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# PXle-4163 Specifications

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# PXIe-4163 Specifications



**Note** In this document, the PXIe-4163 (10 pA) and PXIe-4163 (100 pA) are referred to inclusively as the PXIe-4163.

The information in this document applies to all versions of the PXIe-4163 unless otherwise specified. Use the information in the following table to confirm your module variant.

**Table 1.** PXIe-4163 Variant Identification

Model	Location	Identifying Information
PXIe-4163 (10 pA)	NI Measurement & Automation Explorer (MAX)	PXIe-4163 (10 pA)
	Device Front Panel	PXIe-4163 24-CH 10pA SMU
PXIe-4163 (100 pA)	NI Measurement & Automation Explorer (MAX)	PXIe-4163
	Device Front Panel	PXIe-4163 24-CH Precision SMU

## Definitions

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

**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.

Specifications are **Nominal** unless otherwise noted.

## Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature<sup>1</sup> of  $23\text{ °C} \pm 5\text{ °C}$
- Chassis with slot cooling capacity  $\geq 38\text{ W}$ <sup>2</sup>
  - For chassis with slot cooling capacity = 38 W, fan speed set to HIGH
- Calibration interval of 1 year
- 30 minutes warm-up time
- Self-calibration performed within the last 24 hours
- NI-DCPower Aperture Time is set to 2 power-line cycles (PLC)

## Instrument Capabilities

Channels	0 through 23
DC voltage range	$\pm 24\text{ V}$

The following table and figure illustrate the voltage and the current source and sink ranges of the PXIe-4163.

**Table 2.** PXIe-4163 DC Current Source and Sink Ranges, Warranted

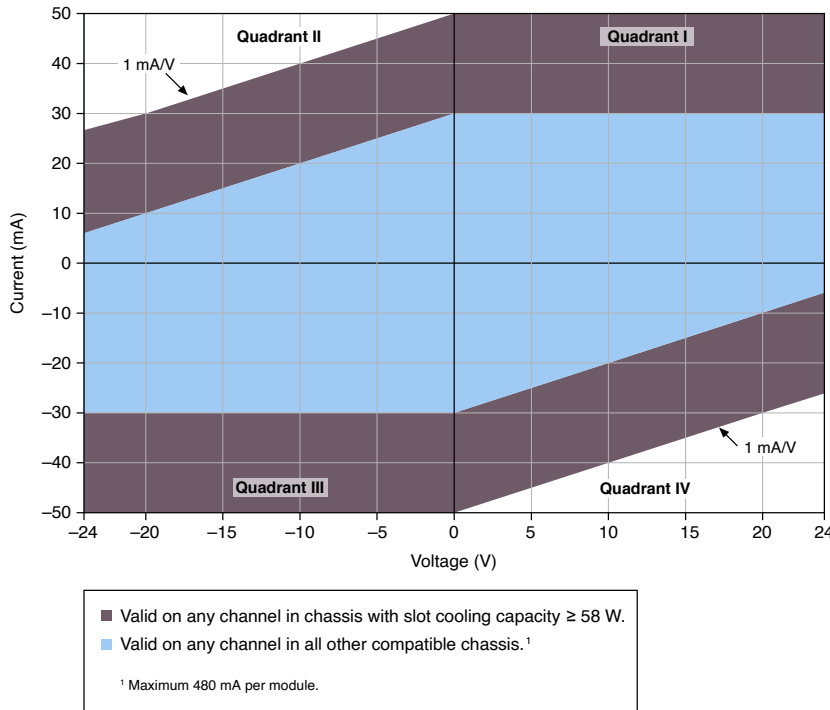
Device Model	Chassis Slot Cooling Capacity	
	$\geq 58\text{ W}$	38 W
PXIe-4163 (10 pA) only	1 $\mu\text{A}$	1 $\mu\text{A}$
All PXIe-4163 models	10 $\mu\text{A}$	10 $\mu\text{A}$
All PXIe-4163 models	100 $\mu\text{A}$	100 $\mu\text{A}$
All PXIe-4163 models	1 mA	1 mA

<sup>1</sup> The ambient temperature of a PXI system is defined as the temperature at the chassis fan inlet (air intake).

<sup>2</sup> For increased capability, NI recommends installing the PXIe-4163 in a chassis with slot cooling capacity  $\geq 58\text{ W}$ .

Device Model	Chassis Slot Cooling Capacity	
	≥58 W	38 W
All PXIe-4163 models	10 mA	10 mA
All PXIe-4163 models	50 mA	30 mA

Figure 1. PXIe-4163 Quadrant Diagram, Any Channel



## Voltage

Table 3. Voltage Programming and Measurement Accuracy/Resolution, Warranted

Range	Resolution and Noise (0.1 Hz to 10 Hz, peak-to-peak, typical)	Accuracy (23 °C ± 5 °C) ± (% of Voltage + Offset) <sup>3</sup>	Tempco <sup>4</sup> ± (% of Voltage + Offset)/°C, 0 °C to 55 °C
		T <sub>cal</sub> ± 5 °C	
24 V	200 μV	0.05% + 5 mV	0.0005% + 1 μV

<sup>3</sup> Refer to remote sense and load regulation sections for additional accuracy derating and conditions.

<sup>4</sup> Temperature coefficient applies beyond 23 °C ± 5 °C within 5 °C of T<sub>cal</sub>.

## Current

**Table 4.** PXIe-4163 (10 pA) Current Programming and Measurement Accuracy/Resolution, Warranted

Range	Resolution and Noise (0.1 Hz to 10 Hz, peak-to-peak, typical)	Accuracy (23 °C ± 5 °C) ± (% of Current + Offset) <sup>5</sup>	Tempco <sup>6</sup> ± (% of Current + Offset)/°C, 0 °C to 55 °C
		T <sub>cal</sub> ± 5 °C	
1 µA	10 pA	0.10% + 100 pA	0.004% + 20 pA
10 µA	100 pA	0.10% + 1 nA	0.004% + 20 pA
100 µA	1 nA	0.10% + 10 nA	0.004% + 100 pA
1 mA	10 nA	0.10% + 100 nA	0.004% + 1 nA
10 mA	100 nA	0.10% + 1 µA	0.004% + 10 nA
30 mA or 50 mA <sup>7</sup>	500 nA	0.10% + 5 µA	0.004% + 50 nA

**Table 5.** PXIe-4163 (100 pA) Current Programming and Measurement Accuracy/Resolution, Warranted

Range	Resolution and Noise (0.1 Hz to 10 Hz, peak-to-peak, typical) <sup>8</sup>	Accuracy (23 °C ± 5 °C) ± (% of Current + Offset) <sup>9</sup>	Tempco <sup>10</sup> ± (% of Current + Offset)/°C, 0 °C to 55 °C
		T <sub>cal</sub> ± 5 °C	
10 µA	100 pA	0.10% + 5 nA	0.004% + 10 pA
100 µA	1 nA	0.10% + 50 nA	0.004% + 100 pA
1 mA	10 nA	0.10% + 500 nA	0.004% + 1 nA
10 mA	100 nA	0.10% + 5 µA	0.004% + 10 nA
30 mA or 50 mA <sup>11</sup>	500 nA	0.10% + 25 µA	0.004% + 50 nA

<sup>5</sup> Refer to remote sense and load regulation sections for additional accuracy derating and conditions.

<sup>6</sup> Temperature coefficient applies beyond 23 °C ± 5 °C within 5 °C of T<sub>cal</sub>.

<sup>7</sup> 50 mA range available only when installed in chassis with slot cooling capacity ≥58 W. 30 mA range available in all other chassis.

<sup>8</sup> Specified values apply for V<sub>output HI</sub> ≤5 V; add 0.0002% of range per volt above 5 V.

<sup>9</sup> Refer to remote sense and load regulation sections for additional accuracy derating and conditions.

<sup>10</sup> Temperature coefficient applies beyond 23 °C ± 5 °C within 5 °C of T<sub>cal</sub>.

## Available DC Output Power

Chassis Slot Cooling Capacity	Per Channel Maximum	Absolute Maximum
≥58 W	1.2 W	28.8 W
38 W	0.7 W	11.5 W

## Additional Specifications

Settling time <sup>12</sup>		<500 μs, typical <sup>13</sup>
Transient response <sup>14</sup>		<100 μs, typical <sup>15</sup>
Wideband source noise <sup>16</sup>		15 mV RMS, typical <100 mV, peak-to-peak, typical
Remote Sense	Voltage	No additional error due to lead drop
	Current	No additional error due to lead drop
	Maximum lead drop	1 V
Load regulation	Voltage <sup>17</sup>	50 μV/mA, typical
	Current	(30 pA + 20 ppm of range)/volt, typical
Functional isolation voltage, any pin to earth ground		60 V DC
Absolute maximum voltage to Output LO	From Sense HI <sup>18</sup>	When $V_{\text{Output HI}} > 0 \text{ V}$ -0.5 V to ( $V_{\text{Output HI}} + 0.5 \text{ V}$ )

<sup>11</sup> 50 mA range available only when installed in chassis with slot cooling capacity ≥58 W. 30 mA range available in all other chassis.

<sup>12</sup> Current limit set to ≥1 mA and ≥10% of the selected current limit range. PXIe-4163 configured for fast transient response.

<sup>13</sup> To settle to 0.1% of voltage step.

<sup>14</sup> PXIe-4163 configured for fast transient response.

<sup>15</sup> To recover within ±20 mV after a load current change from 10% to 90% of range.

<sup>16</sup> 20 Hz to 20 MHz bandwidth. PXIe-4163 configured for normal transient response. Measured at the end of the 1 m SHDB62M-DB62M-LL cable.

<sup>17</sup> At connector pins when using local sense.

<sup>18</sup> Where  $V_{\text{Output HI}}$  is the voltage at the Output HI pin in the same channel as a Sense HI pin.

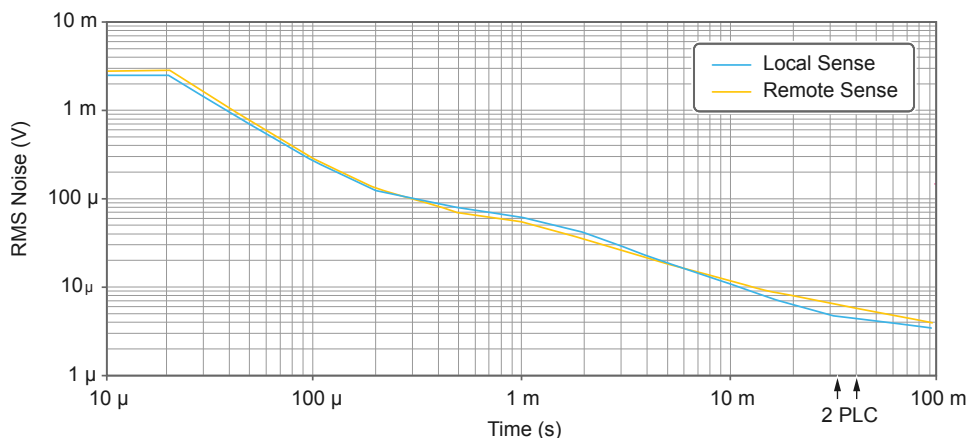
	When $V_{\text{Output HI}} \leq 0 \text{ V}$	$(V_{\text{Output HI}} - 0.5 \text{ V})$ to $0.5 \text{ V}$
	From all other pins	$\pm 25 \text{ V}$



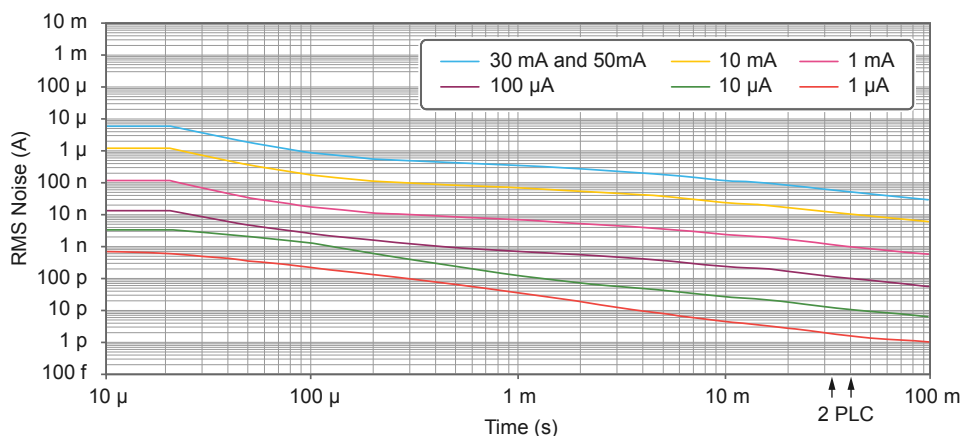
**Notice** Exceeding the absolute maximum voltage from Sense HI to Output LO when using remote sense can result in a Remote Sense OVP Error in NI-DCPower 23.0 and later.

The following figures illustrate noise as a function of measurement aperture for the PXIe-4163.

**Figure 2.** Voltage RMS Noise Versus Aperture Time,<sup>19</sup> Typical



**Figure 3.** Current RMS Noise Versus Aperture Time,<sup>20, 21</sup> Typical



<sup>19</sup> All channels averaged. Channels 9 and 22 have degraded performance.

<sup>20</sup> The 1  $\mu\text{A}$  range applies only to the PXIe-4163 (10 pA).





**Note** When the aperture time is set to two power-line cycles (PLCs), measurement noise differs slightly depending on whether the niDCPower Power Line Frequency is set to 50 Hz or 60 Hz.



**Note** To configure DC Noise rejection, set the niDCPower DC Noise Rejection to normal or second-order.

## Measurement and Update Timing

Available sample rates <sup>22</sup>	(600 kS/s)/N
where	
<ul style="list-style-type: none"> <li>▪ N = 6, 7, 8, ... 2<sup>20</sup></li> <li>▪ S is samples</li> </ul>	
Sample rate accuracy	±50 ppm
Maximum measure rate to host <sup>23</sup>	100,000 S/s per channel, continuous
<b>Maximum source update rate<sup>24</sup></b>	
Single channel	100,000 updates/s
All channels simultaneously	40,000 updates/s per channel

<sup>21</sup> All channels averaged. For the PXIe-4163 (100 pA), channels 7, 9, and 11 have degraded performance.

<sup>22</sup> When source-measuring, both the NI-DCPower Source Delay and Aperture Time properties affect the sampling rate. When taking a measure record, only the Aperture Time property affects the sampling rate.

<sup>23</sup> Load dependent settling time is not included. Normal DC noise rejection is used.

<sup>24</sup> As the source delay is adjusted or if advanced sequencing is used, maximum source update rates may vary.

Input trigger to	
Source event delay	8.5 $\mu$ s
Source event jitter	1.7 $\mu$ s
Measure event jitter	1.7 $\mu$ s

## Triggers



**Note** Pulse widths and logic levels for PXI trigger lines 0 to 7 are compliant with **PXI Express Hardware Specification Revision 1.0 ECN 1**.

**Table 6.** Input Triggers

Types	Start	
	Source	
	Sequence Advance	
	Measure	
Sources (PXI trigger lines 0 to 7)	Polarity	Active high (not configurable)
	Minimum pulse width	100 ns
Destinations <sup>25</sup> (PXI trigger lines 0 to 7)	Polarity	Active high (not configurable)
	Minimum pulse width	>200 ns

**Table 7.** Output Triggers (Events)

Types	Source Complete	
	Sequence Iteration Complete	
	Sequence Engine Done	
	Measure Complete	
Destinations (PXI trigger lines 0 to 7)	Polarity	Active high (not configurable)
	Pulse width	230 ns

<sup>25</sup> Input triggers can come from any source (PXI trigger or software trigger) and be exported to any PXI trigger line. This allows for easier multi-board synchronization regardless of the trigger source.

## Calibration Interval

Recommended calibration interval	1 year
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## Physical

Dimensions	3U, one-slot, PXI Express/CompactPCI Express module
	2.0 cm × 13.0 cm × 21.6 cm (0.8 in. × 5.1 in. × 8.5 in.)
Weight	394 g (13.9 oz)
Front panel connector	Custom 62-position D-SUB, female

## Power Requirements

Chassis Slot Cooling Capacity	+3.3 V Current Draw, Typical		+12 V Current Draw, Typical	
	Idle	Full Output Load	Idle	Full Output Load
38 W	1 A	1 A	1.5 A	3 A
≥58 W		1 A		4.5 A

## Environmental Characteristics

Temperature	Operating	Chassis with slot cooling capacity ≥58 W <sup>26</sup>	0 °C to 55 °C
		All other compatible chassis	0 °C to 40 °C
	Storage		-40 °C to 71 °C

<sup>26</sup> 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.

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