Product Flyer

PXI LCR Meters

Contents

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PXIe-4190

FIGURE 1

PXIe-4190 LCR Meter and SMU

- Femtofarad-class LCR measurements
- Stimulus frequency up to 2 MHz
- Stimulus amplitude up to 7.07 V_{rms}, 70.7 mA_{rms}
- DC bias up to ± 40 V (AC + DC)
- Coaxial, triaxial, and DSUB breakout cables
- Femtoamp-class SMU measurements
- Source/sink up to ±40 V, ±100 mA
- Current sensitivity down to 1 fA
- Software: Includes interactive soft front panel, API support for LabVIEW and text-based languages, shipping examples, and detailed help files

Built for Automated Test and Measurement

NI LCR meters combine high-accuracy LCR measurements, including complex impedance ($|Z|$ & $\angle\theta$) and various mathematical derivative values, with high-precision source measure unit (SMU) capabilities into a single instrument. With the combination of LCR and SMU capabilities into a small footprint you can use the same instrument for both DC and impedance measurements without a switch, simplifying connectivity and ease of use. Additionally, the NI-DCPower driver API gives you flexible configuration options to optimize your LCR measurements for accuracy or speed. You can use this combination of features of the NI LCR meters in a wide range of applications for validating, characterizing, or testing passive components (e.g. multi-layer ceramic capacitors, integrated passive devices, etc.), MEMS structures, ultrasonic ADAS sensors, and wafer parametric research/test.

NI LCR meters are optimized for building automated test systems, with hardware features to reduce test execution time and tight software integration to reduce development effort. Built on the modular PXI platform, NI LCR meters can be combined with other instruments such as oscilloscopes, RF generators and analyzers, and digital instruments to build mixed-signal test systems with multi-core processors and low latency communication. Additionally, the modularity and channel density of these instruments allow you to build systems that test multiple devices in parallel and improve the throughput of each tester.

Table 1. PXI LCR Meters Options

	PXIe-4190	PXIe-4190
Maximum AC Stimulus Frequency (MHz)	2	0.5
Maximum AC Stimulus Amplitude (V$_{rms}$)	7.07	
Maximum AC Current (mA$_{rms}$)	7.07	
Maximum DC Bias Voltage – AC + DC (V)	40	10
LCR Measurement Basic Accuracy (%)	0.05	
SMU Maximum DC Voltage (V)	40	10
SMU Maximum DC Current (mA)	100	
SMU Current Sensitivity (fA)	1	0.001
SourceAdapt Custom Transient Response	●	
2nd Order Noise Rejection	●	
Connectivity	DSUB with breakouts for Coaxial and Triaxial	

Detailed View of a PXI LCR Meter

FIGURE 2

PXIe-4190

Key Features

Channel Density and Scalability

LCR and SMU channel density is increasingly important for multi-site testing and for improving test throughput in applications like production test of multi-layer ceramic capacitors (MLCCs) or integrated passive devices (IPDs). The modularity of the PXI platform allows you to optimize the size of your test system and number of parallel LCR or SMU channels by choosing the appropriate chassis and instruments. In a single PXI chassis, you can add up to 17 LCR meter and SMU channels with the PXIe-4190 or combine with other types of instruments to build tightly integrated mixed signal test systems. For even larger systems, you can mount multiple chassis in an automated test rack and combine them together with PXI remote control modules.

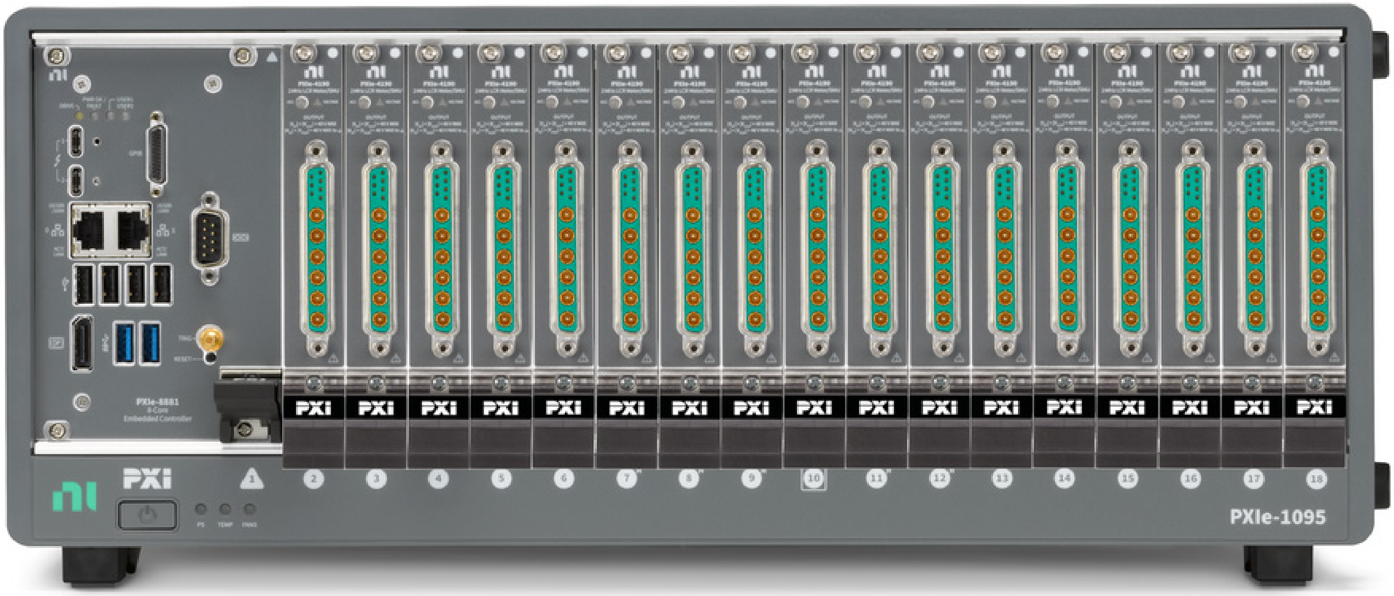


FIGURE 3

You can add up to 17 LCR meter and SMU channels in a single 4U, 19-inch PXI chassis.

Hardware-Timed Sequencing and Triggering

NI LCR meters have a hardware-timed, deterministic sequencing engine that allows the instrument to execute commands and acquire data without any intervention from the host software. This eliminates the software overhead and jitter associated with software-controlled sequences and reduces the execution time of your overall test. Within these hardware-timed sequences, you can modify over 30 properties such as AC stimulus frequency, AC stimulus amplitude, DC voltage bias, measurement time, and impedance range to optimize each step within your sequence.

Each LCR meter has numerous triggers and events such as source trigger, measure trigger, and measure complete, that you can share via the backplane of the PXI chassis to communicate between different instruments. This allows you to synchronize the start of multiple LCR meters, create nested sweeps, or send/receive commands from other instruments like oscilloscopes and RF analyzers.

High-Speed Measurement and Update Rate

The NI PXIe-4190 provides flexible measurement time settings, including preset options (100 ms for slow, 10 ms for normal, and 1 ms for fast) and the ability to choose custom values outside of these three preset values. This allows you to review the measurement noise specs and choose an acceptable level of noise to optimize between measurement accuracy and speed.

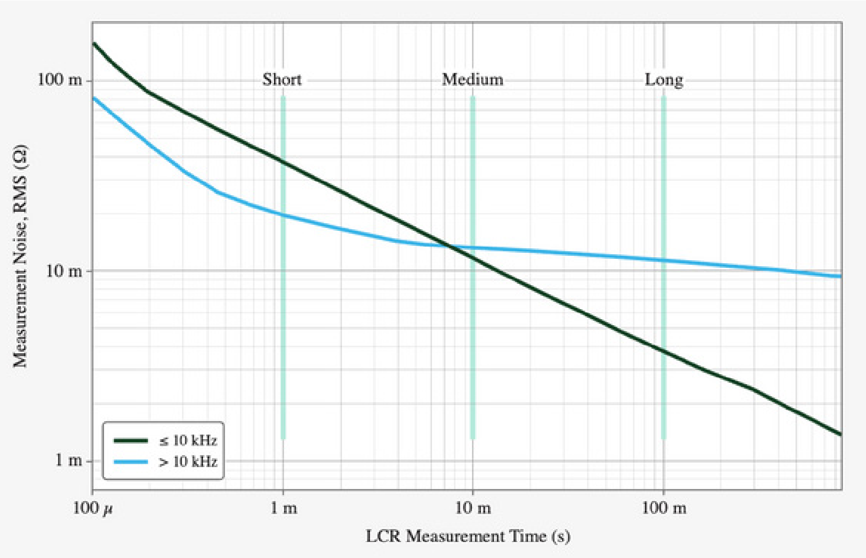


FIGURE 4

Choose the right balance of speed and accuracy by customizing the measurement time.

As an SMU, the NI PXIe-4190 can sample up to 600 kS/s and source up to 100 kS/s, which adds new functionality to a traditionally DC instrument. The high-speed sampling rate allows you to use the SMU as a high voltage or current digitizer to capture transient behavior or monitor current consumption over time. The fast update rate allows you to step through large sequences very quickly or use the SMU to generate arbitrary waveforms at low frequencies. Since NI SMUs communicate and share data via a high bandwidth, low latency PCI express interface, you can use the full update and sampling rate of the instrument to stream data to and from the host PC. This functionality is transparent to the user and does not require you to configure a buffer, allocate memory, or pause your acquisition and wait for data to transfer from the instrument to the host.

High-Precision, High-Accuracy Measurements

NI LCR meters are built with a combination of off-the-shelf high-speed and high-precision data converter technology to provide low noise measurements across a wide range of LCR meter stimulus frequencies and SMU measurement speeds. This design results in high-accuracy LCR measurements at higher AC stimulus frequencies (10 kHz to 2 MHz) and low frequencies (<10 kHz). Additionally, you can perform short, open, and load compensation routines to compensate errors caused by residual impedance (L, R) or stray admittance (C, G) of the signal path.

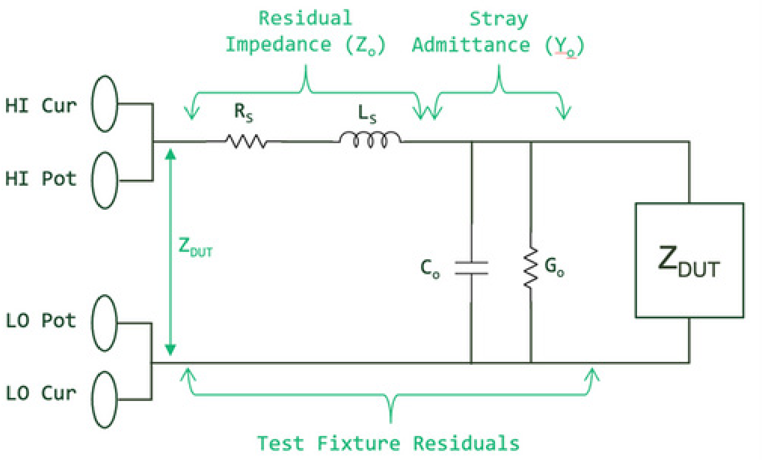


FIGURE 5

Perform short, open, and load compensation routines to compensate for impedance of the signal path

NI LCR meters include a built-in self-calibration feature that corrects for time and temperature drift by recalculating certain internal reference values, gains, and offsets. This method significantly improves accuracy over the full operating temperature range of the device by reducing sources of error such as gain and offset error for voltage and current. For high accuracy devices with +/- 1 °C specifications, the self-calibration routine helps ensure your device is operating within 1 degree of its calibrated temperature and that you can apply the tighter accuracy specifications. The self-calibration routine takes less than 10 seconds to complete and can be called programmatically from your application software.

SourceAdapt Digital Control Loop Technology

SourceAdapt is a digital control loop technology that gives you the ability to optimize the SMU response for any device under test (DUT). This provides fast and stable measurements for a variety of loads, even highly capacitive or inductive loads, and prevents damage to your DUT by removing harmful overshoots and oscillations. By allowing complete customization of the SMU response, this technology allows you to remove unwanted characteristics of the instrument while still maintaining a fast settling time – all without adding any custom circuitry between the instrument and the load. Because this capability is handled programmatically, you can quickly reconfigure your SMU for high speed or high stability testing and maximize the usage of your instrument.

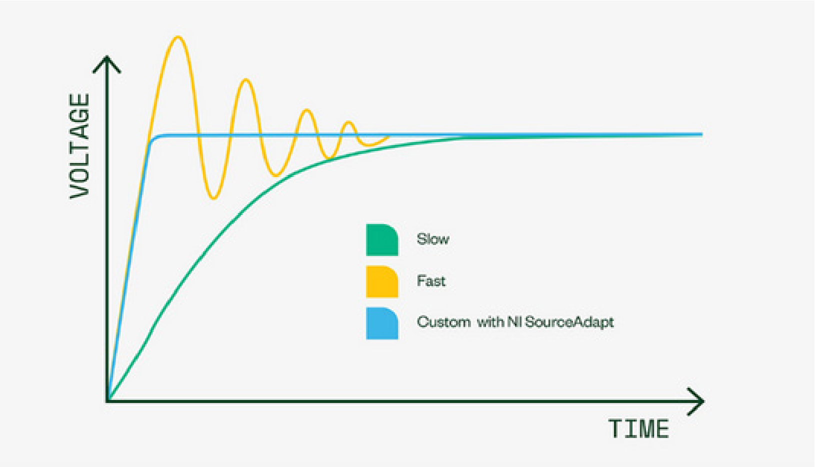


FIGURE 6

SourceAdapt gives you the ability to optimize the SMU response for any DUT.

Software

NI-DCPOWER API

In addition to the soft front panel, the NI-DCPower driver includes a best-in-class API that works with a variety of development options such as LabVIEW, C/C++, C#, and others. To ensure long-term interoperability of LCR Meters and other power instruments, the NI-DCPower driver API is the same API used for all past and current power instruments. 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.

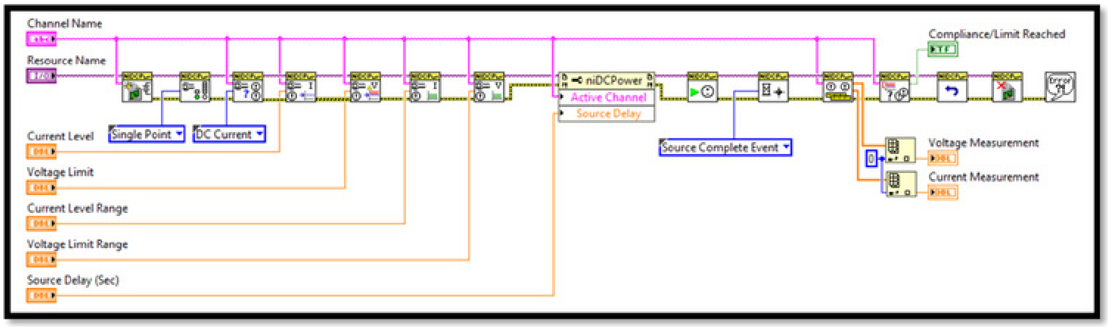


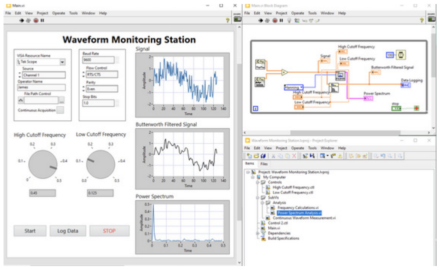
FIGURE 7

LabVIEW VI using the DC-Power API.

NI Software-The Right Tool for the Job

NI has a variety of software for engineers working on research, validation, and production test applications. Learn about our software that helps engineers perform quick ad-hoc tests, build an automated test system, automate data analysis and reporting, develop test sequences, and more.

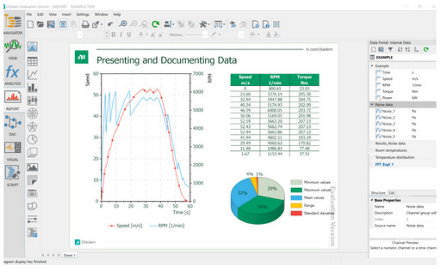
LabVIEW



Graphical programming environment that engineers use to develop automated research, validation, and production test systems.

- Acquire data from NI and third-party hardware and communicate using industry protocols
- Use configurable, interactive display elements
- Take advantage of available analysis functions

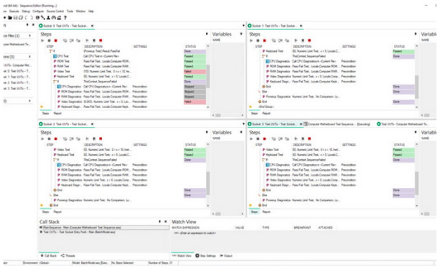
DIAdem



Data analytics software for measurement data search, inspection, analysis, and automated reporting.

- Display data in multiple 2D-axis systems
- Perform calculations with a simple point-and-click interface
- Automate your measurement data analysis workflow, from import to analysis

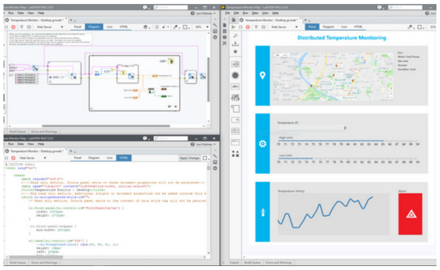
TestStand



Test executive software that accelerates system development for engineers in validation and production.

- Call and execute tests in LabVIEW, Python, C/C++, or .NET
- Conduct complex tasks, such as parallel testing
- Create customer operator interfaces and robust tools for deployment and debugging

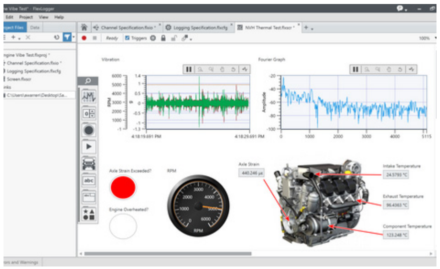
G Web



Development software that helps engineers create web-based user interfaces wihtout the need for traditional web development skills.

- Data transfer APIs for connecting to systems written in LabVIEW, Python, or C#
- Pre-built objects for data display and user input
- Included hosting on SystemLink™ Cloud

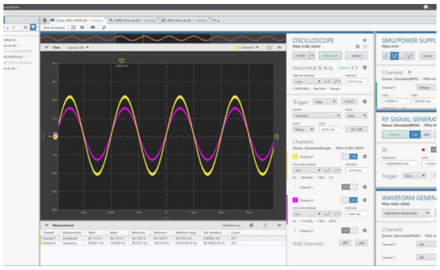
FlexLogger™



No-code data acquisition software engineers use to build validation and verification test applications.

- Interactive visualization tools for monitoring tests with drag-and-drop charts, graphs, and controls
- Ability to set alarms that monitor single channels or groups for unexpected behavior

InstrumentStudio™



Application software that simplifies setup and configuration of NI PXI hardware

- Customizable layouts for monitoring multiple instruments at once
- Interactively debug in tandem with code
- TDMS file export containing instrument settings, measurements, and raw data

Supporting Documentation

Table 2. PXI LCR Meter Documentation

Document Type	Model
Getting Started Guide	PXIe-4190
Specifications	PXIe-4190

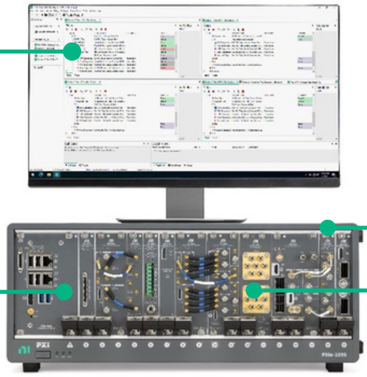
Configure a Custom NI System

NI's online system advisors help you create a custom system based on your specific requirements. Use the advisor to choose compatible hardware, software, accessories, and services and then save your selections as configurations for easy quoting and purchasing later. Visit ni.com/advisor to learn more.

What Is PXI?

A Platform Approach to Test and Measurement

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 and 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

Integrated with 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

PCI Express Gen 3

PARALLEL TEST EXECUTION

Multicore Processors

MEASUREMENT ACCELERATION

FPGAs

INCREASED MEASUREMENT RANGE

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 Instruments

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

Frequency Counters

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

Power Supplies & Loads

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

Switches (Matrix & MUX)

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

GPIB, Serial, & Ethernet

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

Digital Multimeters

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

Waveform Generators

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

Source Measure Units

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

FlexRIO Custom Instruments & Processing

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

Vector Signal Transceivers

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

Data Acquisition Modules

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

NI 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.

	Hardware	Standard	Premium	Description
Duration at Point of Sale	1 year; included	3 years; optional	3 years; optional	NI enhances warranty coverage with additional service benefits provided with a hardware service program.
Maximum Duration with Renewal	≤3 years with service program	≤3 years	≤3 years	NI maintains the high performance and availability of your hardware for up to three years with a hardware service program.
Extended Repair Coverage	•	•	•	NI restores your device's functionality and includes firmware updates and factory calibration; < 10 working days[4] + standard shipping.
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.
Technical Support	•	•	•	NI provides access to support resources for your hardware.
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 is only available for the Traceable calibration level.
4 This applies to non-RF products only. Standard extended repair coverage for RF products is <15 working days + standard shipping.

PremiumPlus Service Program

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

Technical Support

NI hardware service programs and warranty include access to technical support provided by NI support agents during local business hours. Service requests can be managed online. Additionally, take advantage of NI's award-winning online resources and communities.