DEVICE SPECIFICATIONS

NI PXIe-5667 (7 GHz)

Spectrum Monitoring Receiver

This document lists specifications for the NI PXIe-5667 (7 GHz) (NI 5667 (7 GHz)).

The NI 5667 (7 GHz) radio frequency (RF) spectrum monitoring receiver comprises the following devices:

- NI PXIe-5622 (NI 5622) intermediate frequency (IF) digitizer module
- NI PXIe-5694 (NI 5694) IF conditioning module
- NI PXIe-5605 (NI 5605) RF downconverter module
- NI PXIe-5653 (NI 5653) synthesizer/local oscillator (LO) source module
- NI PXIe-5693 (NI 5693) RF preselector module

Specifications are warranted under the following conditions unless otherwise noted:

- 30 minutes warm-up time.
- Calibration cycle is maintained.
- Chassis fan speed is set to High. In addition, NI recommends using slot blockers and EMC filler panels in empty module slots to minimize temperature drift.
- The NI 5653 onboard 100 MHz clock is used as the Reference Clock for the NI 5622.
- The NI 5653 REF OUT (10 MHz) connector is connected to the NI 5694 REF IN connector.
- The NI 5653 and the chassis are locked to the same reference, or the NI 5653 onboard 10 MHz clock is used as the Reference Clock for the chassis reference input.
- The NI 5622 IF digitizer module is revision C or later.
- Modules are connected with NI cables as shown in the *NI 5667 (7 GHz) Spectrum Monitoring Receiver Getting Started Guide*.
- NI-RFSA instrument driver is used.
- Self-calibration is performed after instrument temperature is stable.
- IF output power is set to the default value of -2 dBm.

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

Note Values in this document are specifications unless otherwise noted.

NATIONAL INSTRUMENTS

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.

2σ specifications describe the 95th percentile values in which 95% of the cases are met with a 95% confidence for any ambient temperature of 23 °C ± 5 °C

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 5667 (7 GHz) specifications, visit *ni.com/manuals*.

To access NI 5667 (7 GHz) documentation, navigate to **Start»All Programs» National Instruments»NI-RFSA»Documentation**.

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.

Hot Surface If the NI 5667 (7 GHz) has been in use, it may exceed safe handling temperatures and cause burns. Allow the NI 5667 (7 GHz) to cool before removing it from the chassis.

Caution The protection provided by this product may be impaired if it is used in a manner not described in this document.

Contents

Frequency

Frequency Range

Table 1. NI 5667 (7 GHz) Frequency Range (Nominal)

Path	Input Frequency
Low-frequency bypass path (DC-coupled)	N/A
Low-frequency bypass path (AC-coupled)	10 kHz to 30 MHz
Preselector filter path	20 MHz to 7 GHz
External filter path	87 MHz to 3 GHz

Tuning resolution[1], set by the LO.....533 nHz, nominal
source

Bandwidth

Equalized bandwidth[2]

Standard configuration.....25 MHz, typical

Optional configuration.....50 MHz, typical

3 dB resolution bandwidth.....Fully adjustable

Bandwidth range

Standard configuration.....<1 Hz to 25 MHz, typical

Optional configuration.....<1 Hz to 50 MHz, typical

Table 2. FFT Window Shape Factor

Window Function	60 dB : 6 dB Ratio
4-term Blackman-Harris	2.5
7-term Blackman Harris	4.1

[1] Tuning resolution refers to the digital downconversion (DDC) tuning resolution of the NI 5622 IF digitizer.

[2] Self-calibration was performed using the NI-RFSA instrument driver with the NI 5605 downconverter preselector disabled. The signal is not equalized when using the NI 5605 downconverter preselector. Equalization is performed by digital filters in the NI 5622 digitizer. Equalization applies only to the NI 5694 IF signal conditioning bypass path, which is valid for instantaneous bandwidths greater than 20 MHz.

Table 2. FFT Window Shape Factor (Continued)

Window Function	60 dB : 6 dB Ratio
Uniform	1.57
Hanning	1.94
Hamming	2.13
Exact Blackman	2.52
Flat Top	2.0
Low Side Lobe	2.78

NI 5694 Analog IF Filters

Table 3. NI 5694 Analog IF Filter Configurations (Typical)

Instantaneous Bandwidth[3]	NI 5694 IF Conditioning Filter Path	Minimum 3 dB Bandwidth	Final IF Center Frequency	Filter Technology[4]
>20 MHz to 50 MHz	IF Bypass	50 MHz[5]	187.5 MHz	LC
>5 MHz to 20 MHz	20 MHz	20 MHz	193.6 MHz	LC
>1.4 MHz to 5 MHz	5 MHz	5 MHz	193.6 MHz or 21.4 MHz	LC
>400 kHz to 1.4 MHz	1.4 MHz	1.4 MHz	193.6 MHz or 21.4 MHz	SAW
≤400 kHz[6]	400 kHz	400 kHz	193.6 MHz	SAW
>30 kHz to 400 kHz[7]	400 kHz	400 kHz	21.4 MHz	SAW
≤30 kHz[7]	30 kHz	30 kHz	21.4 MHz	Quartz crystal

[3] Instantaneous bandwidth is specified with the Device Instantaneous Bandwidth property or the NIRFSA_ATTR_DEVICE_INSTANTANEOUS_BANDWIDTH attribute.
[4] *LC* refers to discrete component filters, and *SAW* refers to surface acoustic wave filters.
[5] The bandwidth is set by the NI 5622 digitizer.
[6] The NI 5694 IF conditioning downconversion is disabled.
[7] The NI 5694 IF conditioning downconversion is enabled.

Frequency Reference[8]

All values given are typical unless otherwise stated.

Internal frequency reference

- Frequency.....10 MHz
- Initial calibration accuracy.....$\pm 50 \times 10^{-9}$, (15 °C to 35 °C)
- Temperature stability
  - 0 °C to 55 °C.....$\pm 50 \times 10^{-9}$
  - 15 °C to 35 °C.....$\pm 10 \times 10^{-9}$, maximum
- Aging
  - Per day.....$\pm 0.5 \times 10^{-9}$, after 30 days
  - Per year.....$\pm 100 \times 10^{-9}$, after 30 days
- Accuracy.....*Initial calibration accuracy* ± *aging* ± *temperature stability*

External frequency reference input (REF IN)

- Frequency.....5 MHz to 100 MHz in 1 MHz steps
- Lock range.....$\pm 0.2 \times 10^{-6}$
- Amplitude.....0.5 V_{pk-pk} to 2.0 V_{pk-pk} into 50 Ω (≥1 V_{pk-pk} recommended)
- Absolute maximum amplitude.....5 V_{pk-pk}
- Input impedance.....50 Ω, nominal
- Coupling.....AC coupled
- Connector.....SMA

10 MHz reference output (REF OUT (10 MHz))

- Accuracy.....10 MHz × *Frequency reference accuracy*
- Amplitude
  - Maximum.....1.5 V_{pk-pk} into 50 Ω
  - Typical.....1.0 V_{pk-pk} into 50 Ω
- Coupling.....AC coupled
- Connector.....SMA

[8] The NI 5653 reference oscillator determines these values.

100 MHz reference output
(REF OUT (100 MHz))

Accuracy.....100 MHz × *Frequency reference accuracy*

Amplitude

Maximum.....1.5 V_{pk-pk} into 50 Ω

Typical.....1.0 V_{pk-pk} into 50 Ω

Coupling.....AC coupled

Connector.....SMA

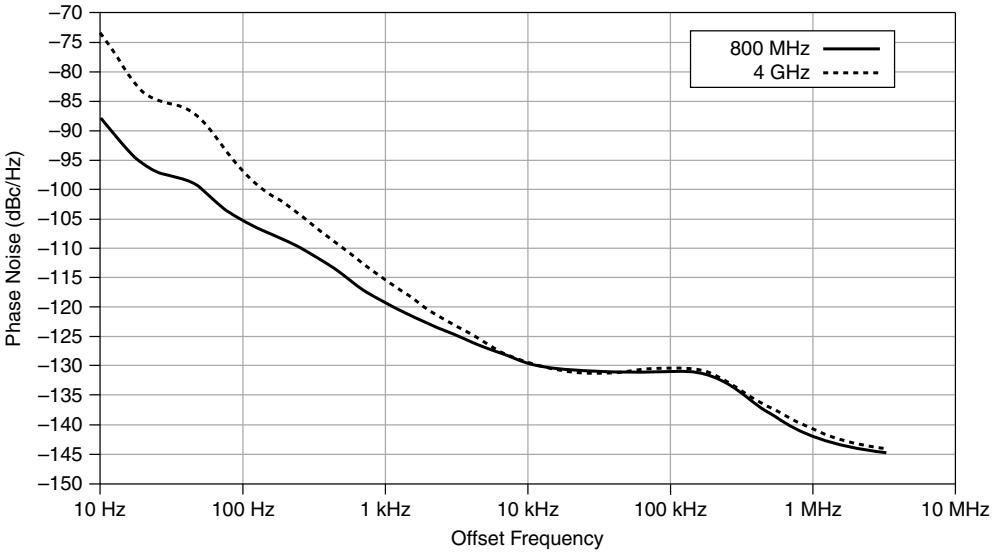
Spectral Purity

Table 4. NI 5667 Single Sideband (SSB) Phase Noise (Typical)[9]

Offset Frequency	Single Sideband Phase Noise (dBc/Hz)	
	23 °C ± 5 °C	0 °C to 55 °C
10 Hz	N/A	-80, nominal
100 Hz	-100	-98
1 kHz	-114	-112
10 kHz	-126	-124
100 kHz	-128	-127
1 MHz	-140	-140

[9] This specification is based on an RF center frequency of 800 MHz that uses the internal reference of the NI 5653. This specification is valid when the NI 5667 IF filter bandwidth is set to 5 MHz, the NI 5622 Sample Clock is locked to the NI 5653 100 MHz reference output, and the NI 5653 LO YIG main coil drive is set to normal.

Figure 1. NI 5667 (7 GHz) Phase Noise at 800 MHz and 4 GHz Center Frequency (Nominal)



Residual FM

10 Hz to 10 kHz, 800 MHz center frequency.....< 0.5 Hz (rms, typical)

NI 5693 Preselector Filters

Figure 2. NI 5693 Preselector Filter Definition

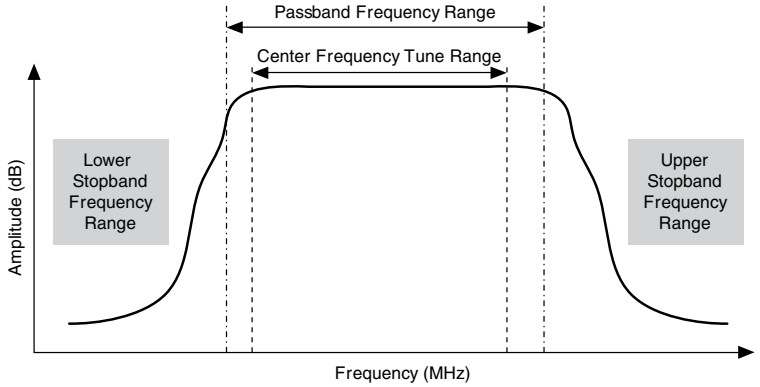


Table 5. NI 5693 Preselector Filters Characteristics (Nominal)

Preselector Filter Band	Center Frequency Tune Range[10] (MHz)	Passband Frequency Range[11] (MHz)	Lower Stopband Frequency Range (MHz)	Upper Stopband Frequency Range (MHz)	Stopband Rejection (dB)
1	20 to 34	19 to 35	<14	>42	>20
2	>34 to 60	33 to 61	<27	>70	>20
3	>60 to 100	59 to 110	<49	>128	>20
4	>100 to 160	90 to 170	<75	>185	>20
5	>160 to 225	140 to 245	<115	>285	>20
6	>225 to 350	205 to 370	<170	>420	>20
7	>350 to 555	330 to 575	<280	>660	>20
8	>555 to 950	530 to 975	<450	>1,120	>20
9	>950 to 1,560	910 to 1,640	<775	>1,920	>20
10	>1,560 to 2,000	1,520 to 2,040	<1,350	>2,320	>20
11	>2,000 to 2,500	1,960 to 2,540	<1,700	>2,860	>20
12	>2,500 to 3,000	2,460 to 3,040	<2,140	>3,460	>20
13	>3,000 to 3,600	2,960 to 3,840	<2,650	>4,350	>20
14	>3,600 to 4,600	3,560 to 4,640	<3,350	>5,050	>20
15	>4,600 to 5,800	4,560 to 5,840	<3,850	>6,550	>20
16	>5,800 to 7,000	5,760 to 7,040	<4,900	>8,250	>20

[10] The NI 5693 preselector filter band selection is based on the center frequency tune range. The lowest frequency preselector band is selected at the band-crossing frequencies.

[11] *Passband Frequency Range* is the calibrated range of the preselector filter band.

Notch Filters

Figure 3. NI 5693 Notch Filter Frequency Range Definition

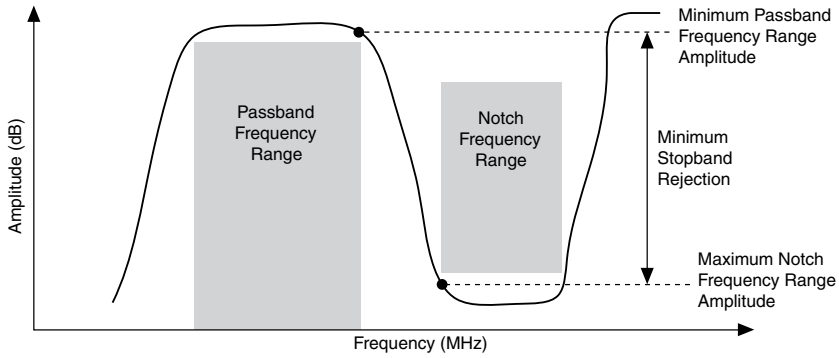


Table 6. NI 5693 Notch Filter Characteristics (Nominal)

Notch Filter Band	Passband Frequency Range (MHz)	Notch Frequency Range (MHz)	Notch Filter Rejection (dB)[12]	Preselector Filter Band[12]
N1	32 to 44	55 to 80	>38	2
N2	60 to 77	88 to 108	>25	3
N3	90 to 110	50 to 80	>40	3
N4	120 to 166	88 to 108	>23	4

Amplitude

Amplitude Range

Amplitude range

Preselector path.....Average noise level to +10 dBm, nominal

Low-frequency bypass path[13].....Average noise level to +30 dBm, nominal

External filter path.....Average noise level to +10 dBm, nominal

[12] Notch filter bands are a cascade of a preselector filter and a notch filter. Stopband rejection specifications for the preselector filter band apply in the notch filter bands.

[13] The maximum amplitude range is limited by the NI 5605 downconverter.

Average Noise Level

Table 7. Average Noise Level for Preselector and Low-Frequency Bypass Paths (Typical)[14]

Center Frequency	IF Conditioning Bypass Path (dBm/Hz)		IF Conditioning, Downconversion Enabled, and Disabled Paths (dBm/Hz)	
	23 °C ± 5 °C	0 °C to 55 °C	23 °C ± 5 °C	0 °C to 55 °C
10 kHz to 1 MHz[15]	-100	-100	-100	-100
>1 MHz to 10 MHz[15]	-127	-125	-127	-125
>10 MHz to 30 MHz[15]	-128	-128	-128	-128
>20 MHz to 87 MHz[16]	-153	-151	-158	-156
>87 MHz to 1.5 GHz[16]	-161	-159	-162	-161
1.5 GHz to 3.6 GHz[16]	-160	-158	-160	-159
>3.6 GHz to 7 GHz[17]	-158	-156	-158	-157

Noise Figure

Table 8. Noise Figure for Preselector Paths (Nominal)[18]

Center Frequency	IF Conditioning Bypass Path (dB)		IF Conditioning, Downconversion Enabled, and Disabled Paths (dB)	
	23 °C ± 5 °C	0 °C to 55 °C	23 °C ± 5 °C	0 °C to 55 °C
>20 MHz to 87 MHz[19]	21	23	16	18
>87 MHz to 1.5 GHz[19]	13	15	12	14

[14] This specification is based on the termination of the NI 5693 RF IN connector and a reference level of ≤-50 dBm with ≥10 RMS averages.

[15] This specification is valid when the NI 5693 low-frequency bypass path is enabled on the DC coupled path and the IF filter bandwidth is set to 300 kHz.

[16] This specification is valid when the NI 5693 preselector filter path is enabled.

[17] This specification is based on enabling the NI 5605 downconverter preselector.

[18] This specification is computed from the *Average Noise Level* measurement. *Noise Figure* equals *Average Noise Level* + 174 dB.

[19] This specification is valid when the NI 5693 low-frequency bypass path is enabled on the DC coupled path and the IF filter bandwidth is set to 300 kHz.

Table 8. Noise Figure for Preselector Paths (Nominal)[18] (Continued)

Center Frequency	IF Conditioning Bypass Path (dB)		IF Conditioning, Downconversion Enabled, and Disabled Paths (dB)	
	23 °C ± 5 °C	0 °C to 55 °C	23 °C ± 5 °C	0 °C to 55 °C
>1.5 GHz to 3.6 GHz	14	16	14	15
>3.6 GHz to 7 GHz[17]	16	18	16	17

Table 9. Noise Figure for Low-Frequency Bypass Paths (Nominal)[21]

Center Frequency	IF Conditioning Bypass Path (dB)		IF Conditioning, Downconversion Enabled, and Disabled Paths (dB)	
	23 °C ± 5 °C	0 °C to 55 °C	23 °C ± 5 °C	0 °C to 55 °C
>10 kHz to 1 MHz[22]	74	74	74	74
>1 MHz to 10 MHz[22]	47	49	47	49
>10 MHz to 30 MHz[22]	46	46	46	46

Absolute Amplitude Accuracy

Table 10. Absolute Amplitude Accuracy for the Preselector Path[23]

Center Frequency	Absolute Amplitude Accuracy (dB)	
	23 °C ± 5 °C	0 °C to 55 °C
20 MHz to 40 MHz	±1.5	±1.8
	±0.4, typical	±1.1, typical
>40 MHz to 2.5 GHz	±1.3	±1.6
	±0.6, typical	±1.0, typical

20 This specification is valid when the NI 5693 preselector filter path is enabled.

21 This specification is computed from the *Average Noise Level* measurement. *Noise Figure* equals *Average Noise Level* + 174 dB.

22 This specification is valid when the low-frequency bypass path is enabled on the DC coupled path and the IF filter bandwidth is set to 300 kHz.

23 This specification is based on a reference level of -50 dBm to -10 dBm and is valid when the IF filter bandwidth is set to 5 MHz, IF conditioning downconversion is disabled, and the signal power value is set to the reference level value. This specification is measured at the center frequency and is within ±5 °C the temperature at the last self-calibration.

Table 10. Absolute Amplitude Accuracy for the Preselector Path[23] (Continued)

Center Frequency	Absolute Amplitude Accuracy (dB)	
	23 °C ± 5 °C	0 °C to 55 °C
>2.5 GHz to 3.6 GHz	±1.5	±1.8
	±0.7, typical	±1.2, typical
>3.6 GHz to 7 GHz[17]	±4.0	±5.0
	±1.5, typical	±2.2, typical

IF path switching uncertainty[24].....±0.16 dB, typical

IF Amplitude Response

Table 11. NI 5667 (7 GHz) IF Amplitude Response (Typical)[25]

NI 5694 IF Conditioning Filter Path	Measurement Bandwidth	IF Amplitude Response (dB)		
		Center Frequency 20 MHz to 200 MHz 23 °C ± 5 °C	Center Frequency >200 MHz to 3.6 GHz 23 °C ± 5 °C	Center Frequency >3.6 GHz to 7 GHz 23 °C ± 5 °C
IF bypass	≤50 MHz	±0.8	±0.5	±1.0
	≤25 MHz	±0.4	±0.4	±0.5
	≤5 MHz	±0.1	±0.1	±0.2
20 MHz[26]	≤20 MHz	±0.5	±0.5	±0.5
5 MHz	≤5 MHz	±0.6	±0.6	±0.8
1.4 MHz	≤1.4 MHz	±0.4	±0.4	±0.4
400 kHz	≤400 kHz	±0.4	±0.4	±0.4
30 kHz[27]	≤30 kHz	±0.4	±0.4	±0.4

[24] When the IF Conditioning Downconversion Enabled property or NIRFSA_ATTR_IF_CONDITIONING_DOWN_CONVERSION_ENABLED attribute is disabled and a 5 MHz IF path is used, an amplitude error occurs between the property/attribute and all other paths and filters within the NI 5694. This specification is valid when the center frequency is set to 612.5 MHz.

[25] The IF passband response is relative to the IF center frequency. This specification applies when self-calibration is performed with digital IF equalization enabled.

[26] This specification is valid when IF conditioning downconversion is disabled.

[27] This specification is valid when IF conditioning downconversion is enabled.

IF Phase Linearity (Deviation from Linear Phase)

Table 12. NI 5667 (7 GHz) IF Phase Linearity (Deviation from Linear Phase) (Typical)[28]

NI 5694 IF Conditioning Filter Path	Measurement Bandwidth	Deviation from Linear Phase (degrees) (23 °C)		
		Center Frequency 20 MHz to 200 MHz	Center Frequency >200 MHz to 3.6 GHz	Center Frequency >3.6 GHz to 7 GHz
IF Bypass	≤50 MHz	±7.0	±5.0	±4.0
	≤25 MHz	±1.0	±1.3	±1.0
	≤5 MHz	±0.0	±0.1	±0.1

Phase Synchronous Paths

IF BW for multi channel.....5 MHz, 20 MHz, 50 MHz, nominal phase-coherent measurements

Spurious Responses

Non-Input Related (Residual) Spurs[29]

Non-input related (residual) spurs
at 23 °C ± 5 °C

Center frequency.....-110 dBm, typical
20 MHz to 200 MHz

Center frequency.....-115 dBm, typical
>200 MHz to 3.6 GHz

Center frequency.....-112 dBm, typical
>3.6 GHz to 7 GHz[17]

[28] The IF passband response is relative to the IF center frequency on the IF bypass path. This specification has a reference level of -40 dBm to 0 dBm and applies when self-calibration is performed with digital IF equalization enabled.

[29] This specification has a reference level of -50 dBm and is valid when the device instantaneous bandwidth is set to >20 MHz when the FFT width is set to <24 MHz, when the device instantaneous bandwidth is set to ≤20 MHz when the FFT width is set to <12.8 MHz, and when the NI 5693 preselector filter path is used.

RF Input Port Emissions Level[30]

RF input port emissions level at 23 °C ± 5 °C

Center frequency.....-92 dBm, typical
>20 MHz to 3.6 GHz

Center frequency.....-120 dBm, typical
>3.6 GHz to 7 GHz[17]

Image Rejection[31]

Image rejection at 23 °C ± 5 °C

Center frequency.....-90 dBc, typical
>20 MHz to 1 GHz

Center frequency.....-80 dBc, typical
>1 GHz to 3.6 GHz

Center frequency.....-94 dBc, typical
>3.6 GHz to 7 GHz[17]

IF Rejection

Table 13. IF Rejection (Typical)[32]

Center Frequency	IF Rejection (dBc)			
	IF1	IF2	IF3	IF4
100 MHz to 3.6 GHz	59	92	92	90
>3.6 GHz to 7 GHz	87	92	N/A	90

30 This specification applies under normal operations and not during system self-calibration.

31 This specification is based on a 0 dBm input signal level with a reference level of 0 dBm and includes images from all conversion stages. This specification is valid when the NI 5693 preselector filter path is used.

32 IF rejection is the suppression of an input signal at the IF frequency when the RF signal analyzer is tuned elsewhere. This specification is based on a 0 dBm input signal level with a reference level of 0 dBm, and is valid when the NI 5693 preselector filter path is used.

Linearity

Third-Order Intermodulation Distortion

Table 14. Third-Order Intermodulation Distortion Preselector Path In-Band (Typical)

Center Frequency	Third-Order Intercept Point (dBm)			
	23 °C ± 5 °C		0 °C to 55 °C	
	Preamp Disabled[33]	Preamp Enabled[34]	Preamp Disabled[33]	Preamp Enabled[34]
>80 MHz to 1 GHz	+20	+1	+19	0
>1 GHz to 3 GHz	+21	0	+21	-1
>3 GHz to 3.6 GHz	+20	+2	+19	+1
>3.6 GHz to 7 GHz	+18	+2	+17	+1

Table 15. Third-Order Intermodulation Distortion Preselector Path Out-of-Band (Typical)

Center Frequency	Third-Order Intercept Point (dBm)			
	23 °C ± 5 °C		0 °C to 55 °C	
	Preamp Disabled[35]	Preamp Enabled[36]	Preamp Disabled[35]	Preamp Enabled[36]
>20 MHz to 1 GHz	+35	+15	+34	+15
>1 GHz to 3 GHz	+34	+10	+34	+9

[33] This specification is based on two -10 dBm tones spaced 700 kHz apart. This specification is valid when both tones are within the NI 5693 preselector bandwidth with a reference level of -5 dBm and the IF filter bandwidth is set to 5 MHz.

[34] This specification is based on two -30 dBm tones spaced 700 kHz apart. This specification is valid when both tones are within the NI 5693 preselector bandwidth with a reference level of -25 dBm and the IF filter bandwidth is set to 5 MHz.

[35] This specification is based on two -10 dBm tones placed outside the NI 5693 preselector bandwidth such that the intermodulation distortion product occurs in band. This specification has a reference level of -5 dBm and is valid when the IF filter bandwidth is set to 5 MHz.

[36] This specification is based on two -30 dBm tones placed outside the NI 5693 preselector bandwidth such that the intermodulation distortion product occurs in band. This specification has a reference level of -25 dBm and is valid when the IF filter bandwidth is set to 5 MHz.

Table 15. Third-Order Intermodulation Distortion Preselector Path Out-of-Band (Typical) (Continued)

Center Frequency	Third-Order Intercept Point (dBm)			
	23 °C ± 5 °C		0 °C to 55 °C	
	Preamp Disabled[35]	Preamp Enabled[36]	Preamp Disabled[35]	Preamp Enabled[36]
>3 GHz to 3.6 GHz	+40	+26	+40	+25
>3.6 GHz to 7 GHz	+34	+19	+33	+19

Second Harmonic Intercept Points

Table 16. Second Harmonic Intercept Points Preselector Path (Typical)

Source Frequency	Second Harmonic Intercept Point (dBm)			
	23 °C ± 5 °C		0 °C to 55 °C	
	Preamp Disabled[37]	Preamp Enabled[38]	Preamp Disabled[37]	Preamp Enabled[38]
>20 MHz to 250 MHz	+75	+68	+75	+68
>250 MHz to 1.8 GHz	+80	+58	+80	+58
>1.8 GHz to 3.5 GHz[17]	+70	+64	+70	+64

37 This specification is based on a -5 dBm tone at the RF IN connector with a reference level of -5 dBm. This specification is valid when the IF filter bandwidth is set to 5 MHz and the receiver tune frequency is set to twice the source frequency.

38 This specification is based on a -35 dBm tone at the RF IN connector with a reference level of -25 dBm. This specification is valid when the IF filter bandwidth is set to 5 MHz and the receiver tune frequency is set to twice the source frequency.

Gain Compression

Table 17. NI 5693 Gain Compression Preselector Path (Nominal)

Center Frequency	Input Power at <1 dB Gain Compression (dBm)			
	23 °C ± 5 °C		0 °C to 55 °C	
	Preamp Disabled[39]	Preamp Enabled[40]	Preamp Disabled[39]	Preamp Enable[40]
>20 MHz to 2.5 GHz	+8	-17	+7	-18
>2.5 GHz to 3.6 GHz	+6	-17	+6	-18
>3.6 GHz to 7 GHz[17]	+6	-16	+5	-17

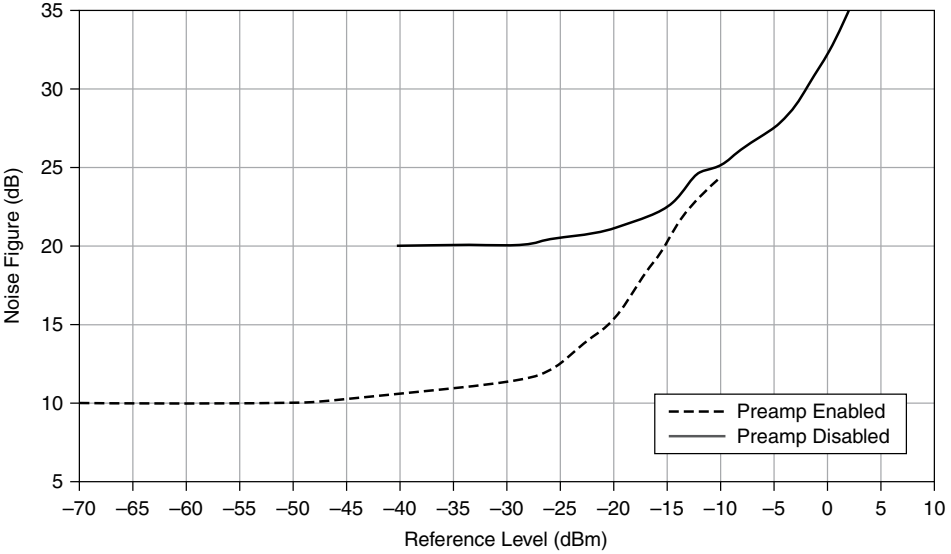
[39] This measurement uses the two-tone desensitization method[41] with input referred at the power level, a reference level of 0 dBm, and the IF filter bandwidth set to 110 kHz. The tone frequency spacing is >1.5 times the instantaneous bandwidth.

[40] This measurement uses the two-tone desensitization method[41] with input referred at the power level, a reference level of -30 dBm, and the IF filter bandwidth set to 110 kHz. The tone frequency spacing is >1.5 times the instantaneous bandwidth.

[41] The two-tone desensitization method places two tones within the NI 5693 preselector filter bandwidth with a tone spacing of 5 MHz. The lower amplitude tone power is set to -30 dBm. The amplitude variation of the lower amplitude cannot be >1 dB, because higher amplitude tone power is increased from low power to the input power at 1 dB of the *Gain Compression* specification.

Dynamic Range

Figure 4. Noise Figure versus Reference Level (Nominal)[42]



[42] The center frequency is set to 1 GHz.

Figure 5. In-Band Third-Order Intercept (TOI) versus Reference Level (Nominal)[43]

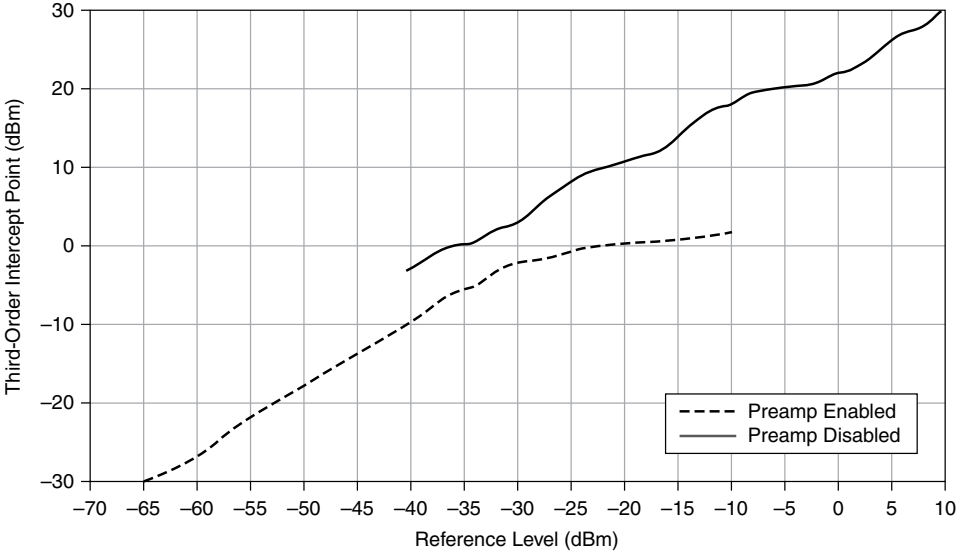
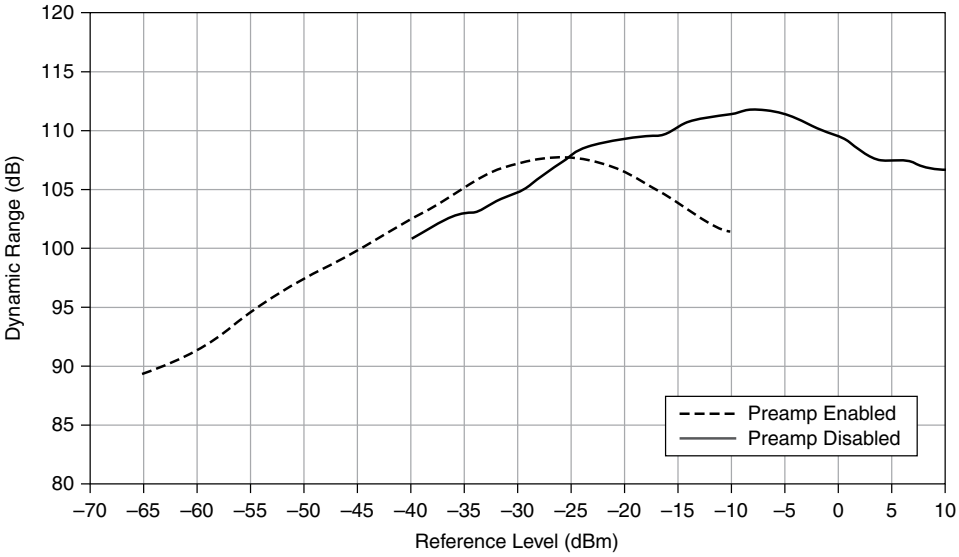


Figure 6. Dynamic Range versus Reference Level (Nominal)[44]



[43] The center frequency is set to 1 GHz.

[44] The center frequency is set to 1 GHz. Dynamic range is defined by the following equation: *Dynamic Range* = 2/3 × (*TOI* + 174 - *Noise Figure)*.

Measurement Speed

Table 18. Scan Rate of NI-RFSA Read Power Spectrum Mode (Nominal)[45]

Frequency Range	Instantaneous Bandwidth (MHz)	RBW (kHz)	Average Scan Rate (GHz/sec)
>20 MHz to 3.6 GHz	50	20	13
>20 MHz to 3.6 GHz	50	100	17
>20 MHz to 3.6 GHz	50	500	17
>20 MHz to 7 GHz[46]	50	20	12
>20 MHz to 7 GHz[46]	50	100	14
>20 MHz to 7 GHz[46]	50	500	16

Table 19. Scan Rate of NI-RFSA RF List Mode (Nominal)[47]

Frequency Range	Instantaneous Bandwidth (MHz)	RBW (kHz)	Average Scan Rate (GHz/sec)
>20 MHz to 3.6 GHz	50	20	30
>20 MHz to 3.6 GHz	50	100	32
>20 MHz to 3.6 GHz	50	500	32
>20 MHz to 7 GHz[46]	50	20	25
>20 MHz to 7 GHz[46]	50	100	30
>20 MHz to 7 GHz[46]	50	500	30

[45] This specification is based on using an NI 8133 controller and NI 1075 chassis. This specification is valid when the LO YIG main coil drive is set to fast and the FFT window type is set to 4-term blackman-harris.

[46] This specification is valid when disabling the NI 5605 downconverter preselector.

[47] This specification is based on acquiring I/Q data and converting it to power spectrum using the Spectral Measurements Toolkit and using an NI 8133 controller and NI 1075 chassis. This specification is valid when the frequency settling is set to 1.2 msec, the LO YIG main coil drive is set to fast, and the FFT window type is set to 4-term blackman-harris.

Table 20. RF Configuration List Mode Tuning Time (Nominal)

Step Size	Tuning Time (ms)[48]	
	Fast Configuration	Normal Configuration
50 MHz	1.2	7.1
3.5 GHz	17.1	20.1

Input/Output

NI 5693 RF Input (RF IN)

Connector.....SMA (F)

Reference impedance.....50 Ω

Maximum safe input power

- Preselector Path.....+30 dBm
- Low-frequency bypass path,.....+10 dBm
  NI 5605, 0 dB RF attenuation
- Low-frequency bypass path,.....+25 dBm
  NI 5605, ≥10 dB RF attenuation

Safe DC input voltage

- Preselector path
  - Minimum.....-25 V
  - Maximum.....25 V
- AC-coupled low-frequency bypass path
  - Minimum.....-25 V
  - Maximum.....25 V
- DC-coupled low-frequency bypass path
  - Minimum.....0 V
  - Maximum.....0 V

VSWR

- Low-frequency bypass.....<1.5 : 1, nominal
- Preselector path
  - 20 MHz to 950 MHz.....<2.0 : 1, nominal
  - >950 MHz to 2 GHz.....<2.6 : 1, nominal

[48] *Tuning time* refers to tuning within a single band (i.e. 20 MHz to 3.6 GHz).

>2 GHz to 3 GHz.....<1.9 : 1, nominal
>3 GHz to 7 GHz.....<3.6 : 1, nominal

NI 5693 External Filter Input/Output (EXT FILTER IN/OUT)

Connector.....SMA (F)

Reference impedance.....50 Ω

Safe DC input voltage
- Minimum.....-25 V
- Maximum.....25 V

VSWR.....<2.0 : 1, nominal

LO IN and LO OUT Front Panel Connectors (NI 5605)

Connector.....SMA (F)

Reference impedance.....50 Ω

Coupling.....AC

LO IN maximum safe power level.....+15 dBm

LO IN safe DC input voltage
- Minimum.....-25 V
- Maximum.....25 V

LO OUT maximum safe power level.....+15 dBm

LO OUT safe DC input voltage
- Minimum.....0 V
- Maximum.....0 V

LO frequency
- LO1.....4.6 GHz to 8.3 GHz
- LO2.....4.0 GHz
- LO3.....800 MHz

LO output level
- LO1.....+5 to +12 dBm, nominal (varies with frequency)
- LO2.....+9 dBm, nominal
- LO3.....+9 dBm, nominal

NI 5694 Ref/LO Input (REF/LO IN)

Connector.....SMA (F)

Reference impedance.....50 Ω

Frequency (Ref selected).....10 MHz, ±5 ppm

Frequency (LO selected).....215 MHz, nominal

Safe DC input voltage

- Minimum.....-12 V
- Maximum.....12 V

VSWR (10 MHz, 215 MHz).....<2:1, nominal

Operating power

- Reference selected.....10 dBm ± 1 dBm
- LO selected.....10 dBm ± 1 dBm

NI 5694 Reference Output (REF OUT)

Connector.....SMA (F)

Reference impedance.....50 Ω

Frequency.....10 MHz

Safe DC input voltage

- Minimum.....-12 V
- Maximum.....12 V

VSWR.....<2:1, nominal

Output power.....10 dBm ± 1 dBm

NI 5694 LO Output (LO OUT)

Connector.....SMA (F)

Reference impedance.....50 Ω

Frequency.....215 MHz

Safe DC input voltage

- Minimum.....-12 V
- Maximum.....12 V

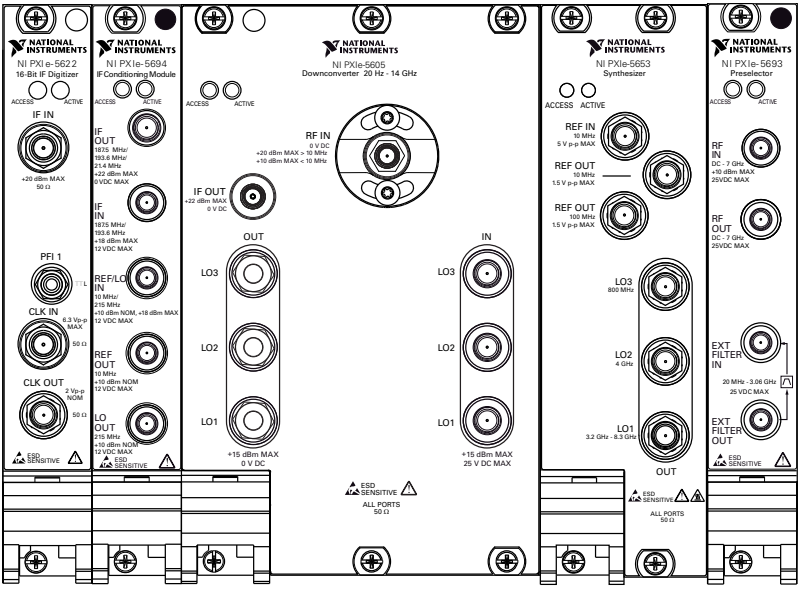
VSWR.....<2:1, nominal

Output power.....10 dBm ± 1 dBm

Physical Characteristics

Hardware Front Panel

Figure 7. NI 5667 (7 GHz) Front Panel



Power Requirements

Table 21. NI 5667 (7 GHz) Power Requirements (Nominal)

Module	Power Requirements (Voltages ± 5%)	
	From +3.3 VDC	From +12 VDC
NI 5693	1.30 A (4.29 W)	0.85 A (10.2 W)
NI 5653	1.10 A (3.63 W)	4.00 A (48.0 W)
NI 5605	1.20 A (3.96 W)	3.40 A (40.8 W)
NI 5694	1.31 A (4.32 W)	1.40 A (16.8 W)
NI 5622	1.75 A (5.78 W)	2.25 A (27.0 W)

Physical Dimensions

NI 5693

Size.....3U, one slot, PXI Express module
21.6 cm × 2.0 cm × 13.0 cm
(8.5 in. × 0.8 in. × 5.1 in.)

Weight.....465 g (16.4 oz)

NI 5653

Size.....3U, two slot, PXI Express module
21.6 cm × 4.0 cm × 13.0 cm
(8.5 in. × 1.6 in. × 5.1 in.)

Weight.....1,076 g (37.8 oz)

NI 5605

Size.....3U, four slot, PXI Express module
21.6 cm × 8.0 cm × 13.0 cm
(8.5 in. × 3.2 in. × 5.1 in.)

Weight.....1,882 g (66.4 oz)

NI 5694

Size.....3U, one slot, PXI Express module
21.6 cm × 2.0 cm × 13.0 cm
(8.5 in. × 0.8 in. × 5.1 in.)

Weight.....465 g (16.4 oz)

NI 5622

Size.....3U, one slot, PXI Express module
21.6 cm × 2.0 cm × 13.0 cm
(8.5 in. × 0.8 in. × 5.1 in.)

Weight.....376 g (13.3 oz)

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 B emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class B emissions

- AS/NZS CISPR 11: Group 1, Class B emissions
- FCC 47 CFR Part 15B: Class B emissions
- ICES-001: Class B 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 and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

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.

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Visit *ni.com/register* to register your National Instruments product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting *ni.com/certification*. If your product supports calibration, you can obtain the calibration certificate for your product at *ni.com/calibration*.

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