

RIGOL

Performance Verification Guide

DG2000 Series Function/Arbitrary Waveform Generator

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RIGOL (SUZHOU) TECHNOLOGIES INC.

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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 follow the instructions specified in this manual to use the instrument properly.

Use the BNC Output Connector Properly.

The BNC output connector on the front panel only allows to output the signal but not to input the signal.

Use Proper Power Cord.

Only the exclusive 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, connect the earth terminal of the power cord to the Protective Earth terminal before connecting any input or output terminals.

Connect the Probe Correctly.

If a probe is used, the probe ground lead must be connected to earth ground. Do not connect the ground lead to high voltage. Improper way of connection could result in dangerous voltages being present on the connectors, controls or other surfaces of the oscilloscope and probes, which will cause potential hazards for operators.

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.

Ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the operator might be exposed to the danger of an electric shock.

Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

Do Not Insert Objects Into the Air Outlet.

Do not insert objects into the air outlet, as doing so may cause damage to 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 on.

Do Not Operate With Suspected Failures.

If you suspect that any damage may occur 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.

Provide Adequate Ventilation.

Inadequate ventilation may cause an increase of temperature in the instrument, which would cause damage to the instrument. So please keep the instrument well ventilated and inspect the air outlet and the fan regularly.

Do Not Operate in Wet Conditions.

To avoid short circuit inside the instrument or electric shock, never operate the instrument in a humid environment.

Do Not Operate in an Explosive Atmosphere.

To avoid personal injuries or damage to the instrument, never operate the instrument in an explosive atmosphere.

Keep Product Surfaces Clean and Dry.

To avoid dust or moisture from affecting the performance of the instrument, keep the surfaces of the instrument clean and dry.

Prevent Electrostatic Impact.

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.

Use the Battery Properly.

Do not expose the battery (if available) to high temperature or fire. Keep it out of the reach of children. Improper change of a battery (lithium battery) may cause an explosion. Use the **RIGOL** specified battery only.

Handle with Caution.

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

Document Overview

This manual is used to guide users to correctly test the performance specifications of DG2000 series function/arbitrary waveform generator. The performance verification test mainly verifies whether DG2000 series can work normally and is within specifications.

Main topics in this Manual:

Chapter 1 Test Overview

This chapter introduces the preparations before the performance verification test, the recommended test devices, the test result record, the test notices and the related information of the technical parameters.

Chapter 2 Performance Verification Test

This chapter introduces the test method, procedures and limits of each performance specification in details.

Appendix

The appendix provides the test results record forms and performance specifications of DG2000 series function/arbitrary waveform generator.

Format Conventions in this Manual:

1. Keys:

The keys on the front panel are usually denoted by the format of "Key Name (Bold) + Text Box". For example, **Pulse/Utility** denotes the Utility key.

2. Menu Labels:

The menu labels are usually denoted by the format of "Menu Word (Bold) + Character Shading". For example, **System Setting**.

3. Connectors:

The connectors on the front or rear panel are usually denoted by the format of "Connector Name (Bold) + Square Brackets (Bold)". For example, **[Counter]**.

4. Operation Procedures:

"→" represents the next step of operation. For example, when the backlight of the **Shift** key is illuminated, pressing **Pulse/Utility** → **System Setting** denotes that first press **Pulse/Utility** on the front panel, and then tap the **System Setting** menu label.

Content Conventions in this Manual:

DG2000 series function/arbitrary waveform generator includes the following models. Unless otherwise noted in this manual, DG2102 is taken as an example to illustrate the performance verification test methods of DG2000 series.

| Model | No. of Channels | Max. Output Frequency |
|--------------|------------------------|------------------------------|
| DG2052 | 2 | 50 MHz |
| DG2072 | 2 | 70 MHz |
| DG2102 | 2 | 100 MHz |

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Chapter 1 Test Overview

Test Preparations

Before performing the test, make sure that the instrument is within the calibration period (the recommended calibration period is 1 year) and has been warmed 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 the table below or other test devices whose performance specifications satisfy the "Performance Requirement" listed in the table below to test the performance specifications of the DG2000 series.

Table 1-1 Recommended test devices

| Device | Performance Requirement | Recommended Instrument |
|-------------------------------|--|----------------------------|
| Frequency Counter | >10MHz Accuracy: 0.1ppm | Keysight 53131A |
| Digital Multimeter | 6 ¹ / ₂ digits | RIGOL DM3068 |
| Power Meter | -30dBm to +20dBm Accuracy: ±0.02dB Resolution: 0.01dB | Keysight N1913A |
| Power Sensor | -30dBm to +20dBm | Keysight N8482A |
| Spectrum Analyzer | Minimum resolution bandwidth is 100Hz | RIGOL DSA815 |
| Oscilloscope | Bandwidth: 500MHz Rise/Fall time measurement function Overshoot measurement function | RIGOL DS4052/DS4054 |
| Power Sensor Connecting Cable | Used to connect the power meter and power sensor | -- |
| Connecting Cable | BNC (m)-BNC (m) | -- |
| Connecting Cable | BNC (m)-Dual banana plug (m) | -- |
| 50Ω Load | 50Ω/1W | -- |
| Adaptor | N (f)-BNC (m) | -- |
| Adaptor | BNC (f)-N (m) | -- |

Test Result Record

Record and keep the test results of each test item. The test result record forms, which provide all the test items and the corresponding performance specification limits as well as spaces for users to record the test results, are provided in "**Appendix A: Test Result Record Form**" of this manual.

Tip:

It is recommended that you photocopy the test result record form before each test. During the test process, record the test results on the copies so that the forms can be used repeatedly.

Test Notices

To achieve optimum test effect, all the test procedures should follow the following recommendations.

- 1) Make sure that the environment temperature is between 18°C and 28°C and every test is performed under the specified operation temperature (18°C to 28°C).
- 2) Before performing each test, make sure that the instrument has been warmed up for at least 30 minutes.
- 3) Before performing each test, restore the instrument to factory setting.

Technical Parameters

Chapter 2 of this manual provides the corresponding specification of each test item. Besides, "**Appendix B: Performance Specifications**" provides the detailed performance specifications of DG2000 series.

Chapter 2 Performance Verification Test

This chapter introduces the performance verification test methods of DG2000 series function/arbitrary waveform generator by taking CH1 of DG2102 as an example. The test methods are also applicable to CH2.

The 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

Frequency Accuracy Test

Specification

| Frequency characteristic | |
|--------------------------|---|
| Accuracy | $\pm(1 \text{ ppm}^{[1]})$ of the setting value + 10 pHz), 18°C to 28°C |

Note^[1]: ppm denotes one part per million. For example, if the setting frequency is 1MHz and the actual output frequency is between 0.999 998 999 999 999 99MHz and 1.000 001 000 000 000 01MHz, the instrument is up to the specification requirement and the test passes.

Test Procedures

1. Make sure that the environment temperature is between 18°C and 28°C and DG2000 has been warmed up for at least 30 minutes. Connect the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG2000 with the signal input terminal of the frequency counter using a dual-BNC cable as shown in Figure 2-1.

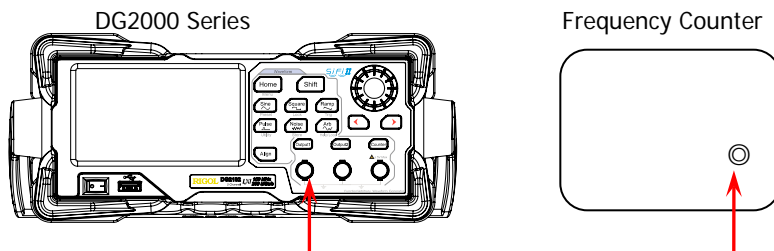



Figure 2-1 Connect DG2000 and the Frequency Counter

2. Turn on the frequency counter and set its output impedance to 1MΩ.
3. Turn on DG2000. When the **Shift** key is illuminated, press **Sine/Preset** and tap the **Def** icon, then a dialog box is displayed, tap **"Apply"** to restore DG2000 to the factory setting.
4. Set DG2000:
 - a) Set the output waveform of CH1 to a sine waveform with 1MHz frequency and 1Vpp amplitude.
 - b) Press **Output1** or tap the channel output configuration status bar  to turn on the output of CH1 in the channel setting interface.
5. Record the reading of the frequency counter and judge whether the reading is between 0.999 998 999 999 999 99MHz and 1.000 001 000 000 000 01MHz.
6. Set CH1 of DG2000 to output square, ramp and pulse waveforms (the frequencies are 1MHz and the amplitudes are 1Vpp) respectively. Record the

readings of the frequency counter respectively and judge whether the readings are between 0.999 998 999 999 99MHz and 1.000 001 000 000 001MHz.

7. Repeat steps 1 to 6 to test the frequency accuracy of CH2 and record the test results.

Test Record Form

| Waveform | Setting Value | Measurement Value | Specification | Pass/Fail | |
|----------|--|-------------------|--|-----------|--|
| Sine | Frequency: 1MHz Amplitude: 1Vpp | | 0.999 998 999 999 999 99MHz to 1.000 001 000 000 000 01MHz | | |
| Square | | | | | |
| Ramp | | | | | |
| Pulse | | | | | |

AC Amplitude Accuracy Test

Specification

| Output Characteristic | |
|-----------------------|--|
| Amplitude (into 50Ω) | |
| Accuracy | Typical (1kHz Sine, 0V Offset, >10mVpp, Auto) ±(1% of setting value) ±5mV |

Test Procedures

1. Make sure that the environment temperature is between 18°C and 28°C and DG2000 has been warmed up for at least 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 DG2000; connect the 50Ω load and the voltage input terminals of the digital multimeter using a BNC-Dual banana plug connecting cable as shown in Figure 2-2.

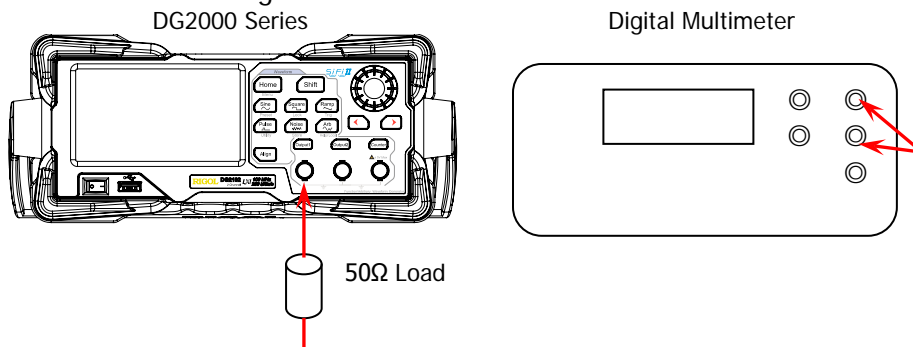




Figure 2-2 Connect DG2000 and the Digital Multimeter via a 50Ω Load

2. Turn on the multimeter, select the ACV measurement function and set the range to "Auto".
3. Turn on DG2000. When the **Shift** key is illuminated, press **Sine/Preset** and tap the **Def** icon, then a dialog box is displayed, tap **"Apply"** to restore DG2000 to the factory setting.
4. Set DG2000:
 - a) Set the output impedance of CH1 to 50Ω. (Tap the channel output configuration status bar  under the user interface to enter the channel setting interface. Tap the **OutputSet** → **HighZ** to select "Off". Tap the **Impedance** menu label, and set the impedance to 50Ω.)
 - b) Set the output waveform of CH1 to a sine waveform with 1kHz frequency, 20mVpp amplitude and 0V_{dc} offset.

- c) Press **Output1** or tap the channel output configuration status bar  to turn on the output of CH1 in the channel setting interface.

5. Record the reading of the multimeter and judge whether it is within the specification ("Amplitude Output Value (Vrms)" in Table 2-1) range.
6. Keep the output impedance of CH1 of DG2000 at 50Ω and the output waveform of CH1 as a sine waveform with 1kHz frequency and 0V_{dc} offset. Set the output amplitude of CH1 to 100mVpp, 500mVpp, 1Vpp, 5Vpp and 10Vpp respectively. Record the readings of the multimeter respectively and judge whether the readings are within the specification ("Amplitude Output Value (Vrms)" in Table 2-1) range.

Table 2-1 Amplitude output values (Vrms) of AC amplitude accuracy test

| Amplitude Setting Value (Vpp) | Allowed Error (Vpp) ^[1] | Amplitude Output Value (Vpp) | Amplitude Output Value (Vrms) ^[2] |
|-------------------------------|------------------------------------|------------------------------|--|
| 20mVpp | ±5.2mVpp | 14.8mVpp to 25.2mVpp | 5.2mVrms to 8.9mVrms |
| 100mVpp | ±6mVpp | 94mVpp to 106mVpp | 33.2mVrms to 37.5mVrms |
| 500mVpp | ±10mVpp | 490mVpp to 510mVpp | 173.3mVrms to 180.3mVrms |
| 1Vpp | ±15mVpp | 0.985Vpp to 1.015Vpp | 348.3mVrms to 358.9mVrms |
| 5Vpp | ±55mVpp | 4.945Vpp to 5.055Vpp | 1.75Vrms to 1.7875Vrms |
| 10Vpp | ±105mVpp | 9.895Vpp to 10.105Vpp | 3.5Vrms to 3.5732Vrms |

Note^[1]: "Allowed Error" is calculated from the specification "±(1% of setting value) ±5mVpp".

Note^[2]: "Amplitude Output Value (Vrms)" is calculated from "Amplitude Output Value (Vpp)".

The conversion relation between Vrms and Vpp is $V_{pp} = 2\sqrt{2}V_{rms}$.

7. Repeat Step 1-6 to test the AC amplitude accuracy of CH2 and record the test results.

Test Record Form

| Amplitude Setting Value | Setting | Measurement Value | Specification | Pass/Fail |
|-------------------------|---|-------------------|--------------------------|-----------|
| 20mVpp | Frequency: 1kHz Offset: 0V _{dc} Impedance: 50Ω | | 5.2mVrms to 8.9mVrms | |
| 100mVpp | | | 33.2mVrms to 37.5mVrms | |
| 500mVpp | | | 173.3mVrms to 180.3mVrms | |
| 1Vpp | | | 348.3mVrms to 358.9mVrms | |
| 5Vpp | | | 1.75Vrms to 1.7875Vrms | |
| 10Vpp | | | 3.5Vrms to 3.5732Vrms | |

DC Offset Accuracy Test

Specification

| Output Characteristic | |
|-----------------------|---|
| Offset (into 50Ω) | |
| Accuracy | $\pm(1\% \text{ of setting value} + 5\text{mV} + 1\% \text{ of amplitude})$ |

Test Procedures



- Make sure that the environment temperature is between 18°C and 28°C and DG2000 has been warmed up for at least 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 DG2000; connect the 50Ω load and the voltage input terminals of the digital multimeter using a BNC-Dual banana plug connecting cable as shown in Figure 2-2.
- Turn on the multimeter, select the DCV measurement function and set the range to "20V".
- Turn on DG2000. When the **Shift** key is illuminated, press **Sine/Preset** and tap the **Def** icon, then a dialog box is displayed, tap **"Apply"** to restore DG2000 to the factory setting.
- Set DG2000:
 - Set the output impedance of CH1 to 50Ω. (Tap the channel output configuration status bar  under the user interface to enter the channel setting interface. Tap the **OutputSet** → **HighZ** to select "Off". Tap the **Impedance** menu label, and set the impedance to 50Ω.)
 - Set the output waveform of CH1 to a sine waveform with 1kHz frequency, 5Vpp amplitude and 0V_{dc} offset.
 - Press **Output1** or tap the channel output configuration status bar  to turn on the output of CH1 in the channel setting interface.
- Record the reading of the multimeter and judge whether it is within the specification ("Offset" in Table 2-2) range.
- Keep the output impedance of CH1 of DG2000 at 50Ω and the output waveform of CH1 as a sine waveform with 1kHz frequency and 5Vpp amplitude. Set the offset of the output waveform of CH1 to -2.5V_{dc}, -1V_{dc}, -500mV_{dc}, 500mV_{dc}, 1V_{dc} and 2.5V_{dc} respectively. Record the readings of the multimeter respectively and judge whether the readings are within the specification ("Offset" in Table 2-2) range.

Table 2-2 Offset limits of DC offset accuracy test

| Offset Setting Value | Amplitude Setting Value | Allowed Error ^[1] | Offset ^[2] |
|----------------------|-------------------------|------------------------------|--|
| -2.5V _{dc} | 5Vpp | ±0.080V _{dc} | -2.580V _{dc} to -2.420V _{dc} |
| -1V _{dc} | | ±0.065V _{dc} | -1.065V _{dc} to -0.935V _{dc} |
| -500mV _{dc} | | ±0.060V _{dc} | -0.560V _{dc} to -0.440V _{dc} |
| 0V _{dc} | | ±0.055V _{dc} | -0.055V _{dc} to 0.055V _{dc} |
| 500mV _{dc} | | ±0.060V _{dc} | 0.440V _{dc} to 0.560V _{dc} |
| 1V _{dc} | | ±0.065V _{dc} | 0.935V _{dc} to 1.065V _{dc} |
| 2.5V _{dc} | | ±0.080V _{dc} | 2.420V _{dc} to 2.580V _{dc} |

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

Note^[2]: Offset = offset setting value \pm allowed error.

7. Repeat Step1-6 to test the DC offset accuracy of CH2 and record the test results.

Test Record Form



| Offset Setting Value | Setting | Measurement Value | Specification | Pass/Fail | |
|----------------------|---|-------------------|--|-----------|--|
| -2.5V _{dc} | Frequency: 1kHz Amplitude: 5Vpp Impedance: 50Ω | | -2.580V _{dc} to -2.420V _{dc} | | |
| -1V _{dc} | | | -1.065V _{dc} to -0.935V _{dc} | | |
| -500mV _{dc} | | | -0.560V _{dc} to -0.440V _{dc} | | |
| 0V _{dc} | | | -0.055V _{dc} to 0.055V _{dc} | | |
| 500mV _{dc} | | | 0.440V _{dc} to 0.560V _{dc} | | |
| 1V _{dc} | | | 0.935V _{dc} to 1.065V _{dc} | | |
| 2.5V _{dc} | | | 2.420V _{dc} to 2.580V _{dc} | | |

AC Flatness Test

Specification

| Output Characteristic | |
|-----------------------|---|
| Flatness | Typical (Sine, 1 Vpp) ≤5 MHz: ±0.1 dB ≤15 MHz: ±0.2 dB ≤25 MHz: ±0.3 dB ≤40MHz: ±0.5 dB >40 MHz: ±1 dB |

Test Procedures

- Make sure that the environment temperature is between 18°C and 28°C and DG2000 has been warmed up for at least 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 DG2000; connect the 50Ω load and the voltage input terminals of the digital multimeter using a BNC-Dual banana plug connecting cable as shown in Figure 2-2.
- Turn on DG2000. When the **Shift** key is illuminated, press **Sine/Preset** and tap the **Def** icon, then a dialog box is displayed, tap **"Apply"** to restore DG2000 to the factory setting.
- Set DG2000:
 - Set the output impedance of CH1 to 50Ω. (Tap the channel output configuration status bar  under the user interface to enter the channel setting interface. Tap the **OutputSet** → **HighZ** to select "Off". Tap the **Impedance** menu label, and set the impedance to 50Ω.)
 - Set the output waveform of CH1 to a sine waveform with 1kHz frequency and 1Vpp amplitude.
 - Press **Output1** or tap the channel output configuration status bar  to turn on the output of CH1 in the channel setting interface.
- Turn on the multimeter and select the ACV measurement function. Turn on the dBm operation function and set the reference resistance to 50Ω. Read the measurement value and take it as the reference power (P_{ref}).

Tip:

In this step, if the dBm operation function is not turned on, you can also calculate the reference power using the formula

$$dBm = 10 \times \text{Log}_{10}[(V_{\text{reading}}^2 / R_{\text{ref}}) / 1mW]$$

according to the measurement value of

the multimeter.

Wherein, V_{reading} is the measurement value of the multimeter.

5. Calibrate the power meter:
 - a) Connect the power sensor to the input terminal and **[POWER REF]** terminal of the power meter respectively.
 - b) Press **Zero/Cal** → **Zero** → **Cal**. Turn on **power reference** after the calibration finishes and observe whether the measurement value of the power meter is a 0dBm, 50MHz signal.
 - c) Turn off **power reference**.
6. Disconnect DG2000 and the multimeter. Connect the power sensor and the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG2000 using a BNC (f)-N (m) adaptor, as shown in Figure 2-3.

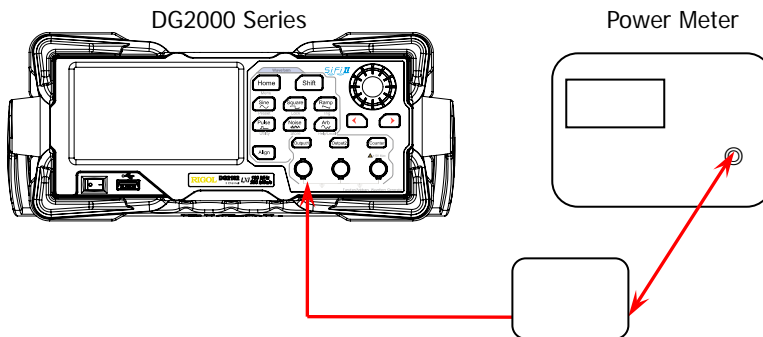


Figure 2-3 Connect DG2000 and the Power Meter

7. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 5MHz frequency and 1Vpp amplitude. Set the frequency factor of the power meter to 5MHz, record the measurement value of the power meter and judge whether "measurement value- P_{ref} " is between -0.1dB and +0.1dB.
8. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 10MHz frequency and 1Vpp amplitude. Set the frequency factor of the power meter to 10MHz, record the measurement value of the power meter and judge whether "measurement value- P_{ref} " is between -0.2dB and +0.2dB.
9. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 15MHz frequency and 1Vpp amplitude. Set the frequency factor of the power meter to 15MHz, record the measurement value of the power meter and judge whether "measurement value- P_{ref} " is between -0.2dB and +0.2dB.

10. Keep the output impedance of CH1 of DG2000 at 50Ω . Set the output waveform of CH1 as a sine waveform with 20MHz frequency and 1Vpp amplitude. Set the frequency factor of the power meter to 20MHz, record the measurement value of the power meter and judge whether "measurement value- P_{ref} " is between -0.3dB and +0.3dB.
11. Keep the output impedance of CH1 of DG2000 at 50Ω . Set the output waveform of CH1 as a sine waveform with 25MHz frequency and 1Vpp amplitude. Set the frequency factor of the power meter to 25MHz, record the measurement value of the power meter and judge whether "measurement value- P_{ref} " is between -0.3dB and +0.3dB.
12. Keep the output impedance of CH1 of DG2000 at 50Ω . Set the output waveform of CH1 as a sine waveform with 30MHz frequency and 1Vpp amplitude. Set the frequency factor of the power meter to 30MHz, record the measurement value of the power meter and judge whether "measurement value- P_{ref} " is between -0.5dB and +0.5dB.
13. Keep the output impedance of CH1 of DG2000 at 50Ω . Set the output waveform of CH1 as a sine waveform with 40MHz frequency and 1Vpp amplitude. Set the frequency factor of the power meter to 40MHz, record the measurement value of the power meter and judge whether "measurement value- P_{ref} " is between -0.5dB and +0.5dB.
14. Keep the output impedance of CH1 of DG2000 at 50Ω . Set the output waveform of CH1 as a sine waveform with 50MHz frequency and 1Vpp amplitude. Set the frequency factor of the power meter to 50MHz, record the measurement value of the power meter and judge whether "measurement value- P_{ref} " is between -1dB and +1dB.
15. Repeat Step 1-14 to test the AC flatness of CH2 and record the test results.

Test Record Form

| Frequency Setting Value | Setting | Measurement Value | Calculation Result ^[1] | Specification | Pass/Fail | |
|-------------------------|---|-------------------|-----------------------------------|---------------|-----------|--|
| 5MHz | Amplitude: 1Vpp Impedance: 50Ω | | | ±0.1dB | | |
| 10MHz | | | | ±0.2dB | | |
| 15MHz | | | | ±0.2dB | | |
| 20MHz | | | | ±0.3dB | | |
| 25MHz | | | | ±0.3dB | | |
| 30MHz | | | | ±0.5dB | | |
| 40MHz | | | | ±0.5dB | | |
| 50MHz | | | | ±1dB | | |

Note^[1]: Calculation result = Measurement value - P_{ref}.

Harmonic Distortion Test

Specification

| Sine Wave Spectrum Purity | |
|---------------------------|---------------------------------------|
| Harmonic Distortion | Typical ^[1] |
| | DC to 10 MHz (included): <-55 dBc |
| | 10 MHz to 20 MHz (included): <-50 dBc |
| | 20 MHz to 40 MHz (included): <-40 dBc |
| | >40 MHz: <-35 dBc |

Note^[1]: 0 dBm output, DC offset 0, impedance 50 Ω.

Test Procedures

1. Make sure that the environment temperature is between 18°C and 28°C and DG2000 has been warmed up for at least 30 minutes. Connect the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG2000 with the signal input terminal of the spectrum analyzer using a dual-BNC connecting cable and N-BNC adaptor as shown in Figure 2-4.

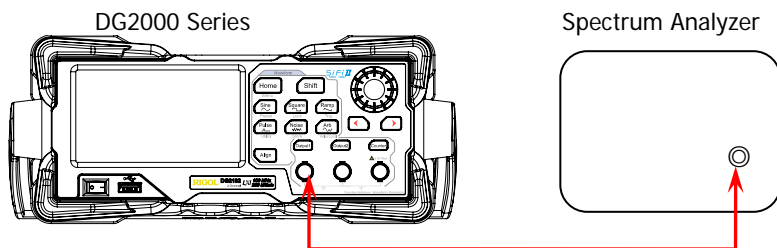

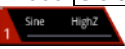


Figure 2-4 Connect DG2000 and the Spectrum Analyzer

2. Turn on DG2000. When the **Shift** key is illuminated, press **Sine/Preset** and tap the **Def** icon, then a dialog box is displayed, tap "**Apply**" to restore DG2000 to the factory setting.
3. Set DG2000:
 - a) Set the output impedance of CH1 to 50Ω. (Tap the channel output configuration status bar  under the user interface to enter the channel setting interface. Tap the **OutputSet** → **HighZ** to select "Off". Tap the **Impedance** menu label, and set the impedance to 50Ω.)
 - b) Set the output waveform of CH1 to a sine waveform with 10MHz frequency, 0dBm amplitude and 0V_{dc} offset.
 - c) Press **Output1** or tap the channel output configuration status bar  to turn on the output of CH1 in the channel setting interface.

4. Turn on and set the spectrum analyzer:
 - a) Set the reference level to 10dBm and input attenuation to 20dB.
 - b) Set the start frequency to 5MHz and stop frequency to 30MHz.
 - c) Set the resolution bandwidth to 3kHz.
5. Use the marker function to make measurements and record the measurement values of the base waveform and 2nd order harmonic. Calculate^[2] the harmonic distortion and judge whether it is less than -55dBc.
6. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 20MHz frequency, 0dBm amplitude and 0V_{dc} offset.
7. Keep the reference level, input attenuation and resolution bandwidth of the spectrum analyzer as 10dBm, 20dB and 3kHz respectively. Set its start frequency to 10MHz and stop frequency to 60MHz.
8. Use the marker function to make measurements and record the measurement values of the base waveform and 2nd order harmonic. Calculate^[2] the harmonic distortion and judge whether it is less than -50dBc.
9. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 40MHz frequency, 0dBm amplitude and 0V_{dc} offset.
10. Keep the input attenuation, reference level and resolution bandwidth of the spectrum analyzer as 20dB, 10dBm and 3kHz respectively. Set its start frequency to 30MHz and stop frequency to 130MHz.
11. Use the marker function to make measurements and record the measurement values of the base waveform and 2nd order harmonic. Calculate^[2] the harmonic distortion and judge whether it is less than -40dBc.
12. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 60MHz frequency, 0dBm amplitude and 0V_{dc} offset.
13. Keep the input attenuation, reference level and resolution bandwidth of the spectrum analyzer as 20dB, 10dBm and 3kHz respectively. Set its start frequency to 50MHz and stop frequency to 150MHz.
14. Use the marker function to make measurements and record the measurement values of the base waveform and 2nd order harmonic. Calculate^[2] the harmonic distortion and judge whether it is less than -35dBc.
15. Repeat Step 1-14 to test the harmonic distortion of CH2 and record the test

results.

Note^[2]: 2nd order harmonic distortion = 2nd order harmonic measurement value – base waveform measurement value

For example, when the output waveform frequency of the channel is 10MHz, if the base waveform measurement value is 0.8dBm and the 2nd order harmonic measurement value is -56.2dBm, the 2nd order harmonic distortion = (-56.2) -0.8=-57dBc<-55dBc and the test result fulfills the specification requirement.

Test Record Form

| Frequency Setting Value | Setting | Measurement Value | Calculation Result ^[3] | Specification | Pass/Fail | |
|-------------------------|---|---------------------------------|-----------------------------------|---------------|-----------|--|
| 10MHz | Waveform: Sine Amplitude: 0dBm Offset: 0V _{dc} | Base waveform: | | < -55dBc | | |
| | | 2 nd order harmonic: | | | | |
| 20MHz | | Base waveform: | | < -50dBc | | |
| | | 2 nd order harmonic: | | | | |
| 40MHz | | Base waveform: | | < -40dBc | | |
| | | 2 nd order harmonic: | | | | |
| 60MHz | | Base waveform: | | < -35dBc | | |
| | | 2 nd order harmonic: | | | | |

Note^[3]: Calculation result = 2th order harmonic measurement value - base waveform measurement value.

Spurious Signal Test

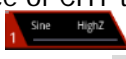

Specification

| Sine Wave Spectrum Purity | |
|-----------------------------------|--|
| Spurious signal (non-harmonic) | Typical ^[1] ≤ 10 MHz: < -60 dBc > 10 MHz: < -60 dBc + 6 dB/octave ^[2] |

Note^[1]: 0 dBm output, DC offset 0, impedance 50 Ω .

Note^[2]: 6 dBc/octave means that when the frequency doubles, the specification increases by 6 dBc. For example, when the output frequency of DG2000 is 10MHz, the specification is < -60 dBc and when the output frequency is 30MHz, the specification is < -60 dBc+2 \times 6dBc, namely < -48 dBc.

Test Procedures

- Make sure that the environment temperature is between 18°C and 28°C and DG2000 has been warmed up for at least 30 minutes. Connect the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG2000 with the RF input terminal of the spectrum analyzer using a dual-BNC cable and N-BNC adaptor as shown in Figure 2-4.
- Turn on DG2000. When the **Shift** key is illuminated, press **Sine/Preset** and tap the **Def** icon, then a dialog box is displayed, tap "**Apply**" to restore DG2000 to the factory setting.
- Set DG2000:
 - Set the output impedance of CH1 to 50 Ω . (Tap the channel output configuration status bar  under the user interface to enter the channel setting interface. Tap the **OutputSet** \rightarrow **HighZ** to select "Off". Tap the **Impedance** menu label, and set the impedance to 50 Ω .)
 - Set the output waveform of CH1 to a sine waveform with 5MHz frequency, 0dBm amplitude and 0V_{dc} offset.
 - Press **Output1** or tap the channel output configuration status bar  to turn on the output of CH1 in the channel setting interface.
- Turn on and set the spectrum analyzer:
 - Set the reference level to 10dBm and input attenuation to 20dB.
 - Set the start frequency to 0Hz and stop frequency to 30MHz.
 - Set the resolution bandwidth to 1kHz.
 - Set the peak offset to 3dB.
 - Set the sweep mode to single.
- After the spectrum analyzer finishes a sweep, use **Peak** and the marker function to measure the maximum spurious signal (except harmonics) and

- record the measurement result as **A**. Calculate the non-harmonic spurious signal (**A**-0dBm) and judge whether it is within the specification range.
6. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 10MHz frequency, 0dBm amplitude and 0V_{dc} offset.
 7. Keep the reference level, input attenuation, resolution bandwidth, peak offset and sweep mode of the spectrum analyzer as 10dBm, 20dB, 1kHz, 3dB and single respectively. Set its start frequency to 0Hz and stop frequency to 50MHz.
 8. Press **Sweep/Trig** → **Single** to perform a sweep.
 9. After the spectrum analyzer finishes a sweep, use **Peak** and the marker function to measure the maximum spurious signal (except harmonics) and record the measurement result as **A**. Calculate the non-harmonic spurious signal (**A**-0dBm) and judge whether it is within the specification range.
 10. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 20MHz frequency, 0dBm amplitude and 0V_{dc} offset.
 11. Keep the reference level, input attenuation, resolution bandwidth, peak offset and sweep mode of the spectrum analyzer as 10dBm, 20dB, 1kHz, 3dB and single respectively. Set its start frequency to 0Hz and stop frequency to 100MHz.
 12. Repeat Step 8 and 9.
 13. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 30MHz frequency, 0dBm amplitude and 0V_{dc} offset.
 14. Keep the reference level, input attenuation, resolution bandwidth, peak offset and sweep mode of the spectrum analyzer as 10dBm, 20dB, 1kHz, 3dB and single respectively. Set its start frequency to 0Hz and stop frequency to 150MHz.
 15. Repeat Step 8 and 9.
 16. Keep the output impedance of CH1 of DG2000 at 50Ω. Set the output waveform of CH1 as a sine waveform with 60MHz frequency, 0dBm amplitude and 0V_{dc} offset.
 17. Keep the reference level, input attenuation, resolution bandwidth, peak offset and sweep mode of the spectrum analyzer as 10dBm, 20dB, 1kHz, 3dB and single respectively. Set its start frequency to 0Hz and stop frequency to 300MHz.

18. Repeat Step 8 and 9.
19. Repeat Step 1-18 to test the spurious signal (non-harmonic) of CH2 and record the test results.

Test Record Form

| Output Frequency | Start Frequency | Stop Frequency | A | A-0dBm | Specification | Pass/Fail |
|------------------|-----------------|----------------|---|--------|---------------|-----------|
| 5MHz | 0Hz | 30MHz | | | <-60dBc | |
| 10MHz | 0Hz | 50MHz | | | <-60dBc | |
| 20MHz | 0Hz | 100MHz | | | <-54dBc | |
| 30MHz | 0Hz | 150MHz | | | <-48dBc | |
| 60MHz | 0Hz | 300MHz | | | <-30dBc | |

Rise/Fall Time Test

Specification

| Signal Characteristic | |
|-----------------------|---------------------------------|
| Square | |
| Rise/Fall Time | Typical (1 Vpp, 1 kHz) ≤9 ns |

Test Procedures

1. Make sure that the environment temperature is between 18°C and 28°C and DG2000 has been warmed up for at least 30 minutes. Connect the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG2000 with the signal input terminal of the oscilloscope using a dual-BNC connecting cable as shown in Figure 2-5.

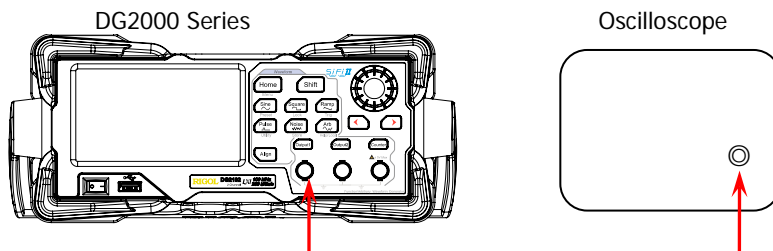




Figure 2-5 Connect DG2000 and the Oscilloscope

2. Turn on DG2000. When the **Shift** key is illuminated, press **Sine/Preset** and tap the **Def** icon, then a dialog box is displayed, tap **"Apply"** to restore DG2000 to the factory setting.
3. Set DG2000:
 - a) Set the output impedance of CH1 to 50Ω. (Tap the channel output configuration status bar  under the user interface to enter the channel setting interface. Tap the **OutputSet** → **HighZ** to select "Off". Tap the **Impedance** menu label, and set the impedance to 50Ω.)
 - b) Set the output waveform of CH1 to a square waveform with 1kHz frequency, 1Vpp amplitude and 0V_{dc} offset.
 - c) Press **Output1** or tap the channel output configuration status bar  to turn on the output of CH1 in the channel setting interface.
4. Turn on and set the oscilloscope:
 - a) Set the vertical scale to 200mV/div.

- b) Set the horizontal time base to 1 μ s.
 - c) Adjust the trigger level to a proper value.
 - d) Set the input impedance to 50 Ω .
 - e) Turn on the rise time and fall time measurement functions.
5. Set the edge type of the oscilloscope to rising edge, record the measurement result of the rise time and judge whether it is within the specification range.
 6. Set the edge type of the oscilloscope to falling edge, record the measurement result of the fall time and judge whether it is within the specification range.
 7. Repeat Step 1-6 to test the rise/fall time of CH2 and record the measurement results.

Test Record Form



| Waveform | Setting | Measurement Value | | Specification | Pass/Fail | |
|----------|--|-------------------|-----------|---------------------------------------|-----------|--|
| | | Rise Time | Fall Time | | | |
| Square | Frequency: 1kHz Amplitude: 1Vpp Offset: 0V _{dc} | Rise Time | | Typical (1 Vpp, 1 kHz) ≤ 9 ns | | |
| | | Fall Time | | | | |

Overshoot Test

Specification

| Signal Characteristic | |
|-----------------------|-------------------------------|
| Square | |
| Overshoot | Typical (100kHz, 1Vpp) ≤5% |

Test Procedures

- Make sure that the environment temperature is between 18°C and 28°C and DG2000 has been warmed up for at least 30 minutes. Connect the channel output terminal (take CH1 as an example; the test method is also applicable to CH2) of DG2000 with the signal input terminal of the oscilloscope using a dual-BNC connecting cable as shown in Figure 2-5.
- Turn on DG2000. When the **Shift** key is illuminated, press **Sine/Preset** and tap the **Def** icon, then a dialog box is displayed, tap "**Apply**" to restore DG2000 to the factory setting.
- Set DG2000:
 - Set the output impedance of CH1 to 50Ω. (Tap the channel output configuration status bar  under the user interface to enter the channel setting interface. Tap the **OutputSet** → **HighZ** to select "Off". Tap the **Impedance** menu label, and set the impedance to 50Ω.)
 - Set the output waveform of CH1 to a square waveform with 100kHz frequency, 1Vpp amplitude and 0V_{dc} offset.
 - Press **Output1** or tap the channel output configuration status bar  to turn on the output of CH1 in the channel setting interface.
- Turn on and set the oscilloscope:
 - Set the input impedance to 50Ω.
 - Set the vertical scale to 200mV/div.
 - Set the horizontal time base to 50ns.
 - Adjust the trigger level to a proper value.
 - Turn on the overshoot measurement function.
- Record the overshoot measurement value and judge whether it is within the specification range.
- Repeat Step 1-5 to test the overshoot of CH2 and record the measurement result.

Test Record Form

| Waveform | Setting | Measurement Value | Specification | Pass/Fail |
|----------|--|-------------------|----------------------------------|-----------|
| Square | Frequency: 100kHz Amplitude: 1Vpp Offset: 0V _{dc} | | Typical (100kHz, 1Vpp) ≤5% | |

Appendix

Appendix A: Test Result Record Form

RIGOL DG2000 Series Function/Arbitrary Waveform Generator Performance Verification Test Record Form

Model: _____ Tested by: _____ Test Date: _____

Channel: CH1

Frequency Accuracy Test

| Waveform | Setting Value | Measurement Value | Specification | Pass/Fail | |
|----------|--|-------------------|--|-----------|--|
| Sine | Frequency: 1MHz Amplitude: 1Vpp | | 0.999 998 999 999 999 99MHz to 1.000 001 000 000 000 01MHz | | |
| Square | | | | | |
| Ramp | | | | | |
| Pulse | | | | | |

AC Amplitude Accuracy Test

| Amplitude Setting Value | Setting | Measurement Value | Specification | Pass/Fail | |
|-------------------------|---|-------------------|--------------------------|-----------|--|
| 20mVpp | Frequency: 1kHz Offset: 0V _{dc} Impedance: 50Ω | | 5.2mVrms to 8.9mVrms | | |
| 100mVpp | | | 33.2mVrms to 37.5mVrms | | |
| 500mVpp | | | 173.3mVrms to 180.3mVrms | | |
| 1Vpp | | | 348.3mVrms to 358.9mVrms | | |
| 5Vpp | | | 1.75Vrms to 1.7875Vrms | | |
| 10Vpp | | | 3.5Vrms to 3.5732Vrms | | |

DC Offset Accuracy Test

| Offset Setting Value | Setting | Measurement Value | Specification | Pass/Fail | |
|----------------------|---|-------------------|--|-----------|--|
| -2.5V _{dc} | Frequency: 1kHz Amplitude: 5Vpp Impedance: 50Ω | | -2.580V _{dc} to -2.420V _{dc} | | |
| -1V _{dc} | | | -1.065V _{dc} to -0.935V _{dc} | | |
| -500mV _{dc} | | | -0.560V _{dc} to -0.440V _{dc} | | |
| 0V _{dc} | | | -0.055V _{dc} to 0.055V _{dc} | | |
| 500mV _{dc} | | | 0.440V _{dc} to 0.560V _{dc} | | |
| 1V _{dc} | | | 0.935V _{dc} to 1.065V _{dc} | | |
| 2.5V _{dc} | | | 2.420V _{dc} to 2.580V _{dc} | | |

AC Flatness Test

| Frequency Setting Value | Setting | Measurement Value | Calculation Result ^[1] | Specification | Pass/Fail | |
|-------------------------|---|-------------------|-----------------------------------|---------------|-----------|--|
| 5MHz | Amplitude: 1Vpp Impedance: 50Ω | | | ±0.1dB | | |
| 10MHz | | | | ±0.2dB | | |
| 15MHz | | | | ±0.2dB | | |
| 20MHz | | | | ±0.3dB | | |
| 25MHz | | | | ±0.3dB | | |
| 30MHz | | | | ±0.5dB | | |
| 40MHz | | | | ±0.5dB | | |
| 50MHz | | | | ±1dB | | |

Note^[1]: Calculation result = Measurement value - P_{ref}.

Harmonic Distortion Test

| Frequency Setting Value | Setting | Measurement Value | Calculation Result ^[1] | Specification | Pass/Fail |
|-------------------------|---|---------------------------------|-----------------------------------|---------------|-----------|
| 10MHz | Waveform: Sine Amplitude: 0dBm Offset: 0V _{dc} | Base waveform: | | < -55dBc | |
| | | 2 nd order harmonic: | | | |
| 20MHz | | Base waveform: | | < -50dBc | |
| | | 2 nd order harmonic: | | | |
| 40MHz | | Base waveform: | | < -40dBc | |
| | | 2 nd order harmonic: | | | |
| 60MHz ^[2] | Base waveform: | | < -35dBc | | |
| | 2 nd order harmonic: | | | | |

Note^[1]: Calculation result = 2th order harmonic measurement value - base waveform measurement value.

Note^[2]: Only applicable to DG2102 and DG2072.

Spurious Signal Test

| Output Frequency | Start Frequency | Stop Frequency | A | A-0dBm | Specification | Pass/Fail |
|----------------------|-----------------|----------------|---|--------|---------------|-----------|
| 5MHz | 0Hz | 30MHz | | | < -60dBc | |
| 10MHz | 0Hz | 50MHz | | | < -60dBc | |
| 20MHz | 0Hz | 100MHz | | | < -54dBc | |
| 30MHz | 0Hz | 150MHz | | | < -48dBc | |
| 60MHz ^[1] | 0Hz | 300MHz | | | < -30dBc | |

Note^[1]: Only applicable to DG2102 and DG2072.

Rise/Fall Time Test

| Waveform | Setting | Measurement Value | Specification | Pass/Fail |
|----------|--|-------------------|----------------------------------|-----------|
| Square | Frequency: 1kHz Amplitude: 1Vpp Offset: 0V _{dc} | Rise Time | Typical (1 Vpp, 1 kHz) ≤ 9 ns | |
| | | Fall Time | | |

Overshoot Test

| Waveform | Setting | Measurement Value | Specification | Pass/Fail |
|----------|---|-------------------|---|-----------|
| Square | Frequency: 100kHz Amplitude: 1Vpp Offset: $0V_{dc}$ | | Typical (100kHz, 1Vpp) $\leq 5\%$ | |

Channel: CH2

Frequency Accuracy Test

| Waveform | Setting Value | Measurement Value | Specification | Pass/Fail |
|----------|--|-------------------|--|-----------|
| Sine | Frequency: 1MHz Amplitude: 1Vpp | | 0.999 998 999 999 999 99MHz to 1.000 001 000 000 000 01MHz | |
| Square | | | | |
| Ramp | | | | |
| Pulse | | | | |

AC Amplitude Accuracy Test

| Amplitude Setting Value | Setting | Measurement Value | Specification | Pass/Fail |
|-------------------------|---|-------------------|--------------------------|-----------|
| 20mVpp | Frequency: 1kHz Offset: 0V _{dc} Impedance: 50Ω | | 5.2mVrms to 8.9mVrms | |
| 100mVpp | | | 33.2mVrms to 37.5mVrms | |
| 500mVpp | | | 173.3mVrms to 180.3mVrms | |
| 1Vpp | | | 348.3mVrms to 358.9mVrms | |
| 5Vpp | | | 1.75Vrms to 1.7875Vrms | |
| 10Vpp | | | 3.5Vrms to 3.5732Vrms | |

DC Offset Accuracy Test

| Offset Setting Value | Setting | Measurement Value | Specification | Pass/Fail |
|----------------------|---|-------------------|--|-----------|
| -2.5V _{dc} | Frequency: 1kHz Amplitude: 5Vpp Impedance: 50Ω | | -2.580V _{dc} to -2.420V _{dc} | |
| -1V _{dc} | | | -1.065V _{dc} to -0.935V _{dc} | |
| -500mV _{dc} | | | -0.560V _{dc} to -0.440V _{dc} | |
| 0V _{dc} | | | -0.055V _{dc} to 0.055V _{dc} | |
| 500mV _{dc} | | | 0.440V _{dc} to 0.560V _{dc} | |
| 1V _{dc} | | | 0.935V _{dc} to 1.065V _{dc} | |
| 2.5V _{dc} | | | 2.420V _{dc} to 2.580V _{dc} | |

AC Flatness Test

| Frequency Setting Value | Setting | Measurement Value | Calculation Result ^[1] | Specification | Pass/Fail |
|-------------------------|---|-------------------|-----------------------------------|---------------|-----------|
| 5MHz | Amplitude: 1Vpp Impedance: 50Ω | | | ±0.1dB | |
| 10MHz | | | | ±0.2dB | |
| 15MHz | | | | ±0.2dB | |
| 20MHz | | | | ±0.3dB | |
| 25MHz | | | | ±0.3dB | |
| 30MHz | | | | ±0.5dB | |
| 40MHz | | | | ±0.5dB | |
| 50MHz | | | | ±1dB | |

Note^[1]: Calculation result = Measurement value - P_{ref}.

Harmonic Distortion Test

| Frequency Setting Value | Setting | Measurement Value | Calculation Result ^[1] | Specification | Pass/Fail |
|-------------------------|---|---------------------------------|-----------------------------------|---------------|-----------|
| 10MHz | Waveform: Sine Amplitude: 0dBm Offset: 0V _{dc} | Base waveform: | | < -55dBc | |
| | | 2 nd order harmonic: | | | |
| 20MHz | | Base waveform: | | < -50dBc | |
| | | 2 nd order harmonic: | | | |
| 40MHz | | Base waveform: | | < -40dBc | |
| | | 2 nd order harmonic: | | | |
| 60MHz ^[2] | | Base waveform: | | < -35dBc | |
| | | 2 nd order harmonic: | | | |

Note^[1]: Calculation result = 2th order harmonic measurement value - base waveform measurement value.

Note^[2]: Only applicable to DG2102 and DG2072.

Spurious Signal Test

| Output Frequency | Start Frequency | Stop Frequency | A | A-0dBm | Specification | Pass/Fail |
|----------------------|-----------------|----------------|---|--------|---------------|-----------|
| 5MHz | 0Hz | 30MHz | | | < -60dBc | |
| 10MHz | 0Hz | 50MHz | | | < -60dBc | |
| 20MHz | 0Hz | 100MHz | | | < -54dBc | |
| 30MHz | 0Hz | 150MHz | | | < -48dBc | |
| 60MHz ^[1] | 0Hz | 300MHz | | | < -30dBc | |

Note^[1]: Only applicable to DG2102 and DG2072.

Rise/Fall Time Test

| Waveform | Setting | Measurement Value | Specification | Pass/Fail |
|----------|--|-------------------|---------------------------------|-----------|
| Square | Frequency: 1kHz Amplitude: 1Vpp Offset: 0V _{dc} | Rise Time | Typical (1 Vpp, 1 kHz) ≤9 ns | |
| | | Fall Time | | |

Overshoot Test

| Waveform | Setting | Measurement Value | Specification | Pass/Fail |
|----------|--|-------------------|-------------------------------|-----------|
| Square | Frequency: 100kHz Amplitude: 1Vpp Offset: 0V _{dc} | | Typical (100kHz, 1Vpp) ≤5% | |

Appendix B: Performance Specifications

Unless otherwise specified, all the specifications can be guaranteed when the following two conditions are met.

- The signal generator is within the calibration period.
- The signal generator has been running ceaselessly for over 30 minutes under the specified operating temperature ($23^{\circ}\text{C}\pm 5^{\circ}\text{C}$).

All the specifications are guaranteed except the parameters marked with "Typical".

| Model | DG2052 | DG2072 | DG2102 |
|--|--|-----------------------------|-----------------------------|
| Channel | 2 | 2 | 2 |
| Max. Frequency | 50 MHz | 70 MHz | 100 MHz |
| Sample Rate | 250 MSa/s | | |
| Waveform | | | |
| Basic Waveforms | Sine, Square, Ramp, Pulse, Noise, DC, Dual-tone | | |
| Advanced Waveforms | PRBS, RS232, Sequence | | |
| Built-in Arbitrary Waveforms | 160 types of waveforms, including Sinc, Exponential Rise, Exponential Fall, ECG, Gauss, HaverSine, Lorentz, etc. | | |
| Frequency Characteristics | | | |
| Sine | 1 μHz to 50 MHz | 1 μHz to 70 MHz | 1 μHz to 100 MHz |
| Square | 1 μHz to 15 MHz | 1 μHz to 20 MHz | 1 μHz to 25 MHz |
| Ramp | 1 μHz to 1.5 MHz | 1 μHz to 1.5 MHz | 1 μHz to 2 MHz |
| Pulse | 1 μHz to 15 MHz | 1 μHz to 20 MHz | 1 μHz to 25 MHz |
| Harmonic | 1 μHz to 20 MHz | 1 μHz to 20 MHz | 1 μHz to 25 MHz |
| PRBS | 2 kbps to 40 Mbps | 2 kbps to 50 Mbps | 2 kbps to 60 Mbps |
| Dual-tone | 1 μHz to 20 MHz | 1 μHz to 20 MHz | 1 μHz to 20 MHz |
| RS232 | baud rate range: 9600, 14400, 19200, 38400, 57600, 115200, 128000, 230400 | | |
| Sequence | 2 k to 60 MSa/s | | |
| Noise (-3 dB) | 100 MHz bandwidth | | |
| Arbitrary Waveform | 1 μHz to 15 MHz | 1 μHz to 20 MHz | 1 μHz to 20 MHz |
| Resolution | 1 μHz | | |
| Accuracy | $\pm(1 \text{ ppm of the setting value} + 10 \text{ pHz})$, 18°C to 28°C | | |
| Sine Wave Spectrum Purity | | | |
| Harmonic Distortion | Typical ^[1] DC to 10 MHz (included): $< -55 \text{ dBc}$ 10 MHz to 20 MHz (included): $< -50 \text{ dBc}$ 20 MHz to 40 MHz (included): $< -40 \text{ dBc}$ >40 MHz: $< -35 \text{ dBc}$ | | |
| Total Harmonic Distortion ^[1] | $< 0.075\%$ (10 Hz to 20 kHz) | | |
| Spurious (non-harmonic) | Typical ^[1] $\leq 10 \text{ MHz}$: $< -60 \text{ dBc}$ $> 10 \text{ MHz}$: $< -60 \text{ dBc} + 6 \text{ dB/octave}$ | | |
| Phase Noise | Typical (0 dBm, 10 kHz offset) | | |

| | |
|------------------------------------|---|
| | 10 MHz: <-105 dBc/Hz |
| Signal Characteristics | |
| Square | |
| Rise/Fall Time | Typical (1 Vpp, 1 kHz) ≤9 ns |
| Overshoot | Typical (100 kHz, 1 Vpp) ≤5% |
| Duty | 0.01% to 99.99% (limited by the current frequency setting) |
| Non-symmetry | 1% of the period + 4 ns |
| Jitter (rms) | Typical (1 Vpp) ≤5 MHz: 2 ppm of the period + 200 ps >5 MHz: 200 ps |
| Ramp | |
| Linearity | ≤1% of peak output (typical, 1 kHz, 1 VPP, 100% symmetry) |
| Symmetry | 0% to 100% |
| Pulse | |
| Pulse | 16 ns to 1000 ks (limited by the current frequency setting) |
| Duty | 0.001% to 99.999% (limited by the current frequency setting) |
| Rising/Falling Edge | ≥8 ns (limited by the current frequency setting and pulse width setting) |
| Overshoot | Typical (1 Vpp, 1 kHz) ≤5% |
| Jitter (rms) | Typical (1 Vpp) ≤5 MHz: 2 ppm of the period + 200 ps >5 MHz: 200 ps |
| Arbitrary Waveform Sequence | |
| Waveform Length | 16 Mpts |
| Vertical Resolution | 16 bits |
| Sample Rate | Interpolation filter: 10 Sa/s to 60 MSa/s Step filter: 2k Sa/s to 50 MSa/s Smooth filter: 2k Sa/s to 50 MSa/s |
| Min Rise/Fall Time | Interpolation filter: ≥8 ns Step filter: 3.0/sample rate Smooth filter: 1.0/sample rate |
| Jitter (rms) | Typical (1 Vpp) Interpolation filter: 200 ps Step filter: <5 ps Smooth filter: <5 ps |
| Overshoot | Typical (1 Vpp) ≤5% |
| Harmonic Output | |
| Harmonic Order | ≤8 |
| Harmonic Type | Even Harmonic, Odd Harmonic, Order Harmonic, User |
| Harmonic Amplitude | The amplitude of each order of the harmonic can be set. |
| Harmonic Phase | The phase of each order of harmonic can be set. |
| Output Characteristics | |
| Amplitude (into 50 Ω) | |
| Range | ≤10 MHz: 1.0 mVpp to 10 Vpp ≤30 MHz: 1.0 mVpp to 5.0 Vpp ≤60 MHz: 1.0 mVpp to 2.5 Vpp >60 MHz: 1.0 mVpp to 1 Vpp |

| | |
|---|---|
| Accuracy | Typical (1 kHz sine, 0 V offset, >10 mVpp, auto) $\pm(1\% \text{ of the setting value}) \pm 5 \text{ mV}$ |
| Flatness | Typical (Sine, 1 Vpp) $\leq 5 \text{ MHz: } \pm 0.1 \text{ dB}$ $\leq 15 \text{ MHz: } \pm 0.2 \text{ dB}$ $\leq 25 \text{ MHz: } \pm 0.3 \text{ dB}$ $\leq 40 \text{ MHz: } \pm 0.5 \text{ dB}$ $> 40 \text{ MHz: } \pm 1 \text{ dB}$ |
| Unit | Vpp, Vrms, dBm |
| Resolution | 0.1 mVpp or 4 digits |
| Offset (into 50 Ω) | |
| Range (Peak ac+dc) | $\pm 5 \text{ Vpk ac+dc}$ |
| Accuracy | $\pm(1\% \text{ of the setting value} + 5 \text{ mV} + 1\% \text{ of the amplitude})$ |
| Waveform Output | |
| Output Impedance | 50 Ω (typical) |
| Protection | Short-circuit protection, automatically disable the waveform output when overload occurs |
| Modulation Characteristics | |
| Modulation Type | AM, FM, PM, ASK, FSK, PSK, PWM |
| AM | |
| Carrier Waveform | Sine, Square, Ramp, Arb |
| Source | Internal/External |
| Modulating Waveform | Sine, Square, Ramp, Noise, Arb |
| Modulation Depth | 0% to 120% |
| Modulation Frequency | 2 mHz to 1 MHz |
| FM | |
| Carrier Waveform | Sine, Square, Ramp, Arb |
| Source | Internal/External |
| Modulating Waveform | Sine, Square, Ramp, Noise, Arb |
| Modulation Frequency | 2 mHz to 1 MHz |
| PM | |
| Carrier Waveform | Sine, Square, Ramp, Arb |
| Source | Internal/External |
| Modulating Waveform | Sine, Square, Ramp, Noise, Arb |
| Phase Deviation | 0° to 360° |
| Modulation Frequency | 2 mHz to 1 MHz |
| ASK | |
| Carrier Waveform | Sine, Square, Ramp, Arb |
| Source | Internal/External |
| Modulating Waveform | Square with 50% duty cycle |
| Key Frequency | 2 mHz to 1 MHz |
| FSK | |
| Carrier Waveform | Sine, Square, Ramp, Arb |
| Source | Internal/External |

| | | | |
|----------------------------------|---|-----------------|------------------|
| Modulating Waveform | Square with 50% duty cycle | | |
| Key Frequency | 2 mHz to 1 MHz | | |
| PSK | | | |
| Carrier Waveform | Sine, Square, Ramp, Arb | | |
| Source | Internal/External | | |
| Modulating Waveform | Square with 50% duty cycle | | |
| Key Frequency | 2 mHz to 1 MHz | | |
| PWM | | | |
| Carrier Waveform | Pulse | | |
| Source | Internal/External | | |
| Modulating Waveform | Sine, Square, Ramp, Noise, Arb | | |
| Width Deviation | 0% to 100% of the pulse width | | |
| Modulation Frequency | 2 mHz to 1 MHz | | |
| External Modulation Input | | | |
| Input Range | AM, PM, FM: 75 mVRMS to ± 5 (Vac+dc) ASK, PSK, FSK: standard 5 V TTL | | |
| Input Bandwidth | 50 kHz | | |
| Input Impedance | 10 k Ω | | |
| Burst Characteristics | | | |
| Carrier Waveform | Sine, Square, Ramp, Pulse, Noise, Arb, PRBS, RS232, Sequence (except DC, dual-tone, and Harmonic) | | |
| Carrier Frequency | 2 mHz to 50 MHz | 2 mHz to 70 MHz | 2 mHz to 100 MHz |
| Burst Count | 1 to 1,000,000 or Infinite | | |
| Internal Period | 1 μ s to 500 s | | |
| Gated Source | External Trigger | | |
| Source | Internal, External, Manual | | |
| Trigger Delay | 0 ns to 100 s | | |
| Sweep Characteristics | | | |
| Carrier Waveform | Sine, Square, Ramp, Arb | | |
| Type | Linear, Log, and Step | | |
| Orientation | Up/Down | | |
| Start/Stop Frequency | Same as the upper/lower limit of the corresponding carrier frequency | | |
| Sweep Time | 1 ms to 500 s | | |
| Hold/Return Time | 0 ms to 500 s | | |
| Source | Internal, External, Manual | | |
| Marker | Falling edge of the sync signal (programmable) | | |
| Frequency Counter | | | |
| Measurement Function | Frequency, Period, Positive/Negative Pulse Width, Duty Cycle | | |
| Frequency Resolution | 7 digits/s (Gate Time = 1 s) | | |
| Frequency Range | 1 μ Hz to 240 MHz | | |

| | | | |
|--|--|--|--------------------------------|
| Period Measurement | Measurement Range | 4 ns to 1,000 ks | |
| Voltage Range and Sensitivity (non-modulating signal) | | | |
| DC Coupling | DC Offset Range | ± 1.5 Vdc | |
| | 1 μ Hz to 100 MHz | 50 mVRMS to ± 2.5 (Vac+dc) | |
| | 100 MHz to 240 MHz | 100 mVRMS to ± 2.5 (Vac+dc) | |
| AC Coupling | 1 μ Hz to 100 MHz | 50 mVRMS to ± 2.5 Vpp | |
| | 100 MHz to 240 MHz | 100 mVRMS to ± 2.5 Vpp | |
| Pulse Width and Duty Cycle Measurement | | | |
| Frequency and Amplitude Ranges | 1 μ Hz to 25 MHz | 50 mVRMS to ± 2.5 (Vac+dc) | DC Coupling |
| Pulse Width | Min. Pulse Width | ≥ 20 ns | |
| | Pulse Width Resolution | 5 ns | |
| Duty | Measurement Range (display) | 0% to 100% | |
| Input Characteristics | | | |
| Input Signal Range | Breakdown Voltage | ± 7 (Vac+dc) | Input Impedance = 1 M Ω |
| Input Adjustment | Coupling Mode | AC | DC |
| | High Frequency Rejection | On: Input Bandwidth = 150 kHz; Off: Input Bandwidth = 240 MHz | |
| Input Trigger | Trigger Level Range | -2.5 V to +2.5 V | |
| | Trigger Sensitivity Range | High, Low | |
| GateTime | 1 ms | 1.048 ms | |
| | 10 ms | 8.389 ms | |
| | 100 ms | 134.218 ms | |
| | 1 s | 1.074 s | |
| | 10 s | 8.590 s | |
| | >10 s | >8.590 s | |
| Trigger Characteristics | | | |
| Trig Input | | | |
| Level | TTL-compatible | | |
| Slope | Rising or falling (selectable) | | |
| Pulse Width | > 100 ns | | |
| Latency | Sweep: <100 ns (typical) Burst: <350 ns (typical) | | |
| Trigger Output | | | |

| | |
|--|--|
| Level | TTL-compatible |
| Pulse Width | >60 ns (typical) |
| Max. Frequency | 1 MHz |
| Two-channel Characteristics - Phase Offset | |
| Range | 0° to 360° |
| Waveform Phase Resolution | 0.03° |
| Reference Clock | |
| External Reference Input | |
| Lock Range | 10 MHz \pm 50 Hz |
| Level | 250 mVpp to 5 Vpp |
| Lock Time | <2 s |
| Input Impedance (Typical) | 1 k Ω , AC coupling |
| Internal Reference Output | |
| Frequency | 10 MHz \pm 50 Hz |
| Level | 3.3 Vpp |
| Output Impedance (Typical) | 50 Ω , AC coupling |
| Synchronous Output | |
| Level | TTL-compatible |
| Impedance | 50 Ω , nominal value |
| Overvoltage Protection | |
| Occurred when: | |
| <ul style="list-style-type: none"> The instrument amplitude setting is greater than 3.2 Vpp or the output AC+DC is greater than $1.6 V_{DC}$ and the input voltage is greater than $\pm 12 \times (1 \pm 5\%)V$ (<10 kHz). Disruptive discharge voltage: $\pm 18(V_{AC} + dc)$. The instrument amplitude setting is smaller than or equal to 3.2 Vpp or the output AC+DC is smaller than $1.6 V_{DC}$ and the input voltage is greater than $\pm 2.6 \times (1 \pm 5\%)V$ (<10 kHz). Disruptive discharge voltage: $\pm 5(V_{AC} + dc)$. | |
| Overcurrent Protection | |
| Occurred when: the current is greater than ± 240 mA. | |
| Programming Time | |
| Configuration Changes | USB |
| Function Change | 10 ms |
| Amplitude Change | 5 ms |
| Frequency Change | 5 ms |
| General Specifications | |
| Power Supply | |
| Power Voltage | 100 V to 127 V (45 Hz to 440 Hz) 100 V to 240 V (45 Hz to 65Hz) |
| Power Consumption | Lower than 30 W |
| Display | |

| | | |
|-----------------------------------|---|---|
| Type | 4.3-inch TFT LCD touch screen | |
| Resolution | 480 horizontal × RGB × 272 vertical resolution | |
| Color | 16 M | |
| Environment | | |
| Temperature Range | Operating: 0°C to 45°C Non-operating: -40°C to 60°C | |
| Cooling Method | Natural air cooling | |
| Humidity Range | Below 30°C: ≤95%RH 30°C to 40°C: ≤75%RH 40°C to 50°C: ≤45%RH | |
| Altitude | Operating: below 3,000 meters Non-operating: below 15,000 meters | |
| Mechanical Characteristics | | |
| Dimensions (W×H×D) | 261.5 mm × 112 mm × 318.4 mm | |
| Weight | Package excluded: 3.2 kg Package included: 4.5 kg | |
| Interface | USB Host, USB Device, and USB-GPIB | |
| IP Protection | IP2X | |
| Calibration Interval | 1 year (recommended) | |
| Certification Information | | |
| EMC | Compliant with EN61326-1:2006 | |
| | IEC 61000-3-2:2000 | ±4.0 kV (Contact Discharge) ±4.0 kV (Air Discharge) |
| | IEC 61000-4-3:2002 | 3 V/m (80 MHz to 1 GHz); 3 V/m (1.4 GHz to 2 GHz); 1 V/m (2.0 GHz to 2.7 GHz) |
| | IEC 61000-4-4:2004 | 1kV power line |
| | IEC 61000-4-5:2001 | 0.5 kV (phase-to-neutral voltage); 0.5 kV (phase-to-earth voltage); 1 kV (neutral-to-earth voltage) |
| | IEC 61000-4-6:2003 | 3 V, 0.15 MHz to 80 MHz |
| | IEC 61000-4-11:2004 | Voltage dip: 0% UT during half cycle 0% UT during 1 cycle 70% UT during 25 cycles Short interruption: 0% UT during 1 cycle |
| Electrical Safety | complies with USA: UL 61010-1:2012, Canada: CAN/CSA-C22.2 No. 61010-1-2012 EN 61010-1:2010, | |

Note^[1]: 0 dBm output, DC offset 0, impedance 50 Ω.