ADVANTEST

ADVANTEST CORPORATION

R3681 Series OPT74

Pulse Modulator

User's Guide

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Applicable Models
R3681
R3671

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1. INTRODUCTION

This chapter introduces you to the organization of this document and a product overview of the R3681 Series Signal Analyzer (Option 74) to help you get the most out of this document.

1.1 Organization of This Document

The contents of each chapter of this manual are as follows:

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

Chapter 1, "INTRODUCTION"	Introduces you to the organization of this document and a product overview to help you get the most out of this document.
Chapter 2, "PRE-OPERATION TIPS"	Provides preliminary tips on using this instrument. Read this chapter before using this instrument.
Chapter 3, "SETUP"	Explains how to set up this instrument on delivery.
Chapter 4, "EXAMPLES OF OPERATIONS"	Describes the names and functions on the rear panel of this instrument.
Chapter 5, "MENU MAP, FUNCTIONAL EXPLANATION"	Describes the menu configurations and functions of soft keys.
Chapter 6, "SCPI COMMAND REFERENCE"	SCPI command reference.
Chapter 7, "SPECIFICATIONS"	Describes the specifications of option 74.
APPENDIX	Describes the waveform file configuration and the header syntax.

1.2 Product Overview

The pulse modulation can be performed on the SG output by adding this option (OPT74) to the digital modulation SG (OPT72).

- The MARKER1 OUT connector and the RAMP IN connector have been added to the rear panel.
- When the RAMP IN connector is used the burst ON/OFF ratio of the SG output is expanded up to 60 dB or more.
- The Sample & Hold mode has been added to the SG ALC mode.

1.3 Other Manuals Pertaining to This Instrument

Available manuals pertaining to the R3681 Series include:

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

  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 Test Guide (Part Code: {ER3681SERIES/T}, English)

  Covers information necessary to verify the performance of the R3681 Series Signal Analyzer, including performance test procedures and specifications.
- R3681 Series OPT72 Digital Signal Generation Module User's Guide (Part Code: {ER3681 OPT72}, English)

  This manual describes the information required to use the R3681 Series OPT72 digital signal generation module. It includes the setup, basic operation, function descriptions, remote control overview, SCPI command, specifications, and maintenance of the signal generation module.

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 side menu

Sample	Represents an on-screen side menu 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 the 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 the method for recovery, refer to the 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.

   [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 the R3681 Series User's Guide.

2.7 Tip on Transportation

This instrument is heavy, so two or more people should carry it or a dolly should be used to transport it.

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 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

3.1 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.***

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.***

3. Make sure that all of the standard accessories are included and they are free from any damage, in accordance with the List of Table 3-1 Standard Accessories (OPT74).

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 (OPT74)

Name	Model	Quantity
R3681 Series OPT74 Pulse Modulator User's Guide	ER3681OPT74	1

3.2 Locating This Instrument

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

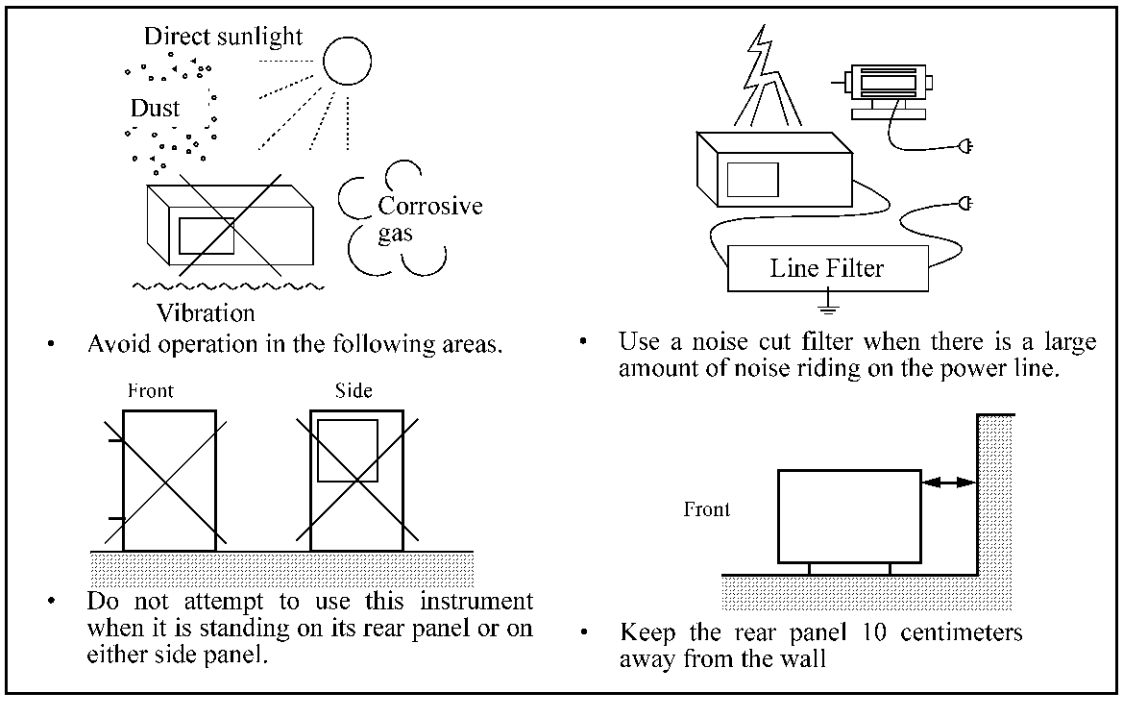
3.2.1 Operating Environment

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 are 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).

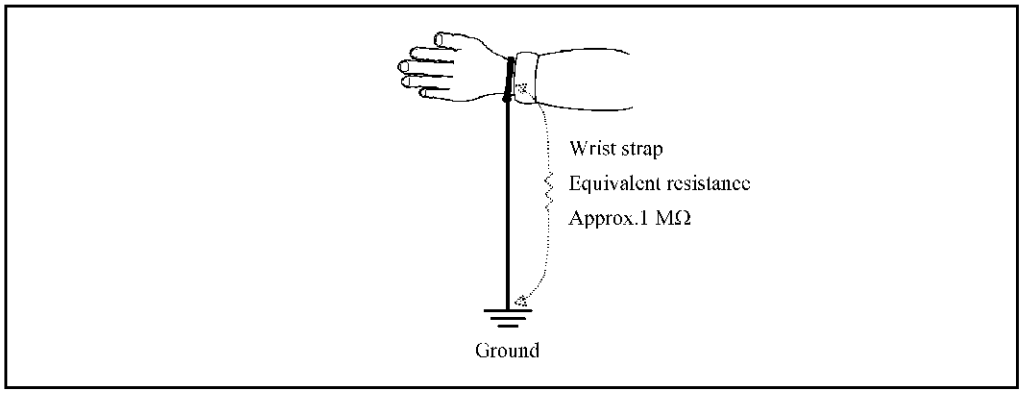


Figure 3-2 Countermeasures for Static Electricity of Human Body

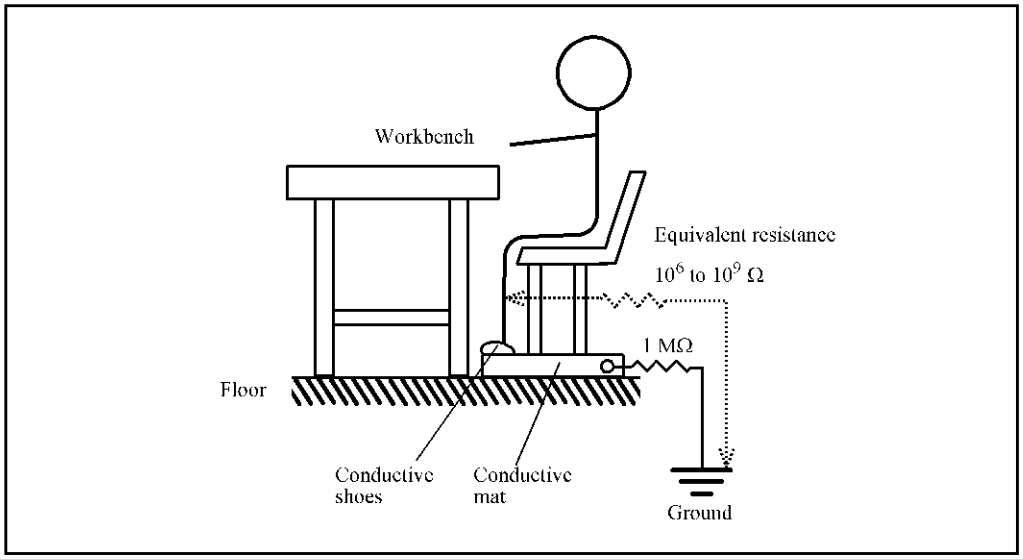


Figure 3-3 Countermeasures for Static Electricity on Work Floor

3.2.2 Prevention of Electrostatic Buildup

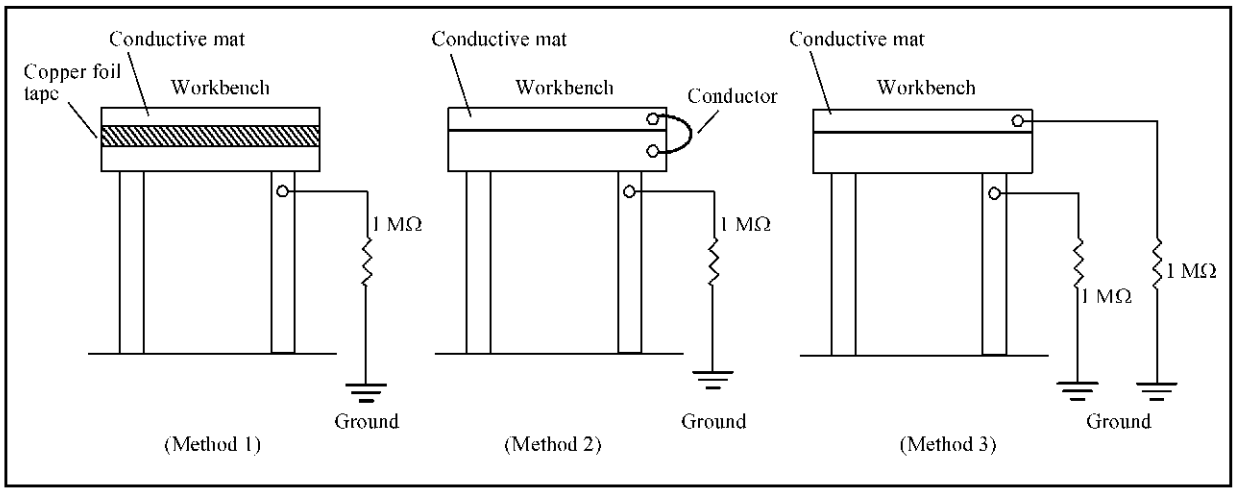


Figure 3-4 Countermeasures for Static Electricity on Workbench

4. EXAMPLES OF OPERATIONS

4.1 The Name and Functions of Each Component on The Rear Panel

This subsection describes the name and function of each component on the rear panel.

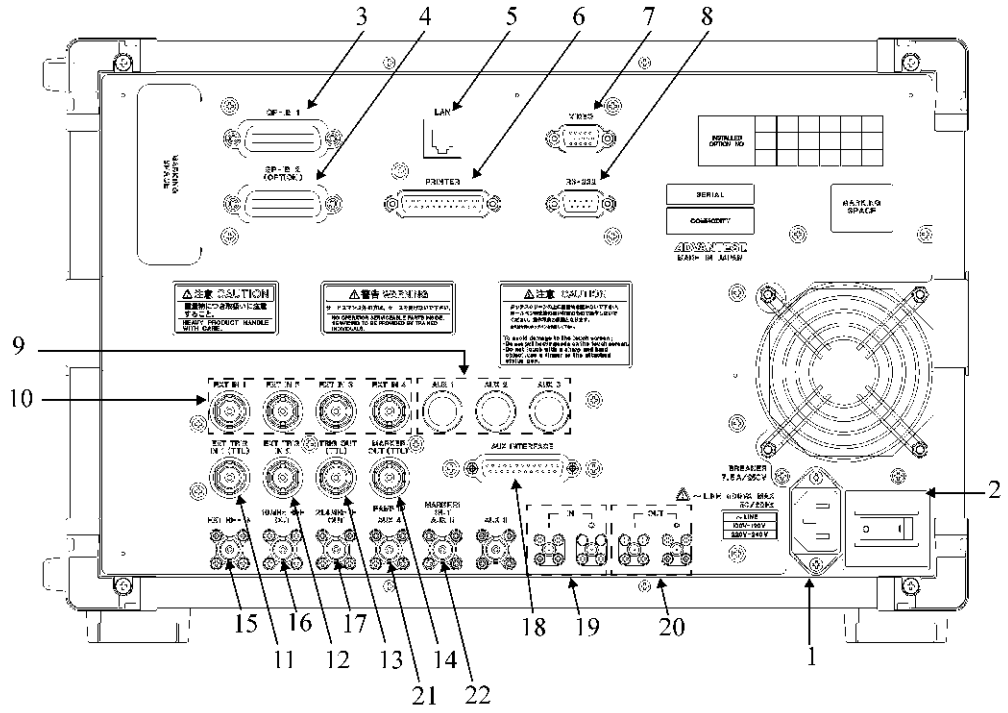


Figure 4-1 Rear Panel

1 to 20	Refer to the R3681 Series OPT72 Digital Signal Generator Module User's Guide.	
21	RAMP IN connector	Inputs the external modulation signal (TTL level (negative logic)).
22	MARKER1 OUT connector	Outputs the MARKER1 signal (TTL level) of AWG.

4.2 Operating Method

This section describes the following basic operating procedures that allow the user to become familiar with the operation of this software.

- 4.2.1 Burst Period Setting

4.2.1 Burst Period Setting

[Required equipment]

OPT3681+74

Output cable: BNC(m)-BNC(m)	2 cables
Conversion adapter: N(m)-BNC(f)	1 adapter
Conversion adapter: SMA(m)-SMA(f)	1 adapter
Conversion adapter: SMA(m)-BNC(f)	1 adapter

NOTE: ***In the R3671, two N(m)-BNC(f) adapters are used instead of an SMA(m)-SMA(f) adapter and an SMA(m)-BNC(f) adapter.***

Turning on the power supply

1. Verify that the power supply circuit breaker on the rear panel is OFF.
2. Connect the attached power cable to the AC power connector on the rear panel.
3. Turn ON the power supply circuit breaker on the rear panel.
   After turning ON the power supply circuit breaker, wait for three seconds or longer.
4. Turn ON the power switch on the front panel.
   When the self-test is completed, the screen returns to the startup screen.

MEMO: ***The display after turning ON the power supply differs depending on the state of last use.***

Initialization

Initializes the settings of this instrument.

5. Touch **[Special]** on the menu bar and select **[Preset]→[All]**.
   Initial setting conditions are loaded.

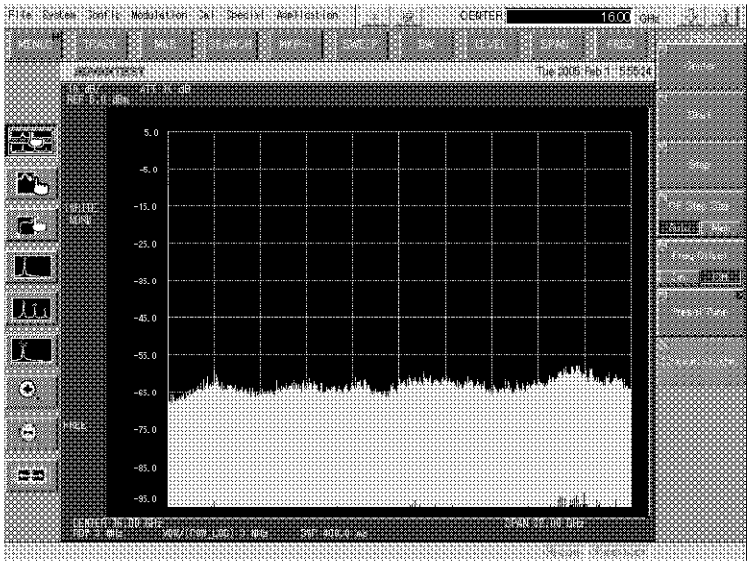


Figure 4-2 Initial Setting Screen

Connection

6. Attach the SMA(f)-SMA(f) adapter to the INPUT connector on the front panel.
   Attach the SMA(m)-BNC(f) adapter to the SMA(f)-SMA(f) adapter and connect the BNC(m)-BNC(m) cable to the SMA(m)-BNC(f) adapter and the SG output.

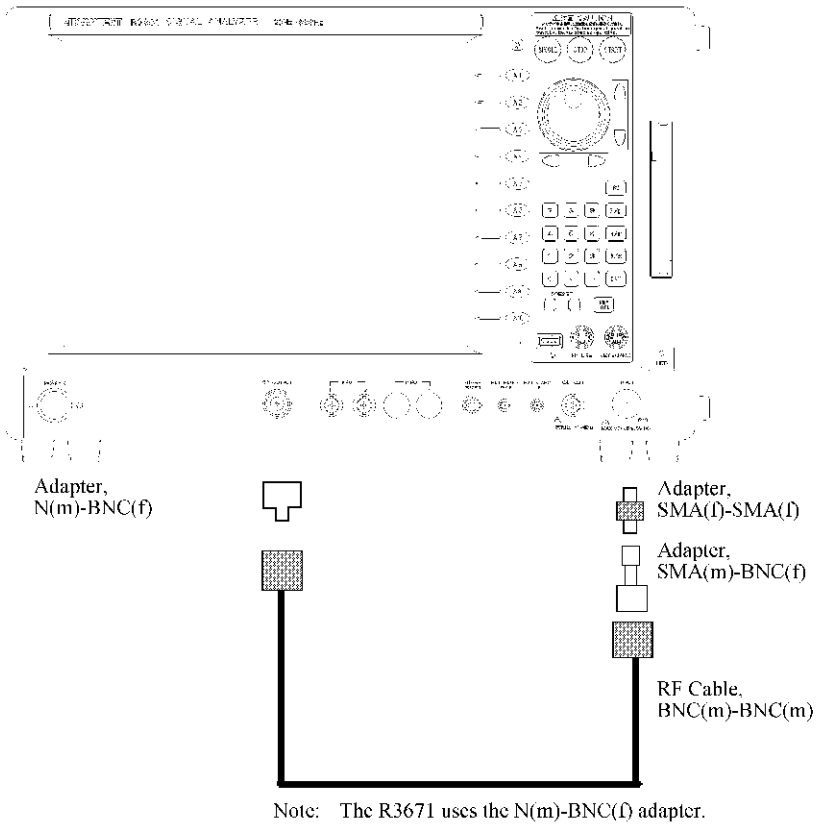


Figure 4-3 Connection diagram

7. Connect the MARKER1 OUT connector and the RAMP IN connector on the rear panel by using a BNC(m)-BNC(m) cable.

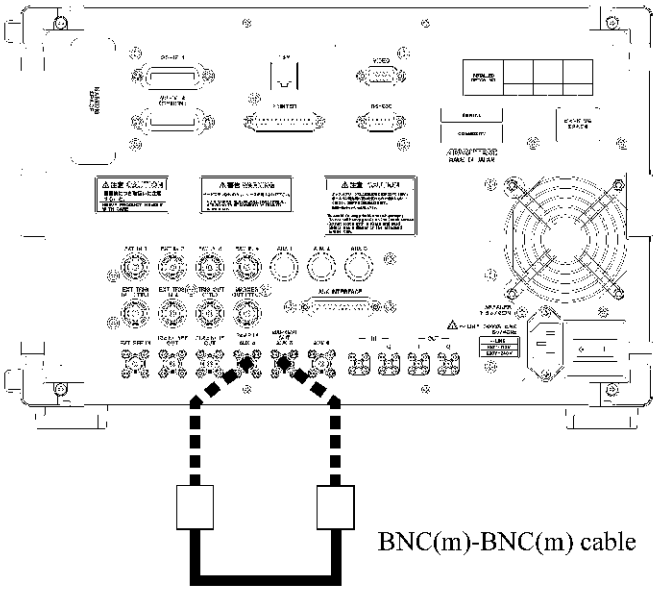


Figure 4-4 Connection diagram

AWG setting

8. Touch **[Config]** on the menu bar and select **[SG+AWG Option]**.
The SG+AWG screen will be displayed.

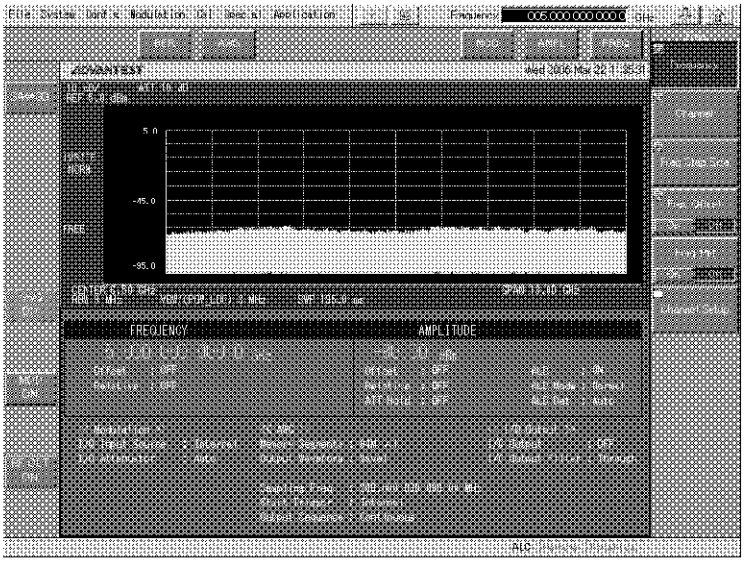


Figure 4-5 SG+AWG Screen

9. Touch **[Cal]** on the menu bar and select **[AWG Cal]** to carry out calibration.

IMPORTANT: Execute auto-calibration after turning on the power supply and letting it warm up for 30 minutes or longer.

10. Touch the **{AWG}** button on the function bar.

11. Touch the **Waveform Setup** key on the soft menu bar.
The **[Waveform Setup]** dialog box will be displayed.

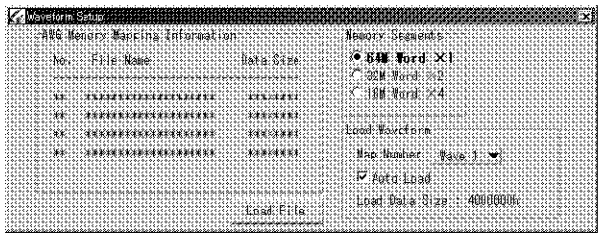


Figure 4-6 **[Waveform Setup]** Dialog Box

12. Touch **[16M Word × 4]** of **[Memory Segments]** on the **[Waveform Setup]** dialog box.
A message box to confirm whether or not it is okay to change **[Memory Segments]** will be displayed. Touch the **[OK]** button.

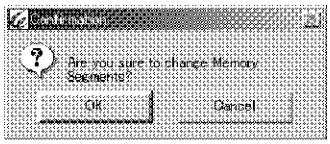


Figure 4-7 **[Memory Segments]** Change Inquiry Message Box

13. Select Wave1 from **[Map Number]** of **[Load Waveform]** in the **[Waveform Setup]** dialog box.

14. Verify that the **[Auto Load]** check box of **[Load Waveform]** on the **[Waveform Setup]** dialog box has been checked.
If it is not checked, touch the check box to check it.

15. Touch the **[Load File]** button in the **[Waveform Setup]** dialog box.
The **[Select Waveform]** dialog box will be displayed.

16. Open the "OPT74" directory in the **[Select Waveform]** dialog box and select the "OPT74.awv" file.
The selected file name will be displayed in the **[Filename]** text box.

17. Touch the **[Load]** button on the **[Select Waveform]** dialog box.
File loading will be started.
When file loading is completed, the **[Select Waveform]** dialog box will disappear from the screen.

CAUTION: If the file size is large, loading takes considerable time.

18. When the file is loaded, NO., the loaded file name and data size will be displayed in **[AWG Memory Mapping Information]** in the **[Waveform Setup]** dialog box. Check them for verification.

19. Touch the close button **|×|** on the **[Waveform Setup]** dialog box to close the dialog box.

20. Press the **START** button on the front panel.
    The I and Q signals are output from the AWG.

MOD setting

21. The modulation On state is set by pressing the active application button **[MOD ON]**.

FREQ setting

22. Touch the **{FREQ}** button on the function bar.

23. Touch the **Frequency** key on the soft menu bar.
    Entry box is displayed and the output frequency can be input.

24. Press **2**, **0**, **0**, **0**, and **M/n**.
    The output frequency from the SG OUTPUT connector is set to 2000 MHz.

AMPL setting

25. Touch the **{AMPL}** button on the function bar.

26. Touch the **Amplitude** key on the soft menu bar.
    The entry box is displayed and the output level can be input.

27. Press **0**, and **ENT**.
    The output level from the SG OUTPUT connector is set to 0 dBm.

28. The output On state is set by pressing the active application button **[RF OUT ON]**.

Checking the SG OUTPUT signal by using the SA

29. Press the active application button **[SA⇔SG]** to display the SA screen.

30. Touch the **{FREQ}** button on the function bar.

31. Press **2**, **0**, **0**, **0**, and **M/n**.

32. Touch the **{SPAN}** button on the function bar.

33. Press [0], and [M/n].

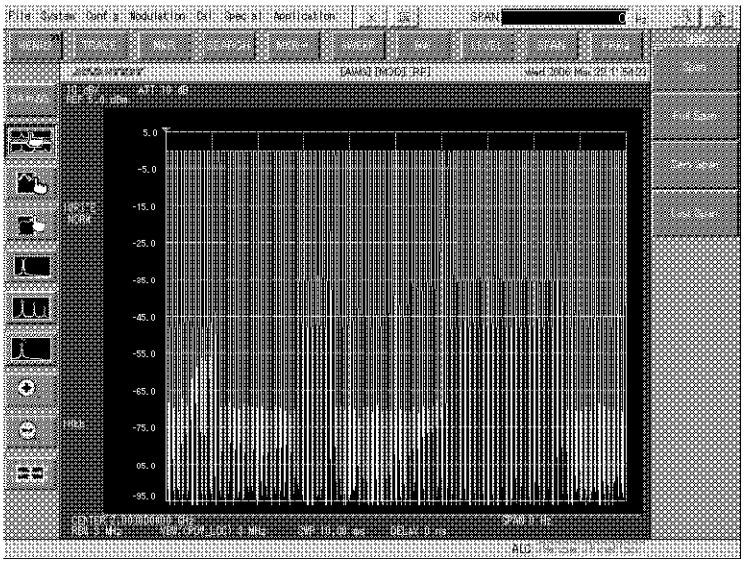


Figure 4-8 Example of Checking the SG OUTPUT Signal by Using the SA

34. Touch the **{SWEEP}** button in the function bar.
35. Touch the **Sweep time** key in the soft menu bar.
36. Press [0], [.], [2], and [ENT].
37. Touch the **Trigger Source** key in the soft menu bar.
38. Touch the **Link** key in the soft menu bar.
39. Touch the **Return** key in the soft menu bar.

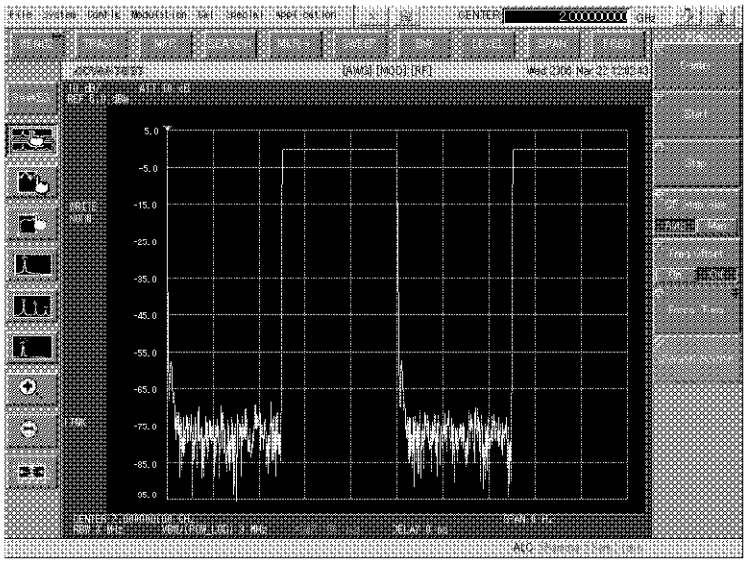


Figure 4-9 OPT74.awv Screen Output Default Settings

Changing the burst period

40. Press the active application button **[SA⇔SG]** to display the SG screen.

41. Press the **STOP** button on the front panel.
    No I and Q signals are output from the AWG.

42. Touch the **{AWG}** button in the function bar.

43. Touch the **Marker Setup** key on the soft menu bar.
    The **|Marker Setup|** dialog box will be displayed.

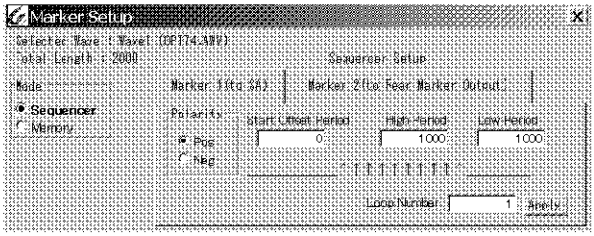


Figure 4-10 **|Marker Setup|** Dialog Box

44. Verify that the **[Mode]** option button on the **[Marker Setup]** dialog box is set to **|Sequencer|**.
    If **[Memory]** has been selected, change it to **[Sequencer]**.

45. Touch the **|Marker 1(to SA)|** tab.

46. Verify that the **[Polarity]** option button on the **[Marker 1(to SA)]** tab is set to **[Pos]**.
    If **[Neg]** has been selected, change it to **[Pos]**.

47. Touch the **[Start Offset Period]** text box on the **[Marker 1(to SA)]** tab.
    The set value is displayed in a black/white inverted state.

48. Input as **0**, **ENT** using the ten-key pad.
    0 will be input to the start offset period.

49. Touch the **[High Period]** text box on the **[Marker 1(to SA)]** tab.
    The set value is displayed in a black/white inverted state.

50. Input as **8**, **0**, **0**, **ENT** using the ten-key pad.
    800 will be input to the high period.

51. Touch the **[Low Period]** text box on the **[Marker 1(to SA)]** tab.
    The set value is displayed in a black/white inverted state.

52. Input as **1**, **2**, **0**, **0**, **ENT** using the ten-key pad.
    1200 will be input to the low period.

53. Touch the **[Loop Number]** text box on the **[Marker 1(to SA)]** tab.
    The set value is displayed in a black/white inverted state.

54. Input as **1**, **ENT** using the ten-key pad.
    1 will be input to the loop number.

55. Press the **[Apply]** button on the **[Marker 1(to SA)]** tab.
    With the above steps, the values of the previously input **[Start Offset Period]**, **[High Period]**, **[Low Period]** and **[Loop Number]** are set.

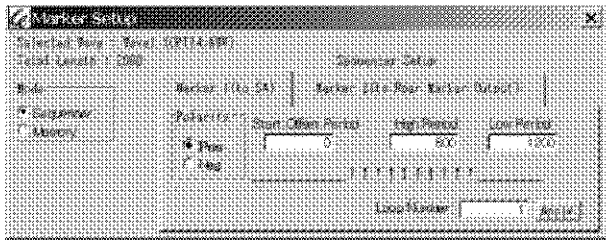


Figure 4-11 **[Marker Setup]** Dialog Box

56. Press the **START** button on the front panel.
    In the OPT74, the signal output turns off when "Hi" is input in the RAMP IN connector.
    Therefore, the output OFF period is decreased by decreasing the Hi period of the MARKER1 signal.

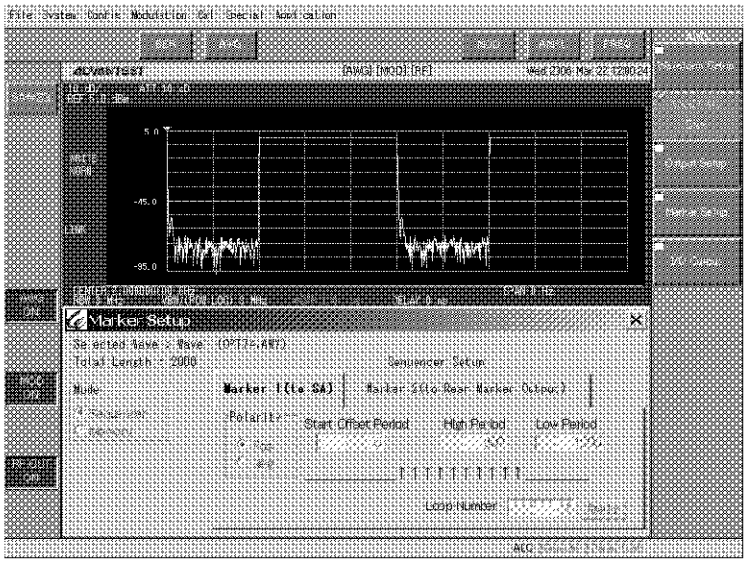


Figure 4-12 OPT74.awv Screen after Changing Burst Period

57. Press the **STOP** button on the front panel.

58. Touch the **Marker Setup** key in the soft menu bar.

59. Click on the **[Neg]** option for the **[Polarity]** button in the **[Marker 1(to SA)]** tab.

60. Press the **START** button on the front panel.

    Because the marker output is inverted, the Hi period of the MARKER1 signal is increased and then the output OFF period is increased.
    Because the SA starts a sweep at a fall time of the MARKER1 signal, the waveform is displayed using the OFF output even if the marker output is inverted.

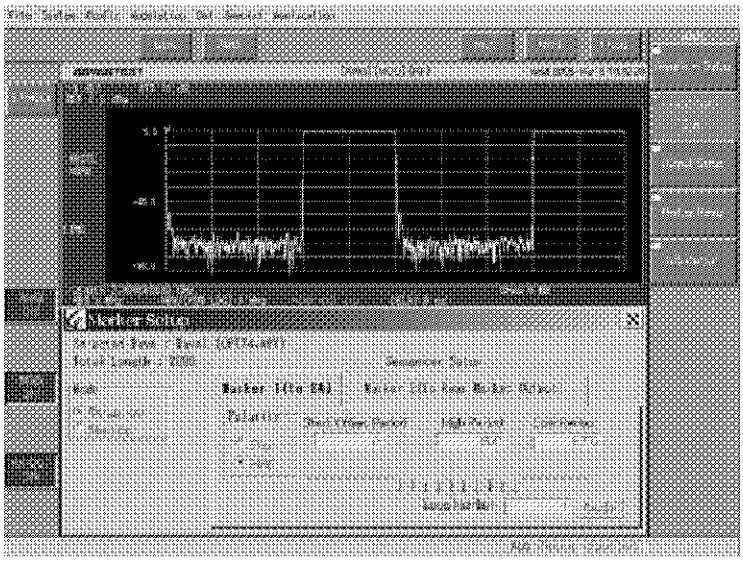


Figure 4-13 OPT74.awv Screen after Setting Marker to Neg

MEMO: ***By editing marker information in the header of a waveform file (.awv), the marker is set according to the edited marker information when the waveform file is loaded.***
In the OPT74.awv file used in this example, the header is written as follows. Setting values are written in the MARKER1 line.
Use a text editor when adding or modifying the header of the waveform file. For more information, refer to the R3681 Series OPT72 User's Guide.

```
{COMMENT:OPT74 Performance Verification}
{DATE:2006/02/24;13:30:24}
{IQOUTPUT:FIX}
{IQFILTER:FLT2_5M}
{STARTTRIGGER:INT;POS}
{OUTPUTSEQUENCE:CONT}
{SAMPLINGFREQ:20000000.000000}
{MARKERMODE:SEQ}
{MARKER1:ON;POS;0;1000;1000;1}
{MARKER2:ON;POS;0;1000;1000;1}
```

5. MENU MAP, FUNCTIONAL EXPLANATION

This chapter describes the configurations and functions of soft keys displayed on the touch screen when this instrument is equipped with the pulse modulator option.

MEMO:

1. **[.....]** ***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.***
2. **{....}** ***Shows a function button on the function bar.***
3. ***Shows a soft key on the soft menu bar.***
4. ***A dialog box is surrounded by a broken line.***
5. ***Shows a text box for numeric input.***
6. ***Operations are supposed to be made through a touch screen, and "touch" means to press a button or a key.***

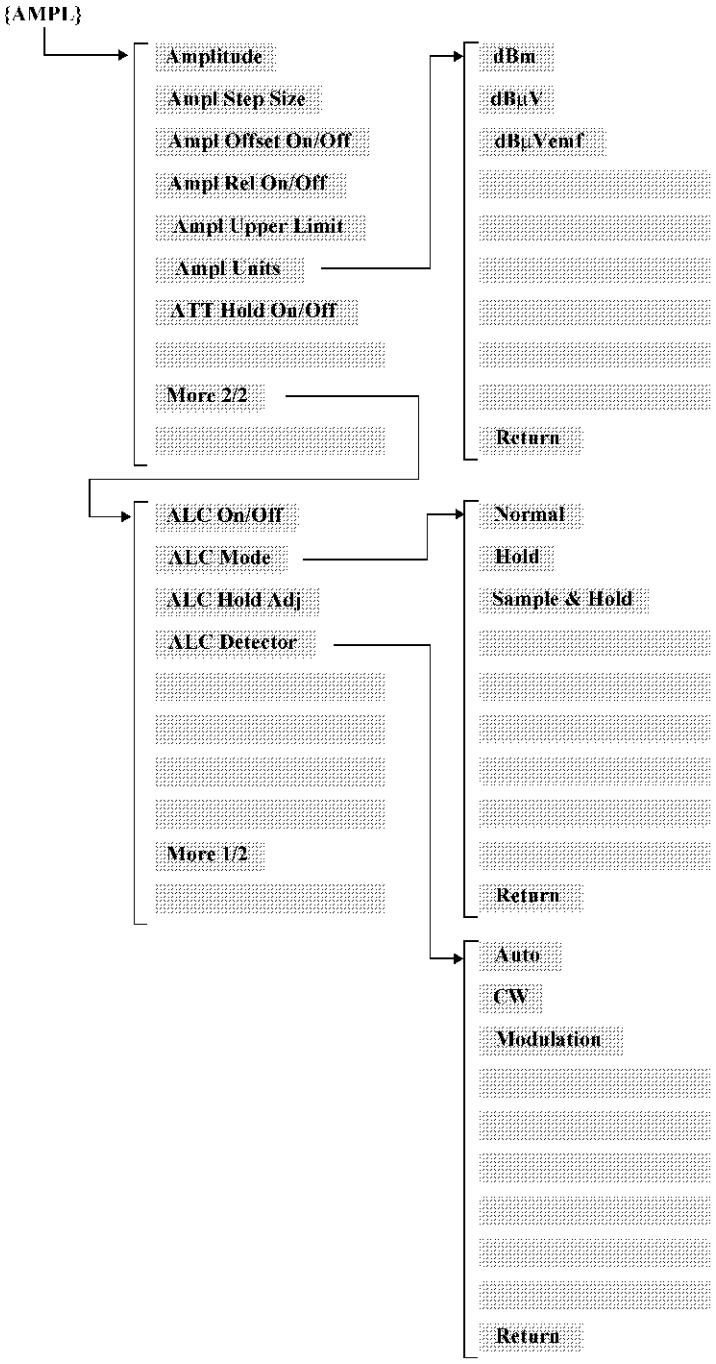
5.1 Menu Index

Operation Key	Pages
{AMPL}	5-2
ALC Detector	5-2
ALC Hold Adj	5-2
ALC Mode	5-2, 5-3
ALC On/Off	5-2
Ampl Offset On/Off	5-2
Ampl Rel On/Off	5-2
Ampl Step Size	5-2
Ampl Units	5-2
Ampl Upper Limit	5-2
Amplitude	5-2
ATT Hold On/Off	5-2
Auto	5-2
CW	5-2
dBm	5-2
dBμV	5-2
dBμVemf	5-2
Hold	5-2, 5-3
Modulation	5-2
Normal	5-2, 5-3
Sample & Hold	5-2, 5-3

5.1.1 {AMPL}

If the **{AMPL}** button is touched, the soft keys, which relate to the RF signal output level setting, are displayed on the soft menu bar.

In the OPT74 Pulse Modulator, **Sample & Hold** in **ALC Mode** is added.



ALC Mode	Displays the menu for selecting the ALC mode of the RF signal.
Normal	Sets ALC to the Normal mode.
Hold	Sets ALC to the Hold mode.
Sample & Hold	Sets ALC to the Sample and Hold mode.
Return	Returns to the previous layer menu.

6. SCPI COMMAND REFERENCE

This chapter describes the command reference of this instrument.

MEMO: For an outline of the remote control, basic measurement procedures, etc., refer to the attached manual "Programming Guide."

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
- Command
- Parameter
- Query

- [Command]

  The 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.
<bch>:	Written in the command header and indicates the BER measurement target channel of the command. The BER measurement channel number can be omitted. However, when it is written, channel number 1 is selected.

<mkr>: Written in the command header and indicates the target marker of the command.
The marker number can be omitted. However, when it is written, a value from 1 to 2 is selected.
[{1|2}]

<mno>: Written in the command header and indicates the Waveform Memory number that is the target of the command.
The Waveform Memory number can be omitted. However, when it is written, a value from 1 to 4 is selected.
[{1|2|3|4}]

- [Function]

  Indicates the outline of the action of this instrument when the command is executed.

- [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]

  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.

  For each read-out parameter, a unit such as "dBm" is displayed in the column for the unit, to show the unit for 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

Function	Command	Parameter	Query	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 running operations	*OPC	---	1	
Recalls device settings	*RCL	<int>	---	
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>	
Self-test execution and inquiry for the results	*TST?	---	<int>	
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 format of "maker name, model name, serial number, version number."

6.3 AMPL Button

In the OPT74 Pulse Modulator, **Sample & Hold** in **ALC Mode** is added.

Function	Command	Parameter	Query	Unit	Remarks
ALC mode NORMAL/ HOLD/SH	[:SOURce<ch=1|2>] :SG:AMPLitude:ALC:MODE	NORMAL| HOLD|SH	NORMAL| HOLD|SH	--	

7. SPECIFICATIONS

Item	Specification	Remarks
ON/OFF ratio	> 60 dB	
Rise time and fall time (10 to 90 %)	< 0.5 μsec	
External modulation signal input (RAMP IN)	BNC (f) on the rear panel TTL level (negative logic)	
MARKER1 output (MARKER1 OUT)	BNC (f) on the rear panel TTL level	

8. PERFORMANCE VERIFICATION

8.1 Overview

8.1.1 Introduction

This chapter describes the performance verification procedure following the order of the items listed in Table 8-1.

Table 8-1 Performance Verification List

Test No.	Test item
8.3.1	MARKER1 OUT Output Waveform
8.3.2	Pulse Modulator Output Waveform

1. Testing environment and conditions

   Conduct performance verification under the following conditions.

   - In a 20 °C to 30 °C environment, after turning on the power and letting it warm up for 30 minutes or longer
   - After automatic calibration has been performed

2. Required measurement instruments

   Table 8-2 shows the list of instruments required for all tests.
   Instruments required for each test are also listed in each test procedure.
   If the user's instruments meet the specifications described in the table, those instruments can be used instead of the recommended models.

3. Performance verification period

   It is recommended that the performance verification is conducted once a year to check whether the pulse modulator option meets its specifications.

4. Performance verification sheets

   Performance verification sheets are provided at the end of this chapter for the user to record the values which are measured in each performance verification test.

   When conducting performance verification, it is recommended that copies of the sheets be made for the test results, and the sheets stored as test records.

5. Notation used in the performance verification procedure

   The soft keys on the touch panel are mainly used to operate the pulse modulator option as well as the signal analyzer.
   Notation of operations described in this chapter is as follows:

   - When continuous operations are described, commas are inserted between operations.
   - Notation used when switching between settings such as On/Off or Auto/Man is described in the following examples:

     (Example) Setting the RBW to Man: **RBW Auto/Man**(Man)

8.1.2 Required Instruments

Table 8-2 show a list of required instruments.
Instruments which are required in all tests are listed. Instruments which are required for individual tests are also listed in each test.
If the user's instruments meet the specifications described in the table, those instruments can be used instead of the recommended models.

Table 8-2 Required Instruments List

No.	Instrument	Requirements	Recommended model	Quantity
1	Oscilloscope	Band: >500 MHz Input: 1 MΩ / 50 Ω, 2 CH Error in delay between channels: <100 ps	TDS5052 Tektronix	1
2	BNC cable	Impedance: 50 Ω Connector: BNC(m)-BNC(m) Length: 1.5 m	A01037-1500 ADVANTEST	2
3	SMA cable	Impedance: 50 Ω Connector: SMA(m)-SMA(m) Length: 1.0 m	SF104/2x11SMA-451 SUHNUR	1
4	Adapter	Connector: SMA(f)-SMA(f)	HRM-501 Hirose Electric Co., Ltd	2
5	Adapter	Connector: N(m)-SMA(f)	HRM-554S Hirose Electric Co., Ltd	1
6	Adapter	Connector: SMA(m)-BNC(f)	HRM-517(09) Hirose Electric Co., Ltd	1

NOTE: In the R3671, another N(m)-SMA(f) adapter is used instead of the SMA(f)-SMA(f) adapter.

8.2 Loading Waveform Data

This section describes procedures for loading the waveform data, which is required for the performance verification, to the waveform storing memory of the digital signal generation option.

The waveform file is stored in advance in the following directory of the R3681 series built-in hard disk.

D:\Advantest\R3681\Waveform\

Refer also to 4.2.1, "Burst Period Setting" in which operation examples of the waveform data loading is described.

Procedure

1. Select the SG+AWG option.
   Operation: **[Config]→[SG+AWG Option]**
2. Display the setting dialog box which is related to loading the waveform data.
   Operation: **[AWG]**, **Waveform Setup**
3. Verify that Auto Load is set.
   If Auto Load is not set, touch the checkbox to set Auto Load.
   Operation: **[Load Waveform]**, **[Auto Load]**
4. Display the dialog box which specifies the waveform file to be loaded.
   Operation: **[Waveform Setup]**, **[Load File]**
5. Touch the waveform file to be loaded to select it.
6. Waveform data loading starts.
   Operation: **[Select Waveform]**, **[Load]**
7. When the waveform data loading is complete, the **[Select Waveform]** dialog box closes and the number, the loaded file name, and data size are displayed in **[AWG Memory Mapping Information]** of the **[Waveform Setup]** dialog box.
8. After all waveform data are loaded, close the **[Waveform Setup]** dialog box.
   Operation: **[Waveform Setup]**, **[×]**

8.3 Pulse Modulator Performance Verification Procedure

This section describes the performance verification procedure following the order of the items listed in Table 8-1.

8.3.1 MARKER1 OUT Output Waveform

[Overview]

When the pulse modulator option is installed, the MARKER1 signal is output to the connector on the rear panel and is also connected to the trigger input in the SA of the R3681 series.
This section describes how to verify the MARKER1 signal waveform that is output to the connector on the rear panel.

[Required instruments]

Instrument	Quantity	Recommended model
Oscilloscope	1	TDS5052
Connector SMA(m)-BNC(f)	1	HRM-517(09) Hirose Electric Co., Ltd
BNC cable BNC(m)-BNC(m)	2	A01037-1500 Advantest

[Connection diagram]

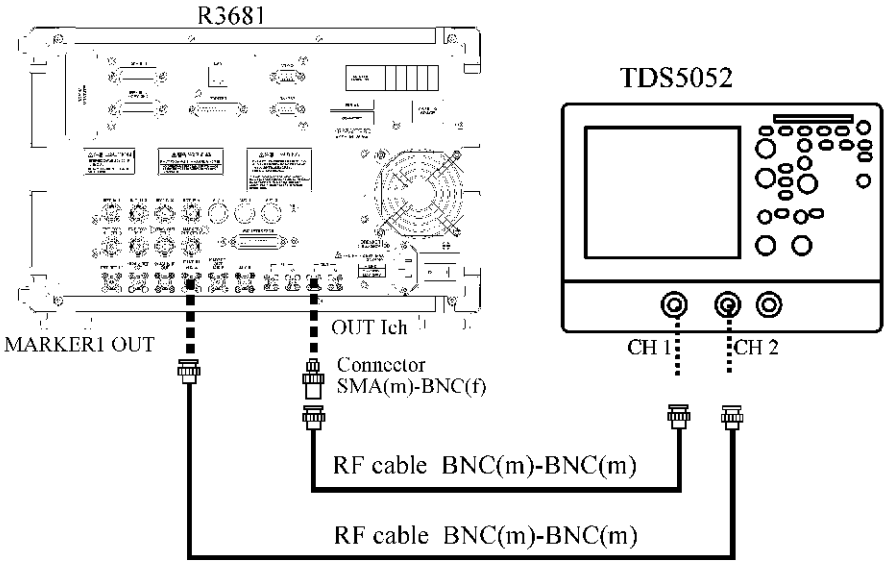


Figure 8-1 Connection Diagram for MARKER1 OUT Output Waveform Verification

[Test procedure]
Initialization

1. Preset this instrument.
   Operation: **[Special]→[Preset]→[All]**

Connecting the instruments

2. Connect the instruments as shown in Figure 8-1.

Setting the oscilloscope

3. Set the oscilloscope as follows:

Vertical axis	CH1 and CH2
Input coupling:	DC
Scale:	CH1; 500 mV/div, CH2; 2 V/div
Input impedance:	1 MΩ
Horizontal axis	
Sweep:	20 μs/div
Trigger	
Source:	CH1
Coupling:	DC
Slope:	Positive
Level:	0 V
Mode:	Auto

Setting the AWG option

4. Referring to 8.2, "Loading Waveform Data," load the waveform file SINWV1.
5. Set the I/Q output mode to Fix Gain Path.
   Operation: **I/Q Output**, **[I/Q Output]**, **[Fix Gain Path ($1V_{P-P}$)]**

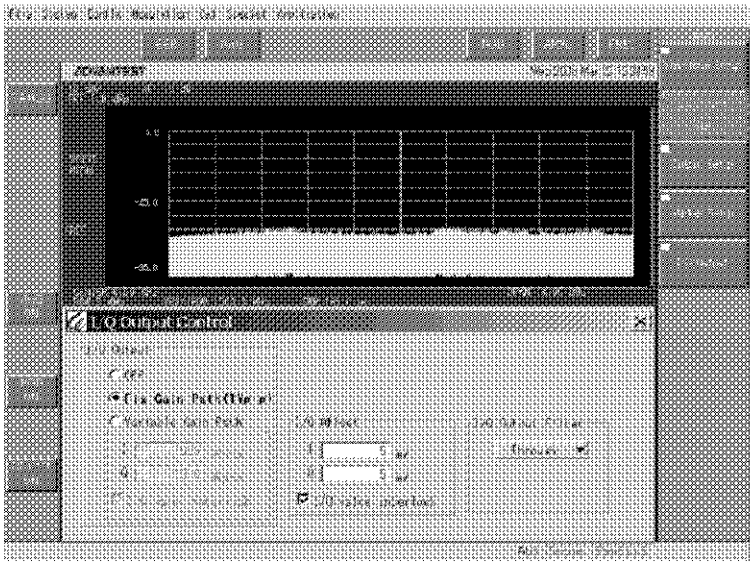


Figure 8-2 I/Q Output Mode Setting

6. After the setting is completed, close the **[I/Q Output Control]** dialog box.
   Operation: **[I/Q Output Control]**, [×]

7. Set the marker 1 output to ON.
   Operation: **Output Setup** , **[Marker1]**, **[ON]**

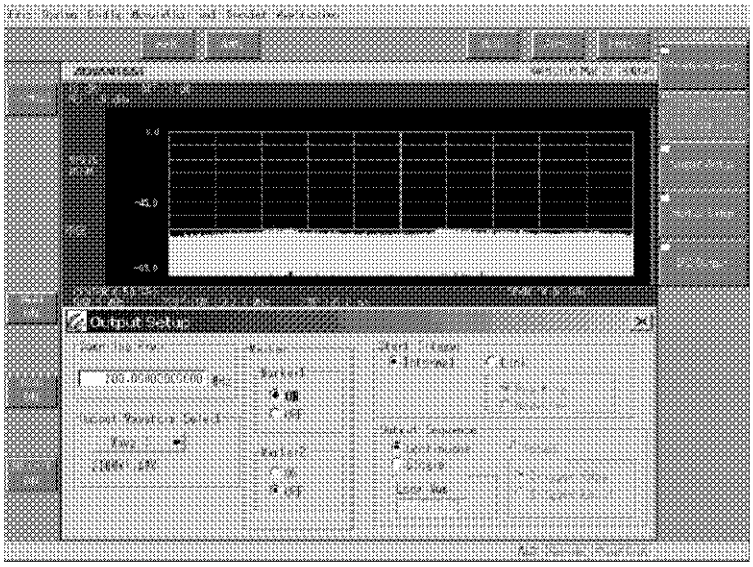


Figure 8-3 Marker Output Setting

8. After the setting is completed, close the **[Output Setup]** dialog box.
   Operation: **[Output Setup]**, [×]

Verifying the sequencer marker settings

9. Set the marker mode to the sequencer marker.
   Operation: **Marker Setup**, **[Mode]**, **[Sequencer]**
10. Set the length of the high period of the sequencer marker to 10,000 points.
    Operation: **[Marker1 (to Rear Marker Output)]**, **[High Period]**, 1, 0, 0, 0, 0, ENT
11. Set the length of the low period of the sequencer marker to 10,000 points.
    Operation: **[Low Period]**, 1, 0, 0, 0, 0, ENT
12. Apply the settings from marker 1.
    Operation: **[Apply]**
13. Output the signal from the AWG.
    Operation: START

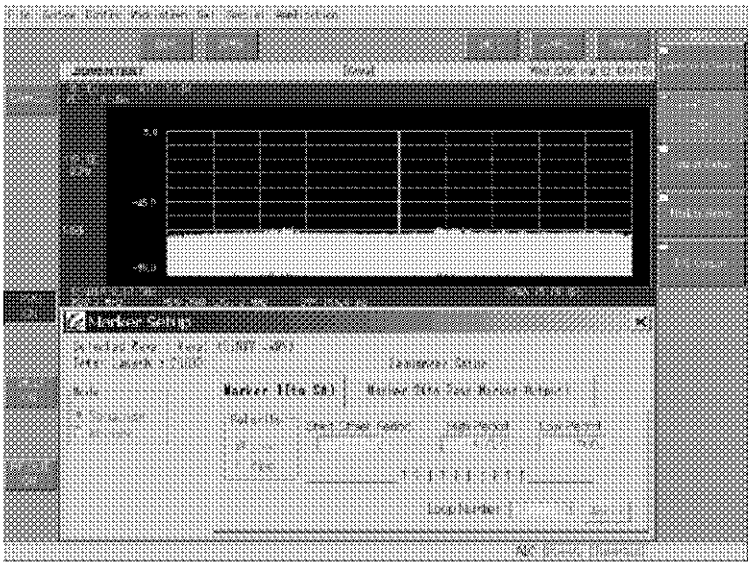


Figure 8-4 Sequencer Marker Setting

14. Verify that the marker, which is high in a period in which the output signal is positive, is output as shown in Figure 8-5. (Verification of positive marker polarity)
15. Stop the signal output.
    Operation: STOP
16. Set the polarity of marker 1 to negative.
    Operation: **[Polarity]**, **[Neg]**, **[Apply]**
17. Output the signal.
    Operation: START

18. Verify that the marker, which is high in a period in which the output signal is negative, is output as shown in Figure 8-6. (Verification of negative marker polarity)

19. Stop the signal output.

    Operation: **STOP**

Verifying the memory marker

20. Set the marker mode to the memory marker.

    Operation: **|Marker Setup|**, **|Mode|**, **|Memory|**

21. Output the signal from the AWG.

    Operation: **START**

22. Verify that the marker, which repeats a high level and a low level for every 1/4 period of the output signal, is output as shown in Figure 8-7.

23. Stop the signal output.

    Operation: **STOP**

PASS/FAIL judgment

24. If output waveforms in steps 14, 18, and 22 are correct, the result is PASS.

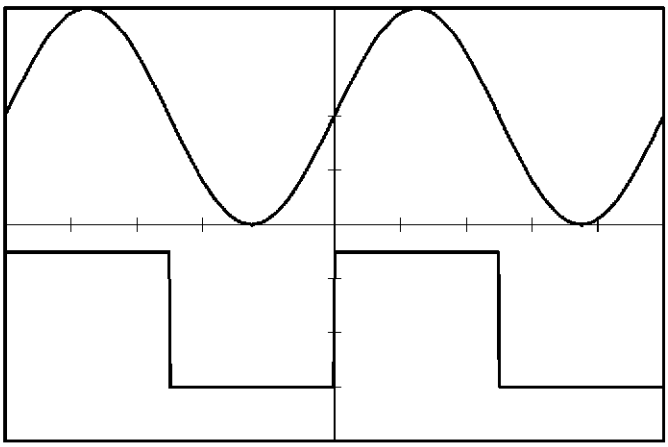


Figure 8-5 Waveform Verification for the Positive Sequencer Marker

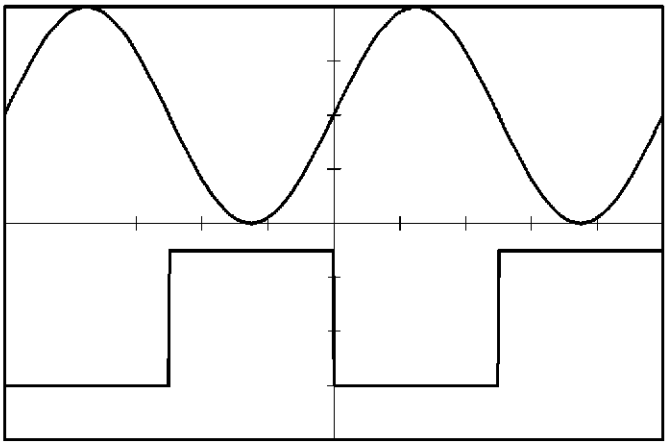


Figure 8-6 Waveform Verification for the Negative Sequencer Marker

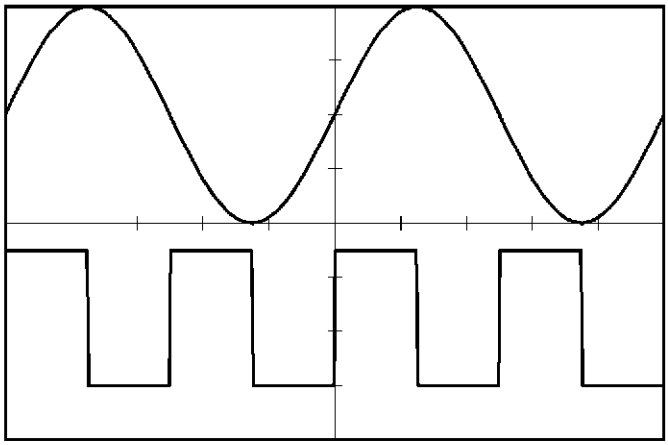


Figure 8-7 Waveform Verification for the Memory Marker

8.3.2 Pulse Modulator Output Waveform

[Overview]

This section describes how to verify whether the ON/OFF ratio, which results from switching the SG output signal by using the added marker 1 output, is sufficient.
This section also describes how to measure a waveform to verify that a rise time and a fall time when the output signal is switched ON and OFF are within the specifications.

[Specifications]

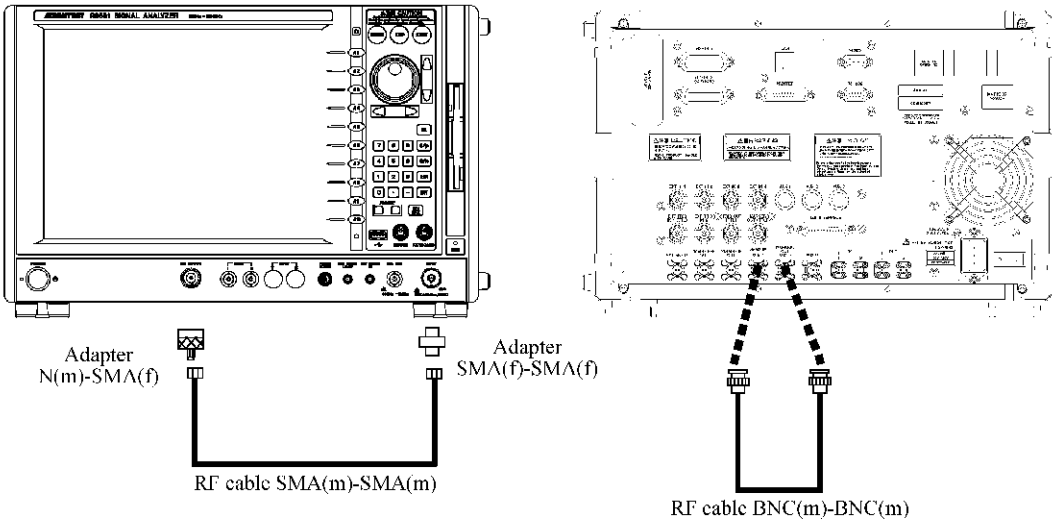
Residual DC offset: ON/OFF ratio: > 60dB
Rise time: < 0.5 μs (10% to 90%)
Fall time: < 0.5 μs (10% to 90%)

[Required instruments]

Product	Quantity	Recommended model
BNC cable BNC(m)-BNC(m)	1	A01037-1500 Advantest
SMA cable SMA(m)-SMA(m)	1	SF104/2x11SMA-451 1000mm SUHNUR
Adapter SMA(f)-SMA(f)	1	HRM-501 Hirose Electric Co., Ltd
Adapter N(m)-SMA(f)	1	HRM-554S Hirose Electric Co., Ltd

NOTE: In the R3671, another N(m)-SMA(f) adapter is used instead of the SMA(f)-SMA(f) adapter.

[Connection diagram]



NOTE: In the R3671, another N(m)-SMA(f) adapter is used instead of the SMA(f)-SMA(f) adapter.

Figure 8-8 Pulse Modulator Output Waveform Verification Connection Diagram

[Test procedure]
Initialization

1. Preset this instrument.
   Operation: **[Special]→[Preset]→[All]**

Connecting the instruments

2. Connect the instruments as shown in Figure 8-8.

Selecting an option from the R3681

3. Select the SG+AWG option.
   Operation: **[Config]→[SG+AWG Option]**

Setting the AWG option and measurement

4. Referring to 8.2, "Loading Waveform Data," and load the waveform file OPT74\OPT74.awv.
5. Output the AWG signal.
   Operation: **START**

SG setting

6. Set the frequency to 2 GHz.
   Operation: **{FREQ}**, **Frequency**, **2**, **G/p**
7. Set the output level to 0 dBm.
   Operation: **{AMPL}**, **Amplitude**, **0**, **ENT**
8. Set MOD to ON.
   Operation: **[MOD ON]**
9. Set the RF output to ON.
   Operation: **[RF OUT ON]**

Measuring the ON/OFF ratio by using the SA function

10. Activate the SA.
    Operation: **[SA⇔SG]**
11. Set the center frequency to 2 GHz.
    Operation: **{FREQ}**, **Center**, **2**, **G/p**

12. Set the frequency span to ZERO SPAN.
    Operation: **{SPAN}**, **Zero Span**
13. Set the Sweep Time to 200 μs.
    Operation: **{Sweep}**, **Sweep Time Auto/Man** (Man), **2**, **0**, **0**, **k/μ**
14. Set the Trigger Source to Link.
    Operation: **Trigger Source**, **Link**, **Return**
15. Set the RBW to 10 MHz.
    Operation: **{BW}**, **RBW Auto/Man** (Man), **1**, **0**, **M/n**
16. Set the trace detector to RMS.
    Operation: **{TRACE}**, **Trace Detector**, **Average RMS**
17. Set the marker on the waveform by using the marker search function.
    Operation: **{SEARCH}**
18. Set the delta marker to ON and move the marker to the Burst OFF period of the waveform.
    Operation: **{MKR}**, **Delta Marker**, **4**, **0**, **k/μ**
19. Read the value of the delta marker. (ON/OFF ratio)
    Record the measurement result in the record sheet. If the result is 60 dB or more, the result is PASS.

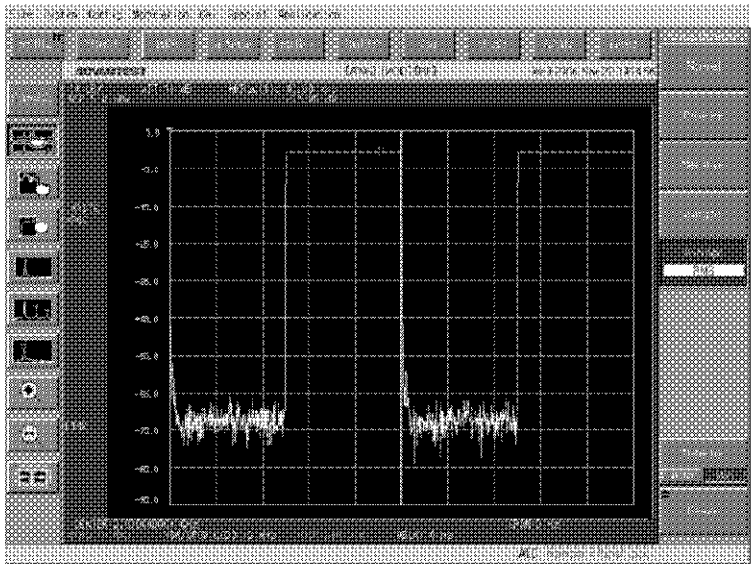


Figure 8-9 ON/OFF Ratio Measurement

20. Set the delta marker to OFF.
    Operation: **Δ Marker On/Off** (Off)

Measuring a rise time and a fall time by using the SA function

21. Set the Sweep Time to 1 μs.
    Operation: **{Sweep}**, **Sweep Time Auto/Man** (Man), **1**, **k/μ**
22. Set the marker on the waveform by using the marker search function.
    Operation: **{SEARCH}**
23. Set the marker to a waveform where the level is 6 dB lower than the peak level by using the XdB Down function. Make a note of the marker time T6dB[nsec].
    Operation: **{MENU2}**, **{MEAS}**, **XdB Down**, **6**, **ENT**
24. Set the marker to a waveform where the level is 54 dB lower than the peak level by using the XdB Down function. Make a note of the marker time T54dB[nsec].
    Operation: **5**, **4**, **ENT**

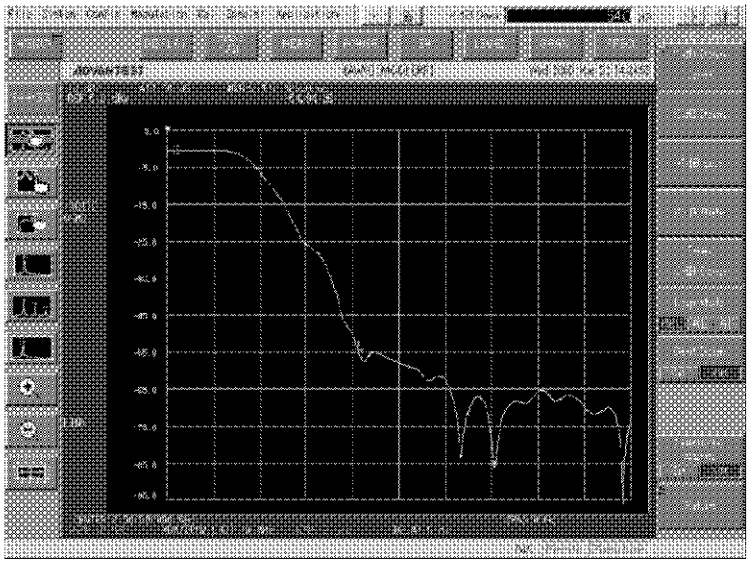


Figure 8-10 Fall Time Measurement

25. Record the result of "T54dB - T6dB" in the fall time section of the record sheet. If the result is 0.5 μs or less, the result is PASS.
26. Set the delta marker to OFF.
    Operation: **{MENU1}**, **{MKR}**, **Δ Marker On/Off** (Off)
27. Set the Trigger Slope to "-".
    Operation: **{SWEEP}**, **Trigger Slope +/-** (-)
28. Set the marker on the waveform by using the marker search function.
    Operation: **{SEARCH}**
29. Set the marker to a waveform where the level is 6 dB lower than the peak level by using the XdB Down function. Make a note of the marker time T6dB[nsec].
    Operation: **{MENU2}**, **{MEAS}**, **XdB Down**, **6**, **ENT**

30. Set the marker to a waveform where the level is 54 dB lower than the peak level by using the XdB Down function. Make a note of the marker time T54dB[nsec].

    Operation: [5], [4], [ENT]

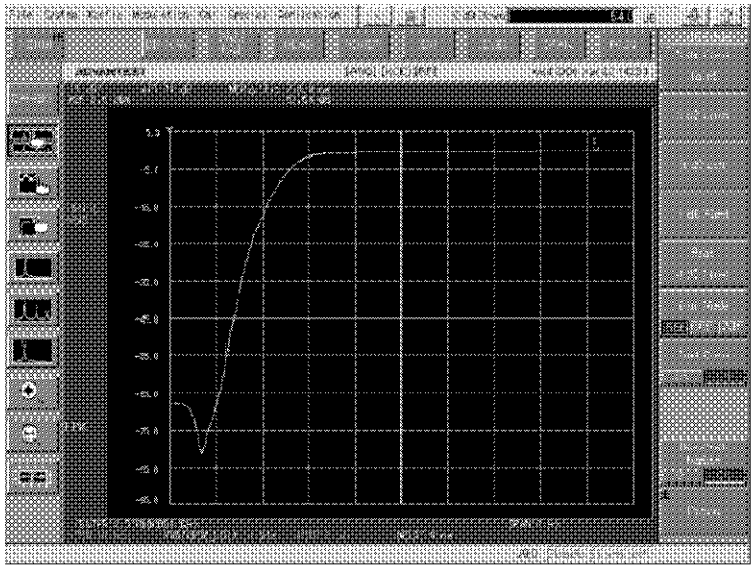


Figure 8-11 Rise Time Measurement

31. Record the result of "T54dB - T6dB" in the rise time section of the record sheet. If the result is 0.5 μs or less, the result is PASS.

8.4 Pulse Modulator Performance Verification Record Sheets

Measured item	Specification (Min.)	Measured value	Specification (Max.)	Pass/Fail
MARKER1 output				
ON/OFF ratio	60 dB			
Fall time			0.5 µs	
Rise time			0.5 µs	

APPENDIX

A.1 Waveform File Configuration

A waveform file is composed of the header, which includes a file generation date and information on settings for the AWG, and the waveform data part.

Text data is used for descriptions in the header, and binary data is used for descriptions in the waveform data part.

Header Comments, a file generation date and settings for the AWG are described.
Waveform data part IQ data is stored. 32-bit frames are used to store I and Q data in alternating sequence (IQIQ...).

MEMO: ***Unless setting information is written in the header, the settings are not reflected in the AWG.***

IMPORTANT: ***A header is not always required for waveform files. A waveform file can be configured only with waveform data, without a header.***

A.2 Header Syntax

In the OPT74 Pulse Modulator, **Sample & Hold** in **ALC Mode** is added.

- ALC Mode
  Enter a ALC mode in this field.

Syntax	Description example
{ALCMOD:*mode***}** mode: NORM/HOLD/SH	{ALCMOD:SH} In this example, the Sample and Hold is selected as the ALC mode.

A.3 Error Codes

No error code is added by installing the OPT74 Pulse Modulator in this instrument.

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