

RIGOL

Calibration Guide

DG4000 Series Function/Arbitrary Waveform Generator

Jan. 2014
RIGOL Technologies, Inc.

Guaranty and Declaration

Copyright

© 2012 RIGOL Technologies, Inc. All Rights Reserved.

Trademark Information

RIGOL is a registered trademark of RIGOL Technologies, Inc.

Publication Number

CGB04102-1110

Notices

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

Product Certification

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

Contact Us

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

E-mail: service@rigol.com

Website: www.rigol.com

Contents

Guaranty and Declaration	I
Chapter 1 Calibration Notices	1-1
Calibration Interval	1-1
Calibration Safety.....	1-1
To Stop the Calibration	1-1
To Acquire the Calibration Service.....	1-2
Recommended Test Devices.....	1-2
Test Notices	1-2
Chapter 2 Calibration Process.....	2-1
Frequency Accuracy Calibration	2-3
AC Amplitude Accuracy Calibration.....	2-4
Low-frequency Flatness Calibration.....	2-5
DC Offset Accuracy Calibration	2-6
Output Impedance Calibration.....	2-7
High-frequency Flatness Calibration	2-9
Frequency Counter Calibration	2-10

Chapter 1 Calibration Notices

Calibration Interval

Regular calibration can ensure the performance specifications of DG4000. You are recommended to calibrate the instrument at a one-year calibration interval. You can choose a proper calibration interval according to your requirement of the performance accuracy but the calibration interval can not exceed 2 years (otherwise, the specifications can not be guaranteed).

You are recommended to perform complete calibration at the calibration interval to ensure that the instrument will remain within specifications for the next calibration.

Calibration Safety

To perform calibration, you need to input the correct password. The password is used to prevent accidental or unauthorized calibration of the instrument.

Press **Utility** →  → **Test/Cal** → **Secure Code**, input the correct password using the knob and direction keys, press **Secure** and the calibration safety protection turns off. Press **CaliSelf** to enter the calibration interface. Press **Preset** to restore the calibration values to their default values.

The calibration password is "2010". The password is stored in the non-volatile memory and will not change at power-off or remote interface reset.

To Stop the Calibration

You can power off the instrument to stop the calibration at any time during the calibration. The calibration data stored will not be cleared when the calibration is stopped and you do not need to calibrate the items already calibrated again in the next calibration.



CAUTION

If the calibration is stopped when the instrument is writing the new calibration constants into the Flash, you may lose all the calibration constants and you need to perform the calibration again.

To Acquire the Calibration Service

RIGOL does not recommend manual calibration by users. If calibration is required, please contact **RIGOL** customer service department or the local distributor.

Recommended Test Devices

It is recommended that you use the test devices listed in the table below or other test devices with the same performance and specifications for calibration.

Table 1-1 Recommended Test Devices

Device	Performance Requirement	Recommended
Digital Multimeter	6 ¹ / ₂	RIGOL DM3068
Frequency Counter	>10 MHz Accuracy: 0.1 ppm	Agilent 53131A
Power Meter	-30 dBm to +20 dBm Accuracy: ±0.02 dB Resolution: 0.01 dB	Agilent E4416A
Signal Generator	Period: <40 ns, Accuracy: 1 ppm	RIGOL DG5000
Cable	BNC (m) – dual banana (m)	--
Cable	BNC (m) – BNC (m)	--
Power Sensor	-30 dBm to +20 dBm	Agilent N8482A
Power Sensor Cable	Used to connect the power meter and power sensor	--
50 Ω Load	50 Ω/1 W	--

Test Notices

For optimum performance, all procedures should comply with the following recommendations.

- 1) Make sure the environment temperature is stable and between 18°C and 28°C. Ideally, the calibration should be performed at 23°C ±1°C.
- 2) Make sure the environment relative humidity is less than 80%.
- 3) Allow a 30-minute warm-up period before the calibration.
- 4) Keep the test cables as short as possible, consistent with the impedance requirements.

Chapter 2 Calibration Process

Warm DG4000 up for at least 30 minutes. Press **Utility** →  → **Test/Cal** → **Secure Code**, use the knob and direction keys to enter the correct password, press **Secure** and the calibration safety protection turns off. Press **CaliSelf** to enter the calibration interface as shown in the figure below.

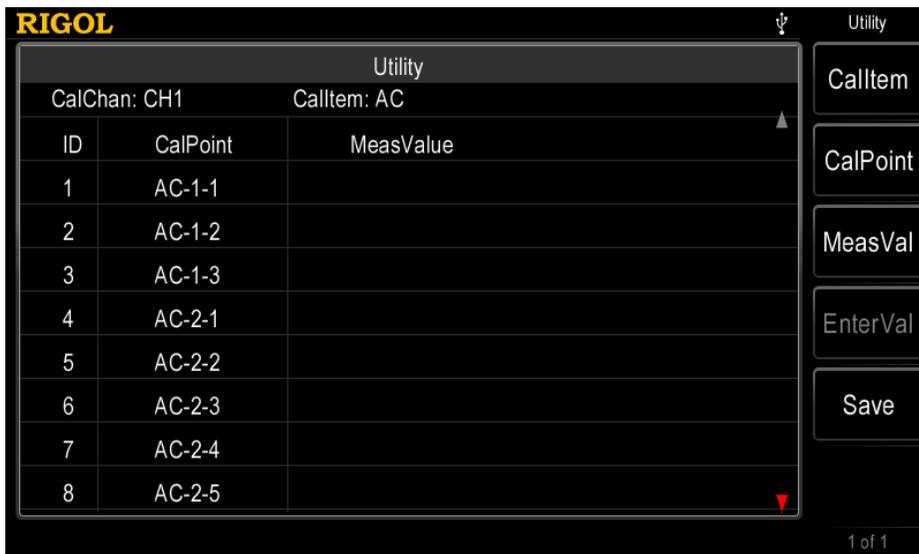


Figure 2-1 Calibration Interface

1. CallItem

Press this softkey to select the desired calibration item. The calibration items of DG4000 manual calibration are listed in the table below. You can select one or more calibration items, but it is recommended to perform a complete calibration.

Table 2-1 Calibration Items

No.	Item
1	AC (AC amplitude accuracy)
2	LFLAT (Low-frequency Flatness)
3	HFLAT (High-frequency Flatness)
4	FREQ (frequency accuracy)
5	LOAD (output impedance)
6	OFFSET (DC offset accuracy)
7	Frequency Counter

2. CalPoint

Press this softkey and the cursor switches to the CalPoint column. At this point, you can rotate the knob to select the calibration point.

Note: you can not select the calibration point in Output Impedance Calibration.

3. MeasVal

After selecting a calibration point, press this softkey and the MeasValue column of the corresponding point becomes editable. At this point, use the numeric keyboard or the knob and direction keys to input the measurement value.

4. EnterVal

After selecting a calibration point and inputting the measurement value, press this softkey to finish the calibration of the point selected.

5. Save

Press this softkey to save the current calibration value.

The calibration method of each calibration item is introduced in detail in the following part.

**CAUTION**

You need to calibrate each item following the sequence below.

Frequency Accuracy Calibration

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the channel output terminal (take CH1 as an example; the calibration 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.

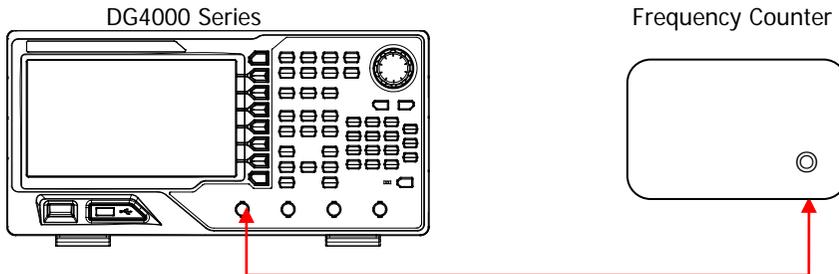


Figure 2-2 Connect DG4000 and the Frequency Counter

2. Press **Output1** at the front panel of DG4000 to enable the channel output.
3. Set the input impedance of the frequency counter to HighZ.
4. Enter the DG4000 calibration interface and press **CallItem** to select **FREQ.**
5. According to the prompt messages in the calibration interface, press **Start** to start the frequency accuracy calibration.
6. Observe the measurement value of the frequency counter. If the current measurement value is lower than 10 MHz, press **Up** to increase the output frequency of DG4000; and if the current measurement value is greater than 10 MHz, press **Down** to reduce the output frequency of DG4000 until the absolute value of the difference between the measurement value of the frequency counter and 10 MHz is lower than 1 Hz.
7. Press **Save** and the frequency accuracy calibration finishes.

AC Amplitude Accuracy Calibration

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

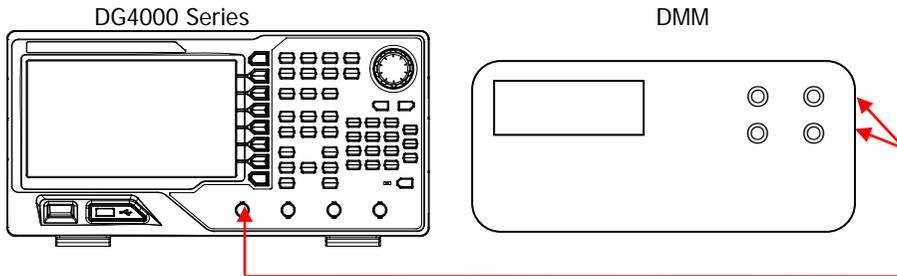


Figure 2-3 Connect DG4000 and the Digital Multimeter

2. Press **Output1** at the front panel of DG4000 to enable the channel output.
3. Turn on the digital multimeter. Select the AC voltage (ACV) measurement function and set the range to "Auto".
4. Enter the DG4000 calibration interface and press **CalItem** to select **AC** (the default setting).
5. Press **CalPoint** and the cursor switches to the first calibration point in the CalPoint column.
6. Press **MeasVal** and the MeasValue column of the point selected becomes editable. At this point, use the numeric keyboard or the knob and direction keys to input the current measurement value of the digital multimeter.
7. Press **EnterVal** to finish the calibration of the point currently selected. The cursor switches to the CalPoint column.
8. Select the next calibration point using the knob. Repeat step 6 and 7 until all the calibration points are calibrated.
9. Press **Save** and the AC amplitude accuracy calibration finishes.

Low-frequency Flatness Calibration

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the channel output terminal (take CH1 as an example; the calibration method is also applicable to CH2) of DG4000 with the voltage input terminals of the digital multimeter using the BNC - dual banana cable as shown in Figure 2-3.
2. Press **Output1** at the front panel of DG4000 to enable the channel output.
3. Turn on the digital multimeter. Select the AC voltage (ACV) measurement function and set the range to "Auto".
4. Enter the DG4000 calibration interface and press **CalItem** to select **LFLAT**.
5. Press **CalPoint** and the cursor switches to the first point in the CalPoint column.
6. Press **MeasVal** and the MeasValue column of the point selected becomes editable. At this point, use the numeric keyboard or the knob and direction keys to input the current measurement value of the digital multimeter.
7. Press **EnterVal** to finish the calibration of the current point. The cursor switches to the CalPoint column.
8. Select the next calibration point using the knob. Repeat step 6 and 7 until all the calibration points are calibrated.
9. Press **Save** and the low-frequency flatness calibration finishes.

DC Offset Accuracy Calibration

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the channel output terminal (take CH1 as an example; the calibration method is also applicable to CH2) of DG4000 with the voltage input terminals of the digital multimeter using the BNC - dual banana cable as shown in Figure 2-3.
2. Press **Output1** at the front panel of DG4000 to enable the channel output.
3. Turn on the digital multimeter. Select the DC voltage (DCV) measurement function and set the range to "Auto".
4. Enter the DG4000 calibration interface and press **CalItem** to select **OFFSET**.
5. Press **CalPoint** and the cursor switches to the first point in the CalPoint column.
6. Press **MeasVal** and the MeasValue column of the point selected becomes editable. At this point, use the numeric keyboard or the knob and direction keys to input the current measurement value of the digital multimeter.
7. Press **EnterVal** to finish the calibration of the point currently selected. The cursor switches to the CalPoint column.
8. Select the next calibration point using the knob. Repeat step 6 and 7 until all the calibration points are calibrated.
9. Press **Save** and the DC offset accuracy calibration finishes.

Output Impedance Calibration

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

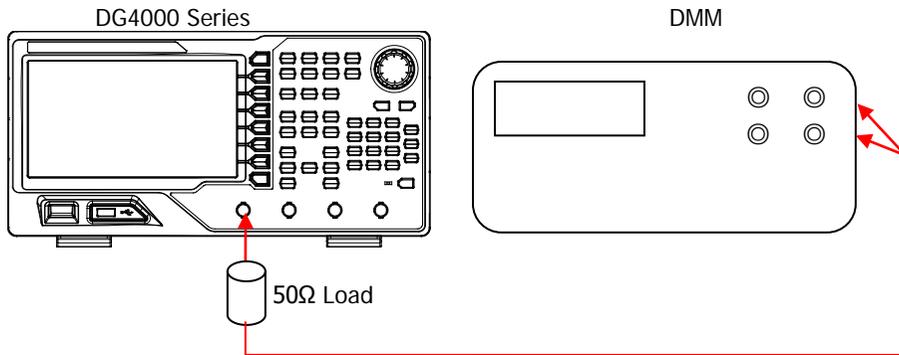


Figure 2-4 Connect DG4000 and the Digital Multimeter via the 50 Ω Load

2. Press **Output1** at the front panel of DG4000 to enable the channel output.
3. Turn on the digital multimeter. Select the AC voltage (ACV) measurement function and set the range to "Auto".
4. Enter the DG4000 calibration interface and press **CallItem** to select **LOAD**.
5. Press **CalPoint** and the cursor switches to the first point in the CalPoint column.
6. You need to calibrate each calibration point twice (otherwise, you can not select the next calibration point).
 - a) Calibration with the 50 Ω load:
Press **MeasVal** and the MeasValue column of the point selected becomes editable. At this point, use the numeric keyboard or the knob and direction keys to input the current measurement value of the digital multimeter. Press **EnterVal** and the prompt message telling you to remove the 50 Ω load is displayed. The cursor switches to the CalPoint column.
 - b) Calibration without the 50 Ω load:
Remove the 50 Ω load and connect the digital multimeter and the channel output terminal of DG4000 directly (the connection method is as shown in Figure 2-3). Press **MeasVal** and the MeasValue column of the point selected becomes editable. At this point, use the numeric keyboard or the knob and direction keys to input the current measurement value of the digital multimeter. Press **EnterVal** and the prompt message telling you to

connect the 50 Ω load is displayed. The cursor switches to the CalPoint column. At this point, please connect the 50 Ω load (the connection method is as shown in Figure 2-4).

7. Select the next calibration point using the knob. Repeat step 6 until all the calibration points are calibrated.
8. Press **Save** and the output impedance calibration finishes.

High-frequency Flatness Calibration

1. Make sure that DG4000 has been warmed up for 30 minutes. Connect the power meter and the power sensor; connect the power sensor with the channel output terminal (take CH1 as an example; the calibration method is also applicable to CH2) of DG4000 as shown in the figure below.

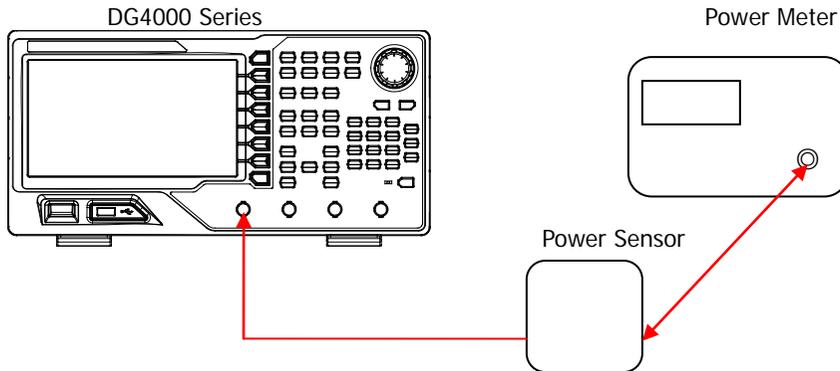


Figure 2-5 Connect DG4000 and the Power Meter

2. Press **Output1** at the front panel of DG4000 to enable the channel output.
3. Enter the DG4000 calibration interface and press **CallItem** to select **HFLAT**.
4. Press **CalPoint** and the cursor switches to the first point in the CalPoint column.
5. The frequency of the first calibration point is 100 kHz. Set an appropriate frequency calibration factor for the power meter according to the ratio of the power sensor.
6. Press **MeasVal** and the MeasValue column of the point selected becomes editable. At this point, use the numeric keyboard or the knob and direction keys to input the current measurement value of the power meter.
7. Press **EnterVal** to finish the calibration of the point currently selected. The cursor switches to the CalPoint column.
8. Select the next calibration point using the knob. Repeat step 5 to step 7 (for each calibration point, set an appropriate frequency calibration factor for the power meter) until all the calibration points are calibrated.
9. Press **Save** and the high-frequency flatness calibration finishes.

Frequency Counter Calibration

1. Make sure that DG4000 has been warmed up for 30 minutes.
2. Connect the output terminal of the signal generator with the **[Counter]** connector at the rear panel of DG4000 using the dual-BNC cable as shown in the figure below.

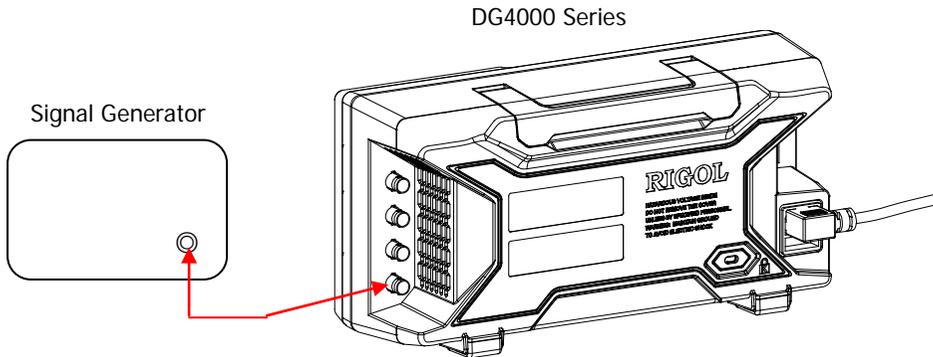


Figure 2-6 Connect DG4000 and the Signal Generator

3. Power on and start the signal generator. Configure the signal generator to output a 40 ns, 5 Vpp sine waveform.
4. Enter the DG4000 calibration interface and press **CallItem** to select **Counter**.
5. According to the prompt messages in the calibration interface, press **Start**; the frequency counter of DG4000 turns on automatically (the status indicator at the left of **Counter** is illuminated but the user interface does not switch to the frequency counter interface) and the frequency resolution calibration of the frequency counter starts.
6. After the calibration finishes, the prompt message telling you that the calibration finishes is displayed.
7. Press **Save** and the frequency resolution calibration of the frequency counter finishes.

After the frequency resolution calibration of the frequency counter finishes, you can press  to return to the calibration interface or press **Utility** to exit the calibration.

By now, the calibration process finishes.