32. Touch the **Analysis Restart** key on the soft menu bar.
Measurement is executed, and the measurement result is displayed.

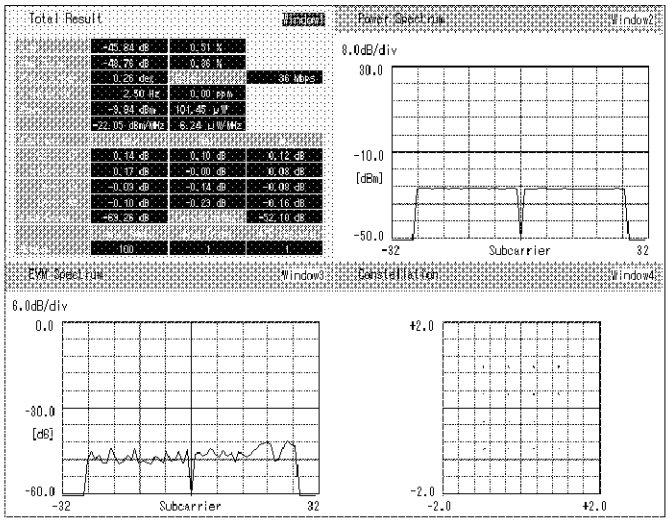


Figure 4-15 Measurement Results of Single Frame Mode

4.3 DUT Frequency Characteristics Measurement Using Equalizer

You can cancel out the frequency characteristics of a signal source and measure the frequency characteristics of a DUT (amp, filter, etc.) by using the Equalizer function.

[Specifications of signal to be measured]

Conforming standards:	IEEE802.11a signal
Center frequency:	5170 MHz
Level:	-10 dBm
Data rate:	36 Mbps (Modulation system 16 QAM)
Number of OFDM symbols:	100 (excluding SIGNAL)

[Measuring conditions]

A/D Capture Length:	10 ms
Threshold Level:	Auto
Symbol Timing:	0
Pilot Track(Phase):	ON
Pilot Track(Amplitude):	OFF
Equalizer:	ON
Trigger Source:	Free Run

[Device connection]

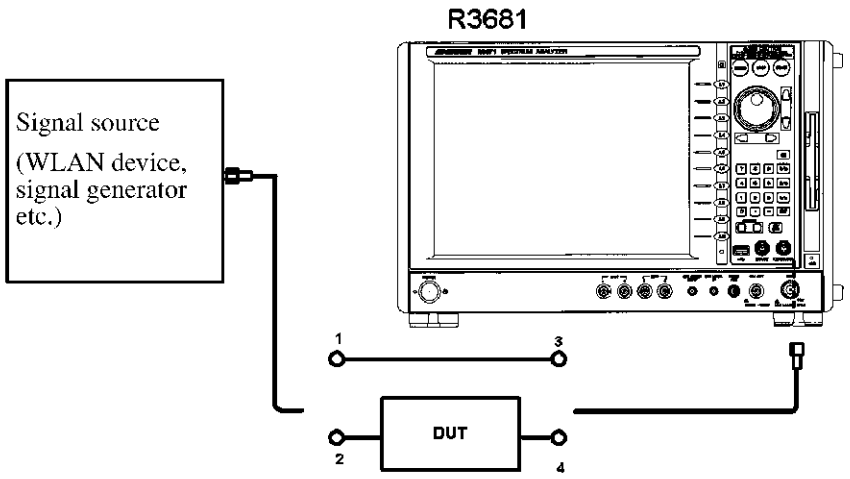


Figure 4-16 Connection Diagram for Frequency Characteristics Measurement of a DUT Using Equalizer

[Setting the Measuring Conditions]

1. Connect the instruments as in circuits 1-3 of Figure 4-16.
2. Touch **[Config]** on the tool bar and select **[Modulation Analyzer]**.
3. Touch **[Modulation]** on the menu bar and select **[OFDM]**.
4. Touch the **{FREQ}** button on the function bar.
   The current center frequency is displayed in entry box 1, and can be changed.
5. Touch the **Center** button.
6. Press **5**, **1**, **7**, **0** and **M/n** in this order on the ten-key pad.
   The center frequency will be set at 5170 MHz.
7. Touch the **{LEVEL}** button on the function bar.
8. Touch the **Auto Level Set** key on the soft menu bar.
   The Ref Level will be set automatically at the optimum value.
9. Touch the **{STD}** button on the function bar.
10. Touch the **IEEE802.11a** key on the soft menu bar.
    The measuring parameters will be set to the IEEE802.11a standard.
11. Touch the **{TRIGGER}** button on the function bar.
12. Touch the **Trigger Source** key on the soft menu bar.
13. Touch the **Free Run** key on the soft menu bar.
14. Touch the **{INPUT}** button on the function bar.
15. Touch the **Input Setup** button on the soft menu bar.
    The **[Input Setup]** dialog box will be displayed.
16. Set the **[Input]** of the **[Input Setup]** dialog box to **[RF]**.
17. Touch the close button **X** in the **[Input Setup]** dialog box to close the dialog box.

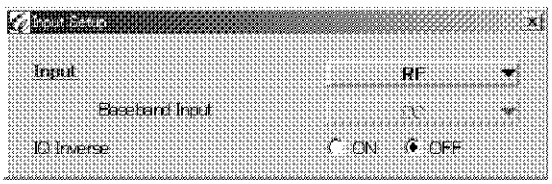


Figure 4-17 **[Input Setup]** Dialog Box

18. Touch the **{MEAS CONTROL}** button on the function bar.

    Touch the **Single Frame** key on the soft menu bar and select the single frame mode.

19. Touch the **Meas Parameters** button on the soft menu bar.

    The **[Measurement Parameters Setup]** dialog box will be displayed.

20. Touch the **[AD Capture]** tab in the **[Measurement Parameters Setup]** dialog box. The screen is switched to the AD Capture Setup screen.

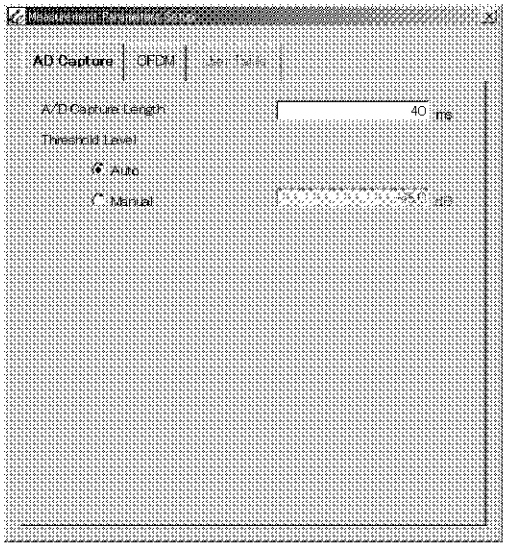


Figure 4-18 **[Measurement Parameters Setup]** Dialog Box - **AD Capture** Setup Tab

21. Set the length of the data to be taken into the memory for one data acquisition.

    Touch the **[A/D Capture Length]** text box in the **[AD Capture]** tab.

    The set value is displayed in a black/white inverted state. Input the numerical value either by pressing **1**, **0** and **ENT** on the ten-key pad or by turning the data knob until the numerical value 10 is displayed.

22. Touch **[Auto]** under **[Threshold Level]** in the **[AD Capture]** tab.

    The setting of the threshold level to search for the frame signal (burst signal) is set to Auto.

    (Set the threshold level when the measuring instrument searches for the frame signal (burst signal) to Auto. If the signal level is unstable, select **[Manual]**.)

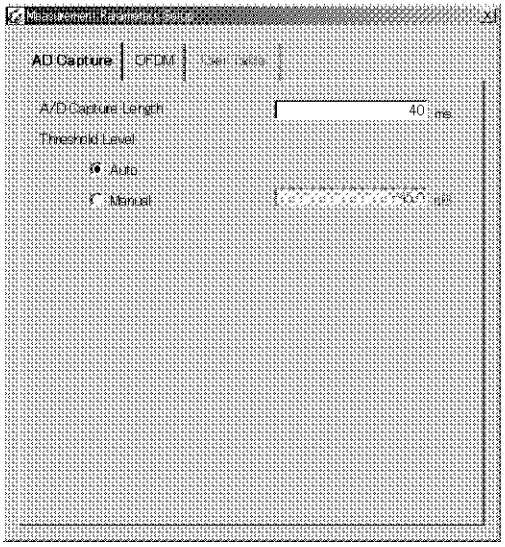


Figure 4-19 **[Measurement Parameters Setup]** Dialog Box - **AD Capture** Setup Tab

23. Touch the **[OFDM]** tab in the **[Measurement Parameters Setup]** dialog box. The screen is switched to the OFDM Setup screen.

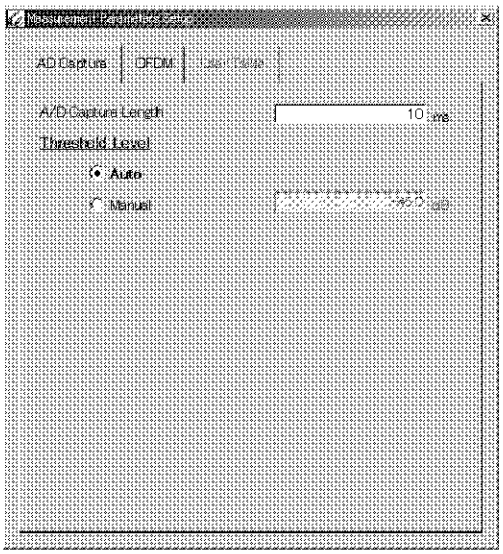


Figure 4-20 **[Measurement Parameters Setup]** Dialog Box - **AD Capture** Setup Tab

24. Touch the [**Symbol Timing**] text box in the [**OFDM**] tab.

    The set value is displayed in a black/white inverted state. Input the numerical value either by pressing [**0**], [**ENT**] on the ten-key pad or by turning the data knob until the numerical value 0 is displayed. (Symbol Timing is set to the FFT process start position at the time of demodulation. The center of the guard interval is taken as 0.)

25. Touch the [**OFF**] option button of [**Pilot Track(Amplitude)**] in the [**OFDM**] tab.

    (Pilot Track (Amplitude) is a function which corrects the amplitude for each symbol by referring to the pilot signal of the signal to be measured.)

26. Touch the [**ON**] option button of [**Pilot Track(Phase)**] in the [**OFDM**] tab.

    (Pilot Track (Phase) is a function which synchronizes the phase for each symbol by referring to the pilot signal of the signal to be measured.)

27. Touch [**ON**] of the [**CH Estimation(Preamble)**] option button in the [**OFDM**] tab.

    The CH Estimation(Preamble) function is a function to estimate and correct the frequency characteristics of the signal to be measured using the preamble portion.

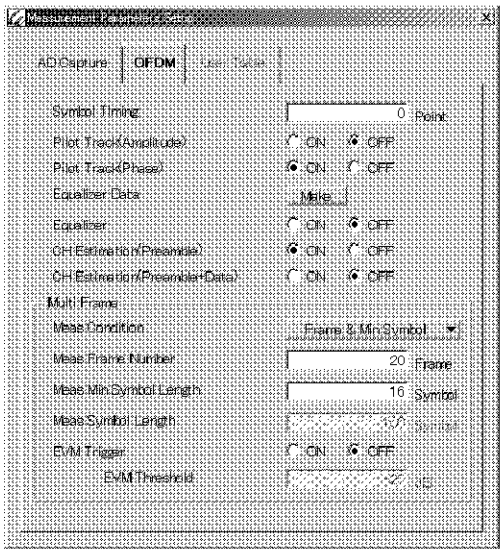


Figure 4-21 [**Measurement Parameters Setup**] Dialog Box - **OFDM** Setup Tab

28. Touch the close button [X] in the [**Measurement Parameters Setup**] dialog box to close the dialog box.

29. Touch the **A/D Capture** key on the soft menu bar.
    A/D data of the signal under test is taken in, and upon completion the waveform of the signal under test is displayed in the Frame Selection display.

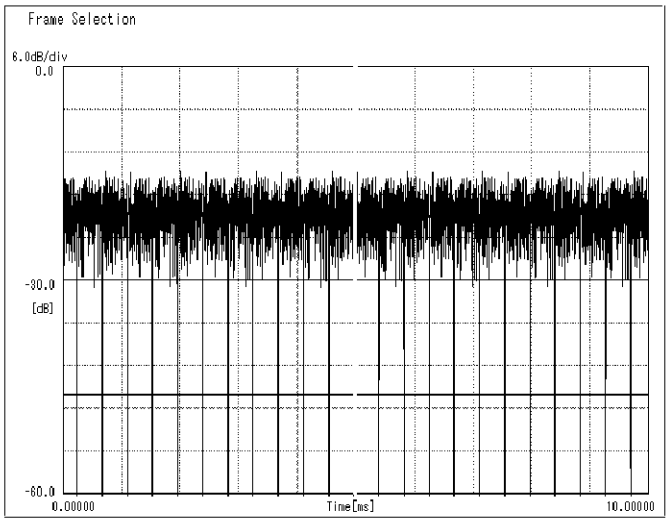


Figure 4-22 Frame Selection Display

30. Touch the Specify Cursor button on the measurement tool bar.

31. In the waveform of the signal under test in the Frame Selection display, touch near a frame to measure it. The cursor is placed within the frame.

32. Touch the **Analysis Restart** key on the soft menu bar.
    Measurement is executed, and the measurement result is displayed.

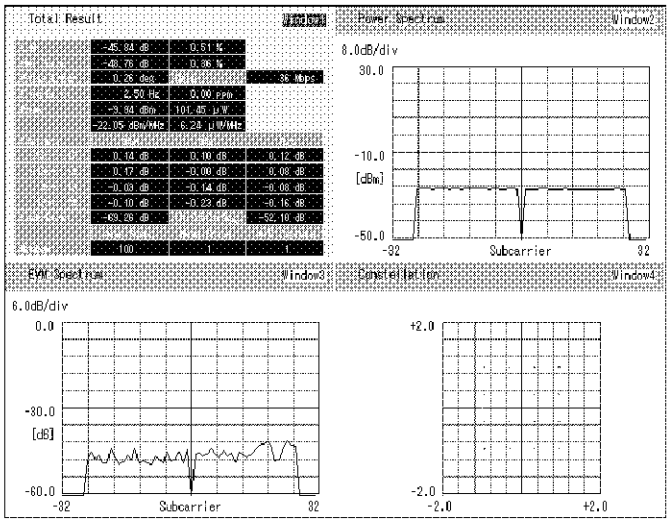


Figure 4-23 Signal Source Measurement Results

33. Check the measurement results to confirm that measurement has been completed normally.

34. Touch the **{MEAS CONTROL}** button on the function bar.

35. Touch the **Meas Parameters** button on the soft menu bar.
    The **[Measurement Parameters Setup]** dialog box will be displayed.

36. Touch the **[OFDM]** tab in the **[Measurement Parameters Setup]** dialog box.
    The screen is switched to the OFDM Setup screen.

37. Touch the **Make** button of **[Equalizer Data]** in the **[OFDM]** tab.
    The Equalizer data is calculated. The Equalizer data is retained until the data is calculated by re-pressing the **Make** button. The data can be used as the frequency characteristics correction data until the INPUT, FREQ, STD, the number of FFT points or the FFT sampling frequency settings are changed.

38. Touch the **[ON]** option button of **[Equalizer]** in the **[OFDM]** tab.
    When analyzing, the frequency characteristics are corrected by using the Equalizer data.
    The Equalizer function has an exclusive relationship to the CH Estimation function. When the Equalizer is set to ON, the CH Estimation function is automatically set to OFF.

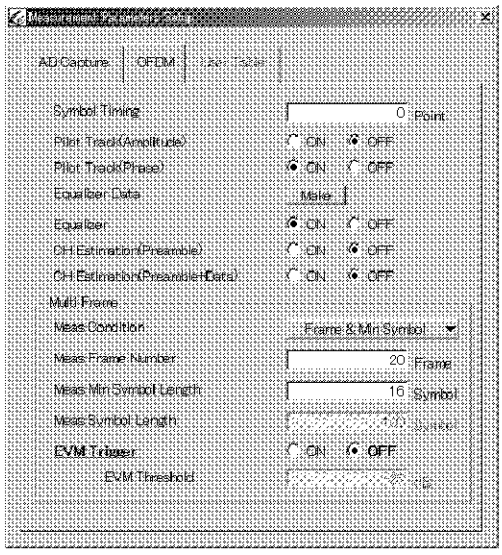


Figure 4-24 **[Measurement Parameters Setup]** Dialog Box

39. Touch the close button **X** in the **[Measurement Parameters Setup]** dialog box to close the dialog box.

40. Touch the **Analysis Restart** key on the soft menu bar.
    The frame at the cursor position is measured again, and the measurement results after Equalizer processing, such as Total Result, are displayed.

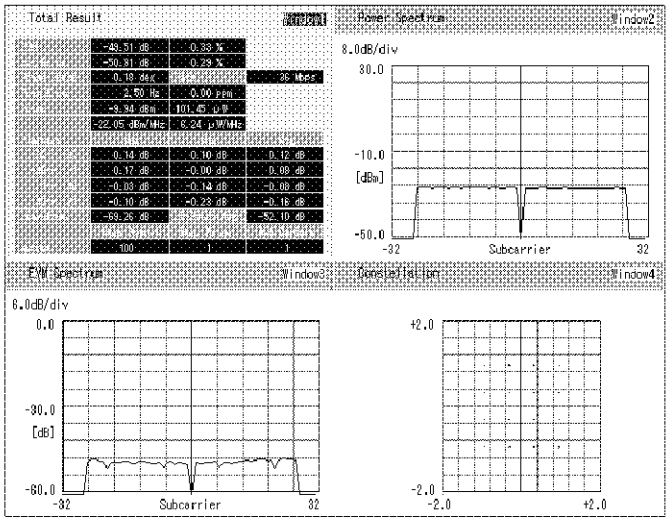


Figure 4-25 Signal Source Measurement Results (After Equalizer Process)

41. Verify that the EVM, etc., of the measurement results have been improved.
42. Connect the instruments as in circuits 2-4 of Figure 4-16.
43. Touch the **{LEVEL}** button on the function bar.
44. Touch the **Auto Level Set** key on the soft menu bar.
    The Ref Level will be set automatically at the optimum value.
45. Touch the **{MEAS CONTROL}** button on the function bar.
46. Touch the **A/D Capture** key on the soft menu bar.
    A/D data of the signal under test is taken in, and upon completion the waveform of the signal under test is displayed in the Frame Selection display.

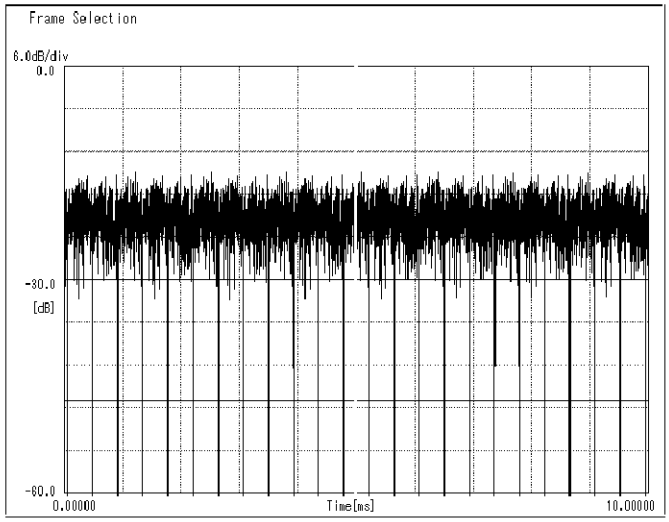


Figure 4-26 Frame Selection Display

47. Touch the Specify Cursor button  on the measurement tool bar.

48. In the waveform of the signal under test in the Frame Selection display, touch near a frame to measure it. The cursor is placed within the frame.

49. Touch the **Analysis Restart** key on the soft menu bar.
    Measurement is executed, and the measurement result is displayed.

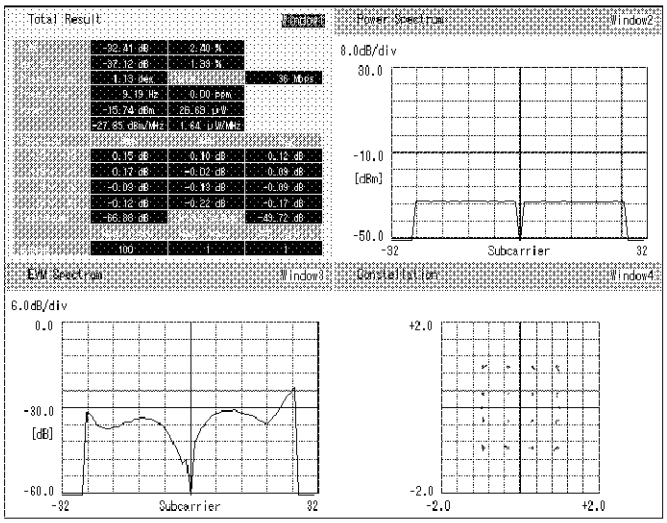


Figure 4-27 DUT Measurement Results

5. MENU MAP, FUNCTIONAL EXPLANATION

This chapter describes the configurations and functions of the soft keys displayed on the touch screen.

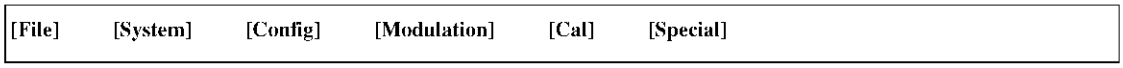
MEMO:

- *[.....] 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 a touch screen, and "touch" means to press a button or a key.*

5.1 Menu Index

5.2 Switching the Communication System

The menu bar of this option is arranged as follows:



The menu bar consists of the same items as those of Spectrum Analyzer except that the additional items; Save Meas. Data... and Save A/D Data... exist under the File menu when Modulation Analyzer is used.

[Save Meas. Data...] Saves the data displayed on the selected display.

[Save A/D Data...] Saves the A/D data.
If the AD data is saved by selecting File Type:DAT, the AD data, whose frequency characteristics were corrected, is saved in text format.
For more information, refer to A.2, "A/D Data Save Function."
If the AD data is saved by selecting File Type:MNT, the AD data, whose frequency characteristics were not corrected, is saved in binary format. These data is used only for maintenance, and therefore cannot be disclosed.

Select Modulation Analyzer from Config on the menu bar to select the modulation analyzing function.

Then select the OFDM modulation analyzing function from the modulation analyzing functions.

Select OFDM from Modulation on the menu bar to select the OFDM modulation analyzing 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 instrument is as follows:

When you touch a function button on the function bar, the associated soft key is displayed on the side menu bar.

5.4 Soft Menu Bar

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

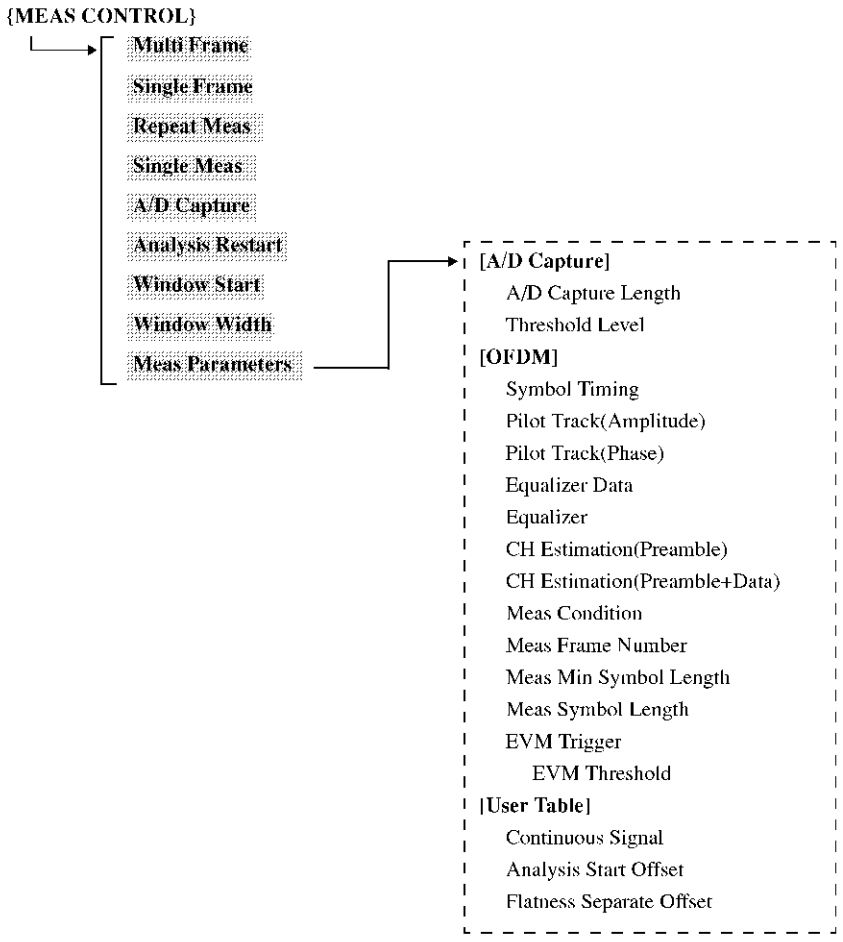
If you touch a button on the function bar, the corresponding soft key will be displayed on the soft menu bar.

5.5 Description of the Functions of Each Key

The functions of each key are described.

5.5.1 {MEAS CONTROL}

When you touch the **{MEAS CONTROL}** button, the soft keys related to the selection of a measurement mode, import and analysis of A/D data on measurement signals, and setup of measurement conditions are displayed on the soft menu bar.



Multi Frame

When you touch the **Multi Frame** button, the measurement mode is set to the Multi Frame mode.
The Multi Frame mode is used to acquire the A/D data on the signal to be measured, analyze multiple frames contained in the data until the conditions set in Meas Parameters are satisfied, and display the measurement results. If the conditions set in Meas Parameters are not satisfied by one acquisition of A/D data on the signal to be measured, repeat A/D data acquisitions the required number of times. With regard to the measurement result, a cumulative value of all frames analyzed after the start of the measurement is displayed as "Total Result." In the displays other than "Total Result," only the result of the immediately preceding analyzed frame is displayed.

MEMO: ***The Multi Frame mode is suitable for performing measurements of multiple symbols repeatedly under the same measurement conditions.***

Single Frame

When you touch the **Single Frame** button, the measurement mode is set to the Single Frame mode.
In the Single Frame mode, using A/D Capture, measurements can be repeatedly performed by using the once acquired A/D data on the measurement signal under various measurement conditions.

MEMO: ***The Single Frame mode is suitable for performing measurement by selecting a burst to be measured from the data captured.***

Repeat Meas

Valid only in the Multi Frame mode.
When you touch the **Repeat Meas** button, measurements in the Multi Frame mode are repeatedly performed. When the conditions set in Meas Parameters are satisfied, the number of symbols measured is returned to 0 and measurement is restarted.

Single Meas

Valid only in the Multi Frame mode.
When you touch the **Single Meas** button, measurement is performed in the Multi Frame mode once. When the conditions set in Meas Parameters are satisfied, the measurement is terminated.

A/D Capture

Valid only in the Single Frame mode.
When you touch the **A/D Capture** button, acquisition of A/D data on the signal to be measured is started. When acquisition of A/D data is complete, the time waveform of the acquired burst is displayed in the form of the Frame Selection display.

IMPORTANT:

Regarding the Frame Selection display
When acquisition by A/D Capture is complete, the envelope waveform of the signal measured is displayed. This is called the Frame Selection display.
Using this display, select the frame to be measured. To select a frame, position the cursor on the frame to be measured.

Analysis Restart

Valid only in the Single Frame mode.
When you touch the **Analysis Restart** button, the measurement is started. When you touch the **Analysis Restart** button after measurement, the measurement is restarted.

IMPORTANT:

When you touch the Analysis Restart button before completing the A/D data acquisition, an error occurs.

Window Start

Valid in the Single Frame mode.
In the frame selected using the Frame Selection display, sets the start position of the range to be analyzed. The set start position moves with the measurement range window in the Meas Window display. The unit used for setting is "symbol(sym)."

Window Width

Valid in the Single Frame mode.
In the frame selected using the Frame Selection display, sets the number of symbols (chips) in the range to be analyzed. The set number of symbols (chips) moves with the measurement range window in the Meas Window display. The unit used for setting is "symbol(sym)."

IMPORTANT:

In the initial analysis of the selected frame, the set previous values of Window Start and Window Width are ignored, and their values are automatically set according to the frame structure and length. In the second and subsequent analyses, the set values become valid.

Meas Parameters

When you touch the **Meas Parameters** button, the dialog box used to set measurement conditions is displayed.

[A/D Capture]

Sets the measurement conditions of A/D data Capture.

[A/D Capture Length]

Sets the A/D data time length of the signal to be measured.

[Threshold Level]

Switches the setting method of the threshold level used to judge whether the frame exists or not between automatic and manual.

Auto: Sets the threshold level automatically.

Manual: Sets the threshold level manually.
When "Manual" is selected, the text box for manual input of the threshold level is displayed.

[OFDM]

Sets the measurement conditions for measuring the OFDM signal.

[Symbol Timing]

In the OFDM symbol, sets the start position of the range used for FFT (demodulation).

[Pilot Track(Amplitude)]

Switches ON and OFF the amplitude correction function which uses the pilot subcarrier.

ON: Uses the amplitude correction function.

OFF: Does not use the amplitude correction function.

[Pilot Track(Phase)] Switches ON and OFF the phase synchronization function which uses the pilot subcarrier.

ON: Uses the phase synchronization function.

OFF: Does not use the phase synchronization function.

[Equalizer Data] The Equalizer data is calculated by touching the **Make** button. The frequency characteristics correction data is calculated based on the measurement results of the Mag Flatness Spectrum and the Phase Error Spectrum. The Equalizer data is retained until re-calculating.

IMPORTANT:

To calculate the Equalizer data, the frame analysis must be completed.

If the measurement conditions (INPUT, FREQ, STD, the number of FFT points or the FFT sampling frequency) are different from the conditions on which the measurement results used in the data calculation are taken, the Equalizer data is invalid and cannot be used.

[Equalizer] Switches the Equalizer function ON and OFF.

ON: Uses the Equalizer function.
The frequency characteristics are corrected by using the Equalizer data.

OFF: Does not use the Equalizer function.

IMPORTANT:

The Equalizer function cannot be used when the Equalizer data does not exist or is invalid.

[CH Estimation (Preamble)]
Switches ON and OFF the channel correction function which uses the preamble (LTS of IEEE802.11a, Section C of HiperLAN/2 or Section C of HiSWANa).

ON: Uses the channel correction function.
The frequency characteristics are corrected.

OFF: Does not use the channel correction function.

[CH Estimation (Preamble+Data)]
Switches ON and OFF the channel correction function which uses the preamble (LTS of IEEE802.11a, Section C of HiperLAN/2 or Section C of HiSWANa) and the data analysis results.

ON: Uses the channel correction function.
The frequency characteristics are corrected.

OFF: Does not use the channel correction function.

IMPORTANT:
The Equalizer function has an exclusive relationship with the CH Estimation (Preamble) function and CH Estimation (Preamble+Data) function. Two or more functions cannot be set to ON at the same time. If one of the three functions is set to ON, the other two functions are automatically set to OFF.

[Meas Condition] Valid in the Multi Frame mode. Sets the Total Result measurement conditions.

Frame: Measures the set number of Frames.

Symbol: Measures the set number of Symbols.

Frame & Min Symbol:
Measures the set number of Frames. However, any Frame whose number of symbols in the data part is less than Min Symbol is not measured.

[Meas Frame Number] Valid in the Multi Frame mode. Sets the number of frames required for Total Result measurement.

[Meas Min Symbol Length]
Valid in the Multi Frame mode. Sets the minimum number of symbols per frame required for Total Result measurement.

[Meas Symbol Length] Valid in the Multi Frame mode. Sets the number of symbols required for Total Result measurement.

[EVM Trigger] Valid in the Multi Frame mode. Sets the EVM trigger ON and OFF.

ON: Turns on the EVM trigger function.

OFF: Turns off the EVM trigger function.
When the function is turned on, a text box for input of the threshold is displayed.

[EVM Threshold]
Sets the threshold when the EVM Trigger is turned on.

[User Table]

[Continuous Signal] Enabled during measurement of the **User Table**. Set whether the signal to be measured is continuous wave or not.

ON: Measures continuous wave.

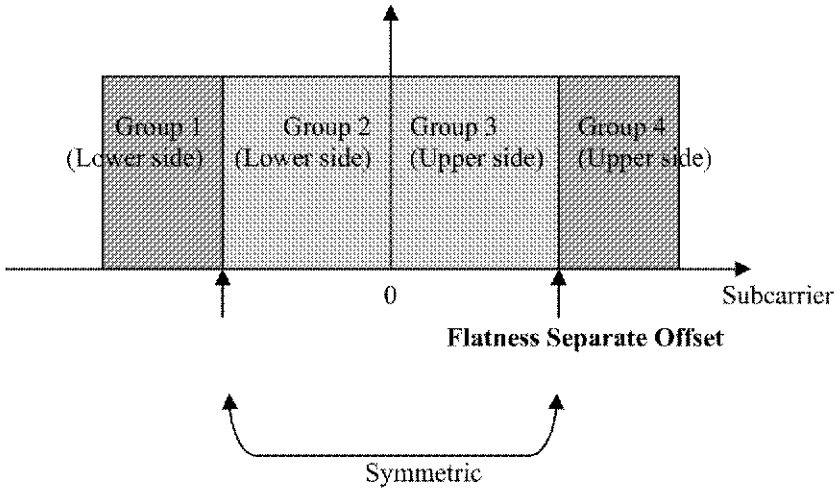
OFF: Analyzes burst signal.

[Analysis Start Offset] Enabled during measurement of the **User Table**. Sets the analysis start point of the frame to be measured.

MEMO: ***If any signal of specifications different from those of the OFDM symbol, such as preamble added to the beginning of the frame, is analyzed, an error in the measurement result may occur. This function is used to remove such signals from the measuring range.***

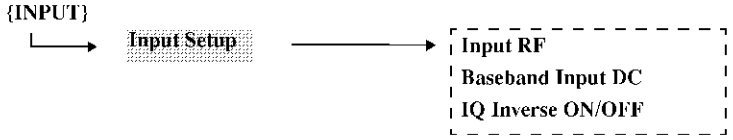
[Flatness Separate Offset]

Sets the subcarrier range for Spectral Flatness measurement in accordance with standards such as IEEE802.11a.



5.5.2 {INPUT}

If you touch the **{INPUT}** key, the soft key for setting the input form for inputting to the measurement equipment will be displayed on the soft menu bar.



Input Setup If you touch the **Input Setup** button, the dialog box for setting the input form for inputting to the measurement equipment will be displayed. Set in accordance with the measuring signal.

[Input] Sets the signal input channel.

RF: Sets to the RF signal input.

Baseband (I&Q):
Sets 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.

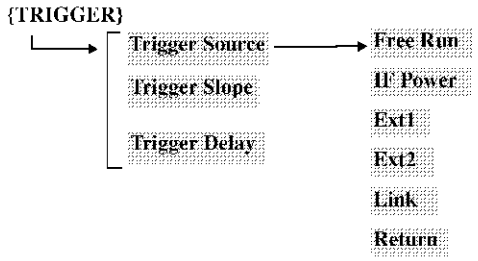
[IQ Inverse] Selects phase inversion or no phase inversion for the signal to be measured.

ON: Inverts.

OFF: Does not invert.

5.5.3 {TRIGGER}

When you touch the **{TRIGGER}** button, the soft keys related to the trigger setup are displayed on the soft menu bar.



Trigger Source

When you touch the **Trigger Source** button, the soft keys related to the trigger setup are displayed on the soft menu bar.

Free Run

Obtains and analyzes data according to the internal timing of the measuring instrument.

IF Power

Obtains and analyzes data synchronized with the IF signal.

Ext1

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

Ext2

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

Link

Obtains and analyzes data synchronizing with the trigger of an optional function.

MEMO: ***For information on the directions for use of 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 polarity of the trigger slope.
Available only for IF Power, Ext1, and Ext2.

+: Starts sweep at the rise of a trigger.

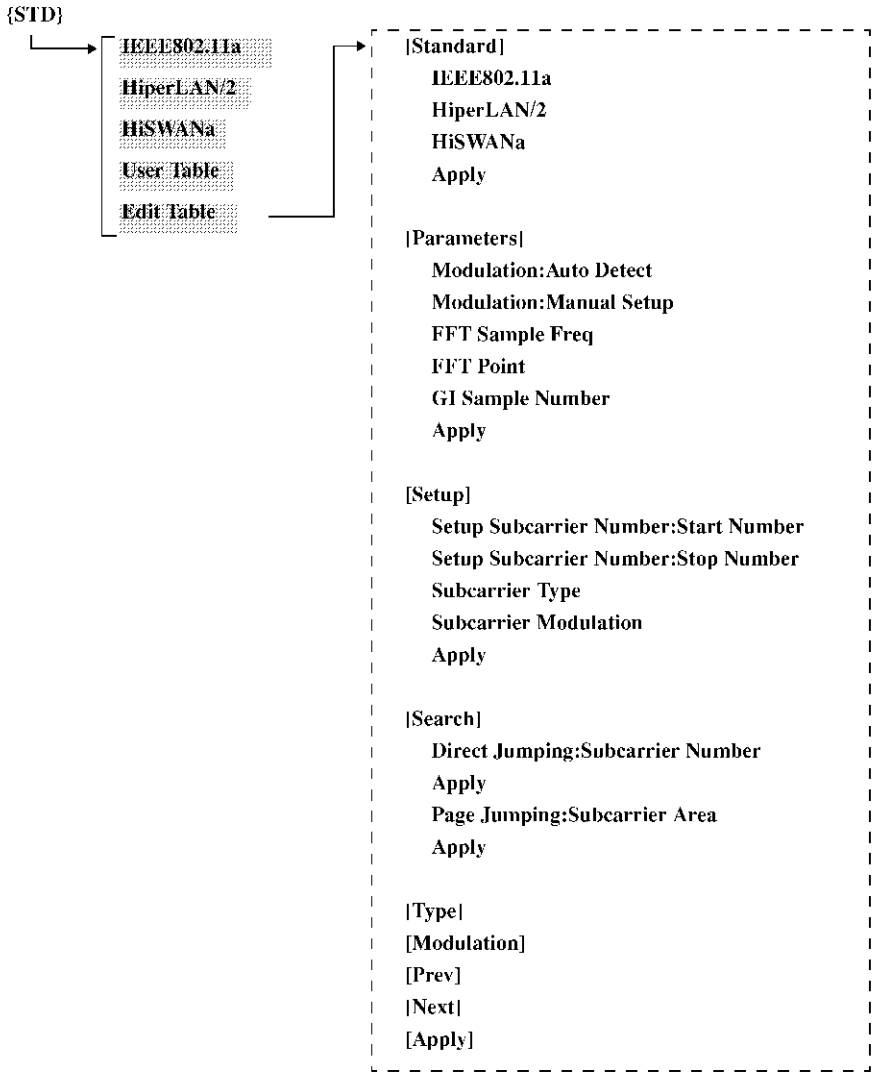
-: Starts sweep at the fall of a trigger.

Trigger Delay

Sets the delay time from the trigger point. Is available only for IF Power, Ext1, and Ext2. When analyzing, the start position of AD data acquisition is shifted to the delay time.

5.5.4 {STD}

If you touch the **{STD}** button, the soft key for setting the analyzing parameter will be displayed on the soft menu bar.



IEEE802.11a Measures the IEEE802.11a signal. It will be set to the measuring conditions conforming to the standards.

HiperLAN/2 Measures the HiperLAN/2 signal. It will be set to the measuring conditions conforming to the standards.

HiSWANa Measures the HiSWANa signal. It will be set to the measuring conditions conforming to the standards.

User Table Measurement can be performed setting arbitrarily the number, type, modulation system, etc. of subcarriers. For measuring conditions, arbitrarily set each measuring parameter with the **Edit Table**.

Edit Table Displays the dialog box for setting measuring parameters. Set in accordance with the measuring signal.

[No.] By setting the number of subcarriers, the range will be set automatically. Manual setting is not possible.

[Type] Sets the type of each subcarrier.

[Modulation] Sets the modulation system for each subcarrier.

[Prev] Moves the page upwards.

[Next] Moves the page downwards.

[Apply] Generates the User Table, applying all arbitrary parameters set in the **Edit Table**.

[Standard] This key is used in the **User Table** mode, to copy settings conforming to standards such as IEEE802.11a. After selecting the standard to be copied, if you press the Apply button, the setting of Type and Modulation for each subcarrier is changed to the setting for the selected standard.
Use this key for changing a part of the setting based on the setting of each standard.

[Parameters] Sets the measuring parameter. Set in accordance with the measuring signal.

[Modulation]

[Auto Detection] The modulation system of each data subcarrier of the signal to be measured is automatically detected by the measurement equipment and measured.

[Manual Setup] Measurement is performed by fixing the modulation system of each subcarrier of the signal to be measured to the system set arbitrarily with Modulation in the **[Edit Table]** dialog box.

---

*NOTE: **For measurement in the User Table, the modulation systems of all individual data subcarriers in the same frame must be the same.***

[FFT Sample Freq] Sets the sampling frequency of the data of the signal to be measured for FFT (demodulation).

[FFT Point] Sets the point number of FFT.

[GI Sample Number] Sets the number of point of GI (guard interval).

[Apply] If you press this button, each setting of the Parameter tab in the **[Edit Table]** dialog box will be applied to the table being edited.

CAUTION: ***This [Apply] button only determines the parameter for editing and no User Table for measurement will be created.***
Press the [Apply] button on the bottom right of the [Edit Table] dialog to create User Tables for measurement.

[Setup] This function is to perform setting of several subcarriers together in setting the measuring parameter for each subcarrier in accordance with the measuring signal.

[Setup Subcarrier Number]

[Start Number] Sets the subcarrier number at the start point of the range in performing measuring parameter setting for multiple subcarriers together.

[Stop Number] Sets the subcarrier number at the end point of the range in performing measuring parameter setting for multiple subcarriers together.

[Subcarrier Type] Sets the type of each subcarrier.

[Subcarrier Modulation]
Sets the modulation system of the subcarrier.

[Apply] If you press this button, each setting of the Setup tab in the **[Edit Table]** dialog box will be applied to the table being edited.

CAUTION: ***This [Apply] button only determines the parameter for editing and no User Table for measurement will be created.***
Press the [Apply] button on the bottom right of the [Edit Table] dialog to create User Tables for measurement.

[Search] Use this function to search for a specific subcarrier from the subcarrier setting list.

[Direct Jumping] Use this function to search for a specific subcarrier.

[Subcarrier Number]
Sets the subcarrier number to be searched for.

[Apply] If you press this button, the set subcarrier for which search has been performed will be displayed in the center of the list.

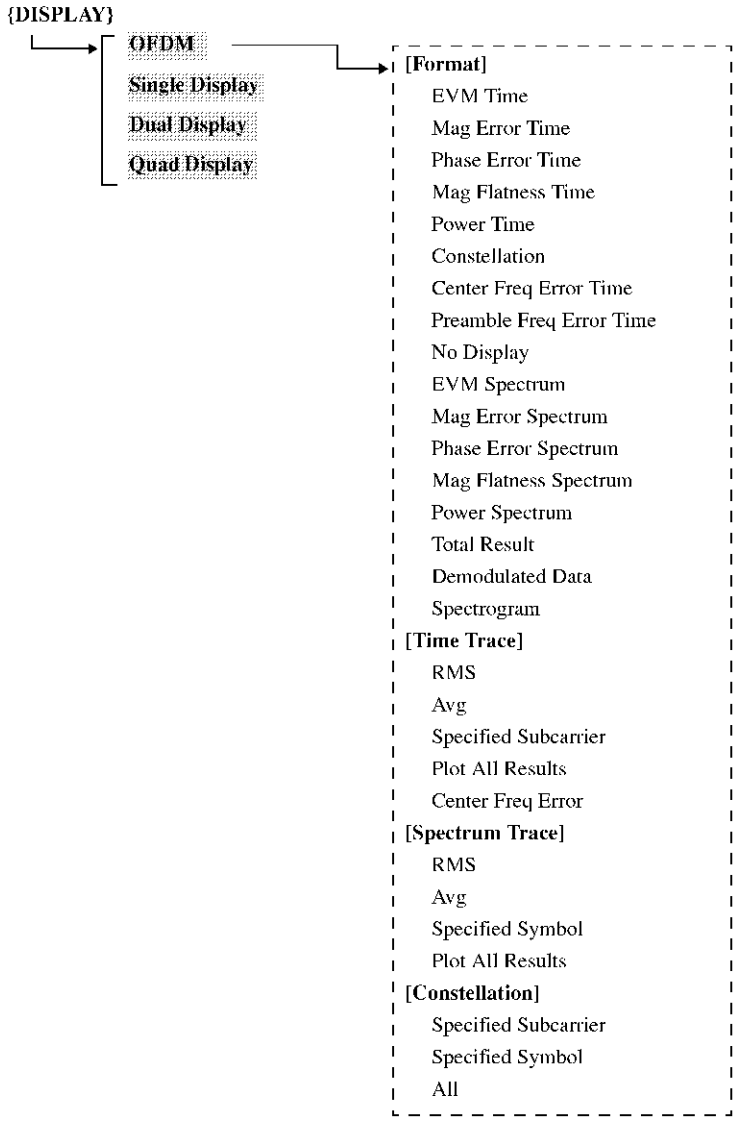
[Page Jumping] Use this function to search for a page for setting a specific subcarrier.

[Subcarrier Area]
Sets the range of the subcarrier to be searched for.

[Apply] If you press this button, the page that includes the subcarrier of the set number for which search has been performed will be displayed.

5.5.5 {DISPLAY}

When you touch the **{DISPLAY}** button, the soft keys related to the display screen setup are displayed on the soft menu bar.



OFDM

Displays the dialog box used to set the type of the display result in the active window on the OFDM result display screen.
Selects **[Format]** of the display result, and sets the selected Format in more detail by setting **[Time Trace]**, **[Spectrum Trace]**, and **[Constellation]**.

[Format]

Selects the type of the display result.

[EVM Time] Displays the EVM of each symbol on a graph.
On the graph, the vertical axis shows EVM (dB) and the horizontal axis shows time (symbol). The EVM RMS value traces, the EVM value trace of any one of the subcarriers, or the EVM value plot of each symbol or subcarrier can be displayed.

[Mag Error Time] Displays the Magnitude Error of each symbol on a graph.
On the graph, the vertical axis shows Magnitude Error (dB) and the horizontal axis shows time (symbol).
The Magnitude Error RMS value trace, the Magnitude Error value trace of any one of the subcarriers, or the Magnitude Error value plot of each symbol or subcarrier can be displayed.

[Phase Error Time] Displays the Phase Error of each symbol on a graph.
On the graph, the vertical axis shows Phase Error (deg) and the horizontal axis shows time (symbol). The Phase Error average value trace, the Phase Error value trace of any one of the subcarriers, or the Phase Error value plot of each symbol or subcarrier can be displayed.

[Mag Flatness Time] Displays the Magnitude Flatness of each symbol on a graph.
On the graph, the vertical axis shows Magnitude Flatness (dB) and the horizontal axis shows time (symbol). The Magnitude Flatness average value trace, the Magnitude Flatness value trace of any one of the subcarriers, or the Magnitude Flatness value plot of each symbol or subcarrier can be displayed.

[Power Time] Displays the power of each symbol on a graph.
On the graph, the vertical axis shows power (dBm) and the horizontal axis shows time (symbol). The average power value trace, the power value trace of any one of the subcarriers, or the power value plot of each symbol or subcarrier can be displayed.

[Constellation] Displays the constellation. On the graph, the vertical axis shows the magnitude of the I signal and the horizontal axis shows the magnitude of the Q signal. Constellations of all symbols or subcarriers, the constellation of any one of the subcarriers, or the constellation of any one of the symbols can be displayed.

[Center Freq Error Time]
Displays the center frequency error of each symbol on a graph.
On the graph, the vertical axis shows the frequency error (Hz) and the horizontal axis shows time (symbol). The center frequency error trace and the average value can be displayed.

[Preamble Freq Error Time]
Displays the center frequency error of the preamble (STS: Short Training Symbols) on a graph.
The result is displayed only when IEEE802.11a is measured.
On the graph, the vertical axis shows the frequency error (Hz) and the horizontal axis shows time (sec).

[No Display] Nothing is displayed.

[EVM Spectrum] Displays the EVM of each subcarrier on a graph.
On the graph, the vertical axis shows EVM (dB) and the horizontal axis shows frequency (subcarrier). The EVM RMS value traces, the EVM value trace of any one of the symbols, or the EVM value plot of each symbol or subcarrier can be displayed.

[Mag Error Spectrum]

Displays Magnitude Error of each subcarrier on a graph.
On the graph, the vertical axis shows Magnitude Error (dB) and the horizontal axis shows frequency (subcarrier). The Magnitude Error RMS value trace, the Magnitude Error value trace of any one of the symbols, or the Magnitude Error value plot of each symbol or subcarrier can be displayed.

[Phase Error Spectrum]

Displays Phase Error of each subcarrier on a graph. On the graph, the vertical axis shows Phase Error (deg) and the horizontal axis shows frequency (subcarrier). The Phase Error average value trace, the Phase Error value trace of any one of the symbols, or the Phase Error value plot of each symbol or subcarrier can be displayed.

[Mag Flatness Spectrum]

Displays the Magnitude Flatness of each subcarrier on a graph.
On the graph, the vertical axis shows Magnitude Flatness (dB) and the horizontal axis shows frequency (subcarrier).
The Magnitude Flatness average value trace, the Magnitude Flatness value trace of any one of the symbols, or the Magnitude Flatness value plot of each symbol or subcarrier can be displayed.

[Power Spectrum]

Displays the power of each subcarrier on a graph.
On the graph, the vertical axis shows power (dBm) and the horizontal axis shows frequency (subcarrier). The average power value trace, the power value trace of any one of the symbols, or the power value plot of each symbol or subcarrier can be displayed.

[Total Result]

Displays the total of the measurement values of all subcarriers for the symbols in the measurement range as the result.

- RMS EVM (dB): Modulation Accuracy
- Mag Error (dB): Magnitude Error
- Phase Error (deg): Phase Error
- Center Frequency Error (Hz, ppm): Center Frequency Error
- Power (dBm, dBm/MHz, W, W/MHz): Power
- Rate: Transmission rate
- Leak-Power (dB): Center Frequency Leakage Power
- Relative to overall power: Relative to the overall power
- Relative to subcarrier average power: Relative to the average power of all subcarriers
- Spectral Flatness (dB): Spectral Flatness
- Number of Meas. Symbol: Number of symbols measured
- Number of Meas. Frame: Number of frames measured
- Number of A/D Capture: Number of A/D data captures

[Demodulated Data] The demodulated data on the signal measured is displayed.
It is displayed for each symbol and subcarrier in a hexadecimal number respectively. The subcarrier type and the modulation system are distinguished by color. The demodulated data on the first 10 symbols (when the dual or quad display is selected) or the first 24 symbols (when the single display is selected) in the measurement range is displayed on the screen. To see the demodulated data on the subsequent symbols, change the measurement range. All the demodulated data in the measurement range can be saved in a file.

BPSK: purple
QPSK: green
16QAM: light blue
64QAM: cream
Pilot subcarrier:yellow
When there are no subcarriers, red asterisks (**) are displayed.

[Spectrogram] Displays the spectrogram.
Displays the time change of the spectrum of the measurement signal. The vertical axis shows time (symbol) and the horizontal axis shows frequency (subcarrier). The color shows the power strength.

[Time Trace] Sets the result graph that has a horizontal axis showing time (symbol). The checked items are displayed on the graph. Multiple items can be selected.

[RMS] Displays the RMS value of the measurement result on a trace.

NOTE: ***RMS can be selected only for EVM Time and Mag Error Time.***

[Avg] Displays the average value of the measurement result on a trace.

NOTE: ***Avg can be selected only for Phase Error Time, Mag Flatness Time, Power Time, and Center Freq Error Time.***

[Specified Subcarrier] Sets the subcarrier number to be displayed on a graph.

NOTE: ***This cannot be selected for Center Freq Error Time.***

[Plot All Results] Displays measurement values of all subcarriers for each symbol on a plot.

NOTE: ***This cannot be selected for Center Freq Error Time.***

[Center Freq Error] Displays the center frequency error of each symbol on a trace.

[Spectrum Trace] Sets the result graph that has a horizontal axis showing frequency (subcarrier). The checked items are displayed on the graph. Multiple items can be selected.

[RMS] Displays the RMS value of the measurement result on a trace.

NOTE: RMS can be selected only for EVM Time and Mag Error Time.

[Avg] Displays the average value of the measurement result on a trace.

NOTE: Avg can be selected only for Phase Error Time, Mag Flatness Time, and Power Time.

[Specified Symbol]
Sets the symbol number to be displayed on a graph.

[Plot All Results]
Displays measurement values of all symbols for each subcarrier on a plot.

[Constellation] Performs setup related to the constellation display.
The checked items are displayed. Only one item can be selected at a time.

[Specified Subcarrier]
Displays the constellation of any one of the subcarriers.

[Specified Symbol]
Displays the constellation of any one of the symbols.

[All] Displays the constellations of all symbols and subcarriers.

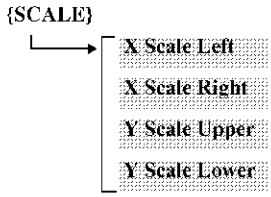
Single Display Selects the single display.

Dual Display Selects the dual display.

Quad Display Selects the quad display.

5.5.6 {SCALE}

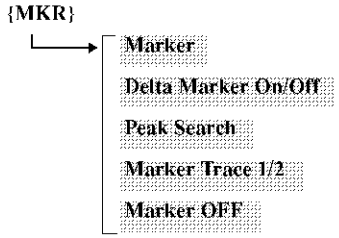
If you touch the **[SCALE]** button, soft keys related to the scale setting of the X and Y axes of the active display window are displayed on the soft menu bar.



X Scale Left	Sets the minimum value of the X axis.
X Scale Right	Sets the maximum value of the X axis.
Y Scale Upper	Sets the maximum value of the Y axis.
Y Scale Lower	Sets the minimum value of the Y axis.

5.5.7 {MKR}

If you touch the **{MKR}** button, the soft keys for setting the markers will be displayed on the side menu bar.



Marker — Sets the X-axis position (subcarrier and symbol) of the normal marker position.

Delta Marker On/Off — Switches between ON and OFF of the delta marker display function.

ON: Displays the delta marker in the same position as that for the normal marker. Displays the relative value to the normal marker (measured value such as EVM) in the marker area.

OFF: Deletes the display of the delta marker.

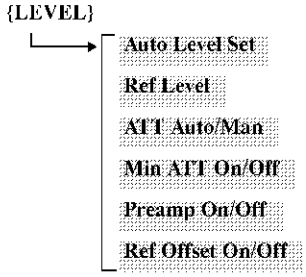
Peak Search — Moves the marker to the maximum peak of trace within the search range.

Marker Trace 1/2 — Moves the normal marker between the traces in a case in which multiple traces exist. Marker moves between the traces every time this switch is pressed.

Marker OFF — Deletes the display of the normal marker.

5.5.8 {LEVEL}

If you touch the **{LEVEL}** button, the soft keys for setting the attenuator, reference level, etc. will be displayed on the soft menu bar.



Auto Level Set

Set the reference level to the optimum value in accordance with the signal to be measured. Executes Auto Level Set when the key is pressed.

IMPORTANT: During Auto Level Set execution, the level of the signal to be measured shall be constant.

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 manually.

Min ATT

Sets ON and OFF of the Min ATT function.

On: Sets the minimum value of the attenuator and performs restriction regardless of ATT Auto or Manual.

Off: Releases the restriction on Min ATT.

Preamp On/Off

Sets ON and OFF of the preamp function.

Ref Offset

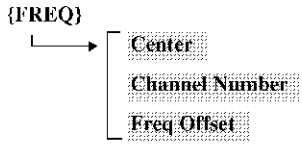
Switches ON and OFF the offset function of the reference level.

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

Off: Cancels the offset function.

5.5.9 {FREQ}

When you touch the **{FREQ}** button, the soft keys related to the measurement frequency setup are displayed on the soft menu bar.



Center

Sets the center frequency of the measurement signal.

CAUTION: ***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

When 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.

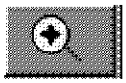
On: Sets the offset value and changes only the displayed center frequency by the offset value.
(Displayed center frequency = Set value + Offset value)

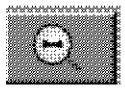
Off: Cancels the offset function.

5.5.10 Measurement Tool Bar

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

Each function can be used by touching the corresponding icon.

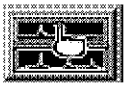
 : Enlarging icon: Use this icon for enlarging the waveform displayed on the window. If you touch this icon after specifying the range with the range specification icon, the range will be enlarged.

 : Diminishing icon: Use this icon for diminishing the waveform displayed on the window.

 : Range specification icon (X-axis mode):
Specifies the range on the window on which the waveform is displayed. Touch both sides of the range to be specified after touching the icon.

 : Range specification icon (Range mode):
Specifies the range on the window on which the waveform is displayed. Touch the top left and bottom right of the range to be specified after touching the icon.

 : Peak search icon: The marker will be placed by searching the peak of the waveform in the range specified by the range specification icon.

 : Switching the active window:
This function is used to turn one of multiple split windows to an active state.

 : Switching the window: Switches between the waveform window and the result window.

 : Cursor specification icon: Specifies the signal to be measured with the cursor.
Select the signal to be measured on the Frame Selection screen after touching the icon.

6. SCPI COMMAND REFERENCE

This chapter describes the SCPI command reference for this instrument.

6.1 Command Reference Format

This section describes the format of explanations of each command described in this chapter.

Explanations of each command include the following items:

Function description

SCPI command

Parameter

Query reply

- [Function description]

  The usage of commands and operation of this instrument when they are executed.

- [SCPI command]

  The SCPI command shows the syntax of a command sent from the external controller to this instrument. The syntax consists of a command part and a parameter part. The command part and parameter part are delimited by a space.

  When there are multiple parameters, they are delimited by commas (,). The three points (...) displayed between commas represent the parameter(s) omitted in the 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.

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

  The part written in lowercase alphabetical characters in the syntax shows that it 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
|:	Written in curly brackets {..} and used as a delimiter for multiple items
<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, the 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 is selected {1|2|3|4}

For example, when a 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.

  When the parameter is a numeric type or a character (string) type, it is enclosed in angle brackets (< >).

  When the parameter is an optional type, 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 >: String of OFF|ON

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

  <block>: Block data type
  The content of data 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 ({ }). When multiple items delimited by a vertical bar (|) exist in curly brackets ({ }), only one of those items is read out. When multiple parameters are read out, they are delimited by commas (,). The three points (...) displayed between commas represent the data omitted in the 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.

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

  When the parameter to be read is a value in a unit, the description like "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 IEEE common 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
Notice of completion of all running operations	*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 for the completion of all running operations	*WAI	-	-	

*1 If the *DDT? command is executed when the macro is undefined, 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 at the last power-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	OFDM	OFDM	
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<ch=1|2>:ATTenuation	<real>	<real>	
ATT(Auto/Manual)	:INPut<ch=1|2>:ATTenuation:AUTO	OFF|ON	OFF|ON	
Min ATT setting	:INPut<ch=1|2>:ATTenuation:MINimum	<real>	<real>	
Min ATT ON/OFF	:INPut<ch=1|2>:ATTenuation:MINimum:STATe	OFF|ON	OFF|ON	
Preamp ON/OFF	:INPut<ch=1|2>:GAIN:STATe	OFF|ON	OFF|ON	
Input Setup				
Input Signal RF/Baseband	:INPut<ch=1|2>:SIGNal	RF|BASeband	RF|BAS	*1
Baseband Input AC/DC	:INPut<ch=1|2>:BASeband	AC|DC	AC|DC	*2
IQ Inverse ON/OFF	:INPut<ch=1|2>:IQ:INVerse	OFF|ON	OFF|ON	

*1: The Level setting item is invalid when selecting the Baseband.
*2: Only valid when selecting the Baseband.

6.3.3 Subsystem-SENSe

Function description	SCPI command	Parameter	Query reply	Remarks
FREQuency				
Center Freq setting	[:SENSe<ch=1|2>]:FREQuency:CENTer	<real>	<real>	
Center Number setting	[:SENSe<ch=1|2>]:FREQuency:CHANnel:NUMBer	<int>	<int>	
Freq Offset setting	[:SENSe<ch=1|2>]:FREQuency:OFFSet	<real>	<real>	*3
Freq Offset ON/OFF	[:SENSe<ch=1|2>]:FREQuency:OFFSet:STATe	OFF|ON	OFF|ON	
Auto Level Set				
Auto Level Set execution	[:SENSe<ch=1|2>]:POWer:LEVel:AUTO	-	-	
Measurement Control				
Multi Frame/Single Frame selection	[:SENSe<ch=1|2>]:CONDition:FRAMe	MULTi|SINGle	MULT|SING	
Measurement Parameters (AD Capture)				
AD Capture Length setting	[:SENSe<ch=1|2>]:CONDition:CAPTure:LENGth	<real>	<real>	
Threshold Level setting (Manual)	[:SENSe<ch=1|2>]:CONDition:THReshold	<real>	<real>	*4
Threshold Level (auto/manual)	[:SENSe<ch=1|2>]:CONDition:THReshold:AUTO	OFF|ON	OFF|ON	
Measurement Parameters (OFDM)				
Symbol Timing setting	[:SENSe<ch=1|2>]:CONDition:STIMing	<int>	<int>	
Pilot Track (Amplitude) ON/OFF	[:SENSe<ch=1|2>]:CONDition:PTRAck:AMPLitude	OFF|ON	OFF|ON	
Pilot Track (Phase) ON/OFF	[:SENSe<ch=1|2>]:CONDition:PTRAck:PHASe	OFF|ON	OFF|ON	
Equalizer Data Calculation	[:SENSe<ch=1|2>]:CONDition:EQUAlizer:DMAKe	-	-	
Equalizer ON/OFF	[:SENSe<ch=1|2>]:CONDition:EQUAlizer:FUNCtion	OFF|ON	OFF|ON	*5
CH Estimation (Preamble) ON/OFF	[:SENSe<ch=1|2>]:CONDition:CESTimation: PREAmble	OFF|ON	OFF|ON	*5
CH Estimation (Preamble+Data) ON/OFF	[:SENSe<ch=1|2>]:CONDition:CESTimation:PDATa	OFF|ON	OFF|ON	*5

*3: Setting becomes possible when Frequency Offset is ON.
*4: Setting becomes possible only when Threshold Level is Manual.
*5: Channel Estimation and Equalizer are exclusive controls.

6.3.3 Subsystem-SENSe

Function description	SCPI command	Parameter	Query reply	Remarks
Meas Condition setting	[:SENSe<ch=1|2>]:CONDition:MCONdition	FRAMe|FMSYmbol|SYMBol	FRAM|FMSY|SYMB	
Meas Frame Number setting	[:SENSe<ch=1|2>]:CONDition:MFRame:NUMBer	<int>	<int>	
Meas Minimum Symbol Length setting	[:SENSe<ch=1|2>]:CONDition:MMSYmbol:LENGth	<int>	<int>	
Meas Symbol Length setting	[:SENSe<ch=1|2>]:CONDition:SYMbol:LENGth	<int>	<int>	
EVM Trigger ON/OFF	[:SENSe<ch=1|2>]:CONDition:ETRigger	OFF|ON	OFF|ON	
EVM Trigger Threshold setting	[:SENSe<ch=1|2>]:CONDition:ETRigger:LEVel	<real>	<real>	
Measurement Parameters (User Table)				
Continuous Signal setting	[:SENSe<ch=1|2>]:CONDition:CSIGnal	OFF|ON	OFF|ON	
Analysis Start Offset setting	[:SENSe<ch=1|2>]:CONDition:STARt:OFFSet	<real>	<real>	
Flatness Separate Offset setting	[:SENSe<ch=1|2>]:CONDition:FSEParate:OFFSet	<int>	<int>	
STD				
Specification Mode selection	[:SENSe<ch=1|2>]:SIGNal:STANdard	OFDM1|OFDM2|OFDM3|USER	OFDM1|OFDM2|OFDM3|USER OFDM1: IEEE802.11a OFDM2: HiperLAN/2 OFDM3: HiSWANa USER: User Table	
Edit Table (Standard)				
Copy of Standard setting	[:SENSe<ch=1|2>]:SIGNal:STANdard:DATA	OFDM1|OFDM2|OFDM3	OFDM1|OFDM2|OFDM3 OFDM1: IEEE802.11a OFDM2: HiperLAN/2 OFDM3: HiSWANa	
Edit Table (Parameters)				
Modulation Auto Detection ON/OFF	[:SENSe<ch=1|2>]:SIGNal:MODulation:DETector:AUTO	OFF|ON	OFF|ON	
FFT Sample Freq setting	[:SENSe<ch=1|2>]:SIGNal:FFT:SAMPle:FREQuency	<real>	<real>	
FFT Point setting	[:SENSe<ch=1|2>]:SIGNal:FFT:POINt	<int>	<int>	
GI Sample Number setting	[:SENSe<ch=1|2>]:SIGNal:GINTerval:SAMPle:NUMBer	<int>	<int>	

Function description	SCPI command	Parameter	Query reply	Rem arks
Edit Table (Setup)				
Subcarrier Number Start setting	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:STARt	<int>	<int>	
Subcarrier Number Stop setting	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:STOP	<int>	<int>	
Subcarrier Type setting	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:TYPE	OFF|DATA|POSitive|NEGative	OFF|DATA|POS|NEG	
Subcarrier Type setting ON/OFF	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:TYPE:STATe	OFF|ON	OFF|ON	
Subcarrier Modulation setting	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:MODulation	BPSK|QPSK|QAM16|QAM64|QAM256	BPSK|QPSK|QAM16|QAM64|QAM256	
Subcarrier Modulation setting ON/OFF	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:MODulation:STATe	OFF|ON	OFF|ON	
Reflection of changing parameters	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:DATA:APPLy	-	-	
Edit (Subcarrier Table)				
Subcarrier Type OFF/Data/Pos/Neg	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:TYPE:DATA	<int>,OFF|DATA|POSitive|NEGative	OFF|DATA|POS|NEG	
Subcarrier Modulation setting	[:SENSe<ch=1|2>]:SIGNal:SUBCarrier:MODulation:DATA	<int>, BPSK|QPSK|QAM16|QAM64|QAM256	<int>, BPSK|QPSK|QAM16|QAM64|QAM256	

6.3.4 Subsystem-TRIGger

Function description	SCPI command	Parameter	Query reply	Remarks
SEQuence				
Trigger Source	:TRIGger<ch=1|2>[:SEQuence]:SOURce	IMMediate|IF|EXTernal1|EXTernal2|LINK	IMM|IF|EXT1|EXT2|LINK	
Trigger Slope	:TRIGger<ch=1|2>[:SEQuence]:SLOPe	POSitive|NEGative	POS|NEG	
IF Level setting	:TRIGger<ch=1|2>[:SEQuence]:LEVel:IF	<real>	<real>	
Ext Level setting	:TRIGger<ch=1|2>[:SEQuence]:LEVel:EXTernal	<real>	<real>	
Trigger Delay setting	:TRIGger<ch=1|2>[:SEQuence]:DELay	<real>	<real>	

6.3.5 Subsystem-INITiate

Function description	SCPI command	Parameter	Query reply	Remarks
INITiate				
Repeat Measurement execution	:INITiate<ch=1|2>:MEASure:REPeat	-	-	
Single Measurement execution	:INITiate<ch=1|2>:MEASure:SINGle	-	-	
Measurement stop	:INITiate<ch=1|2>:ABORt	-	-	

6.3.6 Subsystem-DISPlay

Function description	SCPI command	Parameter	Query reply	Remarks
WINDow				
Ref Level setting	:DISPlay<ch=1|2>[:WINDow<scrn=1>]:TRACe:Y[:SCALe]:RLEVel	<real>	<real>	*6
Level Offset setting	:DISPlay<ch=1|2>[:WINDow<scrn=1>]:TRACe:Y[:SCALe]:RLEVel:OFFSet	<real>	<real>	*7
Level Offset ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1>]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe	OFF|ON	OFF|ON	
Multi Screen setting	:DISPlay<ch=1|2>[:WINDow<scrn=1>]	SINGle|DUAL|QUAD	SING|DUAL|QUAD	
Active Screen setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:ACTive	-	1|2|3|4	
Analysis Display Screen switching	:DISPlay<ch=1|2>:PAGE	AD|OFDM	AD|OFDM	
Screen Format setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:FORMat	OFF|SPECtrogram|TRESult|EVMSpectrum|EVMTime|MESPectrum|METIme|PESPectrum|PETIme|MFSPectrum|MFTIme|CONStellation|CFETime|PSPEctrum|PTIMe|DDATa|PFETime	OFF|SPEC|TRES|EVMS|EVMT|MESP|METI|PESP|PETI|MFSP|MFTI|CONS|CFET|PSPE|PTIM|DDAT|PFET	
Time Trace RMS ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:TIMe:RMS	OFF|ON	OFF|ON	
Time Trace AVG ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:TIMe:AVERage	OFF|ON	OFF|ON	

*6: The setting range depends on whether Preamp is ON or OFF.
Preamp ON: -170 dBm - +30 dBm
Preamp OFF: -170 dBm - +60 dBm

*7: Can only be set when Level Offset is ON.

Function description	SCPI command	Parameter	Query reply	Remarks
Time Trace Specified Subcarrier ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:TIMe:SSUBcarrier	OFF|ON	OFF|ON	
Time Trace Specified Subcarrier Number setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:TIMe:SSUBcarrier:NUMBer	<int>	<int>	
Time Trace All Measurement Value Plot ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:TIMe:PLOT:ALL	OFF|ON	OFF|ON	
Time Trace Center Freq Error ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:TIMe:CFERror	OFF|ON	OFF|ON	
Spectrum Trace RMS ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:SPECtrum:RMS	OFF|ON	OFF|ON	
Spectrum Trace AVG ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:SPECtrum:AVERage	OFF|ON	OFF|ON	
Spectrum Trace Specified Symbol ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:SPECtrum:SSYMbol	OFF|ON	OFF|ON	
Spectrum Trace Specified Symbol Number setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:SPECtrum:SSYMbol:NUMBer	<int>	<int>	
Spectrum Trace All Measurement Value Plot ON/OFF	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:SPECtrum:PLOT:ALL	OFF|ON	OFF|ON	
Constellation Trace setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:CONStellation	ALL|SUBCarrier|SYMBol	ALL|SUBCarrier|SYMBol	
Constellation Specified Subcarrier Number setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:CONStellation:SSUBcarrier:NUMBer	<int>	<int>	
Constellation Specified Symbol Number setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:CONStellation:SSYMbol:NUMBer	<int>	<int>	
X Scale Left setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:X[:SCALe]:LEFT	<real>	<real>	
X Scale Right setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:X[:SCALe]:RIGHt	<real>	<real>	
Y Scale Upper setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:Y[:SCALe]:UPPer	<real>	<real>	
Y Scale Lower setting	:DISPlay<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRACe:Y[:SCALe]:LOWer	<real>	<real>	

6.3.7 Subsystem-MMEMory

Function description	SCPI command	Parameter	Query reply	Remarks
Save/Recall				
Saving the A/D data	:MMEMory:STORe:AD:STATe	<int>	-	*8
Saving the measurement result	:MMEMory:STORe:MEASure:STATe	<int>	-	*8
Saving the settings of this instrument	:MMEMory:STORe:STATe	<int>	-	*8
Loading the settings of this instrument	:MMEMory:LOAD:STATe	<int>	-	*8
Measurement condition Save selection	:MMEMory:SELect:ITEM:OFDM:SETup	OFF|ON	OFF|ON	

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

6.3.8 Subsystem-MEASure

Function description	SCPI command	Parameter	Query reply	Remarks
Total Result				
EVM reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:EVM?	-	<real>,<real>	
Mag Error reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:MAG?	-	<real>,<real>	
Phase Error reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:PHASe?	-	<real>	
Frequency Error reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:FREQ?	-	<real>,<real>	
Transmit Power reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:POWer?	-	<real>,<real>, <real>,<real>	
Rate reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:RATE?	-	R6M|R9M|R12M| R18M|R24M|R36M| R48M|R54M|PERR| RERR	
Spectral Flatness reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:FLATness[:NUMBer<tbl=1|2|3|4>]?	-	<int>,<int>,<real>, <real>,<real> ... <int>,<int>,<real>, <real>,<real>(4 sets)	
Frequency Leakage reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage?	-	<real>,<real>	
Frequency Leakage reading (Overall)	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage:OPOWer?	-	<real>	
Frequency Leakage reading (Average Power)	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage:APOWer?	-	<real>	
Measurement Number reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer?	-	<int>,<int>,<int>	

Function description	SCPI command	Parameter	Query reply	Remarks
Measurement Symbol Number reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:SYMBol?	-	<int>	
Measurement Burst Number reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:BURSt?	-	<int>	
Measurement A/D Capture Number reading	:MEASure<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:CAPTure?	-	<int>	

6.3.9 Subsystem-READ

Function description	SCPI command	Parameter	Query reply	Remarks
Total Result				
EVM reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:EVM?	-	<real>,<real>	
Mag Error reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:MAG?	-	<real>,<real>	
Phase Error reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:PHASe?	-	<real>	
Frequency Error reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:FREQ?	-	<real>,<real>	
Transmit Power reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:POWer?	-	<real>,<real>,<real>,<real>	
Rate reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:RATE?	-	R6M|R9M|R12M|R18M|R24M|R36M|R48M|R54M|PERR|RERR	
Spectral Flatness reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:FLATness[:NUMBer<tbl=1|2|3|4>]?	-	<int>,<int>,<real>,<real>,<real>...,<int>,<int>,<real>,<real>,<real>(4 sets)	
Frequency Leakage reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage?	-	<real>,<real>	
Frequency Leakage reading (Overall)	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage:OPOWer?	-	<real>	
Frequency Leakage reading (Average Power)	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage:APOWer?	-	<real>	
Measurement Number reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer?	-	<int>,<int>,<int>	
Measurement Symbol Number reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:SYMBol?	-	<int>	
Measurement Burst Number reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:BURSt?	-	<int>	
Measurement A/D Capture Number reading	:READ<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:CAPTure?	-	<int>	

6.3.10 Subsystem-FETCh

Function description	SCPI command	Parameter	Query reply	Remarks
Total Result				
EVM reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:EVM?	-	<real>,<real>	
Mag Error reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:MAG?	-	<real>,<real>	
Phase Error reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:PHASe?	-	<real>	
Frequency Error reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:FREQ?	-	<real>,<real>	
Transmit Power reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:POWer?	-	<real>,<real>,<real>,<real>	
Rate reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:RATE?	-	R6M|R9M|R12M|R18M|R24M|R36M|R48M|R54M|PERR|RERR	
Spectral Flatness reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:FLATness[:NUMBer<tbl=1|2|3|4>]?	-	<int>,<int>,<real>,<real>,<real>...<int>,<int>,<real>,<real>,<real>(4 sets)	
Frequency Leakage reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage?	-	<real>,<real>	
Frequency Leakage reading (Overall)	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage:OPOWer?	-	<real>	
Frequency Leakage reading (Average Power)	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:LEAKage:APOWer?	-	<real>	
Measurement Number reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer?	-	<int>,<int>,<int>	
Measurement Symbol Number reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:SYMBol?	-	<int>	
Measurement Burst Number reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:BURSt?	-	<int>	
Measurement A/D Capture Number reading	:FETCh<ch=1|2>[:WINDow<scrn=1|2|3|4>]:TRESult:NUMBer:CAPTure?	-	<int>	

6.3.11 Subsystem-DIAGnostic

Function description	SCPI command	Parameter	Query reply	Remarks
DIAGnostic				
Power on DIAG result reading	:DIAGnostic:PON?	-	PASS|FAIL	

6.3.12 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 reading	:STATus:OPERation:EVENt?	-	<int>	
Questionable Enable Register setting	:STATus:QUEStionable:ENABle	<int>	<int>	
Questionable Event Register reading	:STATus:QUEStionable:EVENt?	-	<int>	
Modulation Enable Register setting	:STATus:QUEStionable:MODulation:ENABle	<int>	<int>	
Modulation Event Register reading	:STATus:QUEStionable:MODulation:EVENt?	-	<int>	
Measuring Enable Register setting	:STATus:OPERation:MEASure:ENABle	<int>	<int>	
Measuring Event Register reading	:STATus:OPERation:MEASure:EVENt?	-	<int>	

6.3.13 Subsystem-HCOPy

Function description	SCPI command	Parameter	Query reply	Remarks
HCOPy				
Outputting a copy 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

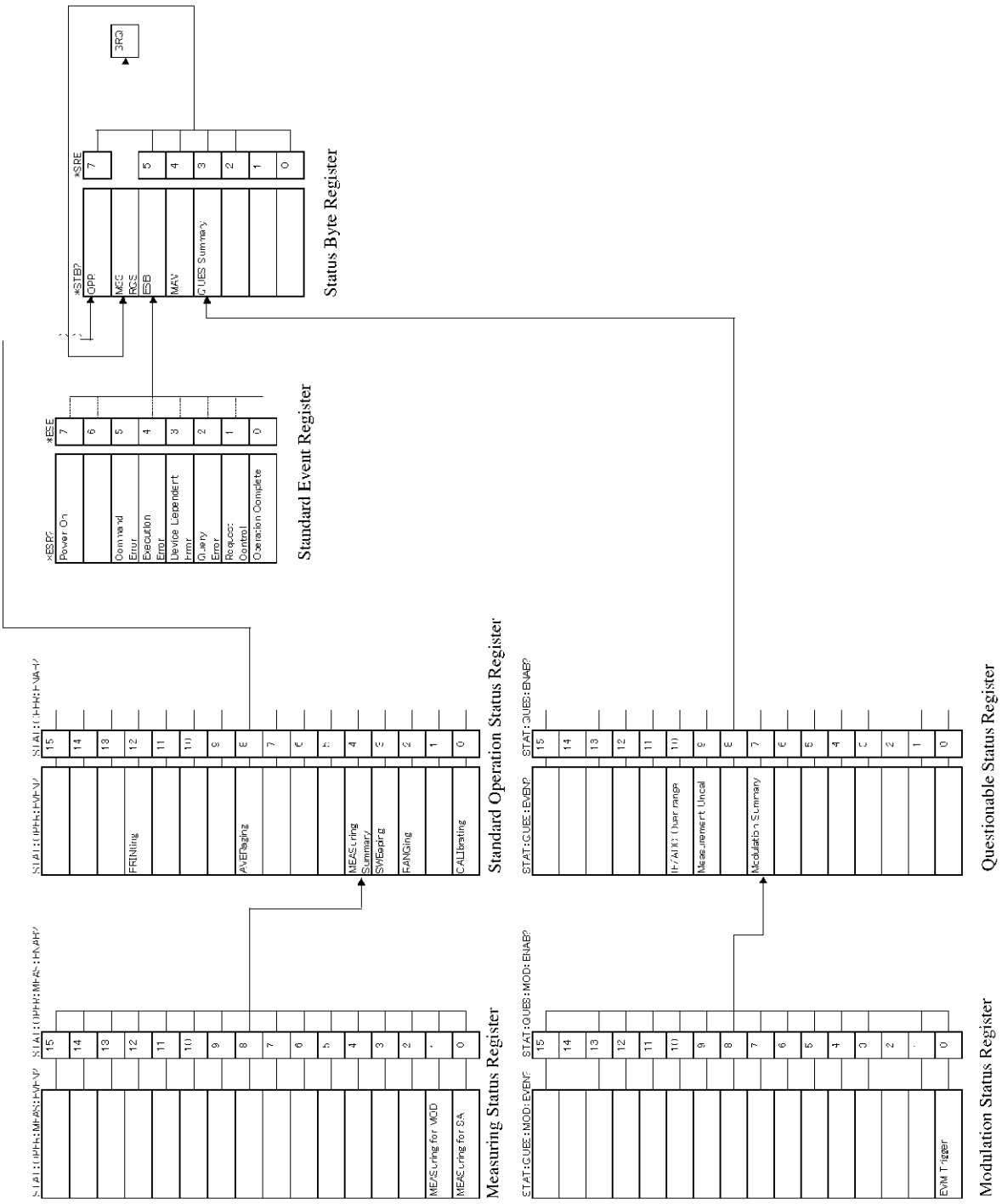


Figure 6-1 Status Registers

7. SPECIFICATIONS

7.1 OFDM Modulation Analysis Compatible System

- IEEE802.11a
- HiperLAN Type2
- HiSWANa
- OFDM analysis not dependent on standards

7.2 Performance of OFDM Modulation Analysis

Item	Specifications
Temperature range	Ambient temperature: +20°C - +30°C
EVM	(100 symbol RMS value obtained from IEEE802.11a, HiperLAN/2, HiSWANa signal with S/N > 40 dB measured with equalizer on)
Residual EVM	-40 dB or lower
Center frequency error	(S/N>40 dB, 1000 symbol average)
Measurement range	
Standard signal	
IEEE802.11a	± 312.5 kHz
HiperLAN/2, HiSWANa	± 312.5 kHz (In the case of Broadcast, Uplink burst)
	± 125 kHz (In the case of Downlink burst)
User Table	± Sub-carrier frequency interval × 0.25
Measurement accuracy	±(100 Hz + (Center frequency × Frequency standard error))
Amplitude measurement	(After automatic calibration, S/N>40 dB, Pre-amplifier off Input attenuator 10 dB, 100 symbol average)
Frequency response (Band 1 M)	<± 1.0 dB (3.4 GHz - 6.0 GHz)
Power measurement accuracy	<± (0.2 dB + Frequency response)
Residual center frequency leak power	-40 dB (to sub-carrier average power)

8. PERFORMANCE VERIFICATION

This chapter describes the way to check whether this instrument meets the prescribed performance.

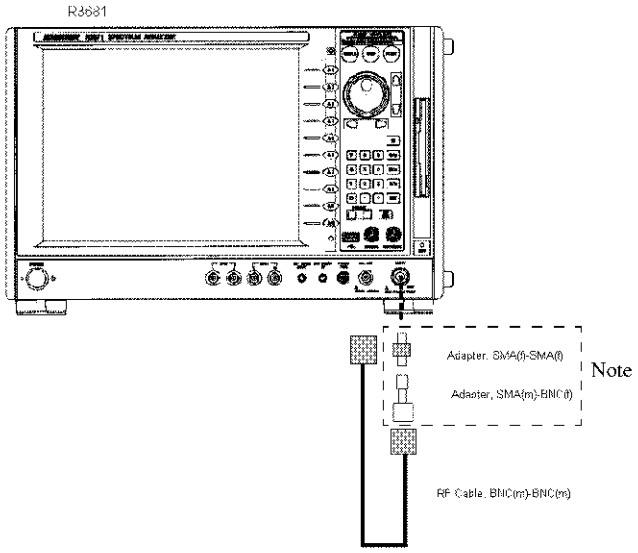
It is recommended to keep a record of the performance test, using a copy of the test data record sheet at the end of this chapter.

IMPORTANT: Perform warming up and all calibrations before carrying out performance verification.

8.1 Preparation for Measurement

The CAL OUT output (50 MHz, -10 dBm) of this instrument is used as the test signal.

Connect as shown in Figure 8-1, using the attached cable for CAL.



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

Figure 8-1 Connection for Test Signal

Before performing the test, set this instrument as follows:

DISPLAY:	Set to show the Total Result
CONFIG:	Select User Table
	Set the same parameter as IEEE802.11a with Edit Table dialog box.
TRIGGER:	Select Trigger Source and Free Run
INPUT:	Select Input RF
MEAS CONTROL:	Select Multi Frame
	Set the Measurement Parameters with the dialog box as follows:
	|AD Capture| A/D Capture Length:40 ms

Threshold Level:	Auto
[OFDM]	
Symbol Timing:0	
Pilot Track(Phase):	ON
Pilot Track(Amplitude):	OFF
Equalizer:	OFF
Meas Condition:	Symbol
Meas Symbol Length:	100
EVM Trigger:	OFF
[User Table]	
Continuous Signal:	ON
Analysis Start Offset:	0 µs
Flatness Separate Offset:	16

8.2 Measurement Procedures

8.2.1 Power Measurement of RF Signal

1. Set the center frequency of this instrument to 49.6875 MHz.
2. Execute Auto Level Set.
3. Measure by pressing **SINGLE** of this instrument.
4. Enter the Power [dBm] of the Total Result in the test data record sheet.

8.2.2 Center Frequency Error Measurement for RF Signal

1. Set the center frequency of this instrument to 49.5875 MHz.
2. Execute Auto Level Set.
3. Measure by pressing **SINGLE** of this instrument.
4. Enter the Freq Error [Hz] of the Total Result in the test data record sheet.

8.3 Test Data Record Sheet

Test data record sheet

Model:

Serial No.:

Test item	Specification			Judgment
	Minimum value	Measured value	Maximum value	Pass/Fail
Power of the RF signal	-10.2 dBm		-9.8 dBm	
Center frequency error of RF signal	-100 Hz		+100 Hz	

APPENDIX

This chapter describes the following supplemental information:

A.1 Technical Reference
A.2 A/D Data Save Function
A.4 Error Message List

A.1 Technical Reference

A.1.1 Measured Value Calculation Method

EVM (Error Vector Magnitude)

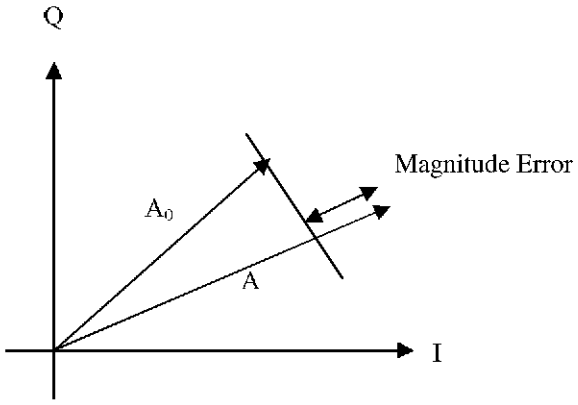
EVM RMS of the Total Result is calculated with the formula for defining EVM in "IEEE Std 802.11a-1999 17.3.9.7 Transmit modulation accuracy test" and "ARIB STD-T70 Version 1.0, 4.9.1 Definition of Modulation Error."

$$Error_{RMS} = \frac{\sum_{i=1}^{N_f} \sqrt{\frac{\sum_{j=1}^{L_p} \left[\sum_{k=1}^{52} \left\{ (I(i,j,k) - I_0(i,j,k))^2 + (Q(i,j,k) - Q_0(i,j,k))^2 \right\} \right]}{52 L_p \times P_0}}}{N_f}$$

The average power P_0 necessary for calculation is assumed as the average power of the ideal constellation ($P_0 = 1$), in accordance with the standards.

The RMS value of EVM Time is calculated for each symbol, using the formula for defining EVM. The RMS value of EVM Spectrum is calculated for each subcarrier, using the formula for defining EVM. The EVM values to be plotted are calculated for each symbol and subcarrier, using the formula for defining EVM.

Magnitude Error



Assuming subcarrier number k, symbol number j, frame number i, ideal constellation (I_0 (i, j, k), Q_0 (i, j, k)),

and measurement symbol (I (i, j, k), Q (i, j, k)), the amplitude of the ideal constellation A_0 and the amplitude of the measurement symbol A are defined as follows:

$$A_0(i,j,k) = \sqrt{(I_0(i,j,k))^2 + (Q_0(i,j,k))^2}$$

$$A(i,j,k) = \sqrt{(I(i,j,k))^2 + (Q(i,j,k))^2}$$

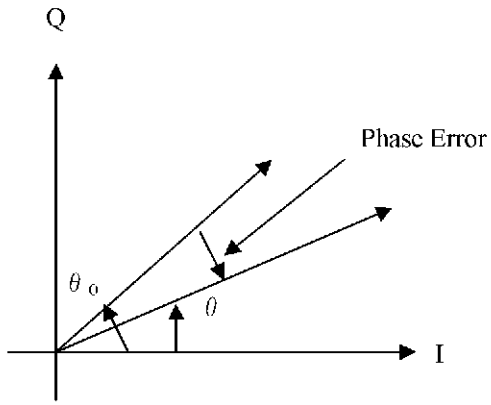
Calculate the Magnitude Error RMS of the Total Result with the following formula.

$$MagError_{RMS} = \frac{\sum_{i=1}^{N_f} \sqrt{\frac{\sum_{j=1}^{L_p} \left[\sum_{k=1}^{N_s} \left\{ \frac{(A(i,j,k) - A_0(i,j,k))^2}{(A_0(i,j,k))^2} \right\} \right]}{N_s \times L_p}}}{N_f}$$

N_s is the number of subcarriers, L_p the length of packet (number of symbols) and N_f the number of frames.

The RMS value of Magnitude Error Time is calculated for each symbol, using the formula for defining Magnitude Error. The RMS value of Magnitude Error Spectrum is calculated for each subcarrier, using the formula for defining Magnitude Error. The Magnitude Error values to be plotted are calculated for each symbol and subcarrier, using the formula for defining Magnitude Error.

Phase Error



The phase of the ideal constellation θ_0 and the phase of the measurement symbol θ are defined as follows:

$$\theta_0(i,j,k) = \arctan\left[\frac{Q_0(i,j,k)}{I_0(i,j,k)}\right]$$

$$\theta(i,j,k) = \arctan\left[\frac{Q(i,j,k)}{I(i,j,k)}\right]$$

Calculate the Phase Error RMS of the Total Result with the following formula.

$$PhaseError_{RMS} = \frac{\sum_{i=1}^{N_f} \sqrt{\frac{\sum_{j\ 1}^{L_p} \left[\sum_{k\ 1}^{N_s} \left\{ (\theta(i,j,k) - \theta_0(i,j,k))^2 \right\} \right]}{N_s \times L_p}}}{N_f}$$

The AVG value of Phase Error Time is calculated for each symbol, using the average value of Phase Error. For the AVG value of Phase Error Spectrum, the average value of Phase Error is calculated for each subcarrier. For Phase Error values to be plotted, Phase Error is calculated for each symbol and subcarrier.

Magnitude Flatness

For Magnitude Flatness, the ratio of the amplitude of the measurement symbol to the amplitude of the ideal constellation is calculated. The difference from Magnitude Error is shown in the following formula.

$$MagError(i,j,k) = \frac{A(i,j,k) - A_0(i,j,k)}{A_0(i,j,k)}$$

$$MagFlat(i,j,k) = \frac{A(i,j,k)}{A_0(i,j,k)}$$

For the AVG value of Magnitude Flatness Time, the average value of Magnitude Flatness is calculated for each symbol. For the AVG value of Magnitude Flatness Spectrum, the average value of Magnitude Flatness is calculated for each subcarrier. For Magnitude Flatness values to be plotted, Magnitude Flatness is calculated for each symbol and subcarrier.

Power

Power is calculated for each symbol from the power for the subcarrier obtained by demodulation (FFT). For the AVG value of Power Time, the average power of all subcarriers is calculated for each symbol. For the AVG value of Power Spectrum, the average power of all symbols is calculated for each subcarrier.

The Power of the Total Result is the average value of total power obtained by aggregating the AVG values of Power Spectrum. The value indicated with the unit of [W/MHz] is the value obtained by dividing the average value of total power with the frequency band width [MHz] of the OFDM signal. The bandwidth here is not OBW, but the value obtained from the difference in frequencies of the two subcarriers most apart upwards and downwards from the center frequency. In the case of IEEE802.11a, HiperLAN/2 and HiSWANa, it is 16.25 (= 0.3125 x 52 subcarriers).

A.1.2 Judgment on Subcarrier Modulation Type

IEEE802.11a

Makes judgment on the modulation type by taking out the RATE data from the decoding data of the SIGNAL. If there is any parity error or the RATE data does not exist, however, judgment is made using the automatic judgment algorithm (Auto Detect).

HiperLAN/2, HiSWANa

Judges automatically.

User Table

Judges with either automatic judgment (Auto Detect) or Manual Setup.

Automatic judgment (Auto Detect) means a method to find the ideal constellation that makes the EVM minimum from ideal constellation maps for each modulation type, and judge the modulation type from the one among them that makes the EVM minimum.

Manual Setup means a method to set a modulation type for each subcarrier to the Edit Table.

IMPORTANT: ***If the EVM is degraded while Auto Detect is being used, there is a risk of misjudging the modulation type. In such a case, the measured value does not represent the correct value.***

A.1.3 Judgment on the Ideal Constellation

The ideal constellation is judged with the same method as Auto Detect for judgment on the modulation type.

IMPORTANT: ***If the EVM is degraded, there is a possibility that the ideal constellation will be misjudged. In such a case, the measured value does not represent the correct value.***

A.1.4 Ideal Constellation Map of 256 QAM

With respect to 256 QAM that can be set by Manual Setup in the case of the User Table, the ideal constellation map is defined as follows:

256 QAM encoding table

Input bits (b0 b1 b2 b3)	I-out	Input bits (b4 b5 b6 b7)	Q-out
0000	-15	0000	-15
0001	-13	0001	-13
0011	-11	0011	-11
0010	-9	0010	-9
0110	-7	0110	-7
0111	-5	0111	-5
0101	-3	0101	-3
0100	-1	0100	-1
1100	+1	1100	+1
1101	+3	1101	+3

256 QAM encoding table

Input bits (b0 b1 b2 b3)	I-out	Input bits (b4 b5 b6 b7)	Q-out
1111	+5	1111	+5
1110	+7	1110	+7
1010	+9	1010	+9
1011	+11	1011	+11
1001	+13	1001	+13
1000	+15	1000	+15

256 QAM Normalization factor (Kmod) = 1/SQRT(170)

A.1.5 User Table Pilot Synchronization

Because the specifications for pilot subcarrier are not defined like IEEE802.11a for the signal measured by the User Table, perform pilot synchronization with the following specifications.

Initial phase

Adjust the initial phase and symbol timing so that the phase of the subcarrier set to PILOT (+) becomes 0 deg and the phase of the subcarrier set to PILOT (-) becomes 180 deg at symbol 0.

Sequence

For symbol 0, set the initial value of the sequence to +1. From symbol 1 and on, invert the polarity of the sequence (+1 → -1, -1 → +1) when the phase of the pilot subcarrier has shifted by ±90 deg or more relative to the preceding symbol. When the sequence is -1, adjust the initial phase and symbol timing so that the phase of the subcarrier set to the PILOT (+) becomes 180 deg and the phase of the subcarrier set to the PILOT (-) becomes 0 deg.

A.1.6 Frequency Characteristics Correcting Function

CH Estimation(Preamble)

This function estimates frequency characteristics (gain and phase) using the preamble portion (LTS: Long Training Symbols) of a signal. The preamble signal is predetermined by the standard, so the correction values for phase and magnitude are determined at the preamble portion for each subcarrier so as to minimize magnitude errors and phase errors. In the data portion, after correction is applied using these correction values, EVM is calculated.

CH Estimation(Preamble+Data)

The correction data, which minimizes the amplitude and phase errors, is calculated for each subcarrier based on the measurement results of the data portion in the CH Estimation (Preamble) function. The measurement results are re-analyzed and calculated by using the calculated correction data. The CH Estimation (Preamble+Data) function can perform the analysis by using a higher accuracy channel estimation than the CH Estimation (Preamble) function.

Pilot Track(Phase)

Using the pilot subcarrier, this function performs analyses, including symbol synchronization and initial phase estimation, for each symbol. This is effective when the carrier frequency or the FFT sampling frequency changes, or in similar situations. (When Pilot Track(Phase) is OFF, symbol synchronization and initial phase synchronization for each symbol are not performed after symbol synchronization and initial phase estimation at the preamble.)

Pilot Track(Amplitude)

This function performs the analysis after correcting the amplitude for each symbol by using the pilot subcarrier. This function is effective when the burst signal level fluctuates. If the Pilot Track (Amplitude) is set to OFF, the amplitude for each symbol is not corrected after the amplitude was corrected by using the preamble.

Equalizer

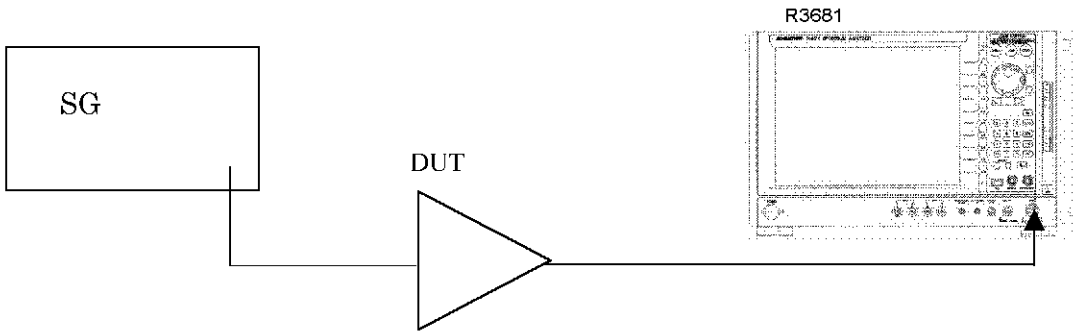
This function corrects amplitude and phase in order to minimize EVM of the data portion.

When the **Make** button of Equalizer Data is touched, the correction values are calculated and are applied. Use this function as follows:

1. Connect the SG signal directly to the measuring instrument and measure EVM. (Equalizer: OFF)

CAUTION: ***Equalizer is not designed to correct distortion of SG, unbalance of IQ signal, or errors of a quadrature modulator, so if there is EVM degradation arising from any of these causes, EVM cannot be reduced using Equalizer.***

2. Touch the **Make** button. The Equalizer data is calculated.
3. Next, turn ON Equalizer.
4. Touch the **Analysis Restart** key on the soft menu bar. EVM corrected by the Equalizer data is displayed.
5. Connect the DUT (Device Under Test) and measure EVM. The amount of EVM worsened by the DUT can be measured.



The difference between the Equalizer and the Channel Estimation is that the Channel Estimation estimates the frequency characteristics by using the preamble for each frame analysis, while the Equalizer estimates the frequency characteristics only when the **Make** button of Equalizer Data is touched.

A.1.7 SCPI Commands Compatibility

SCPI commands are listed in the command table in chapter 6.

If the SCPI commands of the primary version, which are not listed in the current command table, are used, some instruments perform as follows in order to retain the compatibility.

Function Description	SCPI Commands	Performance
Pilot Track ON/OFF	[:SENSe<ch>]:CONDition:PTRAck	Performs in the same way as Pilot Track (Phase) ON/OFF.When set to ON by using this command, Pilot Track(Amplitude) is automatically set to OFF.
Equalizer ON/OFF	[:SENSe<ch>]:CONDition:EQUAlizer	Using this command to set the equalizer to ON is the same as touching the **Make** button of Equalizer Data to calculate the Equalizer data and setting the Equalizer to ON.When set to OFF, Equalizer is set to OFF.
Meas Symbol Length setting	[:SENSe<ch=1|2>]:CONDition:MSYMbol:LENGth	When the number of symbols is set by using this command, the Meas Condition is automatically set to Symbol.

A.2 A/D Data Save Function

This function is used to save A/D conversion data of a signal under test obtained by A/D Capture in a text format file. Ideal A/D data can be obtained after correction of this instrument's internal frequency characteristics.

The sampling frequency is 40 MHz. All data captured by A/D Capture is saved, so set only the necessary length of time in A/D Capture Length before executing A/D Capture.

The magnitudes of I signals and Q signals are written into one file in chronological order. The following shows the format:

I[0], Q[0]

I[1], Q[1]

I[2], Q[2]

.

.

.

I[n-1], Q[n-1]

A.3 Measurement Data Save Function

This function is used to save numeric data used in tables of measurement results and to plot graphs in a CSV format file.

Only data displayed in the active window is saved. To save all displayed data of the 4 measurement result windows, switch each to active and save the results in turn.

In the beginning of the file, the measurement parameters set by the user interface are written. The measurement result data is written following this portion.

A.3.1 Measurement Result Save Format (OFDM)

- Spectrum system display (EVM Spectrum, etc.)

  Measurement result data of EVM Spectrum, Magnitude Error Spectrum, Phase Error Spectrum, Magnitude Flatness Spectrum, and Power Spectrum are saved in the following format:

  ***** Results *****

  Measurement result name

  Specified Symbol Number (This line is deleted when no choice has been made.)

  Title line

  Subcarrier number, RMS/AVG value, Specified Symbol measurement value, ALL values (for the number of symbols)

  Data is saved in order of subcarrier number.

  Whether or not to display RMS/AVG, Specified Symbol, and ALL can be selected, so only those items selected to display are saved in the file.

  For the ALL values, data within the symbol range set in Window Start and Window Width are saved along the horizontal axis in order of symbol number.

  Example of Power Spectrum

  ***** Results *****

  <<< Power [Spectrum] >>>

  Specified Symbol,3

  Subcar,AVG[dBm],Spec Sym[dBm],Symbol[3],Symbol[4],Symbol[5] ...

  -32,-59.73,-54.42,-54.42,-64.55,-67.02 ...

  -31,-58.82,-61.91,-61.91,-70.91,-72.32 ...

  -30,-59.58,-53.31,-53.31,-80.55,-58.05 ...

  :

  :

- Time system display (excluding Freq Error)

  Measurement result data of EVM Time, Magnitude Error Time, Phase Error Time, Magnitude Flatness Time, and Power Time are saved in the following format:

  ***** Results *****

  Measurement result name

  Specified Subcarrier Number (This line is deleted when no choice has been made.)

  Title line

  Symbol number, RMS/AVG value, Specified Subcar measurement value, ALL values (for the number of carriers)

  Data is saved in order of symbol number.

  Data within the symbol range set in Window Start and Window Width are saved.

  Whether or not to display RMS/AVG, Specified Subcarrier, and ALL can be selected, so only those items selected to display are saved in the file.

  Example of Power Time

  ***** Results *****

  <<< Power [Time] >>>

  Specified Subcarrier,27

  Symbol,AVG[dBm],Spec Sub[dBm],Subcar[-32],Subcar[-31],Subcar[-30] ...

  3,-26.13,-52.18,-54.41,-61.97,-53.33 ...

  4,-26.32,-59.69,-64.55,-70.94,-80.57 ...

  5,-25.48,-56.15,-67.02,-72.39,-58.04 ...

  :

  :

- Center Freq Error Time
  Measurement result data of Center Freq Error Time is saved in the following format:

  ***** Results *****
  <<< Center Freq Error Time >>>
  Title line
  Symbol number, waveform data

  Data is saved in order of symbol number.
  Data within the symbol range set in Window Start and Window Width are saved.

  Example of Center Freq Error Time
  ***** Results *****
  <<< Center Frequency Time >>>
  Symbol,AVG[Hz],Center Freq Error[Hz]
  3,-7589,-10556
  4,-7589,-2870
  5,-7589,-9352
  :
  :

- Preamble Freq Error Time
  Measurement result data of Preamble Freq Error Time is saved in the following format:

  ***** Results *****
  <<< Preamble Freq Error Time >>>
  Time of waveform data start position
  Time of waveform data end position
  Time resolution of waveform data
  Title line
  Sample number, waveform data

  Sample numbers are obtained by counting from the beginning of waveform data in chronological order.

  Example of Preamble Freq Error Time
  ***** Results *****
  <<< Preamble Frequency Error Time >>>
  Start Time[s],0.000000400
  Stop Time[s],0.000006000
  Time Resolution[s],0.000000025
  No.,Freq Error[Hz]
  0,-79285
  1,-79404
  2,-79535
  :
  :

- Constellation

  Measurement result data of Constellation is saved in the following format:

  ***** Results *****
  <<< Constellation >>>
  Specified Symbol = n or Specified Subcarrier = m or ALL
  Title line
  Symbol number, subcarrier number, I signal, Q signal

  Data is saved in order of symbol number, and within the same symbol number, in order of subcarrier number.
  Data within the symbol range set in Window Start and Window Width are saved.

  Example of Constellation
  ***** Results *****
  <<< Constellation >>>
  ALL
  Symbol,Subcar,I,Q
  3,-32,********,********
  3,-31,********,********
  3,-30,********,********
  3,-29,********,********
  3,-28,********,********
  3,-27,********,********
  3,-26,-0.95818,-0.84726
  3,-25,-0.94491,+0.92378
  3,-24,-0.25531,-0.94444
  :
  :

- Demodulated Data

  Measurement result data of Demodulated Data is saved in the following format:

  ***** Results *****
  <<< Demodulated Data >>>
  Title line
  Symbol number, subcarrier number, demodulated data, modulation format

  Data is saved in order of symbol number, and within the same symbol number, in order of subcarrier number.
  Data within the symbol range set in Window Start and Window Width are saved.
  Where there is no subcarrier, demodulated data cannot be acquired, so *** is displayed.

  Example of Demodulated Data
  ***** Results *****
  <<< Demodulated Data >>>
  Symbol,Subcar,Data,Mod
  3,-32,***,***
  3,-31,***,***
  3,-30,***,***
  3,-29,***,***
  3,-28,***,***
  3,-27,***,***
  3,-26,0x00,16QAM
  3,-25,0x02,16QAM
  3,-24,0x04,16QAM
  3,-23,0x09,16QAM
  3,-22,0x04,16QAM
  3,-21,0x01,PILOT
  3,-20,0x09,16QAM
  :
  :

- Spectrogram

  Measurement result data of Spectrogram is saved in the following format:

  ***** Results *****
  <<< Spectrogram >>>
  Subcarrier number, ALL values (for the number of symbols)

  Data is saved in the order of subcarrier number along the vertical axis, and in order of symbol number along the horizontal axis.
  Data within the symbol range set in Window Start and Window Width are saved.

  Example of Spectrogram
  ***** Results *****
  <<< Spectrogram >>>
  Subcar,Symbol[3],Symbol[4],Symbol[5] ...
  -32,-54.42,-61.91,-53.36 ...
  -31,-26.08,-26.12,-26.05 ...
  -30,-23.26,-32.61,-23.16 ...
  :
  :

- Meas Window
  Measurement result data of Meas Window is saved in the following format:

  ***** Results *****
  Time of waveform data start position
  Time of waveform data end position
  Time resolution of waveform data
  <<< Meas Window >>>
  Sample number, waveform data, symbol number, symbol type

  Sample numbers are obtained by counting from the beginning of waveform data in chronological order.
  In the sample number line at the symbol start position, symbol number and symbol type are written.
  In other than the symbol start position, the symbol number and symbol type are displayed as *****.

  Example of Meas Window
  ***** Results *****
  Start Time[ms],2.13800
  Stop Time[ms],2.51500
  Time Resolution[ms],0.00001
  <<< Meas Window >>>
  No.,Power[dBm],Symbol No.,Symbol Type
  0,-58.10,********,********
  1,-55.29,********,********
  2,-53.63,********,********
  :
  :
  688,-55.55,********,********
  689,-62.75,********,********
  690,-62.14,0,STS
  691,-55.10,********,********
  692,-54.12,********,********
  :
  :

A.4 Error Message List

This section describes error messages displayed on this instrument.

The following items are explained:

- Error number
- Displayed message
- Cause of occurrence and method to release

Table A-1 Error Message List (1 of 2)

Error number	Displayed message	Description
-232	Invalid data format.	The file format is not correct. Check the storage format of the file or the extension.
-257	Bad File name	The file name is not correct. Change the file name.
-1250	No such file or directory.	The file or directory does not exist. Check the file name or directory name.
-1251	Permission denied.	File operations are prohibited. Check the drive name, file name or directory name.
-1252	Not enough space on the disk.	There is not enough free space. Delete unnecessary files.
-1253	File read/write error.	An error occurred in file reading/writing. Check if there is sufficient disk capacity remaining or if the disk is protected against writing.
-1254	No item is selected.	No item is selected.
-1300	Device is not ready.	A disk is not inserted.
-1400	There is no data in the effective state.	The required data is in an undetermined state.
-1500	Option required.	The corresponding optional function is necessary.
-3200	Math error.	A parameter error or operational error occurred in internal processing.
-3210	Input Level is out of range. Check the Ref. Level.	The input signal level exceeded the allowed range. Check the reference level or input signal level.
-3211	Auto Level Set cannot be succeed. Signal level is not stable.	Auto level setting could not be completed. Check if the input signal level is constant or if the attenuator has been set to manual mode.
-3220	Cannot find out signal. Input level may be too low.	The frame cannot be detected in the A/D data in the multi frame mode or at the position of the frame selection cursor in the single frame mode.
-3221	Analysis has stopped. A/D data is not captured.	In the single frame mode, Analysis Restart was executed without completing A/D capture. Execute Analysis Restart after the completion of A/D capture.

Table A-1 Error Message List (2 of 2)

Error number	Displayed message	Description
-3222	Cannot find Preamble. Standard may be mismatched.	No preamble is detected at the top of the frame in standard signal measurement.
-3223	Analysis has stopped. No subcarrier allocated.	Analysis has been started with all subcarrier types set to OFF. Check the setting of the subcarrier type.
-3224	Analysis has stopped. Two or more pilot subcarriers are required.	Analysis has started in a state in which PILOT (+/-) is below two in subcarrier type setting. Check the setting of the subcarrier type.
-3226	Not available while A/D capturing.	It cannot be accepted during A/D capture.
-3227	Not available while analyzing.	It cannot be accepted during measurement (analysis).
-3228	Not available in I/Q input mode.	It cannot be accepted in I/Q signals.
-3230	Analysis has stopped. Equalizer data is not calculated.	The analysis is executed by setting the Equalizer to ON when the Equalizer data does not exist. Execute the analysis after calculating the Equalizer data.
-3231	Analysis has stopped. Press "Make" button again.	The analysis is executed by using the invalid Equalizer data. Execute the analysis after re-calculating the Equalizer data.
-3232	Cannot calculate equalizer data.	Equalizer data cannot be calculated. Check whether the OFDM analysis was completed correctly.
-3233	Cannot find Ramp Down. Frame length may be too long.	The falling edge of the frame cannot be detected. Check whether the whole frame is in the range of the A/D Capture Length.
-3300	Memory allocation error.	Failed to secure work memory to be used in internal processing.

ALPHABETICAL INDEX

[R]

[S]

[T]

[U]

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SALES & SUPPORT OFFICES

Advantest Korea Co., Ltd.
22BF, Kyobo KangNam Tower,
1303-22, Seocho-Dong, Seocho-Ku, Seoul #137-070, Korea
Phone: +82-2-532-7071
Fax: +82-2-532-7132

Advantest (Suzhou) Co., Ltd.
Shanghai Branch Office:
Bldg. 6D, NO.1188 Gumei Road, Shanghai, China 201102 P.R.C.
Phone: +86-21-6485-2725
Fax: +86-21-6485-2726

Shanghai Branch Office:
406/F, Ying Building, Quantum Plaza, No. 23 Zhi Chun Road,
Hai Dian District, Beijing,
China 100083
Phone: +86-10-8235-3377
Fax: +86-10-8235-6717

Advantest (Singapore) Pte. Ltd.
438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100
Fax: +65-6274-4055

Advantest America, Inc.
3201 Scott Boulevard, Suite, Santa Clara, CA 95054, U.S.A
Phone: +1-408-988-7700
Fax: +1-408-987-0691

ROHDE & SCHWARZ Europe GmbH
Mühldorfstraße 15 D-81671 München, Germany
(P.O.B. 80 14 60 D-81614 München, Germany)
Phone: +49-89-4129-13711
Fax: +49-89-4129-13723

ADVANTEST®

http://www.advantest.co.jp

ADVANTEST CORPORATION
Shin-Marunouchi Center Building, 1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Phone: +81-3-3214-7500