PXIe-4136 Specifications

2022-07-06

Contents

PXIe-4136 Specifications

These specifications apply to the PXIe-4136.

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.
- **Nominal** specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are **Warranted** unless otherwise noted.

Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature[1] of 23 °C ± 5 °C
- Calibration interval of 1 year
- 30 minutes warm-up time
- Self-calibration performed within the last 24 hours
- NI-DCPower Aperture Time property is set to 2 power-line cycles (PLC)
- Fans set to the highest setting if the PXI Express chassis has multiple fan speed settings

Cleaning Statement

Notice Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

Device Capabilities

The following table and figure illustrate the voltage and the current source and sink ranges of the PXIe-4136.

DC voltage ranges	DC current source and sink ranges
▪ 600 mV ▪ 6 V ▪ 20 V ▪ 200 V [2]	▪ 1 µA ▪ 10 µA ▪ 100 µA ▪ 1 mA ▪ 10 mA ▪ 100 mA ▪ 1 A

Table 1. Current Source and Sink Ranges

Figure 1. Quadrant Diagram for PXIe-4136(40W)

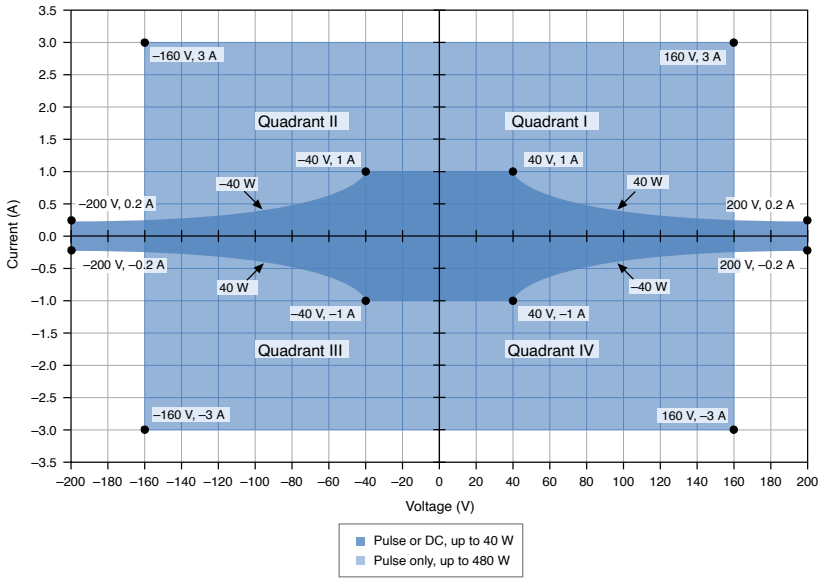
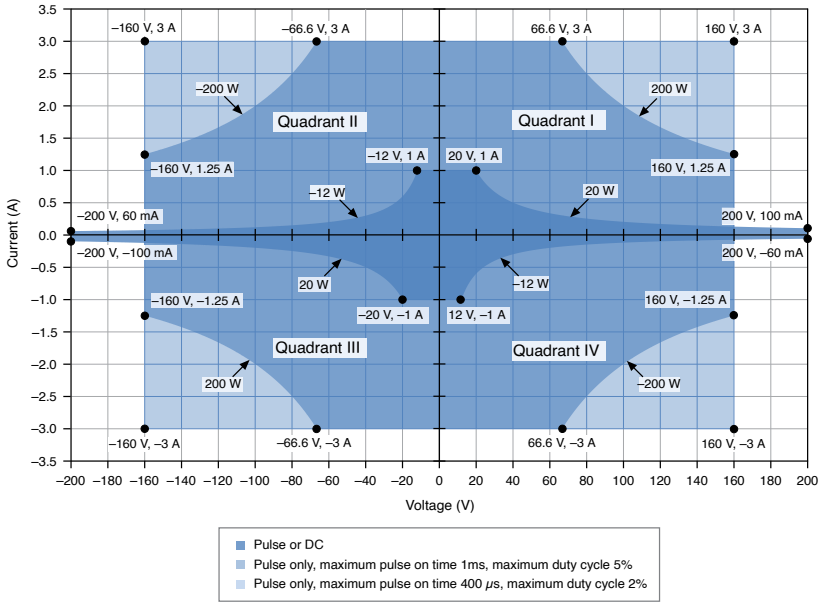


Figure 2. Quadrant Diagram for PXIe-4136(20W)



DC sourcing power and sinking power are limited to the values in the following table, regardless of output voltage. [3]

Caution Limit DC power sinking to 12 W. Additional derating applies to sinking power when operating at an ambient temperature of >45 °C. If the

> PXI Express chassis has multiple fan speed settings, set the fans to the highest setting.

Voltage

Range	Resolution (noise limited)	Noise (0.1 Hz to 10 Hz, peak to peak), Typical	Accuracy (23 °C ± 5 °C) ± (% of voltage + offset) [4] T_{cal} ± 5 °C [5]	Tempco ± (% of voltage + offset)/°C, 0 °C to 55 °C
600 mV	1 µV	4 µV	0.020% + 100 µV	0.0005% + 1 µV
6 V	10 µV	12 µV	0.020% + 640 µV	
20 V	100 µV	40 µV	0.022% + 2 mV	
200 V	1 mV	400 µV	0.025% + 20 mV	

Table 2. Voltage Programming and Measurement Accuracy/Resolution

Related reference

- Load Regulation
- Remote Sense

Current

Range	Resolution (noise limited)	Noise (0.1 Hz to 10 Hz, peak to peak), Typical	Accuracy (23 °C ± 5 °C) ± (% of current + offset) T_{cal} ± 5 °C [] [6]	Tempco ± (% of current + offset)/°C, 0 °C to 55 °C
1 µA	1 pA	8 pA	0.03% + 200 pA	0.0006% + 4 pA
10 µA	10 pA	60 pA	0.03% + 1.4 nA	0.0006% + 22 pA
100 µA	100 pA	400 pA	0.03% + 12 nA	0.0006% + 200 pA
1 mA	1 nA	4 nA	0.03% + 120 nA	0.0006% + 2 nA
10 mA	10 nA	40 nA	0.03% + 1.2 µA	0.0006% + 20 nA
100 mA	100 nA	400 nA	0.03% + 12 µA	0.0006% + 200 nA
1 A	1 µA	4 µA	0.04% + 120 µA	0.0006% + 2 µA

Table 3. Current Programming and Measurement Accuracy/Resolution

Noise

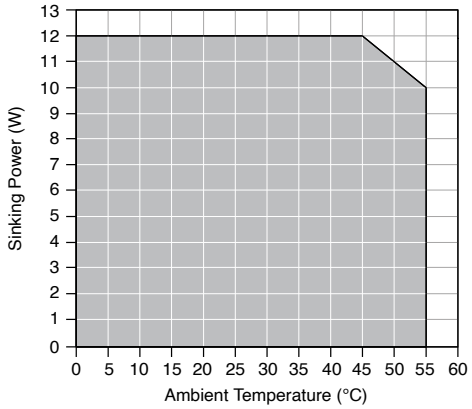
Wideband source noise	<20 mV peak-to-peak in 20 V range, device configured for normal transient response, 10 Hz to 20 MHz, typical

Sinking Power vs. Ambient Temperature Derating

The following figure illustrates sinking power derating as a function of ambient temperature.

This applies to the PXIe-4136 (40W) when used with any chassis and only applies to the PXIe-4136 (40W) when used with a chassis with slot cooling capacity <58W.

Figure 1. Sinking Power vs. Ambient Temperature Derating



Note When using the PXIe-4136 (40W) with a chassis with slot cooling capacity ≥58W, ambient temperature derating does not apply.

Overvoltage Protection

Accuracy[7] (% of OVP limit + offset)	0.1% + 200 mV, typical
Temperature coefficient (% of OVP limit + offset)/°C	0.01% + 3 mV/°C , typical

Measurement location	Local sense
Maximum OVP limit value	210 V
Minimum OVP limit value	2 V

Transient Response and Settling Time

Transient response	<70 µs to recover within 0.1% of voltage range after a load current change from 10% to 90% of range, device configured for fast transient response, typical
Maximum slew rate[8][9]	0.7A/µs

Settling time[10]

Voltage mode, 180 V step, unloaded[11]	<500 µs, typical
Voltage mode, 5 V step or smaller, unloaded[12]	<70 µs, typical
Current mode, full-scale step, 3 A to 100 µA ranges[13]	<50 µs, typical
Current mode, full-scale step, 10 µA range[13]	<150 µs, typical
Current mode, full-scale step, 1 µA range[13]	<300 µs, typical

The following figures illustrate the effect of the transient response setting on the step response of the PXIe-4136 for different loads.

Figure 1. 1 mA Range, No Load Step Response, Nominal

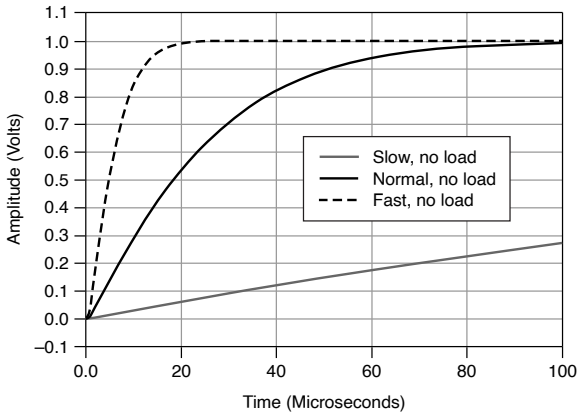
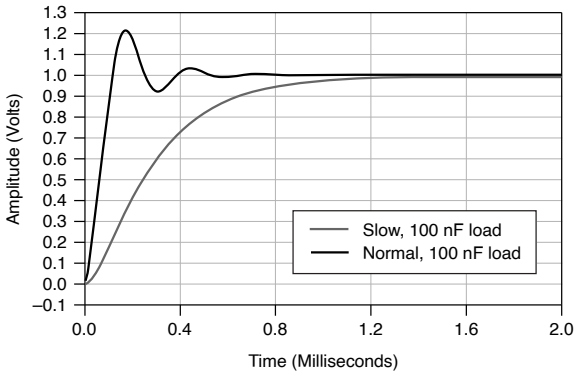


Figure 1. 1 mA Range, 100 nF Load Step Response, Nominal



Load Regulation

Voltage	
Device configured for local sense	200 mV per A of output load change (measured between output channel terminals) , typical
Device configured for remote sense	100 µV per A of output load change (measured between sense terminals) , typical
Current, device configured for local or remote sense	Load regulation effect included in current accuracy specifications, typical

Related reference

- Voltage

Measurement and Update Timing Characteristics

Available sample rates[14]	(1.8 MS/s)/**N** where **N** = 1, 2, 3, … 2^{24}, nominal
Sample rate accuracy	Equal to PXIe_CLK100 accuracy, nominal
Maximum measure rate to host	1.8 MS/s per channel, continuous, nominal

Maximum source update rate[15]

Sequence mode	100,000 updates/s (10 µs/update), nominal
Timed output mode	80,000 updates/s (12.5 µs/update), nominal

Input trigger to

Source event delay	10 µs, nominal
Source event jitter	1 µs, nominal
Measure event jitter	1 µs, nominal

Pulse timing and accuracy[16]

Minimum pulse on time[17]	50 µs, nominal
Minimum pulse off time [18]	50 µs, nominal
Pulse on time or off time programming resolution	100 ns, nominal
Pulse on time or off time programming accuracy	±5 µs, nominal

Pulse on time or off time jitter	1 µs, nominal

Remote Sense

Voltage accuracy	Add 3 ppm of voltage range per volt of HI lead drop plus 1 µV per volt of lead drop per ohm of corresponding sense lead resistance to voltage accuracy specifications
Maximum sense lead resistance	100 Ω
Maximum lead drop per lead	3 V, maximum 202 V between HI and LO terminals

Note Exceeding the maximum lead drop per lead value may cause the driver to report a sense lead error.

Related reference

- Voltage

Safety Interlock

The safety interlock feature is designed to prevent users from coming in contact with hazardous voltage generated by the SMU in systems that implement protective barriers with controlled user access points.

Caution Hazardous voltages of up to the maximum voltage of the PXIe-4136 may appear at the output terminals if the safety interlock terminal is closed. Open the safety interlock terminal when the output connections are accessible. With the safety interlock terminal open, the output voltage level/limit is limited to ±40 V DC, and protection will be

triggered if the voltage measured between the device HI and LO terminals exceeds ±(42 V peak ±0.4 V).

Attention Des tensions dangereuses allant jusqu'à la tension maximale du PXIe-4136 peuvent apparaître aux terminaux de sortie si le terminal de verrouillage de sécurité est fermé. Ouvrez le terminal de verrouillage de sécurité lorsque les connexions de sortie sont accessibles. Lorsque le terminal de verrouillage de sécurité est ouvert, le niveau ou la limite de tension de sortie est limité à ± 40 V CC, et la protection se déclenchera si la tension mesurée entre les terminaux HI et LO de l'appareil dépasse ± (42 Vpic ± 0,4 V).

Caution Do not apply voltage to the safety interlock connector inputs. The interlock connector is designed to accept passive, normally open contact closure connections only.

Attention N'appliquez pas de tension aux entrées du connecteur de verrouillage de sécurité. Le connecteur de verrouillage est conçu pour accepter uniquement des connexions à fermeture de contact passives, normalement ouvertes.

Safety interlock terminal open	
Output	<±42.4 V peak
Setpoint	<±40 V DC

Safety interlock terminal closed	
Output	Maximum voltage of the device
Setpoint	Maximum selected voltage range

Related information

- For more information about Safety Interlock operation, refer to the NI DC Power Supplies and SMUs Help.

Examples of Calculating Accuracy Specifications[19]

Example 1: Calculating 5 °C Accuracy

Calculate the accuracy of 900 nA output in the 1 µA range under the following conditions:

Ambient temperature	28 °C
Internal device temperature	within T_{cal} ±5 °C[20]
Self-calibration	within the last 24 hours

Solution

Because the device internal temperature is within T_{cal} ±5 °C and the ambient temperature is within 23 °C ±5 °C, the appropriate accuracy specification is the following value:

0.03% + 100 pA

Calculate the accuracy using the following formula:

$$\text{Accuracy} = 900\,\text{nA} * 0.03\,\% + 100\,\text{pA}$$
$$= 270\,\text{pA} + 100\,\text{pA}$$

$$= 370\,\text{pA}$$

Therefore, the actual output is within 370 pA of 900 nA.

Example 2: Calculating Remote Sense Accuracy

Calculate the remote sense accuracy of 500 mV output in the 600 mV range. Assume the same conditions as in Example 1, with the following differences:

HI path lead drop	3 V
HI sense lead resistance	2 Ω

LO path lead drop	2.5 V
LO sense lead resistance	1.5 Ω

Solution

Because the device internal temperature is within T_{cal} ±5 °C and the ambient temperature is within 23 °C ±5 °C, the appropriate accuracy specification is the following value:

0.02% + 50 µV

Because the device is using remote sense, use the following remote sense accuracy specification:

Add 3 ppm of voltage range + 11 µV per volt of HI lead drop plus 1 µV per volt of lead drop per Ω of corresponding sense lead resistance to voltage accuracy specifications.

Calculate the remote sense accuracy using the following formula:

$$\text{Accuracy} = \left(500\ \text{mV} * 0.02\,\% + 50\,\mu\text{V}\right) + \frac{600\ \text{mV} * 3\ \text{ppm} + 11\ \mu\text{V}}{1\ \text{V of lead drop}} * 3\ \text{V} + \frac{1\ \mu\text{V}}{\text{V} * \Omega} * 3\ \text{V} * 2\ \Omega + \frac{1\ \mu\text{V}}{\text{V} * \Omega} * 2.5\ \text{V} * 1.5\Omega$$

$$= 100\mu\text{V} + 50\mu\text{V} + 12.8\mu\text{V} * 3 + 6\mu\text{V} + 3.8\,\mu\text{V}$$

$$= 148.2\,\mu\text{V}$$

Therefore, the actual output is within 148.2 µV of 500 mV.

Example 3: Calculating Accuracy with Temperature Coefficient

Calculate the accuracy of 900 nA output in the 1 µA range. Assume the same conditions as in Example 1, with the following differences:

Ambient temperature	15 °C

Solution

Because the device internal temperature is within T_{cal} ±5 °C, the appropriate accuracy specification is the following value:

0.03% + 100 pA

Because the ambient temperature falls outside of 23 °C ±5 °C, use the following temperature coefficient per °C outside the 23 °C ±5 °C range:

0.0006% + 4 pA

Calculate the accuracy using the following formula:

$$\text{TemperatureVariation} = (23\,°C - 5\,°C) - 15°C = 3\,°C$$

$$\text{Accuracy} = (900\ \text{nA} * 0.03\,\% + 100\,\text{pA}) + \frac{900\ \text{nA} * 0.0006\,\% + 4\,\text{pA}}{1\,°C} * 3\,°C$$

$$= 370\,\text{pA} + 28.2\,\text{pA}$$

$$= 398.2\,\text{pA}$$

Therefore, the actual output is within 398.2 pA of 900 nA.

Related reference

- Voltage
- Current
- Voltage
- Current

Trigger Characteristics

Input triggers	
Types	Start, Source, Sequence Advance, Measure, Pulse
Sources (PXI trigger lines <0...7>) [21]	

Polarity	Configurable
Minimum pulse width	100 ns, nominal

Destinations[22] (PXI trigger lines <0...7>)

Polarity	Active high (not configurable)
Pulse width	>200 ns, typical

Output triggers (events)

Types: Source Complete, Sequence Iteration Complete, Sequence Engine Done, Measure Complete, Pulse Complete, Ready for Pulse

Destinations (PXI trigger lines <0...7>)

Polarity	Configurable
Pulse width	Configurable between 250 ns and 1.6 µs, nominal

Protection

Output channel protection

Overcurrent or overvoltage	Automatic shutdown, output disconnect relay opens
Sink overload protection	Automatic shutdown, output disconnect relay opens
Overtemperature	Automatic shutdown, output disconnect relay opens
Safety interlock	Disable high voltage output, output disconnect relay opens

Related reference

- Safety Interlock

Safety Voltage and Current

Notice The protection provided by the PXIe-4136 can be impaired if it is used in a manner not described in the user documentation.

Warning Take precautions to avoid electrical shock when operating this product at hazardous voltages.

Caution Isolation voltage ratings apply to the voltage measured between any channel pin and the chassis ground. When operating channels in series or floating on top of external voltage references, ensure that no terminal exceeds this rating.

Attention Les tensions nominales d'isolation s'appliquent à la tension mesurée entre n'importe quelle broche de voie et la masse du châssis. Lors de l'utilisation de voies en série ou flottantes en plus des références de tension externes, assurez-vous qu'aucun terminal ne dépasse cette valeur nominale.

DC voltage	±200 V

Channel-to-earth ground isolation

Continuous	250 VDC, CAT I
Withstand	1,000 V RMS, verified by a 5 s withstand

Caution Do not connect the PXIe-4136 to signals or use for measurements within Measurement Categories II, III, or IV.

Attention Ne connectez pas le PXIe-4136 à des signaux et ne l'utilisez pas pour effectuer des mesures dans les catégories de mesure II, III ou IV.

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.

DC current range	±1 A

Guard Output Characteristics

Cable guard	
Output impedance	3 kΩ, nominal
Offset voltage	1 mV, typical

Calibration Interval

Recommended calibration interval	1 year

Power Requirement

PXIe-4136 (40W)	3.0 A from the 3.3 V rail and 6.0 A from the 12 V rail
PXIe-4136 (20W)	2.5 A from the 3.3 V rail and 2.7 A from the 12 V rail

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 20 W 40 W	 419 g (14.8 oz) 428 g (15.1 oz)
Front panel connectors	5.08 mm (8 position)
Safety interlock connector	3.55 mm (4 position)

Environmental Guidelines

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

Notice Cover all empty slots using filler panels.

Environmental Characteristics

Temperature

Operating	0 °C to 55 °C
Storage	-40 °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)

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

Safety Compliance Standards

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1

Note For safety certifications, refer to the product label or the Product Certifications and Declarations section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions

Note Group 1 equipment is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Notice For EMC declarations and certifications, and additional information, refer to the Product Certifications and Declarations section.

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 **Engineering a Healthy Planet** 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.

EU and UK Customers

- Waste Electrical and Electronic Equipment (WEEE)—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 RoHS— NI 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 NI 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.)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

NI Services

Visit ni.com/support to find support resources including documentation, downloads, and troubleshooting and application development self-help such as tutorials and examples.

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NI corporate headquarters is located at 11500 N Mopac Expwy, Austin, TX, 78759-3504, USA.

[1] The ambient temperature of a PXI system is defined as the temperature at the chassis fan inlet (air intake).

[2] Voltage levels and limits > |40 VDC| require the safety interlock input to be closed.

[3] Power limit defined by voltage measured between HI and LO terminals.

[4] Accuracy is specified for no load output configurations. Refer to **Load Regulation** and **Remote Sense** sections for additional accuracy derating and conditions.

[5] T_{cal} is the internal device temperature recorded by the PXIe-4136 at the completion of the last self-calibration.

[6] T_{cal} is the internal device temperature recorded by the PXIe-4136 at the completion of the last self-calibration.

[7] Overvoltage protection accuracy is valid with an ambient temperature of 23 °C ± 5 °C and with T_{cal} ±5 °C. T_{cal} is the internal device temperature recorded by the PXIe-4136 at the completion of the last self-calibration.

[8] Optimize transient response, overshoot, and slew rate with NI SourceAdapt by adjusting the Transient Response.

[9] To improve the slew rate, see <insert link>"Examples of Determining Extended Range Pulse Parameters and Optimizing Slew Rate using NI SourceAdapt" on pg xx.

[10] Measured as the time to settle to within 0.1% of step amplitude, device configured for fast transient response.

[11] Current limit set to ≥60 µA and ≥60% of the selected current limit range.

[12] Current limit set to ≥20 µA and ≥20% of selected current limit range.

[13] Voltage limit set to ≥2 V, resistive load set to 1 V/selected current range.

[14] When sourcing while measuring, both the Source Delay and Aperture Time affect the sampling rate. When taking a measure record, only the Aperture Time affects the sampling rate.

[15] As the source delay is adjusted or if advanced sequencing is used, maximum source rates vary. Timed output mode is enabled in Sequence Mode by setting Sequence Step Delta Time Enabled to True.

[16] Shorter minimum on times for in-range pulses can be achieved using Sequence mode or Timed Output mode with Output Function set to Voltage or Current.

[17] **Pulse on time** is measured from the start of the leading edge to the start of the trailing edge.

[18] Pulses fall inside DC limits. **Pulse off time** is measured from the start of the trailing edge to the start of a subsequent leading edge.

[19] Specifications listed in examples are for demonstration purposes only and do not necessarily reflect specifications for this device.

[20] T_{cal} is the internal device temperature recorded by the PXIe-4136 at the completion of the last self-calibration.

[21] Pulse widths and logic levels are compliant with **PXI Express Hardware Specification Revision 1.0 ECN 1.**

[22] Input triggers can be re-exported.