PCI-5406 Specifications

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PCI-5406 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 *Nominal* unless otherwise noted.

Conditions

Specifications are valid under the following conditions unless otherwise noted:

- Ambient temperature range of 0 °C to 55 °C
- Analog filter enabled
- Interpolation set to maximum allowed factor for a given sample rate
- Signals terminated with 50 $\boldsymbol{\Omega}$
- Full operating temperature range

Typical specifications are valid under the following conditions unless otherwise noted:

• Ambient temperature range of 15 °C to 35 °C

CH 0

| Number of channels | 1 |
|--------------------|-----|
| Connector type | BNC |

Output Voltage

| Maximum voltage | ±5 V (ACpk + DC) |
|-----------------|------------------|
| DAC resolution | 16 bits |

Amplitude and Offset

| Amplitude range ^[1] | | | |
|--------------------------------|--------|---------------------------------|--|
| 50 Ω load | | 5.64 mVpk-pk to 10 Vpk-pk | |
| High-impedance load | | 11.28 mVpk-pk to 20 Vpk-pk | |
| Amplitude resolution | <0.06% | 6 (0.004 dB) of amplitude range | |
| Offset range ^[2] | | | |
| Square waveforms | | ±50% of amplitude range | |
| All other waveforms | | ±5 V | |

Accuracy

| AC amplitude accuracy ^[3] | +2.0% of amplitude +1 mV -1.0% of amplitude -1 mV |
|--------------------------------------|--|
| Offset accuracy ^[4] | ±0.5% of offset ±2 mV±0.5% of amplitude |

Output Characteristics

| Output impedance | Software-selectable: 50 Ω or 75 Ω |
|---|--|
| Output enable | Software-selectable: When the output path is disabled, the CH 0 output is terminated to ground with a 1 W resistor with a value equal to the selected output impedance |
| Maximum output overload | The CH 0 output can be connected to a 50 Ω , ±12 V source without sustaining any damage. No damage occurs if the CH 0 output is shorted to ground indefinitely. |
| Waveform summing | Outputs of multiple PCI-5406 signal generators can be connected together |
| Phase adjustment | -180° to +180° |
| Digital interpolation filter ^[5] | Software-selectable: Finite Impulse Response (FIR) filter with available interpolation factors of 2 or 4 |

| Analog filter | Software-selectable: 7-pole elliptical filter |
|----------------------|---|
| Frequency resolution | 0.355 μHz |

Maximum Frequencies for Common Functions

| Maximum frequencies ^[6] | | | |
|------------------------------------|----------|--------|--|
| Sine | | 40 MHz | |
| Square | | 25 MHz | |
| Ramp | | 5 MHz | |
| Triangle | | 5 MHz | |
| User-defined ^[7] | | 40 MHz | |
| Maximum sample rate | | | |
| Sine | 400 MS/s | | |
| Square | 400 MS/s | | |
| Ramp | 100 MS/s | | |

| Triangle | 100 MS/s |
|-----------------------------|----------|
| User-defined ^[7] | 400 MS/s |
| Noise | 100 MS/s |

Sine Waves

- Spectral characteristics may degrade when offset is applied.
- Spectral characteristics at low amplitudes are limited by a -148 dBm/Hz noise floor.
- Output amplitude of -1 dBFS is used for all spectral specifications.

The data presented in the following figures were acquired with the Rohde & Schwarz NRVS Power Meter using the NRV-Z51 Thermal Power Sensor.



Figure 1. Passband Flatness, Expected Voltage 10 Vpk-pk (23.98 dBm)





| Spurious-free dynamic range (SFDR) ^[9] with harmonics ^[10] | | | | |
|--|-----------|----------------------|---------|--|
| <10 MHz | | 50 dB, typical | | |
| 10 MHz to 40 MHz | | 45 dB, | typical | |
| Spurious-free dynamic range (SFDR) ^[9] with | out harmo | nics ^[11] | 1 | |
| <20 MHz | | 70 dB, typical | | |
| 20 MHz to 40 MHz | | 60 dB, typical | | |
| Total harmonic distortion (THD) ^[12] | | | | |
| DC to 1 MHz | | | | |
| ≤1.66 Vpk-pk –60 dBc, typica | | ypical | | |
| >1.66 Vpk-pk -58 dBc, ty | | ypical | | |
| 1 MHz to 40 MHz | | | | |
| ≤1.66 Vpk-pk | | _4 | -41 dBc | |
| >1.66 Vpk-pk | | –32 dBc | | |
| Signal to Noise and Distortion (SINAD) ^[11] | | | | |
| DC to 1 MHz | | | | |
| ≤1.66 Vpk-pk | | | 58 dBc | |

| >1.66 Vpk-pk | | 58 dBc | |
|-------------------------------------|-------------|-------------|--|
| 1 MHz to 40 MHz | | | |
| ≤1.66 Vpk-pk | | 41 dBc | |
| >1.66 Vpk-pk | | 32 dBc | |
| Average noise density | | –114 dBm/Hz | |
| Phase noise density ^[13] | | | |
| 100 Hz | –100 dBc/Hz | | |
| 1 kHz | –110 dBc/Hz | | |
| 10 kHz | –120 dBc/Hz | | |
| Jitter (RMS) ^[14] | | <4.0 ps rms | |

Square Waves

| Pulse response | | | |
|-----------------------------------|-----------------|--|--|
| Rise/fall time | <12 ns, typical | | |
| Aberration (undershoot/overshoot) | <5%, typical | | |
| Duty cycle ^[15] | | | |

| <10 MHz | | 20% to 80% |
|------------------------------|-----------------------------------|------------|
| 10 MHz to 40 MHz | | 50% |
| Jitter (RMS) ^[16] | | |
| <2 MHz | 0.01% of period + 500 ps, typical | |
| ≥2 MHz | 0.1% of period + 70 ps | |

User-Defined Waves

| Waveform size | 16,384 samples |
|---------------|----------------|
| | |

Frequency List Mode

| Frequency steps | 1 to 58,235 steps |
|-----------------|-------------------|
| Step duration | 1 ms to 21 s |

Sample Clock

| Source ^[17] | Onboard VCXO |
|------------------------------------|--------------|
| Frequency accuracy ^[18] | ±25 ppm |

| Interpolation ^[19] | 1 (off) 2 4 | | | |
|---|-------------------|--|--------|---------|
| SYNC OUT/PFI 0 (BNCDestinations[20]PFI 1 (BNC front panelRTSI<06> | | C front panel connector) nel connector) | | |
| Maximum frequency ^[21] | | | | |
| SYNC OUT/PFI 0 | | | | 100 MHz |
| PFI 1 | | | | 100 MHz |
| RTSI<06> | | | | 20 MHz |
| Jitter ^[21] | | | | |
| SYNC OUT/PFI 0 | | 6 ps rms, typical | | |
| PFI 1 | | 12 ps rms, typical | | |
| Duty cycle ^[21] | | | | |
| SYNC OUT/PFI 0 | | | 25% to | o 65% |
| PFI 1 | | | 25% to | o 65% |

Phase-Locked Loop (PLL) Reference Clock

| Sources ^[22] | REF IN (BNC front panel connector) RTSI_7 (PXI RTSI_CLK) None |
|---------------------------------------|--|
| Frequency accuracy ^[23] | When using the PLL, the frequency accuracy of the PCI-5406 is solely dependent on the frequency accuracy of the PLL Reference Clock source |
| Lock time | 200 ms, maximum 70 ms, typical |
| Frequency range ^[24] | 5 MHz to 20 MHz, in steps of 1 MHz. The default value is 10 MHz. |
| Allowed duty cycle range | 40% to 60% |
| Destinations | SYNC OUT/PFI 0 (BNC front panel connector) PFI 1 (BNC front panel connector) RTSI<06> |

REF IN

| Connector type | BNC |
|----------------|-----|
|----------------|-----|

| Direction | | Input |
|------------------------|--|-------------------|
| Input voltage range | <u>j</u> | |
| Sine wave | 0.63 Vpk-pk to 2.8 Vpk-pk into 50 Ω (0 dBm to +13 dBm) | |
| Square wave | 0.2 Vpk-pk to 2.8 Vpk-pk into 50 Ω | |
| Maximum input overload | | ±10 V (ACpk + DC) |
| Input impedance | | 50 Ω |
| Input coupling | | AC |

SYNC OUT/PFI 0 and PFI 1

| Connector type | BNC (x2) | |
|------------------------|--------------------------|--|
| Direction | Bidirectional | |
| Frequency range | DC to 100 MHz | |
| As an input (trigger) | | |
| Destination | Start Trigger | |
| Maximum input overload | -2 V to +7 V (ACpk + DC) | |

| V _{IH} | | 2.0 V | |
|--|--|---|-------------|
| V _{IL} | | 0.8 V | |
| Input impedance | | 1 kΩ | |
| As an output (event) | | | |
| Sources Sources Sources Sources Sources Sync OUT | | divided by integer K (1 ≤ K ≤ Clock : Trigger (Out Start Trigger) | ≤4,194,304) |
| Output impedance 50 Ω | | | |
| Maximum output overload -2 V to +7 V (AC | | Cpk + DC) | |
| Minimum V _{OH} ^[25] | | | |
| 50 Ω load | | | 1.4 V |
| High-impedance load | | | 2.9 V |
| Maximum V _{OL} ^[25] | | | |
| 50 Ω load | | | 0.2 V |

| High-impedance load | 0.2 V | |
|---|---------|--|
| Rise/fall time (20% to 80%) ^[26] | ≤2.0 ns | |

Sync

| Sync duty cycle | | 20% to 80% |
|------------------------------|-----------------------------------|------------|
| Jitter (RMS) ^[27] | | |
| <2 MHz | 0.01% of period + 500 ps, typical | |
| ≥2 MHz | 0.1% of period + 70 ps | |

Start Trigger

| Sources | SYNC OUT/PFI 0 (BNC front panel connector) PFI 1 (BNC front panel connector) RTSI<07> Software (use node or function call) |
|---------|---|
| | Immediate (does not wait for a trigger.) The default is Immediate. |
| Modes | Single Continuous |

| | Steppe Burst | ed |
|--------------------------------|---|------------------------------------|
| Edge detection | Rising Falling Level h Level l | igh ow |
| Minimum pulse width | 25 ns | |
| Delay from Start Trigger to CH | I O analo | og output |
| Sine waveforms | | 1,100 ns, typical |
| Square waveforms | | 1,100 ns + 0.5% of period, typical |
| All other waveforms | | 900 ns |
| Destinations | SYNC OUT/PFI 0 (BNC front panel connector) PFI 1 (BNC front panel connector) RTSI<06> | |
| Exported trigger delay | 65 ns, typical | |
| Exported trigger pulse width | >150 ns | |

Calibration

| Self- calibration | An onboard, 24-bit ADC and precision voltage reference are used to calibrate the gain and offset. Square waveform duty cycle is also calibrated. The self-calibration is initiated by the user through the software and takes approximately 105 seconds to complete. |
|--------------------------------------|--|
| External calibration ^[28] | External calibration calibrates the VCXO, voltage reference, self-calibration ADC, flatness, gain, and offset. Appropriate constants are stored in nonvolatile memory. |
| Calibration interval | Specifications valid within two years of external calibration |
| Warm-up time | 15 minutes |

Power

| +3.3 VDC | 1.4 A |
|-------------|-------------------------------|
| +5 VDC | Refer to the following figure |
| +12 VDC | 0.11 A |
| -12 VDC | 0.01 A |
| Total power | 17.6 W |



Figure 3. 5 V Current Versus Frequency and Amplitude

Environment

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

Indoor use only.

Operating Environment

| Ambient temperature range | 0 °C to 45 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.) |
|------------------------------|--|
| Relative humidity range | 10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.) |

Storage Environment

| Ambient temperature | -25 °C to 85 °C (Tested in accordance with IEC 60068-2-1 and |
|---------------------|--|
| range | IEC 60068-2-2.) |
| | |

| Relative humidity range | 5% to 95%, noncondensing (Tested in accordance with IEC 60068-2-56.) |
|-------------------------|--|
| | |

Shock and Vibration

| Storage shock | 50 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.) |
|-------------------------------------|---|
| Nonoperating random vibration | 5 Hz to 500 Hz, 2.4 g _{rms} (Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.) |

Physical

| Dimensions | 34.1 cm × 2.0 cm × 10.7 cm (13.4 in. × 0.8 in. × 4.2 in.) |
|------------|--|
| Weight | 420 g (14.8 oz) |

Compliance and Certifications

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 <u>Product</u>

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
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

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.

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 For EMC declarations, certifications, and additional information, refer to the <u>Product Certifications and Declarations</u> section.

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 <u>ni.com/product-certifications</u>, 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 <u>ni.com/environment</u>. 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

• X 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 <u>ni.com/environment/weee</u>.

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.)