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What Is PXI?

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This tutorial provides an overview of PXI, including the PXI hardware architecture, software architecture, and an introduction to configuring PXI systems.

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Introduction

PXI (PCI eXtensions for Instrumentation) is a rugged PC-based platform for measurement and automation systems. PXI combines PCI electrical-bus features with the rugged, 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 measurement and automation systems. These systems serve applications such as manufacturing test, military and aerospace, machine monitoring, automotive, and industrial test.

Developed in 1997 and launched in 1998, PXI was introduced as an open industry standard to meet the increasing demands of complex instrumentation systems. Today, PXI is governed by the PXI Systems Alliance (PXISA), a group of more than 65 companies chartered to promote the PXI standard, ensure interoperability, and maintain the PXI specification. For more information on the PXISA, including the PXI specification, refer to the PXISA website at www.pxisa.org.

Hardware Architecture

PXI systems are comprised of three basic components – chassis, system controller, and peripheral modules.


Figure 1. A standard 8-Slot PXI chassis contains an embedded system controller and seven peripheral modules.

PXI Chassis
The chassis provides the rugged and modular packaging for the system. Chassis, generally ranging in size from 4-slots to 18-slots, are also available with special features such as DC power supplies and integrated signal conditioning. The chassis contains the high-performance PXI backplane, which includes the PCI bus and timing and triggering buses (Figure 2). Using these timing and triggering buses, users can develop systems for applications requiring precise synchronization.

- Learn more about PXI Chassis.
- For more information on the functionality of the PXI timing and triggering buses, refer to the PXI Hardware Specification at www.pxisa.org/specs.htm.
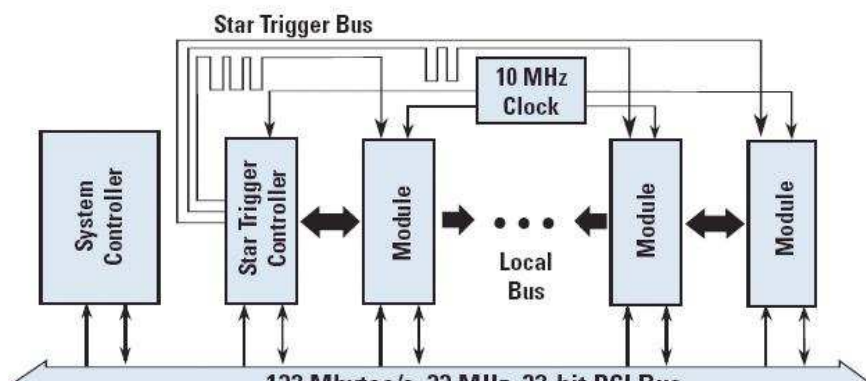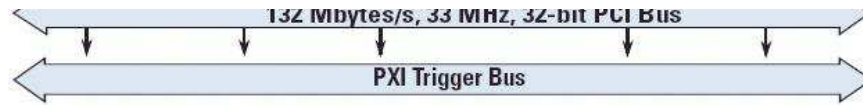
Figure 2. PXI Timing and Triggering Buses – PXI combines industry-standard PC components, such
as the PCI bus, with advanced triggering and synchronization extensions on the backplane.

PXI Controllers
As defined by the PXI Hardware Specification, all PXI chassis contain a system controller slot located in the leftmost slot of the chassis (slot 1). Controller options include remote controllers from a desktop, workstation, server, or a laptop computer and high-performance embedded controllers with either a Microsoft OS (Windows 2000/XP) or a real-time OS (LabVIEW Real-Time)

<u>PXI Remote Controllers</u>
There are two types of PXI remote controllers:

- Laptop control of PXI
- PC control of PXI

Laptop Control of PXI
With ExpressCard MXI (Measurement eXtensions for Instrumentation) and PCMCIA CardBus interface kits, users can control PXI systems directly from laptop computers. During boot-up, the laptop computer will recognize all peripheral modules in the PXI system as PCI devices.

ExpressCard MXI interface kit   PCMCIA CardBus interface kit
Figure 3. Laptop Control of PXI

The ExpressCard MXI interface kit provides a 110 MB/s PCI Express -to- PCI bridge from the laptop computer to the PXI chassis. The PCMCIA CardBus interface kit provides a 50 MB/s PCI -to- PCI bridge from the laptop computer to the PXI chassis. Users now have the advantage of mobile/portable PXI systems with laptop control of PXI. You can purchase any ExpressCard MXI compatible laptop or PCMCIA CardBus compatible laptop to remotely control your PXI system. For more information please refer to Laptop control of PXI.

PC Control of PXI
With MXI-Express and MXI-4 interface kits, users can control PXI systems directly from desktop, workstation, or server computers. During boot-up, the computer will recognize all peripheral modules in the PXI system as PCI devices.

Figure 4a. Remote control with 2-port MXI-Express provides simultaneous
control of two PXI chassis with combined 160 MB/s throughput.

The MXI-Express interface kit provides a 110 MB/s PCI Express -to- PCI bridge from the PC to the PXI chassis. With the NI PXI-PCIe8362 2-port interface kit, users will be able to control two PXI systems simultaneously from a single PC.

Figure 4b. Remote control with MXI-4 provides PC control of PXI, as well as multichassis PXI systems.

The MXI-4 interface kit provides a 78 MB/s PCI -to- PCI bridge from PC to the PXI system. MXI-4 interface kit comes with low-cost copper links or fiber-optic links for both extended distances and electrical isolation. As shown in Figure 4b, you can build multichassis PXI systems with MXI-4 as well. Using a MXI-4 link, you can implement either a daisy-chain or a star topology to build multichassis systems. For more information on topologies for multichassis configurations, refer to the MXI-4 Series User Manual. You can purchase any desktop, workstation or server computer, and then remotely control your PXI system using either MXI-Express or copper/fiber optic MXI-4 serial link. For more information please refer to PC control of PXI.

With PXI remote controllers, you can maximize processor performance with minimized cost by using a desktop computer or laptop to remotely control a PXI system. Because all remote control products are software transparent, no additional programming is required.

<u>PXI Embedded Controllers</u>
Embedded controllers eliminate the need for an external PC, therefore providing a complete system contained in the PXI chassis. PXI embedded controllers are typically built using standard PC components in a small, PXI package. For example, the NI PXI-8187 controller has a Pentium 4-M 2.5 GHz processor, up to 1 GB of DDR RAM, a hard drive, and standard PC peripherals such as USB 2.0, Ethernet, serial, and parallel ports. Additionally, you can install your choice of OSs on the PXI controller, including Windows 2000/XP or LabVIEW Real-Time.

Figure 5. National Instruments PXI-8187 Pentium 4-M 2.5 GHz Embedded Controller. Notice the familiar PC peripherals such as keyboard/mouse and monitor connections, as well as the hard drive, USB 2.0, Ethernet, serial, and other standard PC peripherals. This controller runs standard Windows 2000/XP OSs, or can be targeted with LabVIEW Real-Time.

Embedded controllers are ideal for portable systems and contained "single-box" applications where the chassis is moved from one location to the next. For more information please refer to PXI controllers.

PXI Peripheral Modules
National Instruments offers more than 100 different PXI modules; and because PXI is an open industry standard, nearly 1000 modules are available from the 65+ members of the PXI Systems Alliance.

A categorized list of modules offered by National Instruments and our PXI product partners is available at ni.com/pxi.

Because PXI is directly compatible with CompactPCI, you can use any 3U CompactPCI module in a PXI system. Additionally, CardBus/PCMCIA and PMC (PCI Mezzanine Card) cards can be installed in PXI systems using carrier modules. For example, the National Instruments PXI-8221 PC Card Carrier can be used to connect CardBus and PCMCIA devices to PXI systems.

PXI also preserves investments in stand-alone instruments or VXI systems by providing standard hardware and software for communication to these systems. For example, interfacing a PXI system to GPIB-based instrumentation is no different with a PXI-GPIB module than it is with a PCI-GPIB module. The software is identical. Additionally, a number of methods are available for interfacing PXI and VXI together. For more information, refer to the Web Event on Hybrid PXI and VXI Systems.

Software Architecture

Because PXI hardware is based on standard PC technologies, such as the PCI bus, as well as standard CPUs and peripherals, the standard Windows software architecture is familiar to users as well. Development and operation of Windows-based PXI systems is no different from that of a standard Windows-based PC. Additionally, because the PXI backplane uses the industry-standard PCI bus, writing software to communicate with PXI devices is, in most cases, identical to that of PCI devices. For example, software to communicate to an NI PXI-6251 multifunction data acquisition module is identical to that of an NI PCI-6251 board in a PC. Therefore, existing application software, example code, and programming techniques do not have to be rewritten or reused when moving software between PC-based and PXI-based systems.

Figure 6. Two different packages – one software standard. In software, communication
with a PXI module (bottom) is identical to that with a PCI board (top).

As an alternative to Windows-based systems, you can use a real-time software architecture for time-critical applications requiring deterministic loop rates and headless operation (no keyboard, mouse, or monitor). Additional information on using LabVIEW Real-Time with PXI systems is available at www.ni.com/realtime.

System Configuration

Configure PXI Systems Online with the PXI Advisor at ni.com/pxiadvisor
The fastest and easiest way to specify and configure your new PXI system is by using the online PXI Advisor or PXI/SCXI Advisor. The advisors lead you through a series of questions to help you build your new PXI system with a system controller, software, modules, accessories, and PXI or PXI/SCXI combination chassis. You build your system by answering simple questions and selecting the products best suited to your needs, and you can print or export the image of your PXI system for use in proposals or design reviews. Additionally, the advisors will make recommendations on technical matters, such as specific slot placement of modules, cables and terminal accessories, and integrated software packages. The advisors also use behind-the-scenes logic to prevent incompatible configurations. For example, if you select a LabVIEW Real-Time PXI controller, the advisors will automatically restrict PXI measurement module selection to only those compaatible with LabVIEW Real-Time.

When you are satisfied with your configuration, you can pass that configuration to a National Instruments representative for order, or you can automatically order through the online store. With NI Factory Installation Services as part of your order, you will receive your PXI system just as you configured it. NI installs your selected PXI modules in your chassis, and installs any memory upgrades, National Instruments application software, and required driver software on your embedded controller.

Summary

PXI modular instrumentation defines a rugged computing platform for measurement and automation users that clearly takes advantage of the technology advancements of the mainstream PC industry. By using the standard PCI bus, PXI modular instrumentation systems can benefit from widely available software and hardware components. The software applications and OSs that run on PXI systems are already familiar to users because they are already in use on common desktop computers. PXI meets your needs by adding rugged industrial packaging, plentiful slots for I/O, and features that provide advanced timing and triggering capabilities.

Visit ni.com/pxi for more information on PXI, including links to product pages, pricing, datasheets, and specifications.

If you have any additional questions, you can contact a Technical Sales Representative either by phone at (888) 280-7645 or via e-mail.

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