
PXle-5655

Specifications

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PXIe-5655 Specifications

PXIe-5655 Nomenclature

In this document, the PXIe-5655 with MMPX connectors and the PXIe-5655 with SMA connectors are referred to inclusively as the PXIe-5655. The information in this document applies to all versions of the PXIe-5655 unless otherwise specified.

Definitions

In this document, the term *LO Output* refers to the specifications applicable to the LO 0 OUT and LO 1 OUT 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% ($\approx 2\sigma$) 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

- Calibration cycle is maintained
- The PXle-5655 requires a chassis with slot cooling capacity ≥ 38 W
- 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 PXle-5841 or PXle-5842 getting started documentation, available at ni.com/manuals

Warranted specifications are valid over temperature ranges described in *Environmental Characteristics* unless otherwise noted.

Typical and Typical-95 specifications are valid over ambient temperature ranges of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ unless otherwise noted.

Typical and Measured specifications do not include measurement uncertainty.

LO Frequency

Frequency range	50 MHz to 7.2 GHz
Frequency tuning resolution ¹ When the requested frequency or the LO Frequency Step Size is not a multiple of 1 Hz, the output frequency is inexact due to floating-point math limitations in the software.	1 Hz

1. When the requested LO frequency and LO Frequency Step Size are multiples of 1 Hz, the PXle-5655 rounds to a multiple of the LO Frequency Step Size and tunes exactly to the resulting frequency. The precision of tuning is limited only by the accuracy of the frequency reference.

LO Frequency Settling Time

Table 1. Maximum LO Frequency Settling Time

Frequency Accuracy	Maximum Time No Band Transition (μ s), 0 °C to 55 °C	Maximum Time Band Transition ² (μ s), 0 °C to 55 °C
$\leq 1 \times 10^{-6}$ of final frequency	<100	<230
$\leq 0.1 \times 10^{-6}$ of final frequency	<130	<250
These specifications only include frequency settling. They exclude any residual amplitude settling.		

Internal Frequency Reference

Frequency	10 MHz
Initial calibration accuracy (temperature 15 °C to 35 °C)	$\pm 60 \times 10^{-9}$
Temperature stability	
15 °C to 35 °C	$\pm 30 \times 10^{-9}$, maximum
0 °C to 15 °C, 35 °C to 55 °C	$\pm 50 \times 10^{-9}$, maximum
Aging after 30 days of continuous operation	
Per day	$\pm 1.0 \times 10^{-9}$, maximum
Per year	$\pm 160 \times 10^{-9}$, maximum

2. Band Transition: This specification accounts for a band transition at 6.3 GHz. Any frequency step where the generated frequency transitions from below to above 6.3 GHz or from above to below 6.3 GHz results in the Maximum Settling Time with Band Transition specification.

Per 2 years	$\pm 200 \times 10^{-9}$, maximum
Accuracy	<i>Initial Adjustment Accuracy</i> $\pm$ <i>Aging</i> $\pm$ <i>Temperature Stability</i>



Note For more information about using an external frequency reference or sharing the internal frequency reference, refer to the *Front Panel I/O* section.



Note The frequency reference is the same for both oscillator outputs.

Spectral Purity

Table 2. Single Sideband Phase Noise (dBc/Hz)³

LO Frequency	10 kHz Offset	100 kHz Offset
2.4 GHz	-122	—
5.8 GHz	-115	-123
7.2 GHz	-114	-121

During phase noise measurement, the reference clock is the PXle-5655 onboard oven-controlled crystal oscillator (OCXO). Spurs removed. Warranted specifications are measured at 23 °C $\pm$ 5 °C.

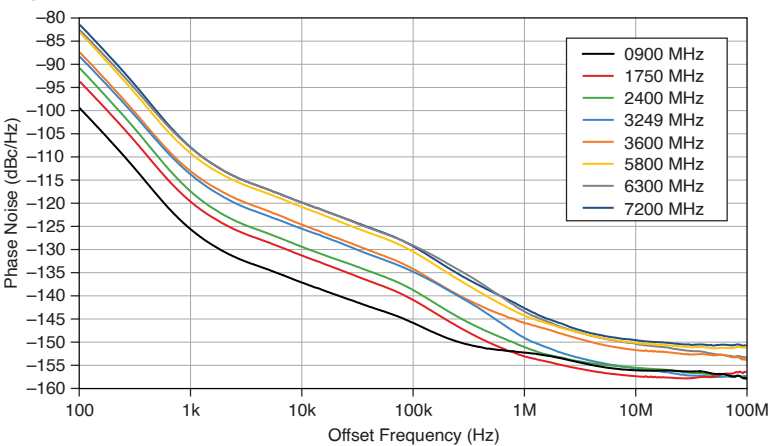
Table 3. Single Sideband Phase Noise (dBc/Hz), Typical and Measured

LO Frequency	10 kHz Offset		100 kHz Offset	
	Typical	Measured	Typical	Measured
2.4 GHz	-127.0	-129.5	-133.6	-138.9
5.8 GHz	-118.9	-120.9	-125.6	-130.6
6.3 GHz	-117.9	-119.9	-124.5	-129.2
7.2 GHz	-117.5	-120.0	-124.1	-129.4

3. For 2,400 MHz performance, refer to the *Single Sideband Phase Noise (dBc/Hz), Typical and Measured* table. PXle-5655 performance exceeds the production test capability at lower carrier frequencies and larger frequency offsets.

LO Frequency	10 kHz Offset		100 kHz Offset	
	Typical	Measured	Typical	Measured
During phase noise measurement, the reference clock is the PXle-5655 onboard OCXO.				

Figure 1. Measured Phase Noise⁴



LO Power

LO output power range	-2 dBm to +10 dBm
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Table 4. LO Output Amplitude Accuracy (±dB)

LO Frequency	23 °C ± 5 °C	23 °C ± 5 °C (Typical)	0 °C to 55 °C (Typical)
50 MHz to <150 MHz	1.5	0.8	1.6
150 MHz to <3.6 GHz	0.9	0.5	1.3
3.6 GHz to <5.0 GHz	1.0	0.5	0.7
5.0 GHz to <5.5 GHz	1.3	0.5	0.9
5.5 GHz to 6.0 GHz	1.6	0.7	1.2
>6.0 GHz to 7.2 GHz	1.7	0.8	1.7

Amplitude accuracy is measured from -2 dBm to +10 dBm.

4. Conditions: Averaged performance of multiple modules; reference clock is the PXle-5655 onboard OCXO; spurs not shown.

LO Output Amplitude Settling Time

<0.5 dB of final value	40 μ s, typical
<0.1 dB of final value	70 μ s, typical

LO Isolation

LO 0 to LO 1	-70 dBc, typical
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LO Loopback Power

LO loopback output power range	-2 dBm to +10 dBm
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Table 5. Output Amplitude Accuracy in Loopback Configuration ($\pm$ dB)

Center Frequency	23 °C $\pm$ 5 °C (Nominal)	0 °C to 55 °C (Nominal)
50 MHz to <150 MHz	1.2	1.6
150 MHz to <3.6 GHz	0.6	0.8
3.6 GHz to <5.0 GHz	0.5	1.0
5.0 GHz to <5.5 GHz	0.6	1.1
5.5 GHz to 6.0 GHz	0.8	1.3
>6.0 GHz to 7.2 GHz	1.2	1.5

In the LO loopback configuration, input to the LO 0 IN or LO 1 IN port is looped to the corresponding LO 0 OUT or LO 1 OUT port with configurable gain. Amplitude accuracy is measured for loopback output levels from -2 dBm to +10 dBm. LO IN power of 0 dBm or higher is required to reach +10 dBm output.

LO Output Nonharmonic Spurs

Table 6. LO Output Nonharmonic Spurs, Typical (dBc)

LO Frequency	Offset -5 MHz to -2 kHz 2 kHz to 5 MHz	Offset -100 MHz to -10 kHz10 kHz to 100 MHz
50 MHz to 7.2 GHz	-65	-65

Conditions: LO Output Power is 0 dBm and 10 dBm. The signal analyzer resolution bandwidth (RBW) is 200 Hz for the 2 kHz to 500 kHz and 5 kHz to 5 MHz offset windows. The RBW is 20 kHz for the wide offset window.

Offset describes the search window around the LO frequency. Performance is not specified outside these windows.

LO Output Harmonic Spurs

Table 7. LO Output Harmonic Related Spurs, Typical (dBc)

LO Frequency	Output Level
50 MHz to 105 MHz	-8
>105 MHz to 7.2 GHz	-30

Conditions: LO Output Power is 0 dBm and 10 dBm.

These harmonic related spurs are located at multiples of the LO frequency.

Table 8. LO Output Sub-Harmonic Related Spurs, Nominal (dBc)

LO Frequency	Sub-Harmonic Level
3.6 GHz to <6.5 GHz	-70
6.5 GHz to 7.2 GHz	-60

Conditions: Sub-harmonics are measured at 0 dBm and 10 dBm.

These sub-harmonic related spurs are located at half of the LO frequency.

Front Panel I/O

LO 0 OUT and LO 1 OUT

Connector	
PXle-5655 with MMPX	MMPX (female)
PXle-5655 with SMA	SMA (female)
Output impedance	50 Ω , nominal, AC coupled
Maximum DC input voltage without damage	± 10 V DC
Absolute maximum output power	+18 dBm
LO output return loss (standing wave ratio), nominal (dB)	
50 MHz to 100 MHz	13.0 (1.58:1)
>100 MHz to 1.0 GHz	16.0 (1.38:1)
>1.0 GHz to 2.2 GHz	13.0 (1.58:1)
>2.2 GHz to 3.6 GHz	12.5 (1.62:1)
3.6 GHz to 7.2 GHz	11.5 (1.73:1)

LO 0 IN and LO 1 IN

Connector	
PXle-5655 with MMPX	MMPX (female)
PXle-5655 with SMA	SMA (female)
Input impedance	50 Ω , nominal, AC coupled
Input range	-6 dBm to 6 dBm
Input return loss	>12 dB
Maximum DC input voltage without damage	± 10 V DC
Absolute maximum input power	17 dBm

REF IN

Connector	
PXle-5655 with MMPX	MMPX (female)
PXle-5655 with SMA	SMA (female)
Frequency	10 MHz, nominal 100 MHz, nominal

	270 MHz, nominal 3.84 MHz $\times$ y, nominal, where y is 4, 8, 16, 24, 25, or 32
Lock range ⁵	$\pm 10 \times 10^{-6}$
Amplitude ⁶	0.7 V pk-pk to 3.3 V pk-pk into 50 Ω , typical
Input impedance	50 Ω , nominal
Coupling	AC

REF OUT

Connector	
PXle-5655 with MMPX	MMPX (female)
PXle-5655 with SMA	SMA (female)
Frequency	10 MHz
Amplitude	1.65 V pk-pk into 50 Ω , typical
Output impedance	50 Ω , nominal

5. Initial Adjustment Accuracy $\pm$ Aging $\pm$ Temperature Stability

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

Coupling	AC
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PFI 0 (Programmable Function Input)

Connector	MMPX (female)
Voltage Levels	
Absolute maximum input voltage range	-0.5 V to 5.5 V
VIL	0.8 V
VIH	2 V
VOL with 100 μ A load	0.2 V
VOH with 100 μ A load	2.9 V
Input impedance	10 k Ω , nominal
Output impedance	50 Ω , nominal
Maximum DC drive strength	24 mA

Safety Voltages

Connect only voltages that are below these limits.

Absolute maximum input power (LO 0/1 IN)	+17 dBm
Absolute maximum reverse power (LO 0/1 OUT)	+18 dBm
Maximum input voltage (REF IN)	3.3 V pk-pk
Measurement Category	CAT I/O

Measurement Category



Warning Do not connect the product to signals or use for measurements within Measurement Categories II, III, or IV, or for measurements on MAINS circuits or on circuits derived from Overvoltage Category II, III, or IV which may have transient overvoltages above what the product can withstand. The product must not be connected to circuits that have a maximum voltage above the continuous working voltage, relative to earth or to other channels, or this could damage and defeat the insulation. The product can only withstand transients up to the transient overvoltage rating without breakdown or damage to the insulation. An analysis of the working voltages, loop impedances, temporary overvoltages, and transient overvoltages in the system must be conducted prior to making measurements.



Mise en garde Ne pas connecter le produit à des signaux dans les catégories de mesure II, III ou IV et ne pas l'utiliser pour des mesures dans ces catégories, ou des mesures sur secteur ou sur des circuits dérivés de surtensions de catégorie II, III ou IV pouvant présenter des surtensions transitoires supérieures à ce que le produit peut supporter. Le produit ne doit pas être raccordé à des circuits ayant une tension maximale supérieure à la tension de fonctionnement continu, par rapport à la terre ou à d'autres voies, sous peine d'endommager et de compromettre l'isolation. Le produit peut tomber en panne et son isolation risque d'être endommagée si les tensions

transitoires dépassent la surtension transitoire nominale. Une analyse des tensions de fonctionnement, des impédances de boucle, des surtensions temporaires et des surtensions transitoires dans le système doit être effectuée avant de procéder à des mesures.

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as *MAINS* voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.



Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are for other circuits not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Environmental Guidelines



Notice This model is intended for use in indoor applications only.

Environmental Characteristics

Temperature and Humidity

Temperature	
Operating	
Chassis with slot cooling capacity $\geq 58\text{ W}$ ^{7[7]}	0 °C to 55 °C
Chassis with slot cooling capacity $\geq 38\text{ W}$ ^{8[8]}	0 °C to 40 °C

7. Tested with chassis fan mode set to Auto and cooling profile set to 58 W/82 W in NI Measurement & Automation Explorer (MAX). Not all chassis with slot cooling capacity $\geq 58\text{ W}$ can achieve this ambient

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
Operating shock	30 g, half-sine, 11 ms pulse

Power Requirements

Table 9. PXIe-5655 Power Requirements

Voltage (V)	Current (A), Nominal
3.3	1.1
12	2.4

temperature range. Refer to PXI chassis specifications to determine the ambient temperature ranges your chassis can achieve.

8. For chassis with slot cooling capacity = 38 W, the fan speed must be set to HIGH for use in this ambient temperature range.

Voltage (V)	Current (A), Nominal
Power is 33 W, nominal. Power consumption is from the 12 V and 3.3 V PXIe Express chassis backplane power supplies.	

Physical Characteristics

Dimensions	1U, one-slot PXI Express module 2.05 cm × 12.9 cm × 21.1 cm (0.9 in. × 5.6 in. × 8.3 in.) For more information, visit ni.com/dimensions and search by module number.
Weight	570 g (20.1 oz)

Calibration

Interval	1 year
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Note For information on aging over calibration intervals greater than 1 year, refer to the [Internal Frequency Reference](#) section.