USB-5684 Specifications





Contents

USB-5684 Specifications	3
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USB-5684 Specifications

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

General

Frequency range	10 MHz to 18 GHz
Input range	-60 dBm to +20 dBm
Input VSWR	

10 MHz to <150 MHz			<1.17:1
150 MHz to 2 GHz			<1.12:1
>2 GHz to 12.4 GHz			<1.22:1
>12.4 GHz to 18 GHz			<1.25:1
Measurement range			
Range 1	+4 dBm to +20 dBm, typical		
Range 2	-16 dBm to +4 dBm, typical		
Range 3	-60 dBm to -16 dBm, typical		
Signal-channel bandwidth		50 kHz, typi	cal

Uncertainty

Absolute Power Measurement Uncertainty Expanded uncertainty with k = 2 for a CW measurement after zeroing. Includes calibration factor and linearity; noise, zero set and drift must be added.

Power Measured		Frequ	ency (GHz)	
(dBm)	≤0.05	>0.05 to 2	>2 to 12.4	>12.4 to 18
-60 to <-16	0.14	0.14	0.14	0.17
-16 to <+4	0.14	0.14	0.13	0.13
+4 to +20	0.14	0.15	0.15	0.14

Table 1. Measurement Uncertainty (dB), 0 °C to 50 °C

Table 2. Measurement Uncertainty (dB), 20 °C to 30 °C

Power Measured	Frequency (GHz)					
(dBm)	≤0.05	>0.05 to 2	>2 to 12.4	>12.4 to 18		
-60 to <-16	0.13	0.12	0.14	0.14		
-16 to <+4	0.11	0.10	0.13	0.11		
+4 to +20	0.11	0.10	0.10	0.11		

Relative Power Measurement Uncertainty Expanded uncertainty with k = 2 for measurement of a change in power of a CW signal after zeroing. Includes calibration factor and linearity; noise, zero set and drift must be added.

Initial			Final Power M	easured (dBm)		
Power Measured		0 °C to 50 °C			20 °C to 30 °C	
(dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16
-60 to <-16	0.14	0.13	0.03	0.08	0.09	0.03

Table 3. Measurement Uncertainty (dB), ≤0.05 GHz

Initial			Final Power M	easured (dBm)	
Power Measured	0 °C to 50 °C				20 °C to 30 °C	
(dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16
-16 to <+4	0.14	0.04	0.13	0.06	0.03	0.09
+4 to +20	0.05	0.14	0.14	0.05	0.06	0.08

Table 4. Measurement Uncertainty (dB), >0.05 GHz to 2 GHz

Initial			Final Power Mo	easured (dBm)		
Power Measured		0 °C to 50 °C			20 °C to 30 °C	
(dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16
-60 to <-16	0.16	0.16	0.03	0.11	0.12	0.03
-16 to <+4	0.17	0.05	0.16	0.09	0.04	0.12
+4 to +20	0.06	0.17	0.16	0.06	0.09	0.11

Table 5. Measurement Uncertainty (dB), >2 GHz to 12.4 GHz

Initial			Final Power M	easured (dBm)		
Power Measured	0 °C to 50 °C				20 °C to 30 °C	
(dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16
-60 to <-16	0.16	0.16	0.04	0.12	0.14	0.04
-16 to <+4	0.17	0.05	0.16	0.10	0.04	0.14
+4 to +20	0.06	0.17	0.16	0.07	0.10	0.12

Table 6. Measurement Uncertainty (dB), >12.4 GHz to 18 GHz

Initial			Final Power M	easured (dBm)		
Power Measured		0 °C to 50 °C	50 °C		20 °C to 30 °C	
(dBm)	+4 to +20	-16 to <+4	-60 to <-16	+4 to +20	-16 to <+4	-60 to <-16
-60 to <-16	0.14	0.15	0.04	0.12	0.14	0.04
-16 to <+4	0.11	0.06	0.15	0.10	0.05	0.14
+4 to +20	0.06	0.11	0.14	0.06	0.10	0.12

Power Measured (dBm)	Noise ^[1]	Zero Set ^[2]	Zero Drift ^[3]
-60 to <-16	<123 pW	<332 pW	<344 pW
-16 to <+4	<10.1 nW	<38.7 nW	<42.9 nW
+4 to +20	<0.856 µW	<1.07 µW	<0.996 µW

Table 7. Noise, Zero Set, Zero Drift Uncertainty

Table 8. Effects of Digital Modulation^[4]

Power Measured (dBm)	Uncertainty (dB)
-60 to <-16	+0.080/-0.048
-16 to <+4	+0.088/-0.038
+4 to +20	+0.067/-0.055

Power Measurement

Measurement	Average p	ower
Measurement resolution	0.01 dB m	aximum
Offset range	-100 dB to	+150 dB
Averaging		
Averaging mode		Auto, manual
Averaging type		Moving, repeat
Number of averages (manual) ^[5]		1 to 65,536

Auto-averaging		
Resolution ^[6]	1 dB, 0.1 dB, 0.01 dB	
Source	Time Slot mode: 1 to 128 slots; or Scope mode: 1 to 16,384 data points	

Continuous Mode

Duty cycle correction	0.001% to 100%
Aperture time	0.01 ms to 1 s
Maximum buffer size	8,192
Measurement time ^[7]	Up to 1,000 measurements per second, unbuffered More than 10,000 measurements per second, buffered

Table 9. Measurement Time Examples

Aperture Time (ms)	Averages = 1, in ms	Averages = 10, in ms
0.01	1.0	1.5
0.1	1.2	3.0
1	4.0	19.1
10	34.6	187
100	347	1907

Scope Mode

Capture time	0.01 ms to 1 s
Data points	1 to 16,384
Resolution	0.01 ms maximum
Measurement time ^[8]	<i>Capture Time</i> * 6.2 + 0.013

Time Slot Mode

Maximum number of slots	128	
Slot width	0.01 ms to 100 ms	
Maximum capture time	1,000 ms (<i>Slot Width</i> * <i>Number of Slots</i>)	
Resolution	0.01 maximum	
Exclusion periods ^[9]		
Start exclusion		0 ms to 10 ms
End exclusion		0 ms to 10 ms

Trigger

Internal Trigger

Source ^[10]	Bus or Continuous (Auto, Single or Multiple)
Range	-35 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

Trigger In

Impedance	4 kΩ, nominal
Туре	TTL/CMOS
Slope	Positive
Delay range	-5 ms to 10 s

Delay resolution	10 µs
Voltage high threshold	2.3 V, typical
Voltage low threshold	1.2 V, typical
Hysteresis	0.2 V, typical
Maximum voltage	±5.5 V
Minimum pulse width	100 ns
Latency ^[11]	10.6 μs, maximum
Repetition period	14.2 μs, minimum

Trigger Out

Trigger Out capability is not currently implemented.

Interface

RF connector	N (m)
Interface to host	USB 2.0 full speed (compatible with USB 1.0 and USB 1.1)

External trigger input	MCX(f)
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Maximum Damage Levels

Maximum DC voltage at RF port	±20 V
Maximum power at RF port	+30 dBm (+34 dBm for 10 μs pulse, 10% duty cycle)
Maximum voltage at trigger input	5.5 V

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-5684 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

Physical Characteristics

Dimensions	110 mm x 45 mm x 25.6 mm, excluding RF connector and silicone cover

Caution Clean the hardware with a soft, nonmetallic brush. Make sure the hardware is completely dry and free from contaminants before returning it to service.

Environment

Maximum altitude	4,600 m operational
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 50 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.)	
Relative humidity range ^[12] (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
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g _{rms}
Nonoperating	5 Hz to 500 Hz, 2.4 g _{rms}

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 <u>Product</u> <u>Certifications and Declarations</u> 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 <u>Product Certifications and Declarations</u> section.

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 <u>ni.com/product-certifications</u>, 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 <u>ni.com/environment</u>. 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

• X 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 <u>ni.com/environment/weee</u>.

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.)