Technical Sales
United States
(866) 531-6285
info@ni.com

Detailed Specifications

For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

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NI PXIe-5185, NI PXIe-5186

- 5 GHz (NI PXIe-5186) and 3 GHz (NI PXIe-5185) analog bandwidths
- Sampling rates of 12.5 GS/s (1 ch active) and 6.25 GS/s (2 ch active)
- 8-bit vertical resolution with input ranges from 110 mV to 1 V full scale
- 2 channels with 50 Ω and 1 MΩ input impedance paths
- Data transfer rates of >700 MB/s from device to host
- 3-slot, 3U PXI Express form factor

Overview

The NI PXIe-5185 and PXIe-5186 digitizers, codeveloped by National Instruments and Tektronix, deliver a new level of performance in the small-form-factor, low-power PXI platform. These digitizers provide the trusted measurement accuracy of Tektronix oscilloscopes and deliver breakthrough acquisition performance in PXI Express. The digital back end uses NI Synchronization and Memory Core (SMC) technology to deliver high-data throughput at rates greater than 700 MB/s and multi-module synchronization with ±80 ps channel-to-channel skew. The result is digitizers that feature leading analog performance optimized for automated test applications.

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Application and Technology

Applications

Automated test of electronic devices
High-energy physics experiments
Wideband RF acquisition
Semiconductor test
High-speed transient capture systems
Radar prototyping and testing
SIGINT and ELINT systems
Electronic warfare systems

Tektronix Enabling Technology

Obtaining Superior Signal Accuracy With Tektronix, Enabling Technology Products

The analog front end and analog-to-digital converter (ADC) ASICs incorporated in the 3 GHz bandwidth NI PXIe-5185 and 5 GHz bandwidth NI PXIe-5186 are state-of-the-art silicon germanium (SiGe) parts designed by Tektronix and used across the full suite of Tektronix high-performance oscilloscopes. With more than a decade of experience in developing with the high-bandwidth (ft = 200 GHz) and reliable IBM SiGe BiCMOS process, Tektronix has continuously delivered the industry's fastest oscilloscopes with high-signal accuracy.

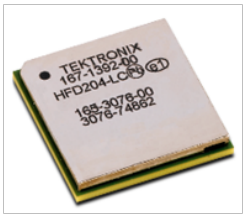

Figure 1. The analog front end and ADC ASICs are state-of-the-art SiGe parts designed by Tektronix.

Low Sampling Jitter With High Effective Number of Bits (ENOB)

One aspect of the superior signal accuracy delivered by Tektronix, Enabling Technology products can be seen in the low sampling jitter of the digitizer. Sampling jitter, also known as phase noise, characterizes the timing deviations in the analog-to-digital conversion process, and is a critical factor when evaluating digitizers and oscilloscopes that sample at multi-gigasample per second rates. These timing deviations can result from inaccuracies inside the ADC or from system design issues. The digitizers' low 500 fs rms integrated jitter results in a 5.5 effective number of bits (ENOB) at 5 GHz.

Input Frequency	Effective Number of Bits (ENOB)
10 MHz	6.5 bits
1GHz	6.3 bits
2.5 GHz	6 bits
5GHz	5.5 bits

Table 1. ENOB Values Across a Range of Input Signal Frequencies for the NI PXIe-5186

The next-closest modular alternatives have more than two times the sampling jitter. Even though both alternatives use 10-bit ADCs, the higher sampling jitter degrades ENOB performance below the 8-bit NI PXIe-5186 at these high-signal frequencies.

	NI PXIe-5186	Digitizer A	Digitizer B
Analog Bandwidth	5 GHz	1.5 GHz	3 GHz
Sample Rate	12.5 GS/s	4 GS/s	8 GS/s
Vertical Resolution	8-bit ADC	10-bit ADC	10-bit ADC
Sampling Jitter	500 fs rms	1200 fs rms	1200 fs rms
RMS Noise	0.35% full scale	0.5% full scale	Not specified
ENOB	6 bits at 2.5 GHz	Not specified above 410 MHz	4.5 bits at 1.8 GHz
Form Factor	3U PXI Express	3U PXI	6U CompactPCI

Table 2. Comparison of Noise, Jitter, and ENOB Performance Between NI PXIe-5186 and Two Modular Alternatives

In addition to this, competitive digitizers with bandwidths above 1 GHz may specify ENOB with bandwidth limiting in place to diminish the impact of a noisy architecture. This means that not only does higher sampling jitter degrade ENOB at higher signal frequencies, but the published ENOB numbers may not be reflective of true product performance due to special test setups, such as the addition of lowpass filtering to the measurement.

Lastly, most other digitizers on the market offer only between 1 and 10 input voltage ranges, resulting in lost bits if the signal amplitude is not at least 90 percent of one of the few voltage input ranges. With the NI PXIe-5185 and PXIe-5186, you can fully optimize ENOB by taking advantage of the more than 2,900 input ranges that are programmable in >0.3 mV steps, from 110 mV full scale up to 1 V full scale.

Ensure the Best Performance Using Built-In Self-Calibration

When measuring high-frequency signals, even the smallest errors due to drift or temperature changes can have an impact on measurements. Upon power-up, the NI PXIe-5185 and PXIe-5186 automatically perform a power-up calibration routine to optimize the linearity performance of the ADCs. The built-in self-calibration, initiated by the user, further enhances the gain and offset accuracy of the digitizers as well as calibrates the analog trigger path.

The digitizers are shipped with NIST-traceable calibration and are supported by NI Calibration Executive.

Digitizers Optimized for Automated Test

Most digitizers and oscilloscopes with more than 1 GHz of bandwidth incorporate features and functionality best suited for interactive, benchtop use with little focus on the automated test use model. A platform optimized for automated test can help overcome the key challenges of building the integrated and/or high-channel-count test systems commonly seen in environments such as validation and production test, physics and scientific experimentation, mil/aero ATE, and radar.

Key Challenges	Features of NI PXIe-5185 and PXIe-5186
Integration Into a Test System	By using the shared NI-SCOPE driver, which offers a common API across all NI digitizers, you can: Streamline test system development. Future-proof the test system's software architecture for upgraded capability. Use any of the common development environments (NI LabVIEW, NI LabWindows™/CVI, Visual Studio.NET, Microsoft Visual C/C++, Microsoft Visual Basic). Because these digitizers are built on the PXI platform, you can: Easily integrate any of the other 1,200+ PXI instruments into your test system including the following: Vector network analyzers (VNAs) RF/microwave signal analyzers Source measure units (SMUs) and digital multimeters Switching High-resolution digitizers Share timing and triggering signals between instruments without external cabling
	Dramatically reduce test times with data throughput rates of >700 MB/s, coupled with the extremely low latency of

Test Throughput	PXI Express communication.
Limited Rack Space	In 3U rack height, you can: Fit up to 10 channels sampling at 6.25 GS/s in a single 18-slot chassis. Add measurement functionality in open slots in the same rack space.
Power Constraints	Minimize power consumption with the lowest-power, high-bandwidth solution available today (only 90 W per digitizer). Select from more than 20 different PXI chassis featuring a variety of slot-count sizes and power options.
Channel Expansion and Synchronization	Build high-channel-count, synchronized test systems with NI T-Clock technology (multi-module synchronization down to ±80 ps resolution).
Sharing Triggers Between Instruments	Share triggers across multiple devices using the built-in trigger lines of the PXI backplane.
Customized Measurements	Define and control your instrument's behavior by using software-defined instrumentation with LabVIEW. Toolkits, such as the LabVIEW Jitter Analysis Toolkit, offer additional support for customizing measurements.
Secure Environments	With no onboard permanent data storage, these digitizers are an ideal solution for secure environments.

Table 3. Features of the NI PXIe-5185/86 that address the key challenges in automated test.

PXI Platform

PXI (PCI eXtensions for Instrumentation) is a PC-based platform for measurement and automation systems. PXI combines PCI electrical-bus features with the rugged, modular, Eurocard packaging of CompactPCI and then adds specialized synchronization buses and key software features. PXI is both a high-performance and low-cost deployment platform for measurement and automation systems. PXI Express, built on the PCI Express bus, accommodates the needs of high-speed devices such as the NI PXIe-5185 and PXIe-5186 by providing even higher data throughput rates. Both PXI and PXI Express data throughput rates are significantly faster than that of GPIB, USB, or LAN — other popular buses for automating test instrumentation.

Figure 2. The NI PXIe-8133 High-Performance Intel Core i7-820QM Processor-Based Embedded Controller and the NI PXIe-5186 5 GHz Digitizer Along With Other NI PXI Instruments

NI-SCOPE Driver and Soft Front Panel

Using the full power of a software-defined instrument requires the ability to programmatically define and control the instrument's behavior. You can programmatically control all NI digitizers using the NI-SCOPE instrument driver, which offers the following:

High-level functions for getting started quickly as well as low-level control for accessing all the digitizer features
More than 50 pre-written example programs that illustrate how to access the full functionality of any NI digitizer
Programming examples for LabVIEW, C++, and Visual Basic

In any test environment, there are times when the ability to quickly troubleshoot an issue is crucial. For those occasions, the NI-SCOPE driver offers the measurement features and responsiveness of a traditional benchtop oscilloscope through the NI-SCOPE Soft Front Panel user interface.

NI Synchronization and Memory Core

Using NI Synchronization and Memory Core technology, the NI PXIe-5186 and PXIe-5185 are x4 PXI Express modules that deliver high-data throughput for faster test execution and precision multi-module timing and synchronization for building high-channel-count, integrated test systems. High-channel-count systems – spanning over 100 channels of NI PXIe-5185 and PXIe-5186 digitizers – can be synchronized down to ±80 ps resolution.

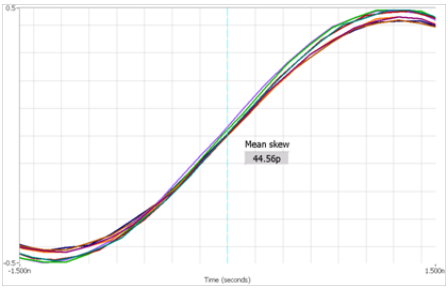

Figure 3. You can build high-channel-count, tightly synchronized test systems using NI T-Clock technology.

The digitizers can transfer data to a host controller at rates greater than 700 MB/s, nearly 40 times faster than a stand-alone instrument controlled over Gigabit Ethernet.

Block Size (MB)	NI PXIe-5186/5185 Digitizers (MB/s)	LXI Gigabit Ethernet Oscilloscope (MB/s)	PXI Express Throughput Advantage
1	496	12.6	39.4
16	700	19.7	35.5

33	738	20.3	36.4

Table 4. Data Transfer Rates of an NI PXIe-5186/85 Versus an LXI-Compliant Oscilloscope Controlled Over Gigabit Ethernet

The digitizers also feature extremely large onboard memory up to 512 MB/ch, or 1 GB of memory when using only a single channel.

Advanced Analysis

LabVIEW Jitter Analysis Toolkit

The LabVIEW Jitter Analysis Toolkit offers a library of functions optimized for performing the high-throughput, jitter, eye diagram, and phase-noise measurements required by automated validation and production test environments. Because the toolkit is written in LabVIEW software, it has the inherent ability to dynamically assign code across multiple CPU cores, resulting in dramatically improved execution speeds when using multicore processors along with the NI PXIe-5185 and PXIe-5186 digitizers in a PXI Express-based measurement system. Multicore adds powerful measurement acceleration in multichannel measurement systems, where you can perform measurements across multiple channels in parallel. The LabVIEW Jitter Analysis Toolkit also offers an easy way for constructing and customizing eye diagrams, eye masks, and bathtub curves.

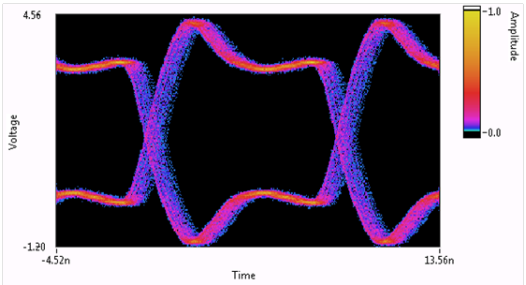

Figure 4. LabVIEW Jitter Analysis Toolkit

NI Spectral Measurements Toolkit

The Spectral Measurements Toolkit provides a set of flexible spectral measurements in LabVIEW and LabWindows/CVI, including power spectrum, peak power and frequency, in-band power, adjacent-channel power, and occupied bandwidth, as well as 3D spectrogram capabilities. In addition, the Spectral Measurements Toolkit contains VIs and functions for performing modulation-domain operations such as passband (IF) to baseband (I-Q) conversion, I-Q to IF conversion, and generation/analysis of analog modulated signals. The combination of these optimized algorithms and the gigahertz processing of your PC or PXI system controller delivers unmatched measurement throughput.

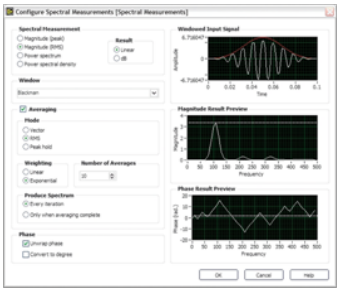

Figure 5. Spectral Measurements Toolkit

LabVIEW Advanced Signal Processing Toolkit

The LabVIEW Advanced Signal Processing Toolkit features software tools, example programs, and utilities to simplify experimentation and development involving time-frequency analysis, time-series analysis, and wavelets. It includes a full version of the LabVIEW Digital Filter Design Toolkit, which is also available separately.

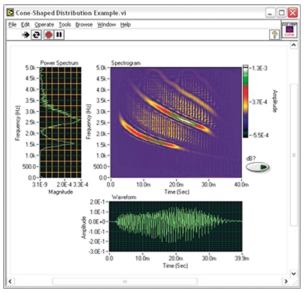

Figure 6. LabVIEW Advanced Signal Processing Toolkit

LabVIEW Digital Filter Design Toolkit

The LabVIEW Digital Filter Design Toolkit offers tools for rapidly designing, analyzing, and implementing digital filters. Use the built-in interactive tools to explore classical filter designs or use the included algorithms, filter topologies, and analysis tools to design floating-point and fixed-point digital filters for deployment on a digital signal processor (DSP) or field-programmable gate array (FPGA).

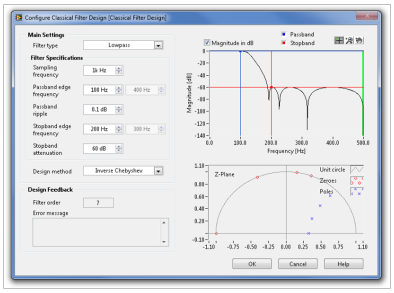

Figure 7. LabVIEW Digital Filter Design Toolkit

Signal Connectivity

For high-speed differential signal connectivity, the Tektronix P6330 differential active probe, when powered by the Tektronix 1103 power supply, can be used with the NI PXIe-5186 and PXIe-5185 to build a high-speed measurement system. Visit tektronix.com/probes for detailed product specifications and ordering information.

Characteristic	Tektronix P6330
Risetime	<140 ps
Bandwidth	3.5 GHz
Attenuation	5X
Differential Input Capacitance	<0.3 pF (typical)
Differential Input Resistance	100 kΩ
Cable Length	1.3 m

Table 5. Tektronix P6330 Probe Characteristics

Figure 6 is indicative of the frequency response performance that you can expect when using the NI PXIe-5185 (green trace) and NI PXIe-5186 (red trace) with the Tektronix P6330 probe in a solder-in configuration.

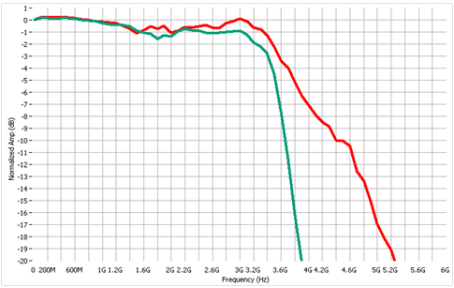

Figure 8. Typical Frequency Response Performance From Using the NI PXIe-5185 or PXIe-5186 with the Tektronix P6330 Probe in a Solder-In Configuration

Optional Software Packages and Accessories

Part Number	Description
Optional Software Packages	
781666-35	NI LabVIEW Jitter Analysis Toolkit
778453-35	NI Spectral Measurements Toolkit
778786-35	NI LabVIEW Modulation Toolkit
777136-35	NI LabVIEW Advanced Signal Processing Toolkit
779023-35	NI LabVIEW Digital Filter Design Toolkit
Accessories	
781845-01	Cable assy, SMA to SMA, coax, RG-402, 50 ohm, 1 meter
781846-01	Cable assy, SMA to SMA, coax, RG-402, 50 ohm, 0.3 meter

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Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you

configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

Support - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
Discussion Forums - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
Online Community - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

Classroom training in cities worldwide - the most comprehensive hands-on training taught by engineers.
On-site training at your facility - an excellent option to train multiple employees at the same time.
Online instructor-led training - lower-cost, remote training if classroom or on-site courses are not possible.
Course kits - lowest-cost, self-paced training that you can use as reference guides.
Training memberships and training credits - to buy now and schedule training later.
Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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Detailed Specifications

12.5 GS/s, 8-Bit Digitizers

This document lists the specifications for the National Instruments PXIe-5185, 3 GHz digitizer (NI 5185) and the NI PXIe-5186, 5 GHz digitizer (NI 5186). NI 5185/5186 digitizers were developed jointly between Tektronix and National Instruments. The devices use Tektronix, Enabling Technology™ to deliver wide analog bandwidth and high-speed sampling on the National Instruments Synchronization and Memory Core (SMC) technology with TClk synchronization.

Unless otherwise noted, the following conditions were used for each specification:

Vertical range set to 0.11 V_{pp}, 0.2 V_{pp}, 0.5 V_{pp}, or 1 V_{pp}
Sample clock set to 6.25 GS/s or 12.5 GS/s
Onboard sample clock locked to PXIe_CLK100 reference clock
0 °C to 50 °C ambient temperature

Warranted (*maximum* and *minimum*) specifications are warranted not to exceed these values within certain operating conditions and include the effects of temperature and uncertainty unless otherwise noted. Specifications are warranted under the following conditions:

The NI 5185/5186 module is warmed up for 25 minutes at ambient temperature
Self-calibration is completed after warm-up period, or when switching from an external sample and/or reference clock to the onboard clock
Calibration cycle is maintained
Chassis fan speed is set to high
NI-SCOPE 3.8 or later instrument driver is used
External calibration is performed at 23 ±3 °C

Characteristic specifications are unwarranted values that are representative of an average unit operating at room temperature.

Typical specifications are unwarranted values that are representative of a majority (90%) of units within certain operating conditions and include the effects of temperature and uncertainty unless otherwise noted.

Specifications are subject to change without notice. For the most recent NI 5185/5186 specifications, visit ni.com/manuals.

To access the NI 5185/5186 documentation, including the *NI High-Speed Digitizers Getting Started Guide*, go to **Start»All Programs»National Instruments»NI-SCOPE»Documentation**.

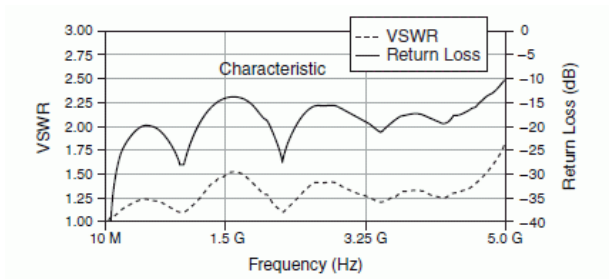
Hot Surface If the NI 5185/5186 has been in use, it may exceed safe handling temperatures and cause burns. Allow the NI 5185/5186 to cool before removing it from the chassis. Refer to the *Environment* section for operating temperatures of this device.

Caution Refer to the *Read Me First: Safety and Electromagnetic Compatibility* document for important safety and electromagnetic compatibility information. To obtain a copy of this document online, visit ni.com/manuals, and search for the document title.

Caution To ensure the specified EMC performance, operate this product only with double-shielded cables (for example, RG-223/U) and accessories.

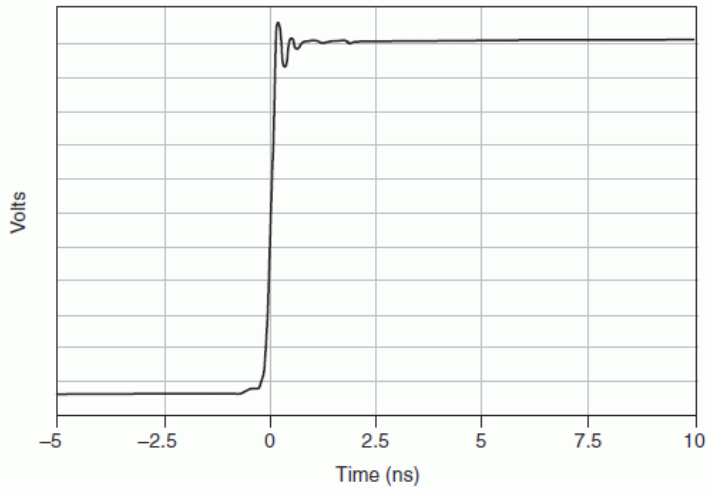
Vertical

Analog Input (Channel 0 and Channel 1)

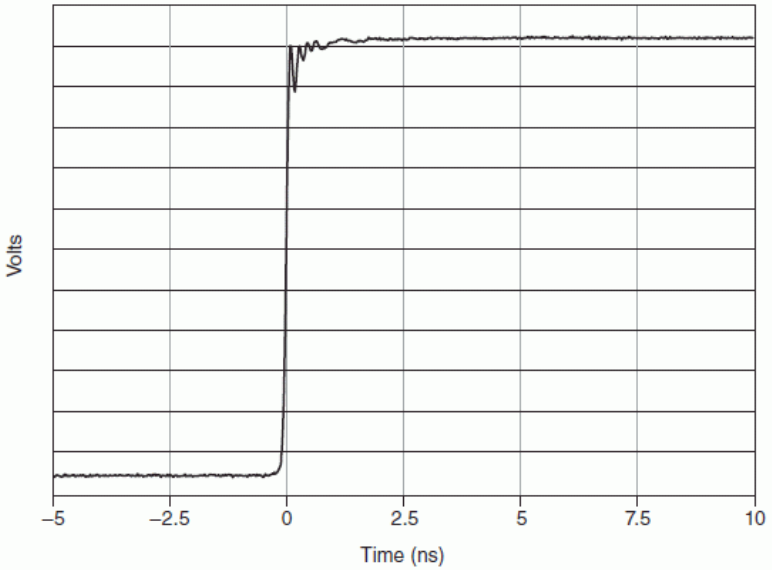
Specification	Value		Comments
Number of Channels	Two (simultaneously sampled)		—
Input Type	Reference Single-Ended		—
Connectors	SMA		—
Impedance and Coupling			
Input Impedance, Typical	50 Ω ±1.5%		—
Input Coupling	DC		—
Voltage Standing Wave Ratio (VSWR), Characteristic	DC ≤ f ≤ 1 GHz	1.25:1	—
	1 GHz < f ≤ 5 GHz	1.8:1	
VSWR and Input Return Loss			
Voltage Levels			
Full Scale (FS) Input Range and Programmable Vertical Offset	Range (V_{pp})	Vertical Offset Range (V)	The NI 5185/5186 can accurately measure signals up to 1 V_{pp} with ±0.25 V offset.
	0.11 V_{pp} to 1 V_{pp} in > 0.3 mV steps	±0.25	
Maximum Input Overload, Characteristic	|Peaks| ≤ 1 V		Signals exceeding the Maximum Input Overload may cause damage to the device.
Accuracy			
Resolution	8 bits		—
DC Accuracy (Programmable Vertical Offset = 0 Volts), Warranted	±(2% of Input + 0.35% of FS + 0.7 mV)		Within ±3 ºC of self-calibration temperature.
Programmable Vertical Offset Accuracy, Warranted	±1.2% of Offset Setting		
DC Drift, Characteristic	±(0.23% of Input + 0.03% of FS) per ºC		Use DC Drift to calculate errors when temperature changes more than ±3 °C since the last self-calibration.
Programmable Vertical Offset Drift, Characteristic	±0.02% of Offset Setting per ºC		Use Programmable Vertical Offset Drift to calculate errors when temperature changes more than ±3 °C since the last self-calibration.
AC Amplitude Accuracy, Warranted	±0.35 dB at 50 kHz		Within ±3 ºC of self-calibration temperature.
AC Amplitude Drift, Characteristic	±0.014 dB per ºC at 50 kHz		Use AC Amplitude Drift to calculate errors when temperature changes more than ±3 °C since the last self-calibration.
Crosstalk, Characteristic	CH 0 to/from CH 1		Measured on one channel with test signal applied to other channel. Same range settings used on both channels.
	DC ≤ f ≤ 1 GHz: –68 dB		
	1 GHz < f ≤ 2.5 GHz: –60 dB		
	2.5 GHz < f ≤ 5 GHz: –47 dB		
Bandwidth and Transient Response			
Bandwidth (–3 dB), Warranted	NI 5185	NI 5186	—
	3 GHz	5 GHz	

Specification	Value		Comments
Rise/Fall Time, Typical	170 ps	105 ps	50% FS input pulse

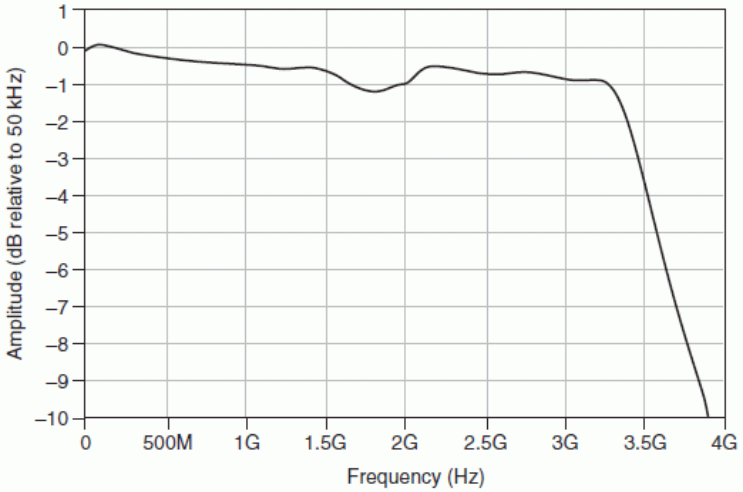
NI 5185 Step Response, 50 Ω, –0.25 V Programmable offset (Characteristic)



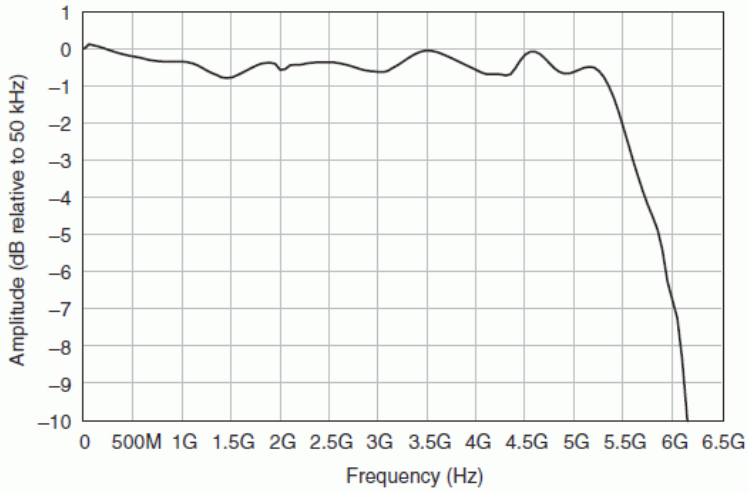
NI 5186 Step Response, 50 Ω, –0.25 V Programmable Offset (Characteristic)



NI 5185 Frequency Response (Characteristic)



NI 5186 Frequency Response (Characteristic)



Spectral Characteristics

Spurious-Free Dynamic Range (SFDR)
Total Harmonic Distortion (THD)
Effective Number of Bits (ENOB)
Signal to Noise and Distortion (SINAD)

Specification	Value			Comments
NI 5185 Spectral Characteristics				
SFDR, Characteristic		**0.11 V_{pp}, 0.2 V_{pp}, 0.5 V_{pp}**	**1 V_{pp}**	–1 dBFS input signal. Includes the 2nd through the 5th harmonics.
	f ≤ 10 MHz	–51 dBc	–50 dBc	
	10 MHz < f ≤ 1GHz	–50 dBc	–47 dBc	
	1 GHz < f ≤ 3 GHz	–46 dBc	–46 dBc	
THD, Characteristic		**0.11 V_{pp}, 0.2 V_{pp}, 0.5 V_{pp}**	**1 V_{pp}**	–1 dBFS input signal. Includes the 2nd through the 5th harmonics.
	f ≤ 10 MHz	–54 dBc	–50 dBc	
	10 MHz < f ≤1 GHz	–49 dBc	–46 dBc	
	1 GHz < f ≤ 3 GHz	–52 dBc	–46 dBc	
ENOB, Characteristic	10 MHz	6.5		–1 dBFS input signal corrected to FS. Includes the 2nd through the 5th harmonics. 18 kHz resoluti
	1 GHz	6.3		
	3 GHz	6.0		
SINAD, Characteristic	10 MHz	40.9 dB		
	1 GHz	39.7 dB		
	3 GHz	37.9 dB		
Specification	**Value**			**Comments**
NI 5186 Spectral Characteristics				
SFDR, Characteristic		**0.11 V_{pp}, 0.2 V_{pp}, 0.5 V_{pp}**	**1 V_{pp}**	–1 dBFS input signal. Includes the 2nd through the 5th harmonics.
	f ≤ 10 MHz	–51 dBc	–50 dBc	
	10 MHz < f ≤ 1 GHz	–50 dBc	–47 dBc	
	1 GHz < f ≤ 2.5 GHz	–46 dBc	–42 dBc	
	2.5 GHz < f ≤ 5 GHz	–40 dBc	–40 dBc	
THD, Characteristic		**0.11 V_{pp}, 0.2 V_{pp}, 0.5 V_{pp}**	**1 V_{pp}**	–1 dBFS input signal. Includes the 2nd through the 5th harmonics.
	f ≤10 MHz	–54 dBc	–50 dBc	

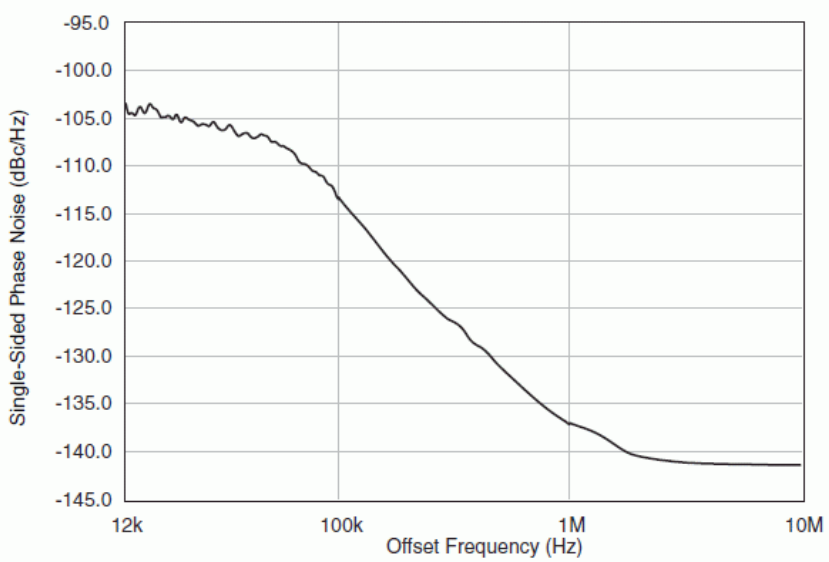
Specification	Value			Comments
	10 MHz < f ≤ 1 GHz	–49 dBc	–46 dBc	
	1 GHz < f ≤ 2.5 GHz	–47 dBc	–41 dBc	
	2.5 GHz < f ≤ 5 GHz	–43 dBc	–43 dBc	
ENOB, Characteristic	10 MHz	6.5		–1 dBFS input signal corrected to FS. Includes the 2nd through the 5th harmonics. 18 kHz resoluti
	1 GHz	6.3		
	2.5 GHz	6.0		
	5 GHz	5.5		
SINAD, Characteristic	10 MHz	40.9 dB		
	1 GHz	39.7 dB		
	2.5 GHz	37.9 dB		
	5 GHz	34.9 dB		
Noise				
RMS Noise, Typical	0.35% of FS			50 Ω terminator connected to input.
Average Noise Density, Typical	–137 dBFS/Hz			
Skew				
Channel-to-Channel Skew, Characteristic	<10 ps			—

Horizontal

Sample Clock

Specification	Value			Comments
Sources	1. Internal: Onboard Clock (Internal VCO)* 2. External: Front panel SMA connector			*Internal Sample clock is locked to the PXIe_CLK100 Reference Clock.
Onboard Clock (Internal VCO)				
Sample Rate Range	Real-Time Sampling (One channel enabled)	Real-Time Sampling (Two channels enabled)	Random Interleaved Sampling (RIS)	*Divide by *n* decimation from 6.25 GS/s used for all rates less than maximum sample rate. For more information about Sample Clock and decimation, refer to the *NI High-Speed Digitizers Help*.
	190.740 kS/s to 12.5 GS/s*	190.740 kS/s to 6.25 GS/s*	Up to 250 GS/s With one channel enabled, stepped in multiples of 12.5 GS/s. With two channels enabled, stepped in multiples of 6.25 GS/s.	

NI 5185/5186 Phase Noise (Plotted without Spurs) at 1 GHz, 3 dBmInput Signal, Locked to 100 MHz PXI Express Backplane (Characteristic)



Specification	Value	Comments
Sample Clock Jitter,	500 fs rms (12 kHz to 10 MHz)	Includes the effects of the converter aperture uncertainty and the clock circuitry jitter. Excludes trigger jitter.

Specification	Value	Comments
Characteristic		
Timebase Frequency	3.125 GHz	When not using external Sample clock.
Timebase Accuracy, Warranted	Phase-Locked to Reference Clock	The chassis clock or external reference clock must be accurate to 25 ppm. ppm = parts per million (1×10^{-6})
	Accuracy equal to the backplane or user-provided reference clock.	
External Sample Clock		
Sources	CLK IN (front panel SMA connector)	—
Frequency Range	1.6 GHz to 3.125 GHz	Divide by *n* decimation available where 1 ≤ *n* ≤ 65535. For more information about Sample clock and decimation, refer to the *NI High-Speed Digitizers Help*. The effective sample rate can be 1 × Input Frequency or 2 × Input Frequency in two-channel mode, or 1 × Input Frequency, 2 × Input Frequency or 4 × Input Frequency in one-channel mode; use the Sample clock Timebase Multiplier property or the *NISCOPE_ATTR_SAMP_CLK_TIMEBASE_MULT* attribute to specify.
Duty Cycle Tolerance, Typical	45% to 55%	—

Phase-Locked Loop (PLL) Reference Clock

Specification	Value	Comments
Sources	1. PXIe_CLK100 (backplane connector) 2. REF CLK (front panel SMB connector)	—
Frequency Range	10 MHz, 100 MHz The PLL Reference clock frequency must be accurate to ±25 ppm	—
Duty Cycle Tolerance, Characteristic	45% to 55%	—

CLK IN (Sample Clock Input, Front Panel Connector)

Specification	Value	Comments
Input Voltage Range, Characteristic	Sine wave: 0.45 V_{pp} to 1.78 V_{pp} (–3 dBm to 9 dBm)	—
Maximum Input Overload, Characteristic	3 Vrms, |Peaks| ≤ 4.25 V	—
Impedance	50 Ω	Nominal
Coupling, Characteristic	AC	—

REF CLK (Reference Clock In, Front Panel Connector)

Specification	Value	Comments
Frequency, Characteristic	10 MHz, 100 MHz	—
Impedance	50 Ω	Nominal
Input Voltage Range, Characteristic	Sine wave: –2 dBm to 16 dBm	—
Maximum Input Overload, Typical	1.6 Vrms, |Peaks| ≤10 V (1 ms peak)	—
Coupling	AC	—

Trigger

Reference (Stop) Trigger

Specification	Value			Comments
Trigger Types, Characteristic	Edge, Digital, Immediate, and Software			Refer to the following sections and to the *NI High-Speed Digitizers Help* for more information about what sources are available for each trigger type.
Trigger Sources, Characteristic	CH 0, CH 1, TRIG, PXI_Trig <0..6>, and Software			—
Time Resolution	TDC	Onboard Clock	External Clock	TDC = Time to Digital Conversion Circuit
	On	2.56 ps	—	
	Off	2.56 ns	External Clock Period × 8	
Rearm Time	TDC		Rearm Time	Holdoff set to 0.
	On		10 µs	

Specification	Value		Comments
	Off	2 µs	
Holdoff	Rearm time to 10.99 s		—
Trigger Delay	From 0 to 1,450,000 seconds (15 days)		—
Analog Trigger (Edge Trigger Type)			
Sources, Characteristic	1. CH 0 (front panel SMA connector) 2. CH 1 (front panel SMA connector) 3. TRIG (front panel SMA connector)		—
Trigger Level Range	CH 0, CH 1	TRIG (External Trigger)	—
	100% FS	±5 V	
Voltage Resolution	8 bits (1 in 256)	10 bits (1 in 1,024)	—
Edge Trigger Sensitivity,	CH 0, CH 1, Typical	TRIG (External Trigger), Characteristic	—
	3% FS ≤ 1 GHz	2% FS ≤ 100 MHz	
Trigger Level Accuracy	CH 0, CH 1, Typical	TRIG (External Trigger), Characteristic	*Within ±5 ºC of self-calibration temperature
	±5% FS ≤ 100 MHz*	±5% ≤ 100 MHz	
Trigger Jitter	CH 0, CH 1. Typical	TRIG (External Trigger), Characteristic	—
	≤16 ps rms	≤16 ps rms	
Digital Trigger (Digital Trigger Type)			
Sources	PXIe_Trig <0..6> (backplane connector)		—
TRIG (External Trigger, Front Panel Connector)			
Connector	SMA		—
Impedance	50 Ω		—
Coupling	DC		—
Input Voltage Range	±5 V		Nominal
Maximum Input Overload, Characteristic	|Peaks| ≤ 6 V		—

TClk Specifications

National Instruments TClk synchronization method and the NI-TClk driver are used to align the sample clocks on any number of SMC-based modules in a chassis. For more information about TClk synchronization, refer to the *NI-TClk Synchronization Help*, which is located within the *NI High-Speed Digitizers Help*.

Specifications are valid for any number of NI 5185/5186 modules installed in one PXIe chassis.
All parameters set to identical values for each SMC-based module.
For other configurations, including multichassis systems, contact NI Technical Support at ni.com/support.

Note You can only use NI-TClk to synchronize NI 5185/5186 devices to other NI 5185/5186 devices. These specifications apply only to synchronizing identical modules without using an external sample clock.

Specification	Value	Comments
Intermodule SMC Synchronization Using NI-TClk for Identical Modules (Typical)		
Skew	500 ps	Caused by clock and analog path delay differences. No manual adjustment performed.
Skew after manual adjustment	160 ps	—
Sample Clock Delay/Adjustment Resolution	80 ps	—
Triggers that can be TClk synchronized	Reference trigger	Synchronized triggers are synchronized to ±1 sample clock timebase

Waveform Specifications

Specification	Value	Comments
Onboard Memory Sizes	32 MB; 1 GB	Onboard memory is shared between all enabled channels.
Minimum Record Length, Characteristic	1 sample	—
Number of Pretrigger Samples, Characteristic	Zero up to full record length	Single-record mode and multiple-record mode.
Number of Posttrigger Samples, Characteristic	Zero up to full record length	Single-record mode and multiple-record mode.

Specification	Value		Comments
Maximum Number of Records in Onboard Memory, Characteristic	16 MB per channel	4,096*	* It is possible to exceed these numbers if you fetch records while acquiring data. For more information, refer to the *NI High-Speed Digitizers Help*.
	512 MB per channel	100,000*	
Allocated Onboard Memory per Record, Characteristic	[(Record length × 1 byte/sample) + 1,500], rounded up to: 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, or an integer multiple of 128 KB		—

Memory Sanitization

For information on memory sanitization, refer to the *NI PXIe-5185/5186 Letter of Volatility*, which is available for download from ni.com/manuals.

Calibration

Specification	Value
Power-Up Calibration	Automatically performed by the device at power-up to calibrate the gain, offset, and phase of the ADCs on the device. Typically takes 5–10 minutes to complete.
Self-Calibration	Self-calibration is done on software command. The calibration corrects for gain, offset, triggering, and timing errors for all input ranges, excluding External Trigger input channel. Refer to the *NI High-Speed Digitizers Help* for information on when to self-calibrate the device.
External Calibration	The external calibration calibrates the onboard references used in self-calibration, the input overload levels, and the external trigger levels. All calibration constants are stored in nonvolatile memory.
Interval for External Calibration	1 year
Warm-Up Time	25 minutes

Power

Specification	Value
+3.3 VDC	5.1 A
+12 VDC	6.1 A
+5 V_{aux}	12 mA
Total Power	90 W

Software

Specification	Value
Driver Software	NI-SCOPE 3.8 or later. NI-SCOPE is an IVI-compliant driver that allows you to configure, control, and calibrate the NI 5185/5186. NI-SCOPE provides application programming interfaces for many development environments.
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++ Microsoft Visual Basic
Interactive Soft Front Panel and Configuration	The NI-SCOPE Soft Front Panel version 3.8 or later supports interactive control of the NI 5185/5186. The NI-SCOPE Soft Front Panel is included on the NI-SCOPE DVD. National Instruments Measurement & Automation Explorer (MAX) also provides interactive configuration and test tools for the NI 5185/5186. MAX is included on the NI-SCOPE DVD.

Environment

Note To ensure that the NI 5185/5186 cools effectively, follow the guidelines in the *Maintain Forced-Air Cooling Note to Users* included in the hardware kit.

Specification	Value
Operating Temperature	0 ºC to +50 ºC in all NI PXIe chassis. Meets IEC 60068-2-1 and IEC 60068-2-2.
Storage Temperature	–40 ºC to +71 ºC. Meets IEC 60068-2-1 and IEC 60068-2-2.
Operating Relative Humidity	10% to 90%, noncondensing. Meets IEC 60068-2-56.
Storage Relative Humidity	5% to 95%, noncondensing. Meets IEC 60068-2-56.

Specification	Value
Operating Shock	30 g, half-sine, 11 ms pulse. Meets IEC 60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.
Storage Shock	50 g, half-sine, 11 ms pulse. Meets IEC 60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.
Operating Vibration	5 Hz to 500 Hz, 0.31 g_{rms}. Meets IEC 60068-2-64.
Storage Vibration	5 Hz to 500 Hz, 2.46 g_{rms}. Meets IEC 60068-2-64. Test profile exceeds requirements of MIL-PRF-28800F, Class B.
Altitude	2,000 m maximum (at 25 °C ambient temperature)
Pollution Degree	2
The NI 5185/5186 is intended for indoor use only.	

Safety, Electromagnetic Compatibility, and CE Compliance

Safety Standards

This product is designed to meet the requirements of the following standards of safety for electrical equipment 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.

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
AS/NZS CISPR 11: Group 1, 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 generates radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations and 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 amended for CE marking, as follows:
2006/95/EC; Low-Voltage Directive (safety)
2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

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 not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* 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.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit ni.com/environment/weee.htm.

电子信息产品污染控制管理办法 （中国 RoHS）

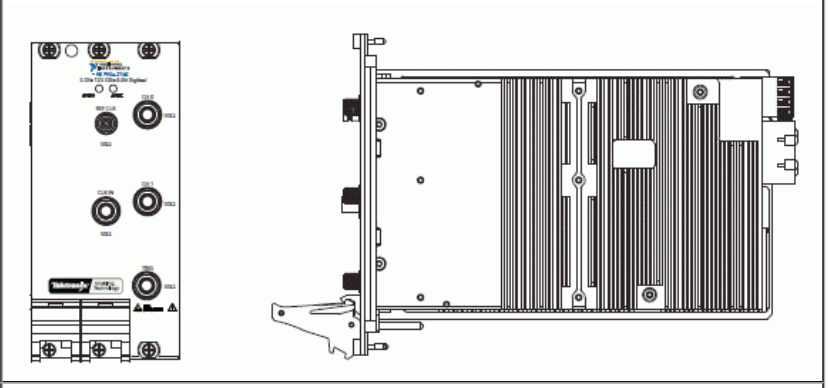
中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。
关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。
(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

Physical

Front Panel Connectors

Label	Function	Connector Type
CH 0	Analog input	SMA female
CH 1	Analog input	SMA female
TRIG	External analog trigger	SMA female
REF CLK	Imports an external reference clock to the digitizer.	SMB jack
CLK IN	Imports an external sample clock to the digitizer.	SMA female

Dimensions and Weight

Dimensions	3U, 3 slot, PXIe Module 21.6 × 6.2 × 13.0 cm (8.5 × 2.4 × 5.1 in.) 
Weight	1,208 g (42.61 oz.)

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