
USB-5681

Specifications

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These specifications apply to the USB-5681 .

All specifications are subject to change without notice.



Notice The protection provided by the USB-5681 can be impaired if it is used in a manner not described in this document.

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

Characteristics describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- **Typical** specifications describe the performance met by a majority of models.
- **Nominal** specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are **Typical** unless otherwise noted.

Conditions

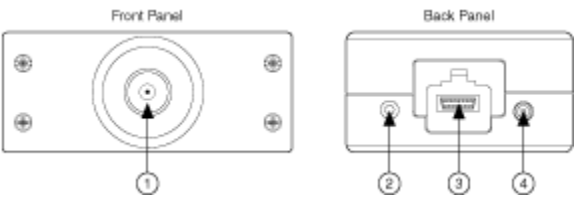
Minimum or maximum specifications are warranted under the following conditions unless otherwise noted.

- 1 hour warm-up time at ambient temperature
- Calibration cycle maintained
- Temperature 0 °C to 55 °C

USB-5681 Pinout

Use the pinout to connect to terminals on the USB-5681 .

The following figure shows both panels of the device.



- 1. Type-N Connector
- 2. LED
- 3. Mini-B USB Port
- 4. External Trigger Terminal

Table 1. Information about the USB-5681 module back panel LED

LED	Indication
Green	The USB-5681 is connected to a computer or a chassis and is functioning properly.
Yellow	An error has occurred.
Off	The USB-5681 is not initialized.



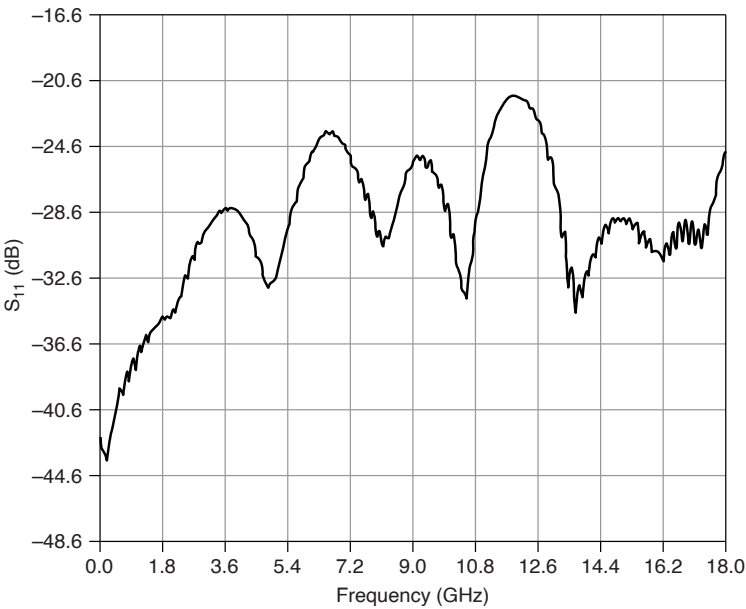
Note The USB-5681 device has a USB 2.0 interface with a USB Type Mini-B port. You can remotely program the device using this USB interface. In addition to communication, the USB supplies power to the device. The interface is USB 2.0 and 1.1 compatible and operates with an interface speed of 12 Mb/s.

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

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
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Uncertainty

Linearity	<3% (± 0.13 dB)
Calibration factor¹	
10 MHz	<2.3% (± 0.10 dB)
50 MHz to 18 GHz	<1.5% (± 0.07 dB)
Noise²	
Measurement range 1	<8 μ W (-21 dBm)
Measurement range 2	<40 nW (-44 dBm)
Zero set³	
Measurement range 1	<1 μ W
Measurement range 2	<3 nW

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

Zero drift⁴	
Measurement range 1	<0.5 μ W
Measurement range 2	< 3 nW
Temperature compensation (0 °C to 50 °C)	<1.4% ($\pm$ 0.06 dB)
Effect of digital modulation⁵	
Power level $\geq$ 18 dBm	<1.4% ($\pm$ 0.06 dB)
Power level <18 dBm	<0.5% ($\pm$ 0.02 dB)

System

Measurement	Average power
Measurement resolution	0.01 dB
Offset range	-100 dB to +150 dB
Averaging	
Averaging mode	Auto, repeat

4. 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.

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

Number of averages (repeat) ⁶	1 to 40,000
Auto-averaging	
Resolution ⁷	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

Continuous Mode

Duty cycle correction	0.01% to 100%
Aperture time	0.01 ms to 300 ms
Measurement time ⁸	(<i>Number of Averages</i> × a) + b , where a and b depend on the aperture time, as shown in the following table.

Table 2. Measurement Time Variables

Aperture Time	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

- 6. 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.
- 7. 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.
- 8. Times based on benchmark results. Performance may vary based on your system.

Aperture Time	a (ms)	b (ms)
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 ⁹	$(\text{Capture Time} \times 6.69) + (\text{Data Points} \times 0.36 \text{ ms}) + 13.6 \text{ ms}$

Time Slot Mode

Maximum number of slots	128
Slot width	0.01 ms to 100 m
Maximum capture time	300 ms ($\text{Slot Width} \times \text{Number of Slots}$)
Resolution	0.01 ms
Exclusion periods ¹⁰	

9. 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.

10. The start exclusion time plus the end exclusion time must be less than the slot width.

Start exclusion	0 ms to 100 ms
End exclusion	0 ms to 100 ms

Trigger

Source ¹¹	Immediate, external, internal, software
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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
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11. 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.

Type	TTL/CMOS
Slope	Positive or negative
Delay range	-5 ms to 10 s
Delay resolution	10 μ s
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 μ s ¹²

Maximum Damage Levels

Maximum DC voltage at RF port	± 20 V
Absolute power	+30 dBm

12. The external trigger source is sampled approximately every 7.5 μ s.

DC Power Requirements (5 V) from Host USB

Typical current	450 mA
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Caution You can impair the protection provided by the USB-5681 if you use it in a manner not described in this document.

Calibration

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

Dimensions	25 mm × 45 mm × 110 mm, excluding RF connector and silicone cover
Weight	230 g (0.51 lb)

Environmental

Specifications in this document are guaranteed under the following specified environmental conditions unless otherwise stated.

Maximum altitude	4,600 m (at 25 °C ambient temperature)
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 to 50 °C (Tested in accordance with MIL-PRF-28800F (Class 3).)	
Relative humidity range ¹³ (noncondensing)		
At 50 °C		45%
At 40 °C		75%
At 30 °C		95%

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

Operating Shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with MIL-PRF-28800F.)
Random Vibration	

13. Tested in accordance with MIL-PRF-28800F (Class 3).

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

Safety Compliance Standards

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

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1



Note For safety certifications, refer to the product label or the [Product Certifications and Declarations](#) section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia, and New Zealand (per CISPR 11), Class A equipment is intended for use only in heavy-industrial locations.



Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.



Note For EMC declarations, certifications, and additional information, refer to the [Product Certifications and Declarations](#) section.

CE Compliance

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)
- 2014/53/EU; Radio Equipment Directive (RED)
- 2014/34/EU; Potentially Explosive Atmospheres (ATEX)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

Environmental Management

NI 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 ***Engineering a Healthy Planet*** 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.

EU and UK Customers

-  **Waste Electrical and Electronic Equipment (WEEE)**—At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit ni.com/environment/weee.

电子信息产品污染控制管理办法（中国RoHS）

-     **中国RoHS**—NI符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于NI中国RoHS合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)