SPECIFICATIONS

PXIe-5831

Up to 44 GHz, 1 GHz Bandwidth, Vector Signal Transceiver

These specifications apply to the PXIe-5831 Vector Signal Transceiver for intermediate frequency (IF) and millimeter wave (mmWave) frequencies.

The PXIe-5831 IF only instrument configuration comprises the following modules:

- PXIe-5820 Vector Signal Transceiver
- PXIe-3622 Vector Signal Up/Down Converter

The PXIe-5831 IF and mmWave instrument configuration comprises the following modules:

- PXIe-5820 Vector Signal Transceiver
- PXIe-3622 Vector Signal Up/Down Converter
- PXIe-5653 RF Analog Signal Generator (LO source)
- One or two mmRH-5582 mmWave Radio Heads

There is no single instrument labeled "PXIe-5831."

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Definitions

In this document, the terms *RF*, *RF Input*, and *RF Output* refer to the specifications applicable to the mmWave TRX ports.

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

measurement uncertainties, temperature drift, and aging. Warranted specifications are ensured by design or verified during production and calibration.

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.
- *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.
- *Measured* specifications describe the measured performance of a representative model.

Specifications are *Warranted* unless otherwise noted.

Conditions

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

- 30 minutes warm-up time
- Self-calibration is performed after the specified warm-up period has completed
- Module temperature, as reported by the onboard temperature sensor, is within ±5 °C of the last self-calibration temperature
- Calibration cycle is maintained
- Modules are installed in an NI chassis with slot cooling capacity = 82 W
- The chassis fan mode is set to Auto and Cooling Profile is set to 58 W/82 W in NI Measurement & Automation Explorer (MAX)
- Empty chassis slots contain slot blockers and EMC filler panels to minimize temperature drift and reduce emissions
- Modules are connected with NI cables as shown in the *PXIe-5831 Getting Started Guide*
- RFmx, NI-RFSA, or NI-RFSG instrument driver is used
- Calibration IP is used properly during the creation of custom FPGA bitfiles
- LO Step Size is set to the default value and the LO Source is set to Onboard
- Acquisition Type is set to IQ

Warranted specifications are valid under the following condition unless otherwise noted.

- Over ambient temperature ranges of 0 °C to 45 °C

Typical and Typical-95 specifications are valid under the following condition unless otherwise noted.

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

Typical and Measured specifications do not include measurement uncertainty and are measured immediately after a device self-calibration is performed.

Instrument Terminology

Refer to the following list for definitions of common PXIe-5831 instrument terms used throughout this document.

Table 1. Instrument Terminology Definitions

Term	Definition
IF IN/OUT Ports	Refers to the IF IN/OUT 0 and IF IN/OUT 1 connectors on the PXIe-3622 front panel for intermediate frequency (IF) signals.
TRX Ports	Refers to the DIRECT TRX PORTS or SWITCHED TRX PORTS on the mmRH-5582 front panel for RF signals.
DIRECT TRX PORTS	RF connectors 0, 1, or 8 on mmRH-5582 modules labeled with DIRECT TRX PORTS.
SWITCHED TRX PORTS	RF connectors 0 through 7 or 0 through 15 on mmRH-5582 modules labeled with SWITCHED TRX PORTS only.
LO1	Refers to the local oscillator responsible for the up and down conversion between IF and mmWave frequencies.
LO2	Refers to the local oscillator internal to the PXIe-3622 responsible for the up and down conversion between baseband and IF.
Onboard	Refers to the value of the **LO Source** property and changes purpose depending on the designated LO and instrument configuration. A value of Onboard configures the hardware as follows: • **PXIe-5831 IF only instrument**—LO1: N/A LO2: Sets the source of LO2 to one of the internal synthesizers of the PXIe-3622. • **PXIe-5831 IF and mmWave instrument**—LO1: Sets the source of LO1 to the PXIe-5653. LO2: Sets the source of the LO2 to one of the internal synthesizers of the PXIe-3622.

Table 1. Instrument Terminology Definitions (Continued)

Term	Definition
Secondary	Refers to the value of the **LO Source** property for LO1 in the PXIe-5831 IF and mmWave instrument configuration. The value of Secondary sets the source of LO1 to the internal PXIe-3622 synthesizers. This setting optimizes frequency settling time, but may worsen phase noise. NI recommends using this setting when LO sharing and speed optimization for spectral scanning is preferred.
Offset Mode is Automatic	Refers to the NI-RFSA **Downconverter Frequency Offset Mode** property or NI-RFSG **Upconverter Frequency Offset Mode** property set to Automatic. The PXIe-5831 contains a direct conversion architecture. Offset mode allows the instrument to operate in low IF mode, which increases the separation between the signal of interest and the residual sideband image and residual LO leakage power. However, low IF mode limits the available instantaneous bandwidth. A setting of Automatic allows the driver to enable low IF mode when the signal bandwidth is small enough to allow it. Automatic is the default value. NI recommends keeping offset mode set to the default value.

Table 1. Instrument Terminology Definitions (Continued)

Term	Definition
Offset Mode is Enabled	Refers to the NI-RFSA **Downconverter Frequency Offset Mode** property or NI-RFSG **Upconverter Frequency Offset Mode** property set to Enabled. The PXIe-5831 contains a direct conversion architecture. Offset mode allows the instrument to operate in low IF mode, which increases the separation between the signal of interest and the residual sideband image and residual LO leakage power.
Offset Mode is User-Defined	Refers to the NI-RFSA **Downconverter Frequency Offset Mode** property or NI-RFSG **Upconverter Frequency Offset Mode** property set to User-Defined. The PXIe-5831 contains a direct conversion architecture. Offset Mode set to User-Defined allows the instrument to operate with maximum instantaneous bandwidth. By default, the offset is selected to maximize the available instantaneous bandwidth.

Related Information

Refer to the PXIe-5831 section of the NI RF Vector Signal Transceivers Help for more information about instrument terminology.

Frequency

Frequency range[1]

IF IN/OUT 0, IF IN/OUT 1	5 GHz to 21 GHz
TRX ports[2] (Transmit)	22.5 GHz to 31.3 GHz 37 GHz to 44 GHz
TRX ports[2] (Receive)	22.5 GHz to 44 GHz

[1] *Frequency range* refers to the range of upconverter or downconverter center frequencies. The actual frequency coverage extends beyond the upconverter or downconverter frequency by up to half of the frequency bandwidth.

[2] The mmRH-5582 DIRECT TRX PORTS and SWITCHED TRX PORTS share the same frequency ranges and are only available on the PXIe-5831 IF and mmWave instrument configurations.

Frequency bandwidth	1 GHz within the specified frequency ranges
Tuning resolution[3]	4.45 uHz

Table 2. Default LO Step Size[4,5]

Frequency Range	Step Size	
	Onboard	Secondary
5 GHz to 14.2 GHz	2 MHz	—
>14.2 GHz to 21 GHz	4 MHz	—
22.5 GHz to 44 GHz	<1 Hz	8 MHz

Frequency Settling Time

Table 3. PXIe-5653 Maximum Frequency Lock Time,[6] Typical

Frequency Step Size	Frequency Lock Time (ms)
≤25 MHz	0.85
≤50 MHz	1.10
≤75 MHz	1.35
≤80 MHz	1.35
≤90 MHz	1.35
≤100 MHz	1.35
≤250 MHz	1.80
≤500 MHz	6
≤1.0 GHz	10
≤2.0 GHz	13

[3] Tuning resolution combines LO step size capability and frequency shift DSP implemented on the FPGA.

[4] The worst case LO spurious content degrades for smaller LO step sizes and improves for larger LO step sizes that are multiples of 2 MHz and 10 MHz.

[5] LO step size can be set using the driver software.

[6] PXIe-5653 Frequency Tuning Time consists of *Lock Time + Settling Time to Required Accuracy*. For example, a 50 MHz step requires 1.1 ms (the frequency lock time) + 0.75 (the frequency settling time), or 1.85 ms to lock and settle to 0.1 ppm accuracy.

Table 3. PXIe-5653 Maximum Frequency Lock Time,[6] Typical (Continued)

Frequency Step Size	Frequency Lock Time (ms)
≤3.0 GHz	15
≤5.1 GHz	17

Table 4. PXIe-5831 Maximum Frequency Settling Time[7] (LO1), Typical

Settling Accuracy (Relative to Final Frequency)	Settling Time (ms)	
	Onboard[6]	Secondary
$\leq 1.0 \times 10^{-6}$	0.00	0.50
$\leq 0.1 \times 10^{-6}$	0.75	0.80
$\leq 0.01 \times 10^{-6}$	1.60	1.00

Table 5. PXIe-5831 Maximum Frequency Settling Time (LO2), Typical

Settling Accuracy (Relative to Final Frequency)	Settling Time (ms), Onboard
1.0×10^{-6}	0.50
0.1×10^{-6}	0.80
0.01×10^{-6}	1.00
The LO2 frequency settling time includes the frequency lock time.	

Internal Frequency Reference

LO1 source

Onboard

Initial adjustment accuracy[8]	$\pm 50 \times 10^{-9}$
Temperature stability	$\pm 50 \times 10^{-9}$

[6] PXIe-5653 Frequency Tuning Time consists of *Lock Time + Settling Time to Required Accuracy*. For example, a 50 MHz step requires 1.1 ms (the frequency lock time) + 0.75 (the frequency settling time), or 1.85 ms to lock and settle to 0.1 ppm accuracy.

[7] *Frequency settling* refers to the time it takes the frequency to settle once the hardware receives the frequency change. The additional time due to software initiated frequency changes is not included and varies by computer.

[8] Over a temperature range of 15 °C to 35 °C.

Aging	±100 × 10^{-9} per year
Accuracy	*Initial adjustment accuracy* ± *Aging* ± *Temperature stability*
Secondary	
Initial adjustment accuracy	±5 × 10^{-6}
Temperature stability	±1 × 10^{-6}, maximum
Aging	±1 × 10^{-6} per year, maximum
Accuracy	*Initial adjustment accuracy* ± *Aging* ± *Temperature stability*
LO2 source (Onboard)	
Initial adjustment accuracy	±5 × 10^{-6}
Temperature stability	±1 × 10^{-6}, maximum
Aging	±1 × 10^{-6} per year, maximum
Accuracy	*Initial adjustment accuracy* ± *Aging* ± *Temperature stability*

Spectral Purity

Table 6. IF Single Sideband Phase Noise (IF IN/OUT Ports), Typical

Frequency	Phase Noise (dBc/Hz, Single Sideband)
5 GHz to 7.1 GHz	-103
>7.1 GHz to 14.2 GHz	-97
>14.2 GHz to 21 GHz	-95
Conditions: 20 kHz offset; self-calibration °C ± 5 °C ; LO2 LO Source: Onboard.	

Table 7. RF Single Sideband Phase Noise (DIRECT TRX PORTS), Typical

Frequency	Phase Noise (dBc/Hz, Single Sideband)	
	Onboard	Secondary
22.5 GHz to 31.3 GHz	-97	-86
>31.3 GHz to 40 GHz	-99	-86

Table 7. RF Single Sideband Phase Noise (DIRECT TRX PORTS), Typical (Continued)

Frequency	Phase Noise (dBc/Hz, Single Sideband)	
	Onboard	Secondary
40 GHz to 44 GHz	-103	-85
Conditions: 20 kHz offset; self-calibration °C ± 5 °C ; LO1 LO Source: Onboard or Secondary.		

Figure 1. Onboard Phase Noise at 5.5 GHz, 10 GHz, and 18 GHz, Measured (Spurs Not Shown)

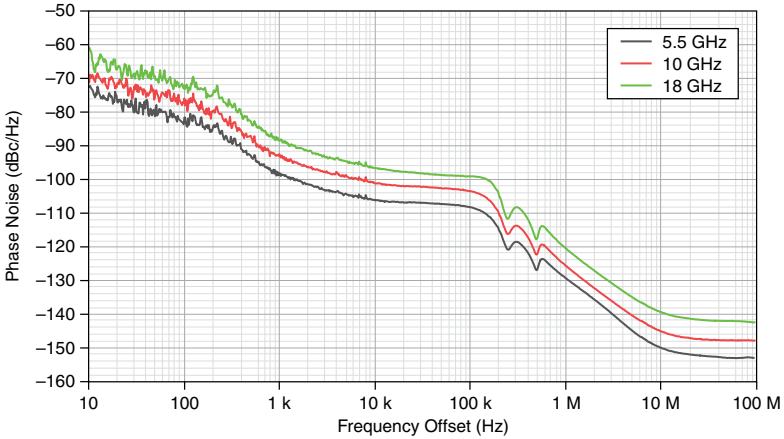
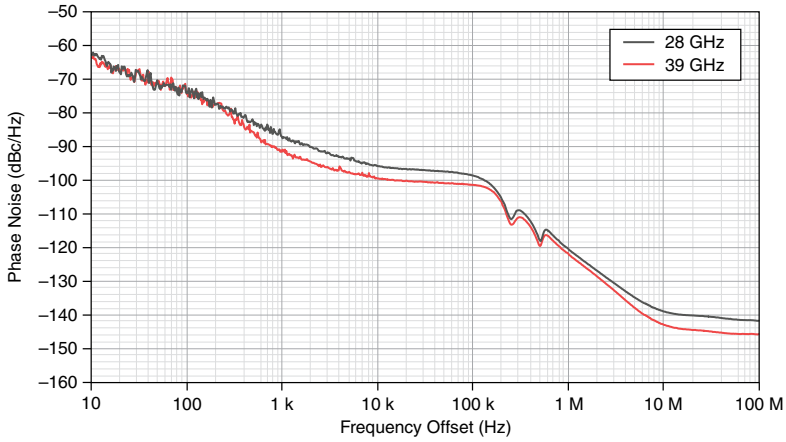


Figure 2. Onboard Phase Noise at 28 GHz and 39 GHz, Measured[9] (Spurs Not Shown)



Transmit (IF IN/OUT Ports)

IF Output Amplitude Range

Table 8. IF Output Maximum Settable Power

Upconverter Center Frequency	IF IN/OUT 0 (dBm)		IF IN/OUT 1 (dBm)	
	Specification	Nominal	Specification	Nominal
5 GHz to 8 GHz	14	19	13	18
>8 GHz to 12 GHz	13	17	12	16
>12 GHz to 18 GHz	12	17	10	16

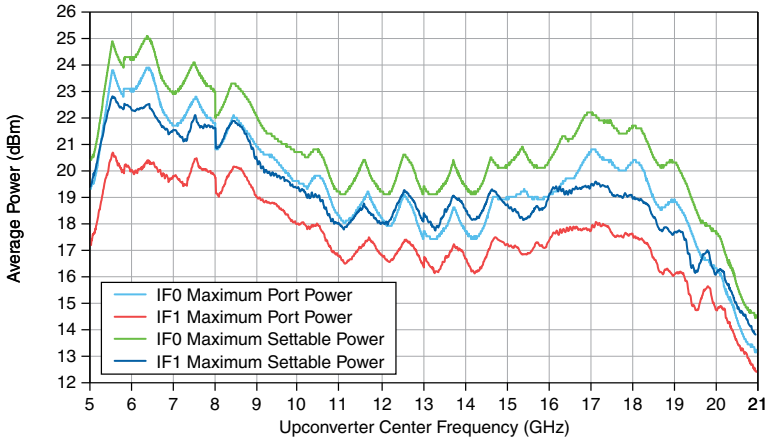
[9] LO1 **LO Source** property is set to Onboard.

Table 8. IF Output Maximum Settable Power (Continued)

Upconverter Center Frequency	IF IN/OUT 0 (dBm)		IF IN/OUT 1 (dBm)	
	Specification	Nominal	Specification	Nominal
>18 GHz to 21 GHz	7	14	6	13
The power range refers to CW average power. For modulated signal generation, it is important to consider the impact of peak to average power ratio (PAPR). For example, a modulated 80 MHz 802.11ax signal with a 11 dB PAPR can be generated with up to +4 dBm average modulated power when the CW average power is 15 dBm.				

Output attenuator resolution	1 dB, nominal
Digital attenuation resolution[10]	<0.1 dB

Figure 3. IF Output Maximum CW Average Power, Measured



IF Output Amplitude Settling Time[11]

<0.5 dB of final value	27 µs, nominal
<0.1 dB of final value	40 µs, nominal

[10] Average output power ≥ -100 dBm.

[11] Refers to the time it takes to switch between two analog gain states with frequency unchanged once the hardware receives the amplitude change. The additional time due to software-initiated amplitude changes is not included and varies by computer. When changing frequencies, reconfiguration time is dominated by the frequency settling. Refer to *Frequency Settling Time* for more information.

IF Output Amplitude Accuracy

Table 9. IF Output Absolute Amplitude Accuracy (dB) (Offset Mode is User-Defined)

Upconverter Center Frequency	23 °C ± 5 °C			0 °C to 45 °C
	Specification	Typical-95	Typical	Specification
5 GHz to 8 GHz	±1.2	±0.8	±0.5	±1.9
>8 GHz to 12 GHz	±1.4	±1.0	±0.6	±2.1
>12 GHz to 18 GHz	±1.8	±1.4	±0.8	±2.7
>18 GHz to 21 GHz	±2.1	±1.7	±1.0	±2.9

Conditions: Peak power level -30 dBm to +12 dBm; measured with a CW signal at 10 MHz offset from the configured upconverter center frequency; measurement performed after the PXIe-5831 has settled; Upconverter/Downconverter Frequency Offset Mode: User-Defined.

This specification is valid only when the module is operating within the specified ambient temperature range and within ±5 °C from the last self-calibration temperature, as measured with the onboard temperature sensors.

This specification requires that temperature correction is being performed. Temperature correction is applied automatically if `NIRFSG_ATTR_AUTOMATIC_THERMAL_CORRECTION` is enabled (default). Temperature correction is applied if necessary only when NI-RFSG settings are adjusted. If `NIRFSG_ATTR_AUTOMATIC_THERMAL_CORRECTION` is disabled, the `niRFSG_PerformThermalCorrection` must be explicitly called.

Table 10. IF Output Relative Amplitude Accuracy (Offset Mode is User-Defined), Typical

Upconverter Center Frequency	Relative Amplitude Accuracy (dB)
5 GHz to 8 GHz	±0.25
>8 GHz to 12 GHz	±0.30
>12 GHz to 18 GHz	±0.40

Table 10. IF Output Relative Amplitude Accuracy (Offset Mode is User-Defined), Typical (Continued)

Upconverter Center Frequency	Relative Amplitude Accuracy (dB)
>18 GHz to 21 GHz	±0.40

Conditions: Peak power level -30 dBm to +12 dBm; measured with a CW signal at 10 MHz offset from the configured upconverter center frequency; measurement performed after the PXIe-5831 has settled; Upconverter/Downconverter Frequency Offset Mode: User-Defined.

Relative accuracy describes the residual absolute accuracy error when compared to the absolute accuracy error at 0 dBm.

This specification is valid only when the module is operating within the specified ambient temperature range and within ±5 °C from the last self-calibration temperature, as measured with the onboard temperature sensors.

This specification requires that temperature correction is being performed. Temperature correction is applied automatically if `NIRFSG_ATTR_AUTOMATIC_THERMAL_CORRECTION` is enabled (default). Temperature correction is applied if necessary only when NI-RFSG settings are adjusted. If `NIRFSG_ATTR_AUTOMATIC_THERMAL_CORRECTION` is disabled, the `niRFSG_PerformThermalCorrection` must be explicitly called.

IF Output Frequency Response

Table 11. IF Output Frequency Response (dB)

Upconverter Center Frequency	23 °C ± 5 °C			0 °C to 45 °C
	Specification	Typical-95	Typical	Specification
5 GHz to 8 GHz	1.8	1.2	1.1	2.2
>8 GHz to 12 GHz	1.9	1.3	1.1	2.2
>12 GHz to 18 GHz	2.5	1.8	1.7	2.8

Table 11. IF Output Frequency Response (dB) (Continued)

Upconverter Center Frequency	23 °C ± 5 °C			0 °C to 45 °C
	Specification	Typical-95	Typical	Specification
>18 GHz to 21 GHz	2.7	2.0	1.9	2.9

Conditions: Peak power level -30 dBm to +10 dBm; module temperature within ±5 °C of last self-calibration temperature.

Frequency response is defined as the maximum relative amplitude deviation from the reference offset frequency. For the PXIe-5831 IF output, the reference offset frequency is 10 MHz higher than the upconverter center frequency. For the absolute amplitude accuracy at the reference offset, refer to the *IF Output Amplitude Accuracy* section.

Figure 4. IF Output Frequency Response, 0 dBm, Peak Output Power Level, Equalized, Measured

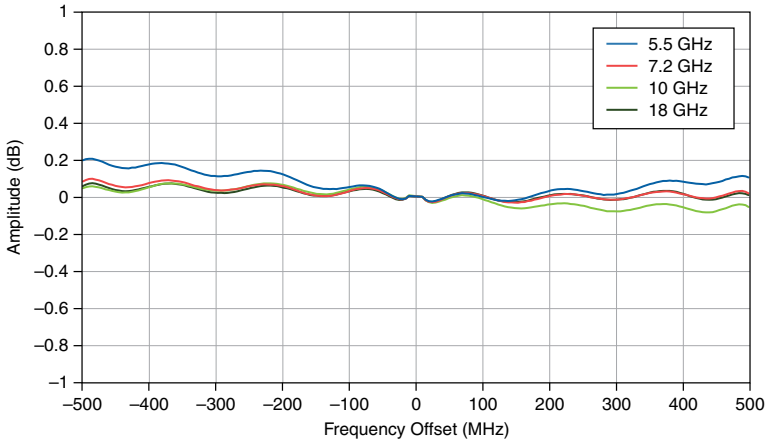
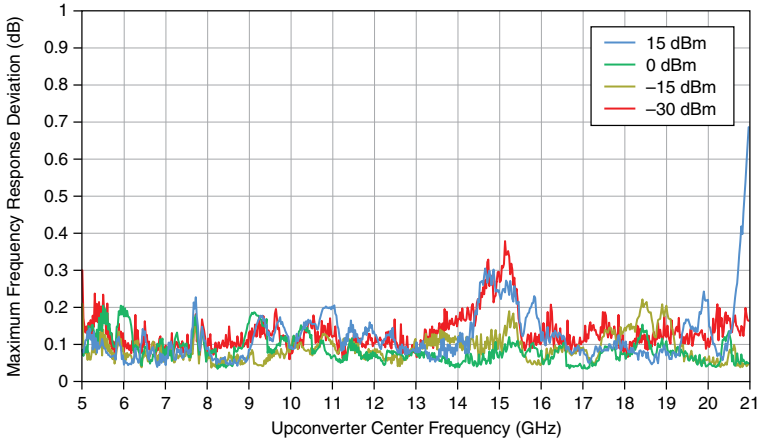


Figure 5. Maximum IF Output Frequency Response Deviation versus Upconverter Center Frequency, Measured



IF Output Average Noise Density

Table 12. Output Average Noise Density (dBm/Hz), Typical

Upconverter Center Frequency	Output Power Level (Peak)		
	-10 dBm	0 dBm	15 dBm
5 GHz to 8 GHz	-156	-149	-135
>8 GHz to 12 GHz	-154	-148	-135
>12 GHz to 18 GHz	-151	-145	-132
>18 GHz to 21 GHz	-149	-145	-131

Conditions: 10 averages; 40 dB baseband signal attenuation; noise measurement frequency offset 200 MHz relative to output frequency.

Measured on the PXIe-3622 IF IN/OUT 1 port. The IF IN/OUT 0 port has a 1 dB to 5 dB degradation compared to the IF IN/OUT 1 port.

IF Output Third-Order Intermodulation

Table 13. Third-Order IF Output Intermodulation Distortion (IMD_3) (dBc), Typical

Upconverter Center Frequency	IF IN/OUT 0			IF IN/OUT 1		
	Output Power Level (Peak)			Output Power Level (Peak)		
	-30 dBm	0 dBm	15 dBm	-30 dBm	0 dBm	15 dBm
5 GHz to 8 GHz	-56	-56	-49	-45	-46	-46
>8 GHz to 12 GHz	-58	-57	-41	-53	-52	-39
>12 GHz to 18 GHz	-55	-55	-37	-53	-50	-35
>18 GHz to 21 GHz	-55	-54	-34	-50	-50	-32

Conditions: Measured by generating two -7 dBFS tones centered at +100 MHz within the instantaneous bandwidth with 10 MHz separation.

IF Output Nonharmonic Spurs

Table 14. IF Output Nonharmonic Spurs (dBc) (Default LO Step Size), Typical

Frequency	Offset ≤ 500 kHz	500 kHz < Offset ≤ 20 MHz	Offset > 20 MHz[12]
5 GHz to 8 GHz	-62	-44	<-70
>8 GHz to 12 GHz	-59	-51	<-70
>12 GHz to 18 GHz	-54	-51	<-70
>18 GHz to 21 GHz	-53	-59	<-70

Conditions: Output full scale level 0 dBm. Measured with a single tone at 0 dBFS.

Note Offset refers to ± desired signal offset (Hz) around the current LO frequency.

[12] The maximum offset is limited to within the equalized bandwidth of the referenced LO Frequency.

Table 15. IF Output Nonharmonic Spurs (dBc) (1 MHz LO Step Size), Measured

Frequency	0 Hz ≤ Offset ≤ 5 MHz
5 GHz to 7.1 GHz	-64
>7.1 GHz to 14.2 GHz	-46
>14.2 GHz to 21 GHz	-40

Conditions: Output full scale level 0 dBm.

Note Offset refers to ± desired signal offset (Hz) around the current LO frequency.

IF Output LO Residual Power

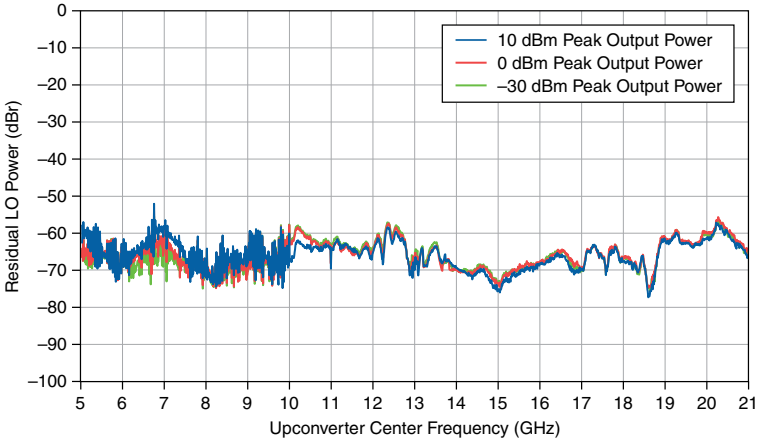
Table 16. IF Output LO Residual Power (dBc), Typical

Upconverter Center Frequency	Self-Calibration °C ± 1 °C	Self-Calibration °C ± 5 °C
5 GHz to 8 GHz	-50	-47
>8 GHz to 12 GHz	-48	-36
>12 GHz to 18 GHz	-46	-35
>18 GHz to 21 GHz	-36	-28

Conditions: Peak output power -30 dBm to +15 dBm. Input tone power at a maximum of -3 dBr. LO2 **LO Source** property set to Onboard.

LO Residual Power averaged across a maximum of 1 GHz bandwidth.

Figure 6. IF Output LO Residual Power, Measured



IF Output Residual Sideband Image

Table 17. IF Output Residual Sideband Image (dBc), Typical

Upconverter Center Frequency	Self-Calibration °C ± 1 °C	Self-Calibration °C ± 5 °C
5 GHz to 8 GHz	-39	-34
>8 GHz to 12 GHz	-48	-41
>12 GHz to 18 GHz	-50	-46
>18 GHz to 21 GHz	-48	-43

Conditions: Peak output power levels -30 dBm to +15 dBm. Input tone power at a maximum of -3 dBr. LO2 **LO Source** property set to Onboard.

This specification describes the maximum residual sideband image within the 1 GHz device instantaneous bandwidth.

Figure 7. IF Output Residual Sideband Image, 0 dBm Peak Power, Measured

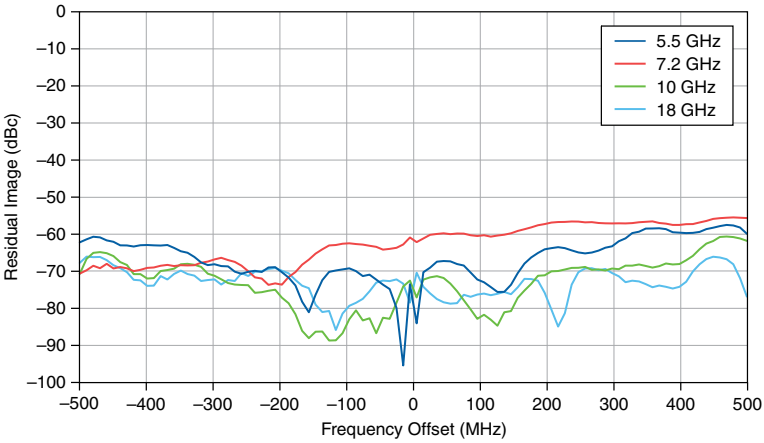
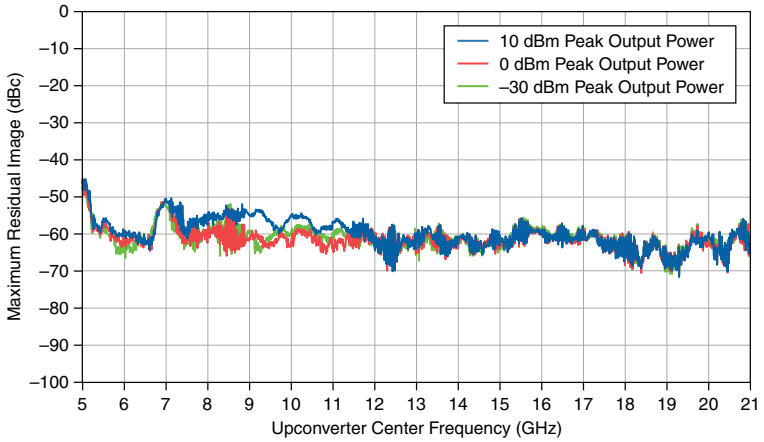


Figure 8. Maximum IF Output Residual Sideband Image Versus Upconverter Center Frequency, Measured



Transmit (TRX Ports)

RF Output Amplitude Range

Table 18. RF Output Maximum Settable Power

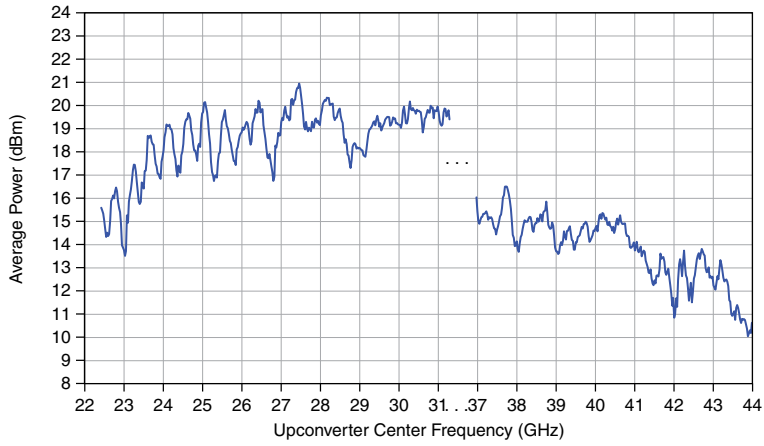
Upconverter Center Frequency	Specification (dBm)	Nominal (dBm)
22.5 GHz to 31.3 GHz	14	18
37 GHz to 40 GHz	10	15
>40 GHz to 44 GHz	9	14

Conditions: Valid over 23 °C ± 5 °C.

The power range refers to CW average power. For modulated signal generation, it is important to consider the impact of peak to average power ratio (PAPR). For example, a modulated 80 MHz 802.11ax signal with a 11 dB PAPR can be generated with up to +4 dBm average modulated power when the CW average power is 15 dBm.

Output attenuator resolution	1 dB, nominal
Digital attenuation resolution[13]	<0.1 dB

Figure 9. RF Output Maximum CW Average Power, Measured



[13] Average output power ≥ -100 dBm.

RF Output Amplitude Settling Time[14]

<0.5 dB of final value	31 µs, nominal
<0.1 dB of final value	43 µs, nominal

RF Output Amplitude Accuracy

Table 19. RF Output Absolute Amplitude Accuracy (dB) (Offset Mode is User-Defined)

Upconverter Center Frequency	Specification	Typical-95	Typical
22.5 GHz to 31.3 GHz	±2.0	±1.6	±1.0
37 GHz to 40 GHz	±2.2	±1.9	±1.2
>40 GHz to 44 GHz	±2.9	±2.1	±1.3

Conditions: Valid over 23 °C ± 5 °C; for frequencies ≥ 37 GHz to < 40 GHz, peak power level is -40 dBm to +6 dBm; for frequencies ≥ 40 GHz, peak power level is -40 dBm to +2 dBm; measured with a CW signal at 10 MHz offset from the configured upconverter center frequency; measurement performed after the PXIe-5831 has settled; Upconverter/Downconverter Frequency Offset Mode: User-Defined.

This specification is valid only when the module is operating within the specified ambient temperature range and within ±5 °C from the last self-calibration temperature, as measured with the onboard temperature sensors.

This specification requires that temperature correction is being performed. Temperature correction is applied automatically if `NIRFSG_ATTR_AUTOMATIC_THERMAL_CORRECTION` is enabled (default). Temperature correction is applied if necessary only when NI-RFSG settings are adjusted. If `NIRFSG_ATTR_AUTOMATIC_THERMAL_CORRECTION` is disabled, the `niRFSG_PerformThermalCorrection` must be explicitly called.

Table 20. RF Output Relative Amplitude Accuracy (Offset Mode is User-Defined), Typical

Upconverter Center Frequency	Relative Amplitude Accuracy (dB)
22.5 GHz to 31.3 GHz	±0.50
37 GHz to 40 GHz	±0.55

[14] Varying RF output power range.

Table 20. RF Output Relative Amplitude Accuracy (Offset Mode is User-Defined), Typical (Continued)

Upconverter Center Frequency	Relative Amplitude Accuracy (dB)
>40 GHz to 44 GHz	±0.60

Conditions: For frequencies ≤ 31.3 GHz, peak power level is -40 dBm to +10 dBm; for frequencies ≥ 37 GHz, peak power level is -40 dBm to +6 dBm; measured with a CW signal at 10 MHz offset from the configured upconverter center frequency; measurement performed after the PXIe-5831 has settled; Upconverter/Downconverter Frequency Offset Mode: User-Defined.

Relative accuracy describes the residual absolute accuracy error when compared to the absolute accuracy error at 0 dBm.

This specification is valid only when the module is operating within the specified ambient temperature range and within ±5 °C from the last self-calibration temperature, as measured with the onboard temperature sensors.

This specification requires that temperature correction is being performed. Temperature correction is applied automatically if `NIRFSG_ATTR_AUTOMATIC_THERMAL_CORRECTION` is enabled (default). Temperature correction is applied if necessary only when NI-RFSG settings are adjusted. If `NIRFSG_ATTR_AUTOMATIC_THERMAL_CORRECTION` is disabled, the `niRFSG_PerformThermalCorrection` must be explicitly called.

RF Output Frequency Response

Table 21. RF Output Frequency Response (dB)

Upconverter Center Frequency	Specification	Typical-95	Typical
22.5 GHz to 23 GHz	2.8	2.4	1.1
>23 GHz to 31.3 GHz	2.2	1.8	1.0
37 GHz to 40 GHz	2.3	1.9	1.1

Table 21. RF Output Frequency Response (dB) (Continued)

Upconverter Center Frequency	Specification	Typical-95	Typical
>40 GHz to 44 GHz	2.7	2.5	1.4

Conditions: Valid over 23 °C ± 5 °C; for frequencies ≤ 31.3 GHz, peak power level is -35 dBm to +10 dBm; from 37 GHz to 40 GHz, peak power level is -35 dBm to +5 dBm; from >40 GHz to 44 GHz, peak power level is -35 dBm to 0 dBm; module temperature within ±5 °C of last self-calibration temperature.

Frequency response is defined as the maximum relative amplitude deviation from the reference offset frequency. For the PXIe-5831 RF output, the reference offset frequency is 10 MHz higher than the upconverter center frequency. For the absolute amplitude accuracy at the reference offset, refer to the *RF Output Amplitude Accuracy* section.

Figure 10. RF Output Frequency Response, 0 dBm, Peak Output Power Level, Equalized, Measured

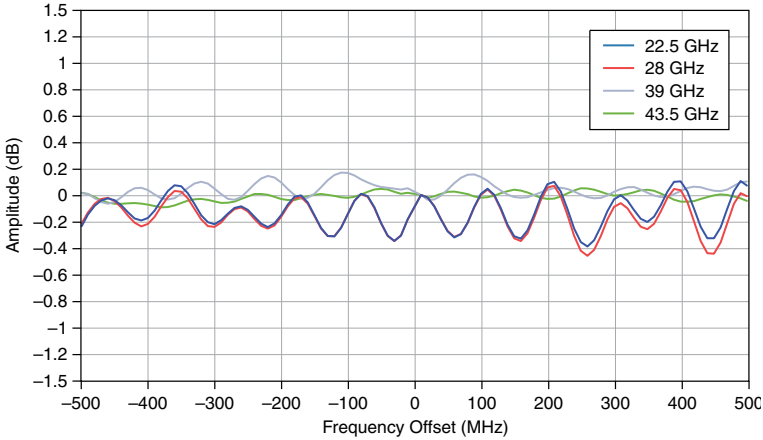
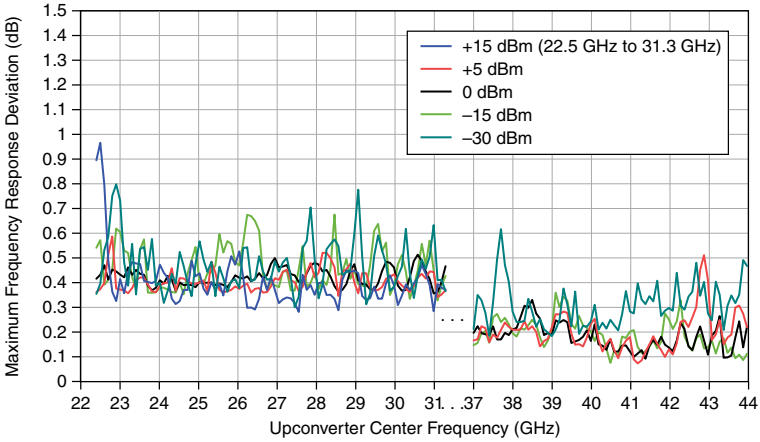


Figure 11. Maximum RF Output Frequency Response Deviation versus Upconverter Center Frequency, Measured



RF Output Average Noise Density

Table 22. RF Output Average Noise Density (dBm/Hz), Measured

Upconverter Center Frequency	Output Power Level (Peak)		
	-10 dBm	0 dBm	10 dBm
22.5 GHz to 31.3 GHz	-153	-143	-132
37 GHz to 40 GHz	-153	-142	-131
>40 GHz to 44 GHz	-152	-144	-132
Conditions: 15 averages; 40 dB baseband signal attenuation; noise measurement frequency offset 200 MHz relative to output frequency.			

RF Output Third-Order Intermodulation

Table 23. Third-Order RF Output Intermodulation Distortion (IMD_3) (dBc), Typical

Upconverter Center Frequency	Output Power Level (Peak)		
	-20 dBm	0 dBm	10 dBm
22.5 GHz to 31.3 GHz	-55	-52	-48
37 GHz to 40 GHz	-61	-57	-43

Table 23. Third-Order RF Output Intermodulation Distortion (IMD_3) (dBc), Typical (Continued)

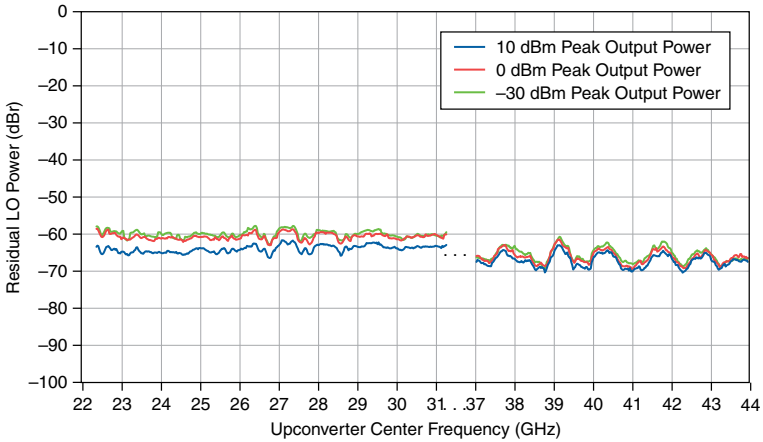
Upconverter Center Frequency	Output Power Level (Peak)		
	-20 dBm	0 dBm	10 dBm
>40 GHz to 44 GHz	-56	-55	-40
Conditions: Measured by generating two -7 dBFS tones centered at +100 MHz within the instantaneous bandwidth with 10 MHz separation.			

RF Output LO Residual Power

Table 24. RF Output LO Residual Power (dBc), Typical

Upconverter Center Frequency	Self-Calibration °C ± 1 °C	Self-Calibration °C ± 5 °C
22.5 GHz to 31.3 GHz	-46	-33
37 GHz to 40 GHz	-50	-37
>40 GHz to 44 GHz	-47	-34
Conditions: Peak output power -30 dBm to +15 dBm. Input tone power at a maximum of -3 dBr. LO1 and LO2 **LO Source** property set to Onboard. LO Residual Power averaged across a maximum of 1 GHz bandwidth.		

Figure 12. RF Output LO Residual Power, Measured



RF Output Residual Sideband Image

Table 25. RF Output Residual Sideband Image (dBc), Typical

Upconverter Center Frequency	Self-Calibration °C ± 1 °C	Self-Calibration °C ± 5 °C
22.5 GHz to 31.3 GHz	-51	-41
37 GHz to 40 GHz	-49	-44
>40 GHz to 44 GHz	-42	-38

Conditions: Peak output power levels -30 dBm to +15 dBm. Input tone power at a maximum of -3 dBr. LO1 and LO2 **LO Source** property set to Onboard.

This specification describes the maximum residual sideband image within the 1 GHz device instantaneous bandwidth.

Figure 13. RF Output Residual Sideband Image, 0 dBm Peak Power, Measured

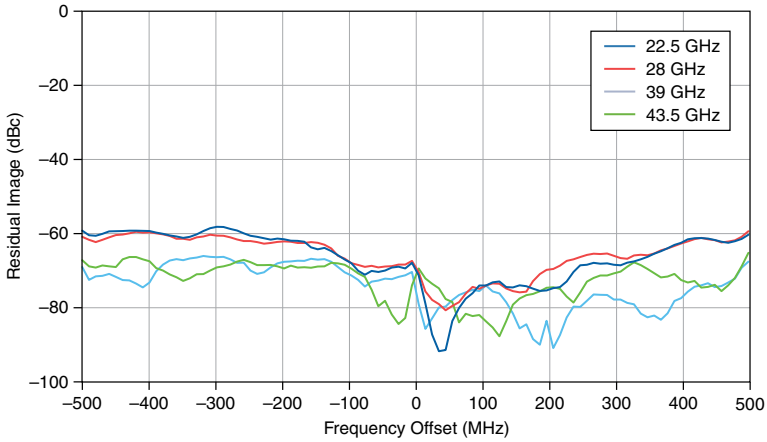
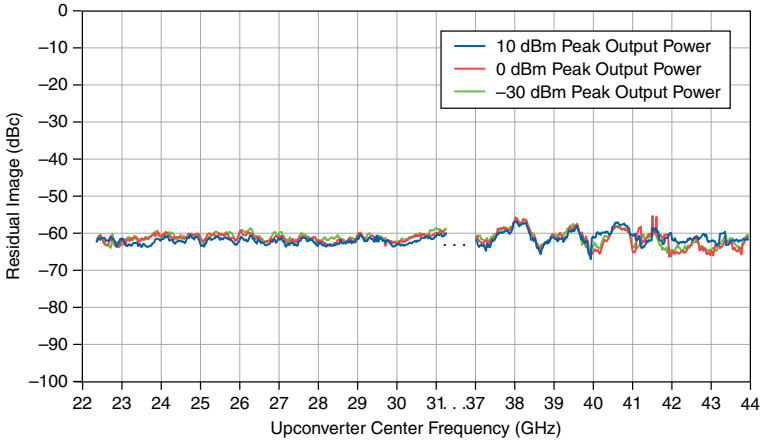


Figure 14. Maximum RF Output Residual Sideband Image Versus Upconverter Center Frequency, Measured



Receive (IF IN/OUT Ports)

IF Input Amplitude Range

Amplitude range	Average noise level to +20 dBm (CW RMS)
Gain resolution	1 dB, nominal

Table 26. IF Input Analog Gain Range, Nominal

Downconverter Center Frequency	IF Analog Gain Range (dB)
5 GHz to 8 GHz	≥61
>8 GHz to 12 GHz	≥57
>12 GHz to 18 GHz	≥58
>18 GHz to 21 GHz	≥57

IF Input Amplitude Settling Time[15,16]

<0.5 dB of final value	27 µs, nominal
<0.1 dB of final value	40 µs, nominal

IF Input Amplitude Accuracy

Table 27. IF Input Absolute Amplitude Accuracy (dB) (Offset Mode is User-Defined)

Downconverter Center Frequency	23 °C ± 5 °C			0 °C to 45 °C
	Specification	Typical-95	Typical	Specification
5 GHz to 8 GHz	±1.2	±0.8	±0.5	±1.6
>8 GHz to 12 GHz	±1.4	±1.0	±0.7	±1.6
>12 GHz to 18 GHz	±1.8	±1.4	±0.9	±2.0
>18 GHz to 21 GHz	±2.0	±1.5	±0.9	±2.6

Conditions: Reference level -30 dBm to +30 dBm; measured with a CW signal at 10 MHz offset from the configured downconverter center frequency when a user-defined frequency offset is not applied; measurement performed after the PXIe-5831 has settled; Upconverter/Downconverter Frequency Offset Mode: User-Defined.

This specification is valid only when the module is operating within the specified ambient temperature range and within ±5 °C from the last self-calibration temperature, as measured with the onboard temperature sensors.

Table 28. IF Input Relative Amplitude Accuracy (Offset Mode is User-Defined), Typical

Downconverter Center Frequency	Relative Amplitude Accuracy (dB)
5 GHz to 8 GHz	±0.25
>8 GHz to 12 GHz	±0.40
>12 GHz to 18 GHz	±0.40

15 Constant RF input signal, varying input reference level.

16 Settling time refers to the time it takes the amplitude to settle once the hardware receives the amplitude change. The additional time due to software initiated amplitude changes is not included and varies because of the computing speed of different computers (RAM, CPU, etc.).

Table 28. IF Input Relative Amplitude Accuracy (Offset Mode is User-Defined), Typical (Continued)

Downconverter Center Frequency	Relative Amplitude Accuracy (dB)
>18 GHz to 21 GHz	±0.40

Conditions: Reference level -30 dBm to +30 dBm; measured with a CW signal at 10 MHz offset from the configured downconverter center frequency; measurement performed after the PXIe-5831 has settled; Upconverter/Downconverter Frequency Offset Mode: User-Defined.

Relative accuracy describes the residual absolute accuracy error when compared to the absolute accuracy error at 0 dBm.

This specification is valid only when the module is operating within the specified ambient temperature range and within ±5 °C from the last self-calibration temperature, as measured with the onboard temperature sensors.

IF Input Frequency Response

Table 29. IF Input Frequency Response (dB)

Downconverter Center Frequency	23 °C ± 5 °C			0 °C to 45 °C
	Specification	Typical-95	Typical	Specification
5 GHz to 8 GHz	2.2	1.8	1.2	2.8
>8 GHz to 12 GHz	2.3	2.0	1.1	3.2
>12 GHz to 18 GHz	2.4	2.0	1.2	3.4
>18 GHz to 21 GHz	2.7	2.1	1.2	3.4

Conditions: Input reference level -30 dBm to +20 dBm; module temperature within ±5 °C of last self-calibration temperature.

Frequency response is defined as the maximum relative amplitude deviation from the reference offset frequency. For the PXIe-5831 IF input, the reference offset frequency is 10 MHz higher than the downconverter center frequency. For the absolute amplitude accuracy at the reference offset, refer to the *IF Input Amplitude Accuracy* section.

Figure 15. IF Input Frequency Response, 0 dBm, Reference Level, Equalized, Measured

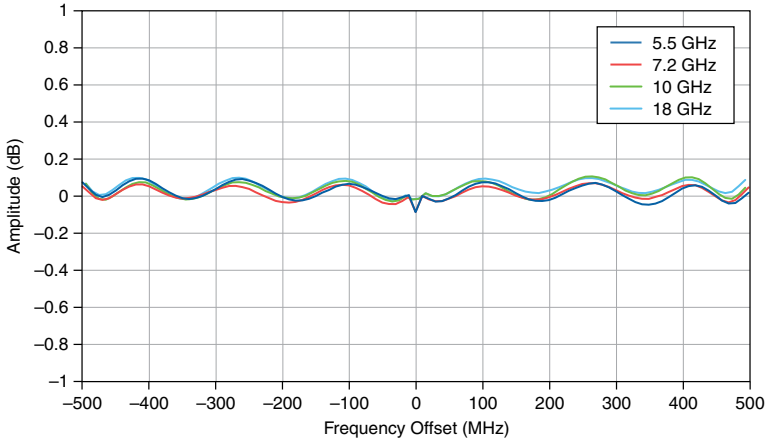
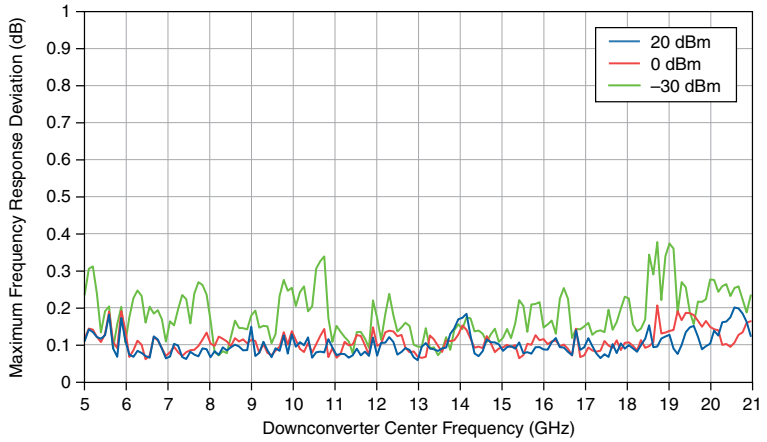


Figure 16. Maximum IF Input Frequency Response Deviation versus Downconverter Center Frequency, Measured



IF Input Average Noise Density

Table 30. Input Average Noise Density (dBm/Hz), Typical

Downconverter Center Frequency	-30 dBm Reference Level	0 dBm Reference Level
5 GHz to 8 GHz	-162	-142
>8 GHz to 12 GHz	-162	-142
>12 GHz to 18 GHz	-159	-141
>18 GHz to 21 GHz	-158	-141
Conditions: Input terminated with a 50 Ω load; 10 averages; noise measurement frequency offset 6 MHz to output frequency. Measured on the PXIe-3622 IF IN/OUT 1 port. The IF IN/OUT 0 port has a 2 dB degradation compared to the IF IN/OUT 1 port.		

IF Input Third-Order Input Intermodulation

Table 31. IF Input Third-Order Intercept Point (IIP_3) (dBm), Typical

Downconverter Center Frequency	Reference Level		
	-30 dBm	0 dBm	15 dBm
5 GHz to 8 GHz	-6	20	35
>8 GHz to 12 GHz	-4	19	33
>12 GHz to 18 GHz	-7	20	33
>18 GHz to 21 GHz	-7	16	31
Conditions: Measured by generating two -6 dBFS tones centered at +100 MHz within the instantaneous bandwidth with 10 MHz separation.			

IF Input Residual Spurs

Table 32. IF Input Residual Spurs (dBm), Typical

Frequency	60 kHz ≤ Offset < 60 MHz	Offset ≥ 60 MHz[17]
5 GHz to 8 GHz	-74	-74
>8 GHz to 12 GHz	-75	-75
>12 GHz to 18 GHz	-73	-77
>18 GHz to 21 GHz	-78	-78

Conditions : Reference level 0 dBm. Measured with the IF IN 1 port terminated with 50 Ω.

Note Offset refers to ± desired signal offset (Hz) around the current LO frequency.

IF Input LO Residual Power

Table 33. IF Input LO Residual Power (dBr[18]), Typical

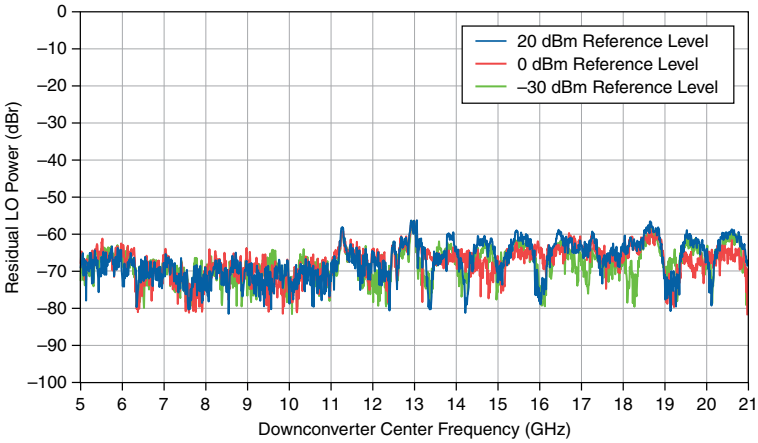
Downconverter Center Frequency	Self-Calibration °C ± 1 °C	Self-Calibration °C ± 5 °C
5 GHz to 8 GHz	-54	-44
>8 GHz to 12 GHz	-47	-38
>12 GHz to 18 GHz	-49	-38
>18 GHz to 21 GHz	-44	-35

Conditions: Reference level is -30 dBm to +15 dBm. Input tone power at a maximum of -3 dBr. LO2 **LO Source** property set to Onboard.

LO Residual Power averaged across a maximum of 1 GHz bandwidth.

[17] The maximum offset is limited to within the equalized bandwidth of the referenced LO Frequency.
[18] dBr is relative to the full scale of the configured RF reference level.

Figure 17. IF Input LO Residual Power, Measured



IF Input Residual Sideband Image

Table 34. IF Input Residual Sideband Image (dBc), Typical

Downconverter Center Frequency	Self-Calibration °C ± 1 °C	Self-Calibration °C ± 5 °C
5 GHz to 8 GHz	-47	-39
>8 GHz to 12 GHz	-51	-42
>12 GHz to 18 GHz	-50	-41
>18 GHz to 21 GHz	-50	-44

Conditions: Peak output power levels -30 dBm to +15 dBm. LO2 **LO Source** property set to Onboard.

This specification describes the maximum residual sideband image within the 1 GHz device instantaneous bandwidth.

Figure 18. IF Input Residual Sideband Image, 0 dBm, Reference Level, Measured

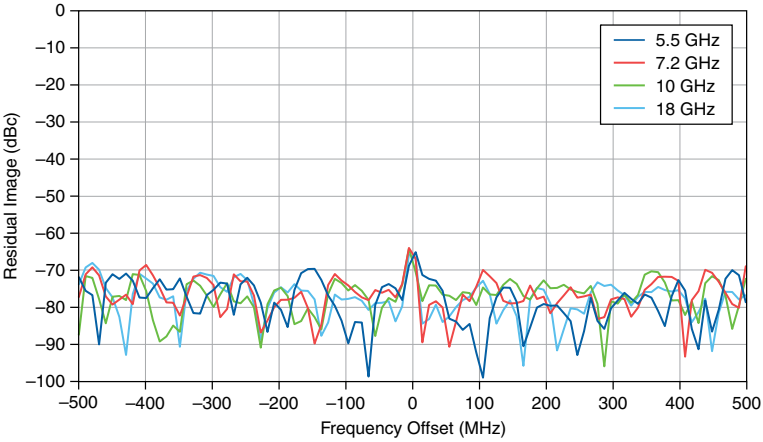
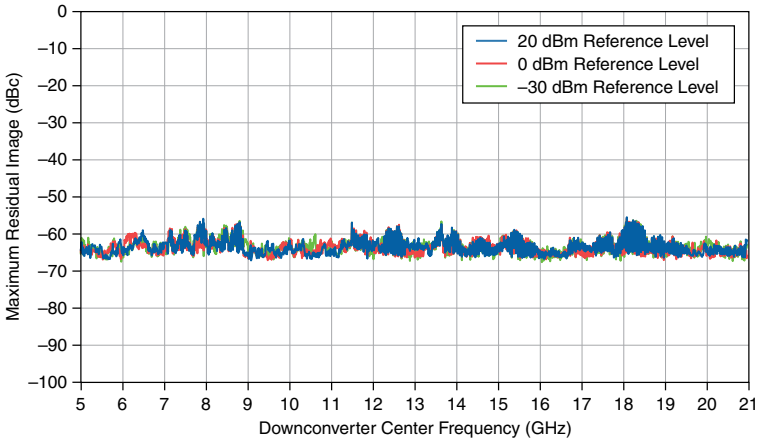


Figure 19. Maximum IF Input Residual Sideband Image Versus Downconverter Center Frequency, Measured



Receive (TRX Ports)

RF Input Amplitude Range

Amplitude range	Average noise level to +30 dBm (CW RMS)
RF gain resolution	1 dB, nominal

Table 35. Input RF Analog Gain Range, Nominal

Downconverter Center Frequency	RF Analog Gain Range (dB)
22.5 GHz to 31.3 GHz	≥66
>31.3 GHz to 37 GHz	≥69
>37 GHz to 40 GHz	≥68
>40 GHz to 44 GHz	≥67

RF Input Amplitude Settling Time[19,20]

<0.5 dB of final value	31 µs, nominal
<0.1 dB of final value	43 µs, nominal

RF Input Amplitude Accuracy

Table 36. RF Input Absolute Amplitude Accuracy (dB) (Offset Mode is User-Defined)

Downconverter Center Frequency	Specification	Typical-95	Typical
22.5 GHz to 31.3 GHz	±2.1	±1.9	±1.0
>31.3 GHz to 37 GHz	±1.8	±1.5	±0.8
>37 GHz to 40 GHz	±2.2	±2.0	±1.0
>40 GHz to 43.5 GHz	±2.3	±2.1	±1.1
>43.5 GHz to 44 GHz	±2.9	±2.7	±1.6

Conditions: Valid over 23 °C ± 5 °C; reference level -30 dBm to +30 dBm; measured with a CW signal at 10 MHz offset from the configured downconverter center frequency; measurement performed after the PXIe-5831 has settled; Upconverter/Downconverter Frequency Offset Mode: User-Defined.

This specification is valid only when the module is operating within the specified ambient temperature range and within ±5 °C from the last self-calibration temperature, as measured with the onboard temperature sensors.

[19] Constant RF input signal, varying input reference level.

[20] Settling time refers to the time it takes the amplitude to settle once the hardware receives the amplitude change. The additional time due to software initiated amplitude changes is not included and varies because of the computing speed of different computers (RAM, CPU, etc.).

Table 37. RF Input Relative Amplitude Accuracy (Offset Mode is User-Defined), Typical

Downconverter Center Frequency	Relative Amplitude Accuracy (dB)
22.5 GHz to 31.3 GHz	±0.5
>31.3 GHz to 37 GHz	±0.6
>37 GHz to 40 GHz	±0.7
>40 GHz to 43.5 GHz	±0.7
>43.5 GHz to 44 GHz	±1.0

Conditions: Reference level -30 dBm to +30 dBm; measured with a CW signal at 10 MHz offset from the configured downconverter center frequency; measurement performed after the PXIe-5831 has settled; Upconverter/Downconverter Frequency Offset Mode: User-Defined.

Relative accuracy describes the residual absolute accuracy error when compared to the absolute accuracy error at 0 dBm.

This specification is valid only when the module is operating within the specified ambient temperature range and within ±5 °C from the last self-calibration temperature, as measured with the onboard temperature sensors.

RF Input Frequency Response

Table 38. RF Input Frequency Response (dB)

Downconverter Center Frequency	Specification	Typical-95	Typical
22.5 GHz to 31.3 GHz	2.1	1.5	1.2
>31.3 GHz to 37 GHz	2.1	1.3	1.1
>37 GHz to 40 GHz	2.1	1.4	1.3
>40 GHz to 44 GHz	2.9	1.8	1.6

Conditions: Valid over 23 °C ± 5 °C; input reference level -30 dBm to +30 dBm; module temperature within ±5 °C of last self-calibration temperature.

Frequency response is defined as the maximum relative amplitude deviation from the reference offset frequency. For the PXIe-5831 RF input, the reference offset frequency is 10 MHz higher than the downconverter center frequency. For the absolute amplitude accuracy at the reference offset, refer to the *RF Input Amplitude Accuracy* section.

Figure 20. RF Input Frequency Response, 0 dBm, Reference Level, Equalized, Measured

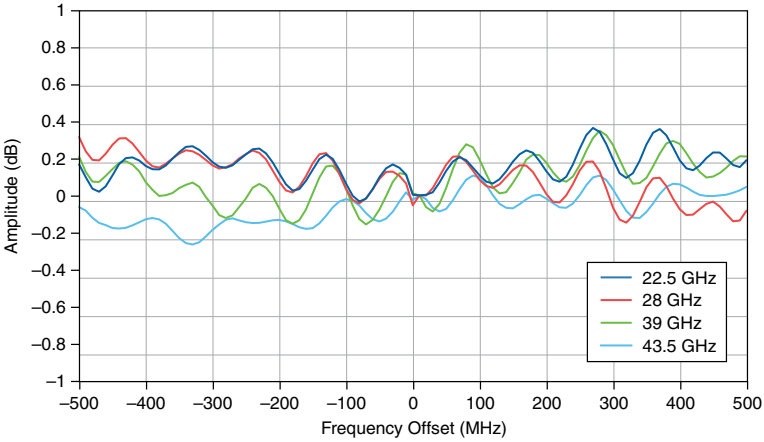
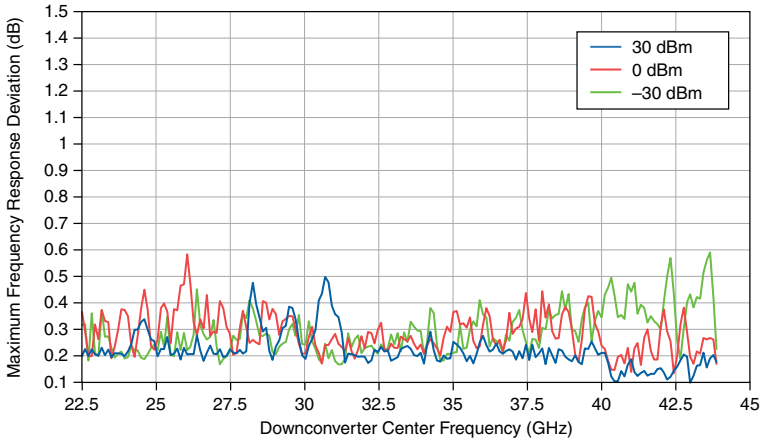


Figure 21. Maximum RF Input Frequency Response Deviation versus Downconverter Center Frequency, Measured



RF Input Average Noise Density

Table 39. RF Input Average Noise Density (dBm/Hz), Typical

Downconverter Center Frequency	-30 dBm Reference Level	0 dBm Reference Level
22.5 GHz to 31.3 GHz	-161	-137
>31.3 GHz to 37 GHz	-163	-141
>37 GHz to 40 GHz	-162	-139
>40 GHz to 44 GHz	-160	-139
Conditions: Input terminated with a 50 Ω load; 15 averages; 40 dB baseband signal attenuation; noise measurement frequency offset 6 MHz to output frequency.		

RF Input Third-Order Input Intermodulation

Table 40. RF Input Third-Order Intercept Point (IIP_3) (dBm), Typical

Downconverter Center Frequency	Reference Level		
	-30 dBm	0 dBm	15 dBm
22.5 GHz to 31.3 GHz	-15	15	28
>31.3 GHz to 37 GHz	-21	10	26
>37 GHz to 40 GHz	-23	9	25
>40 GHz to 44 GHz	-20	10	26
Conditions: Measured by generating two -7 dBFS tones centered at +100 MHz within the instantaneous bandwidth with 10 MHz separation.			

RF Input LO Residual Power

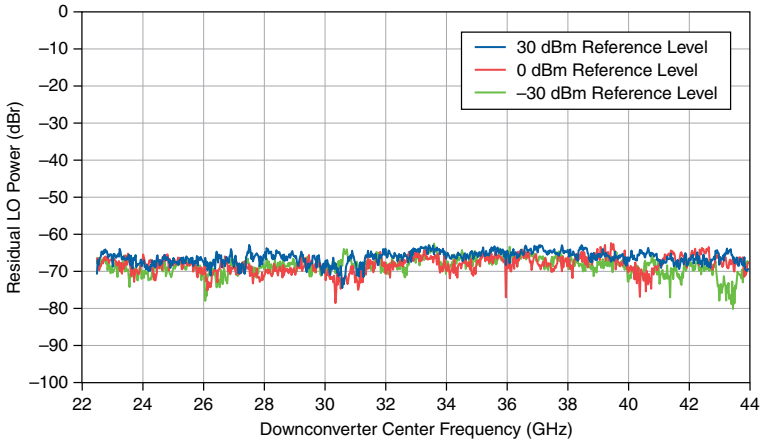
Table 41. RF Input LO Residual Power (dBr[21]), Typical

Downconverter Center Frequency	Self-Calibration °C ± 1 °C	Self-Calibration °C ± 5 °C
22.5 GHz to 31.3 GHz	-49	-38
>31.3 GHz to 37 GHz	-52	-40
>37 GHz to 40 GHz	-52	-40
>40 GHz to 44 GHz	-50	-39

Conditions: Reference level is -30 dBm to +15 dBm. Input tone power at a maximum of -3 dBr. LO1 and LO2 **LO Source** property set to Onboard.

LO Residual Power averaged across a maximum of 1 GHz bandwidth.

Figure 22. RF Input LO Residual Power, Measured



[21] dBr is relative to the full scale of the configured RF reference level.

RF Input Residual Sideband Image

Table 42. RF Input Residual Sideband Image (dBc), Typical

Downconverter Center Frequency	Self-Calibration °C ± 1 °C	Self-Calibration °C ± 5 °C
22.5 GHz to 31.3 GHz	-54	-43
>31.3 GHz to 37 GHz	-60	-54
>37 GHz to 40 GHz	-60	-53
>40 GHz to 44 GHz	-55	-46

Conditions: Peak output power levels -30 dBm to +15 dBm. LO1 and LO2 **LO Source** property set to Onboard.

This specification describes the maximum residual sideband image within the 1 GHz device instantaneous bandwidth.

Figure 23. RF Input Residual Sideband Image, 0 dBm, Input Power Level, Measured

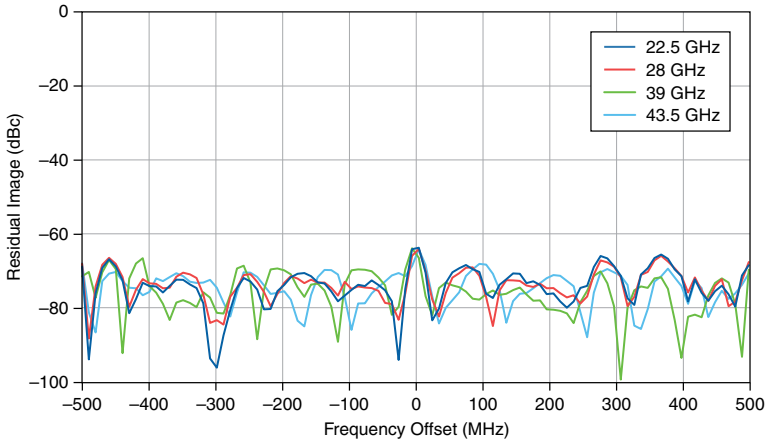
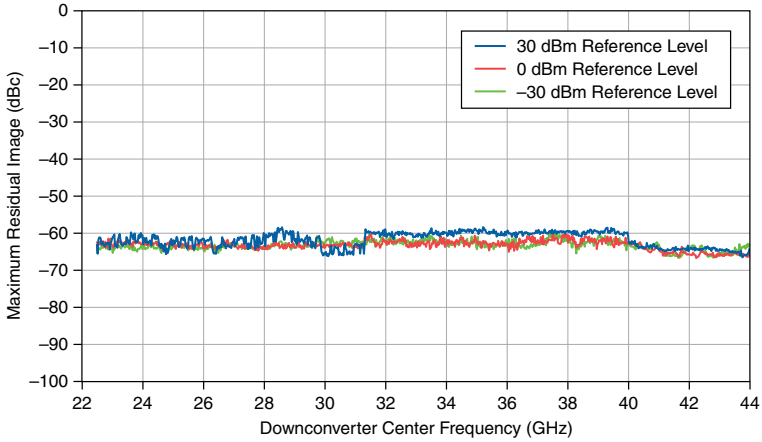


Figure 24. Maximum RF Input Residual Sideband Image Versus Downconverter Center Frequency, Measured



Application-Specific Modulation Quality

WLAN 802.11ax

IF IN/OUT Ports

The following measurements were taken using RFmx and corresponding RFmx default values.

Table 43. WLAN 802.11ax RMS EVM (dB), Shared Onboard LO2, Nominal[22,23]

I/Q Carrier Frequency	Signal Bandwidth	
	80 MHz	160 MHz
5.1 GHz to 7.2 GHz	-50	-47

[22] Conditions: IF0 loopback to IF1; waveform bandwidth: 80 MHz; waveform PAPR: 10.55 dB; MCS Index: 11; 16 OFDM data symbols; 20 packet averages; Channel Estimation Type: Ch Estimation Ref (Preamble); Upconverter/Downconverter Frequency Offset Mode: Enabled; LO2 LO Source: SG_SA_Shared; Reference Level: Average Power Level + Waveform PAPR; Reference Level Headroom: 0 dB.

[23] EVM shown is the average of RF output power levels including -24 dBm to 0 dBm.

Figure 25. WLAN 802.11ax RMS EVM versus Average Power, Measured[22]

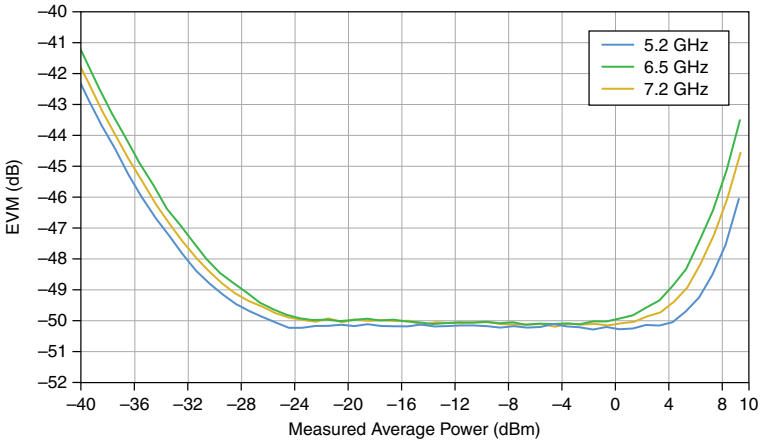
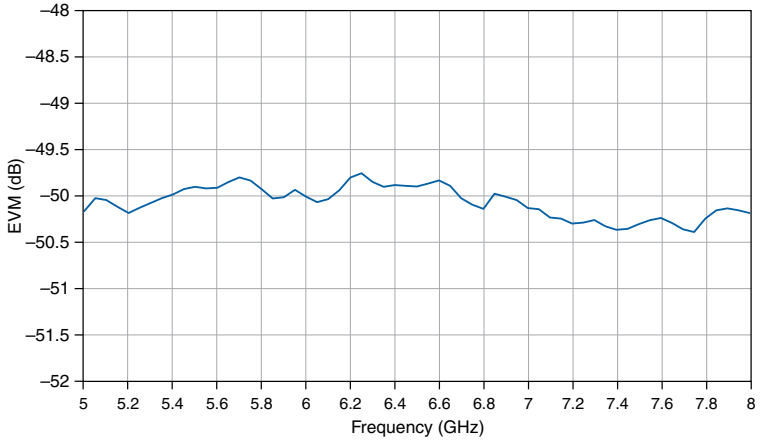


Figure 26. WLAN 802.11ax RMS EVM versus Frequency, Nominal[22,23]



5G New Radio (NR)

IF 5G NR (IF IN/OUT Ports)

Table 44. IF 5G NR EVM (dB), Shared Onboard LO2, Typical[24]

I/Q Carrier Frequency	NR Carrier Configuration		
	1 × 100 MHz[25]	2 × 100 MHz[26]	1 × 400 MHz[27]
5 GHz to 8 GHz	-50	-47	-43
>8 GHz to 12 GHz	-49	-46	-43
>12 GHz to 18 GHz	-47	-44	-41
>18 GHz to 21 GHz	-44	-43	-41
Conditions: IF average power level is -25 dBm to 0 dBm. LO2 LO Source: SG_SA_Shared.			

Table 45. IF 5G NR EVM (dB), Independent Onboard LO2, Typical[24]

I/Q Carrier Frequency	NR Carrier Configuration		
	1 × 100 MHz[25]	2 × 100 MHz[26]	1 × 400 MHz[27]
5 GHz to 8 GHz	-41	-41	-40
>8 GHz to 12 GHz	-39	-39	-38
>12 GHz to 18 GHz	-35	-35	-35
>18 GHz to 21 GHz	-35	-35	-35
Conditions: IF average power level is -25 dBm to 0 dBm. LO2 LO Source: Onboard.			

[24] Conditions: NR Downlink, FDD, FR2, 64-QAM, Fully Filled Resource Blocks; IF0 loopback to IF1; Upconverter/Downconverter Frequency Offset Mode: Automatic; Reference Level: Average Power Level + Waveform PAPR; Reference Level Headroom: 0 dB; 2 slots analyzed; 1 packet averages.

[25] 1 × 100 MHz Carrier: 60 kHz Subcarrier Spacing, 11.23 dB PAPR.

[26] 2 × 100 MHz Carrier: 60 kHz Subcarrier Spacing, 11.06 dB PAPR.

[27] 1 × 400 MHz Carrier: 120 kHz Subcarrier Spacing, 11.41 dB PAPR.

Figure 27. IF 5G NR 1 CC x 100 MHz RMS EVM versus Average Power, Measured[24,25]

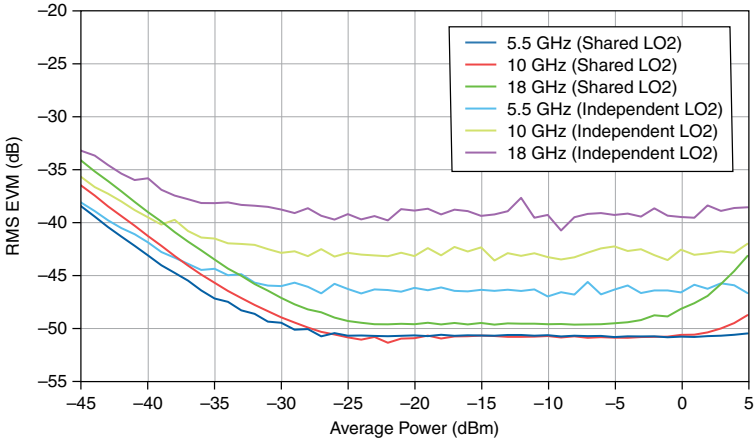


Figure 28. IF 5G NR 2 CC x 100 MHz RMS EVM versus Average Power, Measured[24,26]

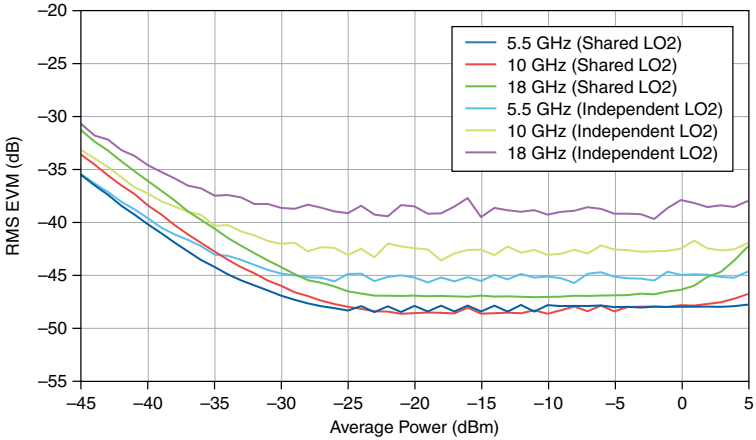


Figure 29. IF 5G NR 1 CC x 400 MHz RMS EVM versus Average Power, Measured[24,27]

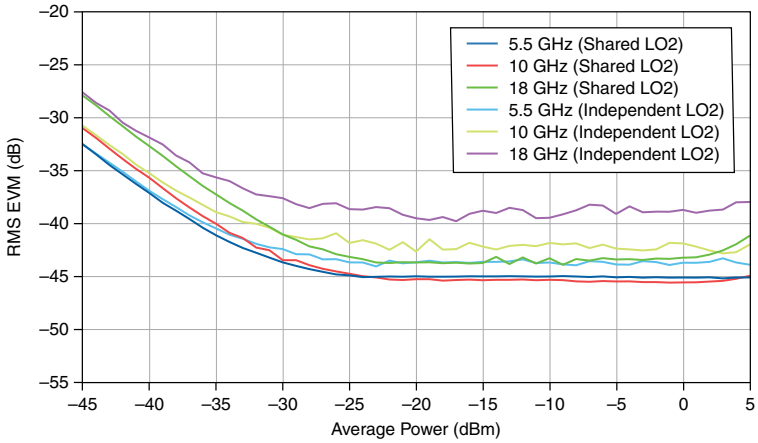
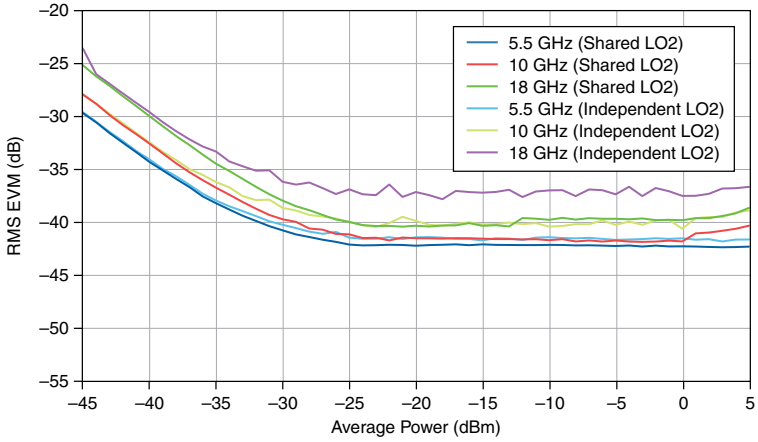


Figure 30. IF 5G NR 2 CC x 400 MHz RMS EVM versus Average Power, Measured[24,28]



[28] 2 × 400 MHz Carriers: 120 kHz Subcarrier Spacing, 11.88 dB PAPR.

Figure 31. IF 5G NR RMS EVM versus Frequency (Shared LO2), Measured[24,29,30]

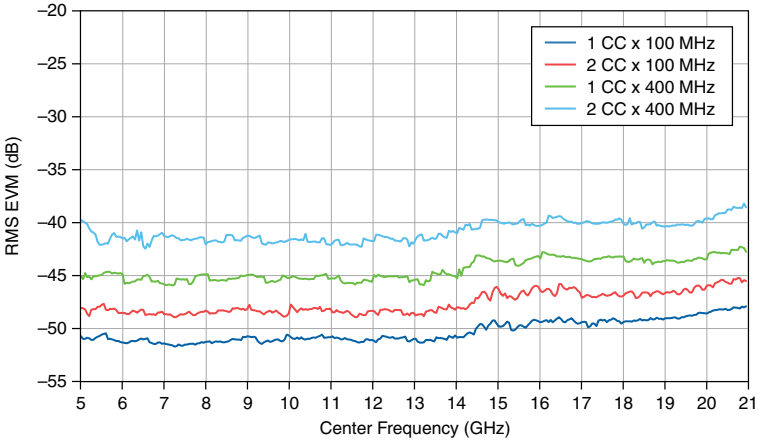
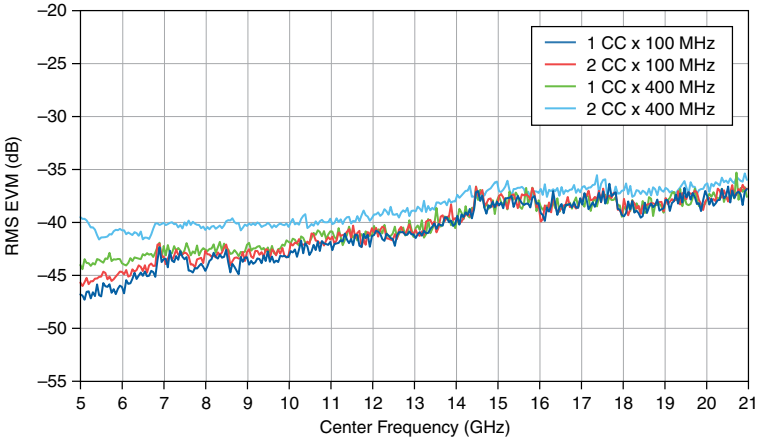


Figure 32. IF 5G NR RMS EVM versus Frequency (Independent LO2), Measured[24,29,30]



29 1 × 100 MHz Carrier: 60 kHz Subcarrier Spacing, 11.23 dB PAPR. 2 × 100 MHz Carrier: 60 kHz Subcarrier Spacing, 11.06 dB PAPR. 1 × 400 MHz Carrier: 120 kHz Subcarrier Spacing, 11.41 dB PAPR. 2 × 400 MHz Carriers: 120 kHz Subcarrier Spacing, 11.88 dB PAPR.

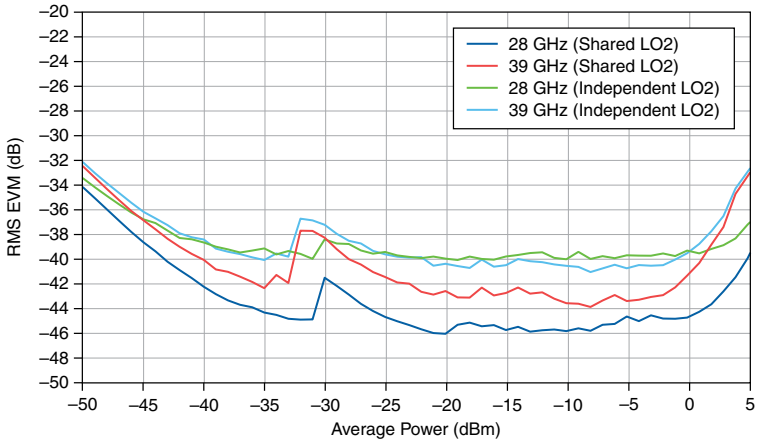
30 IF output average power level is -10 dBm.

RF 5G NR (DIRECT TRX PORTS)

Table 46. RF 5G NR EVM (dB), Nominal[31,32]

I/Q Carrier Frequency	Shared Onboard LO2	Independent Onboard LO2
22.5 GHz to 31.3 GHz	-44	-40
37 GHz to 40 GHz	-43	-40
>40 GHz to 44 GHz	-42	-41
Conditions: RF average power level is -10 dBm. LO1 LO Source: Onboard.		

Figure 33. RF 5G NR 1 CC × 100 MHz RMS EVM versus Average Power, Measured[32,33]

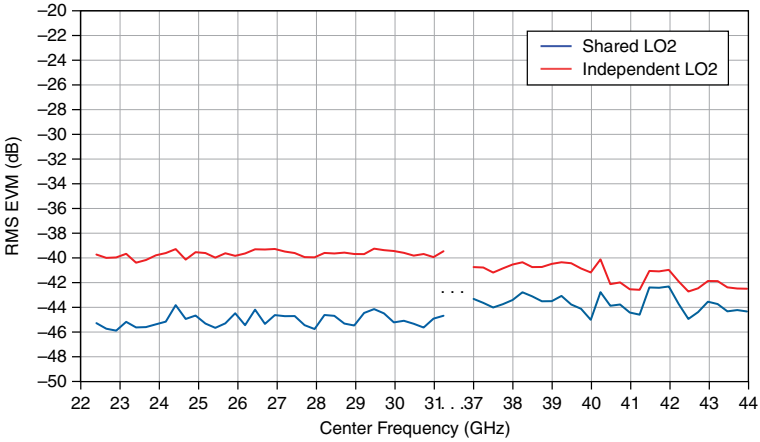


31 Conditions: NR Downlink, FDD, FR2, 64-QAM, Fully Filled Resource Blocks; RF loopback to RF; Upconverter/Downconverter Frequency Offset Mode: Automatic; Reference Level: Average Power Level + Waveform PAPR; Reference Level Headroom: 0 dB from 22.5 GHz to 31.3 GHz and 3 dB from 37 GHz to 44 GHz; LO1 LO Source: Onboard; 2 slots analyzed; 1 packet averages.

32 1 × 100 MHz Carrier: 120 kHz Subcarrier Spacing, 11.16 dB PAPR.

33 Conditions: NR Downlink, FDD, FR2, 64-QAM, Fully Filled Resource Blocks; RF loopback to RF; Upconverter/Downconverter Frequency Offset Mode: Automatic; Reference Level: Average Power Level + Waveform PAPR; Reference Level Headroom: 0 dB at 28 GHz and 3 dB at 39 GHz; LO1 LO Source: Onboard; 2 slots analyzed; 1 packet averages.

Figure 34. RF 5G NR RMS EVM versus Frequency, Measured[31,32,34]



Front Panel I/O

PXIe-5820

Refer to the *PXIe-5820 Specifications* for more information about characteristics of the PXIe-5820 front panel input and output.

PXIe-3622

I/Q IN	
Connectors	MMPX (female)
Input coupling, per terminal	DC
Input type	Differential
Differential impedance	100 Ω
I/Q OUT	
Connectors	MMPX (female)
Output coupling, per terminal	DC
Output type	Differential
Number of channels	2
Impedance	100 Ω

[34] RF average power level is -10 dBm.

LO1 IN and LO2 IN	
Connectors	MMPX (female)
Frequency range[35]	3.55 GHz to 7.1 GHz
Input power range[36]	+6 dBm to +10 dBm, nominal
Input return loss	10 dB, nominal
Absolute maximum input power	+10 dBm
LO1 coupling	AC coupled
LO2 coupling	DC coupled to ground
Impedance	50 Ω
LO1 OUT and LO2 OUT	
Connectors	MMPX (female)
Frequency range	3.55 GHz to 7.1 GHz
Absolute maximum output power	+10 dBm
LO1 coupling	AC coupled
LO2 coupling	DC coupled to ground
Output power resolution[37]	0.5 dB, nominal
Impedance	50 Ω
Output return loss	10 dB, nominal
DIO	
Connector	Mini HDMI
IF OUT mmWave	
Connectors	SMA 27 GHz (female)
Output impedance	50 Ω
Return loss	10 dB, nominal
Coupling	AC coupled to ground
IF IN mmWave	
Connectors	SMA 27 GHz (female)
Input impedance	50 Ω

[35] This frequency range is applicable for only LO2 IN when using the PXIe-5831 IF and mmWave instrument configuration.

[36] The PXIe-5831 supports receiving an external LO with a range of signal power levels. To properly configure the PXIe-5831 LO signal path for the provided level, set `NIRFSA_ATTR_LO_IN_POWER` or `NIRFSG_ATTR_LO_IN_POWER`.

[37] Output power resolution refers to the RF attenuator step size used to compensate for the LO output power.

Return loss	10 dB, nominal
Coupling	AC coupled to ground
IF IN/OUT	
Connectors	SMA 27 GHz (female)
Impedance	50 Ω
Coupling	AC coupled to ground
Absolute maximum input power	+25 dBm

Figure 35. PXIe-3622 IF IN Port Return Loss, Measured

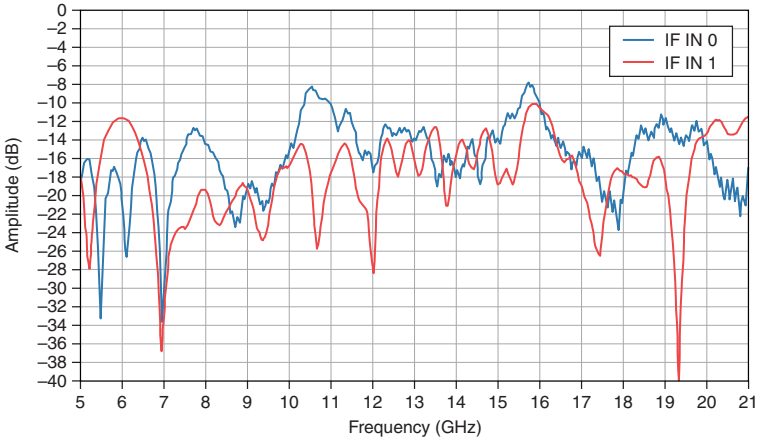
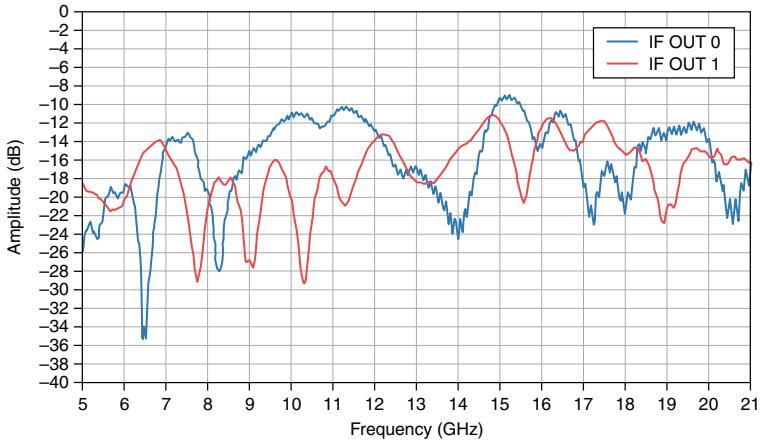


Figure 36. PXIe-3622 IF OUT Port Return Loss, Measured



LO1 0 mmWave	
Connector	SMA 27 GHz (female)
Frequency range	3.55 GHz to 14.2 GHz
LO1 1 mmWave	
Connector	SMA 27 GHz (female)
Frequency range	3.55 GHz to 14.2 GHz
REF IN/OUT	
Connectors	MMPX (female)
Frequency	10 MHz
Input tolerance[38]	$\pm 10 \times 10^{-6}$
Input amplitude[39]	0.7 V pk-pk to 3.3 V pk-pk, typical
Coupling	DC
Output amplitude	1.65 V pk-pk into 50 Ω, nominal
Impedance	50 Ω

[38] *Frequency Accuracy = Input Tolerance × Reference Frequency*
[39] Jitter performance improves with increased slew rate of input signal.

PXIe-5653

Table 47. LO Output Level

LO	Minimum	Nominal	Maximum
LO1 (from 3.2 GHz to 8.2 GHz)	*Nominal Value* - 2.5 dB	Varies by frequency according to the following equation: $10.5 - 3\left(\frac{Frequency(GHz) - 3.2GHz}{5.0GHz}\right)(dBm)$	*Nominal Value* + 2.5 dB
LO1 (at 8.3 GHz)	+4 dBm	+6.5 dBm	+9 dBm
LO2	+6.5 dBm	+9 dBm	+13 dBm
LO3	+7 dBm	+9 dBm	+13 dBm

Note The PXIe-5653 LO2 OUT and LO3 OUT connectors are not used in any PXIe-5831 instrument configuration.

mmRH-5582

DIRECT TRX PORTS	
Connectors	2.4 mm (female)
Absolute maximum input power	
Reference power ≤+30 dBm	Reference power + 6 dB
Reference power >+30 dBm	+36 dBm
Impedance	50 Ω

Figure 37. mmRH-5582 RF Input Port Return Loss, Measured

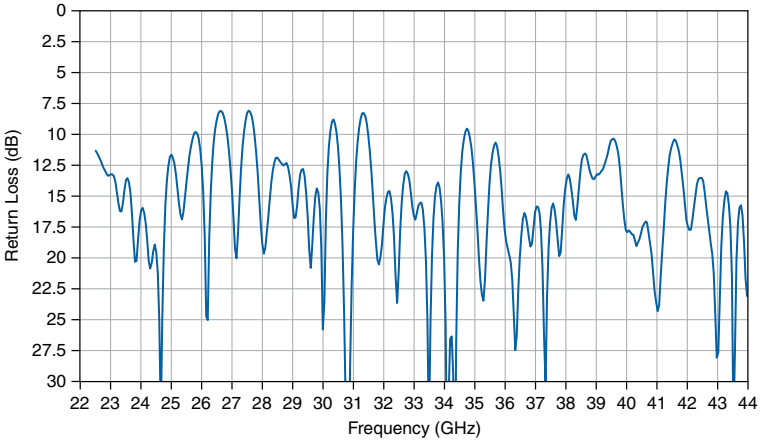
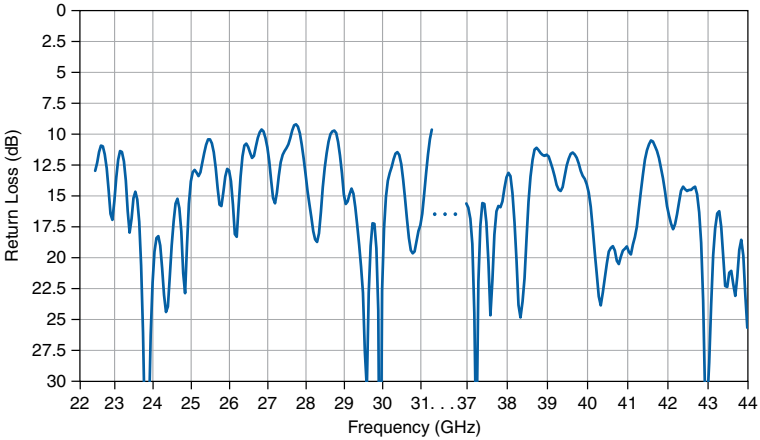


Figure 38. mmRH-5582 RF Output Port Return Loss, Measured



SWITCHED TRX PORTS	
Connectors	2.4 mm (female)
Impedance	50 Ω
IF OUT	
Connector	SMA 27 GHz (female)
Impedance	50 Ω

LO IN	
Connector	SMA 27 GHz (female)
Frequency range	10 GHz to 13.5 GHz
Input power	+5 dBm, nominal
Impedance	50 Ω, nominal
Absolute maximum input power	+20 dBm
Coupling	DC
IF IN	
Connector	SMA 27 GHz (female)
Impedance	50 Ω, nominal
Absolute maximum input power	+10 dBm
Coupling	AC
DIO IN	
Connector	Mini HDMI
DIO OUT	
Connector	Mini HDMI

Power Requirements

Table 48. PXIe-5831 Power Requirements, Nominal

Module	+3.3 VDC	+12 VDC	Total Power (W)
PXIe-5820	3.3 A (10.89 W)	6.0 A (72.0 W)	82.89
PXIe-3622	≤5.0 A (6.93 W)	≤5.0 A (67.2 W)	74.13
PXIe-5653	1.10 A (3.63 W)	4.0 A (48.0 W)	51.63
PXIe-5831 (combined instrument)	—	—	208.65

Table 49. mmRH-5582 Power Requirements

Module	+12 VDC	Total Power (W)
mmRH-5582 (Direct TRX Ports Only)	3.8 A	45.6
mmRH-5582 (Switched and Direct TRX Ports)	4.1 A	49.2
mmRH-5582 (Switched TRX Ports Only)	4.4 A	52.8

Calibration

Interval	1 year

Physical Characteristics

Table 50. PXIe-5831 Physical Characteristics, Nominal

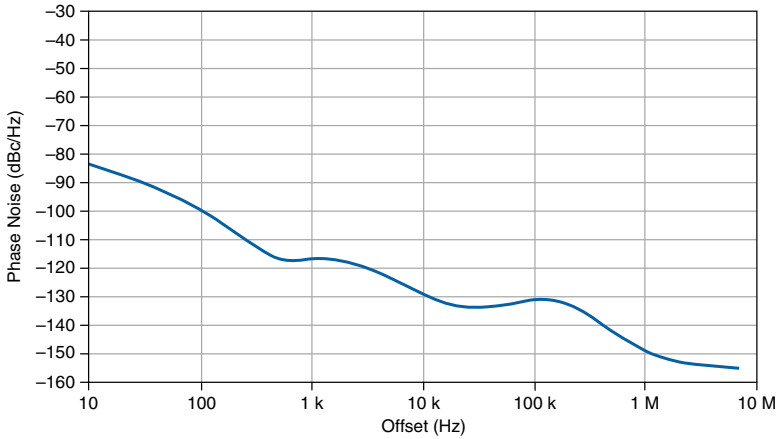
Module	Dimensions	Weight	
		Grams	Ounces
PXIe-5820	3U, 2 slots	795	28.0
PXIe-3622	3U, 2 slots	1,066	37.6
PXIe-5653	3U, 2 slots	1,076	37.8
PXIe-5831 (combined instrument)	3U, 6 slots	2,937	103.4

Table 51. mmRH-5582 Physical Characteristics, Nominal

Module	Dimensions	Weight	
		Grams	Ounces
mmRH-5582 (Direct TRX Ports Only)	21.9 cm × 15.5 cm × 9.9 cm (8.65 in. × 6.11 in. × 3.91 in.)	2,940	103.7
mmRH-5582 (Switched and Direct TRX Ports)		3,132	110.5
mmRH-5582 (Switched TRX Ports Only)		3,324	117.3

Appendix A: PXIe-5653 LO1 Single Sideband Phase Noise

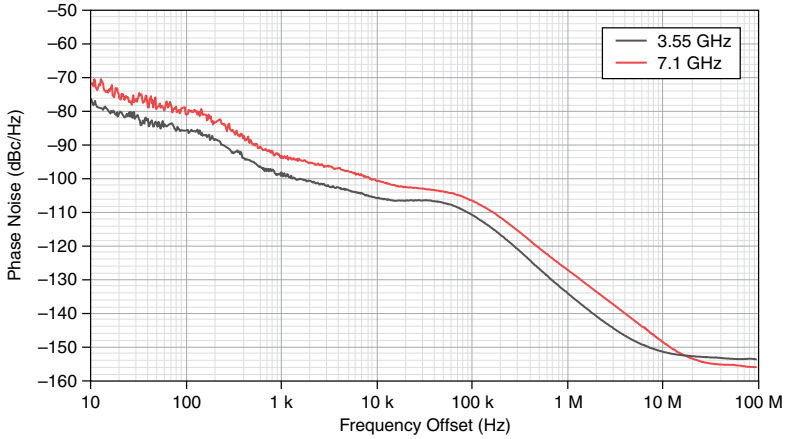
Figure 39. PXIe-5653 Phase Noise, Measured[40] (Spurs Not Shown)



[40] LO1 frequency is 5 GHz. Representative of nominal performance difference across the entire frequency range of LO1.

Appendix B: PXIe-3622 Single Sideband Phase Noise

Figure 40. PXIe-3622 Internal LO1 VCO Phase Noise, Measured[41] (Spurs Not Shown)



Environmental Characteristics

Temperature and Humidity	
Temperature	
Operating	0 °C to 45 °C
Storage	-41 °C to 71 °C
Humidity	
Operating	10% to 90%, noncondensing
Storage	5% to 95%, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)

[41] Measured at the PXIe-3622 LO1 OUT port.

Shock and Vibration	
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g RMS
Non-operating	5 Hz to 500 Hz, 2.4 g RMS
Operating shock	30 g, half-sine, 11 ms pulse

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 *Commitment to the Environment* 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)

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