

RIGOL

Performance Verification Guide

**DG5000 Series Function/Arbitrary
Waveform Generator**

Jul. 2012

RIGOL Technologies, Inc.

Guaranty and Declaration

Copyright

© 2012 RIGOL Technologies, Inc. All Rights Reserved.

Trademark Information

RIGOL is a registered trademark of RIGOL Technologies, Inc.

Publication Number

PVB07101-1110

Notices

- **RIGOL** products are protected by patent law in and outside of P.R.C.
- **RIGOL** reserves the right to modify or change parts of or all the specifications and pricing policies at company's sole decision.
- Information in this publication replaces all previously corresponding material.
- **RIGOL** shall not be liable for losses caused by either incidental or consequential in connection with the furnishing, use or performance of this manual as well as any information contained.
- Any part of this document is forbidden to be copied or photocopied or rearranged without prior written approval of **RIGOL**.

Product Certification

RIGOL guarantees this product conforms to the national and industrial standards in China as well as the ISO9001:2008 standard and the ISO14001:2004 standard. Other international standard conformance certification is in progress.

Contact Us

If you have any problem or requirement when using our products, please contact RIGOL Technologies, Inc. or your local distributors, or visit: www.rigol.com.

Safety Requirement

General Safety Summary

Please review the following safety precautions carefully before putting the instrument into operation so as to avoid any personal injuries or damages to the instrument and any product connected to it. To prevent potential hazards, please use the instrument only specified by this manual.

Use Proper Power Cord.

Only the power cord designed for the instrument and authorized by local country could be used.

Ground The Instrument.

The instrument is grounded through the Protective Earth lead of the power cord. To avoid electric shock, it is essential to connect the earth terminal of power cord to the Protective Earth terminal before any inputs or outputs.

Observe All Terminal Ratings.

To avoid fire or shock hazard, observe all ratings and markers on the instrument and check your manual for more information about ratings before connecting.

Use Proper Overvoltage Protection.

Make sure that no overvoltage (such as that caused by a thunderstorm) can reach the product, or else the operator might expose to danger of electrical shock.

Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

Use Proper Fuse.

Please use the specified fuses.

Avoid Circuit or Wire Exposure.

Do not touch exposed junctions and components when the unit is powered.

Do Not Operate With Suspected Failures.

If you suspect damage occurs to the instrument, have it inspected by qualified service personnel before further operations. Any maintenance, adjustment or replacement especially to circuits or accessories must be performed by **RIGOL** authorized personnel.

Keep Well Ventilation.

Inadequate ventilation may cause increasing of temperature or damages to the device. So please keep well ventilated and inspect the intake and fan regularly.

Do Not Operate in Wet Conditions.

In order to avoid short circuiting to the interior of the device or electric shock, please do not operate in a humid environment.

Do Not Operate in an Explosive Atmosphere.

In order to avoid damages to the device or personal injuries, it is important to operate the device away from an explosive atmosphere.

Keep Product Surfaces Clean and Dry.

To avoid the influence of dust and/or moisture in air, please keep the surface of device clean and dry.

Electrostatic Prevention.

Operate in an electrostatic discharge protective area environment to avoid damages induced by static discharges. Always ground both the internal and external conductors of the cable to release static before connecting.

Handling Safety

Please handle with care during transportation to avoid damages to buttons, knob interfaces and other parts on the panels.

Safety Terms and Symbols

Terms on the Product. These terms may appear on the Product:

- DANGER** indicates an injury or hazard may immediately happen.
- WARNING** indicates an injury or hazard may be accessible potentially.
- CAUTION** indicates a potential damage to the instrument or other property might occur.

Symbols on the Product. These symbols may appear on the product:



Hazardous Voltage



Please Refer to Manuals



Protective Earth Terminal



Chassis Ground



Test Ground

Document Overview

This manual guides users to correctly test the performance of **RIGOL** DG5000 series function/arbitrary waveform generator. For the operation method of the instrument, please refer to the DG5000 User's Guide.

Main topics in this manual:

Chapter 1 Overview

This chapter introduces the preparations and precautions of the performance verification test.

Chapter 2 Performance Verification Test

This chapter introduces the limit, test method and procedures of each performance.

Appendix Test Record Form

In the appendix, a test record form is provided for recording the test results so as to determine whether each performance fulfills the requirement.

Format Conventions in this Manual:

Front Panel Key: denoted by "Text Box + Button Name (Bold)", for example, **Utility**.

Menu Softkey: denoted by "Character Shading + Menu Word (Bold)", for example, **I/O Setup**.

Operation Step: denoted by an arrow "→", for example, **Utility** → **I/O Setup**.

Content Conventions in this Manual:

In this manual, DG5352 is taken as an example to illustrate the performance verification test method. The introductions in this manual are applicable to all the models of the DG5000 series.

Model	Channels	Max. Frequency	Sample Rate
DG5072/DG5071	2/1	70 MHz	1 GSa/s
DG5102/DG5101	2/1	100 MHz	1 GSa/s
DG5252/DG5251	2/1	250 MHz	1 GSa/s
DG5352/DG5351	2/1	350 MHz	1 GSa/s

Contents

- Guaranty and Declaration..... I**
- Safety Requirement..... II**
 - General Safety Summary..... II
 - Safety Terms and Symbols IV
- Document OverviewV**
- Chapter 1 Overview 1-1**
 - Test Preparations1-1
 - Recommended Test Devices1-1
 - Test Result Record1-2
 - Specifications1-2
- Chapter 2 Performance Verification Test 2-1**
 - Frequency Accuracy Test.....2-2
 - AC Amplitude Accuracy Test2-4
 - DC Offset Accuracy Test.....2-7
 - AC Flatness Test.....2-10
 - Harmonic Distortion Test.....2-13
 - Spurious Signal Test2-18
 - Rise/Fall Time Test2-20
 - Overshoot Test2-22
- Appendix Test Record Form..... 1**

Chapter 1 Overview

Test Preparations

Before the test, please warm the instrument up for at least 30 minutes under the specified operation temperature (18°C to 28°C).

Recommended Test Devices

It is recommended that you use the test devices listed in Table 1-1 or other test devices that fulfill the specification requirements for the performance verification test.

Table 1-1 Recommended Test Devices

Device	Performance Requirement	Recommended
Frequency Counter	>10 MHz Accuracy: 0.1 ppm	Agilent 53131A
Digital Multimeter	6 ¹ / ₂	RIGOL DM3068
Power Meter	-30 dBm to +20 dBm Accuracy: ±0.02 dB Resolution: 0.01 dB	Agilent E4416A
Spectrum Analyzer	Minimum resolution bandwidth is 10 Hz.	RIGOL DSA1000A
Oscilloscope	Rise/fall time measurement function Overshoot measurement function	RIGOL DS4000 series
Cable	BNC (m)-BNC (m)	--
Cable	BNC (m)-Dual banana plug (m)	--
50 Ω Load	50 Ω/1 W	--
Power Sensor	-35 dBm to +20 dBm	Agilent N8482A
Power Sensor Cable	Used to connect the power meter and power sensor	--
Connector	N (f)-BNC (m)	--
Connector	BNC (f)-N (m)	--

Test Result Record

Record and keep the test result of each test. In the Appendix of this manual, a test result record form which lists all the test items and their corresponding performance limits as well as spaces for users to record the test results, is provided.

Tip:

It is recommended that users photocopy the test record form before each test and record the test results in the copy so that the form can be used repeatedly.

Specifications

The specification of each test item is provided in chapter 2. For other specifications, refer to DG5000 User's Guide or DG5000 Data Sheet (can be downloaded from www.rigol.com).

Tip:

All the specifications are only valid when the instrument has been warmed up for more than 30 minutes under the specified operation temperature (18°C to 28°C).

Chapter 2 Performance Verification Test

This chapter introduces the performance verification test method for DG5000 series function/arbitrary waveform generator by taking CH1 of DG5352 as an example (the test method of CH1 is also applicable to CH2).

Test items include:

- Frequency Accuracy Test
- AC Amplitude Accuracy Test
- DC Offset Accuracy Test
- AC Flatness Test
- Harmonic Distortion Test
- Spurious Signal Test
- Rise/Fall Time Test
- Overshoot Test

Note:

- 1) Make sure that the instrument has been warmed up for at least 30 minutes before executing any of the following tests.
- 2) Any of the following tests must be done under the specified operation temperature (18°C to 28°C).
- 3) Please reset the instrument to the factory setting before or after executing any of the following tests.

Frequency Accuracy Test

Specification:

Frequency Characteristics	
Accuracy	± 1 ppm
Note: ppm denotes one part per million. For example, if the setting frequency is 1 MHz and the actual output frequency is between 0.999999 MHz (-1 ppm) and 1.000001 MHz (+1 ppm), the frequency accuracy of the instrument is guaranteed and the test passes.	

Test Device:

1. Frequency Counter

Test Procedures:

1. Connect CH1 of DG5000 and the signal input terminal of the frequency counter using the dual-BNC cable as shown in the figure below.

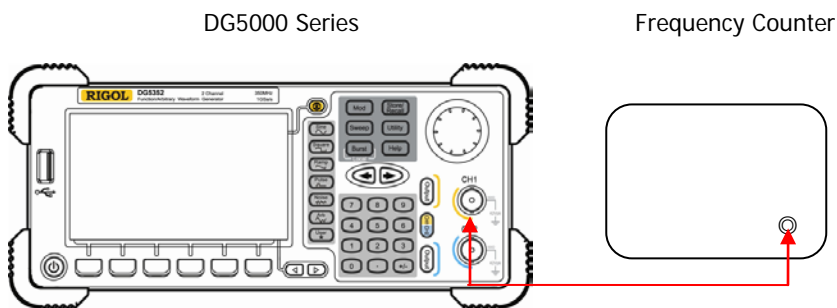


Figure 2-1 Connect DG5000 and the Frequency Counter

2. Set the output impedance of the frequency counter to $1\text{ M}\Omega$.
3. Press **Utility** → **System** → **Preset** to restore DG5000 to its default setting.
4. Configure DG5000:
 - a) Output a sine waveform with 1 MHz frequency and 1 Vpp amplitude.
 - b) Press **Output** to enable CH1.
5. Record the reading of the frequency counter and check if the reading is between 0.999999 MHz and 1.000001 MHz.

6. Configure DG5000 to output a square, ramp and pulse waveform with 1 MHz frequency and 1 Vpp amplitude respectively. Record the readings of the frequency counter and check if the readings are between 0.999999 MHz and 1.000001 MHz.
7. Test the frequency accuracy of CH2 according to the steps above and record the test results.

Test Record Form:

Channel: CH1

Waveform	Setting	Measurement Value	Limit Calculated from Specification ^[1]	Pass/Fail	
Sine	Frequency: 1 MHz		0.999999 MHz to 1.000001 MHz		
Square					
Ramp	Amplitude: 1 Vpp				
Pulse					

Channel: CH2

Waveform	Setting	Measurement Value	Limit Calculated from Specification ^[1]	Pass/Fail	
Sine	Frequency: 1 MHz		0.999999 MHz to 1.000001 MHz		
Square					
Ramp	Amplitude: 1 Vpp				
Pulse					

Note^[1]: $\pm 1\text{ppm}$, 18°C to 28°C

AC Amplitude Accuracy Test

Specification:

Output Characteristics	
Amplitude (into 50 Ω)	
Accuracy	Typical (1 kHz Sine, 0 V _{DC} Offset, >10 mVpp, Auto) $\pm 1\%$ of setting ± 1 mVpp

Test Devices:

1. Digital Multimeter
2. 50 Ω Load

Test Procedures:

1. Connect the 50 Ω load to CH1 of DG5000; connect the 50 Ω load and the voltage input terminals of the digital multimeter using BNC-Dual banana plug cable as shown in the figure below.

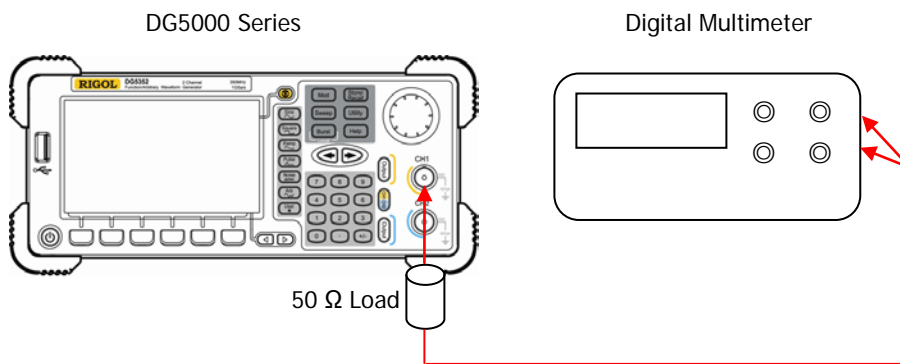


Figure 2-2 Connect DG5000 and the Digital Multimeter via the 50 Ω Load

2. Select AC voltage (ACV) measurement function for the digital multimeter and set the range to "Auto".
3. Press **Utility** \rightarrow **System** \rightarrow **Preset** to restore DG5000 to its default setting.

4. Configure DG5000:
 - a) Set the output impedance of CH1 to 50 Ω (press **Utility** → **CH1Set** → **Resi** to select "Load").
 - b) Output a sine waveform with 1 kHz frequency, 0 V_{DC} offset and 20 mVpp amplitude.
 - c) Press **Output** to enable CH1.
5. Record the reading of the digital multimeter and check if the reading exceeds the range listed in the "Limit of Output Amplitude (Vrms)" in **Table 2-1**.
6. Keep other settings of DG5000 unchanged, set the output amplitude to 100 mVpp, 500 mVpp, 1 Vpp, 5 Vpp and 10 Vpp respectively, record the readings of the digital multimeter and check if the readings exceed the ranges listed in the "Limit of Output Amplitude (Vrms)" in the table below.

Table 2-1 Limits of AC Amplitude Accuracy Test

Setting Amplitude (Vpp)	Permitted Error ^[1] (Vpp)	Limit of Output Amplitude (Vpp)	Limit of Output Amplitude (Vrms) ^[2]
20 mVpp	±1.2 mVpp	18.8~21.2 mVpp	6.6~7.5 mVrms
100 mVpp	±2 mVpp	98~102 mVpp	34.7~36.1 mVrms
500 mVpp	±6 mVpp	494~506 mVpp	174.7~178.9 mVrms
1 Vpp	±11 mVpp	0.989~1.011 Vpp	349.7~357.5 mVrms
5 Vpp	±51 mVpp	4.949~5.051 Vpp	1.75~1.7861 Vrms
10 Vpp	±101 mVpp	9.899~10.101 Vpp	3.5~3.5717 Vrms

Note^[1]: "Permitted Error" is calculated from the specification "±1% of setting ±1 mVpp".

Note^[2]: "Limit of Output Amplitude (Vrms)" is calculated from "Limit of Output Amplitude

(Vpp)". The relation between Vrms and Vpp is $1V_{pp} = 2\sqrt{2}V_{rms}$.

7. Test the AC amplitude accuracy of CH2 according to the steps above and record the test results.

Test Record Form:

Channel: CH1

Setting Amplitude	Setting	Measurement Value	Limit Calculated from Specification ^[1]	Pass/Fail
20 mVpp	Frequency: 1 kHz Offset: 0 V _{DC} Impedance: 50 Ω		6.6~7.5 mVrms	
100 mVpp			34.7~36.1 mVrms	
500 mVpp			174.7~178.9 mVrms	
1 Vpp			349.7~357.5 mVrms	
5 Vpp			1.75~1.7861 Vrms	
10 Vpp			3.5~3.5717 Vrms	

Channel: CH2

Setting Amplitude	Setting	Measurement Value	Limit Calculated from Specification ^[1]	Pass/Fail
20 mVpp	Frequency: 1 kHz Offset: 0 V _{DC} Impedance: 50 Ω		6.6~7.5 mVrms	
100 mVpp			34.7~36.1 mVrms	
500 mVpp			174.7~178.9 mVrms	
1 Vpp			349.7~357.5 mVrms	
5 Vpp			1.75~1.7861 Vrms	
10 Vpp			3.5~3.5717 Vrms	

Note^[1]: typical (1 kHz Sine, 0 V_{DC} Offset, >10 mVpp, Auto) ±1% of setting ±1 mVpp

DC Offset Accuracy Test

Specification:

Output Characteristics	
Offset (into 50 Ω)	
Accuracy	$\pm(1\% \text{ of setting} + 5 \text{ mV} + 0.5\% \text{ of amplitude})$

Test Devices:

1. Digital Multimeter
2. 50 Ω Load

Test Procedures:

1. Connect the 50 Ω load to the CH1 of DG5000; connect the 50 Ω load and the voltage input terminals of the digital multimeter using the BNC-Dual banana plug cable as shown in **Figure 2-2**.
2. Select DC voltage (DCV) measurement function for the digital multimeter and set the range to 20 V scale.
3. Press **Utility** \rightarrow **System** \rightarrow **Preset** to restore DG5000 to its default setting.
4. Configure DG5000:
 - a) Set the output impedance of CH1 to 50 Ω (press **Utility** \rightarrow **CH1Set** \rightarrow **Resi** to select "Load").
 - b) Output a sine waveform with 1 kHz frequency, 5 V_{pp} amplitude and 0 V_{DC} offset.
 - c) Press **Output** to enable CH1.
5. Record the reading of the digital multimeter and check if the reading exceeds the range listed in the "Offset Limit" in **Table 2-2**.
6. Keep other settings of DG5000 unchanged, set the offset to -2.5 V_{DC}, -1 V_{DC}, -500 mV_{DC}, 500 mV_{DC}, 1 V_{DC} and 2.5 V_{DC} respectively, record the readings of the digital multimeter and check if the readings exceed the ranges listed in the "Offset Limit" in **Table 2-2**.

Table 2-2 Limits of DC Offset Accuracy Test

Setting Offset	Setting Amplitude	Permitted Error ^[1]	Offset Limit ^[2]
$-2.5 V_{DC}$	5 Vpp	$\pm 0.005 V_{DC}$	$-2.505 \sim -2.495 V_{DC}$
$-1 V_{DC}$		$\pm 0.02 V_{DC}$	$-1.02 \sim -0.98 V_{DC}$
$-500 mV_{DC}$		$\pm 0.025 V_{DC}$	$-0.525 \sim -0.475 V_{DC}$
$0 V_{DC}$		$\pm 0.030 V_{DC}$	$-0.030 \sim 0.030 V_{DC}$
$500 mV_{DC}$		$\pm 0.035 V_{DC}$	$0.465 \sim 0.535 V_{DC}$
$1 V_{DC}$		$\pm 0.04 V_{DC}$	$0.96 \sim 1.04 V_{DC}$
$2.5 V_{DC}$		$\pm 0.055 V_{DC}$	$2.445 \sim 2.555 V_{DC}$

7. Test the DC offset accuracy of CH2 according to the steps above and record the test results.

Test Record Form:

Channel: CH1

Setting Offset	Setting	Measurement Value	Offset Limit ^[2]	Pass/Fail
-2.5 V _{DC}	Frequency: 1 kHz Amplitude: 5 V _{pp} Impedance: 50 Ω		-2.505 ~ -2.495 V _{DC}	
-1 V _{DC}			-1.02 ~ -0.98 V _{DC}	
-500 mV _{DC}			-0.525 ~ -0.475 V _{DC}	
0 V _{DC}			-0.030 ~ 0.030 V _{DC}	
500 mV _{DC}			0.465 ~ 0.535 V _{DC}	
1 V _{DC}			0.96 ~ 1.04 V _{DC}	
2.5 V _{DC}			2.445 ~ 2.555 V _{DC}	

Channel: CH2

Setting Offset	Setting	Measurement Value	Offset Limit ^[2]	Pass/Fail
-2.5 V _{DC}	Frequency: 1 kHz Amplitude: 5 V _{pp} Impedance: 50 Ω		-2.505 ~ -2.495 V _{DC}	
-1 V _{DC}			-1.02 ~ -0.98 V _{DC}	
-500 mV _{DC}			-0.525 ~ -0.475 V _{DC}	
0 V _{DC}			-0.030 ~ 0.030 V _{DC}	
500 mV _{DC}			0.465 ~ 0.535 V _{DC}	
1 V _{DC}			0.96 ~ 1.04 V _{DC}	
2.5 V _{DC}			2.445 ~ 2.555 V _{DC}	

Note^[1]: "Permitted Error" is calculated from the specification " \pm (1% of setting + 5 mV + 0.5% of amplitude)".

Note^[2]: Offset Limit = Setting Offset - Permitted Error

AC Flatness Test

Specification:

Output Characteristics	
Flatness (relative to 100 kHz Sine wave, 500 mVpp, 50 Ω)	Typical
	<10 MHz: ±0.1 dB
	10 MHz to 60 MHz: ±0.2 dB
	60 MHz to 100 MHz: ±0.4 dB
	100 MHz to 250 MHz: ±1.0 dB
>250 MHz: ±1.5 dB	

Test Devices:

1. Digital Multimeter
2. 50 Ω Load
3. Power Meter
4. Power Sensor

Test Procedures:

1. Connect the 50 Ω load to CH1 of DG5000; connect the 50 Ω load and the voltage input terminals of the digital multimeter using the BNC-Dual banana plug cable as shown in **Figure 2-2**.
2. Press **Utility** → **System** → **Preset** to restore DG5000 to its default setting.
3. Configure DG5000:
 - a) Set the output impedance of CH1 to 50 Ω (press **Utility** → **CH1Set** → **Resi** to select "Load").
 - b) Output a sine waveform with 1 kHz frequency and 500 mVpp amplitude.
 - c) Press **Output** to enable CH1.
4. Select the AC voltage (ACV) measurement function for the digital multimeter. Enable the dBm operation function and set the reference resistance to 50 Ω. Read the measurement value and use it as the reference power (P_{ref}) (tip: you can also use the value measured by the digital multimeter to calculate the reference power using the formula " $10 \times \text{Log}_{10} [(\text{Reading}^2 / R_{ref}) / 1 \text{ mW}]$ ").

5. Calibrate the power meter:
 - a) Connect the power sensor to the input terminal and the **[POWER REF]** terminal of the power meter.
 - b) Press **Zero/Cal** → **Zero** → **Cal**. After the calibration is finished, enable **power reference** and observe whether the measurement value of the power meter is a 0 dBm, 50 MHz signal.
 - c) Disable **power reference**.
6. Connect the power sensor to CH1 of DG5000 via the BNC (f)-N (m) connector as shown in the figure below.

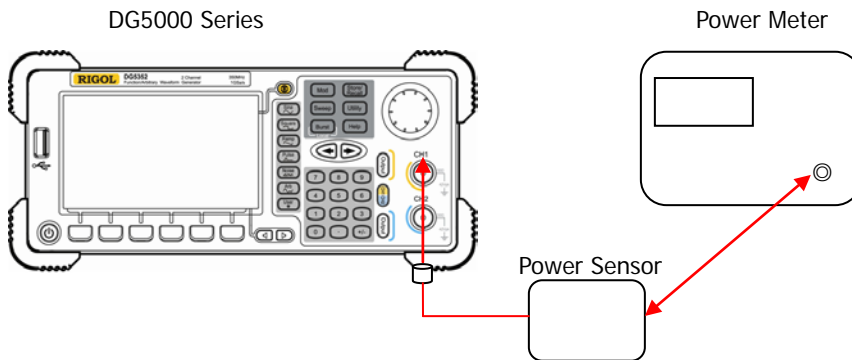


Figure 2-3 Connect DG5000 and the Power Meter

7. Keep other settings of DG5000 unchanged and set the output frequency to 8 MHz. Set the frequency factor of the power meter to 8 MHz, record the measurement value of the power meter and check if "measurement value - P_{ref} " is within the range from -0.1 dB to +0.1 dB.
8. Keep other settings of DG5000 unchanged and set the output frequency to 50 MHz. Set the frequency factor of the power meter to 50 MHz, record the measurement value of the power meter and check if "measurement value - P_{ref} " is within the range from -0.2 dB to +0.2 dB.
9. Keep other settings of DG5000 unchanged and set the output frequency to 70 MHz. Set the frequency factor of the power meter to 70 MHz, record the measurement value of the power meter and check if "measurement value - P_{ref} " is within the range from -0.4 dB to +0.4 dB.

10. Keep other settings of DG5000 unchanged and set the output frequency to 200 MHz (only for DG5252/DG5251 and DG5352/DG5351). Set the frequency factor of the power meter to 200 MHz, record the measurement value of the power meter and check if “measurement value - P_{ref} ” is within the range from -1.0 dB to +1.0 dB.
11. Keep other settings of DG5000 unchanged and set the output frequency to 300 MHz (only for DG5352/DG5351). Set the frequency factor of the power meter to 300 MHz, record the measurement value of the power meter and check if “measurement value - P_{ref} ” is within the range from -1.5 dB to +1.5 dB.
12. Test the AC flatness of CH2 according to the steps above and record the test results.

Test Record Form:

Channel: CH1

Setting Frequency	Setting	Measurement Value	Calculation Result ^[1]	Specification	Pass/Fail
8 MHz	Amplitude: 500 mVpp Impedance: 50 Ω			±0.1 dB	
50 MHz				±0.2 dB	
70 MHz				±0.4 dB	
200 MHz ^[2]				±1.0 dB	
300 MHz ^[3]				±1.5 dB	

Channel: CH2

Setting Frequency	Setting	Measurement Value	Calculation Result ^[1]	Specification	Pass/Fail
8 MHz	Amplitude: 500 mVpp Impedance: 50 Ω			±0.1 dB	
50 MHz				±0.2 dB	
70 MHz				±0.4 dB	
200 MHz ^[2]				±1.0 dB	
300 MHz ^[3]				±1.5 dB	

Note^[1]: calculation result=measurement value - P_{ref} .

Note^[2]: only for DG5252/DG5251 and DG5352/DG5351.

Note^[3]: only for DG5352/DG5351.

Harmonic Distortion Test

Specification:

Sine Wave Spectrum Purity	
Harmonic Distortion	Typical (0 dBm)
	≤100 MHz: < -45 dBc
	>100 MHz: < -35 dBc

Test Device:

1. Spectrum Analyzer

Test Procedures:

1. Connect the channel output terminal of CH1 of DG5000 with the RF input terminal of the spectrum analyzer using the dual-BNC cable and N-BNC connector as shown in the figure below.

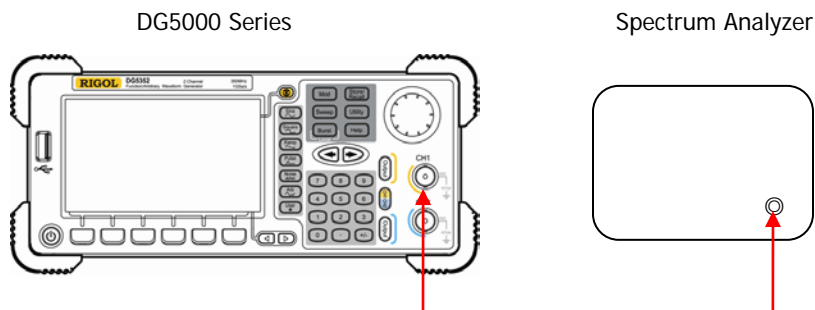


Figure 2-4 Connect DG5000 and Spectrum Analyzer

2. Press **Utility**→**System**→**Preset** to restore DG5000 to its default setting.
3. Configure DG5000:
 - a) Set the output impedance of CH1 to 50 Ω (press **Utility** → **CH1Set**→ **Resi** to select "Load").
 - b) Output a sine waveform with 10 MHz frequency, 0 dBm amplitude and 0 V_{DC} offset.
 - c) Press **Output** to enable CH1.

4. Set the spectrum analyzer:
 - a) Set the input attenuation to 20 dB and the reference level to 10 dBm;
 - b) Set the start frequency to 5 MHz and the stop frequency to 65 MHz;
 - c) Set the resolution bandwidth to 3 kHz.

5. Enable the peak table^[1] function of the spectrum analyzer. Record the measurement values of the fundamental waveform, second harmonic and third harmonic and check if the harmonic distortion is lower than -45 dBc through calculation^[2].

6. Keep other settings of DG5000 unchanged and set the output frequency to 50 MHz.

7. Set the spectrum analyzer:
 - a) Set the input attenuation is 20 dB and the reference level to 10 dBm;
 - b) Set the start frequency to 10 MHz and the stop frequency to 200 MHz;
 - c) Set the resolution bandwidth to 3 kHz.

8. Record the measurement values of the fundamental waveform, second harmonic and third harmonic in the peak table and check if the harmonic distortion is lower than -45 dBc through calculation^[2].

9. Keep other settings of DG5000 unchanged and set the frequency to 250 MHz (only for DG5352/DG5351 and DG5252/DG5251).

10. Set the spectrum analyzer:
 - a) Set the input attenuation is 20 dB and the reference level to 10 dBm;
 - b) Set the start frequency to 200 MHz and the stop frequency to 800 MHz;
 - c) Set the resolution bandwidth to 3 kHz.

11. Record the measurement values of the fundamental waveform, second harmonic and third harmonic and check if the harmonic distortion is lower than -35 dBc through calculation^[2].

12. Keep other settings of DG5000 unchanged and set the frequency to 300 MHz (only for DG5352/DG5351).

13. Set the spectrum analyzer:
 - a) Set the input attenuation to 20 dB and the reference level to 10 dBm;
 - b) Set the start frequency to 250 MHz and the stop frequency to 1 GHz;
 - c) Set the resolution bandwidth to 3 kHz.
14. Record the measurement values of the fundamental waveform, second harmonic and third harmonic and check if the harmonic distortion is lower than -35 dBc through calculation^[2].
15. Test the harmonic distortion of CH2 according to the steps above and record the test results.

Note^[1]: If the measurement value of the third harmonic is not displayed in the peak table, you do not need to record the measurement value of the third harmonic.

Note^[2]: The n^{th} Harmonic Distortion = The Measurement Value of the n^{th} Harmonic - The Measurement Value of the Fundamental Wave
Wherein, $n=2$ or 3 and the fundamental wave is the first harmonic. For example, if the measurement value of the fundamental wave is -10 dBm and the measurement value of the second harmonic is -72 dBm, the second harmonic distortion = $(-72) - (-10) = -62$ dBc < -60 dBc. The test result fulfills the specification requirement.

Test Record Form:

Channel: CH1

Setting Frequency	Setting	Measurement Value	Calculation Result ^[1]	Specification	Pass/Fail ^[2]
10 MHz	Waveform: Sine Amplitude: 0 dBm Offset: 0 V _{DC}	1 (fundamental wave):		<-45 dBc	--
		2:			
		3:			
50 MHz		1 (fundamental wave):		<-45 dBc	--
		2:			
		3:			
250 MHz ^[3]		1 (fundamental wave):		<-35 dBc	--
		2:			
		3:			
300 MHz ^[4]	1 (fundamental wave):		<-35 dBc	--	
	2:				
	3:				

Channel: CH2

Setting Frequency	Setting	Measurement Value	Calculation Result ^[1]	Specification	Pass/Fail ^[2]
10 MHz	Waveform: Sine Amplitude: 0 dBm Offset: 0 V _{DC}	1 (fundamental wave):		< -45 dBc	--
		2:			
		3:			
50 MHz		1 (fundamental wave):		< -45 dBc	--
		2:			
		3:			
250 MHz ^[3]		1 (fundamental wave):		< -35 dBc	--
		2:			
		3:			
300 MHz ^[4]	1 (fundamental wave):		< -35 dBc	--	
	2:				
	3:				

Note^[1]: calculation result=the measurement value of the nth harmonic – the measurement value of the fundamental wave.

Note^[2]: the test fails if the calculation result is greater than the specification.

Note^[3]: only for DG5352/DG5351 and DG5252/DG5251.

Note^[4]: only for DG5352/DG5351.

Spurious Signal Test

Specification:

Sine Wave Spectrum Purity (Typical 0 dBm)	
Spurious signal (non-harmonic)	≤ 100 MHz: < -50 dBc > 100 MHz: -50 dBc + 6 dB/octave

Test Device:

1. Spectrum Analyzer

Test Procedures:

1. Connect CH1 of DG5000 with the RF input terminal of the spectrum analyzer using the dual-BNC cable and N-BNC connector as shown in **Figure 2-4**.
2. Press **Utility** → **System** → **Preset** to restore DG5000 to its default setting.
3. Configure DG5000:
 - a) Set the output impedance of CH1 to 50 Ω (press **Utility** → **CH1Set** → **Resi** to select "Load").
 - b) Output a sine waveform with 10 MHz frequency, 0 dBm amplitude and 0 V_{DC} offset.
 - c) Press **Output** to enable CH1.
4. Set the spectrum analyzer:
 - a) Set the reference level to 10 dBm and input attenuation to 20 dB;
 - b) Set the start frequency to 0 Hz and stop frequency to 100 MHz;
 - c) Set the resolution bandwidth to 1 kHz;
 - d) Set the peak excursion to 3 dB;
 - e) Set the sweep mode to single;
 - f) Press **Peak** to find the maximum peak.
5. Measure the maximum spurious signal (except the harmonics) using cursor measurement and record the measurement result **A**. Subtract 0 dBm from **A** and compare the result with the specification.

6. Keep other settings of DG5000 unchanged and set the output frequency of DG5000 to 50 MHz, 100 MHz, 200 MHz and 300 MHz respectively.
7. Keep other settings of the spectrum analyzer unchanged, set the stop frequency of the spectrum analyzer to 150 MHz, 200 MHz, 400 MHz and 600 MHz respectively (correspond to the output frequency of DG5000) and repeat step 5.
8. Test the spurious signal of CH2 according to the steps above and record the test results.

Test Record Form:

Channel: CH1

Output Frequency	Start Frequency	Stop Frequency	A	A-OdBm	Limit	Pass/ Fail
10 MHz	0 Hz	100 MHz			≤ 100 MHz: < -50 dBc > 100 MHz: -50 dBc + 6 dBc/octave ^[1]	
50 MHz	0 Hz	150 MHz				
100 MHz	0 Hz	200 MHz				
200 MHz	0 Hz	400 MHz				
300 MHz	0 Hz	600 MHz				

Channel: CH2

Output Frequency	Start Frequency	Stop Frequency	A	A-OdBm	Limit	Pass/ Fail
10 MHz	0 Hz	100 MHz			≤ 100 MHz: < -50 dBc > 100 MHz: -50 dBc + 6 dBc/octave ^[1]	
50 MHz	0 Hz	150 MHz				
100 MHz	0 Hz	200 MHz				
200 MHz	0 Hz	400 MHz				
300 MHz	0 Hz	600 MHz				

Note^[1]: 6 dBc/octave means that when the frequency doubles, the specification increases by 6 dBc. For example, when the output frequency of the signal generator is 100 MHz, the limit specification is -50 dBc and when the output frequency is 200 MHz, the limit specification is -50 dBc+6 dBc.

Rise/Fall Time Test

Specification:

Signal Characteristics	
Square	
Rise/Fall Time	Typical (1 Vpp) <2.5 ns (DG5352/5351 and DG5252/DG5251) <3 ns (DG5102/DG5101) <4 ns (DG5072/DG5071)

Test Device:

1. Oscilloscope

Test Procedures:

1. Connect CH1 of DG5000 with the signal input terminal of the oscilloscope using dual-BNC cable as shown in the figure below.

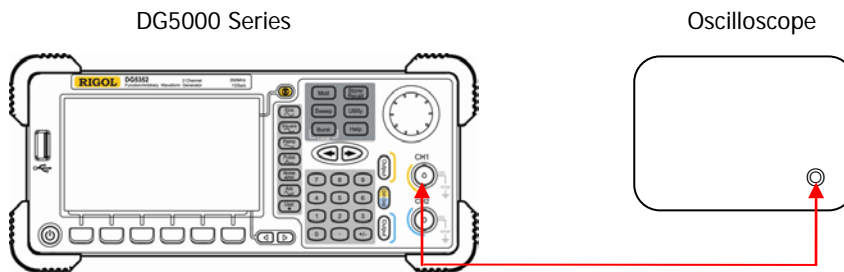


Figure 2-5 Connect DG5000 and the Oscilloscope

2. Press **Utility** → **System** → **Preset** to restore DG5000 to its default setting.
3. Configure DG5000: set the output impedance to 50 Ω and configure it to output a square waveform with 1 MHz frequency, 1 Vpp amplitude and 0 V_{DC} offset. Press **Output** to enable CH1.
4. Set the oscilloscope:
 - a) Set the vertical scale to 200 mV/div;
 - b) Set the horizontal time base to 1 ns;
 - c) Set a proper trigger level;

- d) Set the input impedance to 50 Ω ;
 - e) Enable rise time and fall time measurement functions.
5. Set the edge type to rising edge. Record the measurement result of the rise time and check if it is within the specification range.
 6. Set the edge type to falling edge. Record the measurement result of the fall time and check if it is within the specification range.
 7. Test the rise/fall time of CH2 according to the steps above and record the test results.

Test Record Form:

Channel: CH1

Waveform	Setting	Measurement Value		Specification	Pass/Fail	
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V _{DC}	Rise time		Typical (1 Vpp) <2.5 ns (DG5352/5351 and DG5252/DG5251) <3 ns (DG5102/DG5101) <4 ns (DG5072/DG5071)		
		Fall time				

Channel: CH2

Waveform	Setting	Measurement Value		Specification	Pass/Fail	
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V _{DC}	Rise time		Typical (1 Vpp) <2.5 ns (DG5352/5351 and DG5252/DG5251) <3 ns (DG5102/DG5101) <4 ns (DG5072/DG5071)		
		Fall time				

Overshoot Test

Specification:

Signal Characteristics	
Square	
Overshoot	Typical (1 Vpp) <5%

Test Device:

1. Oscilloscope

Test Procedures:

1. Connect CH1 of DG5000 and the signal input terminal of the oscilloscope using dual-BNC cable as shown in **Figure 2-5**.
2. Press **Utility** → **System** → **Preset** to restore DG5000 to its default setting.
3. Configure DG5000:
 - a) Set the output impedance of CH1 to 50 Ω (press **Utility** → **CH1Set** → **Resi** to select "Load").
 - b) Output a square waveform with 1 MHz frequency, 1 Vpp amplitude and 0 V_{DC} offset.
 - c) Press **Output** to enable CH1.
4. Set the oscilloscope:
 - a) Set the input impedance to 50 Ω;
 - b) Set the vertical scale to 200 mV/div;
 - c) Set the horizontal time base to 100 ns;
 - d) Set a proper trigger level;
 - e) Enable the overshoot measurement function.
5. Record the measurement value of the oscilloscope and check if the value is within the specification range.
6. Test the overshoot of CH2 according to the steps above and record the test result.

Test Record Form:

Channel: CH1

Waveform	Setting	Measurement Value	Specification	Pass/Fail
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V _{DC}		Typical (1 Vpp) <5%	

Channel: CH2

Waveform	Setting	Measurement Values	Specification	Pass/Fail
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V _{DC}		Typical (1 Vpp) <5%	

Appendix Test Record Form

RIGOL DG5000 Series Function/Arbitrary Waveform Generator Performance Verification Test Record Form

Model: _____ Tested by: _____ Test Date: _____

Frequency Accuracy Test

Channel: CH1

Waveform	Setting	Measurement Value	Limit calculated from specification ^[1]	Pass/Fail	
Sine	Frequency: 1 MHz		0.999999 MHz to 1.000001 MHz		
Square					
Ramp	Amplitude: 1 Vpp				
Pulse					

Channel: CH2

Waveform	Setting	Measurement Value	Limit calculated from specification ^[1]	Pass/Fail	
Sine	Frequency: 1 MHz		0.999999 MHz to 1.000001 MHz		
Square					
Ramp	Amplitude: 1 Vpp				
Pulse					

Note^[1]: ± 1 ppm, 18°C to 28°C

AC Amplitude Accuracy Test

Channel: CH1

Setting Amplitude	Setting	Measurement Value	Limit calculated from specification ^[1]	Pass/Fail
20 mVpp	Frequency: 1 kHz Offset: 0 V _{DC} Impedance: 50 Ω		6.6~7.5 mVrms	
100 mVpp			34.7~36.1 mVrms	
500 mVpp			174.7~178.9 mVrms	
1 Vpp			349.7~357.5 mVrms	
5 Vpp			1.75~1.7861 Vrms	
10 Vpp			3.5~3.5717 Vrms	

Channel: CH2

Setting Amplitude	Setting	Measurement Value	Limit calculated from specification ^[1]	Pass/Fail
20 mVpp	Frequency: 1 kHz Offset: 0 V _{DC} Impedance: 50 Ω		6.6~7.5 mVrms	
100 mVpp			34.7~36.1 mVrms	
500 mVpp			174.7~178.9 mVrms	
1 Vpp			349.7~357.5 mVrms	
5 Vpp			1.75~1.7861 Vrms	
10 Vpp			3.5~3.5717 Vrms	

Note^[1]: typical (1 kHz sine, 0 V_{DC} offset, >10 mVpp, auto) ±1% of setting ±1 mVpp

DC Offset Accuracy Test

Channel: CH1

Setting Offset	Setting	Measurement Value	Offset Limit ^[1]	Pass/Fail
-2.5 V _{DC}	Frequency: 1 kHz Amplitude: 5 V _{pp} Impedance: 50 Ω		-2.505 ~ -2.495 V _{DC}	
-1 V _{DC}			-1.02 ~ -0.98 V _{DC}	
-500 mV _{DC}			-0.525 ~ -0.475 V _{DC}	
0 V _{DC}			-0.030 ~ 0.030 V _{DC}	
500 mV _{DC}			0.465 ~ 0.535 V _{DC}	
1 V _{DC}			0.96 ~ 1.04 V _{DC}	
2.5 V _{DC}			2.445 ~ 2.555 V _{DC}	

Channel: CH2

Setting Offset	Setting	Measurement Value	Offset Limit ^[1]	Pass/Fail
-2.5 V _{DC}	Frequency: 1 kHz Amplitude: 5 V _{pp} Impedance: 50 Ω		-2.505 ~ -2.495 V _{DC}	
-1 V _{DC}			-1.02 ~ -0.98 V _{DC}	
-500 mV _{DC}			-0.525 ~ -0.475 V _{DC}	
0 V _{DC}			-0.030 ~ 0.030 V _{DC}	
500 mV _{DC}			0.465 ~ 0.535 V _{DC}	
1 V _{DC}			0.96 ~ 1.04 V _{DC}	
2.5 V _{DC}			2.445 ~ 2.555 V _{DC}	

Note^[1]: the offset limit is calculated by adding/subtracting the permitted error from the setting offset. "Permitted Error" is calculated from the specification " \pm (1% of setting + 5 mV + 0.5% of amplitude)".

AC Flatness Test

Channel: CH1

Setting Frequency	Setting	Measurement Value	Calculation Result ^[1]	Specification	Pass/Fail
8 MHz	Amplitude: 500 mVpp Impedance: 50 Ω			±0.1 dB	
50 MHz				±0.2 dB	
70 MHz				±0.4 dB	
200 MHz ^[2]				±1.0 dB	
300 MHz ^[3]				±1.5 dB	

Channel: CH2

Setting Frequency	Setting	Measurement Value	Calculation Result ^[1]	Specification	Pass/Fail
8 MHz	Amplitude: 500 mVpp Impedance: 50 Ω			±0.1 dB	
50 MHz				±0.2 dB	
70 MHz				±0.4 dB	
200 MHz ^[2]				±1.0 dB	
300 MHz ^[3]				±1.5 dB	

Note^[1]: calculation result=measurement value - P_{ref}.

Note^[2]: only for DG5252/DG5251 and DG5352/DG5351.

Note^[3]: only for DG5352/DG5351.

Harmonic Distortion Test

Channel: CH1

Setting Frequency	Setting	Measurement Value	Calculation Result ^[1]	Specification	Pass/Fail ^[2]
10 MHz	Waveform: Sine Amplitude: 0 dBm Offset: 0 V _{DC}	1 (fundamental wave):		<-45 dBc	--
		2:			
		3:			
50 MHz		1 (fundamental wave):		<-45 dBc	--
		2:			
		3:			
250 MHz ^[3]		1 (fundamental wave):		<-35 dBc	--
		2:			
		3:			
300 MHz ^[4]		1 (fundamental wave):		<-35 dBc	--
		2:			
		3:			

Note^[1]: calculation result=the measurement value of the nth harmonic — the measurement value of the fundamental wave.

Note^[2]: the test fails if the calculation result is greater than the specification.

Note^[3]: only for DG5352/DG5351 and DG5252/DG5251.

Note^[4]: only for DG5352/DG5351.

Harmonic Distortion Test

Channel: CH2

Setting Frequency	Setting	Measurement Value	Calculation Result ^[1]	Specification	Pass/Fail ^[2]
10 MHz	Waveform: Sine Amplitude: 0 dBm Offset: 0 V _{DC}	1 (fundamental wave):		< -45 dBc	--
		2:			
		3:			
50 MHz		1 (fundamental wave):		< -45 dBc	--
		2:			
		3:			
250 MHz ^[3]		1 (fundamental wave):		< -35 dBc	--
		2:			
		3:			
300 MHz ^[4]	1 (fundamental wave):		< -35 dBc	--	
	2:				
	3:				

Note^[1]: calculation result=the measurement value of the nth harmonic – the measurement value of the fundamental wave.

Note^[2]: the test fails if the calculation result is greater than the specification.

Note^[3]: only for DG5352/DG5351 and DG5252/DG5251.

Note^[4]: only for DG5352/DG5351.

Spurious Signal Test

Channel: CH1

Output Frequency	Start Frequency	Stop Frequency	A	A-OdBm	Limit	Pass/ Fail
10 MHz	0 Hz	100 MHz			≤ 100 MHz: < -50 dBc > 100 MHz: -50 dBc + 6 dBc/octave ^[1]	
50 MHz	0 Hz	150 MHz				
100 MHz	0 Hz	200 MHz				
200 MHz	0 Hz	400 MHz				
300 MHz	0 Hz	600 MHz				

Channel: CH2

Output Frequency	Start Frequency	Stop Frequency	A	A-OdBm	Limit	Pass/ Fail
10 MHz	0 Hz	100 MHz			≤ 100 MHz: < -50 dBc > 100 MHz: -50 dBc + 6 dBc/octave ^[1]	
50 MHz	0 Hz	150 MHz				
100 MHz	0 Hz	200 MHz				
200 MHz	0 Hz	400 MHz				
300 MHz	0 Hz	600 MHz				

Note^[1]: 6 dBc/octave means that when the frequency doubles, the specification increases by 6 dBc. For example, when the output frequency of the generator is 100 MHz, the limit specification is -50 dBc and when the output frequency is 200 MHz, the limit specification is -50 dBc+6 dBc.

Rise/Fall Time Test

Channel: CH1

Waveform	Setting	Measurement Value		Specification	Pass/Fail	
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V _{DC}	Rise time		Typical (1 Vpp) <2.5 ns (DG5352/5351 and DG5252/DG5251) <3 ns (DG5102/DG5101) <4 ns (DG5072/DG5071)		
		Fall time				

Channel: CH2

Waveform	Setting	Measurement Value		Specification	Pass/Fail	
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V _{DC}	Rise time		Typical (1 Vpp) <2.5 ns (DG5352/5351 and DG5252/DG5251) <3 ns (DG5102/DG5101) <4 ns (DG5072/DG5071)		
		Fall time				

Overshoot Test:

Channel: CH1

Waveform	Setting	Measurement Value	Specification	Pass/Fail
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V _{DC}		Typical (1 Vpp) <5%	

Channel: CH2

Waveform	Setting	Measurement Value	Specification	Pass/Fail
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V _{DC}		Typical (1 Vpp) <5%	