PRODUCT FLYER

PXI High-Speed Serial Instruments

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PXI High-Speed Serial Instruments

PXle-6591R, PXle-6592R, and PXle-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.

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

Detailed View of PXIe-7902 High-Speed Serial Instrument

- Timing and synchronization
- Stream data through PCI Express
- Xilinx FPGA
- Onboard Memory
- High-Speed Serial Connectivity
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.](image)
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.

Program FPGAs with Vivado

Experience 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.
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.

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.
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.
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
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.

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

\(^1\)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.