SPECIFICATIONS

PXIe-5694

IF Conditioning Module

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Definitions

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

NATIONAL INSTRUMENTS

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% (≈2σ) 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 ºC to 55 ºC
- 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
- NI-RFSA instrument driver version 2.6 or later is used
- 10 MHz reference input uses a stable 10 MHz reference output signal with an accuracy of 10 MHz ± 0.5 ppm.

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

- Over ambient temperature ranges of 23 °C ± 5 °C

Frequency

Input center frequency

IF conditioning bypass[1]	187.5 MHz, nominal
Signal conditioning downconversion disabled[2]	193.6 MHz, nominal
Signal conditioning downconversion enabled[3]	193.6 MHz, nominal

[1] Set the PXIe-5694 signal conditioning bypass path using **Device Instantaneous Bandwidth** property with a value greater than 20 MHz.

[2] Select the PXIe-5694 IF signal conditioning path set by setting the **Signal Conditioning Enabled** property to Disabled. This path is valid for a device instantaneous bandwidth less than or equal to 20 MHz.

[3] Select the PXIe-5694 IF Downconversion path by setting the **Signal Conditioning Enabled** property to Enabled. This path is valid for a device instantaneous bandwidth less than or equal to 20 MHz.

Output center frequency	
IF conditioning bypass	187.5 MHz, nominal
Signal conditioning downconversion disabled	193.6 MHz, nominal
Signal conditioning downconversion enabled	21.4 MHz, nominal

Table 1. PXIe-5694 Spectral Purity: 215 MHz LO Phase Noise (Typical)[4]

Offset Frequency	23 °C ± 5 °C (dBc/Hz)	0 °C to 55 °C (dBc/Hz)
100 Hz	-100	-98
1 kHz	-110	-108
10 kHz	-130	-128
100 kHz	-145	-143
1 MHz	-155	-153
2.5 MHz	-155	-153

Amplitude

Table 2. PXIe-5694 Gain (Typical)[5]

Signal Path	Step Gain Enabled Property	23 °C ± 5 °C Maximum Gain (dB)	23 °C ± 5 °C Nominal Gain Variation (dB)[6]
Signal conditioning bypassed	N/A	> -1.5	0.5
IF conditioning downconversion disabled	Disabled	-6.6	0 to 3
	Enabled	8.4	0 to 3

[4] Measured at the LO OUT connector using the PXIe-5693 10 MHz clock as a reference input signal.

[5] You can control the PXIe-5694 module gain by setting the **Reference Level** and the **IF Output Power Level** properties. The PXIe-5694 module gain is defined by the following equation: *Module Gain = Reference Level - IF Output Power Level*.

[6] Gain variation covers path-to-path variations.

Table 2. PXIe-5694 Gain (Typical)[5] (Continued)

Signal Path	Step Gain Enabled Property	23 °C ± 5 °C Maximum Gain (dB)	23 °C ± 5 °C Nominal Gain Variation (dB)[6]
IF conditioning downconversion enabled	Disabled	4.1	0 to 3.3
	Enabled	19.3	0 to 3.5

Table 3. PXIe-5694 Gain Accuracy (Typical)[7]

Signal Path	Step Gain Enabled Property	23 °C ± 5 °C (dB)	0 °C to 55 °C (dB)
Signal conditioning bypassed	N/A	±0.40	±1.0
IF conditioning downconversion disabled	Disabled	±0.20	±0.42
	Enabled	±0.30	±0.69
IF conditioning downconversion enabled	Disabled	±0.30	±0.56
	Enabled	±0.30	±0.60

Table 4. PXIe-5694 Gain Range (Typical)[8]

Signal Path	Step Gain Enabled Property	23 °C ± 5 °C (dB)	0 °C to 55 °C (dB)
IF conditioning downconversion disabled	Disabled	23.1	21.2
	Enabled	23.1	21.1
IF conditioning downconversion enabled	Disabled	22.7	20.3
	Enabled	22.7	20.3

Calibrated gain range (23 °C ± 5 °C)	25 dB, nominal
Gain resolution (23 °C ± 5 °C)	1 dB, nominal

[7] The **Downconverter Gain** property is read-only. *Gain accuracy* is the difference between the value reported by NI-RFSA and the actual measured gain.

[8] *Gain range* is the difference between the maximum and minimum PXIe-5694 module gain settings.

Analog IF Bandwidth

Bandpass Filter Passband

Table 5. PXIe-5694 Bandpass Filter Passband (Typical)

Signal Path	Minimum 3 dB Bandwidth	Final IF Center Frequency	Filter Technology[9]
Signal conditioning bypassed	160 MHz	187.5 MHz	N/A
20 MHz filter	20 MHz	193.6 MHz	LC
5 MHz filter	5 MHz	193.6 MHz or 21.4 MHz	LC
1.4 MHz filter	1.4 MHz	193.6 MHz or 21.4 MHz	SAW
400 kHz filter	400 kHz	193.6 MHz or 21.4 MHz	SAW
30 kHz filter	30 kHz	21.4 MHz	Quartz crystal

Bandpass Filter Rejection

Table 6. PXIe-5694 Bandpass Filter Rejection (Typical)

Signal Path	Frequency Offset[10] (± MHz)	Stopband Rejection (dBc)
20 MHz filter	23.0	>30
5 MHz filter	11.0	>30
1.4 MHz filter	1.40	>28
400 kHz filter	0.525	>28
30 kHz filter	0.025	>30

[9] LC refers to discrete component filters and SAW refers to surface acoustic wave filters.

[10] The frequency offset is relative to the IF center frequency output signal, which is either 193.6 MHz or 21.4 MHz.

Linearity

Table 7. PXIe-5694 Third-Order Intercept Point In-Band (Typical)[11]

Signal Path	Step Gain Enabled Property	23 °C ± 5 °C (dBm)	0 °C to 55 °C (dBm)
Signal conditioning bypassed	N/A	+40, nominal	+40, nominal
IF conditioning downconversion disabled	Disabled	+31	+31
	Enabled	+22	+21
IF conditioning downconversion enabled	Disabled	+21	+20
	Enabled	+16	+14

Table 8. PXIe-5694 Third-Order Intercept Point Out-of-Band[12]

Signal Path	Step Gain Enabled Property	23 °C ± 5 °C (dBm)	0 °C to 55 °C (dBm)
IF conditioning downconversion disabled	Disabled	+40	+40
	Enabled	+32	+32
IF conditioning downconversion enabled	Disabled	+29	+28
	Enabled	+25	+24

[11] *In-band* refers to the two fundamental tones and the two relevant third-order intermodulation tone products falling within the relevant analog filter passband.

[12] *Out-of-band* third-order intermodulation refers to two tones that are spaced at 1.5 times the filter bandwidth such that the third intermodulation product falls at the passband center frequency.

Gain Compression

Table 9. PXIe-5694 Gain Compression (Typical)[13]

Signal Path	Step Gain Enabled Property	Filter Path	23 °C ± 5 °C (dBm)	0 °C to 55 °C (dBm)
IF conditioning downconversion disabled	Disabled	20 MHz	15.1	15.1
		5 MHz	15.2	15.1
		1.4 MHz	14.6	14.5
		400 kHz	15.0	15.0
	Enabled	20 MHz	6	5.5
		5 MHz	6	5.5
		1.4 MHz	8	8
		400 kHz	8	8
IF conditioning downconversion enabled	Disabled	5 MHz	10.5	10
		1.4 MHz	13.5	13
		400 kHz	13.5	12.5
		30 kHz	11	10
	Enabled	5 MHz	-4.5	-5
		1.4 MHz	-1.5	-2.5
		400 kHz	-1.5	-3
		30 kHz	-4	-5.5

[13] The gain compression measurement uses a two-tone desensitization method with an input referred power level and maximum module gain. This method places two tones within the filter passband. The lower amplitude tone level cannot have an amplitude variation greater than 1 dB as the higher amplitude tone power is increased.

Settling Time[14]

To downconversion path[15]	500 ms, nominal
From downconversion path	50 ms, nominal
Filter path	200 µs, nominal
Gain path	200 µs, nominal

Spurious Responses

IF rejection for IF conditioning downconversion enabled	92 dBc, typical
Residual responses	-81 dBm, typical
Input-related spurs (*M*×*N*) at -15 dBm[16]	-96 dBc, typical
Reference clock harmonics	-84 dBm, typical
Image rejection[17]	
5 MHz filter path	70 dBc, typical
1.4 MHz filter path	66 dBc, typical
400 kHz filter path	52 dBc, typical
LO feedthrough at IF IN connector	-79 dBm, nominal
LO feedthrough at IF OUT connector	-95 dBm, nominal

Physical Characteristics

Front Panel Connectors

IF Input (IF IN)

Connector	SMA female
Reference impedance	50 Ω

[14] Amplitude settled to <0.1 dB of final value.

[15] This value includes phase and frequency settling to less than 0.1 ppm when switching to downconversion enabled mode while utilizing the internal LO source.

[16] *M*×*N* spurs apply to all paths except the 20 MHz filter path; the 20 MHz downconversion path is unspecified for spurious performance.

[17] Measurements use +10 dBm input power.

Safe DC input voltage	
Minimum	-12 V
Maximum	12 V
VSWR[18]	
Signal conditioning bypass path	<1.5:1, nominal
20 MHz filter	<1.25:1, nominal
5 MHz filter	<1.35:1, nominal
1.4 MHz filter	<1.5:1, nominal
400 kHz filter	<1.30:1, nominal

IF Output (IF OUT)

Connector	SMA female
Reference impedance	50 Ω
Safe DC input voltage	
Minimum	0 V
Maximum	0 V
VSWR	
Signal conditioning bypass path 187.5 MHz ± 80 MHz	<1.35:1, nominal
IF conditioning 193.6 MHz ± filter bandwidth/2	<1.5:1, nominal
IF conditioning 21.4 MHz ± Filter Bandwidth/2	<1.5:1, nominal

Reference/LO Input (REF/LO IN)

Connector	SMA female
Reference impedance	50 Ω
Input frequency	
REF IN[19]	10 MHz, ±5 ppm
LO IN[20]	215 MHz, nominal

[18] VSWR measured across respective instantaneous bandwidth.
[19] Use the **Ref Clock Source** property to select REF IN for the REF/LO IN connector.
[20] Use the **LO Source** property to select LO IN for the REF/LO IN connector.

Safe DC input voltage	
Minimum	-12 V
Maximum	12 V
VSWR (10 MHz or 215 MHz)	<2:1, nominal
Operating power	
REF IN[19]	10 dBm ± 1 dB
LO IN[20]	10 dBm ± 1 dB

Reference Output (REF OUT)

Connector	SMA female
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 dB, typical

LO Output (LO OUT)

Connector	SMA female
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 dB, typical

Power

Maximum safe continuous RF power	
IF IN	+18 dBm
IF OUT	+10 dBm
REF/LO IN	+20 dBm
REF OUT	+10 dBm
LO OUT	+10 dBm

Table 10. PXIe-5694 Maximum Power Levels

Signal Path	IF IN Terminal Maximum Operating Power (dBm)[21]		IF OUT Terminal Maximum Power (dBm)
	Step Gain Enabled Property Disabled	Step Gain Enabled Property Enabled	
Signal conditioning bypassed	+10	+10	+22
IF conditioning downconversion disabled	0	-10	+22
IF conditioning downconversion enabled	0	-10	+22

Power requirements	
3.3 V	1.31 A
12 V	1.40 A

Dimensions and Weight

Dimensions	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)

Environment

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

Indoor use only.

[21] Value taken at the maximum **Reference Level** property setting.

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	- 41 °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_{rms} (Tested in accordance with IEC 60068-2-64.)
Nonoperating	5 Hz to 500 Hz, 2.4 g_{rms} (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 CE

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*, 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*. 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*.

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`.)

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