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Find the *National Instruments PXIe-5170* at our website: ***Click HERE***

SPECIFICATIONS

PXIe-5170

PXIe, 4- or 8-Channel, 100 MHz Bandwidth, 14-Bit, Reconfigurable Oscilloscope

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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 expected performance met by a majority of the models.
- *Nominal* specifications describe parameters and attributes that may be useful in operation.

Specifications are *Warranted* unless otherwise noted.

Conditions

Specifications are valid under the following conditions unless otherwise noted.

- All vertical ranges
- Sample rate set to 250 MS/s
- Onboard Sample Clock locked to onboard Reference Clock
- Calibration IP is used properly when using LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes (instrument design libraries) to create FPGA bitfiles. Refer to the *NI Reconfigurable Oscilloscopes Help* for more information about the calibration API.

Warranted specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature range of 0 °C to 45 °C
- The PXIe-5170 module is warmed up for 15 minutes at ambient temperature. Warm-up begins after the chassis is powered, the device is recognized by the host, and the ADC clock is configured using either instrument design libraries or the NI-SCOPE device driver.
- External calibration cycle is maintained

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- The PXI Express chassis fan speed is set to HIGH, the foam fan filters are removed if present, and the empty slots contain PXI chassis slot blockers and filler panels. For more information about cooling, refer to the *Maintain Forced-Air Cooling Note to Users* available at *http://www.ni.com/manuals*.
- External calibration is performed at 23 °C ± 3 °C

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

- Ambient temperature ranges of 0 °C to 45 °C with a 90% confidence level

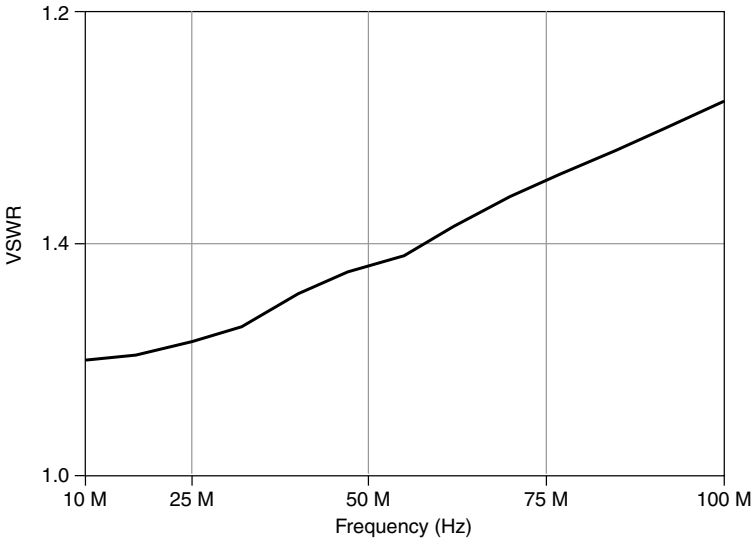
Analog Input

Number of channels	
PXIe-5170 (4 CH)	Four (simultaneously sampled)
PXIe-5170 (8 CH)	Eight (simultaneously sampled)
Input type	Referenced single-ended
Connectors	SMA

Impedance and Coupling

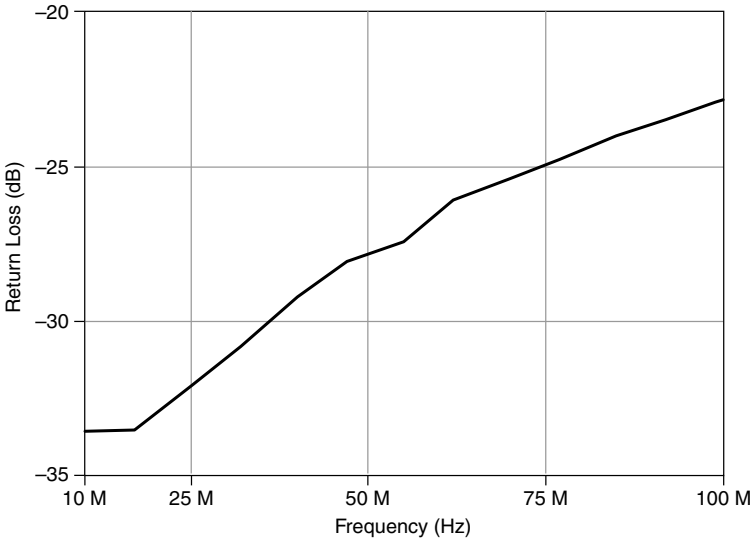
Input impedance, typical	50 Ω ± 1.5%
Input coupling	AC, DC

Figure 1. Voltage Standing Wave Ratio (VSWR), Characteristic



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Figure 2. Input Return Loss, Characteristic



Voltage Levels

Full-scale (FS) input range (V_{pk-pk})	0.2 V, 0.4 V, 1 V, 2 V, or 5 V
Maximum input overload, characteristic[1]	|Peaks| ≤ 5 V

Accuracy

Caution Electromagnetic interference can adversely affect the measurement accuracy of this product. The coaxial channel inputs of this device (CH 0 to CH 7) are not protected for electromagnetic interference. As a result, this device may experience reduced measurement accuracy or other temporary performance degradation when connected cables are routed in an environment with radiated or conducted radio frequency electromagnetic interference. To limit radiated emissions and to ensure that this device functions within specifications in its operational electromagnetic environment, take precautions when designing, selecting, and installing measurement probes and cables.

Resolution	14 bits

[1] Signals exceeding the maximum input overload may cause damage to the device.

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Table 1. DC Accuracy[2]

Input Range	Accuracy		Drift
	Typical[3]	Warranted[4]	Characteristic[5]
V_{pk-pk}	±(% of |Reading| + % of FS + mV)	±(% of |Reading| + % of FS + mV)	±(% of |Reading| + % of FS + mV) per °C
0.2 V	±(0.45 + 0.6 + 0.2)	±(0.90 + 0.65 + 0.7)	±(0.015 + 0.002 + 0.004)
0.4 V	±(0.45 + 0.24 + 0.2)	±(0.80 + 0.25 + 0.7)	±(0.012 + 0.002 + 0.004)
1 V	±(0.45 + 0.2 + 0.2)	±(0.80 + 0.25 + 0.7)	±(0.010 + 0.002 + 0.004)
2 V	±(0.40 + 0.2 + 0.2)	±(0.60 + 0.25 + 0.7)	±(0.005 + 0.002 + 0.004)
5 V	±(0.40 + 0.2 + 0.2)	±(0.55 + 0.25 + 0.7)	±(0.005 + 0.002 + 0.004)

AC amplitude accuracy[2]	
Accuracy, typical[3]	±0.095 dB at 50 kHz
Accuracy, warranted[4]	±0.15 dB at 50 kHz
Drift, characteristic[5]	±0.0013 dB per °C

[2] Verification of these specifications requires the *DC Adjustment Device Temperature (°C)* value. If you are using version 14.0 of the software, visit *ni.com/info* and enter the Info Code `exxpmp` for information on how to read this value. Otherwise, use instrument design libraries or NI-SCOPE to read the value.

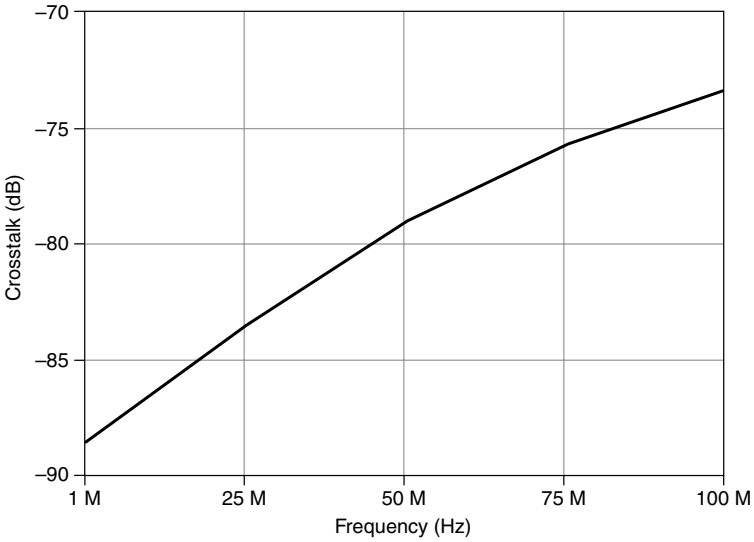
[3] When the reading from the *Device Temperature* sensor is within ±10 °C of the *DC Adjustment Device Temperature (°C)* value.

[4] When the reading from the *Device Temperature* sensor is within ±38 °C of the *DC Adjustment Device Temperature (°C)* value. This increased temperature span encompasses the majority of temperature differences between the last external calibration environment and the operating environment.

[5] Used to calculate additional temperature error when the difference between the *Device Temperature* sensor and the *DC Adjustment Device Temperature (°C)* value is greater than ±10 °C (for typical specifications) or ±38 °C (for warranted specifications).

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Figure 3. Channel-to-Channel Crosstalk, Characteristic[6]



Bandwidth and Transient Response

Bandwidth (-3 dB)[7] 100 MHz

Table 2. Passband Amplitude Flatness[7]

Input Frequency	Full Bandwidth
<50 MHz	-0.5 dB to 0.5 dB
50 MHz to 90 MHz	-1.0 dB to 0.5 dB

AC-coupling cutoff (-3 dB)[8] 120 kHz, characteristic

[6] Measured on one channel with test signal applied to another channel, with the same range setting on both channels.
[7] Normalized to 50 kHz.
[8] With AC coupling enabled, the input impedance is 260 kΩ to ground. Verified using a 50 Ω source.

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Figure 4. Frequency Response, Full Bandwidth, Characteristic

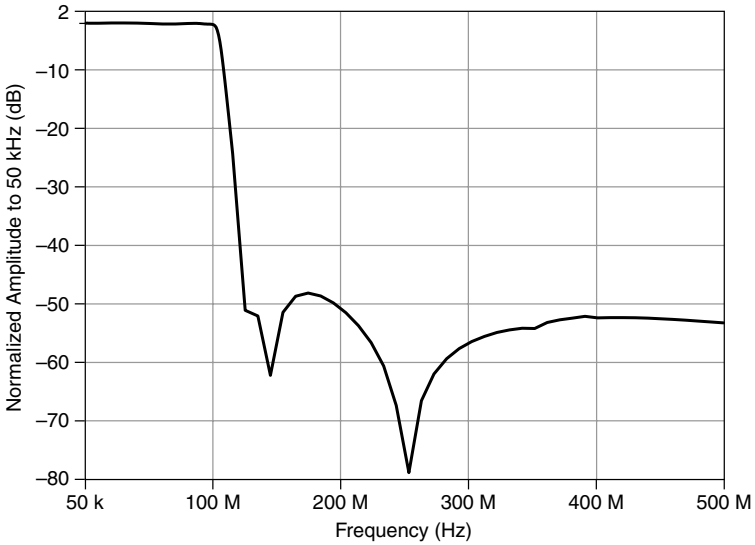
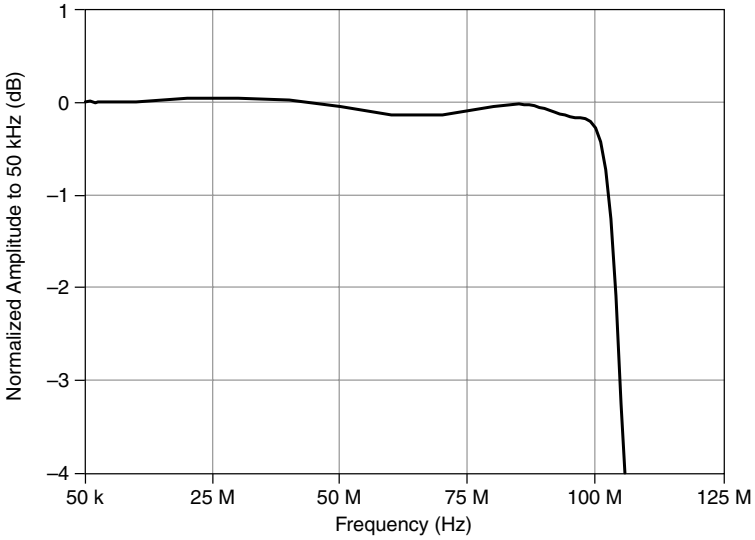


Figure 5. Frequency Response (Zoomed), Full Bandwidth, Characteristic



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Spectral Characteristics

Table 3. Spurious-Free Dynamic Range (SFDR), Characteristic[9]

Input Range (V_{pk-pk})	Input Frequency	Full Bandwidth
0.2 V to 2 V	<10 MHz	-80.0 dBc
	≥10 MHz to <30 MHz	-76.0 dBc
5 V	<10 MHz	-77.0 dBc
	≥10 MHz to <30 MHz	-73.0 dBc

Table 4. Total Harmonic Distortion (THD), Characteristic[10]

Input Frequency	Full Bandwidth
<10 MHz	-77.0
≥10 MHz to <30 MHz	-73.0

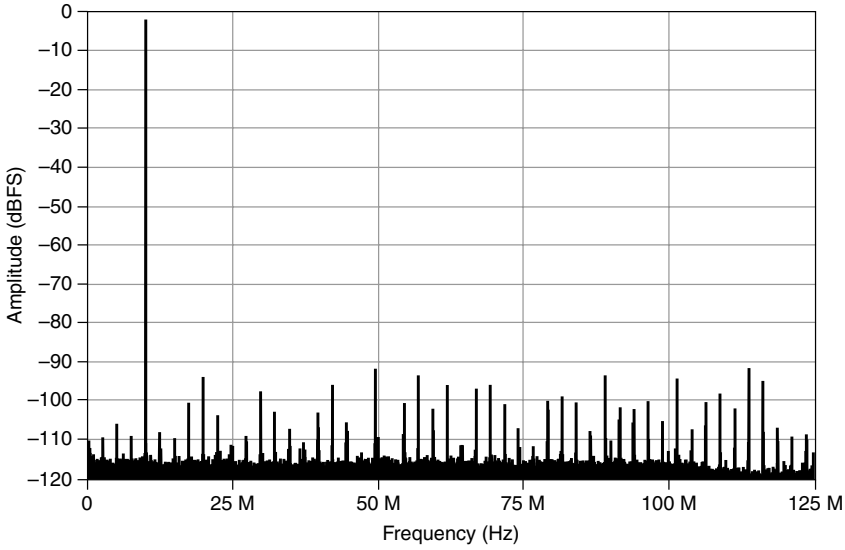
Table 5. Effective Number of Bits (ENOB), Characteristic[9]

Input Range (V_{pk-pk})	Input Frequency	Full Bandwidth
0.2 V	<30 MHz	10.8
All other input ranges	<30 MHz	11.0

[9] -1 dBFS input signal corrected to FS. 358 Hz resolution bandwidth (RBW).
[10] Includes the second through the fifth harmonics. -1 dBFS input signal.

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Figure 6. Single-Tone Spectrum, 2.98 dBm Input Signal at Connector, 1 V_{pk-pk} Input Range, 9.9 MHz Input Tone, Full Bandwidth, Characteristic



Noise

RMS noise, typical[11]	0.017% of FS

Table 6. Average Noise Density (dBm/Hz), Typical[11]

Input Range (V_{pk-pk})	Full Bandwidth (dBm/Hz)
0.2 V	-159.2 dBm/Hz
0.4 V	-153.7 dBm/Hz
1 V	-145.7 dBm/Hz
2 V	-139.7 dBm/Hz
5 V	-131.7 dBm/Hz

[11] Verified using a 50 Ω terminator connected to input.

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Table 7. Average Noise Density (dBFS/Hz), Typical[11]

Input Range (V_{pk-pk})	Full Bandwidth
0.2 V	149.2 dBFS/Hz
All other input ranges	149.7 dBFS/Hz

Table 8. Average Noise Density (nV/√Hz), Typical[11]

Input Range (V_{pk-pk})	Full Bandwidth (nV/√Hz)
0.2 V	3.5 nV/√Hz
0.4 V	6.5 nV/√Hz
1 V	16.4 nV/√Hz
2 V	32.7 nV/√Hz
5 V	81.8 nV/√Hz

Skew

Channel-to-channel skew, characteristic	<120 ps[12]

Horizontal

ADC Clock

Sources	
Internal	Onboard clock
External	CLK IN (from front panel AUX I/O connector) PXIe_DStarA (from backplane)
Duty cycle	45% to 55%
Frequency	250 MHz

[12] For input frequencies less than 75 MHz.

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Reference Clock

Sources	None (internal VCXO) CLK IN (from front panel AUX I/O connector) PXI_Clk10 (from backplane)
Duty cycle tolerance	45% to 55%
Frequency[13]	10 MHz

Onboard Clock

ADC clock frequency	250 MHz
Real-time sample rate range[14]	3.815 kS/s to 250 MS/s
ADC clock accuracy	
Phase-locked to onboard clock	±25.0 ppm
Phase-locked to external clock	Equal to the external clock accuracy

CLK IN

Source	AUX I/O front panel connector
Impedance, characteristic	50 Ω
Coupling	AC
Input voltage range	
As a 250 MHz sine wave	1 dBm through 18 dBm
As a fast slew rate input (square wave, V_{pk-pk})	0.4 V to 5 V
Maximum input overload	
As a 250 MHz sine wave	20 dBm
As a fast slew rate input (square wave, V_{pk-pk})	6 V

PXIe_DStarA

Source	System timing slot
Destinations	ADC clock, FPGA

[13] The PLL Reference Clock frequency must be accurate to ±25 ppm.

[14] Divide by *n* decimation from 250 MS/s. For more information about the Sample Clock and decimation, refer to the *NI Reconfigurable Oscilloscopes Help* at *ni.com/manuals*.

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PXI_Clk10

Source	PXI backplane
Destination	Reference Clock

PXI_Clk100

Source	PXI backplane
Destination	FPGA

CLK OUT

Destination	AUX I/O front panel connector
Source	Reference Clock
Output impedance, characteristic	50 Ω
Logic type	3.3 V LVCMOS
Maximum current drive, characteristic	±8 mA

Trigger

Note The following characteristic behaviors are valid when using the device with the NI-SCOPE API. When using instrument design libraries, these characteristics may not be valid.

Supported trigger	Reference (Stop) Trigger
Trigger types	Edge Window Hysteresis Digital Immediate Software
Trigger sources	PXIe-5170 (8CH): CH 0 to CH 7 PXIe-5170 (4CH): CH 0 to CH 3 PFI <0..7> PXI_Trig <0..6> Software
Time resolution	
Analog triggers	Sample Clock timebase period
Digital triggers	8 ns

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Rearm time[15]	
With interpolation	936 ns
Without interpolation	496 ns
Dead time, characteristic	40 ns
Holdoff	From dead time to [(2^{64} - 1) × Sample Clock timebase period]
Trigger delay	From 0 to [(2^{51} - 1) × Sample Clock timebase period]
Trigger accuracy, characteristic[16]	0.5% of full scale
Trigger jitter, characteristic[16]	15 ps_{rms}
Minimum threshold duration[17]	Sample Clock period

Related Information

For information about when to self-calibrate the device, refer to the NI High-Speed Digitizers Help at ni.com/manuals.

For more information about triggers, refer to the NI High-Speed Digitizers Help at ni.com/manuals.

Programmable Function Interface (PFI 0..7, AUX I/O Front Panel Connector)

Connector	AUX I/O
Direction	Bidirectional per channel
Direction control latency	25 ns
As an Input (Trigger)	
Destination	FPGA diagram Start Trigger (Acquisition Arm) Reference (Stop) Trigger Arm Reference Trigger Advance Trigger
Input impedance, characteristic	10 kΩ
V_{IH}	2 V

[15] Trigger interpolation is used when the Enable TDC NI-SCOPE attribute is set to `TRUE`. Otherwise, trigger interpolation is not used.

[16] Analog triggers. For input frequencies less than 90 MHz.

[17] Data must exceed each corresponding trigger threshold for at least the minimum duration to ensure analog triggering.

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V_{IL}	0.8 V
Maximum input overload	0 V to 3.3 V nominal, 5 V tolerant
Minimum pulsewidth	10 ns
As an Output (Event)	
Sources	FPGA diagram Ready for Start Start Trigger (Acquisition Arm) Ready for Reference Reference (Stop) Trigger End of Record Ready for Advance Advance Trigger Done (End of Acquisition)
Output impedance, characteristic	50 Ω
Logic type	3.3 V CMOS
Maximum current drive, characteristic	12 mA
Minimum pulsewidth	10 ns

AUX I/O Connector Specifications

Connector	MHDMR
Voltage output, characteristic	3.3 V ± 10%
Maximum current drive, characteristic	200 mA
Output impedance, characteristic	<1 Ω

Waveform Specifications

Onboard memory size[18]	
PXIe-5170 (4CH)	0.75 GB
PXIe-5170 (8CH)	1.5 GB
Minimum record length	1 sample
Number of pretrigger samples	Zero up to (record length - 1)
Number of posttrigger samples	Zero up to record length

[18] Onboard memory is shared among all enabled channels.

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Maximum number of records in onboard memory	*Total onboard memory*/(48**number of channels*)
Allocated onboard memory per record[20]	Roundup(Roundup((Coerced number of samples + Number of samples per sample word) / Number of samples per memory word) * Number of samples per memory word + 3 * Number of samples per memory word) * Bytes Per Sample * Number of channels

Memory Sanitization

For information about memory sanitization, refer to the letter of volatility for your device, which is available at *ni.com/manuals*.

FPGA

FPGA support	Xilinx Kintex-7 XC7K325T FPGA
Xilinx Kintex-7 XC7K325T FPGA Resources	
Slice registers	407,600
Slice look-up tables (LUT)	203,800
DSPs	840
18 Kb block RAMs	890

Note Note that some of these resources are consumed by the logic necessary to operate the device and integrate with software, and are thus out of the control of users.

Calibration

External Calibration

External calibration corrects for gain, offset, and timing errors at all input ranges.

All calibration constants are stored in nonvolatile memory.

[19] *Number of channels* is the number of channels enabled rounded up to the nearest power of two.
[20] Descriptions of variables in this equation.
- Number of samples per sample word = 16 samples / number of channels.
- Number of samples per memory word = 48 samples / number of channels
- Coerced number of samples is the number of pre-trigger samples rounded up to the next multiple of the number of samples per sample word + number of post trigger samples rounded up to the next multiple of the number of samples per sample word .

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Self-Calibration

Self-calibration is done on software command. The calibration corrects for intermodule synchronization errors.

Related Information

For information about when to self-calibrate the device, refer to the NI High-Speed Digitizers Help at ni.com/manuals.

Calibration Specifications

Interval for external calibration	2 years
Warm-up time[21]	15 minutes

Software

Driver Software

This device was first supported in LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes 14.0 and NI-SCOPE 15.1. NI-SCOPE is an IVI-compliant driver that allows you to configure, control, and calibrate the device. NI-SCOPE provides application programming interfaces for many development environments.

Related Information

For information about the available software options, refer to the NI PXIe-5170R/5171R Getting Started Guide.

Application Software

NI-SCOPE provides programming interfaces, documentation, and examples for the following application development environments:

- LabVIEW
- LabWindows™/CVI™
- Measurement Studio
- Microsoft Visual C/C++

LabVIEW Instrument Design Libraries for Reconfigurable Oscilloscopes allows the use of the LabVIEW FPGA Module to customize the device FPGA to create application-specific instrument designs.

[21] Warm-up begins after the chassis is powered, the device is recognized by the host, and the device is configured using the instrument design libraries or NI-SCOPE. Running an included sample project or running self-calibration using NI MAX will configure the device and start warm-up.

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Interactive Soft Front Panel and Configuration

The NI-SCOPE Soft Front Panel (SFP) allows interactive control of the PXIe-5170.

Interactive control of the PXIe-5170 was first available in NI-SCOPE SFP version 15.1. The NI-SCOPE SFP is included on the instrument design libraries or NI-SCOPE DVD.

National Instruments Measurement & Automation Explorer (MAX) also provides interactive configuration and test tools for the PXIe-5170. MAX is included on the NI-SCOPE DVD.

TClk Specifications

You can use the National Instruments TClk synchronization method and the NI-TClk driver to align the Sample Clocks on any number of supported devices, in one or more chassis. For more information about TClk synchronization, refer to the *NI-TClk Synchronization Help*, which is located within the *NI High-Speed Digitizers Help*. For other configurations, including multichassis systems, contact NI Technical Support at *ni.com/support*.

Intermodule Synchronization Using NI-TClk for Identical Modules

Synchronization specifications are valid under the following conditions:

- All modules are installed in one PXI Express chassis.
- The NI-TClk driver is used to align the Sample clocks of each module.
- All parameters are set to identical values for each module.
- Modules are synchronized without using an external Sample Clock.
- All filters are disabled.

Note Although you can use NI-TClk to synchronize non-identical SMC-based modules, these specifications apply only to synchronizing identical modules.

Skew, characteristic[22]	300 ps
Skew after manual adjustment, characteristic	≤10 ps
Sample Clock delay/adjustment resolution	3.5 ps

Power

Note Power consumed depends on the FPGA image and driver software used. Specifications for instrument design libraries reflect the performance of a device

[22] Caused by clock and analog path delay differences. No manual adjustment performed. Tested with a NI PXIe-1082 chassis with a maximum slot-to-slot skew of 100 ps. Valid within ±1 °C of self-calibration.

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using the FPGA image from the Multirecord Acquisition sample project. Maximum power consumption occurs at highest operating temperature.

Table 9. PXIe-5170 (4CH) Power Consumption, Typical

	Instrument Design Libraries	NI-SCOPE
+3.3 VDC	6.0 W	5.9 W
+12 VDC	14.5 W	13.4 W
Total power	20.5 W	19.3 W

Table 10. PXIe-5170 (8CH) Power Consumption, Typical

	Instrument Design Libraries	NI-SCOPE
+3.3 VDC	6.4 W	6.3 W
+12 VDC	17.0W	17.2W
Total power	23.4 W	23.5 W

Total maximum power allowed	38.25 W

Dimensions and Weight

Dimensions	18.5 cm × 2.0 cm × 13.0 cm (7.3 in. × 0.8 in. × 5.1 in.) 3U, 1 slot, PXI Express Gen 2 x8 Module
Weight	
PXIe-5170 (4CH)	462 g (16.3 oz.)
PXIe-5170 (8CH)	484 g (17.1 oz.)

Environment

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

Indoor use only.

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Operating Environment

Ambient temperature range	0 °C to 45 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 4 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.)

Storage Environment

Ambient temperature range	-40 °C to 71 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC 60068-2-56.)

Shock and Vibration

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g_{rms}
Nonoperating	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.)

Compliance and Certifications

Safety

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 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

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Electromagnetic Compatibility

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

- EN 61326-2-1 (IEC 61326-2-1): 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 *Online Product Certification* section.

CE Compliance CE

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)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

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 *Minimize Our Environmental Impact* web page at *ni.com/environment*. This page contains the environmental regulations and

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directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)



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