
PCIe-6738 Specifications

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Contents

PCIe-6738 Specifications..... 3

PCIe-6738 Specifications

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 **Typical** unless otherwise noted.

Conditions

Specifications are valid at 25 °C unless otherwise noted.

Analog Output

| | |
|-------------------------------------|--------------------------------|
| Number of channels | 32 voltage outputs |
| Resolution | 16 bits, 1 in 65,536 |
| DNL | ±1.0 LSB maximum |
| Unscaled data format ^[1] | Unsigned integer (0 to 65,535) |
| Monotonicity | 16 bits |

| | |
|---|--|
| Accuracy | Refer to the AO Absolute Accuracy table |
| Maximum update rate (using local FIFO)^[2] | |
| 1 channel | 1 MS/s |
| 8 channels (1 channel per bank) ^[3] | 1 MS/s |
| 32 channels ^[3] | 350 kS/s |
| Timing accuracy (warranted) | 50 ppm of sample rate |
| Timing resolution | 10 ns |
| Output range | ±10 V |
| Output coupling | DC |
| Output impedance | 0.2 Ω |
| Output current drive ^[4] | ±10 mA |
| Overdrive protection | ±15 V |
| Overdrive current | 15 mA |
| Power-on state | ±200 mV |
| Power-on/off glitch | 3.0 V peak for 100 ms |
| FIFO buffer size | 65,535 samples shared among channels used |
| Data transfers | DMA (scatter-gather), programmed I/O |

AO waveform modes

- Nonperiodic waveform
- Periodic waveform regeneration mode from onboard FIFO
- Periodic waveform regeneration from host buffer including dynamic update

| | |
|--------------------------------|---|
| Settling time, full scale step | 15 μ s to ± 4 LSB |
| Slew rate | 3.0 V/ μ s |
| Noise | 1.0 mV RMS, DC to 1 MHz |
| AO update glitch | |
| Magnitude | 3.0 mV |
| Duration | 10 μ s |
| Glitch energy | 3 nVs |
| Channel crosstalk | -65 dB with SHC68-68-A2 cable (generating a 10 V, 100 point sinusoidal at 100 kHz on the reference channel) |
| Output stability | Any passive load |



Note AO update glitch is the glitch energy that occurs on all channels on the same bank as the result of a channel update, regardless of value. For example, if you update the value of AO 0, all channels within that bank AO <0..3> will experience this glitch regardless of whether their output voltages change.

Absolute Accuracy (Warranted)

Absolute accuracy at full-scale number is valid immediately following self calibration and assumes the device is operating within 10 °C of the last external calibration.

Table 1. AO Absolute Accuracy

| Nominal Range Positive Full Scale | Nominal Range Negative Full Scale | Residual Gain Error (ppm of Reading) | Gain Tempco (ppm/°C) | Reference Tempco (ppm/°C) | Offset Tempco (ppm) | Residual Offset Error (ppm of Range) | INL Error (ppm of Range) | Absolute Accuracy at Full Scale (μV) |
|-----------------------------------|-----------------------------------|--------------------------------------|----------------------|---------------------------|---------------------|--------------------------------------|--------------------------|--------------------------------------|
| 10 | -10 | 109 | 12 | 1 | 4 | 95 | 64 | 2,940 |



Note Accuracies listed are valid for up to two years from the device external calibration.

AO Absolute Accuracy Equation

$$\text{AbsoluteAccuracy} = \text{OutputValue} \cdot (\text{GainError}) + \text{Range} \cdot (\text{OffsetError})$$

- **GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)**
- **OffsetError = ResidualOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL_Error**



Notice Electromagnetic interference can adversely affect the measurement accuracy of this product. The analog output pins of this device are not protected for electromagnetic interference. As a result, this device may experience reduced accuracy or other temporary performance degradation when connected cables are routed in an environment with radiated or conducted radio frequency electromagnetic interference.

Digital I/O/PFI

Static Characteristics

| | |
|---|--|
| Number of channels | 10 total, 2 (P0.<0..1>), 8 (PFI<0..7>/P1.<0..7>) |
| Ground reference | D GND |
| Direction control | Each terminal individually programmable as input or output |
| Pull-down resistor | 50 k Ω typical, 20 k Ω minimum |
| Input voltage protection ^[5] | \pm 20 V on up to two pins |

Waveform Characteristics (Port 0 Only)

| | |
|----------------------------------|--|
| Terminals used | Port 0 (P0.<0..1>) |
| Port/sample size | Up to 2 bits |
| Waveform generation (DO) FIFO | 2,047 samples |
| Waveform acquisition (DI) FIFO | 255 samples |
| DI Sample Clock Frequency | 0 to 10 MHz, system and bus activity dependent |
| DO Sample Clock frequency | |
| Regenerate from FIFO | 0 to 10 MHz |
| Streaming from memory | 0 to 10 MHz, system and bus activity dependent |

| | |
|------------------------------|---|
| Data transfers | DMA (scatter-gather), programmed I/O |
| Digital line filter settings | 160 ns, 10.24 μ s, 5.12 ms, disable |

PFI/Port 1 Functionality

| | |
|--------------------------|---|
| Functionality | Static digital input, static digital output, timing input, timing output |
| Timing output sources | Many AI, AO, counter, DI, DO timing signals |
| Debounce filter settings | 90 ns, 5.12 μ s, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input |

Recommended Operating Conditions

| | |
|--|-------------------------------|
| Input high voltage (V_{IH}) | 2.2 V minimum, 5.25 V maximum |
| Input low voltage (V_{IL}) | 0 V minimum, 0.8 V maximum |
| Output high current (I_{OH}) | |
| P0.<0..1> | -24 mA maximum |
| PFI <0..7>/PI<0..7> | -16 mA maximum |
| Output low current (I_{OL}) | |
| P0.<0..1> | 24 mA maximum |
| PFI <0..7>/P1<0..7> | 16 mA maximum |

Electrical Characteristics

| Level | Minimum | Maximum |
|--|---------|---------|
| Positive-going threshold (VT+) | — | 2.2 V |
| Negative-going threshold (VT-) | 0.8 V | — |
| Delta VT hysteresis (VT+ - VT-) | 0.2 V | — |
| I _{IL} input low current (V _{in} = 0 V) | — | -10 μA |
| I _{IH} input high current (V _{in} = 5 V) | — | 250 μA |

Digital I/O Characteristics

Figure 1. P0.<0..1>: I_{OH} versus V_{OH}

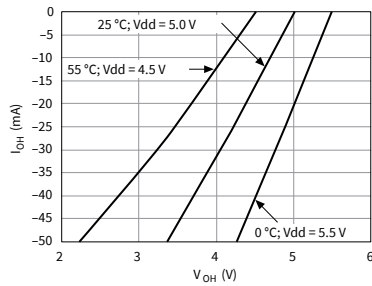


Figure 2. PFI <0..7>/PI: I_{OH} versus V_{OH}

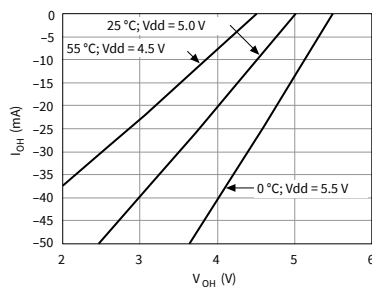


Figure 3. P0.<0..1>: I_{OL} versus V_{OL}

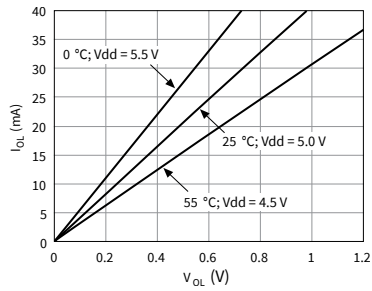
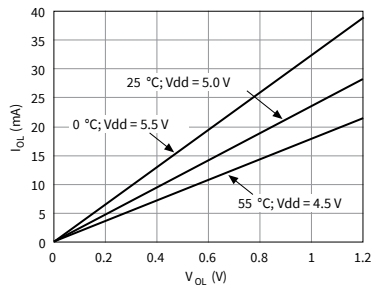


Figure 4. PFI <0..7>/P1: I_{OL} versus V_{OL}



Timing I/O

| | |
|--------------------------|---|
| Number of counter/timers | 4 |
| Resolution | 32 bits |
| Counter measurements | Edge counting, pulse, pulse width, semi-period, period, two-edge separation |
| Position measurements | X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding |
| Output applications | Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling |
| Internal base clocks | 100 MHz, 20 MHz, 100 kHz |

| | |
|---------------------------------|--|
| External base clock frequency | 0 MHz to 25 MHz |
| Base clock accuracy (warranted) | 50 ppm |
| Inputs | Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock |
| Routing options for inputs | Any PFI, RTSI, analog trigger, many internal signals |
| FIFO | 127 samples per counter |
| Data transfers | Dedicated scatter-gather DMA controller for each counter/timer, programmed I/O |

Phase-Locked Loop (PLL)

| | |
|----------------|---|
| Number of PLLs | 1 |
|----------------|---|

Table 2. Reference Clock Locking Frequencies

| Reference Signal | Locking Input Frequency (MHz) |
|------------------|--|
| RTSI <0..7> | 10, 20 |
| PFI <0..7> | 10, 20 |
| Outside of PLL | 100 MHz Timebase; other signals derived from 100 MHz Timebase including 20 MHz and 100 kHz Timebases |

External Digital Triggers

| | |
|--------|---------------|
| Source | Any PFI, RTSI |
|--------|---------------|

| | |
|--|--|
| Polarity | Software-selectable for most signals |
| Analog output function | Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |
| Counter/timer functions | Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock |
| Digital waveform generation (DO) function | Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |
| Digital waveform acquisition (DI) function | Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |

Device-to-Device Trigger Bus

| | |
|--------------------------|---|
| Input source | RTSI <0..7> |
| Output destination | RTSI <0..7> |
| Output selections | 10 MHz Clock; many internal signals |
| Debounce filter settings | 90 ns, 5.12 μ s, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input |

Bus Interface

| | |
|--------------------|--|
| Form factor | x4 PCI Express, specification v1.1 compliant |
| Slot compatibility | x4, x8, and x16 PCI Express slots ^[6] |

| | |
|--------------|---|
| DMA channels | 7 DMA, analog output, digital input, digital output, counter/timer 0, counter/timer 1, counter/timer 2, counter/timer 3 |
|--------------|---|

Power Requirements



Notice The protection provided by the PCle-6738 can be impaired if it is used in a manner not described in the user documentation.

| | |
|--------|--------|
| +3.3 V | 3.0 W |
| +12 V | 14.0 W |

Current Limits



Caution Exceeding the current limits may cause unpredictable behavior by the device and/or chassis.

| | |
|------------------------------|----------------------------|
| +5 V terminal (connector 0) | 1 A maximum ^[7] |
| P0/P1/PFI terminals combined | 1.4 A maximum |

Physical

| | |
|----------------------------------|---|
| Printed circuit board dimensions | 16.8 cm × 11.1 cm (6.60 in. × 4.38 in.) |
| Weight | 110 g (3.8 oz) |
| I/O connector | 1 68-pin VHDCI |

| | |
|----------------------------|---|
| Form factor | Standard height, half length, single slot |
| Integrated air mover (fan) | No |

Calibration

| | |
|--------------------------|------------|
| Recommended warm-up time | 15 minutes |
| Calibration interval | 2 years |

Safety Voltages

Connect only voltages that are below these limits.

| | |
|-------------------------|------------------------------------|
| Channel-to-earth ground | ± 11 V, Measurement Category I |
|-------------------------|------------------------------------|

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.



Caution Do not connect the PCIe-6738 to signals or use for measurements within Measurement Categories II, III, or IV.



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

| | |
|------------------|---|
| Maximum altitude | 2,000 m (800 mbar) (at 25 °C ambient temperature) |
| Pollution degree | 2 |

Indoor use only.



Note Clean the device with a soft, non-metallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

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

Operating Environment

| | |
|---|--|
| Operating temperature, local ^[8] | 0 °C to 55 °C (IEC 60068-2-1 and IEC 60068-2-2) |
| Operating humidity | 10% to 90% RH, noncondensing (IEC 60068-2-78) |
| System slot airflow | 0.4 m/s (80 LFM) |

Storage Environment

| | |
|---------------------------|-----------------|
| Ambient temperature range | -20 °C to 70 °C |
|---------------------------|-----------------|

| | |
|-------------------------|---|
| | (IEC 60068-2-1 and IEC 60068-2-2) |
| Relative humidity range | 5% to 95% RH, noncondensing (IEC 60068-2-78) |

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 Standards

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
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.



Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

CE Compliance

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

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.

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.)