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Find the *National Instruments PXIe-5160* at our website: ***Click HERE***

SPECIFICATIONS

PXIe-5160

500 MHz, 2.5 GS/s, 10-Bit PXI Express 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.

The following characteristic specifications 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.

Conditions

Specifications are valid under the following conditions unless otherwise noted.

- All vertical ranges
- All bandwidths and bandwidth limit filters
- Sample rate set to 1.25 GS/s or 2.5 GS/s
- Onboard Sample clock locked to onboard Reference clock

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

- Ambient temperature ranges of 0 °C to 45 °C
- The PXIe-5160 is warmed up for 15 minutes at ambient temperature
- Self-calibration is completed after warm-up period
- Calibration cycle is maintained
- 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 document available at ni.com/manuals.
- NI-SCOPE 4.1 or later instrument driver is used
- 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

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Vertical

Analog Input

Number of channels	
PXIe-5160 (2 CH)	Two (simultaneously sampled)
PXIe-5160 (4 CH)	Four (simultaneously sampled)
Input type	Referenced single-ended
Connectors	BNC

Impedance and Coupling

Note Impedance and coupling are software-selectable on a per-channel basis.

Table 1. Input Impedance

Impedance Setting	Typical	Warranted
50 Ω	50 Ω ± 1.50%	50 Ω ± 1.75%
1 MΩ	1 MΩ ± 0.75%	1 MΩ ± 0.90%

Input capacitance[1]	15 pF ± 0.8 pF, nominal 15 pF ± 2.5 pF, warranted
Input coupling	AC, DC

Table 2. Voltage Standing Wave Ratio (VSWR), Nominal[2]

Frequency	VSWR
DC ≤ f ≤ 500 MHz	1.1:1

[1] 1 MΩ input only.
[2] 50 Ω input only.

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Voltage Levels

Table 3. 50 Ω Full-Scale (FS) Input Range and Vertical Offset Range

Input Range (V_{pk-pk})	Vertical Offset Range (V)
0.05 V	±0.5
0.1 V	±0.5
0.2 V	±0.5
0.5 V	±0.5
1 V	±0.5
2 V	±1.5
5 V	0

Table 4. 1 MΩ FS Input Range and Vertical Offset Range

Input Range (V_{pk-pk})	Vertical Offset Range (V)
0.05 V	±0.5
0.1 V	±0.5
0.2 V	±0.5
0.5 V	±0.5
1 V	±0.5
2 V	±5
5 V	±5
10 V	±5
20 V	±30
50 V	±15

Maximum input overload[3]	
50 Ω	|Peaks| ≤5 V, nominal
1 MΩ	|Peaks| ≤42 V, nominal

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

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Accuracy

Resolution	10 bits
DC accuracy[4]	±[(2% × |*Reading* - *Vertical Offset*|) + (1.4% × |*Vertical Offset*|) + (0.6% of *FS*) + 600 µV]
DC drift[5]	±[(0.1% × |*Reading* - *Vertical Offset*|) + (0.025% × |*Vertical Offset*|) + (0.03% of *FS*)] per °C, nominal
AC amplitude accuracy[4]	±0.5 dB at 50 kHz
AC amplitude drift[5]	±0.01 dB per °C at 50 kHz, nominal

Table 5. Crosstalk (CH to/from CH), Nominal[6]

Input Impedance	Input Frequency	Crosstalk
50 Ω	DC ≤ *f* ≤ 100 MHz	-60 dB
	100 MHz < *f* ≤ 500 MHz	-45 dB
1 MΩ[7]	DC ≤ *f* ≤ 100 MHz	-55 dB
	100 MHz < *f* ≤ 200 MHz	-45 dB

Bandwidth and Transient Response

50 Ω bandwidth (-3 dB)[8]	500 MHz, typical 475 MHz, warranted[9]

[4] Within ±3 °C of self-calibration temperature. This specification is *typical* for peak-to-peak input ranges of 0.05 V to 0.1 V and *warranted* for all other input ranges.

[5] Used to calculate errors when onboard temperature changes more than ±3 °C from the self-calibration temperature.

[6] Measured on one channel with test signal applied to another channel, with same range setting on both channels.

[7] Only valid on peak-to-peak input ranges of 0.05 V to 10 V.

[8] Normalized to 50 kHz.

[9] For ambient temperature ranges of 0 °C to 30 °C.

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Table 6. 1 MΩ Bandwidth (-3 dB)[12]

Input Impedance	Input Range (V_{pk-pk})	Nominal	Warranted[11]
1 MΩ[10]	0.05 V to 1 V	—	300 MHz
	2 V to 10 V	300 MHz	250 MHz
	20 V to 50 V	300 MHz	—

Bandwidth-limiting filters	20 MHz 175 MHz
Rise/fall time[13]	
50 Ω	750 ps, typical
1 MΩ[14]	1.4 ns, typical
AC-coupling cutoff (-3 dB)[15]	
50 Ω[16]	170 kHz
1 MΩ	17 Hz

10 Verified using a 50 Ω source and 50 Ω feed-through terminator.
11 For ambient temperature ranges of 0 °C to 30 °C.
12 Normalized to 50 kHz.
13 50% FS input pulse.
14 Verified using a 50 Ω source and 50 Ω feed-through terminator.
15 Verified using a 50 Ω source.
16 With AC coupling enabled, the DC resistance to ground is 20 kΩ.

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Figure 1. PXIe-5160 Step Response, 50 Ω, 1 V_{pk-pk} Input Range, -0.25 V Programmable Offset, 500 ps Rising Edge, Nominal

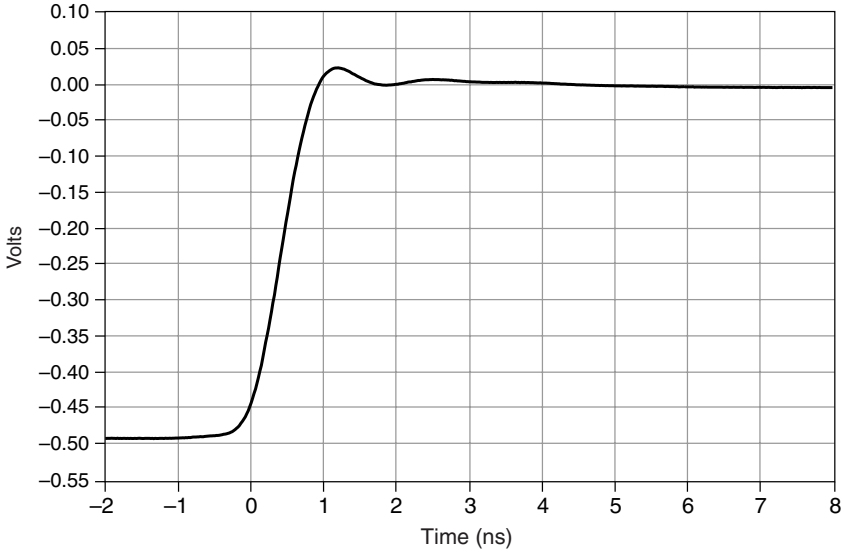
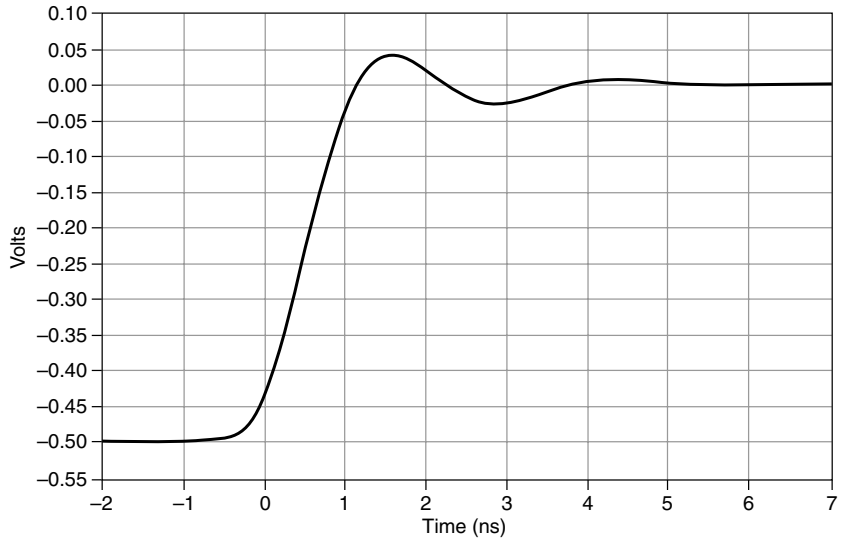


Figure 2. PXIe-5160 Step Response, 1 MΩ, 1 V_{pk-pk} Input Range, -0.25 V Programmable Offset, 500 ps Rising Edge, Nominal[17]



[17] Verified using a 50 Ω source and 50 Ω feed-through terminator.

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Figure 3. PXIe-5160 50 Ω Frequency Response, 1 V_{pk-pk}, 2.5 GS/s, Nominal

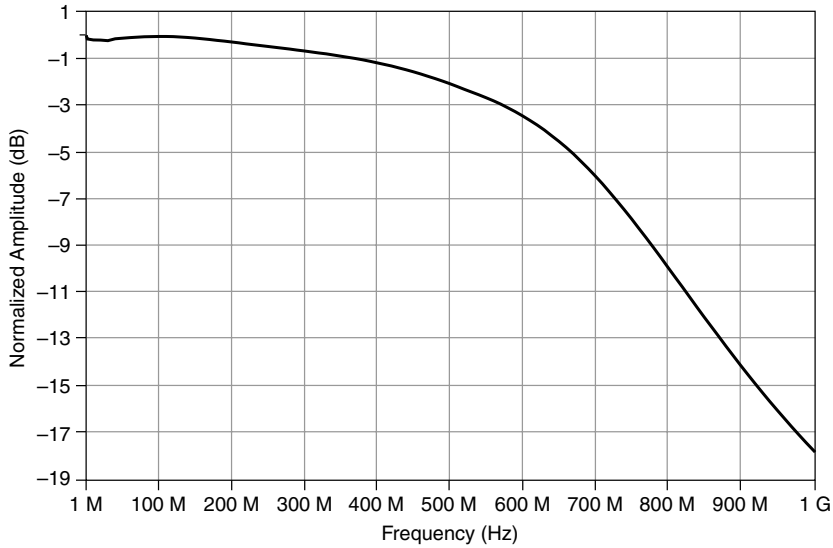
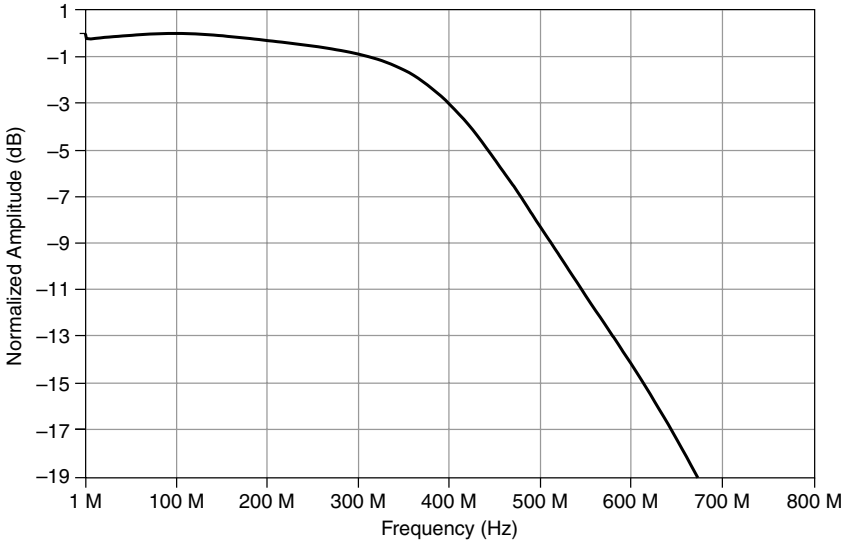


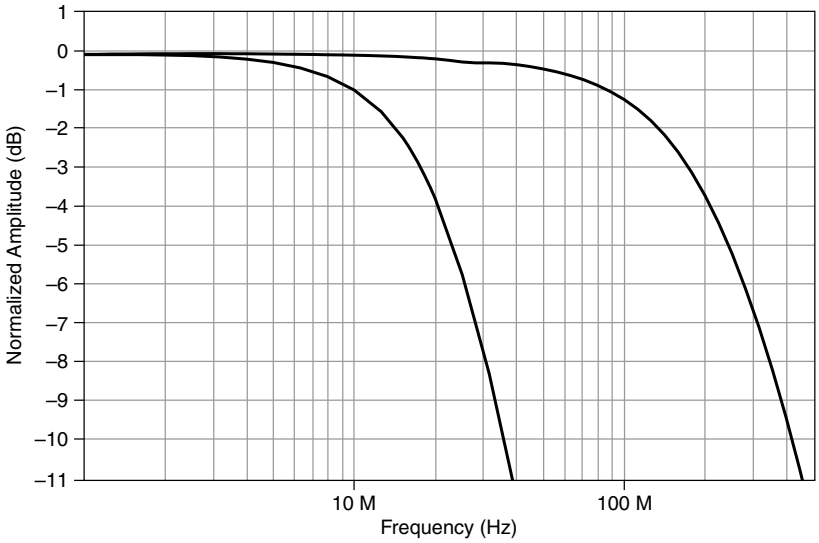
Figure 4. PXIe-5160 1 MΩ Frequency Response, 1 V_{pk-pk}, Nominal[18]



[18] Verified using a 50 Ω source and 50 Ω feed-through terminator.

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Figure 5. PXIe-5160 Bandwidth-Limiting Filters Frequency Response, 1 V_{pk-pk}, Nominal



Spectral Characteristics

50 Ω Spectral Characteristics

Table 7. Spurious-Free Dynamic Range (SFDR), Nominal[19]

Input Frequency	SFDR
<10 MHz	56 dBc
≥10 MHz to ≤100 MHz	54 dBc

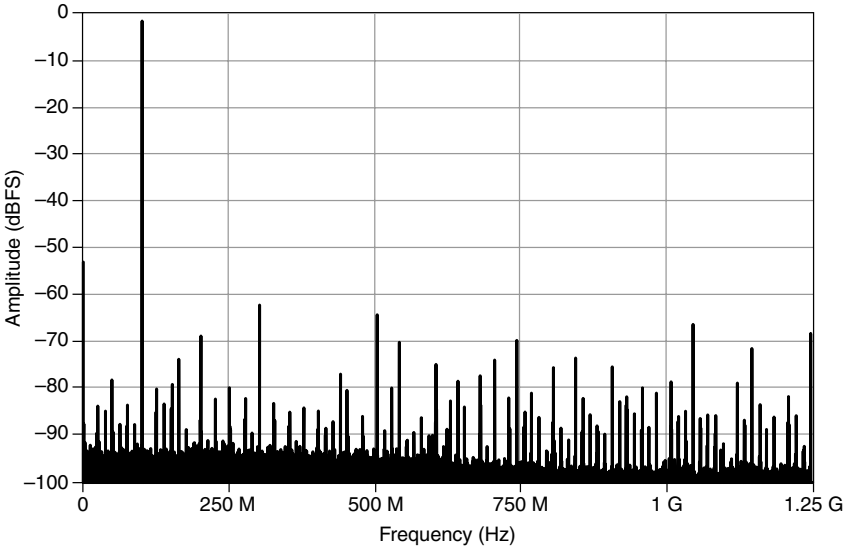
Table 8. Effective Number of Bits (ENOB), Nominal[19]

Input Frequency	Input Range (V_{pk-pk})	ENOB
<100 MHz	0.05 V	7.1
	0.1 V	7.4
	0.2 V to 5 V	7.6

[19] -1 dBFS input signal corrected to FS. Includes the second through the fifth harmonics. 7.2 kHz resolution bandwidth.

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Figure 6. PXIe-5160 Single Tone Spectrum, 2.98 dBm Input Signal at Connector, 50 Ω, 1 V_{pk-pk}, 2.5 GS/s, 101 MHz Input Tone, Full Bandwidth, Nominal



1 MΩ Spectral Characteristics[20]

Table 9. SFDR, Nominal[21]

Input Frequency	Input Range (V_{pk-pk})	SFDR
<10 MHz	0.05 V to 10 V	53 dBc
	20 V	50 dBc
≥10 MHz to ≤100 MHz	0.05 V to 0.5 V	53 dBc
	1 V to 5 V	48 dBc

[20] Verified using a 50 Ω source and 50 Ω feed-through terminator.

[21] -1 dBFS input signal corrected to FS. Includes the second through the fifth harmonics. 7.2 kHz resolution bandwidth.

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Table 10. ENOB, Nominal[21]

Input Frequency	Input Range (V_{pk-pk})	ENOB
<10 MHz	0.05 V	6.8
	0.1 V	7.4
	0.2 V to 20 V	7.6
≤100 MHz	0.05 V	6.8
	0.1 V to 0.5 V	7.4
	1 V to 5 V	7.1

Noise

Table 11. RMS Noise[22]

Input Impedance	Input Range (V_{pk-pk})	Typical	Warranted
50 Ω	0.05 V	0.26% of FS	0.3% of FS
	0.1 V	0.16% of FS	0.19% of FS
	0.2 V to 5 V	0.14% of FS	0.17% of FS
1 MΩ	0.05 V	0.26% of FS	0.3% of FS
	0.1 V	0.16% of FS	0.19% of FS
	0.2 V to 50 V	0.14% of FS	0.17% of FS

Skew

Channel-to-channel skew	
50 Ω to 50 Ω	<25 ps, nominal
1 MΩ to 1 MΩ	<125 ps, nominal
50 Ω to 1 MΩ	<800 ps, nominal

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

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Horizontal

Sample Clock

Sources	
Internal	Onboard clock (internal VCO)
External	Front panel SMB connector

Onboard Clock

Real-time sample rate range[23]	
One channel enabled	76.299 kS/s to 2.5 GS/s
Two channels enabled[24]	76.299 kS/s to 2.5 GS/s
Four channels enabled	76.299 kS/s to 1.25 GS/s
Random interleaved sampling (RIS) range[25]	Up to 50 GS/s
Sample clock jitter[26]	250 fs RMS (12 kHz to 10 MHz), nominal
Timebase frequency	2.5 GHz
Timebase accuracy[27]	±10 ppm, typical ±25 ppm, warranted

Phase-Locked Loop (PLL) Reference Clock

Sources	
Internal	Onboard 10 MHz reference
External	External 10 MHz (front panel CLK IN connector) or PXI_CLK10 (backplane connector)
Duty cycle tolerance	45% to 55%

[23] Divide by *n* decimation from 1.25 GS/s used for all rates less than 1.25 GS/s. For more information about the Sample Clock and decimation, refer to the *NI High-Speed Digitizers Help*.

[24] For the PXIe-5160 (4 CH), supported on channels 0 and 2. For the PXIe-5160 (2 CH), supported on channels 0 and 1.

[25] With one channel enabled, stepped in multiples of 2.5 GS/s. With two channels enabled, stepped in multiples of 2.5 GS/s. With four channels enabled, stepped in multiples of 1.25 GS/s.

[26] Includes the effects of the converter aperture uncertainty and the clock circuitry jitter. Excludes trigger jitter.

[27] When phase-locked to an external Reference Clock, the timebase accuracy is equal to the external Reference Clock accuracy. For example, when locked to the System Reference Clock of a PXI Express chassis, the module inherits the accuracy of the chassis System Reference Clock.

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External Sample Clock (CLK IN, Front Panel Connector)

Input voltage range, when configured as a Sample Clock	-10 dBm through 16 dBm
Maximum input overload, when configured as a Sample Clock	18 dBm
Impedance	50 Ω
Coupling	AC
Frequency range	1.25 GHz to 2.5 GHz[28]

External Reference Clock In (CLK IN, Front Panel Connector)

Input voltage range, when configured as a Reference Clock	200 mV_{pk-pk} to 4 V_{pk-pk}
Maximum input overload, when configured as a Reference Clock	5 V_{pk-pk} with |Peaks| ≤10 V
Impedance	50 Ω
Coupling	AC
Frequency range[29]	10 MHz

Reference Clock Out (CLK OUT, Front Panel Connector)

Output impedance	50 Ω
Logic type	3.3 V CMOS
Maximum current drive	±10 mA

[28] To achieve the same real-time sample rate ranges as the onboard clock, a 2.5 GHz frequency is required.

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

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Trigger

Supported trigger	Reference (Stop) Trigger
Trigger types	Edge Digital Immediate Hysteresis Software
Trigger sources	
PXIe-5160 (2 CH)	CH 0, CH 1, TRIG, PFI 0, PFI 1, PXI_TRIG <0..6>, and Software
PXIe-5160 (4 CH)	CH 0, CH 1, CH 2, CH 3, PFI 0, PFI 1, PXI_TRIG <0..6>, and Software
Time-to-digital conversion circuit time resolution	4 ps
Dead time	710 ns, nominal
Holdoff	6.4 ns to 27.4 s
Trigger delay	From 0 to 73,786,976 seconds (28 months), nominal

Analog Trigger (Edge Trigger Type)

Sources	
PXIe-5160 (2 CH)	CH 0, CH 1, or TRIG[30]
PXIe-5160 (4 CH)	CH 0, CH 1, CH 2, or CH 3
Trigger filters	
Low-frequency reject	150 kHz, nominal
High-frequency reject	150 kHz, nominal
Trigger sensitivity	3% of FS at ≤10 MHz, nominal
Trigger accuracy[31]	6% of FS at ≤10 MHz, nominal
Trigger jitter	4.7 ps, typical

[30] For specifications on the TRIG input, refer to the *External Trigger (TRIG, Front Panel Connector)* section.

[31] When the impedance settings of the triggering input and the analog input channel are the same. For more information about functionality when using mixed impedances between input channels or external trigger, visit *ni.com/kb* and enter `5W8CFE8P`.

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External Trigger (TRIG, Front Panel Connector)

Note TRIG is valid only for the PXIe-5160 (2 CH) device.

Connector	BNC
Impedance	50 Ω or 1 MΩ
Coupling	AC or DC
Input voltage range	
50 Ω	±2.5 V
1 MΩ	±5 V
Maximum input overload	
50 Ω	|Peaks| ≤5 V, nominal
1 MΩ	|Peaks| ≤42 V, nominal
Trigger sensitivity	3% of FS at ≤10 MHz, nominal
Trigger accuracy[32]	6% of FS at ≤10 MHz, nominal
Trigger jitter	4.7 ps, typical

Digital Trigger (Digital Trigger Type)

Sources[33]	
Front panel SMB connector	PFI <0..1>
Backplane connector	PXI_TRIG <0..6>

Programmable Function Interface (PFI 0 and PFI 1, Front Panel Connectors)

Connector	SMB jack
Direction	Bidirectional

[32] When the impedance settings of the triggering input and the analog input channel are the same. For more information about functionality when using mixed impedances between input channels or external trigger, visit *ni.com/kb* and enter `5W8CFE8P`.

[33] Subsample trigger accuracy not supported on PFI 1 or PXI_TRIG<0..6>.

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As an Input (Trigger)

Destinations	Start Trigger (Acquisition Arm) Reference (Stop) Trigger Advance Trigger
Input impedance	10 kΩ
V_{IH}	2.0 V
V_{IL}	0.8 V
Maximum input overload	-0.5 V to 5.5 V
Maximum frequency	25 MHz

As an Output (Event)

Sources	Ready for Start Start Trigger (Acquisition Arm) Ready for Reference Arm Reference Trigger Reference (Stop) Trigger End of Record Ready for Advance Advance Trigger Done (End of Acquisition) Probe Compensation[34]
Output impedance	50 Ω, nominal
Logic type	3.3 V CMOS
Maximum current drive	±10 mA
Maximum frequency	25 MHz

Waveform Specifications

Onboard memory sizes[35]	64 MB or 2 GB
Minimum record length	1 sample
Number of pretrigger samples[36]	Zero up to full record length
Number of posttrigger samples[36]	Zero up to full record length

[34] 1 kHz, 50% duty cycle square wave, PFI 1 only.
[35] Onboard memory is shared among all enabled channels.
[36] Single-record and multirecord acquisitions.

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Maximum number of records in onboard memory[37]	
64 MB	65,536
2 GB	100,000
Allocated onboard memory per record	[(*Record length* + 448 samples) × 2 bytes/sample], rounded up to an integer multiple of 128 bytes (minimum 512 bytes)

Memory Sanitization

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

Calibration

External Calibration

External calibration calibrates the onboard references used in self-calibration and the external trigger levels. All calibration constants are stored in nonvolatile memory.

Self-Calibration

Self-calibration is done on software command. The calibration corrects for gain, offset, triggering, and timing errors for all input ranges.

Calibration Specifications

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

Software

Driver Software

Driver support for this device was first available in NI-SCOPE 4.1.

NI-SCOPE is an IVI-compliant driver that allows you to configure, control, and calibrate the PXIe-5160. NI-SCOPE provides application programming interfaces for many development environments.

[37] You can exceed these numbers if you fetch records while acquiring data. For more information, refer to the *NI High-Speed Digitizers Help*.

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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++
- .NET (C# and VB.NET)

Interactive Soft Front Panel and Configuration

The NI-SCOPE Soft Front Panel (SFP) allows interactive control of the PXIe-5160.

Interactive control of the PXIe-5160 was first available in NI-SCOPE SFP version 4.1. The NI-SCOPE SFP is included on the NI-SCOPE media.

NI Measurement Automation Explorer (MAX) also provides interactive configuration and test tools for the PXIe-5160. MAX is included on the NI-SCOPE media.

TClk Specifications

You can use the NI 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 SMC 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.

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- Modules are synchronized without using an external Sample clock.
- Self-calibration is completed.

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

Skew[38]	100 ps, nominal
Skew after manual adjustment	≤5 ps, nominal
Sample clock delay/adjustment resolution	20 fs

Related Information

For more information about TClk synchronization, refer to the NI-TClk Synchronization Help , which is located within the NI High-Speed Digitizers Help available at ni.com/manuals.

For other configurations, including multichassis systems, contact NI Technical Support at ni.com/support.

Power

+3.3 VDC	2.2 A
+12 VDC	2.3 A
Total power	34.8 W

Dimensions and Weight

Dimensions	3U, 1 slot, PXI Express gen 1 x4 Module, 21.4 × 2.0 × 13.1 cm (8.4 × 0.8 × 5.1 in)
Weight	430 g (15 oz.)

Caution 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.

Environment

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

Indoor use only.

[38] 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.

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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} (Tested in accordance with IEC 60068-2-64.)
Nonoperating	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC 60068-2-64. 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 C22.2 No. 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 61326-1 (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 *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)



EU Customers 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）



中国客户 National Instruments 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 National Instruments 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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374020F-01 December 12, 2017

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