DEVICE SPECIFICATIONS

NI PXI-5691

RF Amplifier

This document lists specifications for the NI PXI-5691 RF amplifier.

Specifications are warranted under the following conditions:

- 10 minutes warm-up time
- Calibration cycle maintained
- Chassis fan speed set to High
- NI-5690 instrument driver used
- NI-5690 instrument driver self-calibration performed after instrument temperature is stable

Specifications describe the warranted, traceable product performance over ambient temperature ranges of 0 ºC to 55 ºC, unless otherwise noted.

Typical values describe useful product performance beyond specifications that are not covered by warranty and do not include guardbands for measurement uncertainty or drift. Typical values may not be verified on all units shipped from the factory. Unless otherwise noted, typical values cover the expected performance of units over ambient temperature ranges of 23 °C ± 5 °C with a 90% confidence level, based on measurements taken during development or production.

Nominal values (or supplemental information) describe additional information about the product that may be useful, including expected performance that is not covered under *Specifications* or *Typical* values. Nominal values are not covered by warranty.

Specifications are subject to change without notice. For the most recent NI 5691 specifications, visit *ni.com/manuals*.

National Instruments RF devices are capable of producing and/or acquiring accurate signals within common Medical Implantable Communication System (MICS) frequency bands. NI RF devices are tested and verified in manufacturing for many measurements. For more information about RF device applications, visit *ni.com/global* to contact a National Instruments branch office.

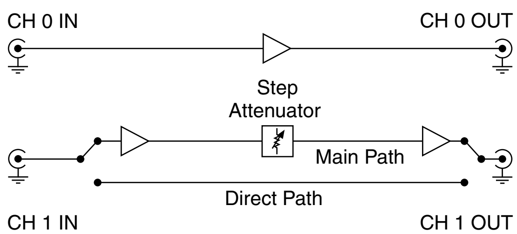
Caution Refer to the *Read Me First: Safety and Electromagnetic Compatibility* document for important safety and electromagnetic compatibility information. To obtain a copy of this document online, visit *ni.com/manuals* and search for the document title.

Caution To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

Caution The input and output connectors on your NI PXI-5691 are sensitive to electrostatic discharge (ESD). Always observe the safety precautions listed in the *Electrostatic Discharge (ESD) Information* section of the *NI RF Signal Conditioning Devices Getting Started Guide*.

Caution Only apply input signals after you power on the NI PXI-5691, and remove input signals before you power off the NI PXI-5691.

Figure 1. NI 5691 Hardware Block Diagram



Contents

Frequency Range

Frequency range .... 50 MHz to 8.0 GHz

Channels

Number of channels 2

Gain

- Channel 0 .... Fixed
- Channel 1 .... Programmable

Channel 0 (CH 0) Performance

Level calibration accuracy[1] .... ±0.9 dB

Absolute maximum input power (no damage) .... +30 dBm typical (7.1 V_{rms}, 10 V_{pk} at 50 Ω)

Maximum reverse power (no damage) .... +20 dBm

Maximum output power .... +25 dBm

DC voltage at input .... ±10 V typical

Gain variation by temperature .... $(-1.18 \times 10^{-12} \times F) - 0.01$ in dB/°C [2]

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[1] Valid for T_{ref} ± 5 °C. For temperatures other than T_{ref}, the level calibration accuracy is valid after applying the gain correction factor for ΔT.

[2] Calculate the correction factor using the following equation:
Δ Gain = (Gain Variation by temperature) * ΔT, where

- $\Delta T = T_{sensor} - T_{ref}$
- T_{sensor} = the temperature reading of the onboard temperature sensor in °C, as reported by the ni5690 Get Temperature VI or the ni5690_getTemperature function
- F = frequency, in Hz
- T_{ref} = 34 °C

Figure 2. Average Measured Gain

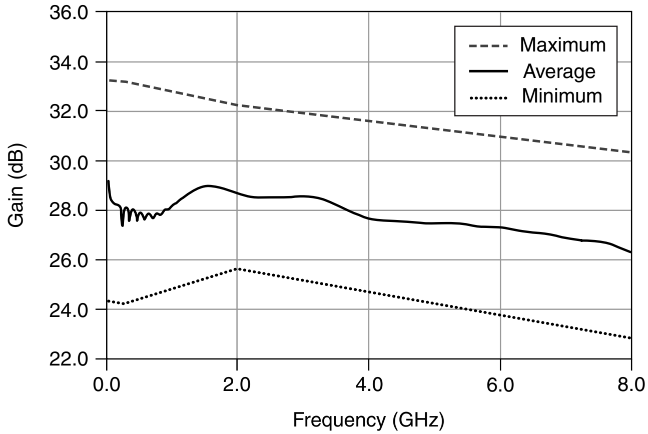


Figure 3. Average Measured Input and Output Voltage Standing Wave Ratio (VSWR)

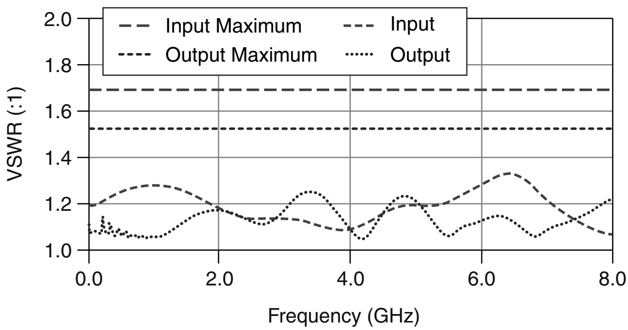


Figure 4. Measured Noise Figure (NF)

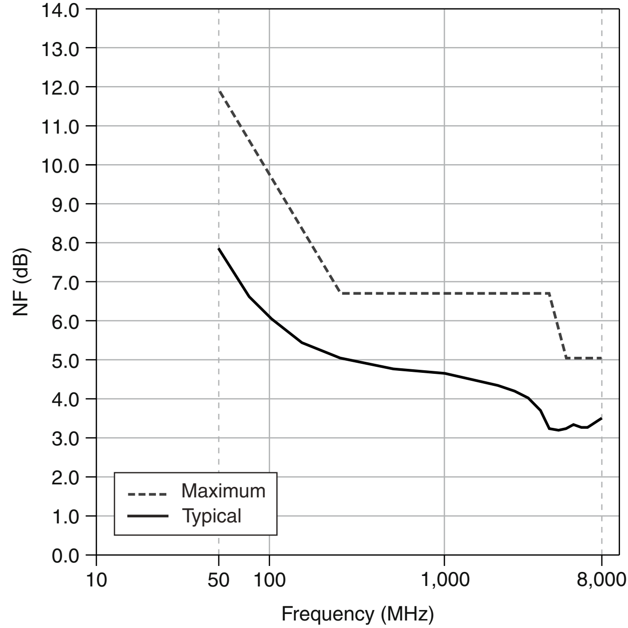


Figure 5. Measured Output Intercept Point (OIP_3)

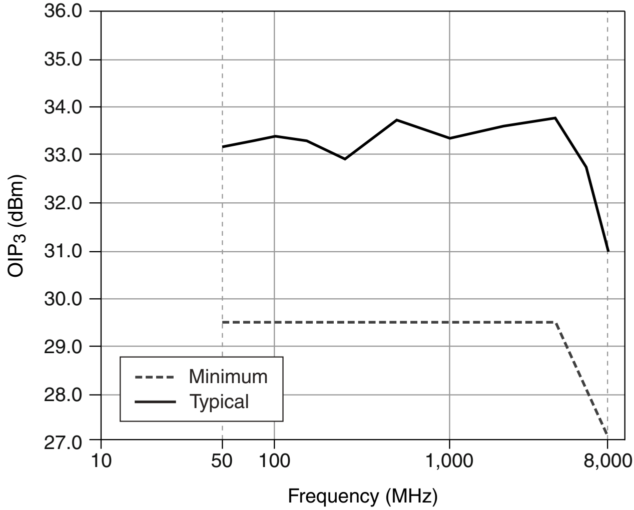


Figure 6. Measured Reverse Gain (S12)

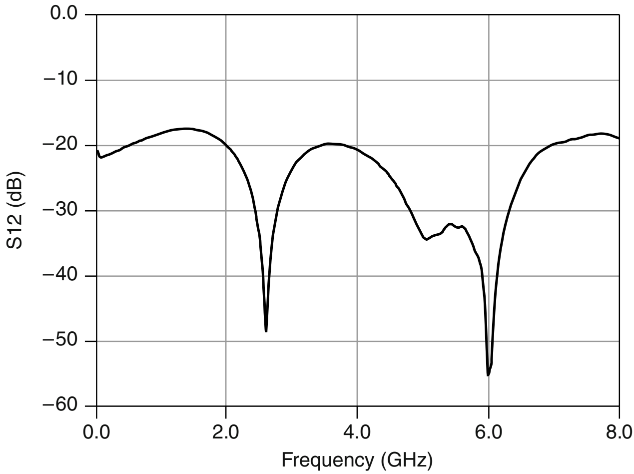


Figure 7. Measured 1 dB Gain Compression

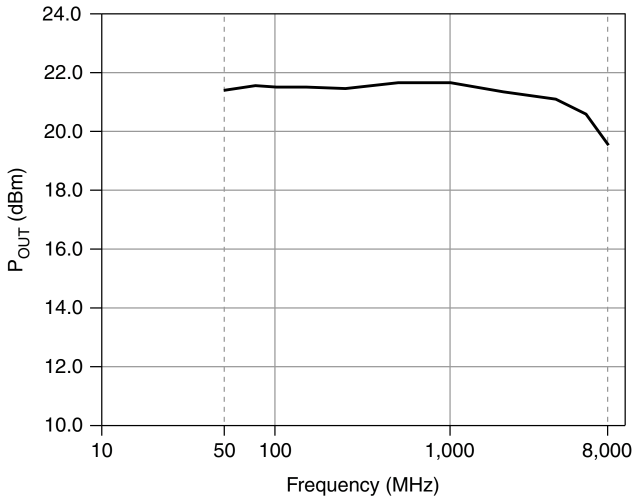


Figure 8. Measured P_{IN} at 1 dB Gain Compression

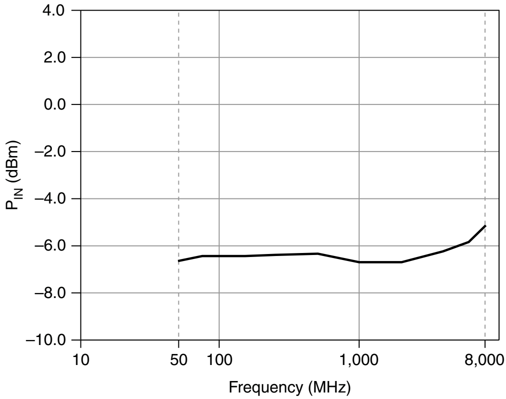


Figure 9. Measured 2nd Harmonic (P_{OUT} = 4 dBm)

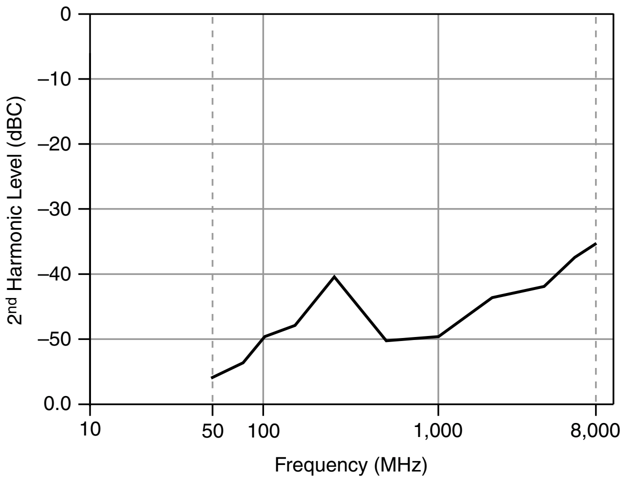
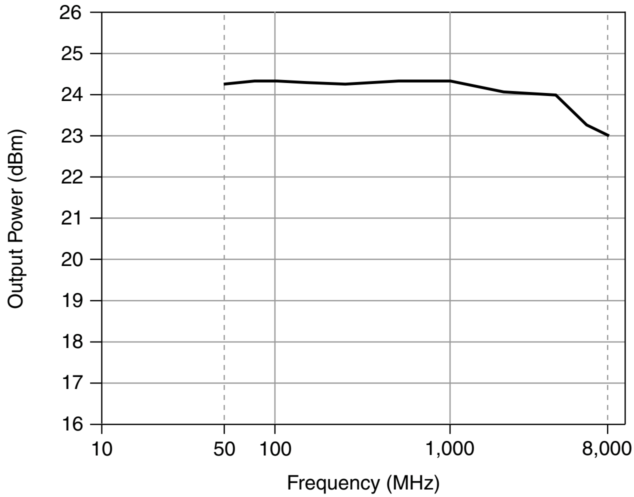


Figure 10. Measured Saturated Output Power



Channel 1 (CH 1)

Main Path

Variable level range.. +31.5 dB

Attenuation resolution.. +0.5 dB typical

Level setting time.. +4 µs maximum[3]

Level calibration accuracy.................................. ±0.9 dB[4]

Absolute maximum input power (no damage)................. +30 dBm typical (7.1 V_{rms}, 10 V_{pk} at 50 Ω)

Maximum reverse power (no damage)............................. +20 dBm

Maximum output power..................................... +25 dBm

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[3] The level settling time is measured to 0.5 dB of final value when switching from minimum to maximum attenuation. Achieving settling times closer to the final attenuation value may take substantially longer.

[4] Valid for T_{ref} ± 5 °C. For temperatures other than T_{ref}, the level calibration accuracy is valid after applying the gain correction factor for ΔT.

DC voltage at input..±10 V typical

Gain variation by temperature............................$(-1.34 \times 10^{-12} \times F) - 0.01$ in dB/°C [5]

Figure 11. Average Measured Programmable Gain Range

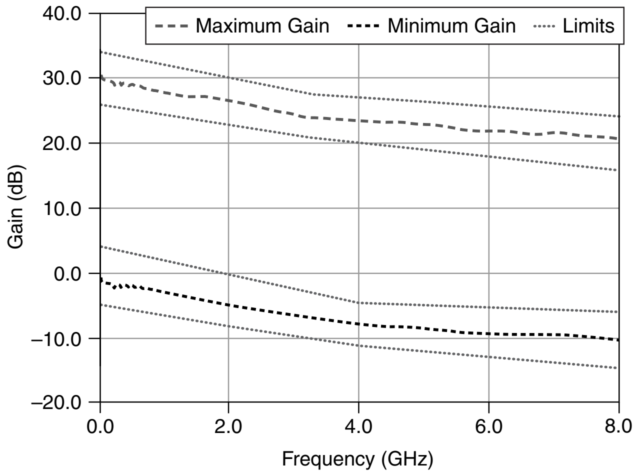
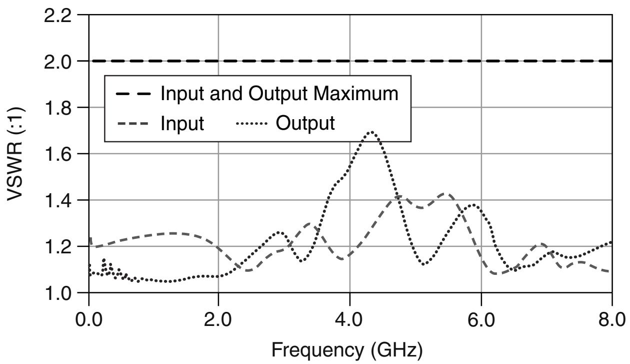


Figure 12. Average Measured Input and Output VSWR at Maximum Gain Setting



[5] Calculate the correction factor using the following equation:
Δ Gain = (Gain Variation by temperature) * ΔT, where

- $\Delta T = T_{sensor} - T_{ref}$
- T_{sensor} = the temperature reading of the onboard temperature sensor in °C, as reported by the ni5690 Get Temperature VI or the ni5690_getTemperature function
- T_{ref} = 34 °C
- F = frequency, in Hz

Figure 13. Average Measured Input and Output VSWR at Minimum Gain Setting

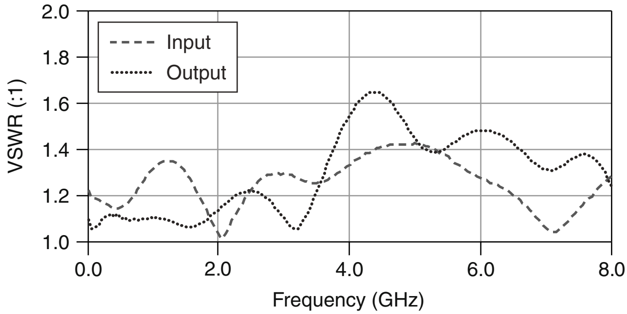


Figure 14. Measured Noise Figure (NF)

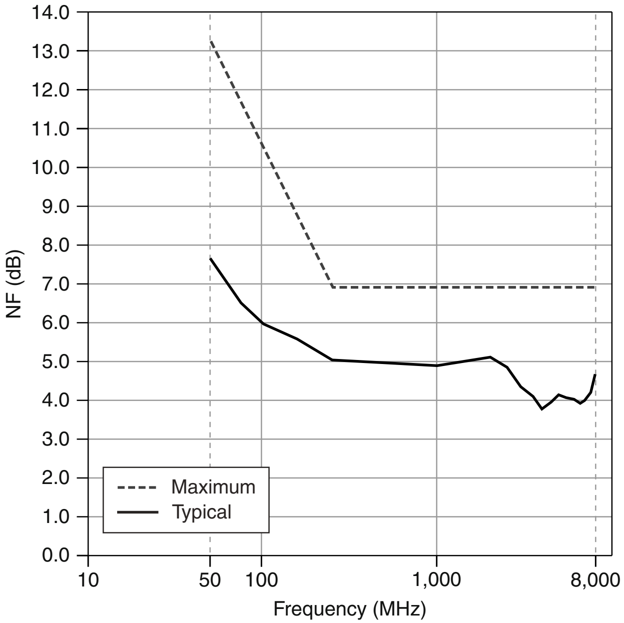


Figure 15. Measured Output Intercept Point (OIP_3)

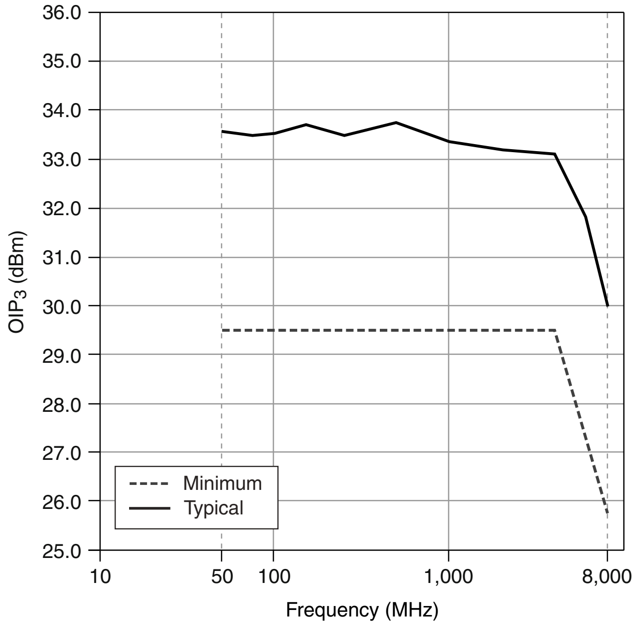


Figure 16. Measured Saturated Output Power (P_{SAT} at Maximum Gain Setting)

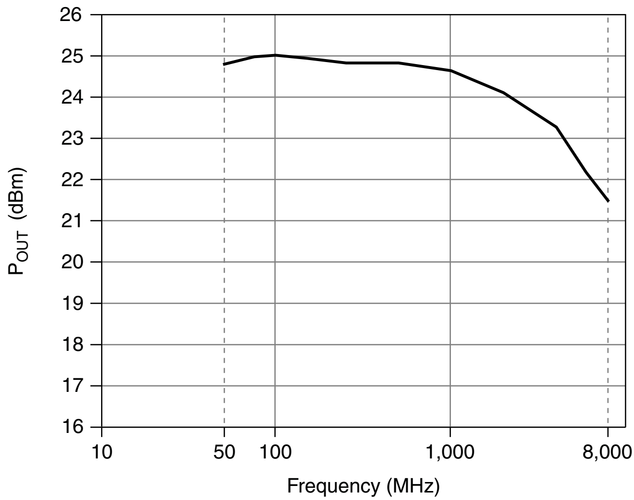


Figure 17. Measured Reverse Gain (S12) at Maximum Gain Setting

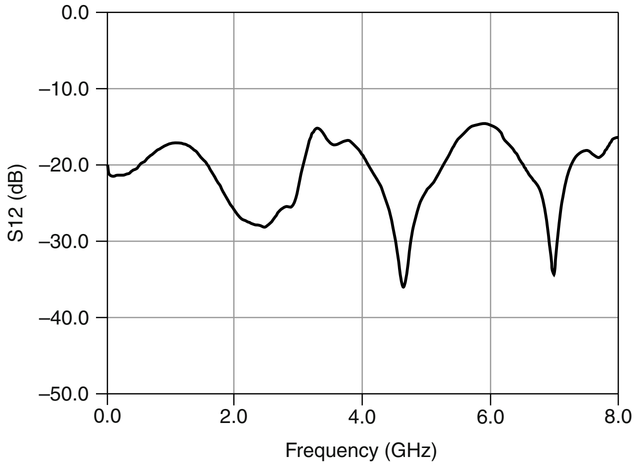


Figure 18. Measured 1 dB Gain Compression

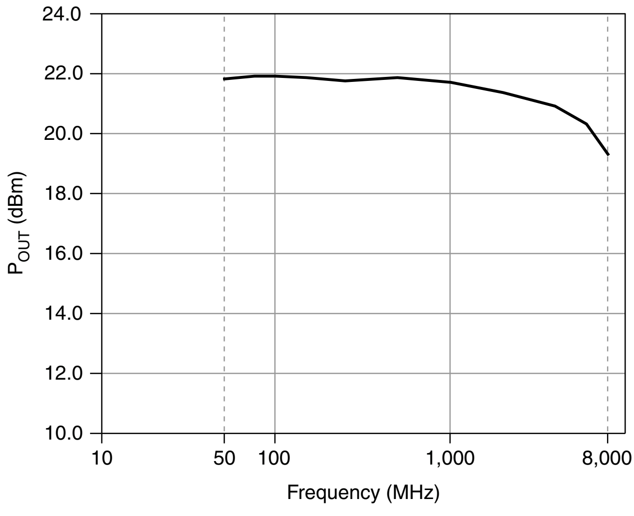


Figure 19. Measured P_{IN} at 1 dB Gain Compression

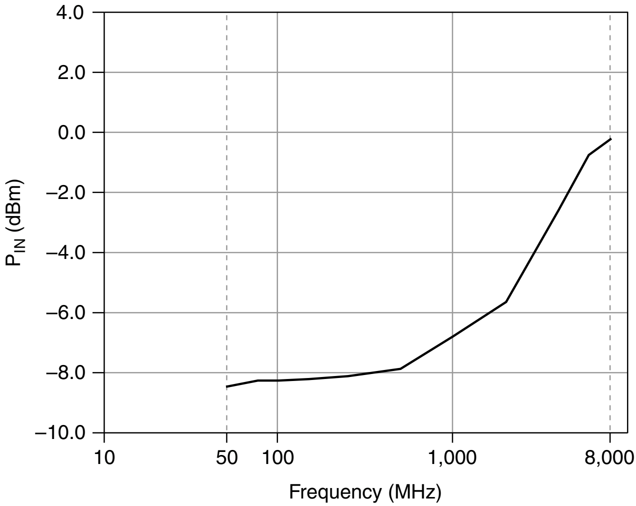
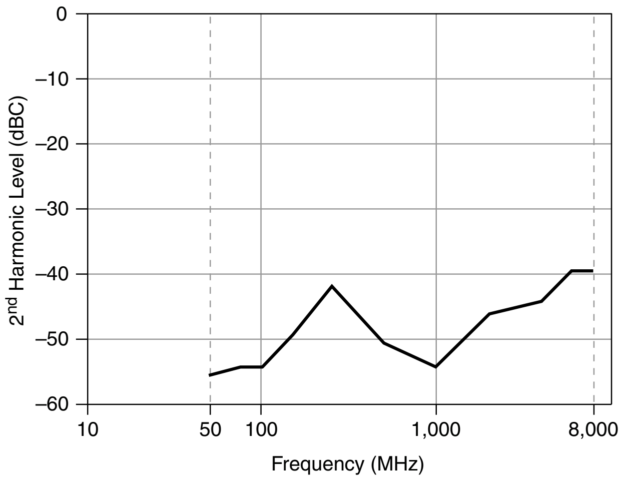


Figure 20. Measured 2nd Harmonic (P_{OUT} = 4 dBm, Maximum Gain Setting)



Direct Path

Level calibration accuracy ±0.9 dB[6]

Maximum input power (no damage) +30 dBm typical (7.1 V_{rms}, 10 V_{pk} at 50 Ω)

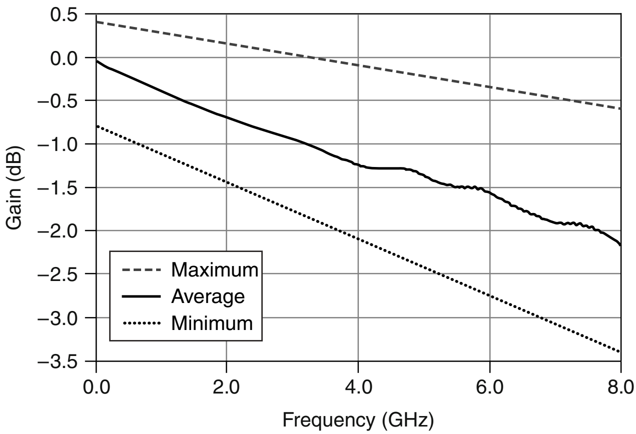
DC voltage at input ±10 V typical[7]

Relay switch time 5 ms maximum

Gain variation by temperature $(-1.34 \times 10^{-12} \times F) - 0.01$ in dB/°C [8]

Direct Path Performance

Figure 21. Average Measured Gain



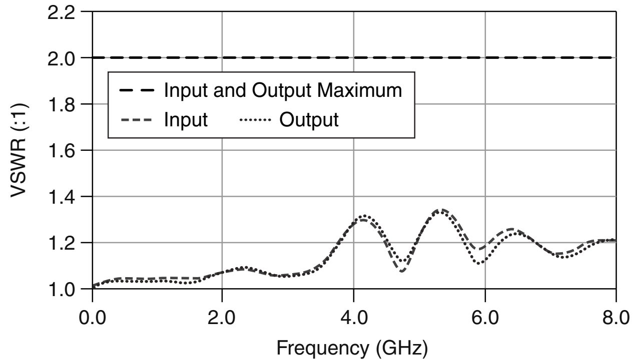
6 Valid for $T_{ref} \pm 5°$ C. For temperatures other than T_{ref}, the level calibration accuracy is valid after applying the gain correction factor for ΔT.

7 DC coupled for input to output, but only calibrated from 50 MHz to 8 GHz.

8 Calculate the correction factor using the following equation:
Δ Gain = (Gain Variation by temperature) * ΔT, where

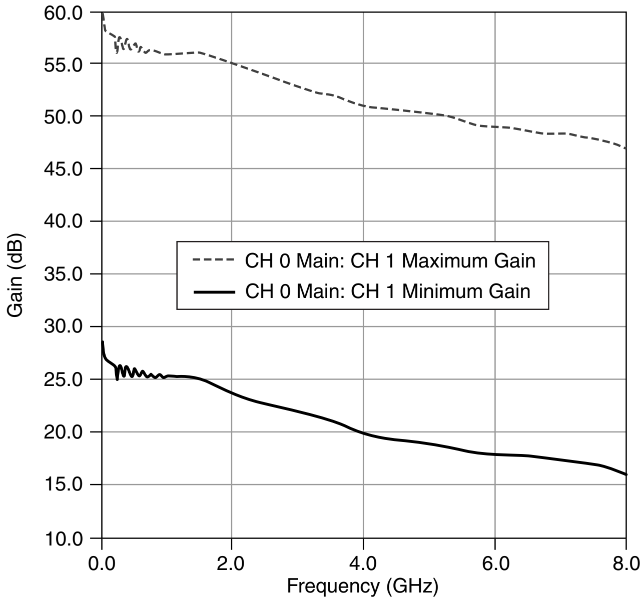
- $\Delta T = T_{sensor} - T_{ref}$
- T_{sensor} = the temperature reading of the onboard temperature sensor in °C, as reported by the ni5690 Get Temperature VI or the ni5690_getTemperature function
- T_{ref} = 34°C
- F = frequency, in Hz

Figure 22. Average Measured Input and Output VSWR



Channel 0/Channel 1 Cascaded Path Performance

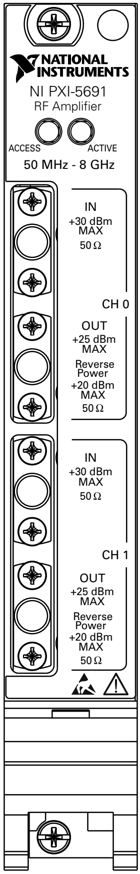
Figure 23. Average Measured Cascaded Gain Response



Note When cascading Channel 0 and Channel 1, each channel is individually calibrated.

Hardware Front Panel

Figure 24. NI 5691 RF Amplifier Front Panel



CH 0 IN

Connector	SMA female
Impedance	50 Ω
Coupling	AC
Input amplitude	+30 dBm maximum

CH 0 OUT

Connector	SMA female
Impedance	50 Ω

Coupling..AC
Output amplitude.......................................+25 dBm maximum

CH 1 IN

Connector..SMA female
Impedance..50 Ω
Coupling..AC[9]
Input amplitude..+30 dBm maximum

CH 1 OUT

Connector..SMA female
Impedance..50 Ω
Coupling..AC
Output amplitude.......................................+25 dBm maximum

Power Requirements

Table 1. Power and Current

Power Rail (V_{DC})	Maximum Current (mA)	Typical Current (mA)	Maximum Power (W)
+3.3	643	234	2.1
+5	1,382	1,310	6.9
+12	240	99	2.9
-12	28	12	0.34

Calibration

Interval..1 year

Physical Characteristics

Dimensions..3U, One Slot, PXI/cPCI Module
21.6 × 2.0 × 13.0 cm (8.5 × 0.8 × 5.1 in.)

Weight..263 g (9.2 oz)

9 Direct path passes input DC level to output.

Environment

Maximum altitude..2,000 m (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.)

Relative humidity range....................................10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range...............................-40 °C to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

Relative humidity range....................................5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Operational shock...30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)

Random vibration

Operating...5 Hz to 500 Hz, 0.3 g_{rms}

Nonoperating...5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating 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 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
- AS/NZS CISPR 11: Group 1, 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 treament of material or inspection/analysis purposes.

Note For EMC declarations and certifications, refer to the *Online Product Certification* section.

CE Compliance

This product meets the essential requirements of applicable European Directives, 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 DoC 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

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 not only to the environment but also to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* 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 Electrical and Electronic Equipment, visit *ni.com/environment/weee.htm*.

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。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

375124E-01 Apr13