SPECIFICATIONS

PXIe-5841

6 GHz, 1 GHz Bandwidth, RF PXI Vector Signal Transceiver

Contents

NATIONAL INSTRUMENTS

Definitions

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 warm-up time
- Self-calibration is performed after the specified warm-up period has completed
- Calibration cycle is maintained
- The chassis fan mode is set to Auto when used in a chassis with ≥58 W slot-cooling capability or the fan mode is set to High when used in any other chassis

- 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-5841 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

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

Unless otherwise noted, specifications assume the PXIe-5841 is configured in the following default mode of operation:

- Reference Clock source: Internal
- RF IN reference level: 0 dBm
- RF IN preamplifier: AUTO
- RF OUT power level: 0 dBm
- LO tuning mode: Fractional
- LO PLL loop bandwidth: Low
- LO step size: 500 kHz
- LO frequency: 2.4 GHz
- LO source: Onboard LO

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

- Over ambient temperature range of 0 °C to 55 °C when used in a chassis with ≥58 W slot-cooling capability.
- Over ambient temperature range of 0 °C to 40 °C when used in any other chassis.

Common Terminology

Refer to the following list for definitions of common PXIe-5841 terms used throughout this document.

Table 1. Common Terminology Definitions

Term	Definition
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-5841 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 set Offset Mode to Enabled when the signal bandwidth is small enough to allow it. You can read back the Offset Mode to determine if the driver selected Enabled or User-Defined. Automatic is the default value. NI recommends keeping Offset Mode set to the default value.
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-5841 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-5841 contains a direct conversion architecture. Offset Mode set to User-Defined allows the instrument to operate with maximum instantaneous bandwidth.

Frequency

The following characteristics are common to both RF IN and RF OUT ports.

Frequency range	9 kHz to 6 GHz

Table 2. PXIe-5841 Bandwidth (Offset Mode is User-Defined)

Center Frequency	Instantaneous Bandwidth
9 kHz to <120 MHz	<120 MHz
120 MHz to 410 MHz	50 MHz
>410 MHz to 650 MHz	100 MHz
>650 MHz to 1.3 GHz	200 MHz
>1.3 GHz to 2.2 GHz	500 MHz
>2.2 GHz to 6 GHz	1 GHz
The PXIe-5841 uses the low frequency subsystem to directly acquire or generate the RF signal below 120 MHz.	

Table 3. PXIe-5841 Bandwidth (Offset Mode is Enabled)

I/Q Carrier Frequency	Maximum Signal Bandwidth
9 kHz to <120 MHz	—
120 MHz to 378 MHz	10 MHz
>378 MHz to 593 MHz	35 MHz
>593 MHz to 1.168 GHz	85 MHz
> 1.168 GHz to 1.943 GHz	235 MHz
>1.943 GHz to 6 GHz	485 MHz
The PXIe-5841 uses the low frequency subsystem to directly acquire or generate the RF signal below 120 MHz.	

Frequency Settling Time

Table 4. Frequency Settling Time, Typical

Accuracy	Settling Time (usec)
$\leq 1.0 \times 10^{-6}$ of final frequency	< 380
$\leq 0.1 \times 10^{-6}$ of final frequency	< 400
This specification includes only frequency settling and excludes any residual amplitude settling.	

Internal Frequency Reference

Onboard LO tuning characteristics	
Frequency tuning resolution[1]	888 nHz
LO step size, fractional mode	Programmable step size, 500 kHz default
LO step size, integer mode for LO ≤ 4 GHz[2]	10 MHz, 20 MHz, 25 MHz, 50 MHz, 100 MHz
LO step size, integer mode for LO > 4 GHz[2]	20 MHz, 50 MHz, 100 MHz, 200 MHz
Onboard LO accuracy	
Initial adjustment accuracy	$\pm 200 \times 10^{-9}$
Temperature stability	$\pm 1 \times 10^{-6}$, maximum
Aging	$\pm 1 \times 10^{-6}$ per year, maximum
Accuracy	*Initial adjustment accuracy* ± *Aging* ± *Temperature stability*

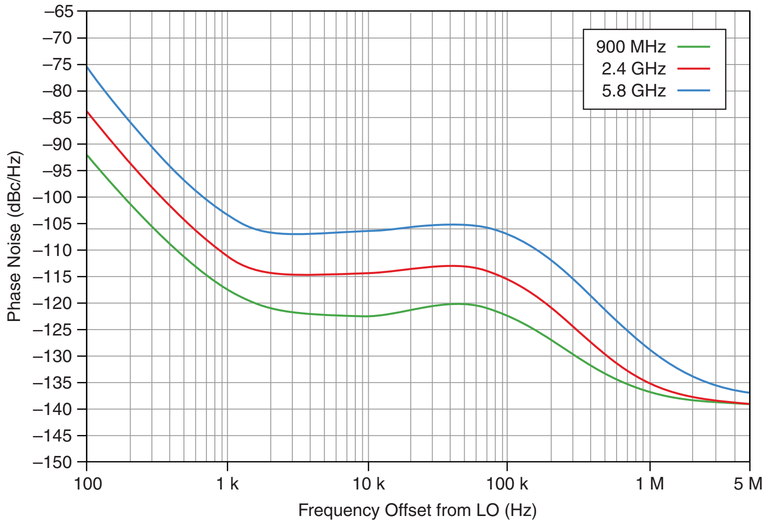
Spectral Purity

Table 5. Single Sideband Phase Noise

LO Frequency	Phase Noise (dBc/Hz, Single Sideband), 20 kHz Offset, Self-Calibration °C ± 10 °C
<3 GHz	-102
3 GHz to 4 GHz	-102
>4 GHz to 6 GHz	-96

1 Tuning resolution combines LO step size capability and frequency shift digital signal processing (DSP) implemented on the FPGA.
2 Larger step sizes in integer mode improves phase noise performance.

Figure 1. Measured Phase Noise[3] at 900 MHz, 2.4 GHz, and 5.8 GHz



RF Input

RF Input Amplitude Range

Table 6. Input Amplitude Range, Nominal

Downconverter Center Frequency	Preamp	RF Input (dB)
9 kHz to <120 MHz	Disabled	Average noise level to +15 dBm continuous wave root-mean-square (CW RMS)
	Auto	
120 MHz to 6 GHz	Disabled	Average noise level to +30 dBm CW RMS
	Auto	
	Enabled	Average noise level to -10 dBm CW RMS

RF gain resolution	1 dB, nominal

[3] Conditions: Measured Port: LO OUT; Reference Clock: internal, phase spurs not shown.

Table 7. Input RF Analog Gain Range, Preamp Auto, Nominal

Downconverter Center Frequency	RF Analog Gain Range (dB)
10 MHz to <120 MHz	≥35
120 MHz to 500 MHz	≥65
>500 MHz to 1.5 GHz	≥65
>1.5 GHz to 2.3 GHz	≥60
>2.3 GHz to 2.9 GHz	≥60
>2.9 GHz to 4.8 GHz	≥55
>4.8 GHz to 6 GHz	≥50

Table 8. Input RF Analog Gain Range, Preamp Enabled, Nominal

Downconverter Center Frequency	RF Analog Gain Range (dB)
120 MHz to 500 MHz	≥30
>500 MHz to 1.5 GHz	≥30
>1.5 GHz to 2.3 GHz	≥25
>2.3 GHz to 2.9 GHz	≥25
>2.9 GHz to 4.8 GHz	≥25
>4.8 GHz to 6 GHz	≥20

RF Input Amplitude Settling Time[4]

<0.5 dB of final value	40 µs, typical
<0.1 dB of final value	70 µs, typical

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

RF Input Relative Amplitude Accuracy

Table 9. Input Relative Amplitude Accuracy (dB)

Center Frequency[5]	Typical
10 MHz to <120 MHz	±0.35
120 MHz to 6 GHz	±0.2

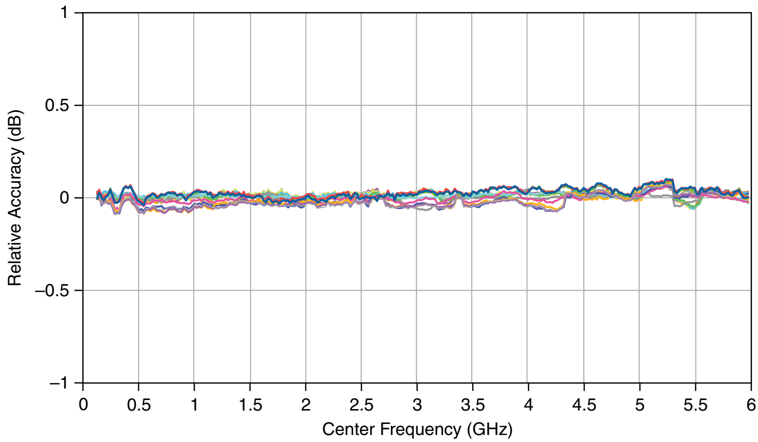
Relative accuracy describes the residual absolute error when compared to the absolute accuracy error at 0 dBm reference level.

Conditions (10 MHz to <120 MHz): Reference level -30 dBm to +15 dBm; measured at the configured frequency; measurement performed after the PXIe-5841 has settled. Measured with a sine tone between -25 dBr to -5 dBr, where dBr is referenced to the configured RF reference level.

Conditions (120 MHz to 6 GHz): Reference level -30 dBm to +30 dBm; measured at 3.75 MHz offset from the configured center frequency when NI-RFSA Downconverter Frequency Offset Mode is User-Defined; measured at the configured center frequency when the NI-RFSA Downconverter Frequency Offset Mode is Enabled; measurement performed after the PXIe-5841 has settled. Preamplifier mode set to automatic. Measured with a sine tone within -25 dBr to -5 dBr, where dBr is referenced to the configured RF reference level.

5 Center frequency refers to NI-RFSA Downconverter Center Frequency when NI-RFSA Downconverter Frequency Offset Mode is User-Defined. Center frequency refers to NI-RFSA I/Q Carrier Frequency when NI-RFSA Downconverter Frequency Offset Mode is Enabled.

Figure 2. Input Relative Accuracy, 120 MHz to 6 GHz, -65 dBm to +30 dBm, Normalized to 0 dBm Reference Level, Measured



RF Input Absolute Amplitude Accuracy

Table 10. Input Absolute Amplitude Accuracy (dB)

Center Frequency[6]	Typical	Specification 0 °C to 55 °C Self-Cal °C ± 5 °C
10 MHz to <120 MHz	±0.35	—
120 MHz to 2.2 GHz	±0.25	±0.7
>2.2 GHz to 4.4 GHz	±0.25	±0.65
>4.4 GHz to 5 GHz	±0.25	±0.7

6 Center frequency refers to NI-RFSA Downconverter Center Frequency when NI-RFSA Downconverter Frequency Offset Mode is User-Defined. Center frequency refers to NI-RFSA I/Q Carrier Frequency when NI-RFSA Downconverter Frequency Offset Mode is Enabled.

Table 10. Input Absolute Amplitude Accuracy (dB) (Continued)

Center Frequency[6]	Typical	Specification 0 °C to 55 °C Self-Cal °C ± 5 °C
>5 GHz to 6 GHz	±0.25	±0.75
Conditions (10 MHz to <120 MHz): Reference level -30 dBm to +15 dBm; measured at the configured frequency; measurement performed after the PXIe-5841 has settled. Conditions (120 MHz to 6 GHz): Reference level -30 dBm to +30 dBm; measured at 3.75 MHz offset from the configured center frequency when NI-RFSA Downconverter Frequency Offset Mode is User-Defined and measured at the configured center frequency when NI-RFSA Downconverter Frequency Offset Mode is Enabled; measurement performed after the PXIe-5841 has settled. Preamplifier mode set to automatic.		

Related Information

Refer to the NI RF Vector Signal Analyzers Help for more information on Downconverter Frequency Offset Mode.

RF Input Frequency Response

Table 11. Input Frequency Response (dB), Equalized (Offset Mode is User-Defined)

Downconverter Center Frequency	NI-RFSA Device Instantaneous Bandwidth	Frequency Response (dB)
≥250 MHz to 410 MHz	50 MHz	±0.45
		±0.35, typical
>410 MHz to 650 MHz	100 MHz	±0.6
		±0.45, typical
>650 MHz to 1.5 GHz	200 MHz	±0.55
		±0.4, typical
>1.5 GHz to 2.2 GHz	200 MHz	±0.5
		±0.35, typical

6 Center frequency refers to NI-RFSA Downconverter Center Frequency when NI-RFSA Downconverter Frequency Offset Mode is User-Defined. Center frequency refers to NI-RFSA I/Q Carrier Frequency when NI-RFSA Downconverter Frequency Offset Mode is Enabled.

Table 11. Input Frequency Response (dB), Equalized (Offset Mode is User-Defined) (Continued)

Downconverter Center Frequency	NI-RFSA Device Instantaneous Bandwidth	Frequency Response (dB)
>2.2 GHz to 2.9 GHz	200 MHz	±0.5
		±0.3, typical
	1 GHz	±1.1
		±0.75, typical
>2.9 GHz to 4.8 GHz	200 MHz	±0.5
		±0.35, typical
	1 GHz	±1.15
		±0.75, typical
>4.8 GHz to 6 GHz	200 MHz	±0.5
		±0.35, typical
	1 GHz	±1.3
		±0.85, typical
Conditions: 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-5841 RF input, the reference offset frequency is 3.75 MHz. For the absolute amplitude accuracy at the reference offset, refer to the *RF Input Absolute Amplitude Accuracy* section.		

Figure 3. Measured 200 MHz Input Frequency Response, 0 dBm Reference Level, Normalized to 3.75 MHz

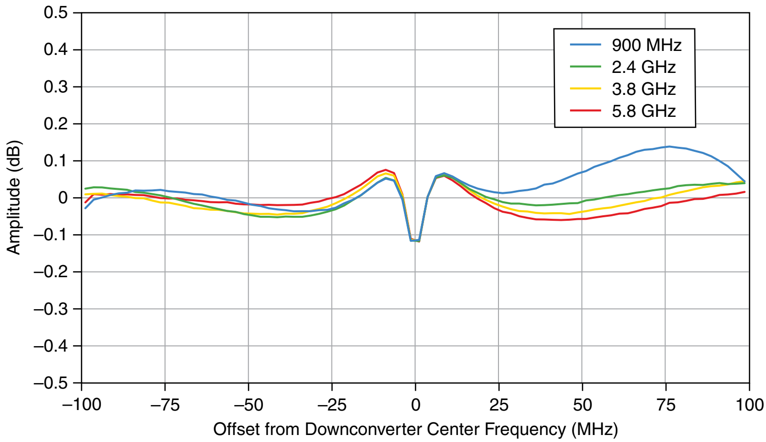


Figure 4. Measured 1 GHz Input Frequency Response, 0 dBm Reference Level, Normalized to 3.75 MHz

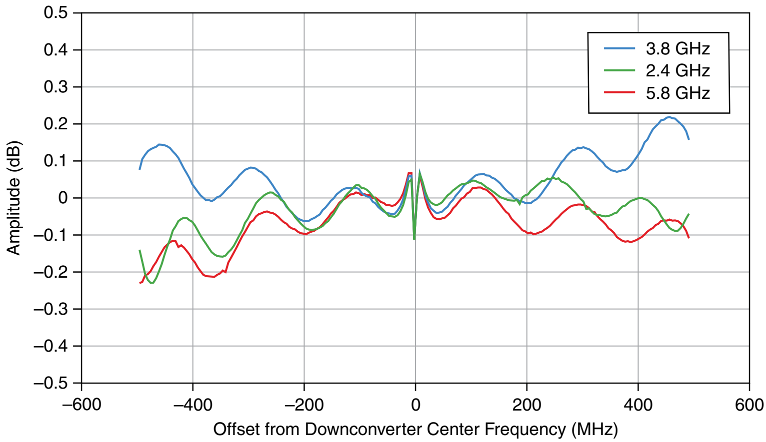


Table 12. Input Frequency Response (dB), Equalized (Offset Mode is Enabled)

I/Q Carrier Frequency	NI-RFSA Signal Bandwidth	Frequency Response (dB)
≥250 MHz to 378 MHz	10 MHz	±0.35
		±0.2, typical

Table 12. Input Frequency Response (dB), Equalized (Offset Mode is Enabled) (Continued)

I/Q Carrier Frequency	NI-RFSA Signal Bandwidth	Frequency Response (dB)
>378 MHz to 593 MHz	35 MHz	±0.35
		±0.25, typical
>593 MHz to 1.168 GHz	85 MHz	±0.5
		±0.35, typical
>1.168 GHz to 1.943 GHz	200 MHz	±0.6
		±0.4, typical
>1.943 GHz to 6 GHz	200 MHz	±0.6
		±0.4, typical
	485 MHz	±1.05
		±0.7, typical
Conditions: 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 specified I/Q carrier frequency. For the absolute amplitude accuracy at the I/Q carrier frequency, refer to the *RF Input Absolute Amplitude Accuracy* section.		

Figure 5. Measured 200 MHz Input Frequency Response, 0 dBm Reference Level, Normalized to I/Q Carrier Frequency (Offset Mode is Enabled)

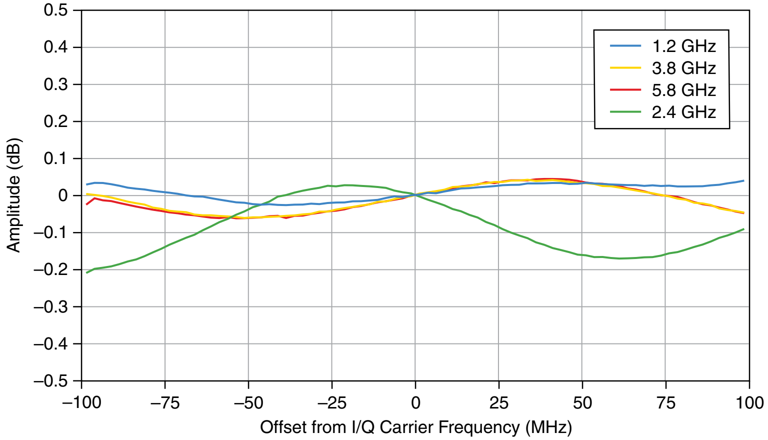
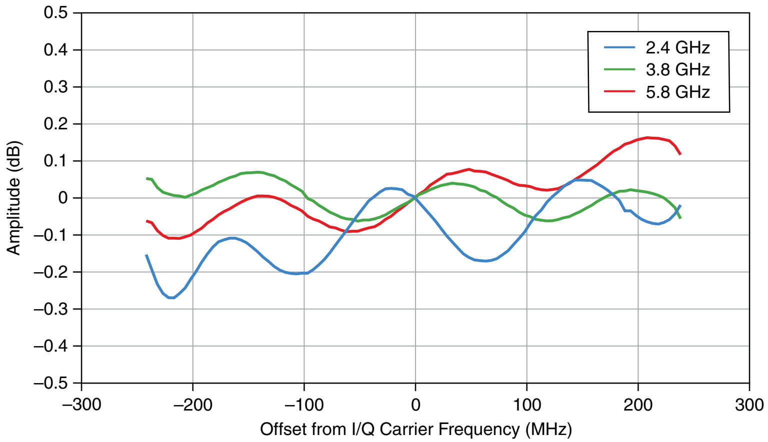


Figure 6. Measured 485 MHz Input Frequency Response, 0 dBm Reference Level, Normalized to I/Q Carrier Frequency (Offset Mode is Enabled)



RF Input Average Noise Density

Table 13. Input Average Noise Density (dBm/Hz), Typical

Downconverter Center Frequency	-50 dBm Reference Level	-10 dBm Reference Level	-5 dBm Reference Level
>120 MHz to 410 MHz	-163	-152	-148
>410 MHz to 2.7 GHz	-164	-151	-147
>2.7 GHz to 4.5 GHz	-164	-149	-145
>4.5 GHz to 6.0 GHz	-162	-149	-145

Conditions: Input terminated with a 50 Ω load; 50 averages; noise measured at 4 MHz offset, normalized to 1 Hz bandwidth. The -50 dBm reference level configuration has the preamplifier enabled. The -10 dBm and -5 dBm reference level configurations have the preamplifier disabled.

RF Input Spurious Responses

RF Input Third-Order Input Intermodulation

Table 14. Third-Order Input Intercept Point (IIP_3, dBm), Typical

Downconverter Center Frequency	-5 dBm Reference Level	-20 dBm Reference Level (Preamp Disabled)	-5 dBm Reference Level (Preamp Enabled)
120 MHz to 410 MHz	20	9	4
>410 MHz to 1.3 GHz	21	9	9
>1.3 GHz to 2.7 GHz	22	9	7
>2.7 GHz to 4.5 GHz	21	9	7
>4.5 GHz to 6.0 GHz	16	3	0

Conditions: Two tones at offsets of 10 MHz and 10.7 MHz. Tone powers are -10 dBm and -25 dBm for -5 dBm and -20 dBm reference levels, respectively.

RF Input Nonharmonic Spurs

Table 15. Input Nonharmonic Spurs (dBc), Typical

Downconverter Center Frequency	10 kHz ≤ Offset < 100 kHz	100 kHz ≤ Offset < 1 MHz	1 MHz ≤ Offset[7]
>120 MHz to 650 MHz	-71	-74	-68
>650 MHz to 1.3 GHz	-71	-72	-73
>1.3 GHz to 2.7 GHz	-69	-70	-74
>2.7 GHz to 4.5 GHz	-66	-64	-67
>4.5 GHz to 6 GHz	-62	-62	-63
Conditions: Reference level 0 dBm. Preamplifier disabled. Measured with a single tone, -6 dBr, where dBr is referenced to the configured RF reference level. LO set to integer mode for downconverter center frequency ≤ 500 MHz. Offset refers to ± desired signal offset (Hz) around the current downconverter center frequency.			

RF Input LO Residual Power

Table 16. Input LO Residual Power (dBr[8]), Typical

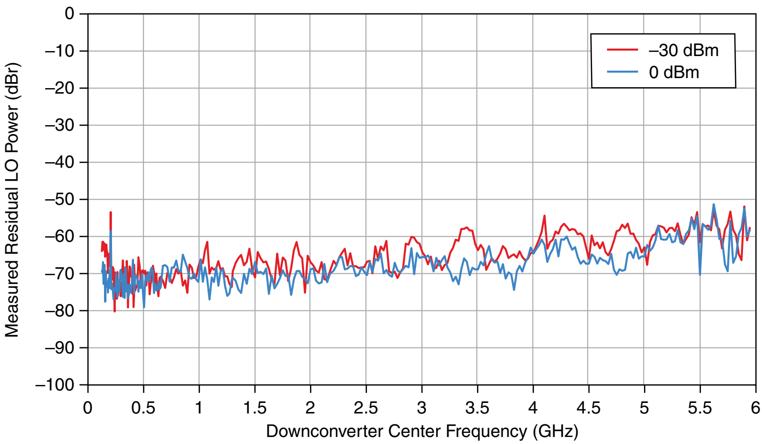
Downconverter Center Frequency	Reference Level	
	-30 dBm to <-20 dBm	-20 dBm to +30 dBm
≥120 MHz to 650 MHz	-50	-53
>650 MHz to 1.3 GHz	-53	-61
>1.3 GHz to 2.7 GHz	-57	-61
>2.7 GHz to 4.5 GHz	-45	-53

7 The maximum offset is limited to within the equalized bandwidth of the referenced LO frequency.
8 dBr is relative to the full scale of the configured RF reference level.

Table 16. Input LO Residual Power (dBr[8]), Typical (Continued)

Downconverter Center Frequency	Reference Level	
	-30 dBm to <-20 dBm	-20 dBm to +30 dBm
>4.5 GHz to 6 GHz	-48	-51
Maximum residual LO power across full device bandwidth using the internal LO of the PXIe-5841. Input tone power at a maximum of -6 dBr. Measurement performed immediately after device self-calibration. The PXIe-5841 uses the low frequency subsystem to directly acquire the RF input signal below 120 MHz.		

Figure 7. Input LO Residual Power, Measured



8 dBr is relative to the full scale of the configured RF reference level.

RF Input Residual Sideband Image

Table 17. Input Residual Sideband Image (dBc), Typical

Downconverter Center Frequency	NI-RFSA Device Instantaneous Bandwidth Setting	Input Bandwidth[9]	Residual Sideband Image (dBc)
≥120 MHz to 410 MHz	50 MHz	50 MHz	-55
>410 MHz to 650 MHz	100 MHz	100 MHz	-55
>650 MHz to 1.3 GHz	200 MHz	200 MHz	-60
>1.3 GHz to 2.2 GHz	500 MHz	200 MHz	-57
		500 MHz	-54
>2.2 GHz to 2.7 GHz	1 GHz	200 MHz	-60
		500 MHz	-55
		1 GHz	-49
>2.7 GHz to 5.2 GHz		200 MHz	-57
		500 MHz	-56
		1 GHz	-53
>5.2 GHz to 6 GHz		200 MHz	-55
		500 MHz	-53
		1 GHz	-49

Conditions: Reference levels -30 dBm to +30 dBm.

The PXIe-5841 uses the low frequency subsystem to directly acquire the RF signal below 120 MHz.

This specification describes the maximum residual sideband image within the device bandwidth centered around a given RF center frequency. Measurement performed immediately after device self-calibration.

[9] The input bandwidth describes the occupied bandwidth of the input signal centered at the downconverter center frequency.

Figure 8. Input Residual Sideband Image, 0 dBm Reference Level, Measured

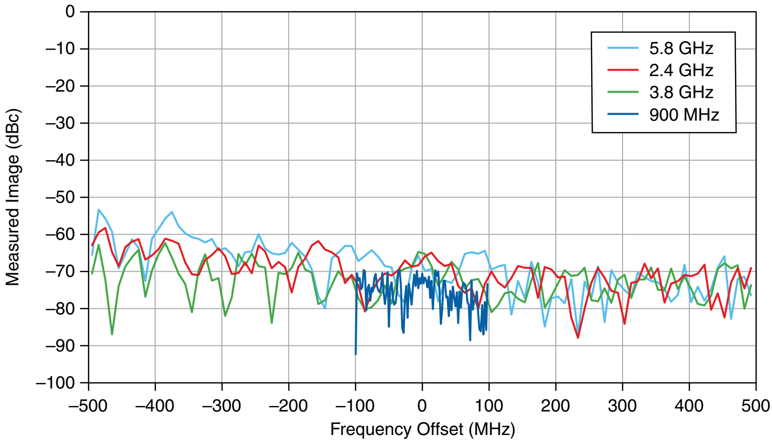
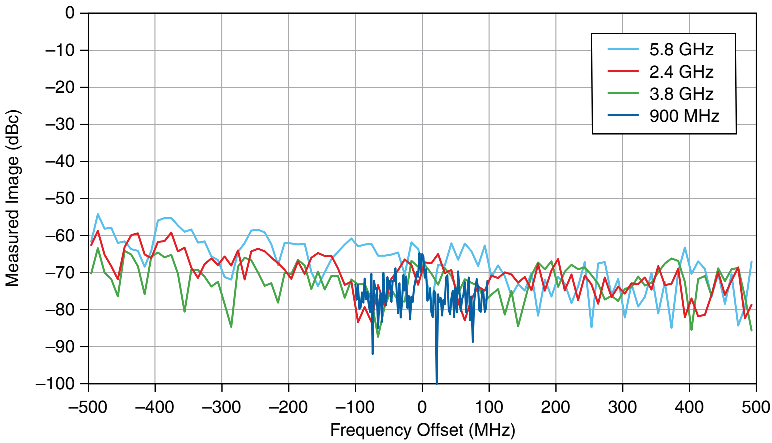


Figure 9. Input Residual Sideband Image, -30 dBm Reference Level, Measured



RF Output

RF Output Power Range

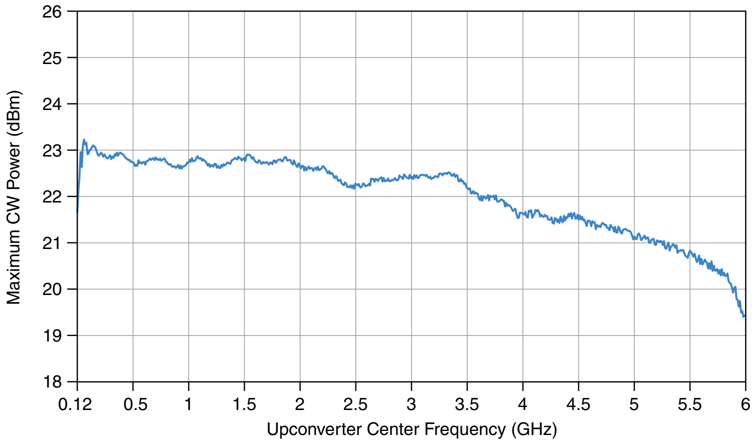
Table 18. Output Power Range

NI-RFSG Bandwidth Setting	Upconverter Center Frequency	Power Range, CW, Average Power	
		Specification	**Nominal**
<120 MHz	9 kHz to <120 MHz	Noise floor to +5 dBm	Noise Floor to +8 dBm
≤200 MHz	120 MHz to 4 GHz	Noise floor to +18 dBm	Noise Floor to ≥+20 dBm
	>4 GHz to 6 GHz	Noise Floor to +15 dBm	Noise Floor to ≥+17 dBm
1 GHz	≥2.2 GHz to 4 GHz	Noise Floor to +18 dBm	Noise Floor to ≥+20 dBm
	>4 GHz to 6 GHz	Noise Floor to +10 dBm	Noise Floor to ≥+15 dBm
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 20 MHz signal between 120 MHz to 4 GHz with a 12 dB PAPR can be generated with up to +6 dBm (+8 dBm, nominal) average modulated power.			

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

[10] Average output power ≥ -100 dBm.

Figure 10. Output Maximum CW Average Power (dBm), Measured



RF Output Amplitude Settling Time[11]

<0.5 dB of final value	60 µs, typical
<0.1 dB of final value	85 µs, typical

RF Output Power Level Accuracy

Table 19. Output Power Level Accuracy (dB)

Center Frequency[12]	Typical	Specification 0 °C to 55 °C Self-Cal °C ± 5 °C
10 MHz to <120 MHz	±0.35	—
>120 MHz to 200 MHz	±0.25	±0.8
>200 MHz to 500 MHz	±0.25	±0.7
>500 MHz to 2.2 GHz	±0.25	±0.65

11 Varying RF output power range.

12 Center frequency refers to NI-RFSG Upconverter Center Frequency when NI-RFSG Upconverter Frequency Offset Mode is User-Defined. Center frequency refers to NI-RFSG I/Q Carrier Frequency when NI-RFSG Upconverter Frequency Offset Mode is Enabled.

Table 19. Output Power Level Accuracy (dB) (Continued)

Center Frequency[12]	Typical	Specification 0 °C to 55 °C Self-Cal °C ± 5 °C
>2.2 GHz to 6 GHz	±0.25	±0.7

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

Conditions (10 MHz to <120 MHz): Power level -30 dBm to +5 dBm; measured at the configured frequency. Measurement performed after the PXIe-5841 has settled.

Conditions (120 MHz to 6 GHz): Power level -30 dBm to +15 dBm; measured at 3.75 MHz offset from the configured center frequency when NI-RFSG Upconverter Frequency Offset Mode is User-Defined; measured at the configured center frequency when NI-RFSG Upconverter Frequency Offset Mode is Enabled. Measurement performed after the PXIe-5841 has settled.

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.

[12] Center frequency refers to NI-RFSG Upconverter Center Frequency when NI-RFSG Upconverter Frequency Offset Mode is User-Defined. Center frequency refers to NI-RFSG I/Q Carrier Frequency when NI-RFSG Upconverter Frequency Offset Mode is Enabled.

RF Output Relative Power Level Accuracy

Table 20. Output Relative Power Level Accuracy (dB)

Center Frequency[13]	Typical
10 MHz to <120 MHz	±0.35
120 MHz to 6 GHz	±0.2

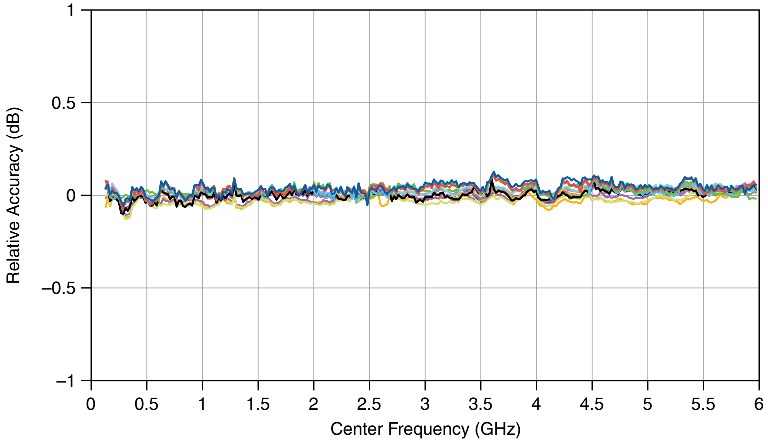
Conditions (10 MHz to <120 MHz): Power level -30 dBm to +5 dBm; measured at the configured frequency. Measurement performed after the PXIe-5841 has settled.

Conditions (120 MHz to 6 GHz): Power level -30 dBm to +15 dBm; measured at 3.75 MHz offset from the configured center frequency when NI-RFSG Upconverter Frequency Offset Mode is User-Defined; measured at the configured center frequency when NI-RFSG Upconverter Frequency Offset Mode is Enabled. Measurement performed after the PXIe-5841 has settled.

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.

13 Center frequency refers to NI-RFSG Upconverter Center Frequency when NI-RFSG Upconverter Frequency Offset Mode is User-Defined. Center frequency refers to I/Q Carrier Frequency when NI-RFSG Upconverter Frequency Offset Mode is Enabled.

Figure 11. Output Relative Power Accuracy, 120 MHz to 6 GHz, -65 dBm to +15 dBm, Normalized to 0 dBm Power Level, Measured



RF Output Frequency Response

Table 21. Output Frequency Response (dB), Equalized (Offset Mode is Disabled)

Upconverter Center Frequency	NI-RFSG Signal Bandwidth Setting	Frequency Response (dB)
≥250 MHz to 410 MHz	50 MHz	±0.55
		±0.45, typical
>410 MHz to 650 MHz	100 MHz	±0.6
		±0.45, typical
>650 MHz to 1.5 GHz	200 MHz	±0.55
		±0.4, typical
>1.5 GHz to 2.2 GHz	200 MHz	±0.4
		±0.3, typical
>2.2 GHz to 2.9 GHz	200 MHz	±0.4
		±0.3, typical
	1 GHz	±1.2
		±0.8, typical

Table 21. Output Frequency Response (dB), Equalized (Offset Mode is Disabled) (Continued)

Upconverter Center Frequency	NI-RFSG Signal Bandwidth Setting	Frequency Response (dB)
>2.9 GHz to 4.8 GHz	200 MHz	±0.6
		±0.45, typical
	1 GHz	±1.25
		±0.85, typical
>4.8 GHz to 6 GHz	200 MHz	±0.55
		±0.4, typical
	1 GHz	±1.9
		±1.35, typical
Conditions: Output peak power level -30 dBm to +15 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-5841 RF Output the reference offset frequency is 3.75 MHz. For the absolute amplitude accuracy at the reference offset, refer to the *RF Output Power Level Accuracy* section.		

Figure 12. Measured 200 MHz Output Frequency Response, 0 dBm Output Power Level, Normalized to 3.75 MHz

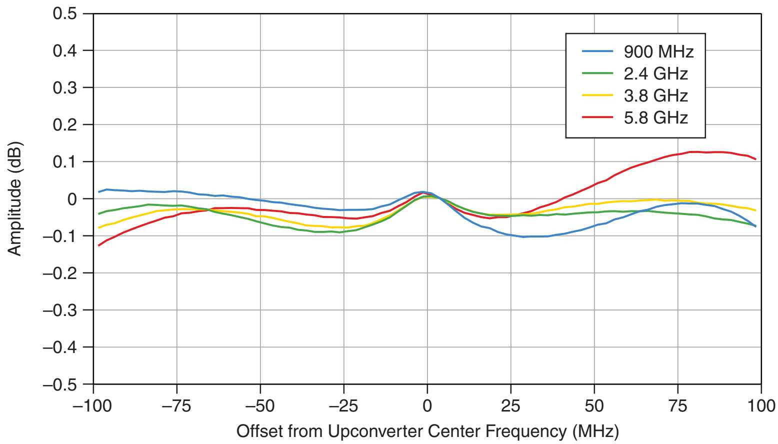


Figure 13. Measured 1 GHz Output Frequency Response, 0 dBm Output Power Level, Normalized to 3.75 MHz

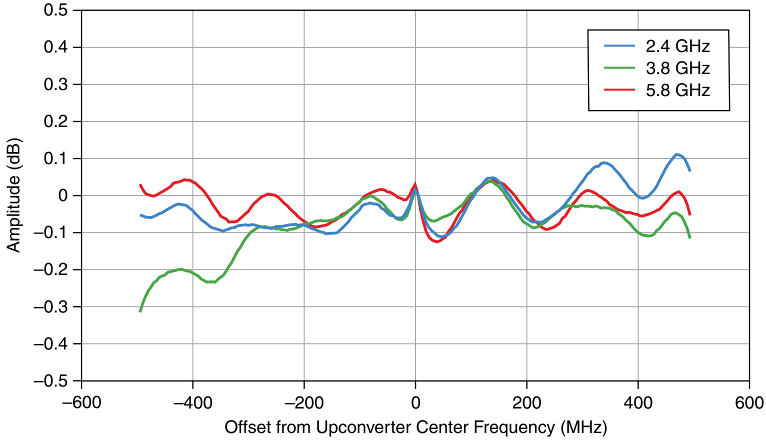


Table 22. Output Frequency Response (dB), Equalized (Offset Mode is Enabled)

I/Q Carrier Frequency	NI-RFSG Signal Bandwidth	Frequency Response (dB)
≥120 MHz to 378 MHz	10 MHz	±0.3
		±0.2, typical
>378 MHz to 593 MHz	35 MHz	±0.55
		±0.4, typical
>593 MHz to 1.168 GHz	85 MHz	±0.4
		±0.25, typical
>1.168 GHz to 1.943 GHz	200 MHz	±0.5
		±0.45, typical

Table 22. Output Frequency Response (dB), Equalized (Offset Mode is Enabled) (Continued)

<table>
<tr><th>I/Q Carrier Frequency</th><th>NI-RFSG Signal Bandwidth</th><th>Frequency Response (dB)</th></tr>
<tr><td rowspan="4">>1.943 GHz to 6 GHz</td><td rowspan="2">200 MHz</td><td>±0.65</td></tr>
<tr><td>±0.45, typical</td></tr>
<tr><td rowspan="2">485 MHz</td><td>±1.0</td></tr>
<tr><td>±0.7, typical</td></tr>
<tr><td colspan="3">Conditions: Output peak power level -30 dBm to +15 dBm; module temperature within ±5 °C of last self-calibration temperature.

Frequency response is defined as the maximum relative amplitude deviation from the specified I/Q carrier frequency. For the absolute amplitude accuracy at the reference offset, refer to the RF Output Power Level Accuracy section.</td></tr>
</table>

Figure 14. Measured 200 MHz Output Frequency Response, 0 dBm Output Power Level, Normalized to I/Q Carrier Frequency (Offset Mode is Enabled)

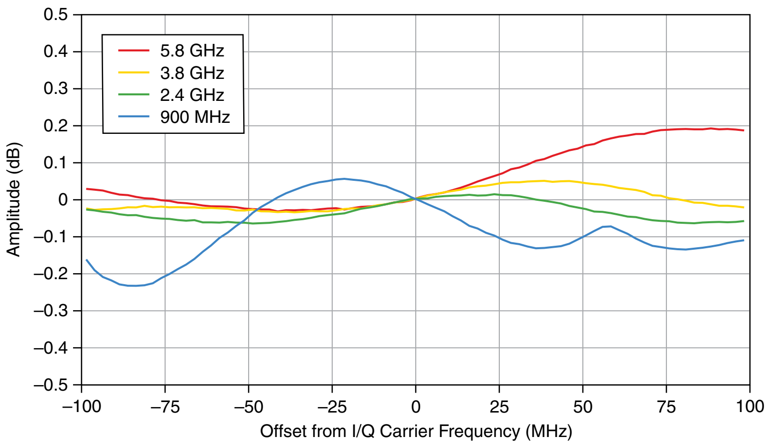
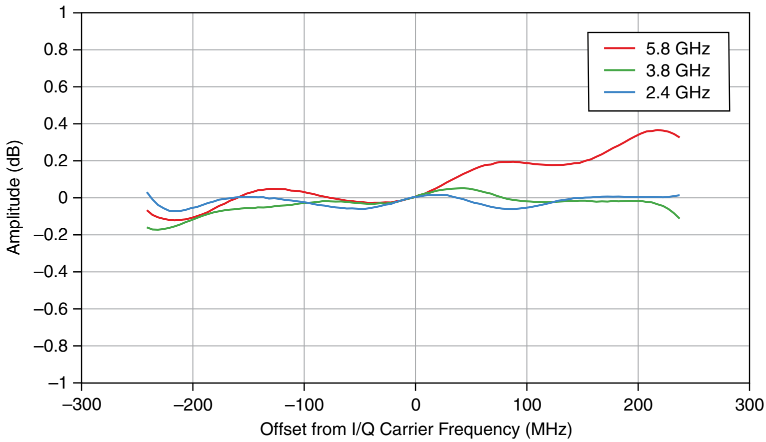


Figure 15. Measured 485 MHz Output Frequency Response, 0 dBm Output Power Level, Normalized to I/Q Carrier Frequency (Offset Mode is Enabled)



RF Output Average Noise Density

Table 23. Output Average Noise Density (dBm/Hz), Typical

Upconverter Center Frequency	Output Power Level (Peak)		
	-30 dBm	0 dBm	10 dBm
10 MHz to <120 MHz	-151	-147	—
120 MHz to 410 MHz	-165	-140	-131
>410 MHz to 1.3 GHz	-165	-143	-134
>1.3 GHz to 2.7 GHz	-164	-142	-132
>2.7 GHz to 4.5 GHz	-162	-144	-134
>4.5 GHz to 6.0 GHz	-163	-139	-128
Conditions: 50 averages; -40 dB baseband signal attenuation; noise measurement frequency offset 4 MHz relative to output frequency.			

RF Output Spurious Responses

RF Output Third-Order Intermodulation

Table 24. Third-Order Output Intermodulation Distortion (IMD_3) (dBc), -6 dBm Tones, Typical

Upconverter Center Frequency	Baseband DAC: -2 dBFS Peak Power Level: 2 dBm	Baseband DAC: -6 dBFS Peak Power Level: 6 dBm
10 MHz to 120 MHz	-65	-70
>120 MHz to 410 MHz	-61	-67
>410 MHz to 1.3 GHz	-58	-66
>1.3 GHz to 2.7 GHz	-57	-68
>2.7 GHz to 4.5 GHz	-55	-64
>4.5 GHz to 6.0 GHz	-58	-63
Conditions: -6 dBm tones at 1.6 MHz and 2.3 MHz offset from the LO. Output power level set to achieve the desired output power per tone allowing specified digital headroom.		

Table 25. Third-Order Output Intermodulation Distortion (IMD_3) (dBc), -36 dBm Tones, Typical

Upconverter Center Frequency	Baseband DAC: -2 dBFS Peak Power Level: -28 dBm	Baseband DAC: -6 dBFS Peak Power Level: -24 dBm
10 MHz to 120 MHz	-71	-72
>120 MHz to 410 MHz	-61	-65
>410 MHz to 1.3 GHz	-59	-65
>1.3 GHz to 2.7 GHz	-62	-69
>2.7 GHz to 4.5 GHz	-60	-70
>4.5 GHz to 6.0 GHz	-61	-68
Conditions: -36 dBm tones at 1.6 MHz and 2.3 MHz offset from the LO. Output power level set to achieve the desired output power per tone allowing specified digital headroom.		

RF Output Harmonics

Table 26. Output Second Harmonic Level (dBc), Typical

Upconverter Center Frequency	CW Average Power		
	-10 dBm	**6 dBm**	**15 dBm**
10 MHz to 120 MHz	-63	-45	—
>120 MHz to 410 MHz	-52	-39	-31
>410 MHz to 1.3 GHz	-49	-41	-35
>1.3 GHz to 2.7 GHz	-45	-40	-34
>2.7 GHz to 4.5 GHz	-45	-40	-34
>4.5 GHz to 6 GHz	-47	-44	-33
Conditions: Measured using a -1 dBFS baseband signal with 1 MHz offset.			

RF Output Nonharmonic Spurs

Table 27. Output Nonharmonic Spurs (dBc), Typical

Upconverter Center Frequency	10 kHz ≤ Offset < 100 kHz	100 kHz ≤ Offset < 1 MHz	1 MHz ≤ Offset[14]
120 MHz to 650 MHz[15]	-82	-77	-65
>650 MHz to 1.3 GHz	-83	-75	-71
>1.3 GHz to 2.2 GHz	-78	-74	-72
>2.2 GHz to 4.5 GHz	-72	-68	-66
>4.5 GHz to 6 GHz	-73	-68	-67
Conditions: Output full scale 0 dBm. Measured with a single tone at 0 dBFS.			

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

[14] The maximum offset is limited to within the equalized bandwidth of the referenced LO Frequency.
[15] LO PLL Fractional Mode disabled.

RF Output LO Residual Power

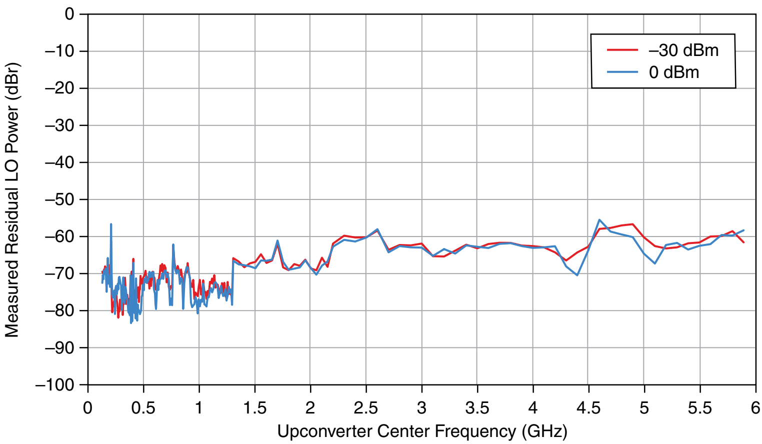
Table 28. Output LO Residual Power (dBc), Typical

Upconverter Center Frequency	LO Residual Power
≥120 MHz to 650 MHz	-55
>650 MHz to 2.2 GHz	-60
>2.2 GHz to 4.5 GHz	-57
>4.5 GHz to 6 GHz	-51

Conditions: Maximum residual LO power across full device bandwidth using the internal LO of the PXIe-5841. Peak output power -30 dBm to +15 dBm, tone at -6 dBFS. Measurement performed immediately after device self-calibration.

The PXIe-5841 uses the low frequency subsystem to directly generate the RF signal below 120 MHz.

Figure 16. Output LO Residual Power, Measured



RF Output Residual Sideband Image

Table 29. Output Residual Sideband Image (dBc), Typical

Upconverter Center Frequency	NI-RFSG Signal Bandwidth Setting	Output Bandwidth	Residual Sideband Image
≥120 MHz to 410 MHz	50 MHz	50 MHz	-46
>410 MHz to 650 MHz	100 MHz	100 MHz	-62
>650 MHz to 1.3 GHz	200 MHz	200 MHz	-60
>1.3 GHz to 2.2 GHz	200 MHz	200 MHz	-65
	500 MHz	500 MHz	-63
>2.2 GHz to 4.5 GHz	200 MHz	200 MHz	-63
	500 MHz	500 MHz	-58
	1 GHz	1 GHz	-53
>4.5 GHz to 6 GHz	200 MHz	200 MHz	-57
	500 MHz	500 MHz	-52
	1 GHz	1 GHz	-43
Conditions: Reference levels -30 dBm to +15 dBm. The PXIe-5841 uses the low frequency subsystem to directly acquire the RF input signal below 120 MHz. This specification describes the maximum residual sideband image within the device bandwidth centered around a given RF center frequency. Measurement performed immediately after device self-calibration.			

Figure 17. Output Residual Sideband Image, 0 dBm Average Output Power, Measured

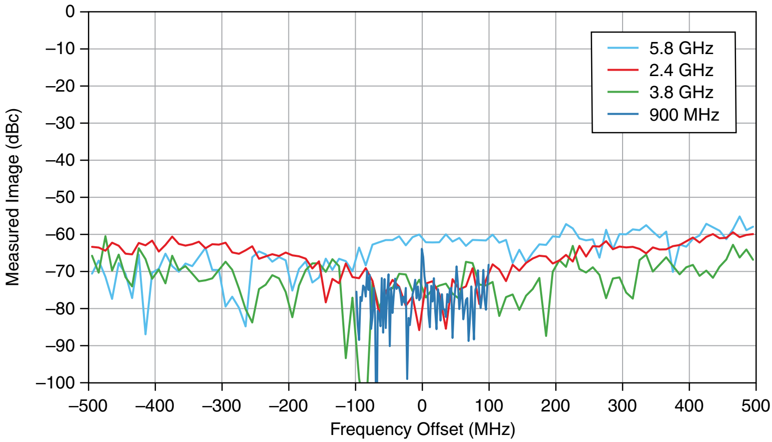
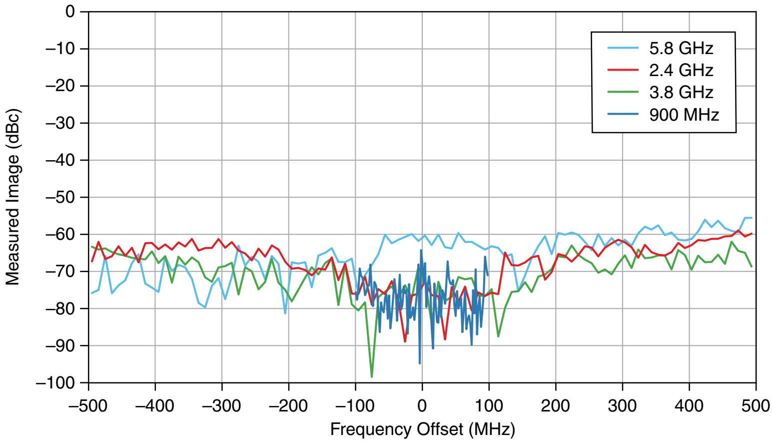


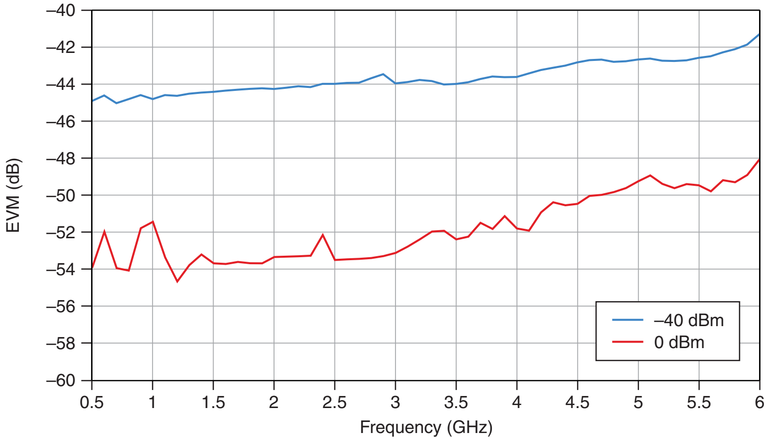
Figure 18. Output Residual Sideband Image, -30 dBm Average Output Power, Measured



Error Vector Magnitude (EVM)

Loopback error vector magnitude, RMS (dB), typical[16]	
I/Q carrier frequency	
400 MHz to <4 GHz	-48
5 GHz to 6 GHz	-47

Figure 19. Measured RMS EVM[17]



[16] Conditions: Modulated signal with 20 MHz bandwidth 64-QAM modulated signal. Pulse-shape filtering: root-raised cosine, alpha=0.25; PXIe-5841 RF input reference level: 0 dBm, Offset Mode: Enabled; PXIe-5841 RF output peak power level: 0 dBm; Reference Clock source: Onboard; Acquisition length: 300 µs.

[17] Conditions: 20 MHz bandwidth 64-QAM modulated signal. Pulse-shape filtering: root-raised cosine, alpha=0.25; PXIe-5841 RF Input reference level, RF output peak power level set to value specified in legend; Offset Mode: Enabled; Reference Clock source: Onboard; acquisition length: 300 µs.

Application-Specific Modulation Quality

5G NR

Figure 20. 5G NR Measured RMS EVM (dB) versus Frequency (Hz)[18]

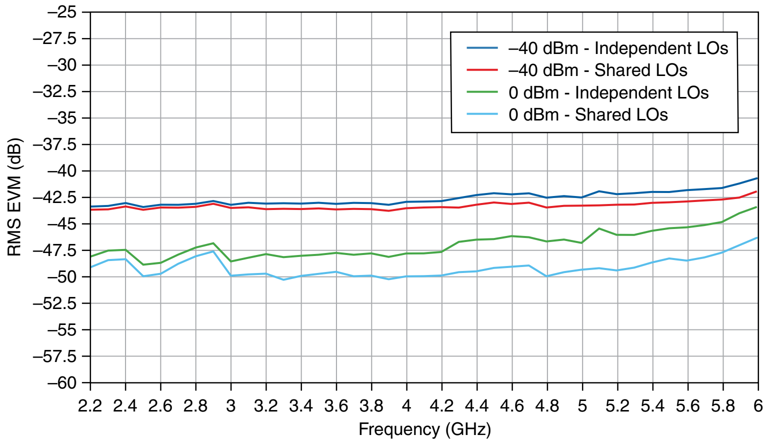
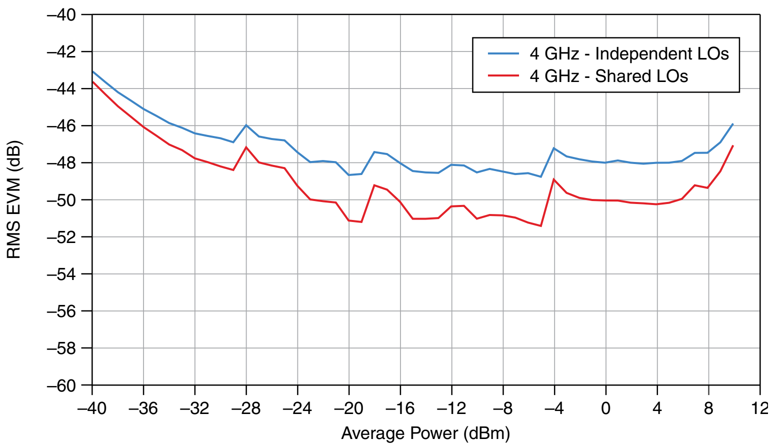


Figure 21. 5G NR Measured RMS EVM (dB) versus Measured Average Power (dBm)[19]



[18] Conditions: RF output loopback to RF input; waveform bandwidth: 100 MHz; Subcarrier spacing: 30 kHz, uplink, 256 QAM; Offset Mode: Enabled; Reference Level Headroom: Default (1 dB); Measurement length : 3 slots.

[19] Conditions: RF output loopback to RF input; Reference/power level: average power +PAPR; waveform bandwidth: 100 MHz; Subcarrier spacing: 30 kHz, uplink, 256 QAM; Offset Mode: Enabled; Reference Level Headroom: Default (1 dB); Measurement length : 3 slots.

WLAN 802.11ax

Figure 22. WLAN 802.11ax Measured RMS EVM (dB) versus Frequency (Hz)[20]

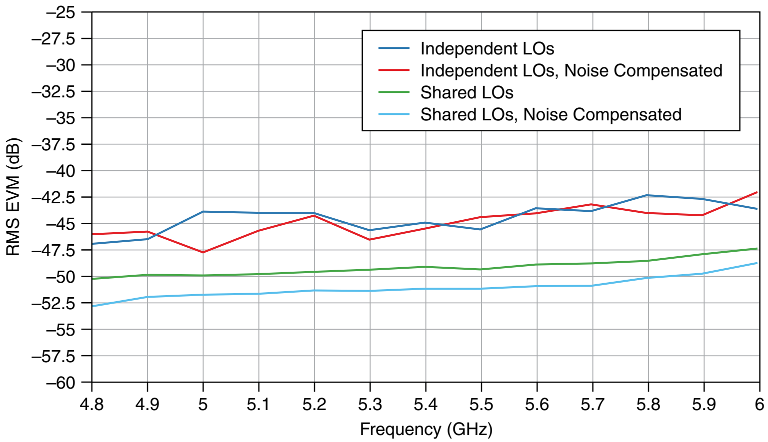
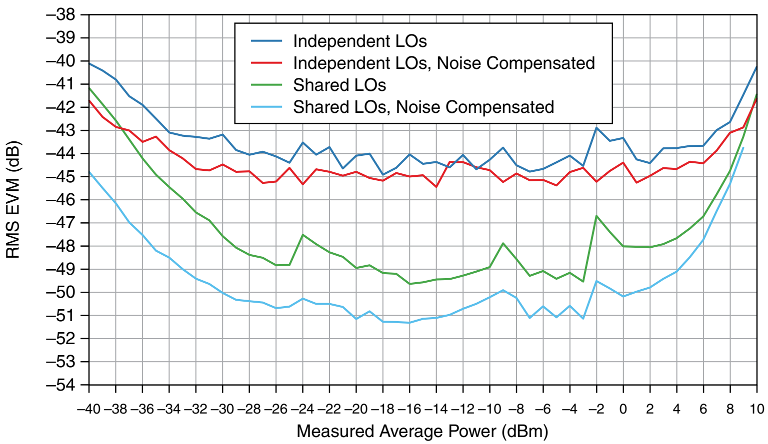


Figure 23. WLAN 802.11ax Measured RMS EVM (dB) versus Measured Average Power (dBm)[21]

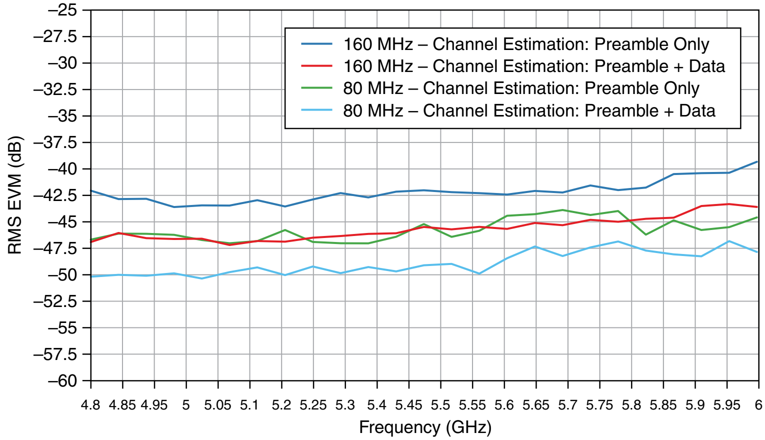


20 Conditions: RF output loopback to RF input; waveform bandwidth: 80 MHz; MCS index: 11; Offset Mode: Enabled; RF output average power: -15 dBm; Reference level: average power + PAPR

21 Conditions: RF output loopback to RF input; waveform bandwidth: 80 MHz; MCS index: 11; Offset Mode: Enabled; carrier frequency: 5.5 GHz.

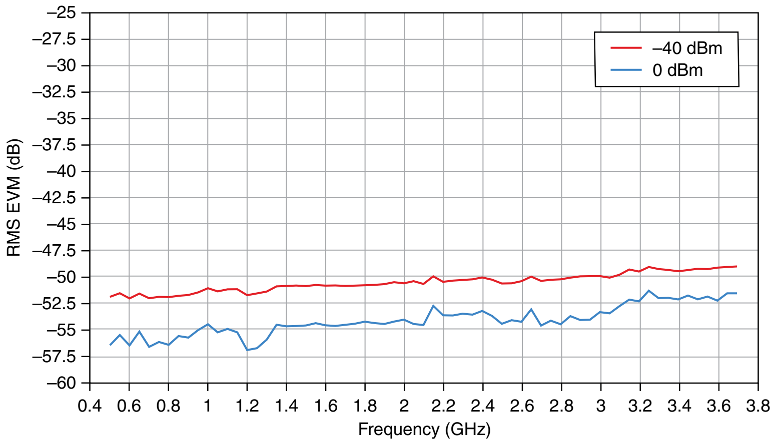
WLAN 802.11ac

Figure 24. WLAN 802.11ac Measured RMS EVM (dB) versus Frequency (Hz)[22]



LTE

Figure 25. LTE Measured RMS EVM (dB) versus Frequency (Hz)[23]

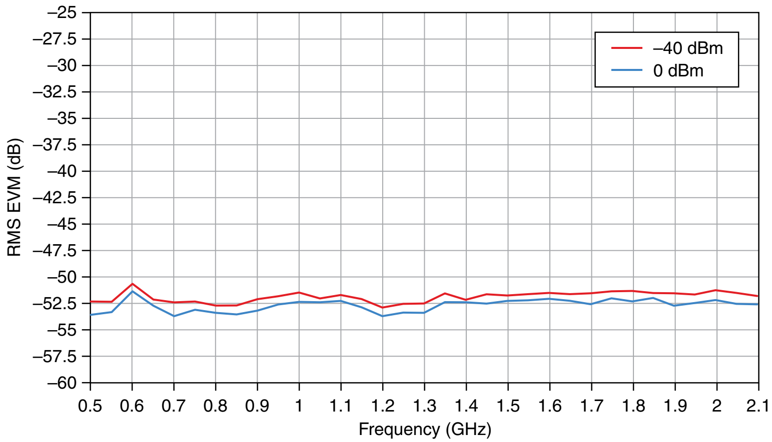


22 Conditions: RF output loopback to RF input; Offset Mode: Enabled; MCS index: 9; RF output average power: 0 dBm; Reference level: average power + PAPR; Internal LO.

23 Conditions: RF Output loopback to RF Input; Offset Mode: Enabled; Independent onboard LOs; 20 MHz BW, Uplink, FDD; average power + PAPR

WCDMA

Figure 26. WCDMA Measured RMS EVM (dB) versus Frequency (Hz)[24]



Baseband Characteristics

Analog-to-digital converters (ADCs)	
Resolution	14 bits
Sample rate	1.25 GS/s
I/Q data rate[25]	19 kS/s to 1.25 GS/s
Digital-to-analog converters (DACs)	
Resolution	16 bits
Sample rate[26]	1.25 GS/s
I/Q data rate[27]	19 kS/s to 1.25 GS/s

Onboard FPGA

FPGA	Xilinx Virtex-7 X690T
LUTs	433,200
Flip-flops	866,400

24 Conditions: RF output loopback to RF input; Offset Mode: Enabled; Independent onboard LOs.
25 I/Q data rates lower than 1.25 GS/s are achieved using fractional decimation.
26 DAC sample rate is internally interpolated to 2.5 GS/s, automatically configured.
27 I/Q data rates lower than 1.25 GS/s are achieved using fractional interpolation.

DSP48 slices	3,600
Embedded block RAM	52.9 Mbits
Data transfers	DMA, interrupts, programmed I/O
Number of DMA channels	56

Onboard DRAM

Memory size	2 banks, 2 GB per bank
Theoretical maximum data rate	12 GB/s per bank

Onboard SRAM

Memory size	2 MB
Maximum data rate (read)	31 MB/s
Maximum data rate (write)	29 MB/s

Front Panel I/O

Notice These test and measurement instruments are not intended for direct connection to the MAINs building installations of measurement categories CAT II, CAT III, and CAT IV.

RF IN

Connector	SMA (female)
Input impedance	50 Ω, nominal, AC coupled
Maximum DC input voltage without damage	±10 VDC
Absolute maximum input power	
<120 MHz	+24 dBm (CW RMS)
≥120 MHz	+33 dBm (CW RMS)

Input Return Loss (VSWR)

Table 30. Input Return Loss (dB) (Voltage Standing Wave Ratio), Typical

Frequency	Preamp Disabled	Preamp Enabled, Auto
100 kHz to <500 MHz	13.5 (1.51:1)	13.5 (1.51:1)
500 MHz to <1.2 GHz	15.0 (1.43:1)	13.5 (1.51:1)
1.2 GHz to <3.8 GHz	15.0 (1.43:1)	15.0 (1.43:1)

Table 30. Input Return Loss (dB) (Voltage Standing Wave Ratio), Typical (Continued)

Frequency	Preamp Disabled	Preamp Enabled, Auto
3.8 GHz to <4.2 GHz	15.0 (1.43:1)	13.5 (1.51:1)
4.2 GHz to <5.8 GHz	15.0 (1.43:1)	15.0 (1.43:1)
5.8 GHz to 6.0 GHz	13.5 (1.51:1)	13.5 (1.51:1)

RF OUT

Connector	SMA (female)
Output impedance	50 Ω, nominal, AC coupled
Absolute maximum reverse power	
<120 MHz	+24 dBm (CW RMS)
≥120 MHz	+33 dBm (CW RMS)

Output Return Loss (VSWR)

Table 31. Output Return Loss (dB) (Voltage Standing Wave Ratio), Typical

Frequency	Typical
100 kHz to <500 MHz	12.0 (1.67:1)
500 MHz to <2.8 GHz	17.0 (1.33:1)
2.8 GHz to <4.5 GHz	14.5 (1.46:1)
4.5 GHz to <5.8 GHz	16.0 (1.38:1)
5.8 GHz to 6.0 GHz	15.0 (1.43:1)

LO OUT (RF IN and RF OUT)

Connectors	MMPX (female)
Frequency range	120 MHz to 6 GHz
Output power	0 dBm ± 2 dB, typical
Output power resolution[28]	0.25 dB, nominal
Output impedance	50 Ω, nominal, AC coupled

28 Output power resolution refers to the RF attenuator step size used to compensate for the LO output frequency response.

Output return loss	
120 MHz to 2 GHz	>12 dB (VSWR < 1.67:1), nominal
>2 GHz to 6 GHz	>8 dB (VSWR < 2.32:1), nominal

LO IN (RF IN and RF OUT)

Connectors	MMPX (female)
Frequency range	120 MHz to 6 GHz
Input power range[29]	-4 dBm to 0 dBm, nominal
Input impedance	50 Ω, nominal, AC coupled
Input return loss (LO IN Enabled)	
120 MHz to 3.6 GHz	>20 dB (VSWR <1.22:1), nominal
>3.6 GHz to 6 GHz	>12 dB (VSWR <1.67:1), nominal
Input return loss (LO IN Disabled)	
120 MHz to 3 GHz	>18 dB (VSWR <1.29:1), nominal
>3 GHz to 6 GHz	>15 dB (VSWR <1.43:1), nominal
Absolute maximum input power	+15 dBm
Maximum DC voltage	±5 VDC

REF IN

Connector	MMPX (female)
Frequency	10 MHz
Tolerance[30]	$\pm 10 \times 10^{-6}$
Amplitude[31]	0.7 $V_{pk\text{-}pk}$ to 3.3 $V_{pk\text{-}pk}$ into 50 Ω, typical
Input impedance	50 Ω, nominal
Coupling	AC

REF OUT

Connector	MMPX (female)
Frequency[32]	10 MHz, nominal

29 The PXIe-5841 supports receiving an external LO with a range of signal power levels. To properly configure the PXIe-5841 LO signal path for the provided level, set `NIRFSA_ATTR_LO_IN_POWER` or `NIRFSG_ATTR_LO_IN_POWER`.

30 *Frequency Accuracy = Tolerance × Reference Frequency*

31 Jitter performance improves with increased slew rate of input signal.

32 Refer to the *Internal Frequency Reference* section for accuracy.

Amplitude	1.65 $V_{pk\text{-}pk}$ into 50 Ω, nominal
Output impedance	50 Ω, nominal
Coupling	AC

PFI 0

Connector	MMPX (female)
Voltage levels[33]	
Absolute maximum input range	-0.5 V to 5.5 V
V_{IL}, maximum	0.8 V
V_{IH}, minimum	2.0 V
V_{OL}, maximum	0.2 V with 100 µA load
V_{OH}, minimum	2.9 V with 100 µA load
Input impedance	10 kΩ, nominal
Output impedance	50 Ω, nominal
Maximum DC drive strength	24 mA

DIGITAL I/O

Connector	Molex Nano-Pitch I/O
5.0 V Power	±5%, 50 mA maximum, nominal

Table 32. DIGITAL I/O Signal Characteristics

Signal	Type	Direction
MGT Tx± <3..0>	Xilinx Virtex-7 GTH	Output
MGT Rx± <3..0>	Xilinx Virtex-7 GTH	Input
MGT REF±	Differential	Input
DIO <1..0>[34]	Single-ended	Bidirectional
DIO <7..2>	Single-ended	Bidirectional
5.0 V	DC	Output
GND	Ground	—

33 Voltage levels are guaranteed by design through the digital buffer specifications.
34 Pins are multiplexed with MGT REF±.

Digital I/O Single-Ended Channels

Number of channels	8
Signal type	Single-ended
Voltage families	3.3 V, 2.5 V, 1.8 V, 1.5 V, 1.2 V
Input impedance	
DIO <1..0>	10 kΩ, nominal
DIO <7..2>	100 kΩ, nominal
Output impedance	50 Ω, nominal
Direction control	Per channel
Minimum required direction change latency	200 ns
Maximum output toggle rate	60 MHz with 100 µA load, nominal

Table 33. DIGITAL I/O Single-Ended DC Signal Characteristics[35]

Voltage Family	V_{IL} Max	V_{IH} Min	V_{OL} Max (100µA load)	V_{OH} Min (100µA load)	Maximum DC Drive Strength
3.3 V	0.8 V	2.0 V	0.2 V	3.0 V	24 mA
2.5 V	0.7 V	1.6 V	0.2 V	2.2 V	18 mA
1.8 V	0.62 V	1.29 V	0.2 V	1.5 V	16 mA
1.5 V	0.51 V	1.07 V	0.2 V	1.2 V	12 mA
1.2 V	0.42 V	0.87 V	0.2 V	0.9 V	6 mA

Digital I/O High Speed Serial MGT[36]

Data rate	500 Mbps to 12 Gbps, nominal
Number of Tx channels	4
Number of Rx channels	4
I/O AC coupling capacitor	100 nF

MGT Tx± <3..0> Channels

Minimum differential output voltage[37]	800 $mV_{pk\text{-}pk}$ into 100 Ω, nominal

35 Voltage levels are guaranteed by design through the digital buffer specifications.
36 For detailed FPGA and High Speed Serial Link specifications, refer to Xilinx documentation.
37 When transmitter output swing is set to the maximum setting.

MGT Rx± <3..0> Channels

Differential input voltage range	
≤ 6.6 GB/s	150 $mV_{pk\text{-}pk}$ to 2000 $mV_{pk\text{-}pk}$, nominal
> 6.6 GB/s	150 $mV_{pk\text{-}pk}$ to 1250 $mV_{pk\text{-}pk}$, nominal
Differential input resistance	100 Ω, nominal

MGT Reference Clock

Clocking resources	
Internal MGT reference[38]	78.125 MHz to 625 MHz
Data Clock	156.25 MHz
MGT REF± Input	60 MHz to 820 MHz, nominal

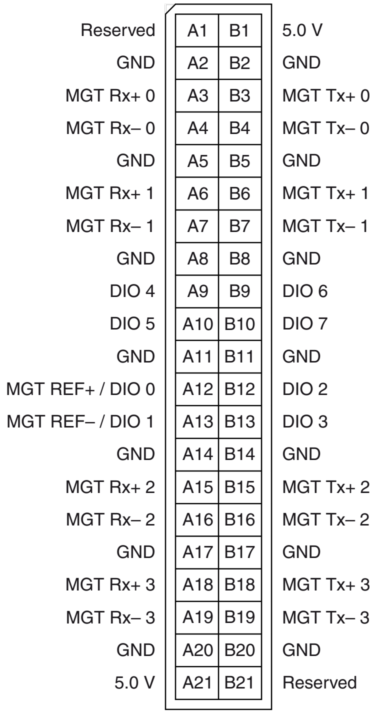
MGT REF± Input

AC coupling capacitors	100 nF
Differential input resistance	100 Ω, nominal
Differential input $V_{pk\text{-}pk}$ range	350 mV to 2000 mV, nominal
Absolute maximum input range	-1.25 V to 4.5 V[39]

38 Internal MGT Reference is derived from the Sample Clock PLL. Available frequencies are 2.5 GHz / *N*, where $4 \leq N \leq 32$. Set via MGT component level IP (CLIP).

39 Absolute maximum levels at input, prior to AC coupling capacitors.

Figure 27. DIGITAL I/O Nano-Pitch Connector



Power Requirements

Table 34. Power Requirements

Voltage (V_{DC})	Typical Current (A)
+3.3	3.3
+12	5.8
Power is 80 W, typical. Consumption is from both PXI Express backplane power connectors. Conditions: Simultaneous generation and acquisition using NI-RFSG and NI-RFSA at 1.25 GS/s IQ rate, 45 °C ambient temperature. Power consumption depends on FPGA image being used.	

Calibration

Interval	1 year

Note For the two-year calibration interval, add 0.2 dB to one year specifications for *RF Input Absolute Amplitude Accuracy*, *RF Input Frequency Response*, *RF Output Power Level Accuracy*, and *RF Output Frequency Response*.

Physical Characteristics

PXIe-5841 module	2U, two slot, PXI Express module 4.1 cm × 12.9 cm × 21.1 cm (1.6 in. × 5.6 in. × 8.3 in.)
Weight	794 g (28.0 oz)

Environmental Characteristics

Temperature and Humidity

Temperature	
Operating	
Chassis with slot cooling capacity ≥58 W[40]	0 °C to 55 °C
All other compatible chassis[41]	0 °C to 40 °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)

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

40 Not all chassis with slot cooling capacity ≥58 W can achieve this ambient temperature range. Refer to PXI chassis specifications to determine the ambient temperature ranges your chassis can achieve.
41 For chassis with slot cooling capacity = 38 W, the fan speed must be set to HIGH to achieve this ambient temperature range.

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)

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.)

378128A-01 October 2, 2019