PRODUCT FLYER

PXI Timing and Synchronization Modules

CONTENTS

PXI Timing and Synchronization Modules

PXIe-6674T, PXIe-6672, PXI-6683 and PXI-6683H
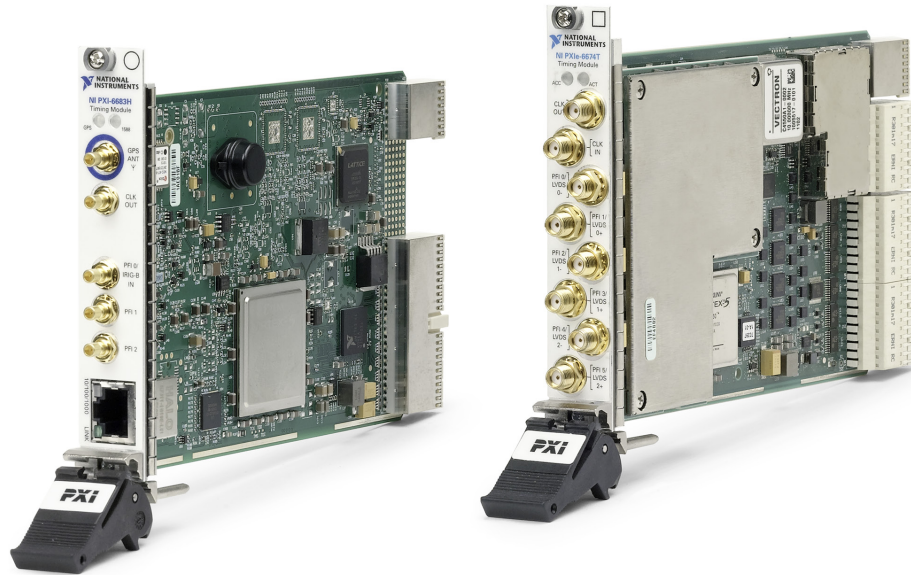
- Generate high-stability PXI system reference clocks and high-resolution sample clocks

- Minimize skew through access to PXI-star and PXIe-Dstar chassis trigger lines

- Import and export system reference clocks for synchronization between multiple chassis or external devices

- Achieve synchronization over large distance through GPS, IEEE 1588, IRIG-B or PPS

- Develop advanced timing and sync applications with NI-Sync and NI-TClk software
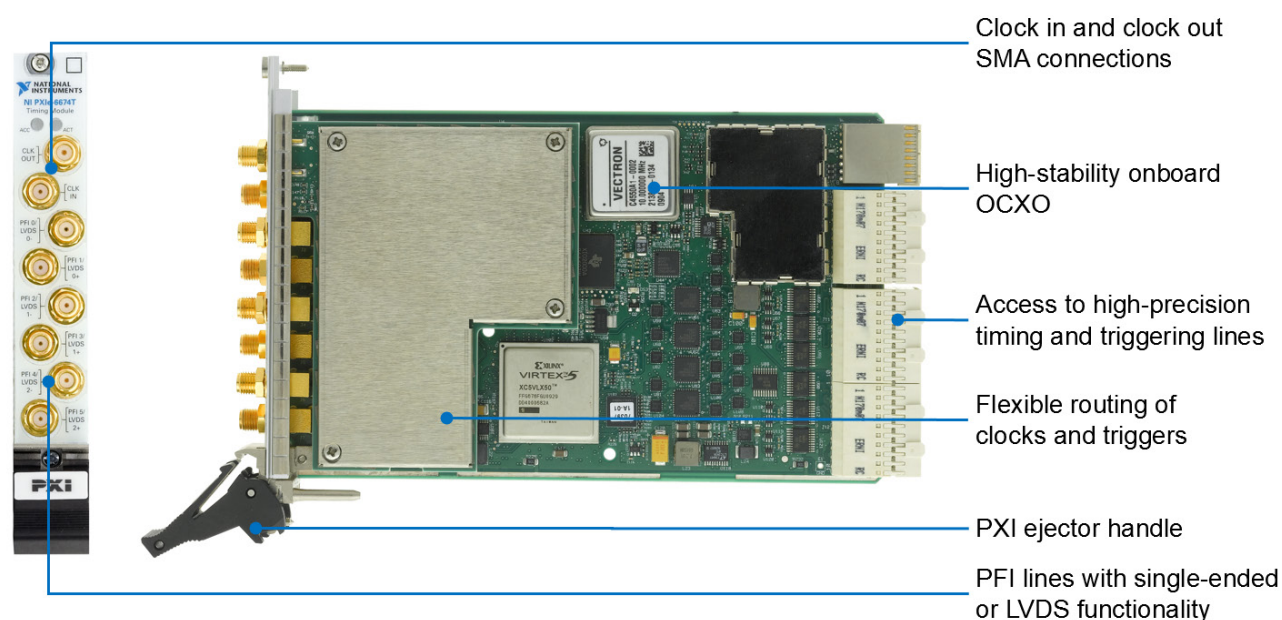
Powerful, Reliable Timing and Synchronization

NI's PXI timing and synchronization modules enable a higher level of synchronization on the PXI platform through high-stability clocks, high-precision triggering and advanced signal routing. Implementing timing and synchronization hardware can vastly improve the accuracy of measurements, provide advanced triggering schemes, and allow synchronization of multiple devices for extremely high-channel-count applications. NI's portfolio includes both signal-based and time-based solutions to deliver the advantages of synchronization to numerous applications.

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Table 1. NI offers various PXI modules to meet a range of timing and synchronization requirements.

	PXI-6683	PXI-6683H	PXIe-6672	PXIe-6674T
Slot Compatibility	PXI Timing or Peripheral Slot	PXI or PXIe Hybrid Peripheral Slot	PXIe System Timing Slot	PXIe System Timing Slot
Oscillator Accuracy*	TCXO / 3.5 ppm	TCXO / 3.5 ppm	TCXO / 3.5 ppm	OCXO / 80 ppb
DDS Clock Generation Range	Not available	Not available	DC to 105 MHz	0.3 Hz to 1 GHz
DDS Clock Generation Resolution	Not available	Not available	0.075 Hz	2.84 µHz
PXI 10MHz Backplane Clock Override	●		●	●
Clock Import Capability	●		●	●
Clock Export Capability	●	●	●	●
Time-Based Synchronization (GPS, IEEE 1588, IRIG-B, PPS)	●	●		
PXI Trigger Access (PXI_TRIG)	●	●	●	●
PXI-Star Trigger Access (PXI_STAR)	●		●	●
PXIe-Dstar Trigger Access (PXI_DSTARA/B/C)				●
Front Panel Physical Connectors	SMB, RJ45	SMB, RJ45	SMB	SMA
PFI Lines on Front Panel	3	3	6	6

*Accuracy within one year of calibration adjustment within 0 ºC and 55 ºC operating temperature range

Detailed View of PXIe-6674T

Clock in and clock out SMA connections

High-stability onboard OCXO

Access to high-precision timing and triggering lines

Flexible routing of clocks and triggers

PXI ejector handle

PFI lines with single-ended or LVDS functionality

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Key Features

High-Stability, High-Accuracy Onboard Clock

Applications requiring highly reliable and consistent clock signals require a highly stable oscillator to avoid clock inaccuracies. For an NI PXI Express chassis, the oscillator is accurate to 25 parts per million (ppm). Inserting an NI PXI timing and synchronization module into the system timing slot of the chassis enables the user to replace this backplane system reference clock using the higher accuracy oscillator of the module. The PXIe-6672 and PXI-6683 modules contain a temperature-compensated crystal oscillator (TCXO) which can achieve accuracies better than 4 ppm. The PXIe-6674T features an oven-controlled crystal oscillator (OCXO) with an accuracy of 80 parts-per-billion (ppb). Note that the PXI-6683H contains the same oscillator as the PXI-6683, but due to its hybrid connectivity is not able to override the backplane clock.
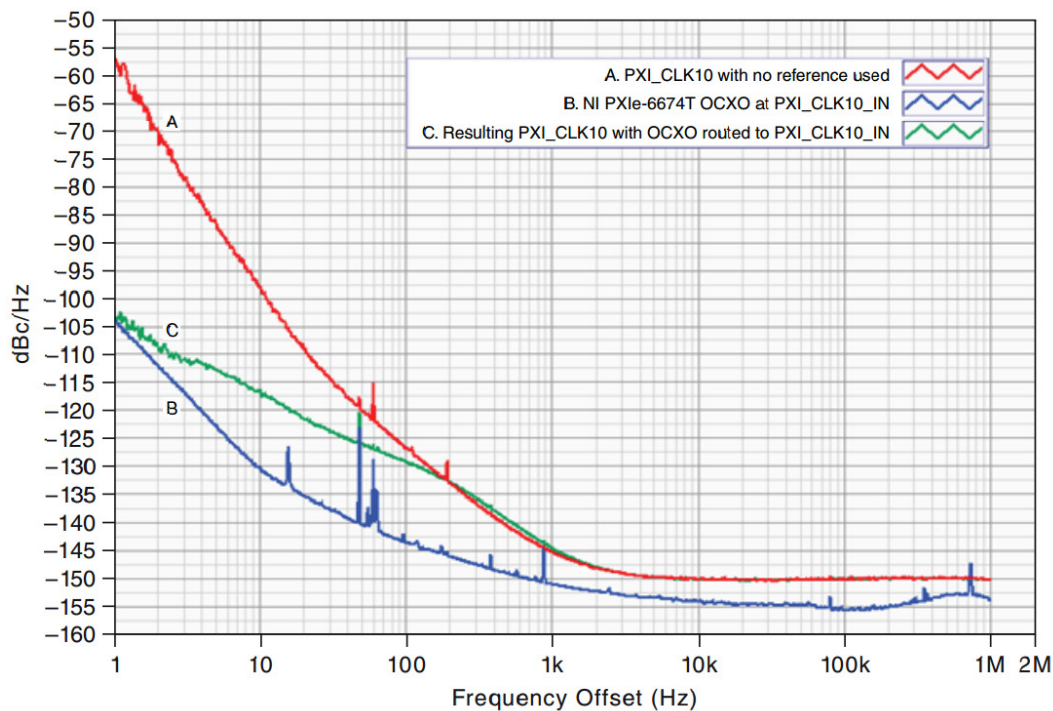

Figure 1. By referencing the OCXO on the PXIe-6674T, the 10 MHz backplane clock of a PXI chassis achieves much lower phase noise and thus more clock stability.

PXI modular instruments with phased-lock loop circuits, such as high-speed digitizers and waveform generators, can take advantage of the high-precision clock of timing and synchronization modules. When locking to a high-accuracy reference clock, the instrument inherits the accuracy of the clock, achieving sample clock resolutions as low as 0.5 Hz with an OCXO-based module.

Skew Reduction with Star and Differential Star Lines

Due to the variation in signal path lengths between slots in a PXI chassis, skew may be introduced when sending clocks or triggers to multiple slot destinations over the PXI trigger bus. To address this, all NI PXI chassis also include trace-length-matched star trigger lines accessible from a timing and synchronization module in the system timing slot. Star trigger lines can reduce skew to a maximum of 1 ns. Additionally, PXI Express chassis include differential star trigger lines capable of minimizing slot-to-slot skew to under 150 ps.
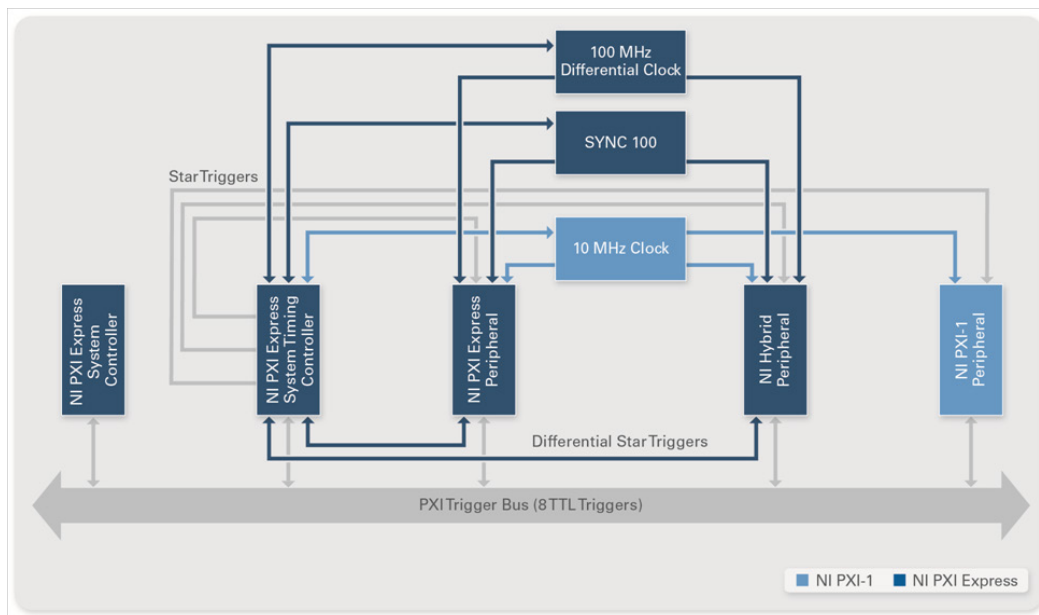

Figure 2. While every slot of the PXI backplane may access the PXI trigger bus, the star trigger lines and differential star trigger lines are only accessible through the system timing slot.

Time-Based Synchronization with GPS, IEEE 1588, IRIG-B or PPS

The NI PXI-6683 and PXI-6683H timing and synchronization modules synchronize PXI and PXI Express systems through time-based technology or protocols. Time-based modules can generate triggers and clock signals at programmable future times and timestamp input events with the synchronized system time including that of real-time systems. For PXI Express systems requiring time-based synchronization with backplane clock discipline or star trigger access, the PXI-6683H can be combined with the PXIe-6674T or PXIe-6672 to provide a full-featured synchronization solution.
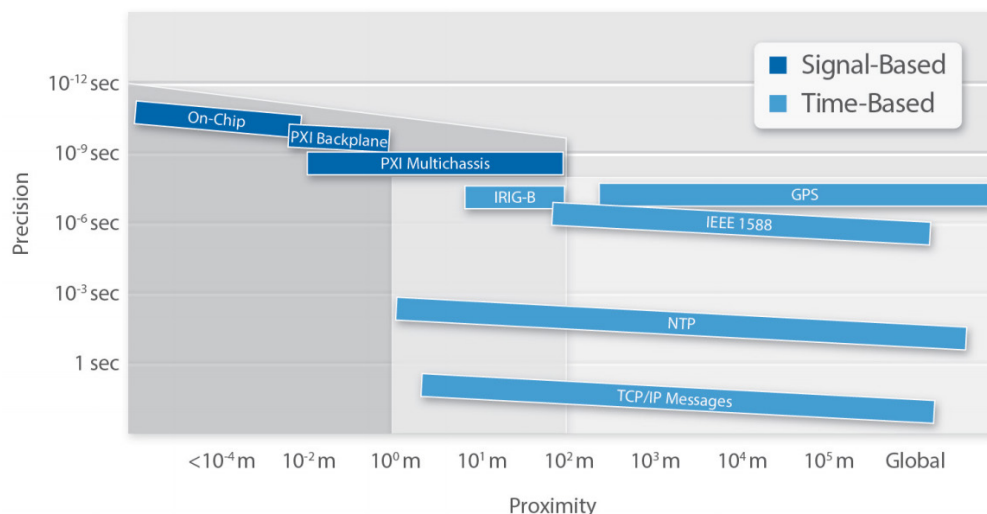
Advanced Routing of Clocks and Triggers

Using a PXI timing and synchronization module provides the capability of advanced routing of clock and trigger signals. Through the combination of system timing slot access and FPGA-based routing, many more source-to-destination routes become possible, allowing more flexible designs and efficient use of system resources.

Table 2. The PXIe-6674T timing and synchronization module features a wide vaiety of source-to-destination routes by combining the power of the PXI Express architecture with the signal-routing capabilities of the onboard FPGA.

Destination

Source	CLK OUT	PFI <0..5>	PFI LVDS <0..2>	PXI CLK 10 IN	PXI STAR <0..16>	PXI TRIG <0..7>	PXIe SYNC CTRL	DSTARA <0..16>	DSTARB <0..16>	OCXO Ref PLL
CLK_IN	•	•	•	•	•	•		•	•	•
PFI <0..5>		•	•		•	•	•		•	
PFI LVDS<0..2>		•	•		•	•	•	•	•	
PXI CLK 10	•	•	•		•	•			•	
PXI CLK 100	•	•	•		•	•			•	
PXI_STAR<0..16>		•	•		•	•	•		•	
PXI TRIG<0..7>		•	•		•	•	•		•	
DSTAR_C<0..16>		•	•		•	•	•	•	•	
OCXO	•	•	•	•	•	•			•	
Clock Gen	•	•	•		•	•		•	•	
Global Software Trigger		•	•		•	•	•		•	

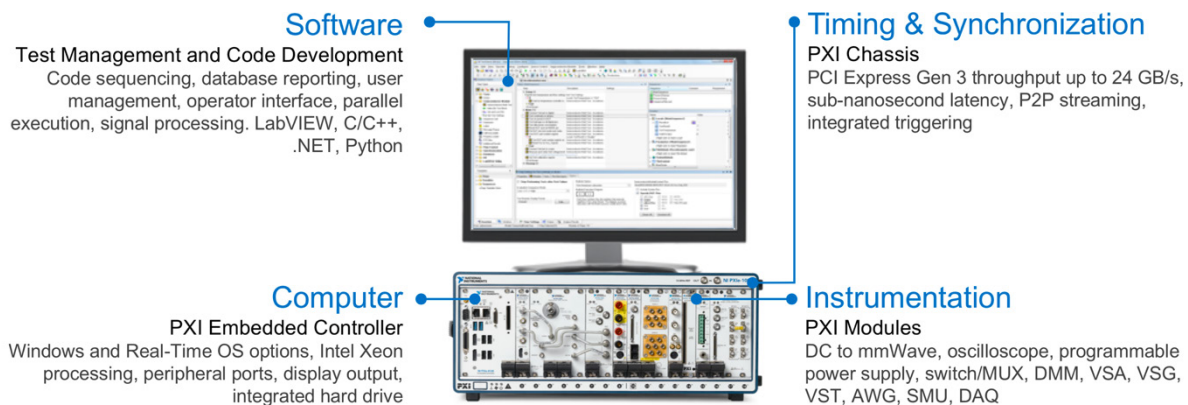# NI-Sync Application Programming Interface (API)

The NI-Sync driver allows configuration of system timing and synchronization through LabVIEW, C, or .NET. This includes signal-based synchronization, such as sharing triggers and clocks to be used directly, or time-based synchronization, using time protocols such as IEEE-1588, IRIG, or GPS for non-tethered systems. NI-Sync is designed for use with other NI drivers, such as NI-DAQmx, for advanced timing, high channel count, distributed or multiple-instrument applications.

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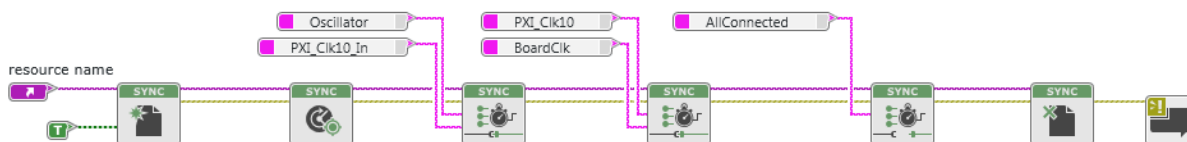
# Platform-Based Approach to Test and Measurement

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.

Software
Test Management and Code Development
Code sequencing, database reporting, user management, operator interface, parallel execution, signal processing. LabVIEW, C/C++, .NET, Python

Timing & Synchronization
PXI Chassis
PCI Express Gen 3 throughput up to 24 GB/s, sub-nanosecond latency, P2P streaming, integrated triggering

Computer
PXI Embedded Controller
Windows and Real-Time OS options, Intel Xeon processing, peripheral ports, display output, integrated hard drive

Instrumentation
PXI Modules
DC to mmWave, oscilloscope, programmable power supply, switch/MUX, DMM, VSA, VSG, VST, AWG, SMU, DAQ

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.

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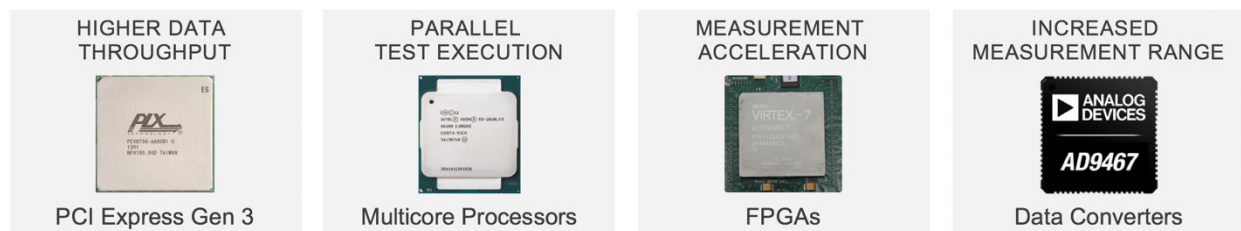
PXI Instrumentation

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

GPIB, 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

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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.

	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[1]	•	•	NI technicians assemble, install software in, and test your system per your custom configuration prior to shipment.
Advanced Replacement[2]		•	NI stocks replacement hardware that can be shipped immediately if a repair is needed.
System Return Material Authorization (RMA)[1]		•	NI accepts the delivery of fully assembled systems when performing repair services.
Calibration Plan (Optional)	Standard	Expedited[3]	NI performs the requested level of calibration at the specified calibration interval for the duration of the service program.

[1]This option is only available for PXI, CompactRIO, and CompactDAQ systems.
[2]This option is not available for all products in all countries. Contact your local NI sales engineer to confirm availability.
[3]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 sparing, 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.

10 December 2019

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