Product Flyer

PXI High-Speed Serial Instruments

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Contents

PXI High-Speed Serial Instruments

PXIe-6591, PXIe-6592, PXIe-6593, PXIe-6594, PXIe-7902, and PXIe-7903

FIGURE 1

From left to right, the PXIe-7902, PXIe-7903, and PXIe-6594.

- Software: API support for LabVIEW, ANSI C, shipping examples, and detailed help files
- Up to 48 Xilinx MGT (Multigigabit Transceivers) with line rates up to 28.2 Gbps
- Ability to implement various high-speed serial protocols on the user-programmable Xilinx Kintex UltraScale[JC1] + or 7 series FPGAs
- Up to 20 GB onboard DDR3 DRAM
- High-speed P2P backplane data streaming up to 7 GB/s to host, disk, or other PXI Express modules

Built for Automated Test and Measurement

PXI High-Speed Serial Instruments help engineers validate, interface through, and test high-speed serial protocols. Select high-speed serial devices, such as the PXIe-7903 and PXIe-7902, were designed for engineers who need high-performance FPGA co-processing capabilities to achieve high volume data movement and in-line, real-time signal processing. They consist of Xilinx Kintex UltraScale+ or 7 series FPGAs and are programmable in LabVIEW FPGA for maximum application-specific customization and reuse. These instruments take advantage of multigigabit transceivers (MGTs) to support line rates up to 28.2 Gbps, up to 48 TX and RX lanes, and up to a combined data rate over 1 Tb/s. As part of the PXI platform, they benefit from PXI clocking, triggering, and high-speed data movement capabilities, including streaming to and from disk, as well as peer-to-peer (P2P) streaming at rates up to 7 GB/s.

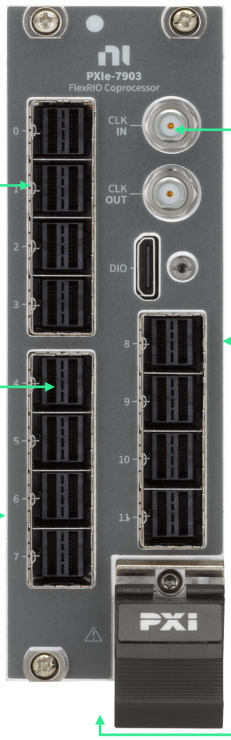
Included with the driver support are reference designs of Gigabit Ethernet, 10 Gigabit Ethernet, Xilinx Aurora 64b/66b, and JESD204 protocols. There are additional reference designs for other protocols within the NI ecosystem. In addition, existing IP for standard or custom protocols can be imported through LabVIEW, guaranteeing compatibility with the device under test (DUT).

Comparison of PXI High-Speed Serial Instruments

	PXIe-6591	PXIe-6592	PXIe-6593	PXIe-6594	PXIe-7902	PXIe-7903[2]
Line Rate	500 Mbps-12.5 Gbps[1]	500 Mbps-10.3125 Gbps[1]	500 Mbps-16.3 Gbps	500 Mbps-28.2 Gbps	500 Mbps-12.5 Gbps[1]	500 Mbps-28.2 Gbps
Channels	8 TX/RX	4 TX/RX	8 TX/RX	8 TX/RX	24 TX/RX	48 TX/RX
FPGA	Kintex-7 K410T	Kintex-7 K410T	Kintex UltraScale KU040, KU060	Kintex UltraScale+ KU15P	Virtex-7 485T	Virtex UltraScale+ XCVU11P
DRAM	2 GB	2 GB	4 GB	8 GB	2 GB	20 GB
Host Streaming BW	3.2 GB/sec	3.2 GB/sec	7 GB/sec	7 GB/sec	3.2 GB/sec	7 GB/sec
Connector	Mini-SAS HD	SFP+	QSFP28	QSFP28	Mini-SAS HD	Mini-SAS HD
Cabling Options	Copper or Optical	Copper or Optical	Copper or Optical	Copper or Optical	Copper or Optical	Copper or Optical
Aux DIO	20 SE	4 SE	8 GPIO	8 GPIO	N/A	8 GPIO

Table 1: NI offers variants of High-Speed Serial Instruments for different density, connectivity, and speed requirements.
[1]Gap in achievable line rates between 8 Gbps and 9.8 Gbps
[2]The PXIe-7903 is a 2-slot module

Detailed View of PXIe-7903 High-Speed Serial Instrument



Data Movement with Ethernet Protocols
100 GbE and Aurora 64b/66b

High-Speed Serial Interface
12 MiniSAS zHD Connectors
48 RX/TX with 28.2 Gbps line rate
Up to 1.35 Tb/s of data transfer

User Programmable FPGA
Customize applications with LabVIEW FPGA or integrate existing IP from languages such as VHDL

Multi-Instrument Synchronization
External Reference Clock Input/Output

High-Performance FPGA
Xilinx Virtex UltraScale+ VU11P FPGA
9,200+ DSP slices
20 GB of DRAM with up to 25 GB/s write speed
341 Mb of Embedded Block and Ultra RAM

Compact Form Factor
Requires only 2 PXI slots

The PXIe-7903 High-Speed Serial Instrument was built to maximize data movement and computational power. Like the PXIe-7902, the PXIe-7903 is designed for engineers who need high-performance FPGA co-processing capabilities to achieve high volume data movement and in-line, real-time signal processing. It includes a Xilinx Virtex UltraScale+ FPGA and supports line rates up to 28 Gbps with up to 48 TX and RX lanes. With a PCI Express Gen 3 x8 interface, its P2P streaming rates reach up to 7 GB/s. The PXIe-7903 can be used in applications that demand extremely high levels of data throughput and processing power, oftentimes used in tandem with the PXI Vector Signal Transceiver.

For more information about example applications, other modules, and high-speed serial in general, visit An Introduction to NI High-Speed Serial Instruments.

Key Advantages of High-Speed Serial Instruments

Protocol Flexibility

PXI High-Speed Serial Instruments leverage Xilinx FPGAs and flexible clocking circuitry to implement a variety of both standard and custom high-speed serial protocols. Through Xilinx Vivado and LabVIEW FPGA, users can import their own VHDL, Verilog, or net-listed IP to implement their DUT's protocol on these instruments.

A low-jitter, high-fidelity reference clock is a critical component of any high-speed serial communications system. All modules have an onboard, any-rate synthesizer for MGT operation over the full range of the Xilinx GTX transceivers, with the PXIe-6591, PXIe-6592, and PXIe-7902 operating from 500 Mbps to 8 Gbps and 9.8 Gbps to their maximum device rates, while the PXIe-6593, PXIe-6594, and PXIe-7903 operate with no such gap between their minimum and maximum line rates. The PXIe-6591, PXIe-6592, PXIe-6593, and PXIe-6594 feature front panel coaxial connectivity for exporting the built-in reference clock, and all four modules have connectivity for importing an external reference clock. Finally, the devices can route the PXI Express 100 MHz or DStarA backplane clocks as a reference for the MGTs.

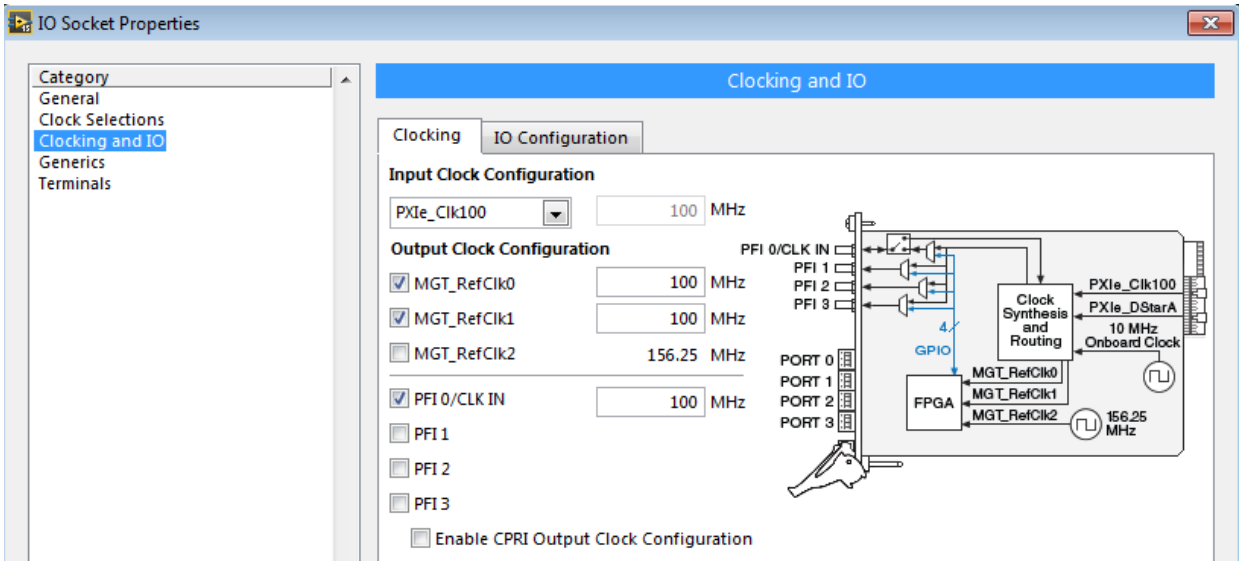


FIGURE 1

PXI High-Speed Serial Instruments feature ultimate clocking flexibility through a configuration-based utility to derive MGT reference clocks for any standard or custom protocol.

For more information about High-Speed Serial Instruments' flexibility with protocols, visit this demonstration: Building a Multiprotocol Capable Test System for Manufacturing and Depot Test Applications.

Program FPGAs with LabVIEW

The LabVIEW FPGA module is an add-on to LabVIEW that extends graphical programming to FPGA hardware and provides a single environment for algorithm capture, simulation, debugging, and compilation of FPGA designs. Traditional methods of programming FPGAs require intimate knowledge of hardware design and years of experience working with low-level hardware description languages. Whether you come from this background or you have never programmed an FPGA, LabVIEW offers substantial productivity improvements that allow you to focus on your algorithms, not the complex glue that holds your design together. For more information on programming FPGAs with LabVIEW, see LabVIEW FPGA Module.

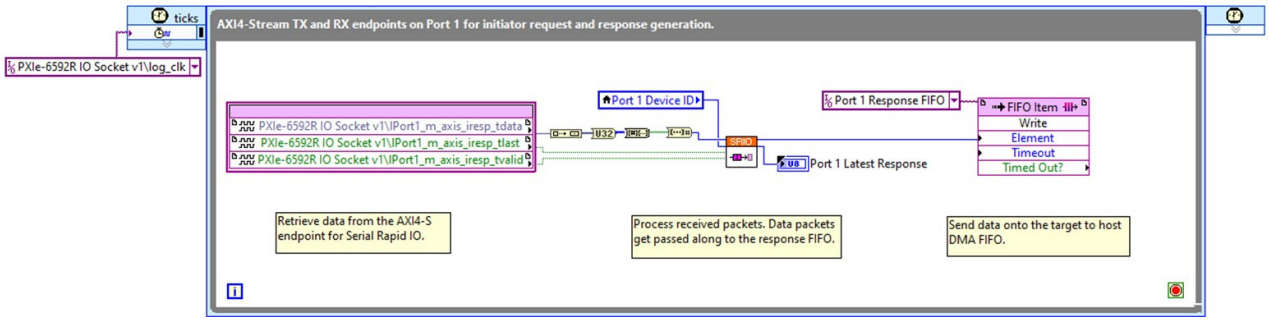


FIGURE 2

Program how you think. LabVIEW FPGA provides a graphical programming approach that simplifies the task of interfacing to I/O and processing data, greatly improving design productivity and reducing time to market.

Program FPGAs with Vivado

Experienced digital engineers can use the Vivado Project Export feature included with LabVIEW FPGA to develop, simulate, and compile for high-speed serial hardware with Vivado. You can export all the necessary hardware files for a design to a Vivado Project that is pre-configured for your specific deployment target. Any LabVIEW signal processing IP used in the LabVIEW design will be included in the export; however, all NI IP is encrypted. You can use Vivado Project Export on all high-speed serial and FlexRIO devices with 7 series or newer FPGAs.

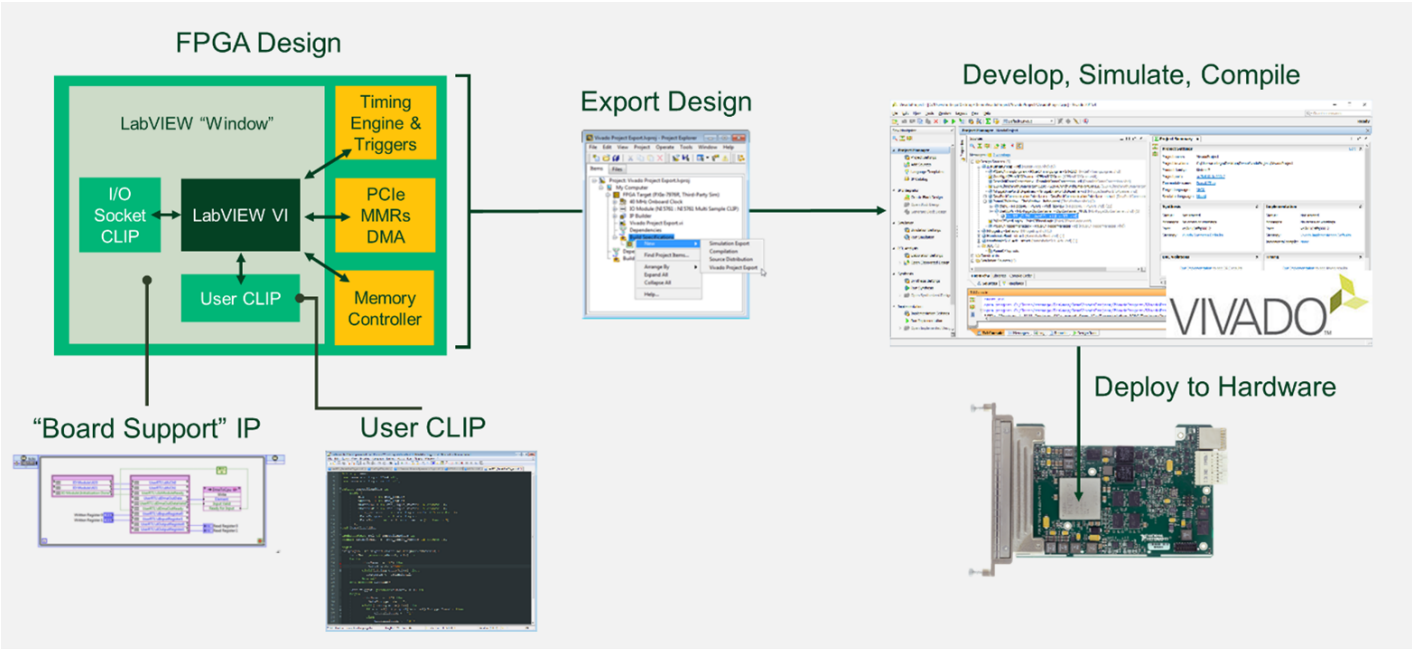


FIGURE 3

For experienced digital engineers, the Vivado Project Export feature allows for exporting all necessary hardware design files to a Vivado project for development, simulation, and compilation.

Data Streaming

As part of the PXI platform, High-Speed Serial Instruments benefit from PXI high-speed data movement capabilities. The modules have a PCI Express Gen 3 x8 interface, which enables sustained data streaming rates of 7 GB/s unidirectional and 2.4 GB/s bidirectional to or from a host processor or other instruments that support P2P streaming. Combined with NI RAID products, the High-Speed Serial Instruments excel at stream-to-disk or digital record and playback applications.

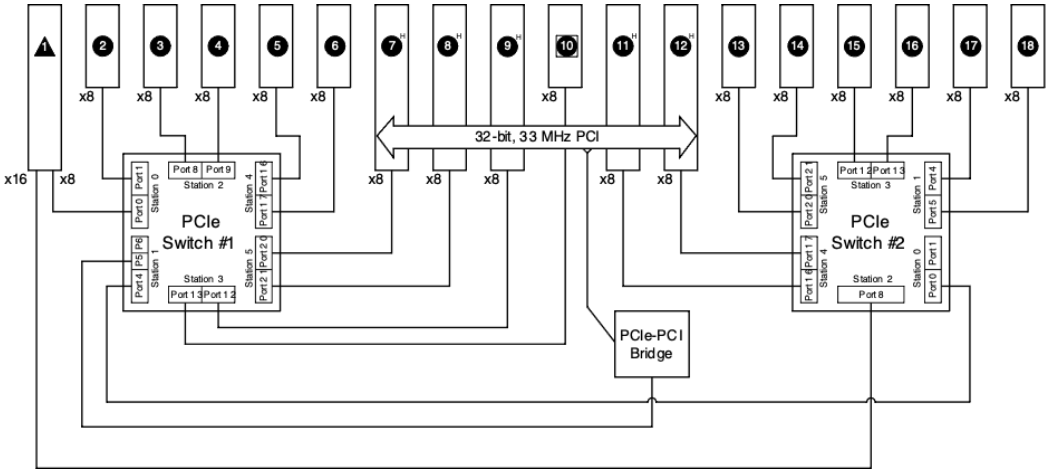


FIGURE 4

NI P2P technology enables point-to-point data communication between modules in a PXI Express chassis, bypassing the host controller and greatly reducing latency and increasing determinism.

Synchronization and Integration

PXI High-Speed Serial Instruments use the inherent timing and synchronization capabilities of the PXI platform to communicate with other instruments within the PXI chassis. A PXI chassis incorporates a dedicated 10 MHz system reference clock, PXI trigger bus, star trigger bus, and slot-to-slot local bus, while a PXI Express chassis adds a 100 MHz differential system clock, differential signaling, and differential star triggers to address the need for advanced timing and synchronization. Reference clocks for the FPGA and MGTs can be locked to the same reference clock as other instruments in the PXI Chassis to prevent drift, and triggers can be imported and exported to synchronize acquisition and generation with other instruments.

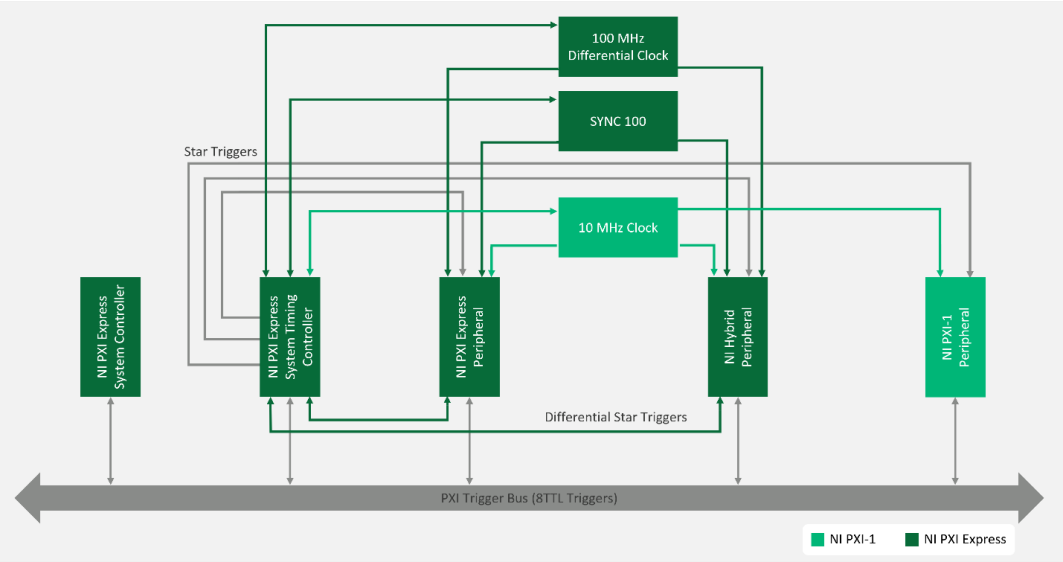


FIGURE 5

PXI High-Speed Serial Instruments lock to the 100 MHz differential clock to stay aligned with other instrumentation in the PXI chassis and have access to PXI triggers to align acquisition or generation.

The phase noise and stability of the backplane system reference clocks are important characteristics of the PXI chassis, as they indicate how reliably you can expect to synchronize modules within the system. Given the choice of components and backplane design, phase noise performance of the PXI Express 100 MHz differential system clock on NI PXI Express chassis has performed orders of magnitude better than other vendors' chassis in the same class.

For more information about how High-Speed Serial Instruments' FPGA-based clocking can be extremely reliable even in multichannel applications, visit this demonstration: Performance Comparison of FPGAs over Traditional Plug-In Cards for Digital Avionics Interfaces.

High-Speed Serial Instruments Software Experience

High-Speed Serial Sample Projects

The High-Speed Serial Instruments driver comes with sample projects for common protocols that are ready to run out of the box. These projects serve as reference designs and come with full source to enable modification. A design consists of LabVIEW code for the host CPU, LabVIEW code for data manipulation on the FPGA, and VHDL IP for protocol implementation.

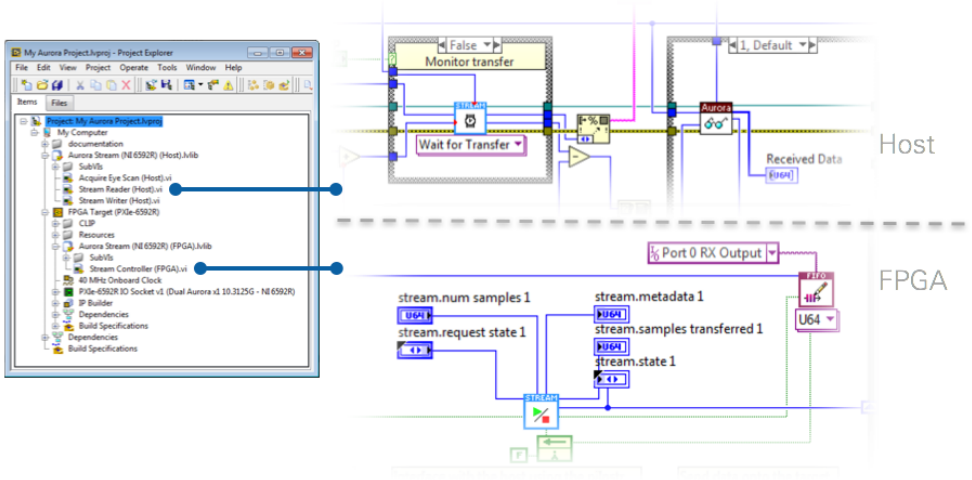


FIGURE 6

Sample projects are protocol reference designs and contain code for both the host CPU and FPGA and run out of the box.

In addition to the sample projects included with the High-Speed Serial Instruments driver, NI has published multiple application reference examples that are available through the online community or VI Package Manager.

Instrument Design Libraries

The sample projects described above are built on common libraries called Instrument Design Libraries (IDLs). IDLs are basic building blocks for common tasks you may want to perform on the FPGA and save you valuable time during development. Some of the most beneficial IDLs are the Streaming IDL, which provides flow control for DMA transfers of data to the host; the DSP IDL, which includes highly optimized functions for common signal processing tasks; and the Basic Elements IDL, which abstracts everyday functions like counters and latches. Many libraries also contain functions that run on the CPU and interface with their corresponding FPGA counterparts.

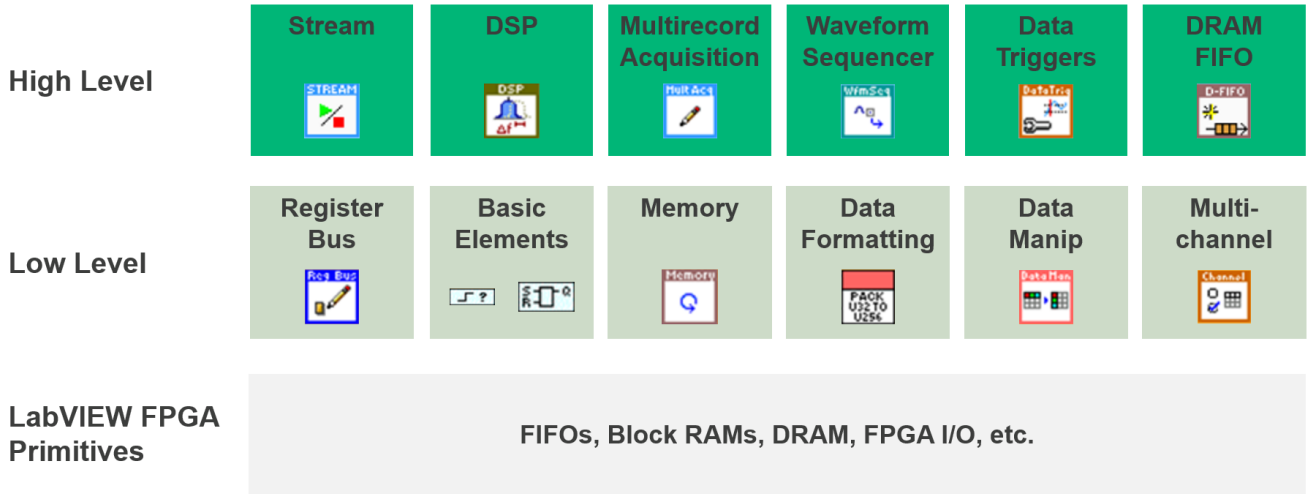


FIGURE 7

The Instrument Design Libraries (IDLs) for LabVIEW FPGA are included with FPGA-based instrument drivers and provide basic building blocks common to many FPGA designs.

Supporting Documentation

Table 2. High Speed Serial Supporting Documentation

Document Type	Model
Getting Started Guide	PXIe-6591, PXIe-6592, PXIe-6593, PXIe-6594, PXIe-7902, PXIe-7903
Specifications	PXIe-6591, PXIe-6592, PXIe-6593, PXIe-6594, PXIe-7902, PXIe-7903

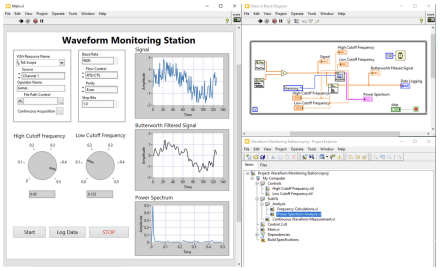
Configure a Custom NI System

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.

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.

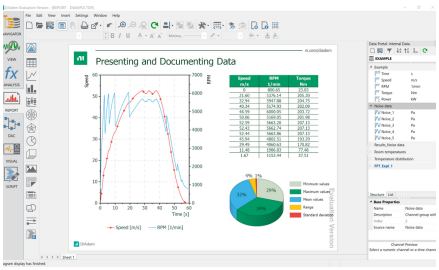
LabVIEW



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

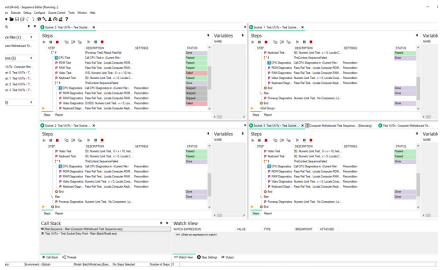
DIAdem



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

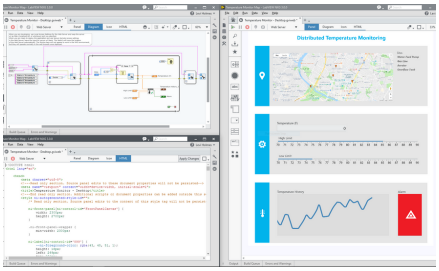
TestStand



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

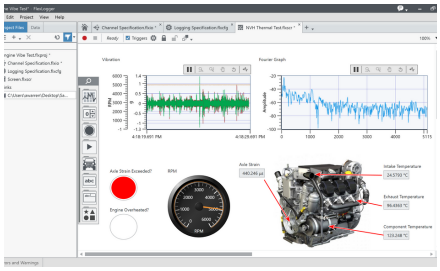
G Web



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

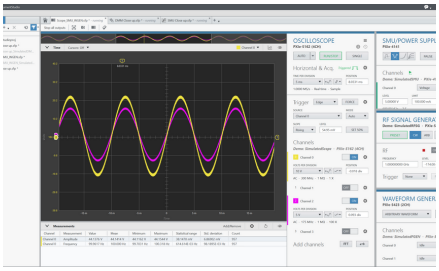
FlexLogger™



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

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

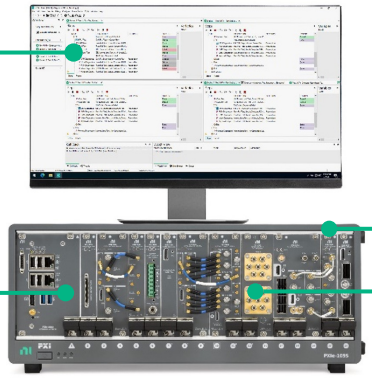
Test Management and Code Development

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

Computer

PXI Embedded Controller

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



Timing and Synchronization

PXI Chassis

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

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.