RIGOL

Performance Verification Guide

DG4000 Series

Function / Arbitrary Waveform Generator

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RIGOL Technologies, Inc.

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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.

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If you have any problem or requirement when using our products or this manual, please contact **RIGOL**.

E-mail: service@rigol.com

Websites: www.rigol.com

General Safety Summary

Please review the following safety precautions carefully before putting the instrument into operation so as to avoid any personal injury or damage 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 for use within the 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 the power cord to the Protective Earth terminal before connecting any inputs or outputs.

Connect the Probe Correctly.

If a probe is used, do not connect the ground lead to high voltage since it has isobaric electric potential as the ground.

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 the instrument.

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 be exposed to the danger of electrical shock.

Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

Do Not Insert Anything Into the Holes of Fan.

Do not insert anything into the holes of the fan to avoid damaging the instrument.

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 **RIGOL** authorized 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 an increase of instrument temperature which would cause damage to the instrument. So please keep the instrument 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 the instrument in a humid environment.

Do Not Operate in an Explosive Atmosphere.

In order to avoid damage 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 the air, please keep the surface of the device clean and dry.

Electrostatic Prevention.

Operate the instrument in an electrostatic discharge protective environment to avoid damage induced by static discharges. Always ground both the internal and external conductors of cables to release static before making connections.

Proper Use of Battery.

If a battery is supplied, it must not be exposed to high temperature or in contact with fire. Keep it out of the reach of children. Improper change of battery (note: lithium

battery) may cause explosion. Use **RIGOL** specified battery only.

Handling Safety.

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

Safety Terms and Symbols

Terms Used in this Manual. These terms may appear in this manual:

WARNING
Warning statements indicate conditions or practices that could result in injury or loss of life.

CAUTION
Caution statements indicate conditions or practices that could result in damage to this product or other property.

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

DANGER	It calls attention to an operation, if not correctly performed, could result in injury or hazard immediately.
WARNING	It calls attention to an operation, if not correctly performed, could result in potential injury or hazard.
CAUTION	It calls attention to an operation, if not correctly performed, could result in damage to the product or other devices connected to the product.

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

Hazardous Voltage

Safety Warning

Protective Earth Terminal

Chassis Ground

Test Ground

Allgemeine Sicherheits Informationen

Überprüfen Sie diefolgenden Sicherheitshinweise sorgfältigumPersonenschädenoderSchäden am Gerätundan damit verbundenen weiteren Gerätenzu vermeiden. Zur Vermeidung vonGefahren, nutzen Sie bitte das Gerät nur so, wiein diesem Handbuchangegeben.

Um Feuer oder Verletzungen zu vermeiden, verwenden Sie ein ordnungsgemäßes Netzkabel.

Verwenden Sie für dieses Gerät nur das für ihr Land zugelassene und genehmigte Netzkabel.

Erden des Gerätes.

Das Gerät ist durch den Schutzleiter im Netzkabel geerdet. Um Gefahren durch elektrischen Schlag zu vermeiden, ist es unerlässlich, die Erdung durchzuführen. Erst dann dürfen weitere Ein- oder Ausgänge verbunden werden.

Anschluss einesTastkopfes.

Die Erdungsklemmen der Sonden sindauf dem gleichen Spannungspegel des Instruments geerdet. SchließenSie die Erdungsklemmen an keine hohe Spannung an.

Beachten Sie alle Anschlüsse.

Zur Vermeidung von Feuer oder Stromschlag, beachten Sie alle Bemerkungen und Markierungen auf dem Instrument. Befolgen Sie die Bedienungsanleitung für weitere Informationen, bevor Sie weitere Anschlüsse an das Instrument legen.

Verwenden Sie einen geeigneten Überspannungsschutz.

Stellen Sie sicher, daß keinerlei Überspannung (wie z.B. durch Gewitter verursacht) das Gerät erreichen kann. Andernfallsbestehtfür den Anwender die GefahreinesStromschlages.

Nicht ohne Abdeckung einschalten.

Betreiben Sie das Gerät nicht mit entfernten Gehäuse-Abdeckungen.

Betreiben Sie das Gerät nicht geöffnet.

Der Betrieb mit offenen oder entfernten Gehäuseteilen ist nicht zulässig. Nichts in entsprechende Öffnungen stecken (Lüfter z.B.)

Passende Sicherung verwenden.

Setzen Sie nur die spezifikationsgemäßen Sicherungen ein.

Vermeiden Sie ungeschützte Verbindungen.

Berühren Sie keine unisolierten Verbindungen oder Baugruppen, während das Gerät in Betrieb ist.

Betreiben Sie das Gerät nicht im Fehlerfall.

Wenn Sie am Gerät einen Defekt vermuten, sorgen Sie dafür, bevor Sie das Gerät wieder betreiben, dass eine Untersuchung durch **RIGOL** autorisiertem Personal durchgeführt wird. Jedwede Wartung, Einstellarbeiten oder Austausch von Teilen am Gerät, sowie am Zubehör dürfen nur von **RIGOL** autorisiertem Personal durchgeführt werden.

Belüftung sicherstellen.

Unzureichende Belüftung kann zu Temperaturanstiegen und somit zu thermischen Schäden am Gerät führen. Stellen Sie deswegen die Belüftung sicher und kontrollieren regelmäßig Lüfter und Belüftungsöffnungen.

Nicht in feuchter Umgebung betreiben.

Zur Vermeidung von Kurzschluß im Geräteinneren und Stromschlag betreiben Sie das Gerät bitte niemals in feuchter Umgebung.

Nicht in explosiver Atmosphäre betreiben.

Zur Vermeidung von Personen- und Sachschäden ist es unumgänglich, das Gerät ausschließlich fernab jedweder explosiven Atmosphäre zu betreiben.

Geräteoberflächen sauber und trocken halten.

Um den Einfluß von Staub und Feuchtigkeit aus der Luft auszuschließen, halten Sie bitte die Geräteoberflächen sauber und trocken.

Schutz gegen elektrostatische Entladung (ESD).

Sorgen Sie für eine elektrostatisch geschützte Umgebung, um somit Schäden und

Funktionsstörungen durch ESD zu vermeiden. Erden Sie vor dem Anschluß immer Innen- und Außenleiter der Verbindungsleitung, um statische Aufladung zu entladen.

Die richtige Verwendung desAkku.

Wenneine Batterieverwendet wird, vermeiden Sie hohe Temperaturen bzw. Feuer ausgesetzt werden. Bewahren Sie es außerhalbder Reichweitevon Kindern auf. UnsachgemäßeÄnderung derBatterie (Anmerkung: Lithium-Batterie) kann zu einer Explosion führen. VerwendenSie nur von **RIGOL** angegebenenAkkus.

Sicherer Transport.

Transportieren Sie das Gerät sorgfältig (Verpackung!), um Schäden an Bedienelementen, Anschlüssen und anderen Teilen zu vermeiden.

Sicherheits Begriffe und Symbole

Begriffe in diesem Guide. Diese Begriffe können in diesem Handbuch auftauchen:

WARNING
Die Kennzeichnung WARNING beschreibt Gefahrenquellen die leibliche Schäden oder den Tod von Personen zur Folge haben können.

CAUTION
Die Kennzeichnung Caution (Vorsicht) beschreibt Gefahrenquellen die Schäden am Gerät hervorrufen können.

Begriffe auf dem Produkt. Diese Bedingungen können auf dem Produkt erscheinen:

DANGER	weist auf eine Verletzung oder Gefährdung hin, die sofort geschehen kann.
WARNING	weist auf eine Verletzung oder Gefährdung hin, die möglicherweise nicht sofort geschehen.
CAUTION	weist auf eine Verletzung oder Gefährdung hin und bedeutet, dass eine mögliche Beschädigung des Instruments oder anderer Gegenstände auftreten kann.

Symbole auf dem Produkt. Diese Symbole können auf dem Produkt erscheinen:

Gefährliche Spannung

Sicherheits-Hinweis

Schutz-erde

Gehäusemasse

Erde

Document Overview

This manual guides users to correctly test the performance of **RIGOL** DG4000 series function/arbitrary waveform generator. For the operation methods of the instrument, please refer to the DG4000 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, DG4162 is taken as an example to illustrate the performance verification method. The introductions in this manual are applicable to all the models of the DG4000 series.

Model	Channels	Max. Frequency	Sample Rate
DG4062	2	60 MHz	500 MSa/s
DG4102	2	100 MHz	500 MSa/s
DG4162	2	160 MHz	500 MSa/s
DG4202	2	200 MHz	500 MSa/s

Contents

Chapter 1 Overview

Test Preparations

Please ensure that your instrument is in the calibration period (the recommended period is 1 year) and warm it up for at least 30 minutes under the specified operation temperature (18℃ to 28℃).

Recommended Test Devices

It is recommended that you use the test devices listed in Table 1-1 or other test devices with the same performance and specifications for performance verification tests.

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** DSA1030A
Oscilloscope	Bandwidth: 500 MHz Rise/fall time measurement function Overshoot measurement function	**RIGOL** DS4054
Cable	BNC (m) – BNC(m)	--
Cable	BNC (m) – dual banana plugs (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 result record form before each test and record the test results in the copy so that the form can be used repeatedly.

Specifications

The specifications of each test item are provided in chapter 2. For other specifications, refer to DG4000 User's Guide or DG4000 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℃ to 28℃).

Chapter 2 Performance Verification Test

Taking DG4162 as an example, this chapter introduces the method of performance verification test for DG4000 series function/arbitrary waveform generator.

Test items include:

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

Note:

1) Please make sure the instrument has been warmed up for at least 30 minutes under the specified operational temperature (18℃ to 28℃) before the test.
2) Any of the following tests must be done under the specified operational temperature (18℃ to 28℃).
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	±2 ppm, 18℃ to 28℃
Note: ppm denotes one part per million. For example, if the setting frequency is 1 MHz and the actual output frequency is between 0.999998 MHz (-2 ppm) and 1.000002 MHz (+2 ppm), the frequency accuracy of the instrument is guaranteed and the test passes.	

Test Procedures:

1. Make sure that the ambient temperature is between 18℃ and 28℃ and DG4000 has been warmed up for 30 minutes. Connect the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG4000 with the signal input terminal of the frequency counter using the dual-BNC cable as shown in the figure below.

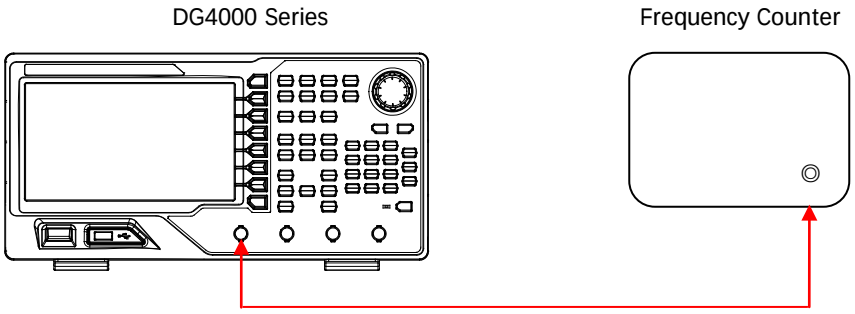

Figure 2-1 Connect DG4000 and the Frequency Counter

2. Press **Preset** at the front panel of DG4000 to restore the instrument to its default setting. Set the input impedance of the frequency counter to 1 MΩ.

3. Configure DG4000 to output a sine waveform with 1 MHz frequency and 1 Vpp amplitude. Press **Output1** to enable the channel output. Record the reading of the frequency counter and check if the reading is between 0.999998 MHz and 1.000002 MHz.

4. Configure DG4000 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 0.999998 MHz and 1.000002 MHz.

5. Repeat steps 1 through 4 to verify the frequency accuracy of CH2.

AC Amplitude Accuracy Test

Specification:

Output Characteristics	
Amplitude (into 50 Ω)	
Accuracy	Typical (1 kHz Sine, 0 V_{DC} Offset, >10 mVpp, Auto) ±1% of setting ±2 mVpp

Test Procedures:

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the 50Ω load to the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG4000; connect the 50Ω load and the voltage input terminals of the digital multimeter using the BNC - dual banana cable as shown in the figure below.

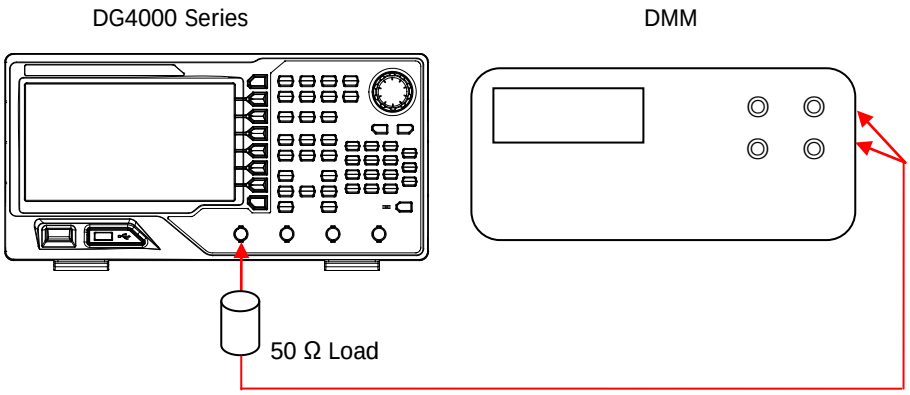

Figure 2-2 Connect DG4000 and the Digital Multimeter via the 50Ω Load

2. Press **Preset** at the front panel of DG4000 to restore the instrument to its default setting. Select AC voltage (ACV) measurement function for digital multimeter (DMM) and set the range to “Auto”.

3. Configure DG4000: the output impedance of the channel tested is 50 Ω (press **Utility** → **CH1Set** → **Resi** and select “Load”); the output is a sine waveform with 1 kHz frequency, 0 V_{DC} offset and 20 mVpp amplitude. Press **Output1** to enable the channel output.

4. Record the reading of the DMM and check if the reading exceeds the range listed in the Limit of Actual Output Amplitude (Vrms) in Table 2-1.

5. Keep other settings of DG4000 unchanged, set the amplitude to 100 mVpp, 500 mVpp, 1 Vpp, 5 Vpp and 10 Vpp respectively, record the readings of the DMM and check if the readings exceed the ranges listed in the Limit of Actual Output Amplitude (Vrms) in Table 2-1.

Table 2-1 Limits of AC Amplitude Accuracy Test

Setting Amplitude (Vpp)	Permitted Error[1] (Vpp)	Limit of Actual Output Amplitude (Vpp)	Limit of Actual Output Amplitude (Vrms) [2]
20 mVpp	±2.2 mVpp	17.8 mVpp~22.2 mVpp	6.3 mVrms~7.9 mVrms
100 mVpp	±3 mVpp	97 mVpp~103 mVpp	34.3 mVrms~36.4 mVrms
500 mVpp	±7 mVpp	493 mVpp~507 mVpp	174.3 mVrms~179.3 mVrms
1 Vpp	±12 mVpp	0.988 Vpp~1.012 Vpp	349.4 mVrms~357.9 mVrms
5 Vpp	±52 mVpp	4.948 Vpp~5.052 Vpp	1.7496 Vrms~1.7864 Vrms
10 Vpp	±102 mVpp	9.898 Vpp~10.102 Vpp	3.5 Vrms~3.5721 Vrms

Note[1]: "Permitted Error" is calculated from the specification "±1% of setting ±2 mVpp".

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

The relation between Vrms and Vpp is $\mathrm{Vpp} = 2\sqrt{2}Vrms$.

6. Repeat steps 1 through 4 to verify the AC amplitude accuracy of CH2.

DC Offset Accuracy Test

Specification:

Output Characteristics	
Offset (into 50 Ω)	
Accuracy	±(1% of setting + 5mV + 0.5% of amplitude)

Test Procedures:

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the 50Ω load to the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG4000; connect the 50Ω load and the voltage input terminals of the digital multimeter using the BNC - dual banana cable as shown in Figure 2-2.

2. Press **Preset** at the front panel of DG4000 to restore the instrument to its default setting. Select DC voltage (DCV) measurement function for digital multimeter (DMM) and set the range to 20 V.

3. Configure DG4000: the output impedance of the channel tested is 50 Ω (press **Utility** → **CH1Set** → **Resi** and select "Load"); the output is a sine waveform with 1 kHz frequency, 0 V_{DC} offset and 5 Vpp amplitude. Press **Output1** to enable the channel output.

4. Record the reading of the DMM and check if the reading exceeds the range listed in the Limit of Actual Offset in Table 2-2.

5. Keep other settings of DG4000 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 DMM and check if the readings exceed the ranges listed in the Limit of Actual Offset in Table 2-2.

Table 2-2 Limits of DC Offset Accuracy Test

Setting Offset	Setting Amplitude	Permitted Error[1]	Limit of Actual Offset
-2.5 V_{DC}	5 Vpp	±0.005 V_{DC}	-2.505 V_{DC}~-2.495 V_{DC}
-1 V_{DC}		±0.02 V_{DC}	-1.02 V_{DC}~-0.98 V_{DC}
-500 mV_{DC}		±0.025 V_{DC}	-0.525 V_{DC}~-0.475 V_{DC}
0 V_{DC}		±0.030 V_{DC}	-0.030 V_{DC}~0.030 V_{DC}
500 mV_{DC}		±0.035 V_{DC}	0.465 V_{DC}~0.535 V_{DC}
1 V_{DC}		±0.04 V_{DC}	0.96 V_{DC}~1.04 V_{DC}
2.5 V_{DC}		±0.055 V_{DC}	2.445 V_{DC}~2.555 V_{DC}

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

6. Repeat steps 1 through 5 to verify the DC offset accuracy of CH2.

AC Flatness Test

Specification:

Output Characteristics	
Flatness (relative to 1kHz Sine wave, 500 mVpp, 50 Ω)	Typical ≤10 MHz: ±0.1 dB ≤60 MHz: ±0.2 dB ≤100 MHz: ±0.4 dB ≤160 MHz: ±0.8 dB

Test Procedures:

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the 50Ω load to the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG4000; connect the 50Ω load and the voltage input terminals of the digital multimeter using the BNC - dual banana cable as shown in Figure 2-2. Press **Preset** at the front panel of DG4000 to restore the instrument to its default setting.

2. Configure DG4000: the output impedance of the channel tested is 50 Ω (press **Utility** → **CH1Set** → **Resi** and select "Load"); the output is a sine waveform with 1 kHz frequency and 500 mVpp amplitude. Press **Output1** to enable the channel output.

3. Select the AC voltage (ACV) measurement function for the multimeter. Enable the dBm operation function and set the reference resistance to 50 Ω. Read the measurement value (you can also use the Vrms value measured by the multimeter to calculate the reference value according to the formula, dBm = 10 x Log10 [(Reading2 / RREF) / 1 mW]). This measurement value is used as the reference power (P_{ref}).

4. Calibrate the power meter:
   a) Connect the power sensor with the input terminal and **[POWER REF]** terminal of the power meter respectively.
   b) Press **Zero/Cal** →**Zero** →**Cal** and wait for the calibration to finish; then, enable **power reference** and observe whether the measurement value of the power meter is 0 dBm, 50 MHz.

c) Disable **power reference**.

5. Disconnect the signal generator and the multimeter. Connect the power sensor with the channel output terminal of DG4000 via the BNC (f)-N (m) connector.

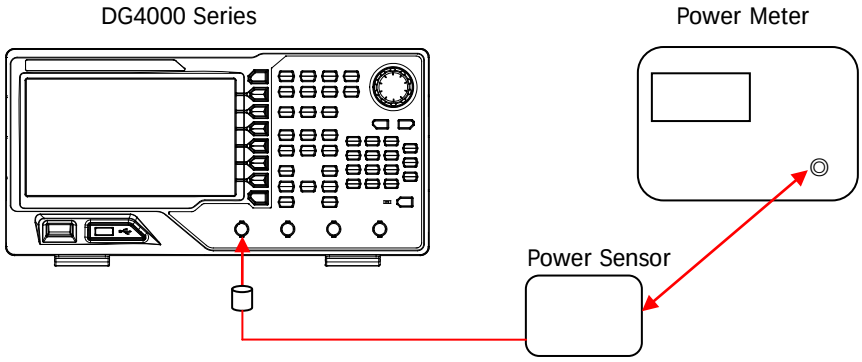

Figure 2-3 Connect DG4000 and the Power Meter

6. Keep other settings of DG4000 unchanged, set the frequency to 10 MHz. Set the frequency factor of the power meter to 10 MHz, record the amplitude measurement value and check if the result of "measurement value - P_{ref}" is in the range from -0.1 dB to +0.1 dB.

7. Keep other settings of DG4000 unchanged, set the frequency to 60 MHz. Set the frequency factor of the power meter to 60 MHz, record the amplitude measurement value and check if the result of "measurement value - P_{ref}" is in the range from -0.2 dB to +0.2 dB.

8. Keep other settings of DG4000 unchanged, set the frequency to 100 MHz (only for DG4102, DG4162 and DG4202). Set the frequency factor of the power meter to 100 MHz, record the amplitude measurement value and check if the result of "measurement value - P_{ref}" is in the range from -0.4 dB to +0.4 dB.

9. Keep other settings of DG4000 unchanged, set the frequency to 160 MHz (only for DG4162 and DG4202). Set the frequency factor of the power meter to 160 MHz, record the amplitude measurement value and check if the result of "measurement value - P_{ref}" is in the range from -0.8 dB to +0.8 dB.

10. Repeat steps 1 through 9 to verify the AC flatness of CH2.

Harmonic Distortion Test

Specification:

Sine Wave Spectrum Purity	
Harmonic Distortion	Typical (0 dBm) DC-1 MHz: <-60 dBc 1 MHz-10 MHz: <-55 dBc 10 MHz-100 MHz: <-50 dBc 100 MHz-160 MHz: <-40 dBc

Test Procedures:

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG4000 with the signal input terminal of the spectrum analyzer using the dual-BNC cable and N-BNC adaptor as shown in the figure below. Press **Preset** at the front panel of DG4000 to restore the instrument to its default setting.

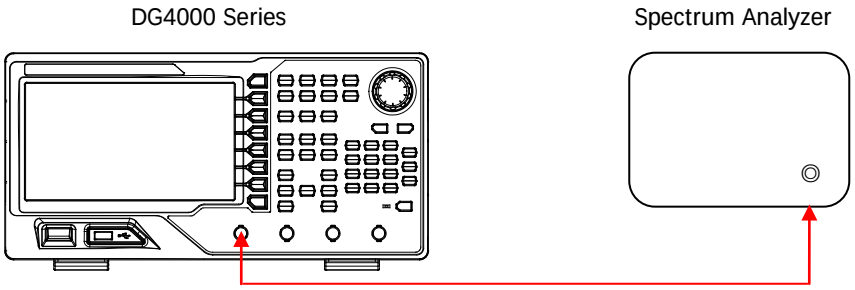

Figure 2-4 Connect DG4000 and Spectrum Analyzer

2. Configure DG4000: the output impedance of the channel tested is 50 Ω (press **Utility** → **CH1Set** → **Resi** and select "Load"); the output is a sine waveform with 1 MHz frequency, 0 dBm amplitude and 0 V_{DC} offset. Press **Output1** to enable the channel output.

3. 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 0 Hz and the stop frequency to 5 MHz;
   c） Set the resolution bandwidth to 1 kHz.

4. Enable the peak table function of the spectrum analyzer and set appropriate peak measurement parameters to make the peak table display the measurement values of the fundamental wave and the second harmonic. Record the measurement values in the peak table and check if the harmonic distortion is less than -60 dBc through calculation[1].

5. Keep other settings of DG4000 unchanged, set the frequency to 10 MHz and set the spectrum analyzer as follows:
   a) Set the input attenuation to 20 dB and the reference level to 10 dBm;
   b) Set the start frequency to 1 MHz and the stop frequency to 50 MHz;
   c) Set the resolution bandwidth to 3 kHz.

6. Record the measurement values in the peak table and check if the harmonic distortion is less than -55 dBc through calculation[1].

7. Keep other settings of DG4000 unchanged, set the frequency to 100 MHz (60 MHz for DG4062 and based on it, to set the start frequency and stop frequency of the spectrum analyzer) and set the spectrum analyzer as follows:
   a) Set the input attenuation to 20 dB and the reference level to 10 dBm;
   b) Set the start frequency to 50 MHz and the stop frequency to 400 MHz;
   c) Set the resolution bandwidth to 3 kHz.

8. Record the measurement values in the peak table and check if the harmonic distortion is less than -50 dBc through calculation[1].

9. Keep other settings of DG4000 unchanged, set the frequency to 160 MHz (only for DG4162 and DG4202) and set the spectrum analyzer as follows:
   a) Set the input attenuation to 20 dB and the reference level to 10 dBm;
   b) Set start frequency to 150 MHz and the stop frequency to 500 MHz;
   c) Set the resolution bandwidth to 3 kHz.

10. Record the measurement values in the peak table and check if the harmonic distortion is less than -40 dBc through calculation[1].

11. Repeat steps 1 through 10 to verify the harmonic distortion of CH2.

Note[1]: The Second Harmonic Distortion = The Measurement Value of the Second Harmonic - The Measurement Value of the Fundamental Wave

The fundamental wave is also considered as 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 does not exceed the specification.

Rise/Fall Time Test

Specification:

Signal Characteristics	
Square	
Rise/Fall Time	Typical (1 Vpp) <8 ns

Test Procedures:

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG4000 with the signal input terminal of oscilloscope using the dual-BNC cable as shown in the figure below. Press **Preset** at the front panel of DG4000 to restore the instrument to its default setting.

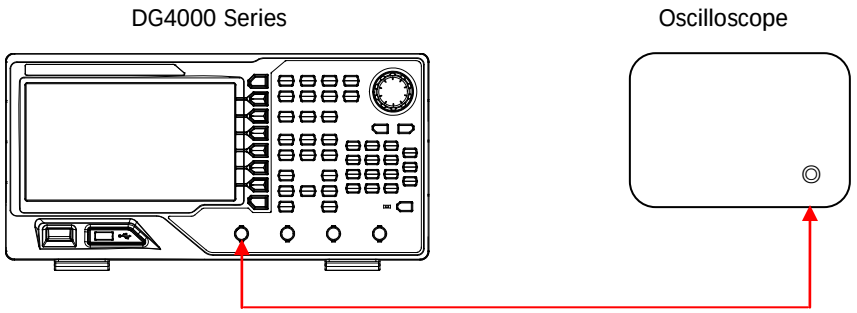

Figure 2-5 Connect DG4000 and Oscilloscope

2. Configure DG4000 to output a square waveform with 1 MHz frequency, 1 Vpp amplitude and 0 V_{DC} offset. Press **Output1** to enable the channel output.

3. 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) Enable rise time and fall time measurement functions.

4. Set the edge type to rising edge. Record the measurement result of the rise time and check if it is within the specification range.

5. Set the edge type to falling edge. Record the measurement result of the fall time and check if it is within the specification range.

6. Repeat steps 1 through 5 to verify the rise/fall time of CH2.

Spurious Signal Test

Specification:

Sine Wave Spectrum Purity	
Spurious signal (non-harmonic)	Typical (0 dBm) ≤10 MHz: <-65 dBc >10 MHz: -65 dBc+6 dBc/octave

Test Procedures:

1. Connect CH1 of DG4000 with the RF input terminal of the spectrum analyzer using the dual-BNC cable and N-BNC connector as shown in Figure 2-4. Press **Preset** at the front panel of DG4000 to restore the instrument to its default setting.

2. Configure DG4000:
   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 **Output1** to enable CH1.

3. Set the spectrum analyzer:
   a) Set the reference level to 10 dBm and the input attenuation to 20 dB;
   b) Set the start frequency to 0 Hz and the 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.

4. 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.

5. Keep other settings of DG4000 unchanged and set the output frequency of DG4000 to 50 MHz, 100 MHz (only for DG4102, DG4162 and DG4202), 150 MHz (only for DG4162 and DG4202) and 200 MHz (only for DG4202) respectively.

6. Keep other settings of the spectrum analyzer unchanged, set the stop frequency of the spectrum analyzer to 150 MHz, 300 MHz, 500 MHz and 600 MHz respectively (correspond to the output frequency of DG4000) and repeat step 5.

7. Test the spurious signal of CH2 according to the steps above and record the test results.

Overshoot Test

Specification:

Signal Characteristics	
Square	
Overshoot	Typical (100 kHz, 1 Vpp) <3%

Test Procedures:

1. Connect CH1 of DG4000 and the signal input terminal of the oscilloscope using dual-BNC cable as shown in Figure 2-5. Press **Preset** at the front panel of DG4000 to restore the instrument to its default setting.

2. Configure DG4000:
   a) Set the output impedance of CH1 to 50 Ω (press **Utility** → **CH1Set**→ **Resi** to select "Load").
   b) Output a square waveform with 100 kHz frequency, 1 Vpp amplitude and 0 V_{DC} offset.
   c) Press **Output1** to enable CH1.

3. 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.

4. Record the measurement value of the oscilloscope and check if the value is within the specification range.

5. Test the overshoot of CH2 according to the steps above and record the test result.

Appendix Test Record Form

RIGOL DG4000 Series Function/Arbitrary Waveform Generator
Performance Verification Test Record Form

Model: _____ Tested by:_____ Test Date:_____

Frequency Accuracy Test

Channel: CH1

Waveform	Settings	Measurement Values	Limits calculated from specification[1]	Pass/Fail	
Sine	Frequency: 1 MHz Amplitude: 1 Vpp		0.999998 MHz to 1.000002 MHz		
Square					
Ramp					
Pulse					

Channel: CH2

Waveform	Settings	Measurement Values	Limits calculated from specification[1]	Pass/Fail	
Sine	Frequency: 1 MHz Amplitude: 1 Vpp		0.999998 MHz to 1.000002 MHz		
Square					
Ramp					
Pulse					

Note[1]: ±2ppm, 18℃ to 28℃

AC Amplitude Accuracy Test

Channel: CH1

Setting Amplitude	Settings	Measurement Values	Limits calculated from specification[1]	Pass/Fail	
20 mVpp	Frequency: 1 kHz Offset: 0 V_{DC} Impedance: 50 Ω		6.3 mVrms~7.9 mVrms		
100 mVpp			34.3 mVrms~36.4 mVrms		
500 mVpp			174.3 mVrms~179.3 mVrms		
1 Vpp			349.4 mVrms~357.9 mVrms		
5 Vpp			1.7496 Vrms~1.7864 Vrms		
10 Vpp			3.5 Vrms~3.5721 Vrms		

Channel: CH2

Setting Amplitude	Settings	Measurement Values	Limits calculated from specification[1]	Pass/Fail	
20 mVpp	Frequency: 1 kHz Offset: 0 V_{DC} Impedance: 50 Ω		6.3 mVrms~7.9 mVrms		
100 mVpp			34.3 mVrms~36.4 mVrms		
500 mVpp			174.3 mVrms~179.3 mVrms		
1 Vpp			349.4 mVrms~357.9 mVrms		
5 Vpp			1.7496 Vrms~1.7864 Vrms		
10 Vpp			3.5 Vrms~3.5721 Vrms		

Note[1]: Typical (1 kHz Sine, 0 V_{DC} Offset, >10 mVpp, Auto) ±1% of setting ±2 mVpp

DC Offset Accuracy Test

Channel: CH1

Setting Offset	Settings	Measurement Values	Limits calculated from specification[1]	Pass/Fail	
-2.5 V_{DC}	Frequency: 1 kHz Amplitude: 5 Vpp Impedance: 50 Ω		-2.505 V_{DC}~-2.495 V_{DC}		
-1 V_{DC}			-1.02 V_{DC}~-0.98 V_{DC}		
-500 mV_{DC}			-0.525 V_{DC}~-0.475 V_{DC}		
0 V_{DC}			-0.030 V_{DC}~0.030 V_{DC}		
500 mV_{DC}			0.465 V_{DC}~0.535 V_{DC}		
1 V_{DC}			0.96 V_{DC}~1.04 V_{DC}		
2.5 V_{DC}			2.445 V_{DC}~2.555 V_{DC}		

Channel: CH2

Setting Offset	Settings	Measurement Values	Limits calculated from specification[1]	Pass/Fail	
-2.5 V_{DC}	Frequency: 1 kHz Amplitude: 5 Vpp Impedance: 50 Ω		-2.505 V_{DC}~-2.495 V_{DC}		
-1 V_{DC}			-1.02 V_{DC}~-0.98 V_{DC}		
-500 mV_{DC}			-0.525 V_{DC}~-0.475 V_{DC}		
0 V_{DC}			-0.030 V_{DC}~0.030 V_{DC}		
500 mV_{DC}			0.465 V_{DC}~0.535 V_{DC}		
1 V_{DC}			0.96 V_{DC}~1.04 V_{DC}		
2.5 V_{DC}			2.445 V_{DC}~2.555 V_{DC}		

Note[1]: ± (1% of setting + 5 mV + 0.5% of amplitude)

AC Flatness Test

Channel: CH1

Setting Frequency	Settings	Measurement Values	specifications	Pass/Fail[1]	
1 kHz	Amplitude:	P_{ref}=	--	--	
10 MHz	500 mVpp		±0.1 dB		
60 MHz	Offset: 0 V_{DC}		±0.2 dB		
100 MHz[2]	Impedance:		±0.4 dB		
160 MHz[3]	50 Ω		±0.8 dB		

Channel: CH2

Setting Frequency	Settings	Measurement Values	specifications	Pass/Fail[1]	
1 kHz	Amplitude:	P_{ref}=	--	--	
10 MHz	500 mVpp		±0.1 dB		
60 MHz	Offset: 0 V_{DC}		±0.2 dB		
100 MHz[2]	Impedance:		±0.4 dB		
160 MHz[3]	50 Ω		±0.8 dB		

Note[1]: Check if the result of "Measurement Value– P_{ref}" exceeds the corresponding specification.

Note[2]: Only for DG4202, DG4162 and DG4102.

Note[3]: Only for DG4202 and DG4162.

Harmonic Distortion Test

Channel: CH1

Setting Frequency	Settings	Measurement Values	specifications	Pass/Fail[1]	
1 MHz	Waveform: Sine Amplitude: 0 dBm Offset: 0 V_{DC}	1(fundamental wave):	<-60 dBc	--	
		2:			
10 MHz		1(fundamental wave):	<-55 dBc	--	
		2:			
100 MHz[2]		1(fundamental wave):	<-50 dBc	--	
		2:			
160 MHz[3]		1(fundamental wave):	<-40 dBc	--	
		2:			

Channel: CH2

Setting Frequency	Settings	Measurement Values	specifications	Pass/Fail[1]	
1 MHz	Waveform: Sine Amplitude: 0 dBm Offset: 0 V_{DC}	1(fundamental wave):	<-60 dBc	--	
		2:			
10 MHz		1(fundamental wave):	<-55 dBc	--	
		2:			
100 MHz[2]		1(fundamental wave):	<-50 dBc	--	
		2:			
160 MHz[3]		1(fundamental wave):	<-40 dBc	--	
		2:			

Note[1]: Check if the result of "the measurement value of the second harmonic – the measurement value of the fundamental wave" exceeds the corresponding specification.

Note[2]: Only for DG4202, DG4162 and DG4102.

Note[3]: Only for DG4202 and DG4162.

Rise/Fall Time Test

Channel: CH1

Waveform	Settings	Measurement Values		Specifications	Pass/Fail	
		Rise Time	Fall Time			
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V_{DC}			Typical (1Vpp) <8 ns		

Channel: CH2

Waveform	Settings	Measurement Values		Specifications	Pass/Fail	
		Rise Time	Fall Time			
Square	Frequency: 1 MHz Amplitude: 1 Vpp Offset: 0 V_{DC}			Typical (1Vpp) <8 ns		

Spurious Signal Test

Channel: CH1

Output Frequency	Start Frequency	Stop Frequency	A	A-0dBm	Limit	Pass/Fail	
10 MHz	0 Hz	100 MHz			≤10 MHz: <-65 dBc >10 MHz: -65 dBc+6 dBc/octave[1]		
50 MHz	0 Hz	150 MHZ					
100 MHz[2]	0 Hz	300 MHz					
150 MHz[3]	0 Hz	500 MHz					
200 MHz[4]	0 Hz	600 MHz					

Channel: CH2

Output Frequency	Start Frequency	Stop Frequency	A	A-0dBm	Limit	Pass/Fail	
10 MHz	0 Hz	100 MHz			≤10 MHz: <-65 dBc >10 MHz: -65 dBc+6 dBc/octave[1]		
50 MHz	0 Hz	150 MHZ					
100 MHz[2]	0 Hz	300 MHz					
150 MHz[3]	0 Hz	500 MHz					
200 MHz[4]	0 Hz	600 MHz					

Note[1]: 6dBc/octave means that when the frequency doubles, the specification increases by 6 dBc.

Note[2]: Only for DG4202, DG4162 and DG4102.

Note[3]: Only for DG4202 and DG4162.

Note[4]: Only for DG4202.

Overshoot Test:

Channel: CH1

Waveform	Setting	Measurement Value	Specification	Pass/Fail
Square	Frequency: 100 kHz Amplitude: 1 Vpp Offset: 0 V_{DC}		Typical (100 kHz, 1 Vpp) <3%	

Channel: CH2

Waveform	Setting	Measurement Value	Specification	Pass/Fail
Square	Frequency: 100 kHz Amplitude: 1 Vpp Offset: 0 V_{DC}		Typical (100 kHz, 1 Vpp) <3%	