VXI Tutorial

VXI Benefits

- *Open, multivendor standards maximize flexibility and minimize obsolescence*
- *Increased system throughput reduces test time or increases capabilities*
- *Smaller size and higher density reduce floor space, enhance mobility or portability, and give close proximity to device(s) under test or control*
- *More precise timing and synchronization improve measurement capability*
- *Standardized VXIplug&play software simplifies system configuration, programming, and ease of integration*
- *Modular, rugged design improves reliability, increases mean time between failure (MTBF), and decreases mean-time to repair (MTTR)*
- *VXI reduces cost over lifetime of system*

Photo courtesy of Guidant Corp/CPI

VXI Fundamentals

The following pages give a brief description of the VXI standard and our VXI products. For more information on VXI and our products, including specifications, configurations, and ordering information, please request our 1998-1999 VXI Solutions Product Guide.

What Is VXI?

VXIbus is an exciting, fast-growing platform for instrumentation systems. First introduced in 1987, VXI has experienced tremendous growth and acceptance around the world. From the beginning, the VXI standard was designed as an open specification to take advantage of the latest computer technologies to decrease test costs, increase throughput, and reduce development time. VXI means smaller, faster test systems for a wide range of applications. With more than 1,000 commercial VXI products available today, VXI serves many diverse industries from automotive to telecom. VXI is used for applications ranging from test and measurement – including portable field testers, functional test systems, and ATE – to high performance data acquisition applications and industrial automation.

National Instruments and VXI*plug&play*

Established in 1993, the VXIplug&play Systems Alliance sought to elevate the level of standardization above and beyond the baseline VXI specifications to make VXI systems easier to build and use. The VXI Consortium made VXI systems open at the hardware level; you can use modules from different vendors in the same mainframe without electrical or mechanical conflict. However, as many of the first VXI users began integrating systems, it was clear that software specifications were needed to ensure multivendor interoperability at the system level.

As a founding member of the alliance, National Instruments has worked side by side with the alliance members to define standards that make VXI systems open at the system level. Today, the VXIplug&play standards are described in a complete set of specifications published by the alliance with hundreds of VXIplug&play products available. VXIplug&play-compliant controllers and instruments are delivered with standardized software to get you up and running quickly.

The Value of Open Industry Standards

The baseline VXI hardware specifications require interoperability between hardware products from different vendors. These specifications cover mechanical and environmental requirements, such as module sizes, mainframe and module cooling, and EMC compatibility between modules, as well as automated system initialization and backplane communication protocols. The VXIplug&play Systems Alliance builds on these baseline specifications to address the system as a whole with the goal of having the end-user up and running in "five minutes or less." Building a system based on open industry standards means that you choose components for your system based on your requirements, regardless of vendor. Open standards also ensure that once your system is built, your investment will continue to pay dividends well into the future.

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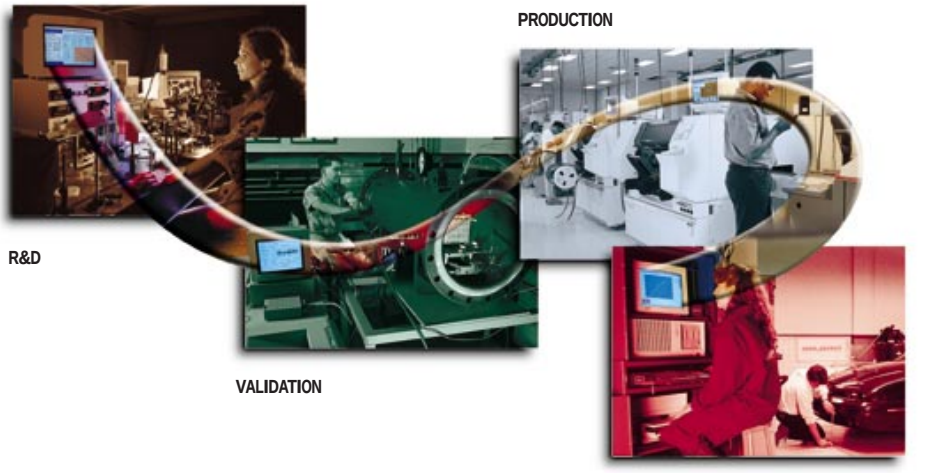


The power and flexibility of virtual instrumentation make it cost-effective and reusable throughout the company.

The Best Technologies

In essence, VXI combines the best technology from GPIB instruments, modular plug-in DAQ boards, and modern computers. Like GPIB, VXI offers a wealth of sophisticated instruments from a wide variety of the world's leading instrument vendors. Like plug-in PC boards, VXI offers modularity, flexibility, and high-performance connectivity to the computer. Because VXI combines a sophisticated instrument environment with a modern computer backplane, VXI instruments have the ability to communicate at very high speeds using the best technology from both GPIB instruments and plug-in DAQ boards.

Easy to Use

To ensure that VXI is easy to use, VXI software uses the best and latest technology that has evolved for instrumentation programming. A wealth of powerful VXI software is available to simplify the programming task. Thanks to VXIplug&play standards, VXI instruments are delivered with ready-to-use standardized software, including soft front panels, instrument drivers, and installation routines written by the instrument vendor to take full advantage of instrument capabilities and make your programming task as easy as possible.

Reduced Test Time and Lower Costs

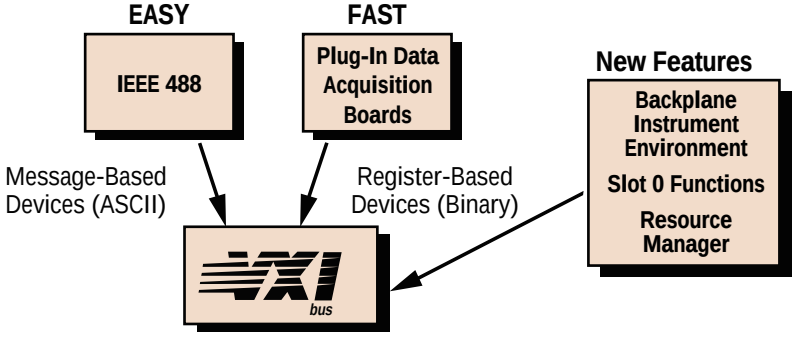
Competitive pressures demand faster time to market, lower unit costs, and an increasing emphasis on quality. You need to test more than ever before, but in less time and with fewer resources. While traditional rack-and-stack systems still meet many test needs, they are limited by slow data rates and proprietary components. Today's test applications demand new levels of performance that rack-and-stack systems just can't meet. VXI delivers this performance so you can make measurements faster and realize higher throughput even in entry-level systems. Built on open standards, VXI also keeps system costs down by fostering competition on equal technical ground, ensuring that you can choose the best components for your application. Finally, VXI delivers more compact systems that require less floor space, cabling, and hardware.

Leveraging Off Mainstream Technology

Instrumentation has always leveraged off widely used technology to drive its innovation. Radio components were used to build the first electronic instruments. Display technology was leveraged off television for use in oscilloscopes and analyzers.

Today, cost-effective, powerful desktop and notebooks computers are paving the way for new types of instruments – virtual instruments. Virtual instruments are designed and built by the user to match specific needs by leveraging off the power and low cost of PCs and workstations.

VXI – The Best of Two Worlds



1. Define Your Objective

The first step in using VXI is to define your objectives. What are your strategies and your goals? Are you integrating VXI into an existing system or are you building a new system? What benefits does VXI offer you? It is important to set realistic expectations against which to measure your success.

National Instruments has a variety of materials and services to help you better understand VXI. We have VXI product literature and technical manuals, VXI specifications, application notes, technical papers, article reprints, newsletters, VXI seminars, hands-on VXI training classes, demonstration equipment, and more.

As the leading supplier of VXI controllers and software, we have a thorough understanding and expertise in VXI system architecture. With our new VXI instrument modules and our PC-based data acquisition product line, we have a complete line of instrumentation to solve a wide range of applications – presenting opportunities for realizing scalable test strategies and corporate-wide reusability. Our experienced worldwide sales and support organization is backed by some of the world's leading VXI hardware and software experts. We are ready to answer questions and help ensure that VXI is a success for you.

2. Choose Your Software and VXI*plug&play* Framework

Software is one of the most important considerations for your VXI system. If you use VXIplug&play-compliant software, your system integration will be as easy as possible. VXIplug&play defines a number of system frameworks to give you a simple way to identify the software you need. Once you choose a framework, you can select products with the knowledge that they include complete software that can be integrated easily in your system.

Your software decisions affect not only overall system performance and system capability, but also development time, productivity, maintenance, and software reuse for future projects. You want to choose tools that have complete debugging capability, application development environments (ADEs) that work with the most popular operating systems and programming languages, and software that can be easily reused from one system to the next. There are many programming languages, operating systems, ADEs, and application software packages to choose from when building a VXI system. It is important to make the right decisions to realize all of the advantages that VXI has to offer, while minimizing your development costs now and development and maintenance costs later.

To simplify your VXI programming task, you should consider an ADE or software package such as LabVIEW or LabWindows/CVI. These packages take full advantage of VXIplug&play technology, represent state-of-the-art-instrumentation software tools, and provide an enterprise-wide software development and execution solution that spans organizational boundaries from R&D to manufacturing and test. LabVIEW and LabWindows/CVI deliver the productivity necessary to stay competitive in today's bottom-line focused world. With comprehensive test management software, including test executives and sequence tests, database connectivity, and statistical process control packages, LabVIEW and LabWindows/CVI make it easy to manage and control your test software. With the graphical front panels, the extensive libraries of ready-to-go instrument drivers, and VXIplug&play software compatibility, our products help you develop your test applications faster and easier than any other software packages available today.

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3. Choose Your Controller

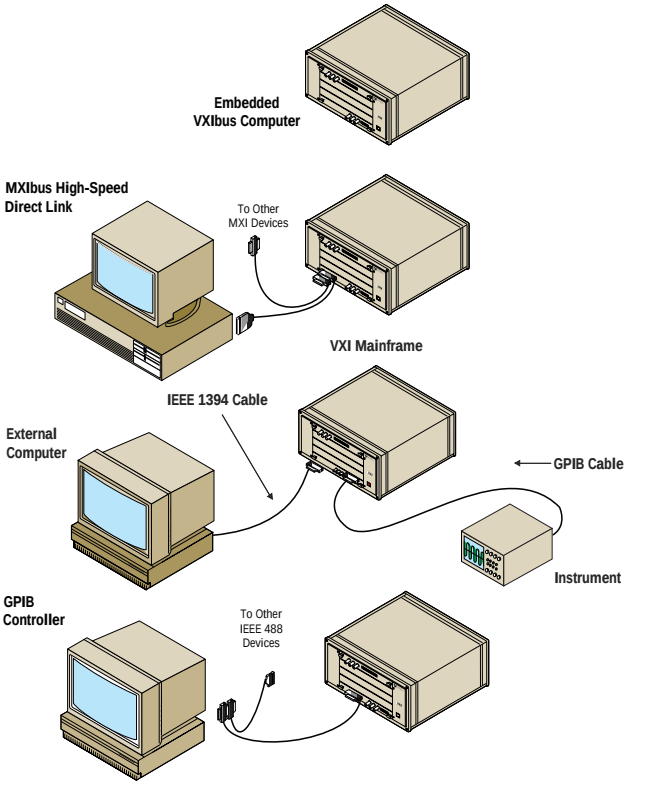
You can use VXI in a variety of ways. You can build a system using VXI instruments only, or you can integrate VXI into a system alongside other GPIB instruments and DAQ boards. Each of the different system configurations has its own unique benefits. The first configuration embeds a custom VXI computer directly inside the mainframe. Using this configuration, you take full advantage of the high-performance capabilities of VXI because your computer can communicate directly with the VXI backplane.

The second configuration combines the performance benefits of a custom embedded computer with the flexibility of general-purpose computers. With this configuration, you use a high-speed MXIbus link to connect an external computer directly to the VXI backplane.

The third configuration uses the low-cost IEEE 1394 or (Firewire) serial bus to control a VXI system. The VXI-1394 uses a board plugged into the computer, a tiny 6-wire IEEE 1394 cable, and a VXI-1394 Slot 0 module to comprise a complete VXI control solution. The VXI-1394 interface kit boasts higher performance than GPIB-to-VXI solutions, but lower performance than MXI-2.

The fourth configuration consists of one or more VXI mainframes linked to an external computer via the GPIB. You can use this configuration to integrate VXI gradually into existing GPIB systems and to program VXI instruments using existing GPIB software.

To select the best controller for your application, you should consider several factors, including physical configuration issues, such as size, location, and flexibility, as well as performance issues, such as throughput, software development tools, and ease of use.



4. Select Your VXI Mainframe

VXI mainframes vary in terms of size, number of slots, usable power, and cooling capacity. VXI mainframes can have as many as 13 slots, but mainframes with fewer slots are available for smaller or even portable applications. When choosing a VXI mainframe for your application, you determine the number of slots that your system needs with an eye on possible future growth. You should also make sure that a VXI mainframe can handle the power and cooling requirements of the VXI controller and instruments that you select. If your application may expand at a later time, you should choose a mainframe that not only accommodates additional instruments, but also supplies sufficient power and cooling for them.

The most costly yet most important part of a VXI mainframe is the power supply. There are typically two specifications given for the VXI mainframe power capability – available power and usable power. Available power refers to the rating of the power supply itself. Usable power refers to the power that can actually be delivered to VXI modules, which more closely reflects how a VXI mainframe will perform in a real application. When comparing power specifications of different mainframes, be sure to check usable power, not available power.

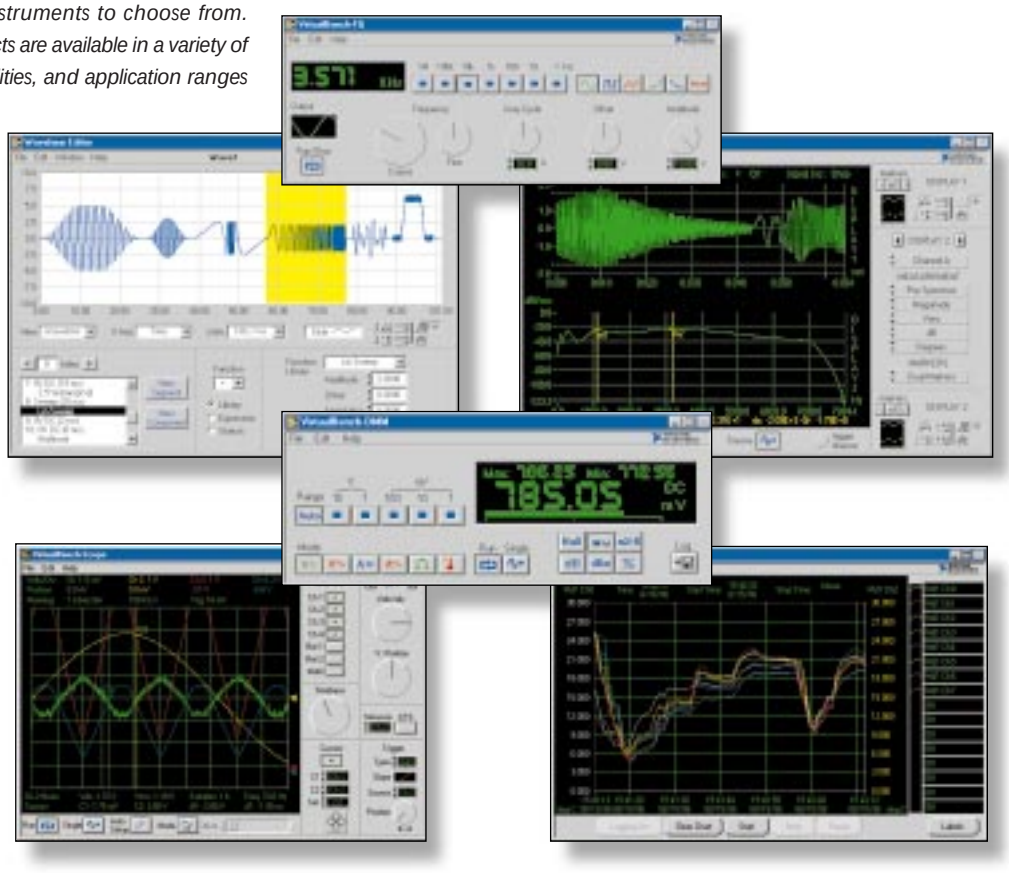
If your VXI system requires less power than is available from your mainframe, that is an advantage, because VXI mainframes have a longer life when the power supply is not fully loaded. For example, if a VXI system consumes 450 W and the VXI mainframe delivers 1100 W usable power, then the power supply is loaded to 41 percent of its capacity (450/1100). If this same system were installed in a VXI mainframe with a power supply rated at 500 W usable, the supply would be operating at 90 percent of capacity and would last a shorter time.

National Instruments offers a unique 9-slot mainframe, the VXI-1200 FlexFrame, which houses both six full C-size VXI modules and three B-size VXI or VME modules. With nine fully compliant VXI slots, the FlexFrame offers the lowest cost-per-slot ratio in the industry. By delivering up to 720 W usable power, the FlexFrame can easily accommodate even the most power-hungry VXI modules in your system. You can rack-mount the FlexFrame or use it alone for benchtop and portable applications. Thanks to the three B-size VXI slots, you can integrate specialized B-size VXI or even VME modules into this mainframe without expensive additional hardware.

Our VXI-1500, a 13-slot C-size mainframe, complies with the VXIplug&play Specification, VPP-8, to ensure connectivity to all VPP-8-compliant mainframe receiver fixtures for the use with interface test adapters. With 1100 W usable power, ample dynamic and peak currents are available for even the most power-intensive applications. Your choice will depend not only on the number of slots, but also on a variety of other factors, such as power and cooling capacities, physical configuration, fixturing, and so on.

5. Select Your VXI Instruments

There is a wide variety of VXI instruments to choose from. Currently, more than 1,000 products are available in a variety of price ranges, performance capabilities, and application ranges – and the selection is growing every day. The selection covers all of the traditional choices available as GPIB instruments as well as "second-generation" virtual instruments, such as our VXI instrument modules, that take advantage of unique VXI virtual instrument capabilities. Although you can use any instrument in your system, choosing instruments that are VXIplug&play compliant will make your system integration task as easy as possible, thanks to the software standards set forth by the VXIplug&play Systems Alliance.



National Instruments can help you understand how particular instruments relate to your application. In the VXIplug&play Systems Alliance, we work with a wide variety of VXI instrument vendors who develop their VXIplug&play instrument drivers using our LabVIEW and

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LabWindows/CVI products. With our VXI instrument modules, National Instruments also presents a scalable instrumentation solution that spans PCMCIA, PCI, PXI, and VXI platforms. You can choose instruments and DAQ modules for any of these platforms knowing that you will not have to rewrite your software as your needs change or expand in the future, because the software runs unmodified on each of these platforms. If you are just beginning to evaluate VXI, you can start out with a PC DAQ board, develop your application, and move to VXI once your system needs dictate without modifying your software.

To complement our VXI Data Acquisition product line, we offer the widest selection of signal conditioning options available today. You can use any of the signal conditioning options for our PC-based DAQ product line, including the high-performance SCXI product line (see the SCXI Overview on page 344). If you prefer a complete VXI solution, we also offer an integrated VXI signal conditioning solution based on the VXI-SC-1000 signal conditioning carrier module. For more information on our VXI signal conditioning, see page 803.

6. Iterate and Integrate

NATIONAL INSTRUMENTS ALLIANCE PROGRAM

After making your selections, it is time to take a look at how the overall result matches your initial objectives. You may make another pass at some selections to optimize important elements, such as performance or cost. National Instruments can assist you in evaluating your overall system proposal to ensure that your VXI system meets your objectives.

When you are ready to integrate and install your system, National Instruments is there to help you. Our experienced sales and support organization is backed by some of the world's leading VXI engineering and software experts. If you are interested in custom integration services, or if you want someone else to design, integrate, or install part or all of your system, we can put you in contact with one or more of approximately 300 National Instruments Alliance Program members who can provide systems integrator services, add-on products, support, and consultation.

Courtesy of Instrumentation Engineering Inc.

Instrument Control Overview

Our Proven Track Record of Innovation Includes

- *Pioneering the Multisystem eXtension Interface (MXI) Bus–the standard for remote VXI control*
- *Introducing the MXI-2, the highest performance remote VXI interface available today (Figure 1)*
- *Developing the first embedded Pentium and Pentium Pro controllers (Figure 2)*
- *Defining the VISA specification – the industry-standard software interface*
- *Creating a B-size/C-size combination VXI mainframe to lower overall system costs*
- *Developing the 1394 (Firewire) interface for remote VXI control (Figure 3)*

VXI Controller Objectives

- *Maximum VXI performance*
- *Maximum CPU performance*
- *Maximum manufacturability and reliability (MTBF)*
- *Maximum upgradability in the future*
- *Software compatibility with the PC industry*
- *Software compatibility with previous-generation products*

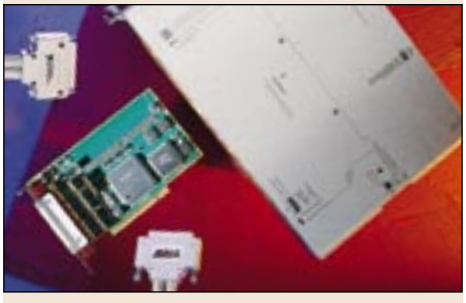

Figure 1. MXI-2 Interface Kit

Figure 2. Embedded Controller

Our VXI Control Leadership

As the market leader, National Instruments offers the broadest range of VXI control solutions available today. Our VXI controllers take advantage of off-the-shelf PC technologies wherever possible to deliver the benefits of this burgeoning industry to you in the form of state-of-the-art VXI control solutions that consistently set new standards for price, performance, and ease of use.

Our commitment to delivering complete VXI solutions does not stop with the hardware. Software is the key to your VXI development success and our comprehensive software offering – from the NI-VXI/VISA I/O software to our LabVIEW and LabWindows/CVI application development tools – provide a total solution to reduce your software development effort. It's the combination of hardware and software that sets our VXI controllers apart from the competition. This is the main reason more developers choose them for their VXI test systems.

Figure 3. VXI-1394

Merging VXI and PC Technologies

All of our VXI controllers leverage off the latest PC technologies such as PCI, Intel microprocessors, and the new IEEE 1394 serial bus technology. What does that mean to you? It means you can choose from our complete line of VXI control options and automatically harness the power of these new technologies while maintaining the lowest cost. The PC industry continually breaks new ground for price and performance with each new generation of technology. When developing a VXI system, its important for you to choose system components that also take advantage of these advancements so that you are always assured of staying ahead of the competition.

High-Performance ASICs

To achieve our goals of performance, manufacturability, and reliability, we have invested substantial resources over a period of several years to develop two very important ASICs, the MITE and the MANTIS. Designed to deliver highest performance, these ASICs serve as a key foundation for all of our VXI products and will continue to be fundamental components for future generations.

VXI Software

Software is a major thrust for National Instruments, relating to our involvement with both the VXI Consortium and the VXIplug&play Systems Alliance. As such, all of our VXI controllers are VXIplug&play compliant. They are also compatible with the scores of software packages and tools available for general-market computers. Our NI-VXI/VISA, which is shipped with all of our controllers, boasts a rich application programming interface (API) that complies with all of the latest VXIplug&play standards. These libraries come complete with powerful interactive debugging utilities to help you get your system up and running quickly.

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Instrument Control Overview

Embedded VXI Controllers

Embedded VXI controllers are special VXI computers that are installed directly in the VXI mainframe, as shown in Figure 4. This control option offers the smallest possible physical size for a VXI system. More importantly, it provides a direct connection, so your computer can take full advantage of high-performance VXI backplane capabilities.

High-Speed MXI Connection to VXI

A direct-connect kit based on the MXIbus combines the performance benefits of an embedded VXI computer with the flexibility and availability of general-purpose computers. This configuration uses a high-speed MXIbus cable to connect an external computer directly to the VXI backplane, as shown in Figure 5. With MXIbus, you can locate the computer beside the VXI mainframe or up to 20 m away. The MXIbus is easily expandable to several mainframes using daisy-chainable multidrop cables.

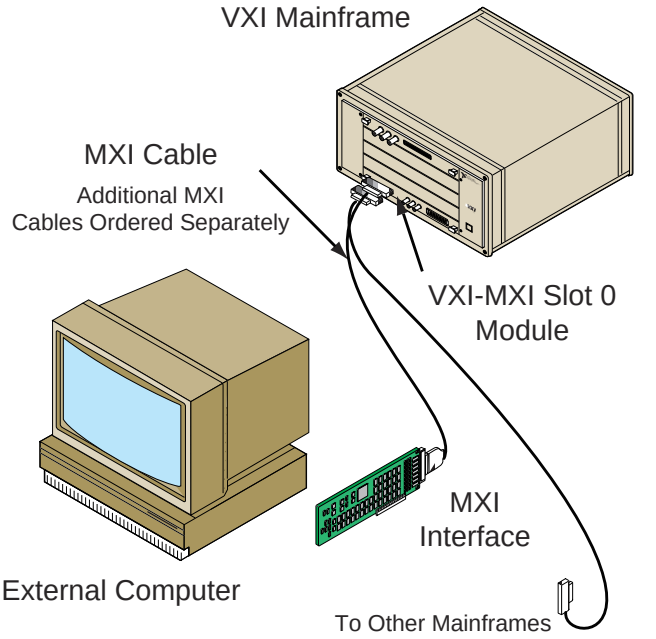

Figure 5. VXI System with MXI-Equipped Computer

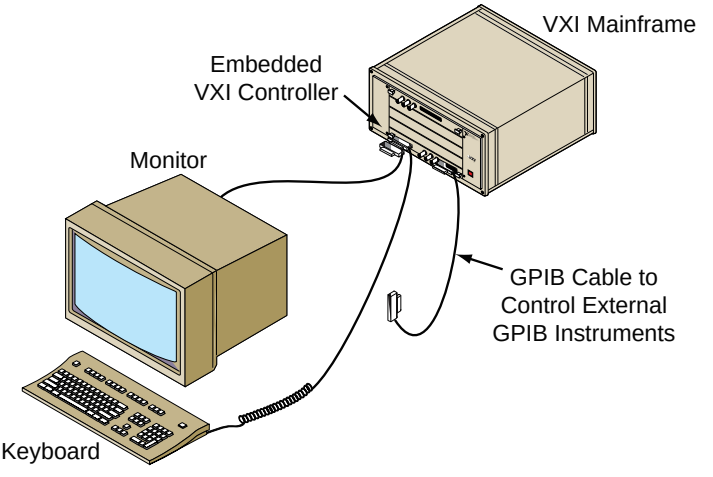

Figure 4. VXI System with Embedded Controller

IEEE 1394 Interface to VXI

The VXI-1394 interface kit (see Figure 6) links any PCI-based computer directly to the VXIbus using the IEEE 1394 or (Firewire) high-speed serial bus. The VXI-1394 interface kit operates in much the same way as MXI but is uses the IEEE 1394 serial bus technology and a very small, flexible six-wire cable. Like MXI, the VXI-1394 interface gives you embedded control operation using a remote computer. The VXI-1394/G adds an IEEE 488 (GPIB) option right on the front panel so that you can control a test system includeing both GPIB and VXI devices using a single IEEE 1394 cable from the host computer.

Embedded VXI Controller Options

Model	Size	Processor	Speed	Windows NT	Windows 98	Windows 95	Windows 3.1	DOS	VxWorks	LabVIEW	CVI	C, C++	Visual Basic	VXI*plug&play* Compliant
VXIpc-800 Series	C-2	Pentium II	>350 MHz	√	√				√	√	√	√	√	√
VXIpc-650/233	B-2	Pentium MMX	233 MHz	√	√	√			√	√	√	√	√	√
VXIpc-650/166	B-2	Pentium MMX	166 MHz	√	√	√			√	√	√	√	√	√
VXIpc-700 Series	C-1	486 DX4	100 MHz	√	√	√	√	√	√	√	√	√	√	√
VXIcpu-030	C-1	68030	25 MHz						√					

GPIB Control of VXI

You can also control a VXI system using a GPIB-equipped computer. In this configuration, one or more VXI mainframes are linked to an external computer via standard GPIB cables. The computer talks across the GPIB to a GPIB-VXI/C interface module (see Figure 7) installed in the leftmost slot of the mainframe, and the GPIB-VXI/C transparently translates GPIB protocols to/from VXI protocols. The computer controls the VXI instruments as familiar GPIB instruments.

Figure 6. VXI-1394 Interface Kit

Figure 7. GPIB Controller for VXI

The GPIB-VXI/C is simply installed in the VXI mainframe, as shown in Figure 8, along with your VXI instruments. The GPIB cable is connected from the computer to the front panel of the GPIB-VXI/C, and the GPIB-equipped computer controls each VXI instrument as a separate GPIB instrument at a unique GPIB address.

System Tradeoffs

In general, embedded VXI controllers, such as our VXIpc-800 Series, offer the maximum in performance and the most compact size. Our low-cost, embedded VXIpc-700 Series offers the best value in an embedded controller, requiring only a single C-size VXI slot. MXI-2 interface kits offer block-transfer performance comparable to embedded controllers with the additional flexibility and expendability of a desktop PC or workstation. A GPIB-VXI connection, which offers a low-cost solution, is particularly suited for applications that are not data transfer intensive and use primarily message-based instruments. The VXI-1394 interface kit boasts block performance faster than the GPIB-VXI/C. You should determine the types of instruments in your system and then select a VXI controller that matches your system capabilities and requirements.

Although embedded VXI controllers create smaller systems, they typically cost more. You can also connect any computer to your VXI mainframe with a remote VXI interface link such as MXI-2, IEEE 1394, or GPIB. In the future, as newer and faster modules appear, you can upgrade your computer to reap the performance gains of these new technologies, yet preserve your VXI controller instrument.

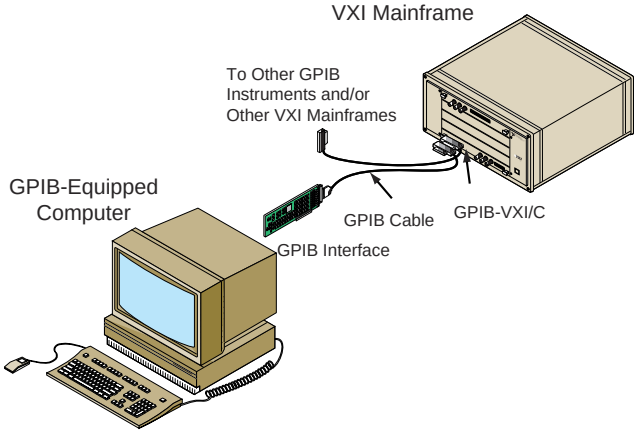

Figure 8. GPIB-Controlled VXI System

MXI Interface Options

MXI Kit	Processor	Internal Bus	Windows NT	Windows 98/95	Windows 3.1	DOS	Mac OS	Solaris Unix	HPUX	LabVIEW	CVI	C, C++	Visual Basic	VXI*plug&play* Compliant
VXI-PCI8000	Intel	PCI	√	√	√	√				√	√	√	√	√
VXI-AT4010	Intel	ISA		√	√	√				√	√	√	√	√
VXI-PCI8040	PowerPC	PCI					√			√		√		
VXI-PCI8022	SPARC	PCI						√		√	√	√	√	√
VXI-PCI8024	PA-RISC	PCI							√	√	√	√	√	√

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Instruments Overview

Introduction

National Instruments offers a wide range of instruments, data acquisition, and signal conditioning solutions for VXI. You can use these products in many diverse applications, ranging from production and manufacturing test to process monitoring and control. Our VXI instrumentation solutions are designed to take full advantage of the VXI virtual instrument capabilities and modular architecture.

Exemplifying our commitment to VXI, National Instruments continues to introduce new and innovative instruments that leverage off the latest measurement technologies – consistently setting new standards for price, performance, and ease of integration. Because all of our VXI modules are VXIplug&play-compliant, they are easy to use and compatible with scores of application development environments, including LabVIEW and LabWindows/CVI.

A Scalable Test Strategy

Our goals for VXI instrumentation include leveraging off leading-edge measurement technologies and modular software to deliver a scalable approach to instrumentation. As your needs for size, performance, and cost dictate your system requirements, you can choose the platform and instrument that's right for your application. Considering the long-term ramifications of your instrumentation choice, a scalable testing strategy facilitates hardware and software reuse – minimizing costs today and in the future.

State-of-the-Art Instrument Technologies

To achieve our goals of performance, cost-effectiveness, and reliability, we have invested substantial resources to develop innovative technologies that deliver powerful measurement solutions at the lowest cost. These technologies include the MITE DMA ASIC for high-speed data transfers, the DAQ-STC which serves as the timing engine to our data acquisition family, and the new Flexible Resolution A/D technology that delivers an unprecedented range of measurement capabilities.

VXI Instrument Objectives

- *Maximum system performance*
- *Accurate and reliable measurements*
- *Scalable instrumentation solutions*
- *Modular/reusable software*
- *Multi-instrument capabilities to lower system costs*

Flexible Resolution A/D Converter

National Instruments developed the Flexible Resolution A/D converter to provide a wealth of measurement capabilities using a single VXI module – effectively lowering your overall system cost. The Flexible Resolution A/D converter contains a high-performance programmable gain instrumentation amplifier and multibit delta-sigma converter topology shown in Figure 1

The Flexible Resolution A/D converter consists of a servo loop. The analog loop filter has high gain at low frequencies, and low gain at higher frequencies because of stability. The output of the filter is digitized by the A/D converter, sampling at 100 MS/s.

At low frequencies, where the loop has high gain, the output of the DAC is forced to be identical to the input. If any difference exists, it will be amplified, inverted and subtracted until the DAC is similar to the input. From Figure 2, you can see that the conversion quality significantly improves with lower frequencies.

High-Performance DMA Increases System Throughput

Moving data across the VXIbus is important for all applications, because overall system performance ultimately depends on the data transfer rate between the VXI controller and the instruments. The faster that data can be moved from the instrument to the VXI controller, the more data can be analyzed, logged, and/or displayed.

Instruments Overview

Because transferring data across the VXIbus is key for many types of applications, the VXI-MIO Series uses the MITE for high-speed DMA transfers. Using the sophisticated DMA capabilities of MITE, these instruments move data to the VXI controller without encumbering the computer CPU. In a system with several instrument modules, overall data throughput is optimized because each instrument transfers data back to the host controller, making the most efficient use of the VXIbus and freeing up the controller CPU for other tasks.

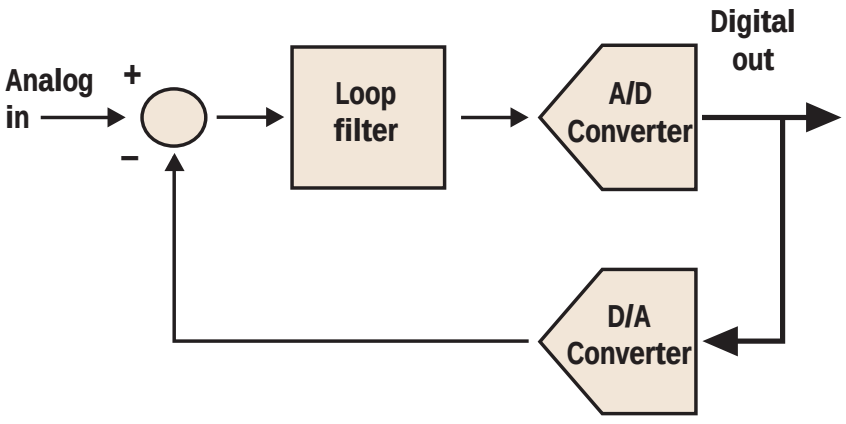

Figure 1. Block Diagram for Multibit Delta-Sigma Converter

Calibration

All of our VXI instruments are calibrated to a NIST-traceable source at the factory prior to shipment. In the field, you can perform software calibration on each module through software routines shipped with the instrument to ensure accurate measurements. Some modules have onboard sources so that you do not need to connect to an external instrument to calibrate your module. National Instruments also works with several third-party calibration service companies to provide on-site calibration if you choose to out-source these tasks.

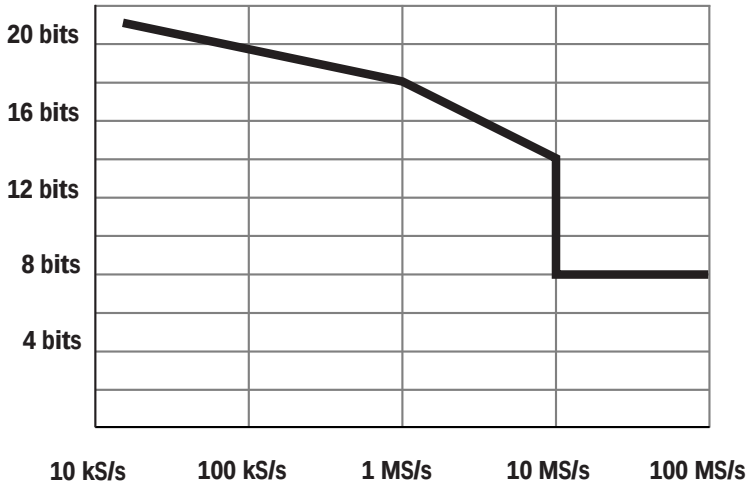

Figure 2. Flexible Resolution Sampling Rate vs Resolution

Arbitrary Waveform Generator

The NI 5412 Arbitrary Waveform Generator is a full-featured 40 MS/s, 12-bit resolution instrument with two independent channels. You can define up to 5,000 different waveform segments in the NI 5412 onboard memory and also employ waveform linking and looping and frequency hopping. For generating standard, repetitive waveforms, the NI 5412 takes advantage of direct digital synthesis (DDS) to generate waveforms with very precise amplitude and frequency resolution.

The NI 5412 also has 32 digital output lines that you can use to generate digital patterns. You simply download the patterns to be generated directly to the NI 5412 and it generates a stream of patterns clocked to an external source; or you can use one of the onboard frequency options. You can use the NI 5412 for generating modulated signals for communications testing, video images for HDTV testing, shock signals for disk drive testing, and noise and transient spikes for power supply testing.

Oscilloscope with Flexible Resolution

The NI 5912 is a high-performance, two-channel, 100 MHz VXI oscilloscope. But because it uses the Flexible Resolution technology, can also function as a high-resolution digitizer for lower frequencies – combining the measurement capabilities of several instruments into one module. The Flexible Resolution ADC, in conjunction with a high-performance programmable gain instrumentation amplifier, offers flexible resolutions over a wide sampling rate range. You can sample at 100 MS/s with 8-bit resolution, 10 MS/s with 13-bits and 1 MS/s with 18-bits.

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Instruments Overview

Reconfigurable Switch Multiplexer/Matrix

The NI 2727 is a reconfigurable VXI high-density armature relay module that consists of a 64 x 1 2-wire multiplexer. Through a combination of wire terminal accessories and software, you can configure the NI 2727 in a number of different multiplexer and matrix configura-tions to solve a wide spectrum of applications. The flexibility of the NI 2727 makes it an excellent choice for many test applications requiring both a relay multiplexer and matrix.

VXI Data Acquisition

You can use our VXI data acquisition instruments (see Table 1) for a wide range of applications, such as waveform acquisition, waveform generation, digital interfacing, pulse generation, static and dynamic voltage measurements, transient analysis, data logging, and frequency counting. Because of their versatility and multifunction capabilities, a single VXI instrument module can replace several instruments in a system. You can use these products in many diverse application areas ranging from production and manufacturing test to process monitoring and control and to data acquisition, with several options for conditioning signals from a wide array of transducers, such as thermocouples, RTDs, thermistors, and strain gauges.

NI 5412

2 independent channels
40 MS/s (16 MHz sine waves)
12-bit resolution
4-16 Msample waveform memory per channel
Waveform linking and looping
32-bit digital pattern generator
NI-Arb Instrument Driver
LabVIEW, LabWindows/CVI, VirtualBench application software

Table 1. NI 5412 Features

NI 5912

2 input channels
10 kS/s to 100 MS/s real-time sampling
1 GS/s random interleaved sampling
8 to 20-bit vertical resolution depending on sampling rate
Digital/Analog triggering
NI-Scope Instrument Driver
LabVIEW, LabWindows/CVI, VirtualBench application software

Table 2. NI 5912 Features

NI 2727

Multiplexer modes – 1, 2, and 4-wire
Matrix modes – 16x4 and 8x8
Fully software programmable
250 V Category II insulation
Very low thermal offset (less than 2 µV)
NI-Switch Instrument Driver
LabVIEW, LabWindows/CVI application software

Table 3. NI 2727 Features

	Features	VXI-MIO-64E-1	VXI-MIO-64XE-10	VXI-DIO-128	VXI-AO-48XDC
Analog Input	Sampling Rate	1.25 MS/s	100 kS/s	–	–
	ADC Resolution	12 bits	16 bits	–	–
	Input Channels	64 single-ended 32 differential	64 single-ended 32 differential	– –	– –
	Digital Triggering	VXI TTL/ECL Triggers, External	VXI TTL/ECL Triggers, External	– –	– –
	Analog Triggering	Yes	Yes	–	–
Analog Output	Output Channels	2	2	–	48
	DAC Resolution	12	16	–	18
	Update Rate	1 MHz	100 kHz	–	100 Hz
Digital	I/O Channels	8 bidirectional	8 bidirectional	64 Input, 64 Output	32 bidirectional
	Counter/Timer	2, 24-bit 20 MHz up/down	2, 24-bit 20 MHz up/down	–	–

Table 1. The Multifunction I/O Capabilities of VXI Data Acquisition Instruments.