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Find the *National Instruments USB-5681* at our website: ***Click HERE***

# NI USB-5681 RF Power Meter Specifications

This document lists specifications for the NI USB-5681 RF power meter. Minimum or maximum specifications are warranted under the following conditions:

- 1 hour warm-up time at ambient temperature
- Calibration cycle maintained
- Temperature 0 °C to 50 °C unless otherwise noted

Typical values are used to define a non-warranty specification that at least 68% of units exhibit at ambient temperatures of 15 °C to 35 °C. Specifications that do not list tolerance values are typical values unless otherwise specified. Tolerance values represent the maximum variation.

Specifications subject to change without notice. For the most recent NI 5681 specifications, visit `ni.com/manuals`.

## General

Frequency range ..... 10 MHz to 18 GHz

Input range ..... –40 dBm to +20 dBm

Input return loss

| | |
|---|---|
| 10 MHz to <150 MHz | >22.12 dB |
| 150 MHz to 2 GHz | >24.94 dB |
| >2 GHz to 12 GHz | >20.08 dB |
| >12 GHz to 18 GHz | >19.08 dB |

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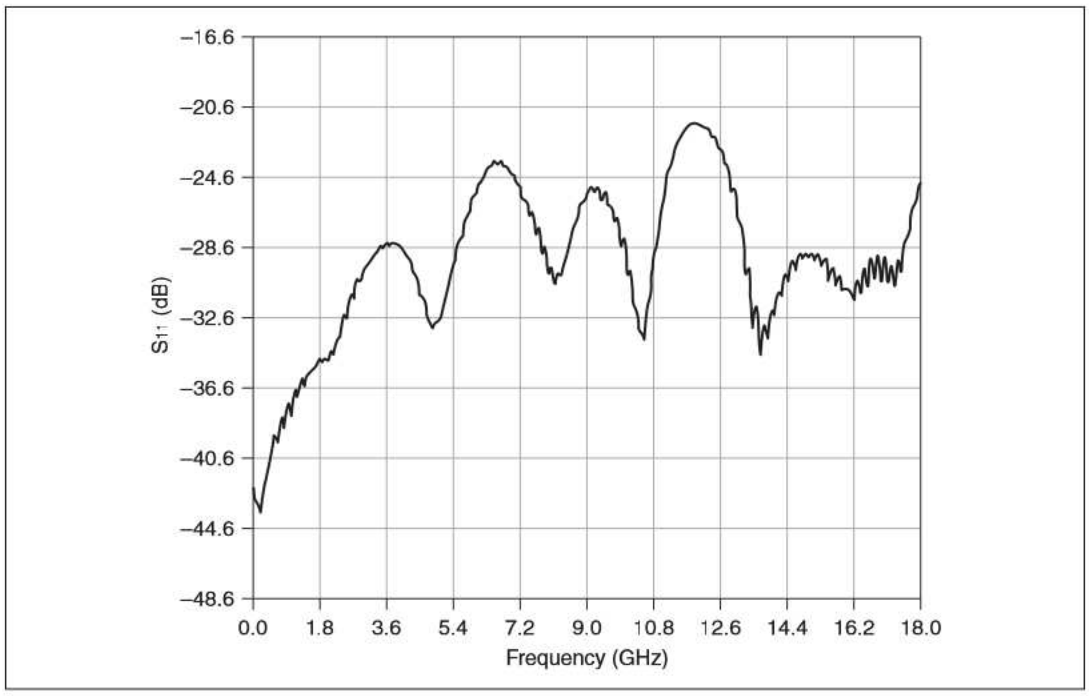



**Figure 1.** Power Meter Return Loss, Measured

Measurement range

Range 1.....+20 dBm to –7 dBm, typical

Range 2.....–7 dBm to –40 dBm, typical

Signal-channel bandwidth .....50 kHz

# Uncertainty

Linearity.....<3% (±0.13 dB)

Calibration factor[1]

10 MHz.....<2.3% (±0.10 dB)

50 MHz to 18 GHz .....<1.5% (±0.07 dB)

Noise[2]

Measurement range 1 .....<8 µW (–21 dBm)

Measurement range 2 .....<40 nW (–44 dBm)

[1] Expanded uncertainty with coverage factor K = 2 for absolute power measurements on a continuous wave (CW) signal at 0 dBm and calibration frequencies 10 MHz, 50 MHz, 100 MHz, 300 MHz, 500 MHz, and 1 GHz to 18 GHz, in 1 GHz increments.

[2] Expanded uncertainty with K = 2 after zero operation when measured with 1 average, and 20 ms aperture time for 5 minutes. Effect of noise can be reduced by increasing the number of averages and/or increasing the aperture time. Noise decreases at a rate equal to the square root of the number of averages and aperture time.



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Zero set[1]

Measurement range 1 ..... <1 µW

Measurement range 2 ..... <3 nW

Zero drift[2]

Measurement range 1 ..... <0.5 µW

Measurement range 2 ..... <3 nW

Temperature compensation

0 °C to 50 °C ..... <1.4% (±0.06 dB)

Effect of digital modulation[3]

Power level ≥18 dBm ..... <1.4% (±0.06 dB)

Power level <18 dBm ..... <0.5% (±0.02 dB)

## System

Measurement ..... Average power

Measurement resolution[4] ..... 0.01 dB

Offset range ..... –100 dB to +150 dB

Averaging ..... Auto, repeat

Number of averages (repeat)[5] ..... 1 to 40,000

Auto-averaging

Resolution[6] ..... 1 dB, 0.1 dB, 0.01 dB, 0.001 dB

Source ..... Time Slot mode: 1 to 128 slots
Scope mode: 1 to 1,024 data points

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[1] Expanded uncertainty with K = 2 after zero operation when measured with 1 average and 20 ms aperture time for 5 minutes.

[2] Expanded uncertainty with K = 2 after one hour warm-up and zero operation and one hour of operation, 1 average, 20 ms aperture time, and when keeping the temperature within ±1 °C.

[3] Measurement error with reference to a CW signal of equal power and frequency at 25 °C.

[4] Resolution in the NI-568x Soft Front Panel (SFP) is two digits after the decimal. Native resolution of the sensor is three digits after the decimal.

[5] Maximum number of averages allowed in Continuous mode and Time Slot mode is 40,000. In Scope mode, the maximum number of averages is equal to 8,231,936 divided by data points.

[6] Averaging resolution of 0.001 dB is not available with the NI-568x SFP. This feature is only available when using the NI-568x instrument driver. Averaging resolution is defined as the place after the decimal to which the reading becomes stable.



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## Continuous Mode

Duty cycle correction.....0.01% to 100%

Aperture time.....0.01 ms to 300 ms

Measurement time[1].....(*Number of Averages* × *a)* + *b*, where *a* and *b* depend on the aperature time, as shown in the following table.

| Aperture Time (ms) | *a* (ms) | *b* (ms) |
|---|---|---|
| 0.01 | 2 | 6.5 |
| 0.1 | 2.3 | 6.5 |
| 1 | 5.4 | 7.1 |
| 10 | 35.8 | 20.5 |
| 100 | 331 | 164 |

## Scope Mode

Capture time .....0.01 ms to 300 ms

Data points.....1 to 1,024

Resolution.....0.01 ms

Measurement time[2].....(*Capture Time in ms* × 6.69) + (*Data Points* × 0.36 ms) + 13.6 ms

## Time Slot Mode

Maximum number of slots.....128

Slot width.....0.01 ms to 100 ms

Maximum capture time.....300 ms (*Slot Width* × *Number of Slots*)

[1] Times based on benchmark results. Performance may vary based on your system.

[2] Times based on benchmark results. Performance may vary based on your system. Formula assumes averaging is set to 1, and trigger source is set to Immediate.



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Resolution ..... 0.01 ms

Exclusion periods[1]

Start exclusion..... 0 ms to 100 ms

End exclusion..... 0 ms to 100 ms

# Trigger

Source[2] ..... Immediate, external, internal, software

## Internal Trigger

Range ..... –20 dBm to +20 dBm

Level accuracy ..... ±0.5 dB, typical

Slope..... Positive or negative

Delay range ..... –5 ms to 10 s

Delay resolution ..... 10 µs

## External Trigger

Impedance ..... 100 kΩ

Type ..... TTL/CMOS

Slope..... Positive or negative

Delay range ..... –5 ms to 10 s

Delay resolution ..... 10 µs

Voltage high threshold..... 2.0 V, typical

Voltage low threshold..... 1.2 V, typical

Hysteresis..... 0.8 V, typical

Maximum voltage ..... ±20 V

Minimum pulse width ..... 7.5 µs[3]

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[1] The start exclusion time plus the end exclusion time must be less than the slot width.

[2] Software trigger not available in the NI-568x SFP. This feature is only available when using the NI-568x instrument driver. Internal and external triggers are not available when using Continuous acquisition mode.

[3] The external trigger source is sampled approximately every 7.5 µs.



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# Maximum Damage Levels

Maximum DC voltage at RF port ..... ±20 V

Absolute power ..... +30 dBm

# DC Power Requirements (5 V) through Host USB

Typical current ..... 150 mA

# Calibration

Interval ..... 1 year; calibration interval starts with the date the product is put into service by the customer

# Physical Dimensions

NI USB-5681 module ..... 25 mm × 45 mm × 110 mm, excluding RF connector and silicone cover

Weight ..... 230 g (0.51 lb)

# Environment

Maximum altitude[1] ..... 4,600 m (at 25 °C ambient temperature)

Pollution Degree ..... 2

Indoor use only.

## Operating Environment

Ambient temperature range ..... 0 °C to 50 °C (Tested in accordance with MIL-PRF-28800F (Class 3).)

Relative humidity range[2] (noncondensing)

At 50 °C ..... 45%

At 40 °C ..... 75%

At 30 °C ..... 95%

[1] Tests were performed per MIL-PRF-28800F (Class 2).

[2] Tested in accordance with MIL-PRF-28800F (Class 3).



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### Storage Environment

Ambient temperature range ..... –40 °C to +71 °C
(Tested in accordance with MIL-PRF-28800F (Class 3).)

Relative humidity range ..... 5% to 95%, noncondensing
(Tested in accordance with MIL-PRF-28800F (Class 3).)

### Shock and Vibration

Nonoperational shock ..... 30 g peak, half-sine, 11 ms pulse
(Tested in accordance with MIL-PRF-28800F.)

Random vibration
nonoperating..... 10 Hz to 500 Hz, Power spectral density 0.03 $g^2$/Hz
(Tested in accordance with MIL-PRF-28800F.)

## Compliance and Certifications

### Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- EN 61010-1

**Note** For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

### Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Minimum Immunity
- EN 5501 Emissions; Group 1, Class A
- EN 61000-4-2/3/4/5/6/11 Immunity
- CE, C-Tick, and FCC Part 15 Emissions; Class A

**Note** For EMC compliance, operate this device according to product documentation.



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## CE Compliance CE

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

## Online Product Certification

To obtain product certifications and the Declaration of Conformity for this product, visit `ni com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

## Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

## Waste Electrical and Electronic Equipment (WEEE)



**EU Customers** At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit `ni com/environment/weee`.

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