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**PXI-5411**

PRODUCT FLYER

# PXI Waveform Generators

## CONTENTS

[PXI Waveform Generators](#)

[Detailed View of PXIe-5433 Arbitrary Waveform Generator](#)

[Key Features](#)

[NI-FGEN Soft Front Panel](#)

[NI-FGEN Application Programming Interface \(API\)](#)

[Platform-Based Approach to Test and Measurement](#)

[PXI Instrumentation](#)

[Hardware Services](#)

# PXI Waveform Generators

PXIe-5413, PXIe-5423, PXIe-5433



- **Software:** Includes interactive soft front panel, API support for LabVIEW and text-based languages, shipping examples, and detailed help files
- One or two 16-bit channels updated at 800 MS/s with 20, 40, and 80 MHz bandwidth
- Maximum  $\pm 12$  V and minimum  $\pm 7.75$  mV output ranges
- Up to 34 channels to build parallel, high-channel-count systems in a single PXI chassis
- Waveform sequencing and streaming with a PCI Express generation 1 x4 link

## The Right Waveform Generators for Your Automated Test System

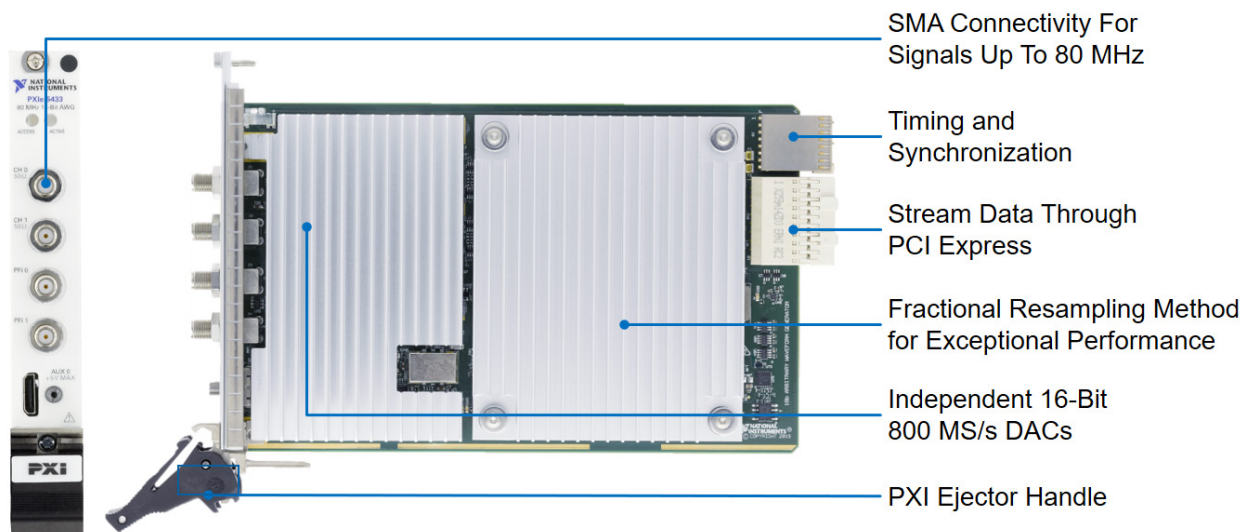
The new PXIe-5413, PXIe-5423, and PXIe-5433 arbitrary waveform generators deliver -92 dB of spurious-free dynamic range and 435 fs integrated system jitter while providing precise waveform adjustment when used with a dedicated standard waveform generation engine. With a new fractional resampling architecture for arbitrary waveform generation, similar dynamic range and jitter performance is available independent of user sample rate. Users also benefit from the high-speed waveform streaming capabilities and multiple-instrument synchronization synonymous with PXI.

For high-speed and communication signal generation, consider the [PXIe-5450](#) and [PXIe-5451](#).

Table 1. NI offers waveform generators ranging from standard function generators to powerful arbitrary waveform generators capable of waveform streaming.

	PXIe-5413		PXIe-5423		PXIe-5433	
Bandwidth	20 MHz		40 MHz		80 MHz	
DAC Resolution; Update Rate	16-bit; 800 MS/s		16-bit; 800 MS/s		16-bit; 800 MS/s	
Max. User-Programmable Arbitrary Waveform	200 MS/s		200 MS/s		400 MS/s Filter On 250 MS/s Filter Off	
Channels	1	2	1	2	1	2
Memory	128 MB	256 MB	128 MB	256 MB	512 MB	1 GB
Max. Voltage	$\pm 6$ V into 50 $\Omega$ $\pm 12$ V into High-Z		$\pm 6$ V into 50 $\Omega$ $\pm 12$ V into High-Z		$\pm 6$ V into 50 $\Omega$ $\pm 12$ V into High-Z	
Scripting	No		Yes		Yes	
Streaming	No		Yes		Yes	

## Detailed View of PXIe-5433 Arbitrary Waveform Generator



# Key Features

## PXI Express Waveform Generator Analog Performance

Modern engineering challenges require increasing signal fidelity and accuracy. PXIe-54x3 instruments use one or two independent, 16-bit digital-to-analog converters (DACs) to generate signals with excellent sine wave flatness throughout the passband. The built-in digital filtering of these waveform generators provides pure, smooth signals with an option to forgo frequency-domain purity for faster rise times and time-domain signal behavior.

### Sine Wave Flatness Performance

PXI Waveform Generators include flatness calibration that results in accurate sine wave performance to the full bandwidth of the device. Whereas traditional devices often have a characteristic roll-off approaching the stated instrument bandwidth, PXIe-54x3 arbitrary waveform generators correct for the roll-off to provide consistent performance over frequency.

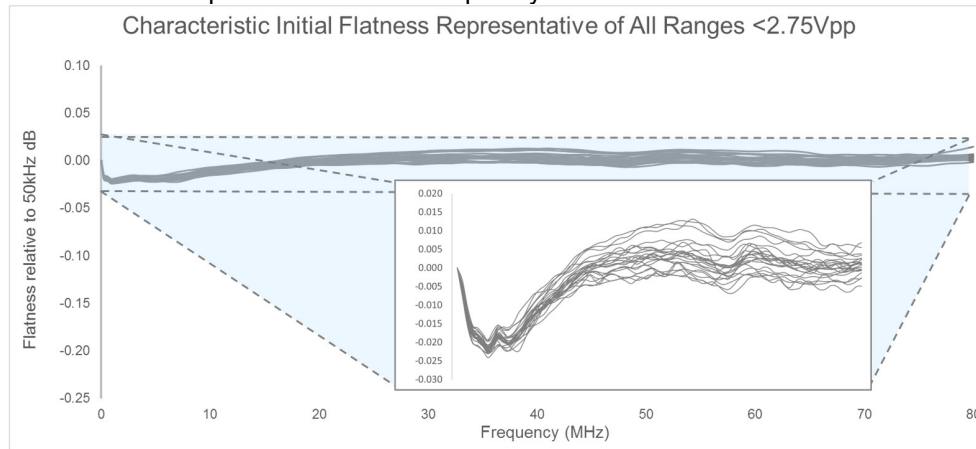


Figure 1. PXI Express waveform generators are designed to generate sine signals with very flat amplitude throughout the instrument's passband.

### Digital Filtering

The datapath of PXI-54x3 arbitrary waveform generators features digital filtering designed to remove unwanted frequency images from the generated signal in arbitrary generation mode that is not available in other modes. With many arbitrary waveform generators, frequency images of the generated signal occur at multiples of the programmed sample rate. When the filter is enabled, the bandwidth of the output signal is limited and the images are removed, which results in purer, cleaner output signals. The only drawback is that the slew rate of any large changes in signal amplitude is reduced because high-frequency components of the signal are removed. You can disable the filtering so the high-frequency contents are included in the signal, which results in the output voltage changing as fast as possible between samples in user-programmed waveforms.

### Fractional Resampling

PXIe-54x3 arbitrary waveform generators output all waveforms, including standard and arbitrary waveforms, with a DAC update rate of 800 MS/s. An algorithm implemented on the Xilinx Kintex-7 FPGA is used to up-sample user-defined arbitrary waveforms. The maximum rate allowed for arbitrary waveforms uploaded to the PXIe-5413 and PXIe-5423 is 200 MS/s. The PXIe-5433 can accept user-defined waveforms up to 400 MS/s when the digital filter is enabled and 250 MS/s when it is disabled. Increasing the sample rate in an arbitrary waveform can improve the time-domain performance by delivering faster slew rates and smoother waveform behavior. Additional samples can significantly improve frequency-domain purity by smoothing point-to-point transitions and eliminating frequency images.

## Automated Test Features

The PXI instrumentation platform was created to serve automated test with fast data buses and multi-instrument triggering. The PXIe-54x3 waveform generators expand on these built-in PXI features with independent generation engines in each multichannel instrument and a frequency list mode for fast execution of frequency sweeps.



*Figure 2. The PXIe-54x3 waveform generators can be coupled with any of NI's 600 PXI modules or the 1500 PXI modules available from over 55 vendors to make smarter test systems.*

## Independent Generation Engines and Sequencing

When using PXI-54x3 arbitrary waveform generators, note that each channel has a separate generation engine producing the output signal. This provides a distinct advantage over other 2-channel instruments that may have only one engine.

If an instrument has only one engine, its channels must share much of their configuration and execution. For example, the two channels of a waveform generator with one engine would potentially need to share triggers, markers, and engine events. By having two separate engines in the waveform generator, each channel can have its own configuration for triggers and markers and even waveform scripts. With the PXIe-54x3 arbitrary waveform generators, only the reference clock source and specific hardware resources must be shared. For example, the two engines must share the only external PFI trigger input, but PXI offers many internal system triggers, so engines don't have to share those.

Most importantly, the channels of a waveform generator with two separate generation engines can start and stop generating signals completely independently of one another. This feature can ultimately result in higher channel density or fewer PXI slots being used in a test system. Some applications require multiple, independently operating channels. If your waveform generator does not have independent generation engines, your application may require two devices and, therefore, two PXI slots.

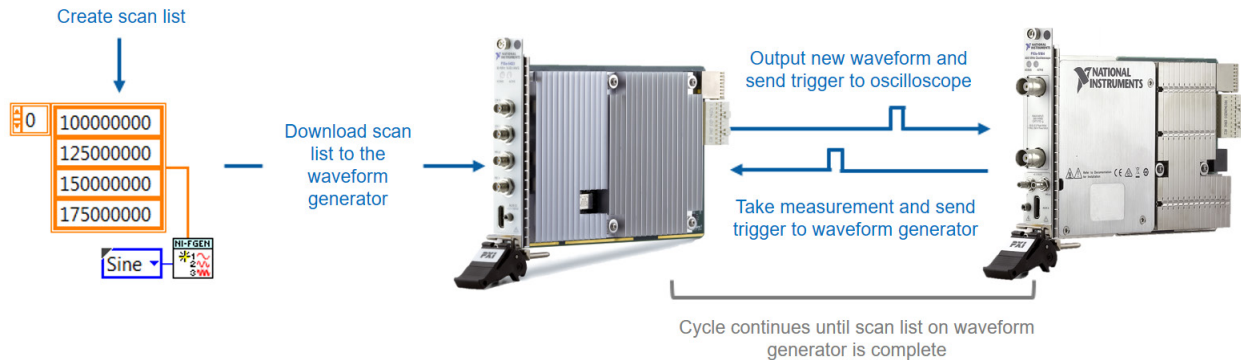
## Frequency List Mode

You can use Frequency List mode to quickly step through a predefined list of frequency values of the standard function mode and create frequency hopping and sweeping. This helps you take the host software out of the process and allows you to advance the list by using digital triggers or hardware-timed internal counters. The Frequency List mode engine adjusts the frequency in a phase-continuous manner. Because of this phase continuity, you can put together a sweep by creating a series of small steps with hardware counter timing. By using this feature, you can significantly reduce the time of tests involving a series of standard function generations without having to create arbitrary waveform sequences.



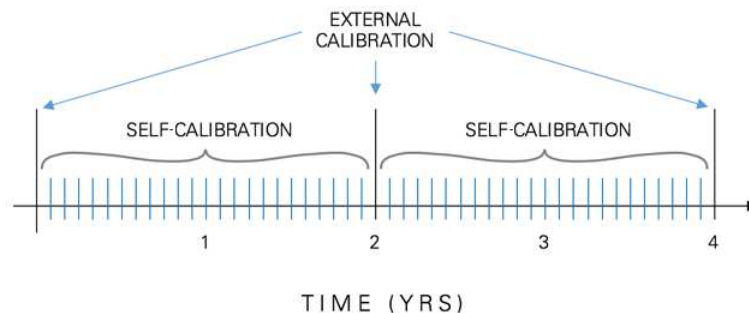
## Synchronization and Integration

NI oscilloscopes use the inherent timing and synchronization capabilities of the PXI platform to communicate with switches and other instruments within the PXI chassis. Using the timing features of the PXI chassis and additional timing software, you can achieve synchronization of <10 ps between channels of multiple oscilloscopes. NI oscilloscopes can also “handshake” with NI waveform generators by sending and receiving hardware-timed triggers over the PXI backplane, scanning through a list of frequencies in a scan list stored in memory onboard the waveform generator. This method of scanning removes the software overhead associated with traditional scan lists and can create a deterministic scan list for faster test execution with more repeatable timing.



## Self-Calibration and Two-Year Guaranteed Specifications

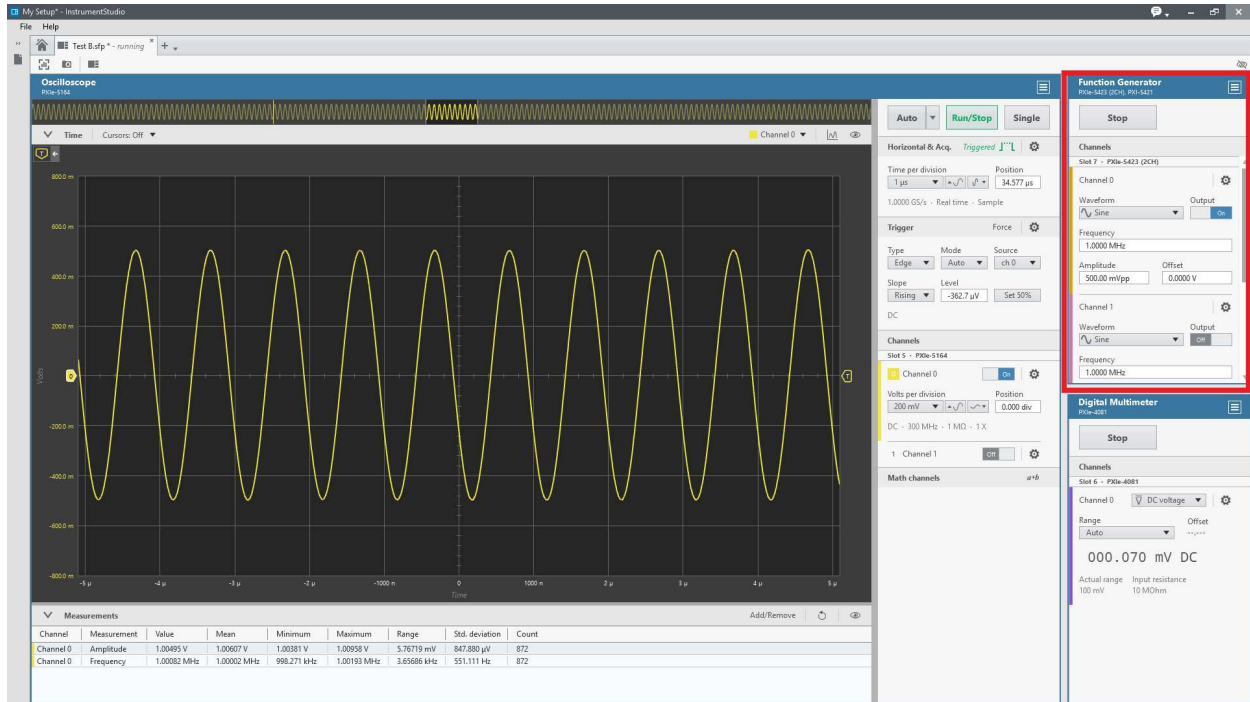
NI waveform generators offer self-calibration, which is a unique feature that corrects for all DC gain and offset drifts within the instrument using a precision analog-to-digital converter internal to the instrument. Using the self-calibration feature makes NI waveform generators highly accurate and stable at any operating temperature.



Performing self-calibration takes only a few minutes to complete and requires no external calibrator, minimizing the maintenance burden of deployed systems. Some NI waveform generators have up to a two-year external calibration cycle thanks to the self-calibration precision circuitry that minimizes the maintenance burden of deployed systems. Visit [ni.com](http://ni.com) to learn more about [NI's calibration services](#).

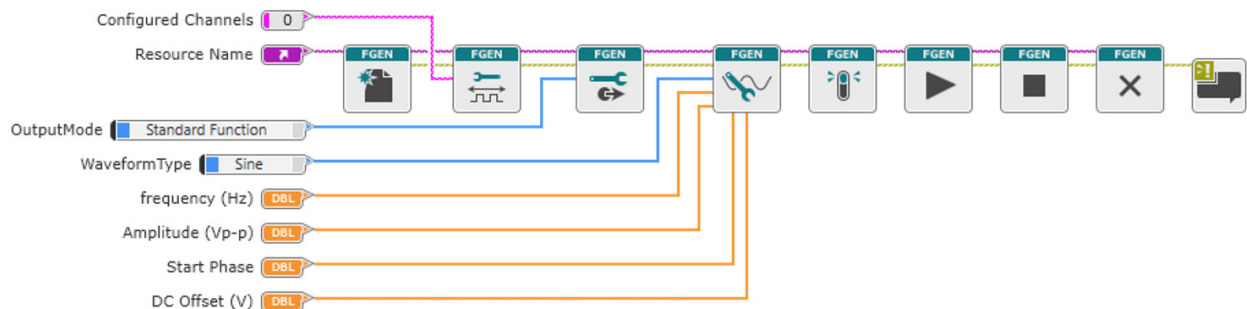
# InstrumentStudio Software for Interactive Measurements

InstrumentStudio helps you to unify your display, export instrument configurations to code, and monitor and debug your automated test system. You can view data on unified displays with large, high-resolution monitors, and then capture multi-instrument screenshots and measurement results. Save project-level configurations for easier test repeatability with specific devices under test, or export instrument configurations to programming environments to simplify your code and guarantee measurement correlation. You can also use InstrumentStudio in parallel with your code to monitor and debug running test applications. InstrumentStudio is free software included with NI-SCOPE, NI-FGEN, NI-DMM, and NI-DCPower driver downloads 18.1 and later.



## NI-FGEN Application Programming Interface (API)

In addition to the soft front panel, the NI-FGEN driver includes a best-in-class API that works with a variety of development options such as LabVIEW, C, C#, and others. To ensure long-term interoperability of waveform generators, the NI-FGEN driver API is the same API used for all past and current NI waveform generators. The driver also provides access to help files, documentation, and dozens of ready-to-run shipping examples you can use as a starting point for your application.

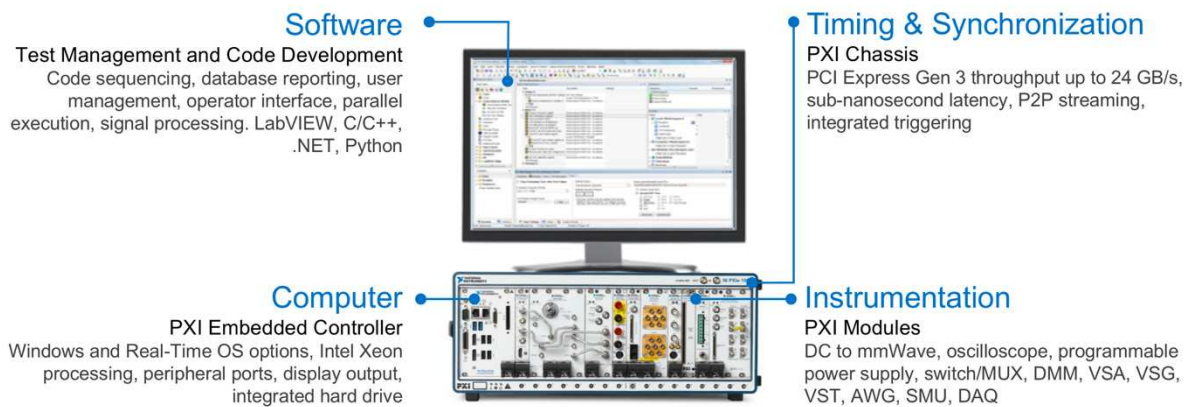




# Platform-Based Approach to Test and Measurement




## What Is PXI?

Powered by software, PXI is a rugged PC-based platform for measurement and automation systems. PXI combines PCI electrical-bus features with the 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 applications such as manufacturing test, military and aerospace, machine monitoring, automotive, and industrial test. Developed in 1997 and launched in 1998, PXI is an open industry standard governed by the PXI Systems Alliance (PXISA), a group of more than 70 companies chartered to promote the PXI standard, ensure interoperability, and maintain the PXI specification.



## Integrating the Latest Commercial Technology

By leveraging the latest commercial technology for our products, we can continually deliver high-performance and high-quality products to our users at a competitive price. The latest PCI Express Gen 3 switches deliver higher data throughput, the latest Intel multicore processors facilitate faster and more efficient parallel (multisite) testing, the latest FPGAs from Xilinx help to push signal processing algorithms to the edge to accelerate measurements, and the latest data converters from TI and ADI continually increase the measurement range and performance of our instrumentation.

<p>HIGHER DATA THROUGHPUT</p>  <p>PCI Express Gen 3</p>	<p>PARALLEL TEST EXECUTION</p>  <p>Multicore Processors</p>	<p>MEASUREMENT ACCELERATION</p>  <p>FPGAs</p>	<p>INCREASED MEASUREMENT RANGE</p>  <p>Data Converters</p>
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# PXI Instrumentation

NI offers more than 600 different PXI modules ranging from DC to mmWave. Because PXI is an open industry standard, nearly 1,500 products are available from more than 70 different instrument vendors. With standard processing and control functions designated to a controller, PXI instruments need to contain only the actual instrumentation circuitry, which provides effective performance in a small footprint. Combined with a chassis and controller, PXI systems feature high-throughput data movement using PCI Express bus interfaces and sub-nanosecond synchronization with integrated timing and triggering.



## Oscilloscopes

Sample at speeds up to 12.5 GS/s with 5 GHz of analog bandwidth, featuring numerous triggering modes and deep onboard memory



## Digital Multimeters

Perform voltage (up to 1000 V), current (up to 3A), resistance, inductance, capacitance, and frequency/period measurements, as well as diode tests



## Digital Instruments

Perform characterization and production test of semiconductor devices with timing sets and per channel pin parametric measurement unit (PPMU)



## Waveform Generators

Generate standard functions including sine, square, triangle, and ramp as well as user-defined, arbitrary waveforms



## Frequency Counters

Perform counter timer tasks such as event counting and encoder position, period, pulse, and frequency measurements



## Source Measure Units

Combine high-precision source and measure capability with high channel density, deterministic hardware sequencing, and SourceAdapt transient optimization



## Power Supplies & Loads

Supply programmable DC power, with some modules including isolated channels, output disconnect functionality, and remote sense



## FlexRIO Custom Instruments & Processing

Provide high-performance I/O and powerful FPGAs for applications that require more than standard instruments can offer



## Switches (Matrix & MUX)

Feature a variety of relay types and row/column configurations to simplify wiring in automated test systems



## Vector Signal Transceivers

Combine a vector signal generator and vector signal analyzer with FPGA-based, real-time signal processing and control



## GPIO, Serial, & Ethernet

Integrate non-PXI instruments into a PXI system through various instrument control interfaces



## Data Acquisition Modules

Provide a mix of analog I/O, digital I/O, counter/timer, and trigger functionality for measuring electrical or physical phenomena

# Hardware Services

All NI hardware includes a one-year warranty for basic repair coverage, and calibration in adherence to NI specifications prior to shipment. PXI Systems also include basic assembly and a functional test. NI offers additional entitlements to improve uptime and lower maintenance costs with service programs for hardware. Learn more at [ni.com/services/hardware](http://ni.com/services/hardware).

	Standard	Premium	Description
Program Duration	3 or 5 years	3 or 5 years	Length of service program
Extended Repair Coverage	•	•	NI restores your device's functionality and includes firmware updates and factory calibration.
System Configuration, Assembly, and Test <sup>1</sup>	•	•	NI technicians assemble, install software in, and test your system per your custom configuration prior to shipment.
Advanced Replacement <sup>2</sup>		•	NI stocks replacement hardware that can be shipped immediately if a repair is needed.
System Return Material Authorization (RMA) <sup>1</sup>		•	NI accepts the delivery of fully assembled systems when performing repair services.
Calibration Plan (Optional)	Standard	Expedited <sup>3</sup>	NI performs the requested level of calibration at the specified calibration interval for the duration of the service program.

<sup>1</sup>This option is only available for PXI, CompactRIO, and CompactDAQ systems.

<sup>2</sup>This option is not available for all products in all countries. Contact your local NI sales engineer to confirm availability.

<sup>3</sup>Expedited calibration only includes traceable levels.

## PremiumPlus Service Program

NI can customize the offerings listed above, or offer additional entitlements such as on-site calibration, custom sparring, and life-cycle services through a PremiumPlus Service Program. Contact your NI sales representative to learn more.

## Technical Support

Every NI system includes a 30-day trial for phone and e-mail support from NI engineers, which can be extended through a [Software Service Program \(SSP\)](#) membership. NI has more than 400 support engineers available around the globe to provide local support in more than 30 languages. Additionally, take advantage of NI's award winning [online resources](#) and [communities](#).

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10 December 2019