

# SPECIFICATIONS

# PXIe-5698

## RF Amplifier

## Contents

---

Definitions.....	2
Conditions.....	2
Amplitude.....	3
Minimal Gain.....	3
Noise Figure.....	4
Average Noise Level.....	5
Absolute Amplitude Accuracy.....	7
Spurious Responses.....	8
Non-Input Related (Residual) Spurs.....	8
Image Rejection.....	8
Linearity.....	9
Third-Order Intermodulation Distortion.....	9
Second Harmonic Intercept.....	9
Gain Compression.....	10
Input and Output Characteristics .....	10
RF IN and RF OUT Front Panel Connectors.....	10
NOISE SOURCE Front Panel Connector.....	10
Voltage Standing Wave Ratio (VSWR).....	11
Power.....	11
Power Requirements.....	11
Power Limits.....	11
Calibration.....	11
Physical Characteristics.....	12
Dimensions and Weight.....	12
Environment.....	12
Operating Environment.....	12
Storage Environment.....	12
Shock and Vibration.....	12
Compliance and Certifications.....	13
Safety.....	13
Electromagnetic Compatibility.....	13
CE Compliance .....	14
Online Product Certification.....	14
Environmental Management.....	14



# Definitions

---

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

The following characteristic specifications 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.
- *Typical-95* specifications describe the performance met by 95% ( $\approx 2\sigma$ ) of models with a 95% confidence.
- *Nominal* specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are *Warranted* unless otherwise noted.

# Conditions

---

*Warranted* specifications are valid under the following conditions unless otherwise noted.

- Over ambient temperature ranges of 0 °C to 55 °C.
- 30 minutes warm-up time.
- Calibration cycle maintained.
- Chassis fan speed set to High. NI recommends using slot blockers and EMC filler panels in empty module slots to minimize temperature drift and reduce emissions.
- NI-RFSA instrument driver is used.

*Typical* specifications are valid under the following conditions unless otherwise noted.

- Over ambient temperature ranges of 23 °C  $\pm$  5 °C.

# Amplitude

## Minimal Gain

**Table 1. PXIe-5698 Minimal Gain (Specification)**

Frequency Range	23 °C ± 5 °C		0 °C to 55 °C	
	Preamplifier Enabled (dB)	Preamplifier Disabled (dB)	Preamplifier Enabled (dB)	Preamplifier Disabled (dB)
10 MHz to 200 MHz	≥23	≥-0.8	≥22	≥-0.8
>200 MHz to 1 GHz	≥32	≥-1.0	≥31	≥-1.0
>1 GHz to 2 GHz	≥32	≥-1.0	≥31	≥-1.0
>2 GHz to 3 GHz	≥29	≥-1.0	≥28	≥-1.0
>3 GHz to 3.6 GHz	≥26	≥-1.0	≥25	≥-1.3
>3.6 GHz to 6 GHz	≥23	≥-1.3	≥22	≥-1.4
>6 MHz to 9 GHz	≥20	≥-1.4	≥19	≥-1.5
>9 GHz to 14 GHz	≥16	≥-2.0	≥15	≥-2.4
>14 GHz to 20 GHz	≥13	≥-2.3	≥13	≥-2.8
>20 GHz to 24 GHz	≥11	≥-2.3	≥10	≥-2.8
>24 GHz to 26 GHz	≥10	≥-2.6	≥8	≥-3.4

Values with preamplifier enabled are based on the stand-alone PXIe-5698 module.

Values with preamplifier disabled reflect insertion loss, as setting preamplifier to disabled bypasses the amplifier stages.

# Noise Figure

**Table 2.** PXIe-5698 Noise Figure (Nominal)

Frequency Range	23 °C ± 5 °C (dB)
10 MHz to 200 MHz	≤3.1
>200 MHz to 1 GHz	≤3.6
>1 GHz to 1.7 GHz	≤3.9
>1.7 GHz to 2.6 GHz	≤4.5
>2.6 GHz to 3.6 GHz	≤5.2
>3.6 GHz to 6 GHz	≤5.0
>6 GHz to 10 GHz	≤5.8
>10 GHz to 14 GHz	≤6.6
>14 GHz to 20 GHz	≤8.8
>20 GHz to 24 GHz	≤11.2
>24 GHz to 26.5 GHz	≤12.6

Values are based on the Noise Figure Y factor method.

**Table 3.** PXIe-5668 with PXIe-5698 Noise Figure, Preamplifier Enabled, Preselector Enabled (Nominal)

Frequency Range	23 °C ± 5 °C (dB)
10 MHz to 200 MHz	≤6.2
>200 MHz to 1 GHz	≤5.2
>1 GHz to 1.7 GHz	≤5.2
>1.7 GHz to 2.6 GHz	≤6.2
>2.6 GHz to 3.6 GHz	≤7.7
>3.6 GHz to 6 GHz	≤6.7
>6 GHz to 10 GHz	≤6.7
>10 GHz to 14 GHz	≤9.2
>14 GHz to 20 GHz	≤10.7
>20 GHz to 24 GHz	≤14.2

**Table 3.** PXIe-5668 with PXIe-5698 Noise Figure, Preamplifier Enabled, Preselector Enabled (Nominal) (Continued)

Frequency Range	23 °C ± 5 °C (dB)
>24 GHz to 26.5 GHz	≤17.7

Values are based on the Average Noise Level -174.2 dBm/Hz with offset for log averaging and window scale [dB].

## Average Noise Level

**Table 4.** PXIe-5668 with PXIe-5698 Average Noise Level, Preamplifier Enabled, Preselector Disabled (Typical)

Frequency Range	23 °C ± 5 °C (dBm/Hz)	0 °C to 55 °C (dBm/Hz)
10 MHz to 200 MHz	≤-169	≤-169
>200 MHz to 1.7 GHz	≤-170	≤-169
>1.7 GHz to 3 GHz	≤-170	≤-168
>3 GHz to 3.6 GHz	≤-167	≤-166
>3.6 GHz to 5 GHz	≤-167	≤-166
>5 GHz to 8 GHz	≤-166	≤-165
>8 GHz to 14 GHz	≤-163	≤-162
>14 GHz to 17 GHz	≤-162	≤-161
>17 GHz to 24 GHz	≤-158	≤-157
>24 GHz to 26.5 GHz	≤-157	≤-155

Values are based on input-terminated, 5 dB RF attenuation, with the preamplifier enabled and preselector disabled, ≤-90 dBm reference level, and >10 averages. Log averaging noise level is normalized to a 1 Hz noise bandwidth.

**Table 5.** PXIe-5668 with PXIe-5698 Average Noise Level, Preamplifier Enabled, Preselector Enabled (Typical)

Frequency Range	23 °C ± 5 °C (dB)	0 °C to 55 °C (dB)
	Preamplifier Enabled (dBm/Hz)	Preamplifier Enabled (dBm/Hz)
>3.6 GHz to 5 GHz	≤-169	≤-168
>5 GHz to 8 GHz	≤-169	≤-168

**Table 5.** PXIe-5668 with PXIe-5698 Average Noise Level, Preamplifier Enabled, Preselector Enabled (Typical) (Continued)

Frequency Range	23 °C ± 5 °C (dB)	0 °C to 55 °C (dB)
	Preamplifier Enabled (dBm/Hz)	Preamplifier Enabled (dBm/Hz)
>8 GHz to 14 GHz	≤-165	≤-164
>14 GHz to 17 GHz	≤-164	≤-163
>17 GHz to 24 GHz	≤-160	≤-159
>24 GHz to 26.5 GHz	≤-158	≤-156

Values are based on input-terminated, 5 dB RF attenuation, with the preamplifier enabled and preselector enabled, ≤-90 dBm reference level, and >10 averages. Log averaging noise level is normalized to a 1 Hz noise bandwidth.

**Table 6.** PXIe-5668 with PXIe-5698 Average Noise Level, Preamplifier Disabled, Preselector Disabled (Typical)

Frequency Range	23 °C ± 5 °C (dBm/Hz)	0 °C to 55 °C (dBm/Hz)
10 MHz to 200 MHz	≤-153	≤-153
>200 MHz to 1.7 GHz	≤-155	≤-152
>1.7 GHz to 3 GHz	≤-153	≤-150
>3 GHz to 3.6 GHz	≤-150	≤-147
>3.6 GHz to 5 GHz	≤-158	≤-156
>5 GHz to 8 GHz	≤-157	≤-155
>8 GHz to 14 GHz	≤-155	≤-153
>14 GHz to 17 GHz	≤-150	≤-148
>17 GHz to 24 GHz	≤-152	≤-150
>24 GHz to 26.5 GHz	≤-149	≤-147

Values are based on input-terminated, 5 dB RF attenuation, with the preamplifier disabled and preselector disabled, ≤-90 dBm reference level, and >10 averages. Log averaging noise level is normalized to a 1 Hz noise bandwidth.

# Absolute Amplitude Accuracy

**Table 7.** PXIe-5668 with PXIe-5698 Absolute Amplitude Accuracy (Typical)

Frequency Range	23 °C ± 5 °C		0 °C to 55 °C	
	Preamplifier Enabled (dBm)	Preamplifier Disabled (dBm)	Preamplifier Enabled (dBm)	Preamplifier Disabled (dBm)
10 MHz to 700 MHz	±0.8	±0.8	±1.2	±1.4
>700 MHz to 1.7 GHz	±0.8	±0.8	±1.2	±1.4
>1.7 GHz to 3.6 GHz	±0.8	±1.0	±1.5	±2.0
>3.6 GHz to 5 GHz	±1.2	±1.2	±1.5	±2.0
>5 GHz to 14 GHz	±1.4	±1.4	±2.0	±2.5
>14 GHz to 20 GHz	±1.6	±1.4	±3.0	±2.5
>20 GHz to 26.5 GHz	±2.0	±1.8	±3.5	±3.2

Values are based on -35 dBm to -55 dBm reference level, 5 dB RF attenuation, 300 kHz IF filter for center frequency <100 MHz, 100 MHz IF filter for center frequency ≥100 MHz, with preamplifier disabled and preselector disabled, and using automatic calibration correction of the NI-RFSA instrument driver within ±5 °C of the temperature at the last calibration.

The absolute amplitude accuracy is measured at the center frequency, after the hardware has settled. The high band to low band signal path transitions can take up to 200 ms for hardware to settle to within 0.1 dB of the final amplitude.

# Spurious Responses

## Non-Input Related (Residual) Spurs<sup>1</sup>

**Table 8.** PXIe-5668 with PXIe-5698 Non-Input Related Spurs (Nominal) (23 °C ± 5 °C)

Frequency Range	Preamplifier Enabled (dBm)	Preamplifier Disabled (dBm)
100 MHz to 3.6 GHz	≤-131	≤-115
>3.6 GHz to 11 GHz	≤-120	≤-115
>11 GHz to 26.5 GHz	≤-115	≤-105

Values use 300 kHz and 5 MHz IF bandwidth, RF input terminated, -60 dBm reference level, 5 dB RF attenuation with preamplifier enabled and 0 dB RF attenuation with preamplifier disabled. The PXIe-5668 preselector is disabled.

## Image Rejection

**Table 9.** PXIe-5668 with PXIe-5698 RF Image Rejection (Nominal) (23 °C ± 5 °C)

Frequency Range	Preamplifier Enabled (dBc)	Preamplifier Disabled (dBc)
100 MHz to 350 MHz	-78	-97
>350 MHz to 1 GHz	-97	-97
>1 GHz to 3.6 GHz	-97	-97
>3.6 GHz to 14 GHz	-88	-88
>14 GHz to 26.5 GHz	-82	-85

Values are based on -35 dBm input signal and reference level, 5 dB RF attenuation with preamplifier enabled, and -15 dBm input signal and reference level, 10 dB RF attenuation with preamplifier disabled. For frequencies <3.6 GHz, the IF filter is either 100 MHz or 320 MHz. For frequencies >3.6 GHz, the preselector is enabled and the IF filter is 100 MHz.

<sup>1</sup> Non-input related (residual) spurs are the responses observed when a 50 Ω termination is connected to the RF IN connector.



# Linearity

## Third-Order Intermodulation Distortion

**Table 10.** PXIe-5668 with PXIe-5698 Third-Order Intermodulation Distortion, Preamplifier Enabled (Typical)

Frequency Range	23 °C ± 5 °C (dBm)
10 MHz to 500 MHz	-9
>500 MHz to 3.6 GHz	-13
>3.6 GHz to 5 GHz	-7.5
>5 GHz to 7.5 GHz	-7
>7.5 GHz to 14 GHz	-7.5
>14 GHz to 17 GHz	-11
>17 GHz to 26.5 GHz	-14

Values are based on two -35 dBm tones spaced at 700 kHz apart, 5 dB RF attenuation, -35 dBm reference level, and the 300 kHz filter. Mixer level is equivalent to input signal level minus RF attenuation plus nominal preamplifier gain. For center frequencies greater than 3.6 GHz, the preselector is enabled.

## Second Harmonic Intercept

**Table 11.** PXIe-5668 with PXIe-5698 Second Harmonic Intercept, Preamplifier Enabled (Typical)

Frequency Range	23 °C ± 5 °C
10 MHz to 300 MHz	+8
>300 MHz to 1 GHz	+9
>1 GHz to 1.8 GHz	+2
>1.8 GHz to 2 GHz	+2
>2 GHz to 9 GHz	+4
>9 GHz to 13.25 GHz	-4

Values are based on a -35 dBm mixer level, 5 dB RF attenuation, and 300 kHz IF filter. Mixer level is equivalent to input signal level minus RF attenuation plus nominal preamplifier gain. For center frequencies greater than 3.6 GHz, the preselector is enabled.

# Gain Compression

**Table 12.** PXIe-5668 with PXIe-5698 Gain Compression, Preamplifier Enabled (Typical)

Frequency Range	23 °C ± 5 °C (dBm)
10 MHz to 3 GHz	-26
>3 GHz to 3.6 GHz	-25
>3.6 GHz to 17 GHz	-18
>17 GHz to 26.5 GHz	-24

Values with preamplifier enabled are based on a two-tone technique, tone separation is greater than one and a half times the instantaneous bandwidth, 5 dB RF attenuation, -35 dBm reference level, and 300 kHz IF filter. For center frequencies greater than 3.6 GHz, the preselector is enabled.

## Input and Output Characteristics

### RF IN and RF OUT Front Panel Connectors

Connectors	2.92 mm female
Impedance	50 $\Omega$ (nominal)
Coupling	AC and DC
Maximum DC Input	$\pm 10$ V
Maximum DC Output	0 V

### NOISE SOURCE Front Panel Connector

Connector	HD BNC
Noise source On	+28 VDC
Noise source Off	0 VDC

## Voltage Standing Wave Ratio (VSWR)

**Table 13.** PXIe-5698 VSWR (Nominal)

Frequency Range	Preamplifier Disabled		Preamplifier Enabled	
	Input VSWR	Output VSWR <sup>2</sup>	Input VSWR	Output VSWR <sup>2</sup>
10 MHz to 1 GHz	1.3	1.3	1.5	1.5
>1 GHz to 2 GHz	1.3	1.3	1.8	1.5
>2 GHz to 3.6 GHz	1.3	1.3	2.3	1.5
>3.6 GHz to 14 GHz	1.3	1.3	2.7	2.2
>14 GHz to 20 GHz	1.5	1.5	3.0	2.3
>20 GHz to 26.5 GHz	1.6	1.6	3.5	2.9

## Power

---

### Power Requirements

**Table 14.** PXIe-5698 Power Requirements

From +3.3 VDC (W)	From +12 VDC (W)	Total (W)
6.93	26.4	33.33

### Power Limits

**Table 15.** PXIe-5698 Power Limits (Nominal)

Signal Path	Maximum Continuous Safe RF Power (dBm)
Preamplifier Enabled	10
Preamplifier Disabled	30

## Calibration

---

Interval 2 years

---

<sup>2</sup> Includes semi-rigid cable, NI 159289A-01.

# Physical Characteristics

---

## Dimensions and Weight

Dimensions	3U, single-slot, PXI Express module, 21.6 cm × 2.0 cm × 13.0 cm (8.5 in. × 0.8 in. × 5.1 in.)
Weight	500 g, (17.6 oz)

---

## Environment

---

Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)
Pollution Degree	2

---

Indoor use only.

## Operating Environment

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.)

---

## Storage Environment

Ambient temperature range	-40 °C to 71 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC 60068-2-56.)

---

## Shock and Vibration

---

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
-----------------	--

---

## Random vibration

Operating	5 Hz to 500 Hz, 0.3 g <sub>rms</sub> (Tested in accordance with IEC 60068-2-64.)
Nonoperating	5 Hz to 500 Hz, 2.4 g <sub>rms</sub> (Tested in accordance with IEC 60068-2-64. Test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

# Compliance and Certifications

## Safety

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 UL and other safety certifications, refer to the product label or the [Online Product Certification](#) 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 [Online Product Certification](#) 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)

## Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit [ni.com/certification](https://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## 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 *Minimize Our Environmental Impact* web page at [ni.com/environment](https://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 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](https://ni.com/environment/weee).

## 电子信息产品污染控制管理办法（中国 RoHS）



**中国客户** National Instruments 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 National Instruments 中国 RoHS 合规性信息，请登录 [ni.com/environment/rohs\\_china](https://ni.com/environment/rohs_china)。(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](https://ni.com/environment/rohs_china).)

Information is subject to change without notice. Refer to the *NI Trademarks and Logo Guidelines* at [ni.com/trademarks](https://ni.com/trademarks) for information on NI trademarks. Other product and company names mentioned herein are trademarks or trade names of their respective companies. For patents covering NI products/technology, refer to the appropriate location: **Help>Patents** in your software, the `patents.txt` file on your media, or the *National Instruments Patent Notice* at [ni.com/patents](https://ni.com/patents). You can find information about end-user license agreements (EULAs) and third-party legal notices in the `readme` file for your NI product. Refer to the *Export Compliance Information* at [ni.com/legal/export-compliance](https://ni.com/legal/export-compliance) for the NI global trade compliance policy and how to obtain relevant HTS codes, ECCNs, and other import/export data. NI MAKES NO EXPRESS OR IMPLIED WARRANTIES AS TO THE ACCURACY OF THE INFORMATION CONTAINED HEREIN AND SHALL NOT BE LIABLE FOR ANY ERRORS. U.S. Government Customers: The data contained in this manual was developed at private expense and is subject to the applicable limited rights and restricted data rights as set forth in FAR 52.227-14, DFAR 252.227-7014, and DFAR 252.227-7015.

© 2016—2018 National Instruments Corporation. All rights reserved.

375869D-01 April 26, 2021