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PRODUCT FLYER

PXI High-Speed Serial Instruments

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PXI High-Speed Serial Instruments

PXIe-6591R, PXIe-6592R, and PXIe-7902



- **Software:** API support for LabVIEW, ANSI C, shipping examples, and detailed help files
- Up to 24 Xilinx GTX Transceivers with line rates up to 12.5 Gbps
- Implementation of various high-speed serial protocols on the user-programmable Xilinx Kintex-7 or Virtex-7 FPGA
- 2 GB onboard DDR3 DRAM
- High-speed data streaming up to 3.2 GB/s to host, disk, or other PXI Express modules

Built for Automated Test and Measurement

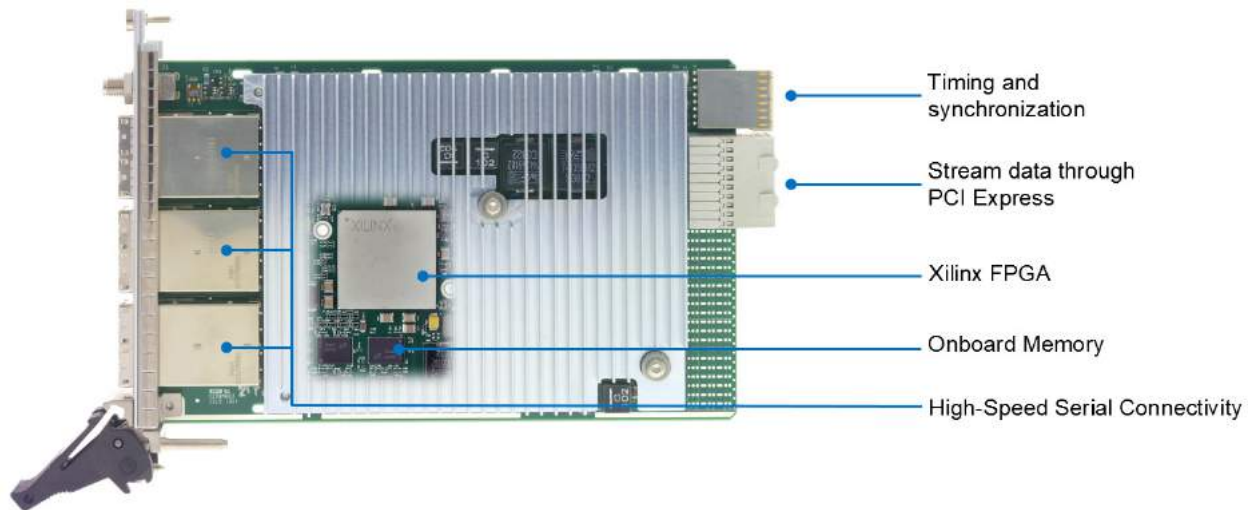
PXI High-Speed Serial Instruments are designed for engineers who need to validate, interface through, and test high-speed serial protocols. They consist of Xilinx Kintex-7 or Virtex-7 FPGAs and are programmable in LabVIEW FPGA for maximum application-specific customization and reuse. These instruments take advantage of FPGA multigigabit transceivers (MGTs) to support line rates up to 12.5 Gbps and up to 24 TX and RX lanes. 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 3.2 GB/s.

Included with the driver support are reference designs of Gigabit Ethernet, 10 Gigabit Ethernet, and Xilinx Aurora 64b66b. There are additional reference designs for other protocols on the [NI Community](#). In addition, existing IP for standard or custom protocols can be imported through LabVIEW, guaranteeing compatibility with the device under test.

Table 1. NI offers variants of high-speed serial instruments for different density, connectivity, and speed requirements.

	PXIe-7902	PXIe-6591R	PXIe-6592R
Data Rate	500 Mbps – 8 Gbps 9.8 Gbps – 12.5 Gbps	500 Mbps – 8 Gbps 9.8 Gbps – 12.5 Gbps	500 Mbps – 8 Gbps 9.8 Gbps – 10.3125 Gbps
Number of Channels	24 TX/RX	8 TX/RX	4 TX/RX
Connector	Mini-SAS HD	Mini-SAS HD	SFP+
FPGA	Virtex-7 485T	Kintex-7 410T	Kintex-7 410T
DRAM	2 GB	2 GB	2 GB
Auxiliary DIO	N/A	20 Single Ended (VHDCI)	4 Single Ended (SMB)
Host and P2P Streaming Bandwidth	3.2 GB/s	3.2 GB/s	3.2 GB/s

Detailed View of PXIe-7902 High-Speed Serial Instrument



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. The PXIe-7902, PXIe-6591R, and PXIe-6592R have an onboard, any-rate synthesizer for MGT operation over the full range of the Xilinx GTX transceivers, from 500 Mbps to 8 Gbps and 9.8 Gbps to the maximum device rate. The PXIe-6591R and PXIe-6592R feature front panel coaxial connectivity for exporting the built-in reference clock, and all three 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.

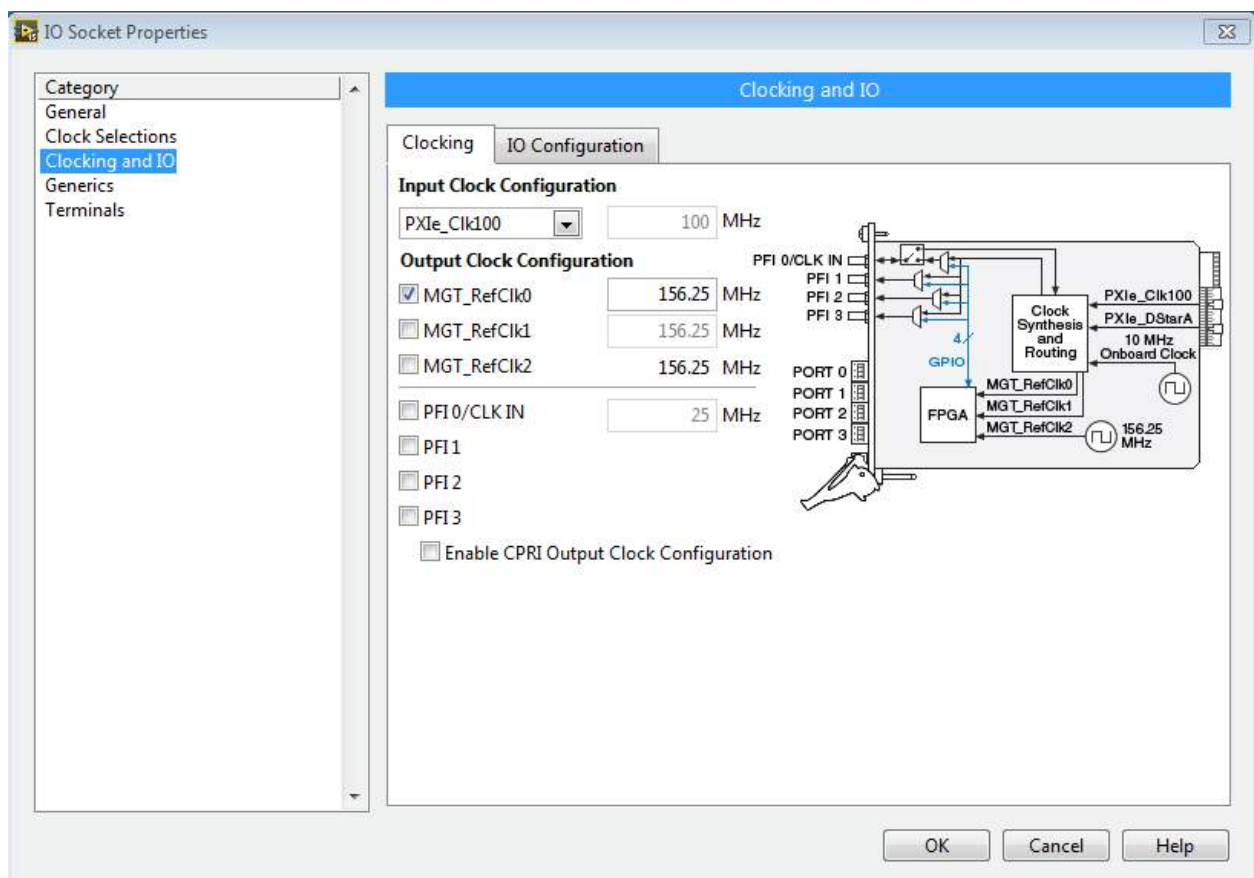


Figure 1. Ultimate clocking flexibility through a configuration-based utility to derive MGT reference clocks for any standard or custom protocol.

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](#).

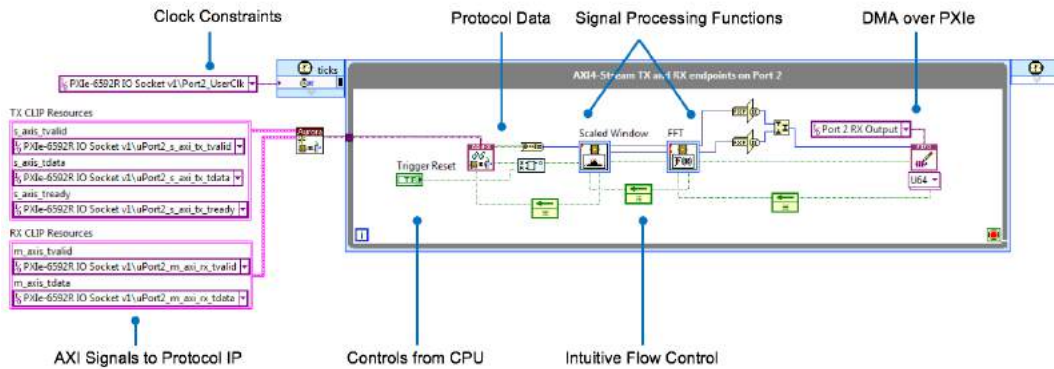


Figure 2. Program how you think. LabVIEW FPGA provides a graphical programming approach that simplifies the task of interfacing to I/O and processing data, greatly improving design productivity and reducing time to market.

Program FPGAs with Vivado

Experienced digital engineers can use the Xilinx Vivado Project Export feature included with LabVIEW FPGA 2017 to develop, simulate, and compile for high-speed serial hardware with Xilinx 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 Xilinx Vivado Project Export on all FlexRIO and high-speed serial devices with Kintex-7 or newer FPGAs.

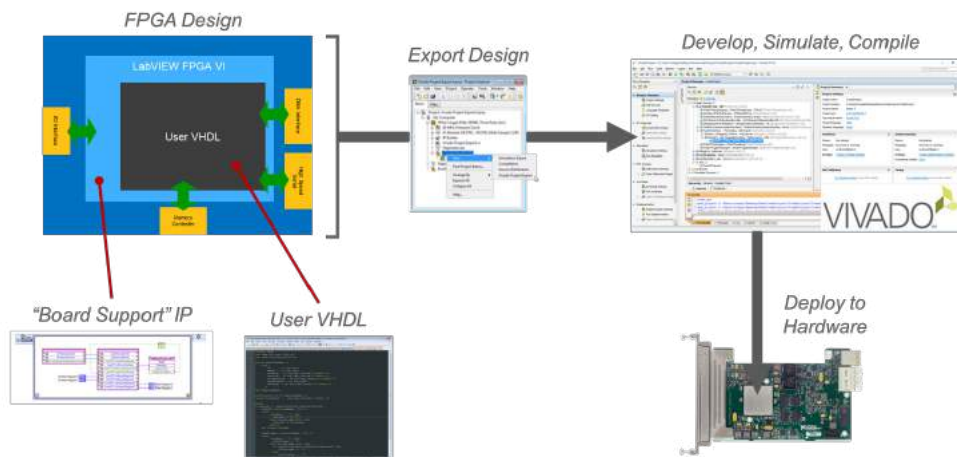


Figure 3. For experienced digital engineers, the Vivado Project Export feature allows for exporting all necessary hardware design files to a Vivado project for development, simulation, and compilation.

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 2 x8 interface, which enables sustained data streaming rates of 3.2 GB/s unidirectional, 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.

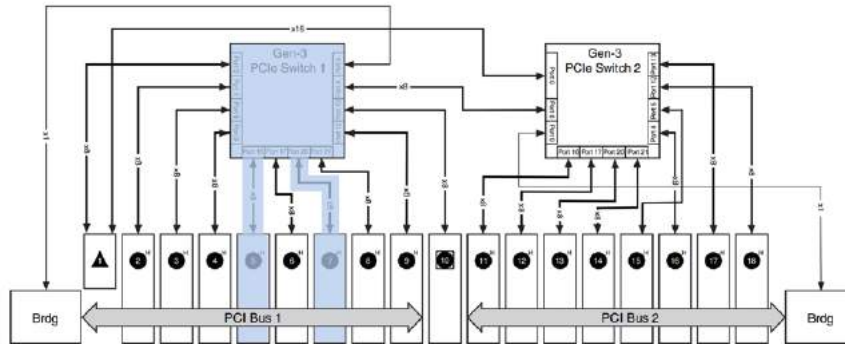


Figure 4. NI P2P technology enables point-to-point data communication between modules in a PXI Express chassis, bypassing the host controller and greatly reducing latency and increasing determinism.

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. 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.

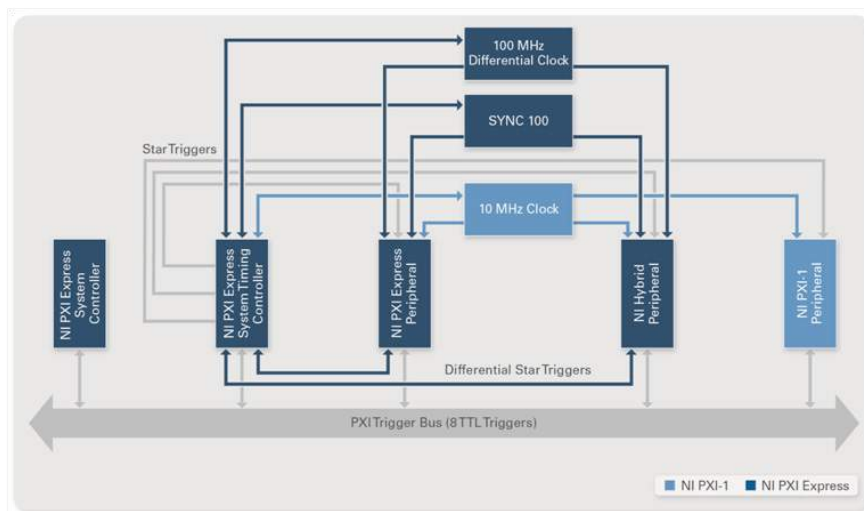


Figure 5. PXI High-Speed Serial Instruments lock to the 100MHz differential clock to stay aligned with other instrumentation in the PXI chassis and have access to PXI triggers to align acquisition or generation.

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.

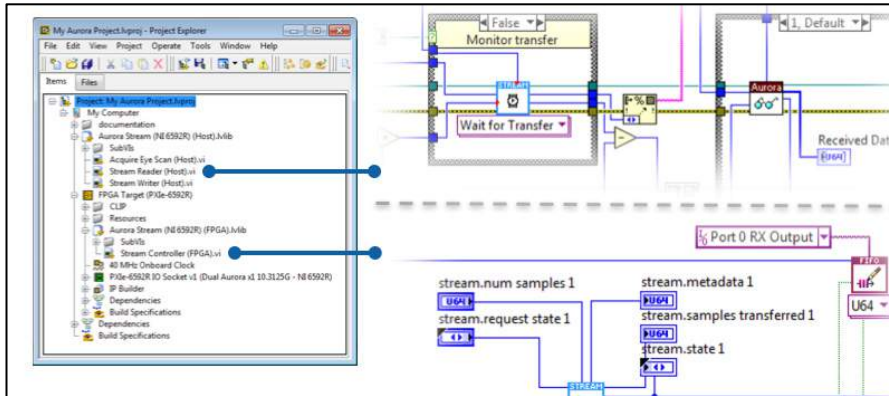


Figure 6. Sample projects are protocol reference designs and contain code for both the host CPU and FPGA and run out of the box.

In addition to the sample projects included with the high-speed serial instruments driver, National Instruments has published multiple application reference examples that are available through the [online community](#) or through 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 valuable 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 every day functions like counters and latches. Many libraries also contain functions that run on the CPU and interface with their corresponding FPGA counterparts.

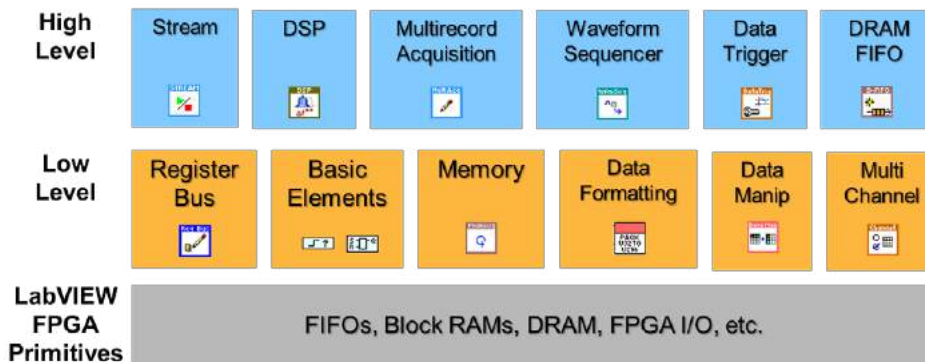
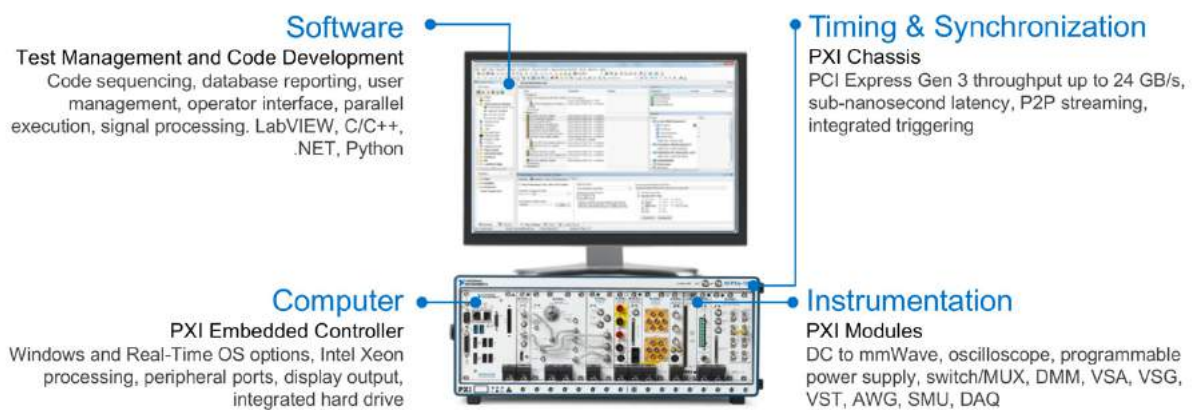


Figure 7. The IDLs for LabVIEW FPGA are included with FPGA-based instrument drivers and provide basic building blocks common to many FPGA designs.

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



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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