RIGOL

# Performance Verification Guide

## DSG800 Series
## RF Signal Generator

**Aug. 2015**

**RIGOL Technologies, Inc.**

# Guaranty and Declaration



## Trademark Information
**RIGOL** is a registered trademark of RIGOL Technologies, Inc.


## Publication Number
PVG02100-1110


## Notices
- **RIGOL** products are covered by P.R.C. and foreign patents, issued and pending.
- **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.
- Information in this publication is subject to change without notice.
- **RIGOL** shall not be liable for either incidental or consequential losses 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, 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

# 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 keys, 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 specifications of **RIGOL** DSG800 series RF signal generator. For the operation methods of the instrument mentioned in this manual, please refer to *DSG800 User's Guide*.

## Main Contents 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 devices, test method and test procedures of each performance specification.

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 specification fulfills the requirement.

## Format Conventions in this Manual:

Front panel key: denoted by the format of "Text Box + Key Name (Bold)". For example, **Syst**.
Menu softkey: denoted by the format of "Character Shading + Menu Word (Bold)". For example, **Information**.
Operation step: denoted by an arrow "→". For example, **Syst** → **Information**.
Connector: denoted by the format of "Square Brackets + Connector Name (Bold)". For example, **[RF OUTPUT 50Ω]**.

# Contents

# Chapter 1 Overview

## Test Preparations

Before performing the test, make the following preparations.

1. The RF signal generator is stored for at least two hours under a temperature of 0℃ to 50℃ and is warmed up for 40 minutes.
2. Make sure that the instrument is within the calibration period (1 year).
3. The test devices required should fulfill the requirements of the "Specification" column in Table 1-1. You can also use the recommended models in the following table for the test.

Table 1-1 Test Devices Required

| Device | Specification | Qty. | Recommended |
|---|---|---|---|
| Signal Analyzer[1] | Total amplitude uncertainty: ±0.19 dB<br>Option: analog modulation and demodulation, phase noise test | 1 | Agilent N9030A |
| Spectrum Analyzer (Optional) | Total amplitude uncertainty: ±0.24 dB | 1 | Agilent E4440A |
| Signal Analyzer (Optional) | Frequency range: 9 kHz to 7.5 GHz<br>Option: analog modulation and demodulation | 1 | Agilent N9000A |
| Power Meter and Power Sensor | Resolution: 0.001 dB<br>Reference accuracy: ±1.2%<br><br>Frequency range: 9 kHz to 18 GHz<br>Max. SWR:<br>1.13 (9 kHz to 2 GHz)<br>1.19 (2 GHz to 14 GHz)<br>1.22 (14 GHz to 16 GHz)<br>1.26 (16 GHz to 18 GHz)<br>Amplitude range: 1 nW to 100 mW (-60 dBm to +20 dBm) | 1 | Agilent N1913A and Agilent E9304A |
| Function/Arbitrary Waveform Generator | Max. output frequency: > 1 MHz<br>Flatness (< 1 MHz): ±0.3 dB<br>Amplitude accuracy (the amplitude is 2 Vpp): < ±30 mV | 1 | RIGOL DG4162 or DG4062 |
| Dual-N Cable | N (male)-N (male) cable<br>Frequency range: DC to 6 GHz<br>SWR: < 1.1<br>Insertion loss: < 1 dB | 1 | -- |
| Dual-BNC Cable | BNC (male)-BNC (male) cable | 2 | -- |
| N-BNC Cable | N (male)-BNC (male) cable | 1 | -- |

**Note:** [1] This signal analyzer can be used in place of the Agilent E4440A spectrum analyzer plus the N9000A signal analyzer.

# 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 specification limits as well as spaces for users to record the test results, is provided.

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

# Specifications

The specification of each test item is provided in chapter 2. For other specifications, refer to *DSG800 User's Guide* or *DSG800 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 40 minutes.

# Chapter 2 Performance Verification Test

This chapter introduces the performance verification test methods and procedures of DSG800 series RF signal generator.

**Note:**

1) Make sure that the instrument has been warmed up for at least 40 minutes before executing any of the following test items.
2) Reset the instrument to the factory setting before or after executing any of the following test items.
3) The definitions of "Typical Value", "Nominal Value" and "Measured value" for this product.
   - Typical (typ.): the typical performance that 80 percent of the measurement results can meet at room temperature (approximately 25℃). This data is not warranted and does not include the measurement uncertainty.
   - Nominal (nom.): the expected average performance or the designed performance attribute (for example, the 50 Ω connector). This data is not warranted and is measured at room temperature (approximately 25℃).
   - Measured (meas.): the performance attribute measured during the design phase and used to be compared with the expected performance (for example, the variation of the amplitude drift with time). This data is not warranted and is measured at room temperature (approximately 25℃).

# Amplitude Accuracy Test

## Specifications

| Absolute Level Uncertainty | | |
|---|---|---|
| Temperature range: 20℃ to 30℃ | | |
| | +13 dBm to -60 dBm | -60 dBm to -110 dBm |
| 100 kHz ≤ f ≤ 3 GHz | ≤ 0.9 dB,<br>≤ 0.5 (typ.) | ≤ 1.1 dB,<br>≤ 0.7 (typ.) |

## Test Devices

1. Power Meter and Power Sensor × 1
2. Dual-N Cable × 1
3. Dual-BNC Cable × 1
4. Signal Analyzer × 1

## Test Connection Diagram

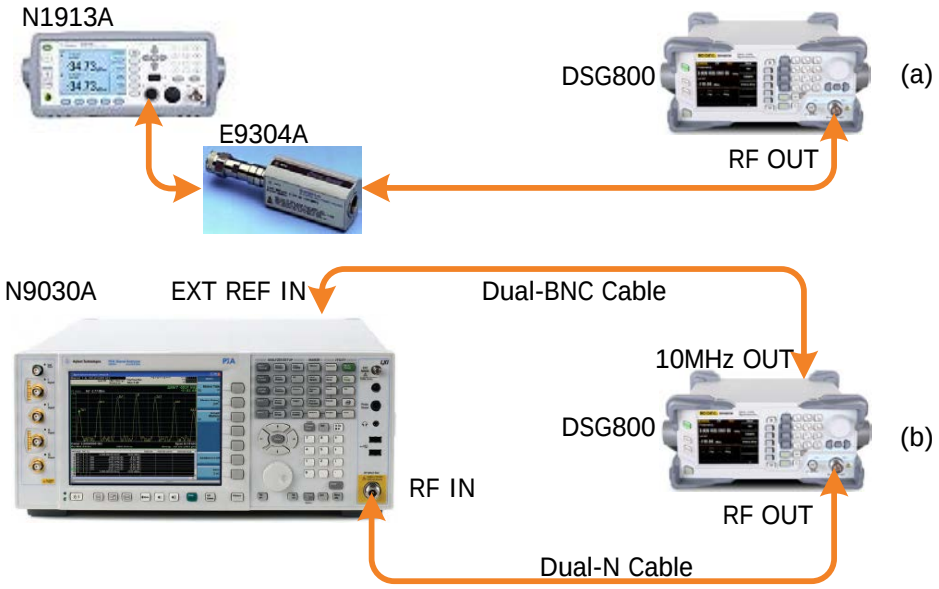


Figure 2-1 Amplitude Accuracy Test Connection Diagram

## Test Procedures

1. Calibrate the power meter:
   a) Connect the power sensor with the **[REF]** terminal and channel A of the power meter. Press **Channel** and set the frequency of channel A to 50 MHz.
   b) Press **Cal** and enable **Power Ref** in the **Zero/Cal** menu. Press **Zero+Cal** and wait for

the calibration to finish; then, observe whether the measurement value of the power meter is a 0 dBm, 50 MHz signal.

c) Disable **Power Ref**.

2. Connect the output terminal of DSG800 with the power sensor, as shown in Figure 2-1 (a).

3. Set DSG800 to output a sine waveform with -10 dBm amplitude. Then, modify the output frequency of DSG800 according to Table 2-1 and turn on the RF output switch **RF/on**.

Table 2-1 Output Frequency of DSG800

| Model | Output Frequency | | | | | | |
|---|---|---|---|---|---|---|---|
| DSG830 | 103 kHz | 1.03 MHz | 50.03 MHz | 503 MHz | 1.903 GHz | 2.493 GHz | 2.903 GHz |
| DSG815 | 103 kHz | 1.03 MHz | 50.03 MHz | 503 MHz | 1.403 GHz | | |

**Note:** When the frequency of the signal measured is less than 10 MHz, you need to switch the signal analyzer to DC coupling mode to ensure the measurement accuracy.

4. Modify the frequency of the power meter accordingly each time the output frequency of DSG800 is modified. Read the amplitude measurement value **A1** and record it to the Test Record Form.

5. Disconnect DSG800 and the power meter. Connect the **[10MHz OUT]** terminal of DSG800 with the **[EXT REF IN]** terminal at the rear panel of the signal analyzer using a dual-BNC cable to synchronize the two instruments.

6. Connect the output terminal of DSG800 with the input terminal of the signal analyzer using a dual-N cable as shown in Figure 2-1 (b).

7. Configure the signal analyzer:
   a) Set the frequency reference input to external.
   b) Set the span to 1 MHz.
   c) Set the reference level to 0 dBm.
   d) Set the input attenuation to 10 dB.
   e) Set the resolution bandwidth to 10 kHz.
   f) Set the sweep time to auto and the sweep time method to accurate.
   g) Set the self-calibration to normal and perform all of the calibration items.

8. Set the output frequency of DSG800 and the center frequency of the signal analyzer according to Table 2-1 (the center frequency of the signal analyzer corresponds to output frequency of DSG800).

9. Each time the center frequency is changed, press **Single**, wait for the instrument to finish a sweep and press **Peak Search** to find the maximum peak. Then, record the result **A2** to the Test Record Form.

10. Calculate the **System Error** (the input attenuation of the signal analyzer is 10 dB) **= A2 - A1** and record the result.

11. Keep the connections shown in Figure 2-1 (b) unchanged, press **Mode Preset** to restore the signal analyzer to its factory setting and set the output amplitude of DSG800 according to Table 2-2.

    Table 2-2 Output Amplitude of DSG800

| **Output Amplitude** | |
|---|---|
| -10 dBm | -80 dBm |

    **Note:** Here, the output amplitude of DSG800 is used as the amplitude **Reference Value**. Different output amplitudes correspond to different reference values.

12. Each time the output amplitude of DSG800 is changed, modify the configurations of the signal analyzer accordingly.
    a) Set the frequency reference input to external.
    b) Set the span to 100 Hz.
    c) Set the reference level to -20 dBm.
    d) Set the input attenuation to 10 dB.
    e) Set the resolution bandwidth to 1 Hz.
    f) Set the sweep time method to accurate.
    g) Set the self-calibration to normal and perform all of the calibration items.

13. Set the output frequency of DSG800 and the center frequency of the signal analyzer according to Table 2-1 (the center frequency of the signal analyzer corresponds to output frequency of DSG800).

14. Each time the center frequency is changed, press **Single** and wait for the instrument to finish a sweep; then, press **Peak Search** to find the maximum peak and record the measurement result **A3** to the Test Record Form.

15. Calculate the **Global Error = A3 - Reference Value** and record the result.

16. Calculate the **Amplitude Accuracy = |Global Error - System Error|** and compare the measurement result with the specification.

# Test Record Form

| DSG800 Output Frequency | Power Meter Measurement Value A1 | Signal Analyzer Measurement Value A2 | System Error[1] |
|---|---|---|---|
| 103 kHz | | | |
| 1.03 MHz | | | |
| 50.03 MHz | | | |
| 503 MHz | | | |
| 1.403 GHz (Only for DSG815) | | | |
| 1.903 GHz (Only for DSG830) | | | |
| 2.493 GHz (Only for DSG830) | | | |
| 2.903 GHz (Only for DSG830) | | | |

| Reference Value | -10 dBm | | | | | |
|---|---|---|---|---|---|---|
| DSG800 Output Frequency | Signal Analyzer Measurement Value A3 | Global Error[2] | Amplitude Accuracy[3] | Limit | Pass/ Fail | |
| 103 kHz | | | | ≤ 0.9 dB, ≤ 0.5 (typ.) | | |
| 1.03 MHz | | | | | | |
| 50.03 MHz | | | | | | |
| 503 MHz | | | | | | |
| 1.403 GHz (Only for DSG815) | | | | | | |
| 1.903 GHz (Only for DSG830) | | | | | | |
| 2.493 GHz (Only for DSG830) | | | | | | |
| 2.903 GHz (Only for DSG830) | | | | | | |

| Reference Value | -80 dBm | | | | | |
|---|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Signal Analyzer Measurement Value A3** | **Global Error[2]** | **Amplitude Accuracy[3]** | **Limit** | **Pass / Fail** | |
| 103 kHz | | | | ≤ 1.1 dB, ≤ 0.7 (typ.) | | |
| 1.03 MHz | | | | | | |
| 50.03 MHz | | | | | | |
| 503 MHz | | | | | | |
| 1.403 GHz (Only for DSG815) | | | | | | |
| 1.903 GHz (Only for DSG830) | | | | | | |
| 2.493 GHz (Only for DSG830) | | | | | | |
| 2.903 GHz (Only for DSG830) | | | | | | |

**Note:**

[1] System Error = A2 - A1

[2] Global Error = A3 - Reference Value

[3] Amplitude Accuracy = |Global Error - System Error|

# Single-sideband Phase Noise Test

## Specifications

| Single-sideband Phase Noise | | | |
|---|---|---|---|
| **Carrier Offset** | **Frequency** | **DSG815** | **DSG830** |
| 20 kHz | 100 MHz | < -100 dBc/Hz | < -100 dBc/Hz |
| | 1 GHz | < -100 dBc/Hz | < -100 dBc/Hz |
| | 3 GHz | -- | < -94 dBc/Hz |

## Test Devices

1. Signal Analyzer × 1
2. Dual-N Cable × 1
3. Dual-BNC Cable × 1

## Test Connection Diagram

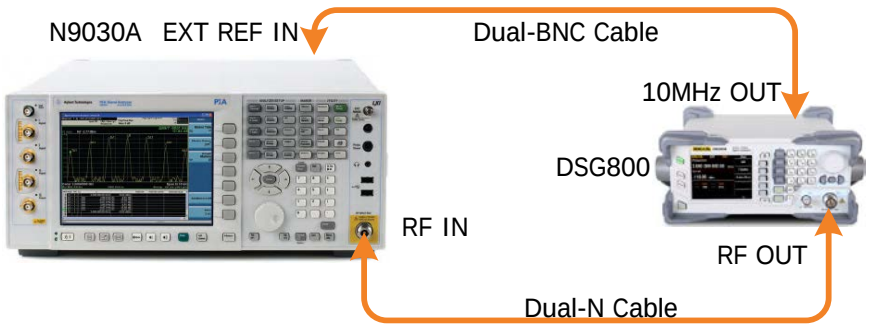


Figure 2-2 Single-sideband Phase Noise Test Connection Diagram

## Test Procedures

1. Connect the **[10MHz OUT]** terminal of DSG800 with the **[EXT REF IN]** terminal at the rear panel of the signal analyzer using a dual-BNC cable to synchronize the two instruments, as shown in Figure 2-2.

2. Connect the RF output terminal of DSG800 with the RF input terminal of the signal analyzer.

3. Set DSG800 to output a sine waveform with 1 GHz frequency and 0 dBm amplitude. Then, turn on the RF output switch **RF/on**.

4. Configure the signal analyzer:
   a) Set the frequency reference input to external.

b) Set the center frequency to 1 GHz.
c) Set the span to 50 kHz.
d) Set the resolution bandwidth to 1 kHz.
e) Set the video bandwidth to 3 Hz.
f) Set the reference level to 0 dBm.
g) Set the input attenuation to 10 dB.
h) Set the trace type to clear write.
i) Set the detector type to RMS average.
j) Set the sweep time to auto and the sweep time method to accurate.

5. Press **Single**, wait for the instrument to finish a sweep and press **Peak Search** to find the maximum peak.

6. Press **Marker** → **Delta** → input 20 kHz. Press **Single** and wait for the instrument to finish a sweep. Press **Marker Function** → **Marker Noise**, read the current measurement result and record it to the Test Record Form.

7. Press **Mode Preset** to reset the signal analyzer to the factory setting. Set the output frequency of DSG800 according to Table 2-3, repeat steps 4 to 6 (note that modify the center frequency of the signal analyzer accordingly in step 4 each time the output frequency of DSG800 is modified) and record the result.

Table 2-3 Output Frequency of DSG800

| **Output Frequency** | |
|---|---|
| 100 MHz | 3 GHz (Only for DSG830) |

8. Compare the measurement result with the specification.

## Test Record Form

| **Single-sideband Phase Noise** | | | | | |
|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Offset** | **Measurement Value** | **Limit** | **Pass/Fail** | |
| 100 MHz | Offset 20 kHz | | < -100 dBc/Hz | | |
| 1 GHz | Offset 20 kHz | | < -100 dBc/Hz | | |
| 3 GHz (Only for DSG830) | Offset 20 kHz | | < -94 dBc/Hz | | |

# Second Harmonic Distortion Test

## Specification

| Second Harmonic Distortion | |
|---|---|
| **Model** | **DSG815/DSG830** |
| Specification | < -30 dBc |

## Test Devices

1. Signal Analyzer × 1
2. Dual-BNC Cable × 1
3. Dual-N Cable × 1

## Test Connection Diagram

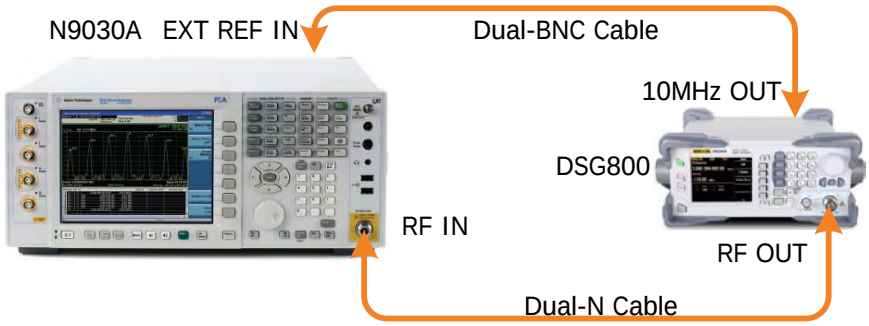


Figure 2-3 Second Harmonic Distortion Test Connection Diagram

## Test Procedures

1. Synchronize DSG800 and the signal analyzer. Connect the RF output terminal of DSG800 with the RF input terminal of the signal analyzer as shown in Figure 2-3.

2. Set the output frequency of DSG800 to **F0** according to Table 2-4 and the amplitude to 0 dBm. Turn on the RF output switch **RF/on**.

   Table 2-4 Output Frequency of DSG800

| Output Frequency (F0) | | | | |
|---|---|---|---|---|
| 10 MHz | 100 MHz | 500 MHz | 1.5 GHz | 2 GHz (Only for DSG830) |

3. Configure the signal analyzer:
   a) Set the center frequency to the output frequency of DSG800.
   b) Set the span to 10 kHz.

c) Set the reference level to 10 dBm.
d) Set the input attenuation to 20 dB.
e) Set the resolution bandwidth to 30 Hz.
f) Set the video bandwidth to 10 Hz.
g) Set the sweep time method to accurate.

**Note:** Modify the center frequency of the signal analyzer accordingly each time the output frequency of DSG800 is changed (the center frequency of the signal analyzer corresponds to output frequency of DSG800).

4. Press **Single** and wait for the instrument to finish a sweep; press **Peak Search** to find the maximum peak. Then, press **Marker** → **Delta** to set the cursor type to Delta. Set the center frequency to **2 × F0**, press **Single** and wait for the instrument to finish a sweep; press **Peak Search** and record the delta result **A1**.

5. Calculate the **Second Harmonic Distortion = Delta A1** and compare the calculation result with the specification.

6. Press **Mode Preset** to reset the signal analyzer to the factory setting. Set the output amplitude of DSG800 in step 2 to 10 dBm.

7. Configure the signal analyzer: set the input attenuation to 30 dB, set the reference level to 20 dBm and the settings of the other parameters are the same with those in step 3.

8. Repeat steps 2 to 5 to measure the second harmonic distortion when the output amplitude of DSG800 is 10 dBm and record the result.

## Test Record Form

| **DSG800 Output Amplitude** | 0 dBm | | | | |
|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Delta A1** | **Calculation Result[1]** | **Limit** | **Pass/Fail** | |
| 10 MHz | | | < -30 dBc | | |
| 100 MHz | | | | | |
| 500 MHz | | | | | |
| 1.5 GHz | | | | | |
| 2 GHz (Only for DSG830) | | | | | |

| **DSG800 Output Amplitude** | 10 dBm | | | | |
|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Delta A1** | **Calculation Result[1]** | **Limit** | **Pass/Fail** | |
| 10 MHz | | | < -30 dBc | | |
| 100 MHz | | | | | |
| 500 MHz | | | | | |
| 1.5 GHz | | | | | |
| 2 GHz (Only for DSG830) | | | | | |

**Note:** [1] Calculation Result = Delta A1

# AM Test

## Specifications

| AM | | |
|---|---|---|
| **Model** | **DSG815/DSG830** | |
| Item | Condition | Specification |
| Modulation Accuracy | $f_{mod}$ = 1 kHz | < Modulation depth setting × 4% + 1% |
| Distortion | $f_{mod}$ = 1 kHz, m[1] < 30%, level = 0 dBm | < 3% (typ.) |

**Note:** [1] m represents the AM depth.

## Test Devices

1. Signal Analyzer × 1
2. Dual-BNC Cable × 1
3. Dual-N Cable × 1

## Test Connection Diagram

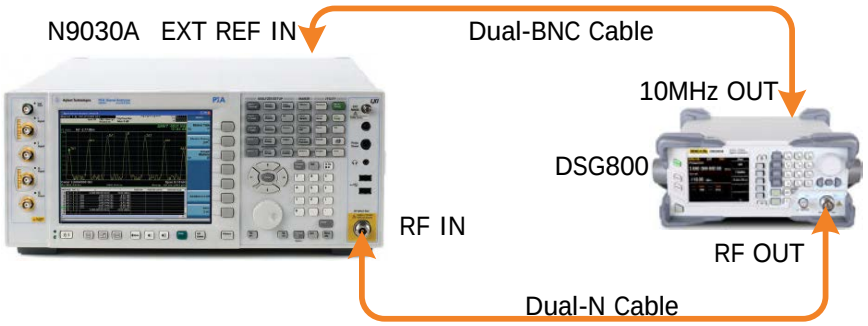


Figure 2-4 AM Test Connection Diagram

## Test Procedures

1. Synchronize DSG800 and the signal analyzer. Connect the RF output terminal of DSG800 with the RF input terminal of the signal analyzer as shown in Figure 2-4.

2. Configure DSG800:
   a) Set the frequency to 1 GHz.
   b) Set the amplitude to -10 dBm.
   c) Turn on the RF output switch **RF/on**.
   d) Turn on the AM switch.
   e) Set the modulation source to internal.

f) Set the modulation depth to 30%.
g) Set the modulation frequency to 1 kHz.
h) Set the modulation waveform to Sine.
i) Turn on the modulation output switch **Mod/on**.

3. Configure the signal analyzer:
   a) Set the center frequency to 1 GHz.
   b) Set the span to 10 kHz.
   c) Set the reference level to 0 dBm.
   d) Set the input attenuation to 10 dB.
   e) Set the resolution bandwidth to 100 Hz.
   f) Set the video bandwidth to 100 Hz.
   g) Set the sweep time method to accurate.
   h) Select AM analog demodulation.

4. Press **Meas Setup** → **Auto Scale** on the signal analyzer and then read the results of the demodulated signal in the AM analog demodulation test interface of the signal analyzer. Record the measurement results of **(Pk - Pk) / 2** and **Distortion**.

   **Note: (Pk - Pk) / 2** represents the peak of the low frequency signal after AM demodulation.

5. Calculate the **Modulation Accuracy = |(Pk - Pk) / 2 - 30%|**, **Distortion = Distortion Value**. Then, compare the calculation results with the specifications.

## Test Record Form

| DSG800 Output Frequency | Item | Measurement Value | Calculation Result | Limit | Pass/Fail | |
|---|---|---|---|---|---|---|
| 1 GHz | Modulation Accuracy[1] | | | < Modulation Depth Setting × 4% + 1% | | |
| | Distortion[2] | | | < 3% (typ.) | | |

**Note:**

[1] Modulation Accuracy = |(Pk - Pk) / 2 - 30%|

[2] Distortion = Distortion Value in the AM Analog Demodulation Test Interface

# FM Test

## Specifications

| FM | | |
|---|---|---|
| **Model** | **DSG815/DSG830** | |
| Item | Condition | Specification |
| Modulation Accuracy | $f_{mod}$ = 1 kHz, internal modulation | < Modulation frequency deviation setting × 2% + 20 Hz |
| Distortion | $f_{mod}$ = 1 kHz, deviation = N[1] × 50 kHz | < 2% (typ.) |

**Note:** [1] The corresponding relations between the values of N and the frequency ranges are as shown in the table below.

| Frequency Range | N |
|---|---|
| f < 227.5 MHz | 0.25 |
| 227.5 MHz ≤ f < 455 MHz | 0.125 |
| 455 MHz ≤ f < 910 MHz | 0.25 |
| 910 MHz ≤ f < 1820 MHz | 0.5 |
| 1820 MHz ≤ f ≤ 3000 MHz | 1 |

## Test Devices

1. Signal Analyzer × 1
2. Dual-BNC Cable × 1
3. Dual-N Cable × 1

## Test Connection Diagram

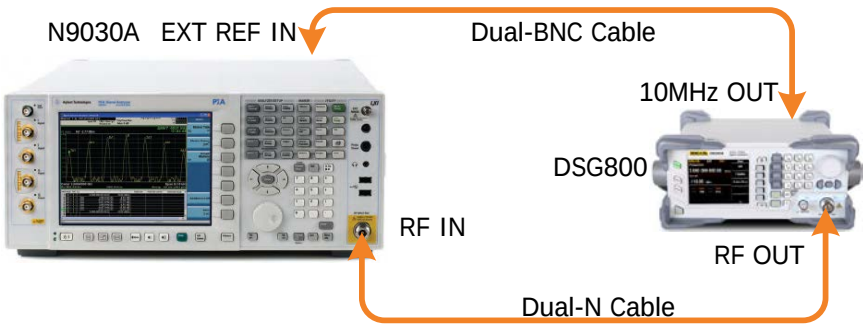


Figure 2-5 FM Test Connection Diagram

## Test Procedures

1. Synchronize DSG800 and the signal analyzer. Connect the RF output terminal of DSG800 with the RF input terminal of the signal analyzer as shown in Figure 2-5.

2. Configure DSG800:
   a) Set the frequency to 1 GHz.
   b) Set the amplitude to -10 dBm.
   c) Turn on the RF output switch **RF/on**.
   d) Select FM modulation.
   e) Turn on the FM switch.
   f) Set the modulation source to internal.
   g) Set the modulation frequency deviation to 50 kHz.
   h) Set the modulation rate to 1 kHz.
   i) Set the modulation waveform to Sine.
   j) Turn on the modulation output switch **Mod/on**.

3. Configure the signal analyzer:
   a) Set the center frequency to 1 GHz.
   b) Set the span to 200 kHz.
   c) Set the reference level to 0 dBm.
   d) Set the input attenuation to 10 dB.
   e) Set the resolution bandwidth to 1 kHz.
   f) Set the video bandwidth to 1 kHz.
   g) Set the sweep time method to accurate.
   h) Select FM analog demodulation.

4. Press **Meas Setup** → **Auto Scale** on the signal analyzer and read the results of the demodulated signal in the FM analog demodulation test interface of the signal analyzer. Record the measurement results of **(Pk - Pk) / 2** and **Distortion**.

   **Note: (Pk - Pk) / 2** represents the peak of the low frequency signal after FM demodulation.

5. Calculate the modulation accuracy and the distortion using the formulas: **Modulation Accuracy = |(Pk - Pk) / 2 - 50 kHz|**, **Distortion = Distortion Value**. Then, compare the calculation results with the specifications.

## Test Record Form

| DSG800 Output Frequency | Item | Measurement Value | Calculation Result | Limit | Pass/Fail | |
|---|---|---|---|---|---|---|
| 1 GHz | Modulation Accuracy[1] | | | < Modulation Frequency Deviation Setting × 2% + 20 Hz | | |
| | Distortion[2] | | | < 2% (typ.) | | |

**Note:**

[1] Modulation Accuracy = |(Pk - Pk) / 2 - 50 kHz|

[2] Distortion = Distortion Value in the FM Analog Demodulation Test Interface

# ØM Test

## Specifications

| ØM | | |
|---|---|---|
| **Model** | **DSG815/DSG830** | |
| Item | Condition | Specification |
| Modulation Accuracy | $f_{mod}$ = 1 kHz, internal modulation | < Modulation phase deviation setting × 1% + 0.1 rad |
| Distortion | $f_{mod}$ = 1 kHz, deviation = N[1] × 5 rad | < 1% (typ.) |

**Note:** [1] For the values of N, please refer to the note of "Specifications" in "FM Test".

## Test Devices

1. Signal Analyzer × 1
2. Dual-BNC Cable × 1
3. Dual-N Cable × 1

## Test Connection Diagram

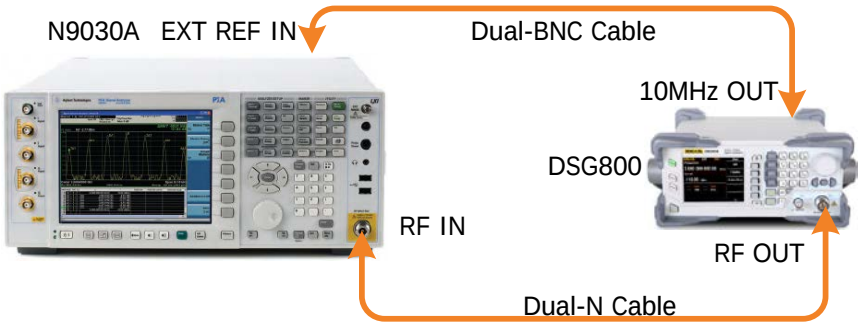


Figure 2-6 ØM Test Connection Diagram

## Test Procedures

1. Synchronize DSG800 and the signal analyzer. Connect the RF output terminal of DSG800 with the RF input terminal of the signal analyzer as shown in Figure 2-6.

2. Configure DSG800:
   a) Set the frequency to 1 GHz.
   b) Set the amplitude to -10 dBm.
   c) Turn on the RF output switch **RF/on**.
   d) Select ØM modulation.
   e) Turn on the ØM switch.

f) Set the modulation source to internal.
g) Set the modulation phase deviation to 5 rad.
h) Set the modulation rate to 1 kHz.
i) Set the modulation waveform to Sine.
j) Turn on the modulation output switch **Mod / on**.

3. Configure the signal analyzer:
   a) Set the center frequency to 1 GHz.
   b) Set the span to 200 kHz.
   c) Set the reference level to 0 dBm.
   d) Set the input attenuation to 10 dB.
   e) Set the resolution bandwidth to 1 kHz.
   f) Set the video bandwidth to 1 kHz.
   g) Set the sweep time method to accurate.
   h) Select ØM analog demodulation.

4. Press **Meas Setup** → **Auto Scale** on the signal analyzer and read the results of the demodulated signal in the ØM analog demodulation test interface of the signal analyzer. Record the measurement results of **(Pk - Pk) / 2** and **Distortion**.

   **Note: (Pk - Pk) / 2** represents the peak of the low frequency signal after ØM demodulation.

5. Calculate the **Modulation Accuracy = |(Pk - Pk) / 2 - 5 rad|**, **Distortion = Distortion Value**. Then, compare the calculation results with the specifications.

## Test Record Form

| DSG800 Output Frequency | Item | Measurement Value | Calculation Result | Limit | Pass / Fail | |
|---|---|---|---|---|---|---|
| 1 GHz | Modulation Accuracy[1] | | | < Modulation Phase Deviation Setting × 1% + 0.1 rad | | |
| | Distortion[2] | | | < 1% (typ.) | | |

**Note:**

[1] Modulation Accuracy = |(Pk - Pk) / 2 - 5 rad|

[2] Distortion = Distortion Value in the ØM Analog Demodulation Test Interface

# Pulse Modulation Test

## Specification

| Pulse Modulation | | |
|---|---|---|
| **Model** | **DSG815/DSG830** | |
| Item | Condition | Specification |
| On/Off Ratio | 100 kHz ≤ f < 3 GHz | > 70 dB |

## Test Devices

1. Signal Analyzer × 1
2. Dual-BNC Cable × 1
3. Dual-N Cable × 1

## Test Connection Diagram

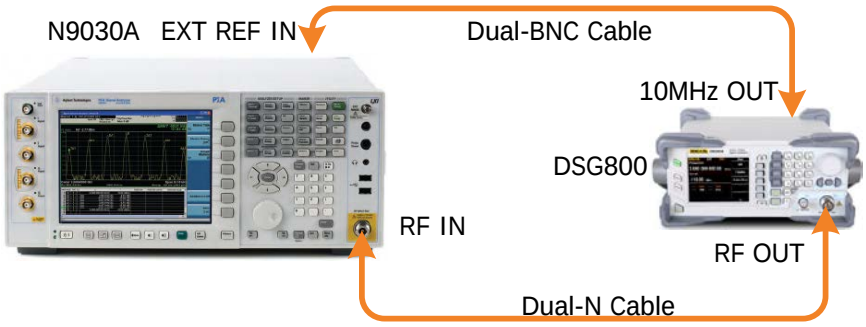


Figure 2-7 Pulse Modulation Test Connection Diagram

## Test Procedures

1. Synchronize DSG800 and the signal analyzer. Connect the RF output terminal of DSG800 with the RF input terminal of the signal analyzer as shown in Figure 2-7.

2. Configure DSG800:
   a) Set the frequency to 1 GHz.
   b) Set the amplitude to -10 dBm.
   c) Turn on the RF output switch **RF/on**.
   d) Turn on the pulse modulation switch.
   e) Set the modulation source to internal.
   f) Set the pulse mode to single.
   g) Set the pulse period to 1 s.
   h) Set the pulse width to 0.5 s.

i) Set the trigger mode to auto.
j) Turn on the modulation output switch **Mod/on**.

3. Configure the signal analyzer:
   a) Set the center frequency to 1 GHz.
   b) Set the span to 0 Hz.
   c) Set the reference level to 0 dBm.
   d) Set the input attenuation to 10 dB.
   e) Set the resolution bandwidth to 100 Hz.
   f) Set the video bandwidth to 100 kHz.
   g) Set the sweep time to 2 s.
   h) Set the sweep time method to accurate.
   i) Set the trigger mode to video trigger.

4. Press **Single** and wait for the instrument to finish a sweep; press **Peak Search** to find the maximum peak.

5. Press **Marker** → **Delta** → input 0.5 s; press **Single** and wait for the instrument to finish a sweep. Read the current measurement result; calculate the **On/Off Ratio = -Delta** and compare the calculation result with the specification.

6. If the model of DSG800 under test is DSG830, press **Mode Preset** to reset the signal analyzer to the factory setting. Set the frequency of DSG800 to 2 GHz (other parameters keep unchanged); then, repeat steps 2 to 5. Record the measurement result and compare the result with the specification.

## Test Record Form

| DSG800 Output Frequency | Item | Measurement Value | Calculation Result[1] | Limit | Pass/Fail | |
|---|---|---|---|---|---|---|
| 1 GHz | On/Off Ratio | | | > 70 dB | | |
| 2 GHz (Only for DSG830) | On/Off Ratio | | | > 70 dB | | |

**Note:** [1] Calculation Result = -Delta

# 10 MHz Reference Input Amplitude Range Test

## Specification

| 10 MHz Reference Input Amplitude Range | |
|---|---|
| Specification | 0 dBm to +10 dBm |

## Test Devices

1. Function/Arbitrary Waveform Generator × 1
2. Signal Analyzer × 1
3. Dual-BNC Cable × 2
4. N-BNC Cable × 1

## Test Connection Diagram

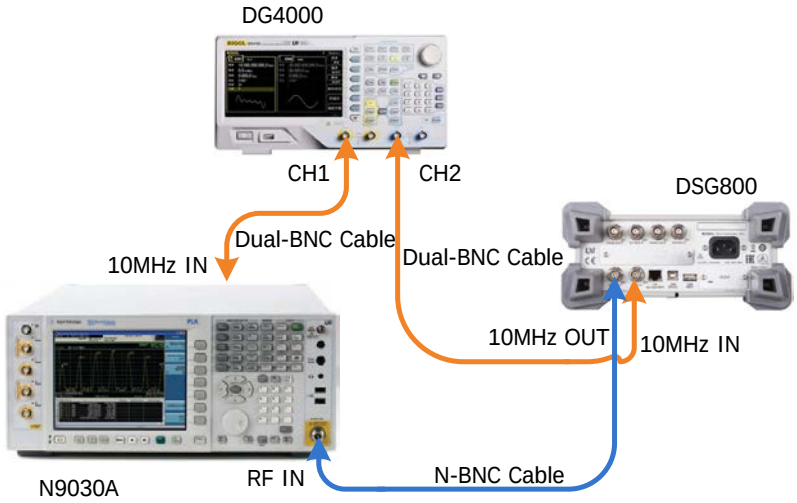


Figure 2-8 10 MHz Reference Input Amplitude Range Test Connection Diagram

## Test Procedures

1. Connect the **[CH1]** output terminal of the function/arbitrary waveform generator with the **[10MHz IN]** input terminal of the signal analyzer. Set the signal analyzer to external reference; set the frequency and amplitude of CH1 of the function/arbitrary waveform generator to 10 MHz and +5 dBm respectively and turn on the output to synchronize the function/arbitrary waveform generator and signal analyzer, as shown in Figure 2-8.

   **Note:** The 10 MHz signal output from the function/arbitrary waveform generator must have relatively higher accuracy (with lower than ±5 ppm deviation); otherwise, this specification cannot be measured.

2. Connect the **[CH2]** output terminal of the function/arbitrary waveform generator with the **[10MHz IN]** input terminal at the rear panel of DSG800. Connect the **[10MHz OUT]** output terminal of DSG800 with the **[RF IN]** terminal of the signal analyzer.

3. Set the frequency and amplitude of CH2 of the function/arbitrary waveform generator to 10 MHz and 0 dBm respectively and turn on the output.

4. Set the center frequency and span of the signal analyzer to 10 MHz and 1 kHz respectively. Press **Peak Search** to read the frequency of the signal.

5. Set the amplitude of CH2 of the function/arbitrary waveform generator to gradually decrease from 0 dBm and monitor the signal frequency measured by the signal analyzer; stop the measurement when the frequency measured is not 10 MHz and record the current amplitude **A1** of CH2 of the function/arbitrary waveform generator.

6. Set the amplitude of CH2 of the function/arbitrary waveform generator to gradually increase from 0 dBm and monitor the signal frequency measured by the signal analyzer; stop the measurement when the frequency measured is not 10 MHz (note that you also need to stop the measurement if the frequency measured is still 10 MHz when the amplitude of CH2 increases to +15 dBm) and record the current amplitude **A2** of CH2 of the function/arbitrary waveform generator.

7. Record the result of (**A1 to A2**), namely the 10 MHz reference input amplitude range. Compare the result with the specification. If the amplitude range measured includes the range required by the specification, the instrument passes the test.

## Test Record Form

| Amplitude Measurement Value A1 | Amplitude Measurement Value A2 | A1 to A2 | Specification | Pass/Fail |
|---|---|---|---|---|
| | | | 0 dBm to +10 dBm | |

# Appendix Test Record Form

**RIGOL** DSG800 Series RF Signal Generator
Performance Verification Test Record Form

Model:_____ Tested By:_____ Test Date:_____

**Amplitude Accuracy Test:**

| DSG800 Output Frequency | Power Meter Measurement Value A1 | Signal Analyzer Measurement Value A2 | System Error[1] |
|---|---|---|---|
| 103 kHz | | | |
| 1.03 MHz | | | |
| 50.03 MHz | | | |
| 503 MHz | | | |
| 1.403 GHz (Only for DSG815) | | | |
| 1.903 GHz (Only for DSG830) | | | |
| 2.493 GHz (Only for DSG830) | | | |
| 2.903 GHz (Only for DSG830) | | | |

| Reference Value | -10 dBm | | | | | |
|---|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Signal Analyzer Measurement Value A3** | **Global Error[2]** | **Amplitude Accuracy[3]** | **Limit** | **Pass/ Fail** | |
| 103 kHz | | | | ≤ 0.9 dB, ≤ 0.5 (typ.) | | |
| 1.03 MHz | | | | | | |
| 50.03 MHz | | | | | | |
| 503 MHz | | | | | | |
| 1.403 GHz (Only for DSG815) | | | | | | |
| 1.903 GHz (Only for DSG830) | | | | | | |
| 2.493 GHz (Only for DSG830) | | | | | | |
| 2.903 GHz (Only for DSG830) | | | | | | |

| Reference Value | -80 dBm | | | | | |
|---|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Signal Analyzer Measurement Value A3** | **Global Error[2]** | **Amplitude Accuracy[3]** | **Limit** | **Pass / Fail** | |
| 103 kHz | | | | ≤ 1.1 dB, ≤ 0.7 (typ.) | | |
| 1.03 MHz | | | | | | |
| 50.03 MHz | | | | | | |
| 503 MHz | | | | | | |
| 1.403 GHz (Only for DSG815) | | | | | | |
| 1.903 GHz (Only for DSG830) | | | | | | |
| 2.493 GHz (Only for DSG830) | | | | | | |
| 2.903 GHz (Only for DSG830) | | | | | | |

**Note:**

[1] System Error = A2 - A1

[2] Global Error = A3 - Reference Value

[3] Amplitude Accuracy = |Global Error - System Error|

## Single Sideband Phase Noise Test:

| **Single-sideband Phase Noise** | | | | | |
|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Offset** | **Measurement Result** | **Limit** | **Pass / Fail** | |
| 100 MHz | Offset 20 kHz | | < -100 dBc/Hz | | |
| 1 GHz | Offset 20 kHz | | < -100 dBc/Hz | | |
| 3 GHz (Only for DSG830) | Offset 20 kHz | | < -94 dBc/Hz | | |

### Second Harmonic Distortion Test:

| DSG800 Output Amplitude | 0 dBm | | | | |
|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Delta A1** | **Calculation Result[1]** | **Limit** | **Pass/Fail** | |
| 10 MHz | | | < -30 dBc | | |
| 100 MHz | | | | | |
| 500 MHz | | | | | |
| 1.5 GHz | | | | | |
| 2 GHz (Only for DSG830) | | | | | |

| DSG800 Output Amplitude | 10 dBm | | | | |
|---|---|---|---|---|---|
| **DSG800 Output Frequency** | **Delta A1** | **Calculation Result[1]** | **Limit** | **Pass/Fail** | |
| 10 MHz | | | < -30 dBc | | |
| 100 MHz | | | | | |
| 500 MHz | | | | | |
| 1.5 GHz | | | | | |
| 2 GHz (Only for DSG830) | | | | | |

**Note:** [1] Calculation Result = Delta A1

### AM Test:

| DSG800 Output Frequency | Item | Measurement Value | Calculation Result | Limit | Pass/Fail | |
|---|---|---|---|---|---|---|
| 1 GHz | Modulation Accuracy[1] | | | < Modulation Depth Setting × 4% + 1% | | |
| | Distortion[2] | | | < 3% (typ.) | | |

**Note:**

[1] Modulation Accuracy = |(Pk - Pk) / 2 - 30%|

[2] Distortion = Distortion Value in the AM Analog Demodulation Test Interface

### FM Test:

| DSG800 Output Frequency | Item | Measurement Value | Calculation Result | Limit | Pass/ Fail | |
|---|---|---|---|---|---|---|
| 1 GHz | Modulation Accuracy[1] | | | < Modulation Frequency Deviation Setting × 2% + 20 Hz | | |
| | Distortion[2] | | | < 2% (typ.) | | |

**Note:**

[1] Modulation Accuracy = |(Pk - Pk) / 2 - 50 kHz|

[2] Distortion = Distortion Value in the FM Analog Demodulation Test Interface

### ØM Test:

| DSG800 Output Frequency | Item | Measurement Value | Calculation Result | Limit | Pass/ Fail | |
|---|---|---|---|---|---|---|
| 1 GHz | Modulation Accuracy[1] | | | < Modulation Phase Deviation Setting × 1% + 0.1 rad | | |
| | Distortion[2] | | | < 1% (typ.) | | |

**Note:**

[1] Modulation Accuracy = |(Pk - Pk) / 2 - 5 rad|

[2] Distortion = Distortion Value in the ØM Analog Demodulation Test Interface

### Pulse Modulation Test:

| DSG800 Output Frequency | Item | Measurement Value | Calculation Result | Limit | Pass/ Fail | |
|---|---|---|---|---|---|---|
| 1 GHz | On/Off Ratio | | | > 70 dB | | |
| 2 GHz (Only for DSG830) | On/Off Ratio | | | > 70 dB | | |

**Note:** [1] Calculation Result = -Delta

### 10MHz Reference Input Amplitude Range Test:

| Amplitude Measurement Value A1 | Amplitude Measurement Value A2 | A1 to A2 | Specification | Pass/ Fail |
|---|---|---|---|---|
| | | | 0 dBm to +10 dBm | |