PCI-5402 Specifications

2025-03-14

Contents

PCI-5402 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 Ω
- 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	14 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% (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-5402 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	20 MHz
Square	20 MHz
Ramp	1 MHz
Triangle	1 MHz
User-defined[7]	20 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.

Passband flatness[8]	±0.4 dB (±5%)

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)

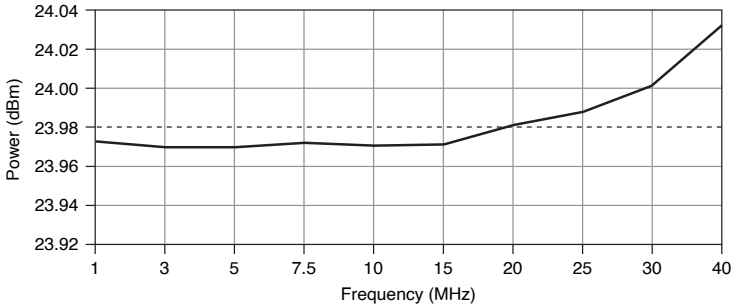
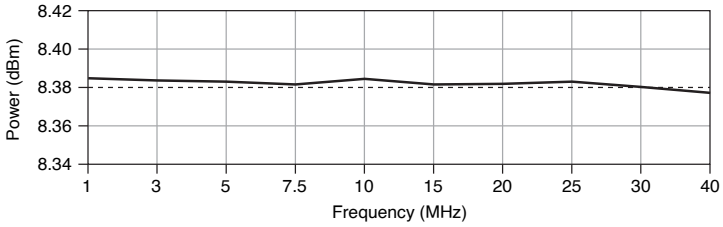


Figure 2. Passband Flatness, Expected Voltage 1.66 Vpk-pk (8.38 dBm)



Spurious-free dynamic range (SFDR)[9] with harmonics[10]	
<10 MHz	50 dB, typical
10 MHz to 20 MHz	45 dB, typical
SFDR[9] without harmonics[11]	70 dB, typical
Total harmonic distortion (THD)[12]	
DC to 1 MHz	
≤1.66 Vpk-pk	–60 dBc, typical
>1.66 Vpk-pk	–58 dBc, typical
1 MHz to 20 MHz	
≤1.66 Vpk-pk	–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 20 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 20 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
Destinations[20]	SYNC OUT/PFI 0 (BNC front panel connector) PFI 1 (BNC front panel connector) RTSI<0..6>
Maximum frequency[21]	
SYNC OUT/PFI 0	100 MHz
PFI 1	100 MHz
RTSI<0..6>	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 65%
PFI 1	25% to 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-5402 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<0..6>

REF IN

Connector type	BNC

Direction	Input
Input voltage range	
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	Sample Clock divided by integer K (1 ≤ K ≤ 4,194,304) PLL Reference Clock Exported Start Trigger (Out Start Trigger) SYNC OUT
Output impedance	50 Ω
Maximum output overload	-2 V to +7 V (ACpk + 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<0..7> Software (use node or function call) Immediate (does not wait for a trigger.) The default is Immediate.
Modes	Single Continuous

	Stepped Burst
Edge detection	Rising Falling Level high Level low
Minimum pulse width	25 ns
Delay from Start Trigger to CH 0 analog 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<0..6>
Exported trigger delay	65 ns, typical
Exported trigger pulse width	>150 ns

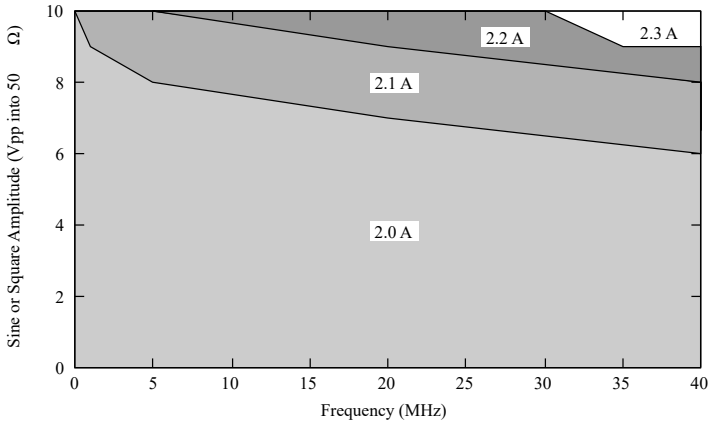
Calibration

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 range	-25 °C to 85 °C (Tested in accordance with IEC 60068-2-1 and 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 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
- 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 Product Certifications and Declarations 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 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`.)

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