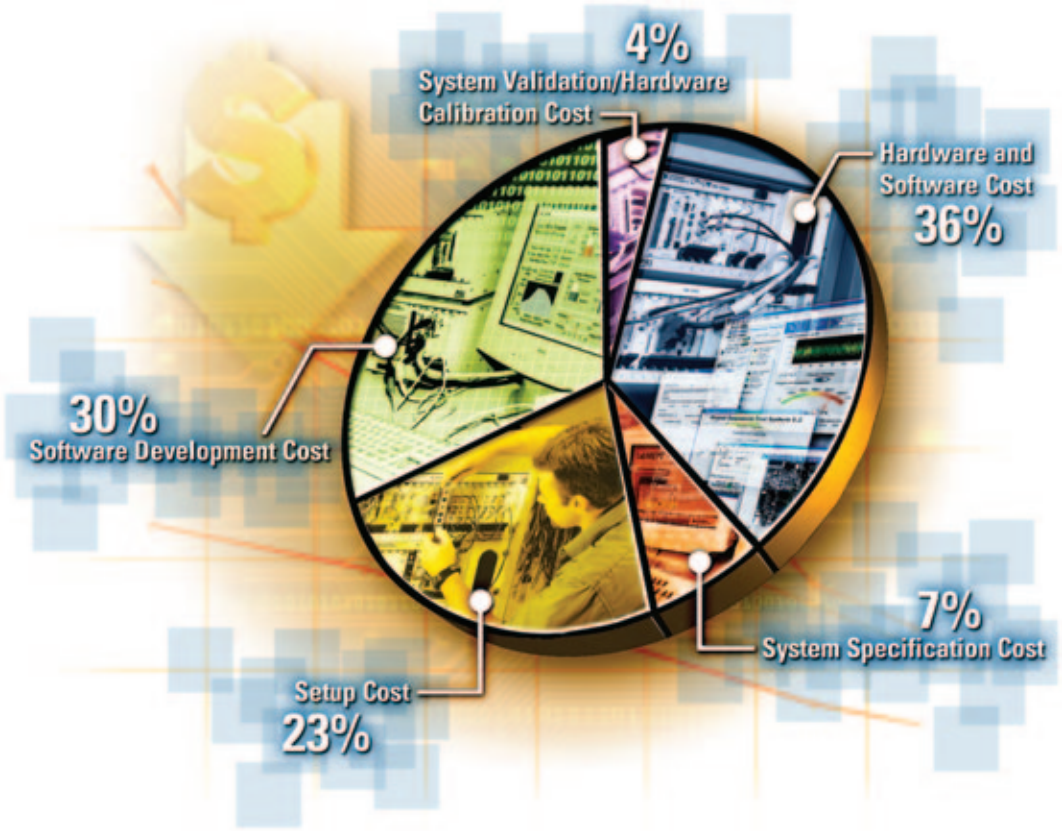
# Instrumentation

The Worldwide Publication for Measurement and Automation

Second Quarter 2004

Newsletter™




## Virtual Instrumentation Technologies Lower Measurement Cost

The design and implementation of test and measurement systems has both fixed costs and time costs. To lower fixed costs, which include the price of your software package and measurement data acquisition hardware, NI has lowered multifunction dat acquisition hardware prices by up to 25 percent. Today, with convenient online shopping, you can determine these costs quickly and easily once you know what you need. Time costs, on the other hand, are more complex to calculate. As a result of the added complexity, time costs are often forgotten, or hidden from the total system cost.

continued on page 4

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# Reducing the Cost of Test – Part II

In the last issue of *Instrumentation Newsletter* we discussed how virtual instrumentation has reduced the cost of test over the past two decades. In this issue I would like to look at this subject in a little more detail. Although there are signs of optimism in the global economy, the past few years have taught us some lessons, leading to a much more cautio us environment for business purchases. Prior to making investments in new equipment and processes, management today is asking for much more justification based on return on investment (ROI).

***Since 1994, installation of the hardware and software has gone from approximately three hours to less than one hour; board and driver configuration that took two hours now takes less than 15 minutes; and software development has improved dramatically from LabVIEW 3 to LabVIEW 7 Express.***

## Determining Return on Investment

For many engineers, financial ROI analysis does not come naturally, and so the analysis of the costs of new equipment or a new system typically focuses on the direct purchase cost. However, this often misrepresents the true costs of a new or updated system. We have all become accustomed to the increasing price/performance of new technology products, and in the past this was often enough to justify a purchase, whether it was a new computer or some other equipment. In the last issue of this newsletter, we mentioned how National Instruments first PC data acquisition card offered 12-bit resolution and a sampling rate of 100 KS/s for a price of $1,495, while today we offer our E-Series data acquisition boards – with 16-bit resolution and 200 KS/s sampling rate – at a price below $395.

However, as previously mentioned, price alone does not, and should not, completely justify purchasing new technology such as our latest DAQ boards. Instead, you should have an idea of the complete costs of the equipment or system you are considering. This means you have to understand the hidden costs of a test system.

## Understanding the Hidden Costs

In the cover article of this issue, you can read about a study National Instruments conducted with engineers in a range of industries and applications. This study showed that hidden costs of system specification, hardware and software setup, software development, system validation, and calibration may amount to twice the purchase price of the hardware and software for a test system. These hidden costs vary from application to application, but they are real and quite significant. It is worth analyzing what these costs mean for you and your company when embarking on the development of a new test system.

## Looking Back to See Progress

One way to evaluate these hidden costs is to look back at previous systems and development efforts and compare the amount of time spent on various aspects of the system to the anticipated development time for a new system. This provides a very good measure of productivity, a metric of particular interest to most managers in these times. The above mentioned survey led NI to compare our most popular 1994 DAQ board with our most popular board today. The results were staggering – installation of the hardware and software has gone from approximately three hours to less than one hour; board and driver configuration that took two hours now takes less than 15 minutes; and software development has improved dramatically from LabVIEW 3 to LabVIEW 7 Express.

National Instruments is fully committed to driving further cost reductions through virtual instrumentation. Whether by continuously improving hardware and software price/performance to minimize direct costs or by reducing the hidden costs that can dramatically affect your productivity, virtual instrumentation clearly delivers a good return on your investment. ■

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# LM-STAR NI Software-Based Test System Saves Millions

In 2001 Lockheed Martin was awarded the largest aircraft contract in history. The Joint Strike Fighter (JSF)/F-35 contract, valued at approximately $200 billion, provides the cornerstone of future defense capability for the United States and its allied partners. A crucial part of the JSF contract is delivering a test system for use in applications from manufacturing to environmental stress screening to depot testing on the more than 3,000 planned JSF aircraft. To meet this challenge, Lockheed Martin Simulation, Training & Support (LM STS) developed the LM-STAR test system to deliver integrated support for avionics test systems. Designed to rapidly develop test solutions and support customers' exact needs in a cost-effective and timely manner, the LM-STAR system uses NI TestStand and LabWindows/CVI software for the core test management and ANSI-C test development environments.

## Open Software Architecture Ensures Rapid Development

In the LM-STAR system, an open software architecture based largely on NI TestStand and LabWindows/CVI supports the seamless transition of test systems from the factory to the field. The LM-STAR solution provides a common test system for all avionics suppliers participating in the JSF Harmonization Plan. Essential for a project of the magnitude of the JSF program, the JSF Harmonization Plan allows multiple suppliers, including BAE Systems, Northrop Grumman, Rockwell Collins, and Raytheon, to simultaneously develop test program sets (TPS) using NI TestStand and LabWindows/CVI for the JSF/F-35. The advanced, open software architecture in the LM-STAR system ensures the rapid development and deployment of mission critical test systems while minimizing long-term maintenance efforts.

***The standardized LM-STAR approach to the JSF/F-35 program, which uses NI TestStand and LabWindows/CVI, has already saved the U.S. government millions of dollars and has the potential to save hundreds of millions more over the life of the program.***

## Test Software Adaptability Enables Multiple Test Configurations

Using the standard features provided by the NI TestStand commercial, off-the-shelf (COTS) test management environment, LM STS test engineers built a common test architecture to facilitate the rapid delivery of configurable test solutions. The key LM-STAR features use many core TestStand components, such as the flexible module adapters for calling tests developed in any test development environment and the TestStand process model for separating the core system functionality from the individual tests. The NI LabWindows/CVI development environment also contributed to the rapid configuration of LM-STAR-based test systems by providing industry-leading instrument connectivity and driver support through a proven ANSI C-based development language and a compiler optimized for test.

## Future Technology Insertion Prevents Obsolescence

The modular test architecture of the LM-STAR system protects mission-critical test systems from obsolescence by using NI TestStand and LabWindows/CVI to ease the insertion of future technologies.

One example is new TestStand support for calling ATLAS TPSs directly from TestStand. This technology is important for supporting legacy avionics test systems through a common test architecture capable of hosting both legacy and future test development environments. Specifically, the new ATLAS interface for NI TestStand 3.0 features the ability to browse and select ATLAS TPS files, specify parameters, and perform remote control. Run-time features include full compliance of TPS Server state transitions, such as attaching, loading, and detaching; parameter reading and writing; global locking; handling of manual TPS intervention; and the ability to pause and terminate sequence execution.

Avionics test system developers are also closely watching the development of the newly

*The Lockheed Martin LM-STAR system based on NI software scales easily to meet a variety of test needs.*

defined XML-based Automatic Test Markup Language (ATML) standard for describing test procedures and test results in XML. The open software architecture in the LM-STAR system will significantly ease the adoption of this data schema for avionics test systems. In fact, NI has already demonstrated that the current NI TestStand 3.0 XML features can generate results in the new Test Results XML schema in accordance with the draft ATML specifications.

## Standardized Approach Yields Significant Cost Savings

The innovative LM-STAR approach to standardized test system development based on commercial, off-the-shelf test software has yielded many cost-saving benefits for LM STS, harmonization suppliers, and the U.S. government. LM STS estimates their standardized LM-STAR approach to the JSF/F-35 program has already saved the U.S. government millions of dollars and has the potential to save hundreds of millions more over the life of the program. ■

*To register for a live Web event on building open architecture test systems using TestStand, visit ni.com/info and enter* **nsi4203**.

***ni.com/teststand***

# Virtual Instrumentation Technologies Lower Costs

continued from page 1

Virtual instrumentation combines software and modular hardware with off-the-shelf PC technologies to provide several solutions for minimizing the hidden time costs that may appear during the development process. Recent advances in virtual instrumentation technologies such as NI LabVIEW and NI-DAQmx measurement services can help you reduce hidden time costs and fixed costs in the development of an automated test or measurement application.

## The Hidden Costs of a Measurement Application

To quantify how engineers and scientists spend their time and thereby gain a better understanding of their virtual instrumentation needs, NI surveyed measurement experts in various industries around the world to determine the breakdown in costs of their most recent test or measurement system. From this survey, we learned that measurement application development can be broken up into five cost areas. The largest single cost is the price of the software and hardware at 36 percent; however, the other four costs can be combined into one hidden time cost which makes up 64 percent of the total cost. Recent advances in virtual instrumentation touch on each of these four hidden time costs – software development, setup, system specification, and system validation/hardware calibration – reducing the chance for failed or over-budget projects.

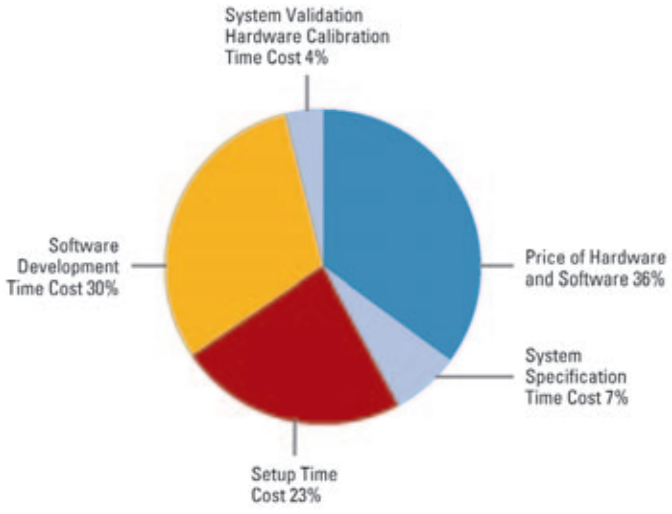


*Figure 1. Hidden time costs account for two-thirds of the total cost of a measurement system.*

## Hidden Application and Development Costs – 30 Percent

Time-saving development tools greatly reduce total system costs. Newly introduced NI-DAQmx measurement services include several time-saving NI technologies including the DAQ Assistant, driver engine, application programming interface (API), and NI Measurement & Automation Explorer (MAX). Using the DAQ Assistant, you interactively configure data acquisition tasks, including timing, triggering, and sensor scaling. The DAQ Assistant helps you develop your test much more quickly by eliminating the need to program most data acquisition functions. Furthermore, it integrates seamlessly with LabVIEW analysis functions such as spectral measurements or filtering by directly transferring data without manipulation or additional programming.

For more complex data acquisition applications, you can use the DAQ Assistant to automatically generate modifiable NI-DAQmx code for LabVIEW, C/LabWindows/CVI, or Measurement Studio .NET. Automatic code generation saves time you would otherwise spend consulting manuals and learning DAQ programming methods through trial and error.

NI-DAQmx software also includes a technology known as virtual channels. Virtual channels associate physical channels on your DAQ device with voltage, sensor, or custom scaling information. Without virtual channel technology, you need to programmatically convert the data returned by the data acquisition driver. Data conversions can include binary data converted to floating-point data and scaled floating-point data to proper engineering units. You configure virtual channels either programmatically or within our configuration software, NI MAX. In addition, NI provides numerous example programs with NI-DAQmx software, as well as over 3,000 example programs in a searchable online database at ***ni.com/devzone***. These example programs address every aspect of application development, further reducing the hidden costs of development time.

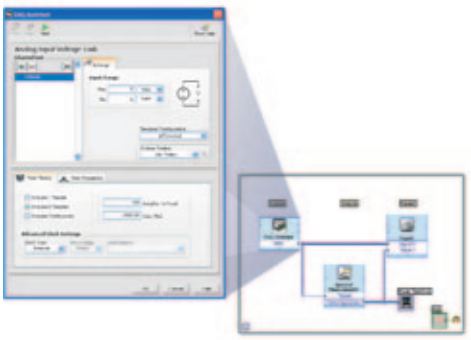

*Figure 2. Reduce hidden costs with new, interactive features in the DAQ Assistant.*

## Hidden Setup and Configuration Costs – 23 Percent

NI-DAQmx measurement services include NI MAX configuration software that can reduce time costs in setup and configuration. NI MAX automatically detects and lets you interactively configure all of your data acquisition, GPIB, FieldPoint, and PXI devices in one environment without programming. You can point and click to run diagnostic tests and quickly check incoming and outgoing signals, ensuring that the data acquisition device and your connections are functioning properly.

## Hidden System Specification Costs – 7 Percent

NI offers several online resources to shorten the time involved in specifying a system. DAQ Designer, available online at ***ni.com/advisors***, asks questions about your application and recommends the optimal accessories, signal conditioning components, data acquisition device, and software to match your needs. Advisors on ***ni.com/advisors*** recommend third-party complementary products such as sensors and laptop computers for your measurement hardware and software. DAQ Designer and advisors save time by quickly helping you identify products that best fit your application needs.

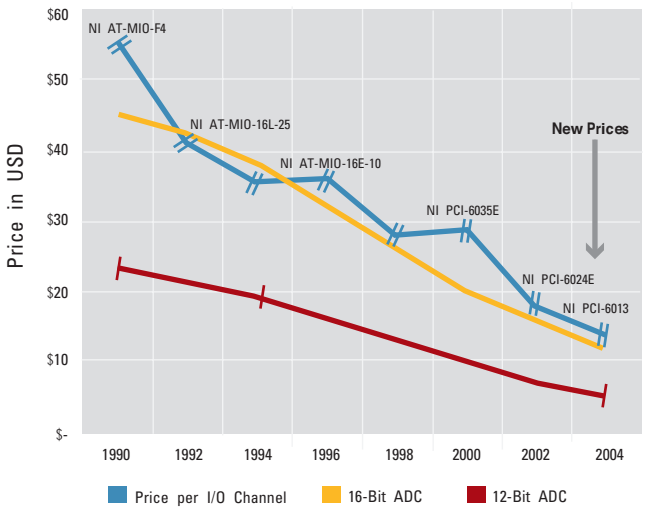


*Figure 3. Price and performance trends for ADCs and NI data acquisition devices demonstrate how virtual instrumentation is reducing costs.*

## Hidden System Validation and Hardware Calibration Costs – 4 Percent

You can calibrate NI data acquisition devices in NI MAX configuration software or programmatically in your DAQ application, rather than manually adjusting potentiometers or removing hardware from the computer for simple device calibration. To help reduce time spent debugging and testing your application, NI-DAQmx measurement services takes a thorough approach to error reporting, suggesting causes of the problem and a possible solution, rather than a numeric error code. Both of these capabilities help reduce the 4 percent of total system cost usually attributed to validation and calibration costs.

## NI Lowers the Price of DAQ Hardware

The price of measurement software and hardware is undoubtedly the most visible cost of a data acquisition (DAQ) system. Many people attempt to save money in this area without considering the effect on total development cost. Figure 1 shows that the price of the software and hardware, on average, makes up about 36 percent of the total application cost. However, the time and money spent in other areas of the development process make up the majority of the total application cost.

Virtual instrumentation not only lowers time costs, but also helps minimize software and hardware costs. To illustrate this, examine Figure 3, which shows price and performance trends for one of the off-the-shelf technologies used in NI data acquisition devices, analog-to-digital converters (ADCs). Note that a 16-bit ADC is priced lower today than a 12-bit ADC in the early 1990s. As a result of trends such as these, NI has been able to provide better data acquisition performance and more I/O channels for an equal or better price, as shown by the blue trace on the graph.

As a volume leader in data acquisition worldwide, NI also can take advantage of economies of scale in its board designs. Many NI data acquisition devices take advantage of ASIC (application specific integrated circuit) technology, which gives you both lower cost and advanced functionality. NI high-volume multifunction DAQ devices use two main ASICs, the NI STC (system timing controller) and the NI mini-MITE bus interface chip. The NI-STC and mini-MITE control all the system timing aspects of the analog and digital subsystems as well as PCI bus communication. Alternative digital electronics do not offer the high-performance features or the cost savings of these high-volume ASICs. Furthermore, as the PC-based data acquisition market grows and NI continues to distribute ASIC development cost over many units, you benefit from lower prices. As a result, NI lowered the price of 13 multifunction DAQ devices in January of 2003 by up to 25 percent.

NI continues to lower the cost of measurement and automation through virtual instrumentation advancements. Lower cost analog-to-digital converters and strategic use of ASIC technology help you reduce your fixed costs, while innovative software environments and utilities increase productivity. Such cost savings help you get your products to market faster and at a more competitive price. ■

## Up to 25 Percent Worldwide Price Reduction for Data Acquisition

National Instruments has reduced prices up to 25 percent for 13 of its most popular data acquisition modules, a development that continues the company's 26-year history of reducing the total cost of measurement and control for engineers and scientists. This price reduction applies to all regions of the world for NI data acquisition devices ranging from 200,000 S/s to 1.25 million S/s, and 16 to 64 analog inputs.

By taking advantage of commercial PC-based technologies and investing in innovative research and development, NI data acquisition cost per I/O channel has decreased by 74 percent since 1990. More recently, NI has taken advantage of low-cost off-the-shelf technologies and significant increases in manufacturing efficiency to pass additional savings to customers. For example, a customer who purchases the 16-bit, 64 analog input PCI-6031E device now benefits from a savings of $400, €700, or ¥69,000 – a price reduction of up to 25 percent.

With these new prices, NI continues to offer a complete low-cost, measurement-ready data acquisition solution with superior accuracy, reliability, software productivity, and support. As a leader for data acquisition in measurement and control, NI is committed to developing state-of-the-art data acquisition technology and passing savings on to its customers. ■

*For more information on this worldwide price change, including a list of all DAQ modules involved, please visit ni.com/info and enter* **nsi4201**.

*To download the DAQ Value white paper or learn about NI-DAQmx technologies, visit ni.com/info and enter* **nsi4202**.

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# Future-Proof Your Instrumentation Systems

Today's instrument control landscape includes an increasing number of I/O options. The changes in PC bus technology and the need for distributed instrumentation have led to several instrument control bus options including GPIB, RS-232, USB, Ethernet, FireWire (IEEE 1394), and Wireless (IEEE 802.11). This increasing number of bus options makes it difficult for you to determine the best option for standardization and scalability.

GPIB, because of its long and successful history, is a valuable case study that can provide insight into understanding the critical tools you need to build scalable instrument control solutions for the future. Using robust, flexible software architectures including I/O libraries, interactive utilities, and configuration tools can provide consistency through bus evolutions and software technology changes.

## Looking Back at Instrument Control Standards

Although instrument control systems have evolved significantly over the last 25 years, two things have remained constant: 1) engineers and scientists have predominantly used the GPIB (IEEE 488) bus for controlling their instruments, and 2) software played a key role in making GPIB the most popular bus for instrument control and will continue to be the critical factor in shaping the success of future instrumentation buses.

***Developing instrumentation systems based on VISA instrument drivers will carry your applications from today to the operating systems and instrument control buses of the future.***

When evaluating the success of GPIB, you might initially attribute its popularity to the fact it is designed specifically for instrument control applications. The bus is defined under IEEE Standard 488.1, which delineates the electrical, mechanical, and functional specifications for the bus, and IEEE Standard 488.2, which defines precisely how controllers and instruments communicate through GPIB. GPIB provides a digital, 8-bit parallel communication interface with data transfer rates up to 8 Mbytes/s, industrial-grade GPIB cables and connectors, and cable length and bus loading limitations to ensure data integrity and throughput.

Even with these rigid hardware specifications, software is actually the most critical component for connecting to and controlling instruments. The overwhelming success of GPIB is a direct result of the flexible and scalable software architecture that has evolved with the technology and made hardware changes transparent to you. For example, as the PC progressed from the ISA bus to the PCI bus and from DOS to the latest Windows operating systems, you were able to use the same standard NI-488.2 software interface to communicate with your GPIB boards, allowing you to migrate your applications without worrying about substantial software rewrites.

Software innovations such as instrument drivers and standard software architectures greatly contributed to GPIB success. Instrument drivers have simplified communicating with and controlling instruments. Without an instrument driver, you had to write several low-level GPIB commands to initialize communication, a number of commands to configure the instrument, several more to take a measurement, and a few more to terminate communication. Instrument drivers encapsulate these low-level commands within intuitive, high-level function calls such as Initialize, Configure, and Close. Instrument drivers provide an easy method for communicating with instruments while shielding you from differing instrument command sets. For example, once you learn to use an instrument driver for one oscilloscope, communicating with another oscilloscope, even from a different vendor, is quite simple.

If you do not have access to an instrument driver for your particular device, standard development environments including NI LabVIEW, NI LabWindows/CVI, and Microsoft Visual Studio .NET (through NI Measurement Studio) now include an innovative, interactive tool for direct I/O – Instrument I/O Assistant. This tool includes interactive debugging and automatic data parsing that can save you up to 80 percent of your development time.

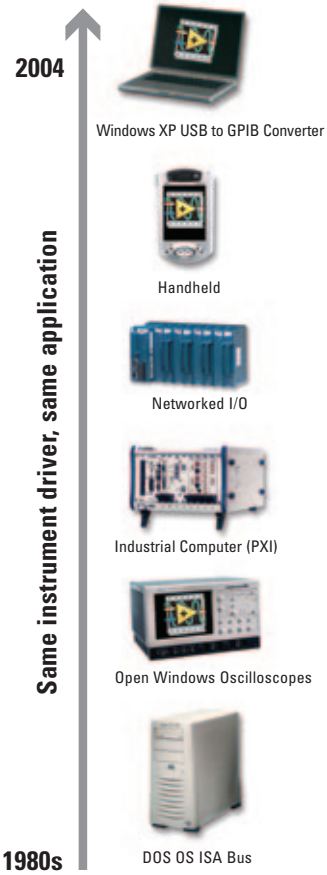


*Figure 1. Flexible and scalable software architecture makes hardware changes transparent.*

In addition to instrument drivers and interactive I/O utilities for easy instrument connectivity, the Virtual Instrument Software Architecture (VISA) was created in the early 1990s to simplify direct communication with instruments based on GPIB and other popular buses such as VXI and RS-232 Serial. VISA defines a common API for communicating with devices based on those different buses. This allows you to migrate your applications between those buses with greater ease and simplicity.

## Instrument Control Today

Over the last several years, standard PC buses have emerged as candidates for instrument control including USB, Ethernet, and FireWire (IEEE 1394). These new buses offer the advantage of widespread availability in new PCs, greater data throughput, and greater potential for

technical advances. However, there are barriers to widespread adoption of these buses.

First, there is currently no clear bus of choice for instrument control among standard busses. As a result, few instruments offer these as options for I/O communication and almost all still provide GPIB connectivity. Second, since GPIB has been the bus of choice for more than 25 years, there are tens of millions of GPIB instruments on the market that cannot be inexpensively replaced. This install base of GPIB instruments makes it difficult for one of the PC buses to supplant it as the new bus of choice for instrument control. Finally, one of the advantages of the PC buses is also a hindrance to their widespread adoption. Because these are commercial buses, there will be rapid, continuous advancements, independent of the test and measurement industry, which may or may not be compatible with previous versions. This rapid change is not suitable for most instrument control applications where stability and long term support are crucial.

Nevertheless, the prevailing bus is not the most important issue – the dynamic to remember is that the same software architecture that has made GPIB popular and guaranteed its longevity also ensures a smooth transition to the buses of the future. VISA provides a common API for communicating with instruments based on GPIB, USB, Ethernet, Serial, and VXI buses as well as PXI modular instruments. VISA-based instrument drivers further shield you from these buses, so you can use the same driver to communicate with an instrument through GPIB, USB, or Ethernet. Essentially, this architecture makes the hardware "disappear." You can interchange the hardware bus and even the hardware itself while maintaining much of your software investment.

In addition, NI-488.2 driver software provides a platform to take advantage of new PC buses. With NI-488.2 software that ships with all NI GPIB controllers, you can communicate with a GPIB instrument through PC buses by using products that bridge PC buses and GPIB on the instrument. The NI GPIB-USB-B and the NI GPIB-ENET/100 connect your USB or Ethernet port respectively to the GPIB connections on your instrument. As buses evolve, NI will continue to deliver powerful, easy software for instrument control and connectivity that improves your productivity and safeguards your test system investment.

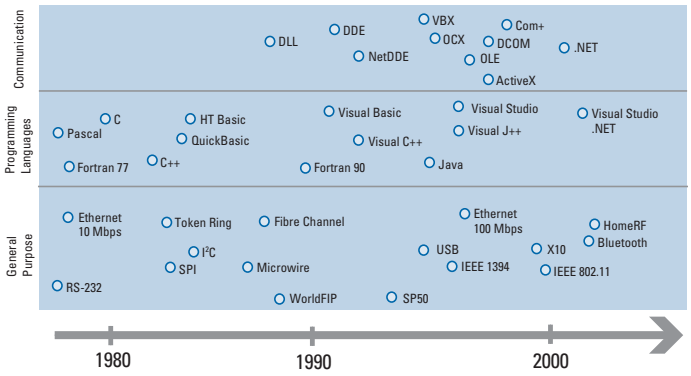


*Figure 3. VISA software architecturing protects you from an abundance of new and emerging network and software technologies.*

## The Future of Instrumentation

Looking forward, test systems will continue to become more complex and more disparate. Systems will include multiple bus systems, mixed I/O, and distributed systems. In addition to the increasing complexity of instrumentation hardware, development cycles continue to decrease, making code reuse and easy portability extremely important.

Looking at Figure 3, you can see that the role of software is more critical than ever. By using flexible instrumentation architectures such as VISA together with instrument drivers, most of the work is done for you. Developing instrumentation systems based on VISA instrument drivers carries your applications from today to the operating systems and instrument control buses of the future.

Learning from the past and looking ahead to more changes, you should not concentrate on one bus or technology, but instead focus on choosing software tools that embrace the I/O and communication technology that best complements your application needs and ensures a smooth transition to incorporate new technology advancements as they arise. ■

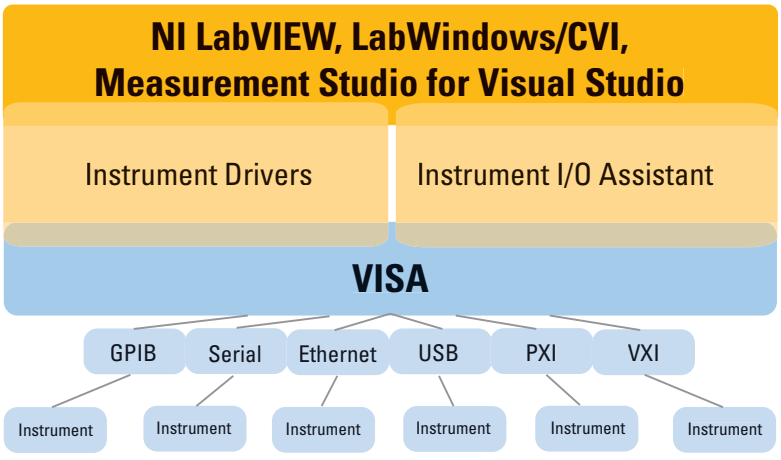


*Figure 2. Use VISA-based instrument drivers or Instrument I/O Assistant to seamlessly migrate your instrument bus without significant application rewrites.*

*To view interactive tutorials and read technical papers about connecting your instruments to LabVIEW, visit ni.com/info and enter* **nsi4204.**

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# Reduce DAQ Development Time with Configurable Software

A common misconception is that the cost of a data acquisition system is simply the sum of the software and hardware purchase prices. In fact, according to a recent NI customer survey, most data acquisition systems incur the majority of their cost (57 percent) after component purchase, once development has begun. Contributing largely to this cost is the time and effort spent setting up and configuring hardware devices, creating application software, and calibrating and testing the system. (For more information on the costs associated with developing a data acquisition system, read "Virtual Instrumentation Technologies Lower Measurement Cost" on page 1.) For nonprogrammers, these tasks often become roadblocks that increase development time and push projects over budget. However, you can bypass these roadblocks and reduce your development time by taking advantage of configuration-based software designed specifically for developing data acquisition systems without programming.

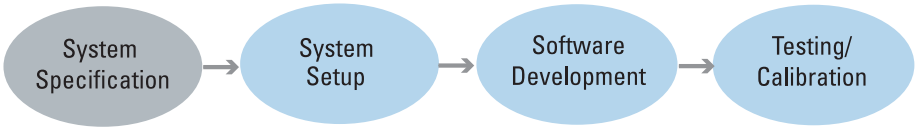



*Figure 1. Configuration-based software reduces development time in the four stages of data acquisition system development.*

## Configuration-Based Software for Data Acquisition

A wide variety of software solutions for data acquisition exist in the test and measurement market today. Ranging from simple turnkey executables to complex programming languages designed for computer scientists, these packages provide functional solutions, but many cause more work than necessary because of either limited functionality or excessive complexity. Configuration-based data acquisition software is the class of software in between that does not require you to program and provides measurement functionality through an easy-to-use interface. For data logging and data acquisition, interactive software provides valuable functions, such as an intuitive user interface, automatic data storage and archiving, data exporting capabilities, alarming and event management, display and trending, and hardware connectivity. By providing critical measurement tools in an easily navigable environment, configuration-based software adds significant value if you need data acquisition functionality but prefer not to program.

***Configuration-based software adds significant value if you need data acquisition functionality but prefer not to program.***

## Configuration-Based Software Streamlines System Development

Every data acquisition system is built in four stages, as shown in Figure 1. In each stage of development, configuration-based software helps you focus on your application, not the programming necessary to implement it.

### System Setup without Programming

The system setup stage includes the physical hardware setup and configuration of your devices. Many hardware vendors provide simple configuration utilities to perform basic operations and some testing, while others offer very powerful, interactive utilities. As mentioned in the cover article of this newsletter, the NI Measurement & Automation Explorer (MAX) is a complete hardware configuration and testing application included with all NI-DAQ devices that saves you time and effort when configuring your system, whether you use data acquisition or other diverse NI hardware products.

### Simplify Software Development

Configuration-based software provides the largest savings in the software development stage. Because many engineers believe that PC-based data acquisition requires programming, this stage can often be a major obstacle. However, using configuration-based software can reduce your development time dramatically when compared to traditional programming solutions.

For data logging and simple data acquisition applications, National Instruments VI Logger offers rapid development without compromising functionality. NI VI Logger is an interactive, flexible tool specifically designed for your data logging applications, and is compatible with NI data acquisition (DAQ) and FieldPoint distributed I/O products. With intuitive dialog windows, you can configure your logging task to acquire, log, view, and share your data. NI VI Logger incorporates easy-to-use tools for:

- Low-speed and high-speed data logging
- Run-time and historical data viewing
- Event detection and action
- Exporting data to spreadsheets, databases, and LabVIEW
- Integration with multiple hardware devices

VI Logger works with a wide variety of NI data acquisition devices, so you can log low-speed signals, such as temperature, and high-speed signals, such as audio. VI Logger includes an interactive viewer for your real-time and historical data. You can quickly scroll back and forth in time or jump to a specific time or value.

With conditional acquisition and logging features, you can set up conditions – such as a time and date or analog or digital trigger – to start acquiring and logging your data. VI Logger can respond to events, such as out-of-range signals, sending e-mail notifications, triggering digital outputs, writing to an analog channel, displaying warning windows, stopping/starting logging, or sounding an alarm.

Because VI Logger requires no programming, you can immediately begin acquiring data from your system without

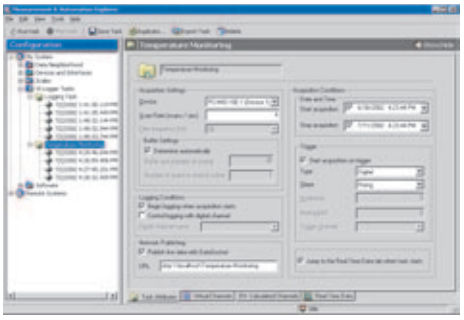


*Figure 2. NI VI Logger is an easy-to-use configuration-based package for data logging and simple data acquisition.*

learning to program or navigate a complex environment. Additionally, VI Logger is tightly integrated with MAX, so your configuration and development tools are conveniently housed in the same interactive environment.

Finally, if you find you need more functionality than VI Logger can offer, you will not lose your work. VI Logger includes NI LabVIEW-compatible VIs to make a transition from VI Logger easy. Simply use the VIs to pull your acquired data into LabVIEW and begin using the expanded configuration tools and programming in LabVIEW to complete your application.

The new DAQ Assistant in LabVIEW 7 steps you through a wizard to create measurement tasks ranging from temperature monitoring to frequency and current measurements to high-speed counter/timer operations, and you can test your configuration immediately with a built-in utility. Additionally, more than 38 interactive Express VIs give you a point-and-click interface for adding analysis, file I/O, report generation, and more to your application – all without programming.

## Quickly and Easily Perform Calibration and Testing

Finally, in the calibration and testing stage, configuration-based software closes the development cycle. Instead of learning a separate software package, simply reuse MAX and take advantage of built-in self-calibration and testing functions. Interactive test panels give you access to all I/O types and channels on your board, including analog input, analog output, digital I/O, and counter/timers. By integrating these tasks with those from the system setup phase, you spend less time learning a new software tool and have a more efficient development experience.

**Which Software Is Right for You?**

| NI VI Logger – Configuration-Based Data Logging Software | NI LabVIEW – Intuitive Graphical Programming Environment |
|---|---|
| Fully interactive environment that requires no programming | Flexibility and scalability of a full-featured programming language with configuration tools to speed development |
| Integration with NI data acquisition and Compact FieldPoint hardware | Integration of thousands of I/O devices from hundreds of vendors, including NI hardware |
| Simple, easy-to-navigate user interface | Drag-and-drop, fully customizable graphical user interface |
| Core data acquisition functionality including analog acquisition, triggering | Expanded measurement functionality including data acquisition, instrumentation, image acquisition, motion control, real-time control |
| Offline analysis with additional software | Built-in inline and offline measurement analysis |
| Logging to file and standard databases, templates for HTML publishing | Logging to file and databases, Web publishing, and automated report generation |

## When Configuration Is Not Enough

Configuration-based software can be appropriate for a variety of data logging and data acquisition applications, but there are also many cases where it will not be enough. Configuration-based software is often limited in the areas of hardware connectivity, scalability, and functionality. Once your application reaches one of these limitations, you will likely need to transition to a more powerful software tool that incorporates some form of programming, such as LabVIEW. The intuitive graphical nature of LabVIEW smooths the transition from total configuration-based development to more sophisticated applications. LabVIEW 7 Express gives you both interactive, configuration-based development and the flexibility and scalability of a full-featured programming language, so your software can grow with the scope of your project.

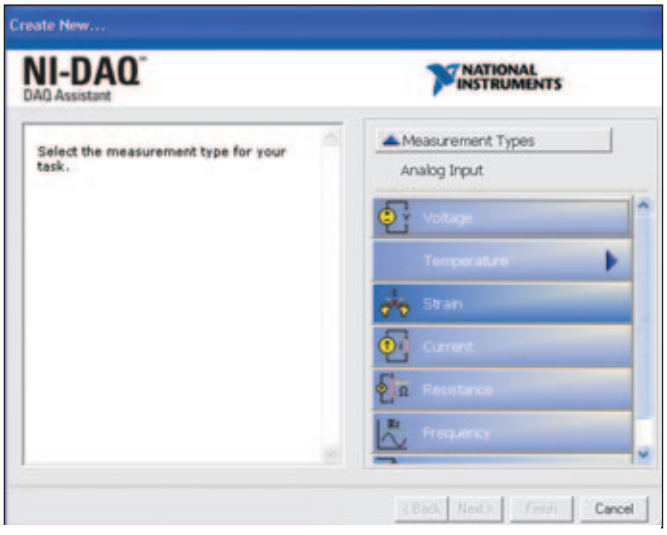



*Figure 3. LabVIEW 7 Express DAQ Assistant delivers configuration ease of use and code generation for programming flexibility.*

Many configuration-based applications operate only with a specific set of hardware devices, limiting you to a single vendor or class of boards. Incorporating non-data acquisition I/O such as image acquisition, motion control, or stand-alone instrumentation is usually impossible with interactive applications. The open LabVIEW environment provides connectivity to thousands of devices from hundreds of vendors, ensuring that you can easily integrate all of your hardware. The project you start today may be very different in scope and nature from the project you finish a year from now. Project requirements can change drastically from inception to completion, and it is critical that your software scales with them. The LabVIEW graphical development environment helps you get started quickly with interactive Express VIs and measurement assistants, and it will not limit you as your application grows.

## Save Time and Money with Configuration-Based Software

Configuration-based software for data acquisition can save you time, and ultimately money, throughout the development of your measurement system. From system setup and application development to calibration and testing, configuration-based software ensures that you spend your time solving problems, not programming software. ■

*Receive VI Logger FREE with the purchase of E Series hardware through August 13. Visit ni.com/info and enter* **nsi4205** *or call 866-456-8364 to order today.*

*To view online demonstrations of VI Logger and LabVIEW, visit ni.com/info and enter* **nsi4206**.

**Nicole McGarry**
**LabVIEW Product Manager**
**nicole.mcgarry@ni.com**

***ni.com/labview***

# Achieve Higher Performance with New 18-Slot PXI Chassis

For test and measurement applications requiring software-configurable triggering, high channel count, and tight synchronization between high-performance modular instruments, the new National Instruments PXI-1045 18-slot chassis is an ideal platform. With a wide temperature operating range of 0 to 55 °C, the new chassis is well suited for environments with extended temperature conditions. The versatile NI PXI-1045 backplane supports all 3U PXI-compatible devices, as well as standard 3U CompactPCI devices.

*Programmatically route triggers between instruments in the NI PXI-1045 18-slot chassis.*

## Straightforward Software System Configuration

Because you configure the NI PXI-1045 chassis directly through NI Measurement & Automation Explorer (MAX), you can easily identify your PXI system without manually installing initialization files. Using software tools such as MAX and NI-DAQmx, you can programmatically configure the trigger routing module on the chassis backplane to reserve and route triggers to and from any of the three bus segments.

## High Channel Count

With its large number of slots, the NI PXI-1045 chassis is ideal for applications requiring high channel count or multiple instrument devices. For example, with this new chassis, you can configure up to 112 channels of 24-bit, 102.4 kS/s dynamic signal acquisition. By synchronizing multiple NI PXI-1045 chassis with the NI PXI-6653 timing and synchronization module, you can configure more than 5,000 channels of tightly correlated dynamic signal acquisition.

## Modular Instrument Synchronization

The backplane of the NI PXI-1045 supplies each peripheral slot with a low jitter (<5 ns) 10 MHz system reference clock you can use to synchronize multiple modular instrument devices and perform unique phase-correlated measurements. You can source external reference clocks, which are automatically detected by the chassis backplane, by using a precise PXI timing device in slot 2 of the NI PXI-1045 chassis, such as the NI PXI-6608 device with 75 ppb accuracy, or an imported 10 MHz source with the BNC connector on the rear of the chassis. ■

*To download the data sheet for the NI PXI-1045 and other NI PXI chassis, visit ni.com/info and enter* **nsi4207.**

**ni.com/pxi**

# Optimize Performance and Quality with VI Analyzer

With the NI LabVIEW VI Analyzer Toolkit, a new LabVIEW add-on, you can quickly detect areas for improvement in your LabVIEW VIs and maintain detailed documentation on your code quality. This toolkit reduces the time it takes to review software by identifying code inefficiencies, suggesting improvements for those areas of code, and providing automatic documentation for the changes.

## Improve Programming Practices

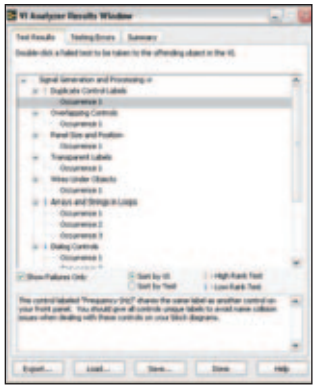
The NI LabVIEW VI Analyzer Toolkit includes 58 tests that encourage good programming practices for creating quality software applications that perform at optimal speeds. The toolkit uses LabVIEW development guidelines based on accepted software engineering best practices to make code improvement suggestions. These guidelines provide a good framework for developing flexible, robust, and high-performance LabVIEW applications.

You can use this toolkit to analyze your VI user interface, block diagram, memory usage, documentation, and other areas of code. The toolkit then recommends improvements in style, performance, and usability. It highlights areas of the code identified for improvement to reduce the time you spend debugging your VIs. With this toolkit new LabVIEW users gain development insight that they would acquire after approximately two years of LabVIEW development experience.

## Automate Software Testing

The LabVIEW VI Analyzer Toolkit also includes a programmatic interface for running tests. With this interface, you can build programs that automatically configure tests, select VIs on which to execute tests, and generate reports. You can use this functionality to build a nightly code review process for all your LabVIEW applications by configuring a new VI Analyzer task.

Whether you use the interactive interface or the programmatic interface, the toolkit creates comprehensive reports in text or HTML formats that provide a summary of each test, indicate those that failed, and identify the code that caused the failure. The report delivers complete documentation of the current state of your source code that you can share with colleagues and use to recommend future code modifications. ■



*The NI LabVIEW VI Analyzer Toolkit provides an interactive tool for improving your VIs.*

*To watch a demo and learn more about the NI LabVIEW VI Analyzer Toolkit, visit ni.com/info and enter* **nsi4208**.

**ni.com/labview**

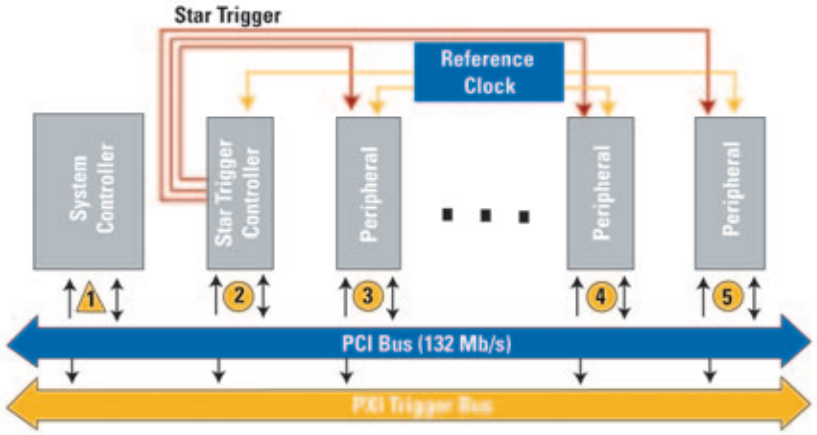
# Building High-Channel-Count Measurement Systems

When you drive on a bridge, you probably do not worry about its structural integrity – but civil engineers do, just as acoustic engineers worry about the source of road noise in a car. These applications, although in different fields, are similar – they require many test points to accurately represent system behavior. In the case of the bridge, you may use several accelerometers to analyze the bridge's vibration profile when stressed. In the acoustic case, you may use microphones to locate an acoustic event, in addition to acquiring temperature, pressure, and digital engine data. From a measurement perspective, these systems rely on the same fundamental principle: they require simultaneous acquisition of many different signals – or stated differently, they require timing and synchronization of multiple channels. With its modular, scalable architecture, PXI provides an excellent platform for such applications, even for those requiring several thousand channels.

*Build multichassis systems with the new NI PXI-6653 timing and synchronization module.*

## Single-Chassis PXI Systems

First consider the backplane of a single PXI chassis. It contains the high-throughput 132 Mbytes/s PCI bus, plus dedicated resources for timing and synchronization – the trigger bus, star trigger lines, and 10 MHz system reference clock. The PCI bus communicates between the peripheral modules and controller, and the timing and synchronization resources pass trigger, reference clock, and sample clock signals from one master module to any number of slave modules. These master and slave devices could be data acquisition, digitizers, sources, digital I/O, DMMs, switching, or other PXI devices. Because the timing and synchronization resources are built directly into the PXI backplane, synchronizing multiple PXI modules requires no external cables. For example, you can create a 34-channel, phase-correlated oscilloscope in a single PXI chassis.




*The NI PXI-6653 timing and synchronization module maps the PXI reference clock, star trigger, and trigger bus across multiple chassis.*

## Expanding Across Chassis

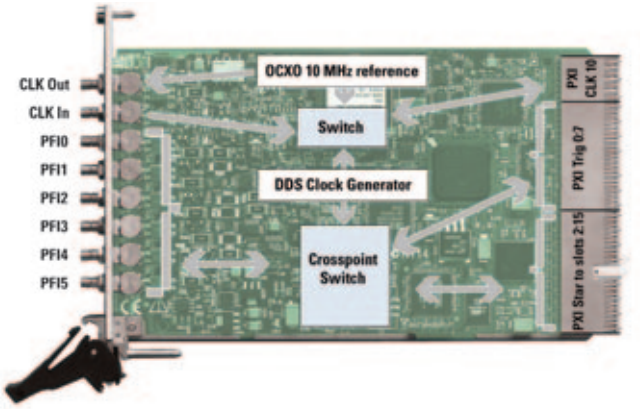
Now consider the case where the necessary channel count is not possible in a single instrumentation chassis. You must consider how all the backplane signals (PCI bus and timing and synchronization) extend across chassis. A few options exist for extending the PCI bus from the master to slave chassis. The simplest is MXI-3, a transparent PCI-to-PCI bridge where each half of the bridge is a PXI module installed in each chassis. If your application is data-intensive, you can use an embedded controller in each chassis for more processing power, and send the data to a central networked location for postprocessing.

Just as MXI-3 maps the PCI bus, the NI PXI-6653 timing and synchronization module maps timing and synchronization signals across chassis. Typically you would install one PXI-6653 in slot 2 (the star trigger slot) of each chassis. In the structural test example, you may have a few chassis full of PXI-4472 dynamic signal acquisition (DSA) modules reading from accelerometers. To synchronize, the DSA module uses two backplane resources – the star trigger and a trigger bus line. To synchronize multiple chassis of these modules, you must pass the star trigger and trigger bus line across the chassis, which the PXI-6653 does through software. Using this method, you can acquire 5,000 channels with under 0.1 degree of phase mismatch. Likewise, for antenna array monitoring, you would synchronize several PXI-5122 high-resolution digitizers. The recommended synchronization method for these digitizers uses the same resources, plus the 10 MHz reference clock. With this method, you can synchronize more than 1,000 high-resolution digitizer channels as well as two channels on the same digitizer. An engine control unit might require analog and digital channels for speed, temperature, pressure, and fuel injectors – all of which must share the same clock. The PXI-6653 can also share a 10 MHz reference clock among chassis by driving its high-precision onboard reference clock to the backplane of the master and slave chassis. By synchronizing the more than 1,000 available PXI modules, you can use the PXI-6653 to build correlated, very high-channel-count systems of physical, electrical, analog, and digital signals. ■

*To download the specifications for the new NI PXI-6653 timing and synchronization module, visit ni.com/info and enter* **nsi4209**.

**ni.com/pxi**

# Improve Channel Count and Timing with New PXI Module




*Improve timing and synchronization and extend channel count with the new NI PXI-6653 timing and synchronization module.*

You can use the new NI PXI-6653 timing and synchronization module to develop precisely timed, high-channel-count systems for automotive, military/aerospace, acoustics, noise and vibration, and scientific research applications. The PXI-6653 can synchronize channels across multiple PXI chassis and improve the timing of single-chassis PXI systems.

## Synchronize Multiple PXI Chassis

PXI provides tight synchronization via the trigger bus, star trigger bus, and 10 MHz system reference clock. However, many applications, such as acoustic holography and antenna array measurement, require acquisition from more synchronized channels than are possible in a single instrumentation chassis. For these applications, the signals must synchronize between PXI chassis for accurate data analysis and correlation. The PXI-6653 module synchronizes channels across chassis by mapping the timing and synchronization resources on the PXI backplane – trigger bus, star trigger, and 10 MHz system reference clock – to the front panel of the module. In these applications, one chassis functions as the master, and one as the slave. The master PXI-6653 module routes the backplane timing and synchronization signals to its front panel, and when those signals are cabled to the front panel of the module in the slave chassis, the slave module can route those signals from its front panel to the PXI backplane. In this way, you can synchronize modules in different PXI chassis for tightly correlated, high-channel-count systems.

## Upgrade Single-Chassis Timing

The PXI-6653 also improves the timing and synchronization resources in a single PXI chassis. In addition to general-purpose signal routing, this new module serves as a star trigger controller when installed in PXI slot 2 to provide precise triggers with less than 1 ns skew. For increased measurement accuracy, you can import a high-precision reference clock or use the onboard oven-controlled crystal oscillator with 75 ppb stability as the timing reference for your entire measurement system. Because you can connect your reference source to one location and share it among multiple devices, you simplify cabling over traditional measurement systems. For applications with specific clock rate requirements, you can generate clocks from DC to 80 MHz with 711 nHz resolution and route them to the PXI backplane or to the front panel SMB connectors. ■

*To download the specifications for the new NI PXI-6653 timing and synchronization module, visit ni.com/info and enter* **nsi4210**.

**ni.com/pxi**

# NI Delivers New Pentium 4 and Celeron PXI Controllers

Three new Pentium 4 and Celeron-based PXI embedded controllers increase the performance of PXI measurement systems. The series includes the NI PXI-8186, which features a 2.2 GHz Intel Pentium 4 processor, the industry's fastest 3U PXI/CompactPCI embedded controller. With the increased processing power of the PXI-8186 controller, engineers can perform more powerful analysis or reduce test time of automated test systems. Additionally, the controllers ease system integration while meeting the demanding reliability requirements of real-time and automated test applications.

## A Compact, High-Performance PC Platform

The NI PXI-8186 controller is part of the NI 8180 Series, which also includes the 850 MHz NI PXI-8185 and the 1.2 GHz NI PXI-8184 Celeron-based embedded controllers. These controllers give engineers a compact, high-performance PC platform for modular instrumentation and work ideally for cost-sensitive applications.

## A Variety of Peripherals in One Module

The NI 8180 Series controllers incorporate an extensive set of standard and extended I/O – such as hard drive, Ethernet, USB, GPIB, and serial – into a single module to ease system integration. They operate with all PXI and CompactPCI peripheral modules and are available with Windows XP, Windows 2000, or NI LabVIEW Real-Time installed. NI delivers worldwide support for the embedded controllers with installations of Windows in English, Japanese, Spanish, German, Korean, French, and traditional Chinese. ■

*The new NI PXI-8186 2.2 GHz Pentium 4 embedded controller increases the performance of PXI measurement systems.*

*To view detailed data sheets, specifications, and pricing, visit ni.com/info and enter* **nsi4211.**

**ni.com/pxi**

# Build Industry-Standard Switch Systems with PXI

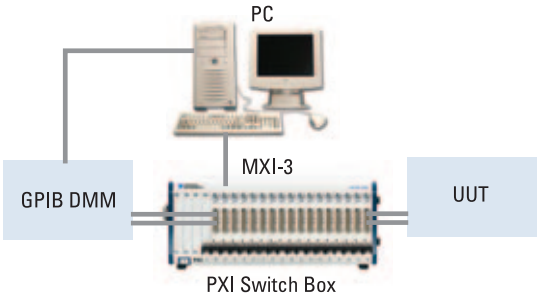
Recent advances in modular instrumentation have resulted in the widespread use of PXI as an industry-standard switching platform. For instance, you now can switch more than 2,000 channels in a single 3U PXI chassis to expand channel count for PXI, GPIB, or VXI measurement hardware. Previously, this level of switching density was only available in more expensive and often proprietary VXI or GPIB-based switching platforms.

With its low system costs, small footprint, and comprehensive range of switch modules, PXI is a well-suited, industry-standard switch box for many switching applications.

## Hybrid Test Systems with PXI Switching

Many automated test applications use stand-alone instruments connected to a PC via a GPIB interface. You can provide a modern switching front-end to this GPIB-based device by incorporating it into a hybrid PXI/GPIB test platform. PXI switching surpasses the traditional limitations of other switch boxes, such as scalability, cost, and interoperability, while providing equal or better relay density.

In the example shown at right, the PXI switching system is controlled through a high-speed serial link, MXI-3, connected to a host computer. The PXI chassis contains 17 NI PXI-2530 switching modules, 128-channel multiplexers featuring high-speed reed relays, for a total of 2,176 channels. This switching system is ideal for voltage scanning applications commonly found in automated test environments.




*The lower cost and smaller footprint of PXI make it an ideal switch platform when used with PXI, GPIB, or VXI instrumentation.*

## Industry-Standard Advantage

Nearly every automated test system benefits from switching – either through increased channel count, better resource utilization, or expanded measurement flexibility. In these systems, switching software and hardware costs account for 30 to 50 percent of automated test systems. Therefore, the cost savings and smaller packaging of PXI switching can prove significant. Using an industry-standard platform such as PXI as a switch box offers maximum equipment reuse while maintaining flexibility for future test needs. ■

*To register for a live Web event on switching and mass interconnect solutions, visit ni.com/info and enter* **nsi4212.**

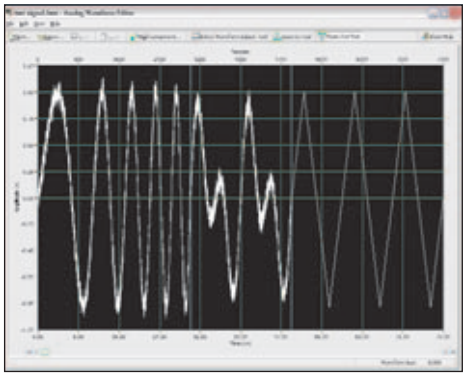
**ni.com/switches**

# NI Analog Waveform Editor Speeds Test Signal Creation

With built-in editing capability and waveform creation tools, the NI Analog Waveform Editor is an excellent tool for rapidly creating analog test signals for prototyping and test. Waveforms created in the editor can be generated using hardware such as an arbitrary waveform generator or analog output device. To create a waveform, you can choose from more than 20 configurable waveform primitives, enter an equation, or import data from a file. The editor also stores the properties you set while creating the waveform, so you can go back and change a single property of the signal, instead of modifying the raw sample data. These features make creating complex analog test signals faster and easier than ever before.

## Waveform Creation Tools

The NI Analog Waveform Editor is an interactive visual tool that maintains the versatility of a programming or scripting language. In addition to selecting from a list of configurable waveform primitives, such as sine, square, and Gaussian noise, you also can load data from a variety of open file formats including binary, ASCII, and LabVIEW .lvm formats, or enter an equation. You then can point-wise combine waveform primitives using mathematical operations to create waveform components. These components then link together to create the final waveform that is saved to disk.



*The NI Analog Waveform Editor stores waveforms hierarchically for easy editing.*

## Convenient Waveform Editing

To make editing waveforms faster and easier, the NI Analog Waveform Editor hierarchically stores the configuration information of the waveform's components and primitives rather than just storing the raw sample data. In this way, you can modify a primitive's properties without disturbing other components. For example, a communications engineer using a multitone test signal may wish to edit the frequency property of a sine wave without changing the other waveform components. With this powerful editing capability and waveform creation tools, the NI Waveform Editor reduces your application development time. ■

*To request an evaluation copy of the NI Analog Waveform Editor, visit ni.com/info and enter* **nsi4213.**

**ni.com/software**

# Four Easy Steps to Virtual Instrumentation on Your PDA

Turn your PDA into something you never expected – a sophisticated, customizable measurement device. Virtual instrumentation has arrived on handheld devices, and it brings with it all of the productivity and flexibility benefits that NI software and modular measurement hardware have delivered on desktop and laptop PCs for decades. The handheld platform provides the added benefits of increased mobility and lower costs for measurement and automation applications.

***In addition to providing the flexibility of multiple measurement applications on a single PDA, virtual instrumentation for PDAs also can provide cost savings over more traditional portable measurement solutions such as laptops.***

## Handheld Virtual Instrumentation Benefits for Engineers

Specialized handheld measurement and control devices such as handheld DMMs and spectrum analyzers have existed for years. However, to take measurements outside that particular device's capabilities, you had to carry another handheld device. You can probably imagine situations that would require you to carry four or five different handheld measurement devices attached to a belt. Needless to say, that defeats the purpose of the handheld concept. It is also possible that you need a handheld solution to a problem, but there is no existing solution portable enough to meet your application's needs. Take the example of a portable snow quality analyzer ("Gillett Sabre Snow Assessment System," http://www.c-cubed.co.uk/html/snow_quality.html). The analyzer should be portable enough that ski resort employees can carry it in a backpack, yet still have the capability to analyze a number of snow qualities like stiffness, hardness, stability, and temperature gradient. While ski resorts and patrons alike may find snow quality information valuable, no such prebuilt solution exists. The combination of virtual instrumentation and PDAs can solve both of the above types of problems.

In addition to providing the flexibility of multiple measurement applications or unique measurement capabilities on a single PDA, virtual instrumentation for handheld devices also can provide cost savings over more traditional portable measurement solutions such as laptops. The table below shows the cost savings gained using the PDA platform for a sample portable monitoring system to be deployed in several service centers. By deploying as few as 10 handheld systems, you can save about $5,500 over an equal number of laptop systems.

## Make Your PDA a Virtual Instrument

The NI LabVIEW graphical development environment makes handheld virtual instrumentation possible. With the NI LabVIEW PDA Module for Palm and PocketPC operating systems, you now can turn your PDA into more than just an organizer in four easy steps:

| | Single Laptop System | Single PDA System | 10-Laptop System | 10-PDA System |
|---|---|---|---|---|
| Computer | $1,000 | $400 | $10,000 | $4,000 |
| Data acquisition device | $800 | $700 | $8,000 | $7,000 |
| Application development software | $1,995 | $2,990 | $1,995 | $2,990 |
| License for additional deployment systems | $0 | $0 | $0 | $495 |
| Connectivity/sensors/signal conditioning | -- | -- | -- | -- |
| Total cost | $3,795 | $4,090 | $19,995 | $14,485 |
| Total savings with PDA system | | ($295) | | $5,510 |

Note: Calculations based on average laptop prices from Dell, average PDA prices from Palm and HP, average PCMCIA DAQ device prices from NI, average handheld DAQ device prices from NI and Capital Equipment Corporation, and LabVIEW Full Development System, PDA module, and PDA deployment license prices.

*Save money on multisystem portable measurement applications by using a PDA for monitoring and control systems.*

*Figure 1. The NI LabVIEW PDA Module and data acquisition ha PalmOS or PocketPC-based handheld into a measurement tool.*

1. Develop the application in LabVIEW on a desktop or laptop computer
2. Build the program into an executable file for the PDA
3. Download the application to the PDA via its synchronization utility
4. Run the application on the PDA

In addition to basic functionality such as file I/O and analysis capabilities, the NI LabVIEW PDA Module includes a number of ways to gather data from the outside world. For example, several data acquisition (DAQ) devices are available from various companies, including NI, to acquire and generate analog and digital signals from the PDA. By adding an NI DAQCard and a PCMCIA sleeve to a Compaq iPAQ PDA, you gain the same power of NI data acquisition (DAQ) that you are accustomed to on laptop computers. In addition, other DAQ devices specifically designed for PDAs have emerged. C-Cubed (www.c-cubed.co.uk), for example, makes a Compact Flash data acquisition device, while Capital Equipment Corporation (cec488.com)


rdware turn your

sells a device that attaches to a Palm PDA. Both devices include LabVIEW drivers.

## Ideal for a Variety of Measurement Applications

The small size of PDAs and handheld data acquisition devices makes them ideal for a variety of applications such as automotive in-vehicle testing. By measuring signals such as engine vibration or temperature and comparing it to signals gathered from an engine in good condition, service technicians or engineers can gather data to help them diagnose defects or problems with the vehicle. Using this diagnostic tool spares technicians from the work of dismantling the vehicle in order to discover the source of the problem, thus saving them time and making them more efficient.

Creating a measurement application based on a PDA can not only save time, but also can provide a low-power solution for applications where powering a measurement device is a concern. For example, a regional airline manufacturer previously used a laptop-based system to test airplanes while in flight. This method required power inverters since these airplanes do not have 110 V outlets. The arrival of virtual instrumentation for handhelds enabled this manufacturer to use a PDA with lower power requirements to improve the implementation.

If your measurement application is too complex to be managed directly by the handheld device itself, LabVIEW PDA can gather data from a larger system. It supports wireless communication protocols such as 802.11 and IrDA. Machine monitoring applications, in which maintenance and reliability engineers monitor the vibration of rotating machinery for predictive maintenance, are excellent candidates for this type of PDA-based solution. For example, you may have distributed PC-based systems throughout a plant that continuously measure vibration from accelerometers on industrial equipment such as turbines, generators, and motors. With a PDA and LabVIEW, you now can approach the monitoring system, press a button, and gather the latest data on the machine's health via one of the wireless protocols – all without disturbing the operation of the machine monitoring system (see Figure 2). The PDA then can log this data to a file and either synchronize the file with a main computer later or communicate back immediately for offline analysis via a wireless connection.

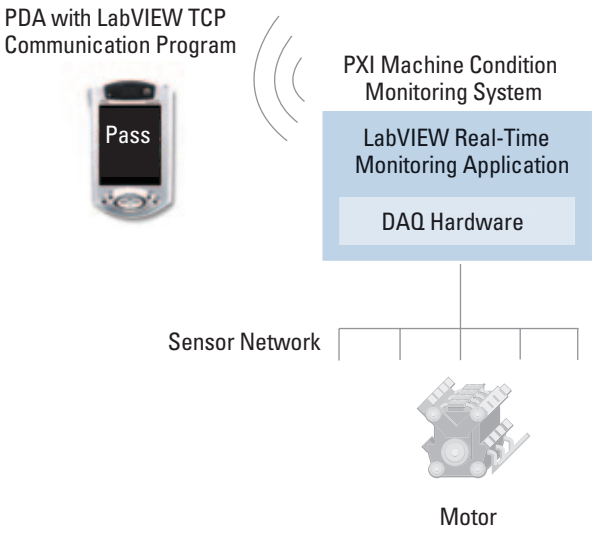



*Figure 2. Machine condition monitoring applications can use LabVIEW and a PDA for quick and easy data retrieval.*

## The Future of PDAs in Measurements

Now that PDAs are multipurpose measurement devices, a variety of new applications and technologies become possible. As PDAs further standardize on peripheral connectivity, such as Compact Flash, Secure Digital (SD), and USB, NI will continue to develop new technologies to meet your needs in taking portable measurements. These new developments in the area of handheld measurements – whether they are new data acquisition devices, more sophisticated wireless communication support, or additional connectivity options – help engineers, scientists, and technicians do their jobs better and more efficiently in the future. ■

*To download a sample executable for your Palm or PocketPC, visit ni.com/info and enter* **nsi4214**.

*To view a Web Event on Demand, visit ni.com/info and enter* **nsi4215**.

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***ni.com/labview***

# New Motion Controllers Offer Integrated I/O

National Instruments recently released a group of high-performance motion controllers that include the PXI-7352, PXI-7354, and PXI-7356 for stepper or servo control. They feature two, four, and six axes each and include eight 16-bit analog inputs for accurate, single point, software-timed data acquisition. Using the new data acquisition inputs on the motion controller, you can acquire simple data acquisition and high-performance motion control with a single board.

*The new high-performance NI PXI-7352, NI PXI-7354, and NI PXI-7356 controllers offer powerful motion control and integration features.*

## Integration with NI Data Acquisition Hardware

For integrated applications requiring hardware-timed acquisition or special signal conditioning, each of the new NI PXI-7350 series controllers offers powerful triggering capabilities with NI data acquisition boards. For situations where the motion control acts as the master in triggering measurements, each new motion controller can trigger at rates of up to 4 MHz if the triggers occur at regular position intervals and 2 kHz for triggers that occur at arbitrary positions. This advanced triggering feature is useful for applications such as scanning where you need to correlate position with measurements.

## Additional Encoder and Other I/O

Along with the eight lines of analog input, these new controllers also include a wealth of other types of I/O, including eight total encoder inputs and 64 digital I/O lines. Because of the additional encoder inputs, you can use dual axis feedback, a feature for increasing end effecter position accuracy and reducing system backlash. With this dual axis feedback, you can assign two encoders to a single axis and sense position on two different points for increasing accuracy and reducing the effects of backlash.

For connecting to external amplifiers, NI also recently released the new UMI-7774 and UMI-7772. These new universal motion interfaces offer industrial D-Sub connectivity and 24-volt isolation, making them ideal for industrial motion control applications. ■

*To download FREE tutorials and example programs, visit ni.com/info and enter* **nsi4216**.

**ni.com/motion**

# NI Compact Vision System Supercharges Machine Vision

Building upon the versatile NI CVS-1454, NI recently released the newest member of the Compact Vision System series – the NI CVS-1455, with more processing power and storage for your demanding machine vision applications. In fact, this new system delivers the power of multiple smart cameras at a lower cost.

Typical smart cameras limit the type of software, the number of sensors, and the selection of different image sensors you can use. With the NI CVS-1454 and 1455, you can choose your software from configurable NI Vision Builder for Automated Inspection or programmable NI LabVIEW software. You can connect multiple cameras to the NI CVS-1455 and choose from a wide variety of IEEE 1394 cameras ranging from high speed to high resolution.

## Processing from Multiple Cameras

The NI CVS-1454 works ideally for simple machine vision applications requiring processing from a single sensor. For more demanding applications that require processing from multiple cameras or high-speed acquisition and image analysis, choose the NI CVS-1455. With its increased nonvolatile storage, you can configure more inspection routines to the CVS unit as well as store more images.

| | NI CVS 1454 | NI CVS 1455 | Typical Smart Camera |
|---|---|---|---|
| Programmable Software | NI LabVIEW Real-Time | NI LabVIEW Real-Time | Not Available |
| Typical Processor Performance | 883 MIPS* | 1436 MIPS* | 60-360 MIPS* |
| Digital I/O | 29 DIO | 29 DIO | 2-20 DIO |
| Cameras | up to 3 | up to 3 | 1 |
| Resolution | up to 2000 x 2000 | up to 2000 x 2000 | 640 x 480 |
| Frame Rate | up to 200 fps | up to 200 fps | 30 fps |
| Nonvolatile Storage | 32 MB | 128 MB | 4-16 MB |
| Base Price | $2,995 | $3,995 | $3,295 |

**MIPS: Million Instructions Per Second*

NI designed the rugged NI Compact Vision System series to perform within harsh industrial environments. It can withstand temperatures ranging from 0 to 55 °C and does not include fans, external vents, or moving parts.

## Increasing Processing Power by Threefold

Performing at 1,436 million instructions per second, the NI CVS-1455 delivers more than three times the processing power of a typical smart camera. The system also includes 128 MB of nonvolatile onboard Flash memory – eight times the storage of a typical smart camera – so you can store more images for offline quality control analysis. Choose the NI CVS-1455 for your rugged machine vision inspection applications. ■

*To access the NI Compact Vision System data sheet, visit ni.com/info and enter* **nsi4217**.

**ni.com/vision**

# New DAQ Devices for Industrial Measurement and Control

NI recently released five new digital I/O and analog output boards for industrial control and measurement applications on PCI bus computers. The new modules extend the reach of PC-based data acquisition to critical applications requiring special hardware features such as digital I/O watchdogs. These watchdogs detect computer fault conditions, such as an application crash, and automatically respond by setting the outputs to a predefined safe state. This provides a mechanism for safe detection and recovery when controlling potentially dangerous actuators such as industrial pumps, valves, and motors. In the past, adding watchdog capabilities would have required expensive external circuitry. By building new high-reliability features into these next generation data acquisition products, the cost for industrial control applications continues to decrease while performance and reliability increase.

***The new PCI-6514 and PCI-6515 digital I/O modules offer 24 V industrial logic levels at just $5 per channel.***

## Lowering Costs per Channel by 70%

The new NI PCI-6722 and PCI-6723 analog output boards lower the cost-per-channel for simultaneous voltage output to just $31, a 70 percent reduction compared to boards with similar features. These boards are ideal for precision analog process control systems, such as multichannel and cascaded PID control loops. With the PCI-6723, you can create up to 32 simultaneous multichannel PID control loops all synchronized to a hardware clock.

The new PCI-6514 and PCI-6515 digital I/O modules offer 24 V industrial logic levels at just $5 per channel – a 35 percent cost reduction – and include an industrial feature set designed to automate even the most demanding applications. The high-reliability industrial digital I/O feature set includes:

- Isolation to protect hardware and allow direct connection to industrial sensors/actuators
- Programmable input filters to eliminate glitches/spikes and remove noise
- Digital I/O watchdogs to detect computer or application errors and ensure safe recovery
- Programmable power-up states to provide safe operation when connected to pumps/valves/motors/relays
- Change detection to trigger your application and return I/O data after a digital event with minimal processor usage
- Industrial logic levels

Starting at just $295, these new boards deliver advanced industrial features at a low price that makes them affordable for high-volume OEM applications such as embedded machine control. For example, San Jose, California-based AutomationWorks, Inc., develops PC-based manufacturing and test machinery for the production of consumer electronics devices such as credit cards, radio tags, and Radio-Frequency ID products. A typical machine may process more than 2,000 units an hour in a discrete control process that includes loading the units into an automatic magazine changer, programming the units with unique ID data, printing information on the units, and automating inspection with machine vision and electronic tests.

"The NI PCI-based DAQ boards are the heart of our automation control strategy," said Jeff Long, President of AutomationWorks. "Their versatility allows us to integrate almost any signal type and power level; their speed and seamless integration into LabVIEW provide us with outstanding performance; and their robustness and low cost help AutomationWorks to maintain a solid bottom line in this competitive industry."

With these new boards, engineers such as Mr. Long can take advantage of innovative NI-DAQ 7.1 measurement services software with NI-DAQmx technology to access the full capabilities of the new modules. NI-DAQmx technology offers dramatic improvements in I/O performance and ease of use:

- DAQ Assistant guides you to fast, accurate measurements with no programming
- Automatic code generation generates data acquisition code for NI LabVIEW, C, Visual Basic .NET, or C# .NET
- Multithreaded streaming technology provides 100 to 1,000X performance improvements
- Automatic timing, triggering, and synchronization technology makes advanced applications easy by automatically routing timing signals
- More than 3,000 FREE software downloads jump-start your project
- Software configuration of all hardware features without switches or jumpers
- Programmable in any language such as NI LabVIEW, LabWindows/CVI, ANSI C, Microsoft Visual C++, C#, and VB .NET

## Ideal for Industrial Automation and Control, OEM

The state-of-the-art combination of industrial hardware features and NI-DAQmx software technology creates a total low-cost data acquisition solution for industrial automation and control and OEM applications. PCI data acquisition boards have never offered more features for industrial applications at such a cost effective price-point. ■

| | Device | Type | Description |
|---|---|---|---|
| NEW! | PCI-6509 | Digital I/O | Industrial 96-CH 5V/TTL/CMOS Digital Input/Output (24 mA) |
| NEW! | PCI-6514 | Digital I/O | Industrial 32 Digital Input, 32 Source Digital Output Isolated (±30 V, 350 mA one line/port) |
| NEW! | PCI-6515 | Digital I/O | Industrial 32 Digital Input, 32 Sink Digital Output Isolated (±30 V, 500 mA one line/port) |
| NEW! | PCI-6528 | Digital I/O | Industrial 24 Digital Input, 24 Digital Output Channel-to-Channel Isolated Digital I/O (+/- 60 VDC, 150 mA) |
| NEW! | PCI-6722 | Analog Output | 8-Channel, 13-Bit, Simultaneous Analog Output, 8 DIO, 2 CTR/TIMER |
| NEW! | PCI-6723 | Analog Output | 32-Channel, 13-Bit, Simultaneous Analog Output, 8 DIO, 2 CTR/TIMER |
| NEW! | PCI-6013 | Multifunction I/O | 200 kS/s, 16-Bit, 16 AI, 8 DIO, 2 CTR/TIMER Multifunction DAQ |
| NEW! | PCI-6014 | Multifunction I/O | 200 kS/s, 16-Bit, 16 AI, 2 AO, 8 DIO, 2 CTR/TIMER Multifunction DAQ |

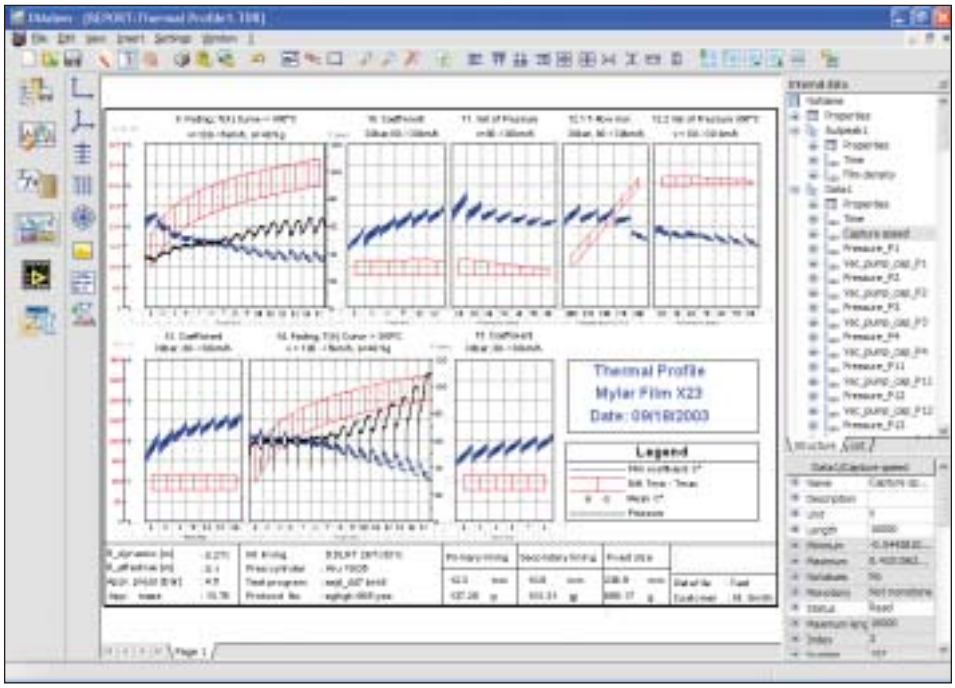
*Starting at just $295, these new boards deliver NI-DAQmx software technology and an industrial feature-set designed to automate even the most demanding industrial DAQ and control applications.*

*To download the industrial digital I/O and data acquisition white paper, visit ni.com/info and enter* **nsi4218**.

**ni.com/dataacquisition**

# Quickly Turn Data into Results with NI DIAdem 9.0

NI DIAdem provides engineers and scientists specialized tools for managing, inspecting, analyzing, and reporting their test data. It also provides a unified environment for transforming test data into the information needed to drive engineering decisions. DIAdem imports data from industry-standard databases and file formats such as ASCII, binary, and Excel, and can handle data sets with more than 1 billion data points. The latest release of DIAdem, version 9.0, features a revised data management interface, drag-and-drop data access, Web-ready report generation, and tighter integration with NI LabVIEW 7 Express – all in a single, easy-to-use interactive environment.




*Use NI DIAdem to shorten the time it takes to convert test data into the information that drives your decisions.*

## Data Navigation and Management

Test data is an asset. The effort and expense that is required to collect test data can be substantial; the new data management tools in DIAdem 9.0 are designed to provide you the best return on your data investment.

The first step in analyzing data is selecting the right data set. The centerpiece of the new DIAdem interface is the NAVIGATOR, which helps you browse data sources such as file systems and databases. These sources, shown in a tree control, display their attributes in a hierarchical manner so you can easily extract the data you want. You use built-in filtering functions to locate data sets based on their descriptive attributes and then drag and drop them into the new Data Portal. The Data Portal is the local repository of loaded data, where data sets are represented as groups of associated channels.

The data NAVIGATOR provides native support for a wide variety of file types including binary, Excel, and ASCII, as well as databases such as the real-time databases used by National Instruments VI Logger, NI LabVIEW Datalogging and Supervisory Control Module, and NI Lookout, along with ASAM and SQL/ODBC. You also can map other data sources onto the NAVIGATOR tree structure through an open plug-in architecture.

## Interactive Visualization, Analysis, and Report Generation

Once you locate and load your data into the Data Portal, you can use the interactive DIAdem environment to inspect, analyze, and report on that data.

In DIAdem VIEW, you visually inspect your data and draw conclusions by interacting with it in both tabular and graphical form. With DIAdem 9.0, you can have multiple page VIEW layouts and drag and drop the data traces from the Data Portal into the display controls. DIAdem 9.0 also provides scroll and zoom cursors you can use to identify peaks and features in your data, and different cursor options and built-in visual analysis tools to graphically delete, fit, or copy ranges of data.

Typically, you perform mathematical analysis on test data to extract additional important results. DIAdem ANALYSIS provides you an interactive library of math functions such as averaging, integration, peak searching, statistics, curve fitting, signal analysis, matrix, and surfacing calculations. You also can extend the analysis capabilities programmatically through LabVIEW, Visual Basic Script, and C++.

The key to any engineering process is the ability to generate publication-quality reports. DIAdem REPORT has several new features including multiple page REPORT layouts and the ability to create Web-ready HTML-formatted reports. In REPORT, you interactively create templates you can reuse with any data set, share with coworkers, or print. You construct the template pages using any combination of 2D/3D graphs, tables, pictures, text, and variables.

## Automating Analysis and Reporting

Automating repetitive tasks saves your organization time and places the focus on interpreting results. DIAdem SCRIPT provides a Visual Basic Script interface to all of the DIAdem functions, so you can create everything from simple time saving macros to fully developed solutions that contain user-defined dialogs.

## New LabVIEW 7 Express Interface

DIAdem 9.0 also delivers a new, integrated LabVIEW panel that launches LabVIEW with a VI template set up to write data from LabVIEW directly back to DIAdem. You can set up a wide range of measurement tasks in LabVIEW and then use DIAdem to interactively view, analyze, and report your data. These functions deliver your results quickly. ■

*To read a white paper about the new features in NI DIAdem 9.0, visit ni.com/info and enter* **nsi4219**.

**ni.com/diadem**

# Maximize Flexibility with Source Code Instrument Drivers

Instrument drivers are the key to rapid development of test and measurement applications. By providing high-level, modular VIs and libraries for easy programming, they deliver the easiest and most straightforward connectivity to your instruments. Open source code instrument drivers, or Plug&Play instrument drivers, deliver additional benefits including more defined driver architectures, debugging capabilities, reduction of maintenance costs, system longevity, and flexibility.

| Instrument | LabVIEW | LabWindows/CVI | IVI-C | IVI-COM |
|---|---|---|---|---|
| **Driver Type** | **Plug & Play** | **Plug & Play** | | |
| Open, Source Code | ✓ | ✓ | | |
| Closed | | | ✓ | ✓ |

*Typical Instrument Driver Source Code Availability*

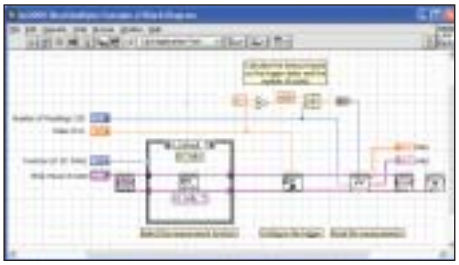
## Types of Instrument Drivers

In addition to different drivers for specific development environments, there are three types of complete, fully functional drivers: 1) native, open source code, 2) wrapped, and 3) closed black-box drivers. Source code drivers, such as Plug&Play drivers, work optimally for ease of use and integration flexibility because they are native to their environment. If you cannot obtain a native source driver for your development environment, wrapped drivers are the next best alternative. Wrapped instrument drivers present nonnative driver technology as a native interface, or wrapper, to the driver. Finally, closed or black-box drivers do not provide access to source code, the ability to extend, or edit the instrument driver, but still offer a good starting point for your instrument systemse.

## Advantages of Source Code Instrument Drivers

In addition to providing ease of use, open source code instrument drivers also maximize your application development flexibility through the following benefits:

- Easily understand instrument driver architecture. Learning how the software works and understanding the process of instrument communication helps you better design your instrumentation applications.
- Debug instrument communications problems. With source code debugging capabilities, you can easily detect and resolve cable issues, instrument address complications, and configuration problems.
- Employ a high-level API. Closed instrument drivers often expose either extraneous low-level details or extremely abstract interfaces. Source code drivers present both clear, high-level VIs and routines, and intuitive access to low-level programming details.
- Easily manage version issues. If your systems are subject to stringent quality specifications such as IS0 9001, you need revision control, which is easily accomplished with source code instrument drivers.
- Continue working with older instruments. For long-term systems, you must maintain support for your legacy instrument systems. If a vendor stops making the instrument you own, will they still support the instrument driver? If not and you do not have the source code, you may be forced into upgrading expensive hardware systems.
- Lower maintenance costs. Because you own the code when using source code drivers, you can lower your maintenance costs by not waiting on instrument vendors for critical features or fixes.
- Create example templates. You can easily transform a source code instrument driver into an example template when creating a driver for a similar instrument model.
- Easily customize for special situations. Source code instrument drivers give you the ability to add functionality and customize the instrument driver for your particular application needs, including optimizations and integration of additional measurements.



*Source code instrument drivers, such as this Keithley 2000 driver, provide clear insight into instrument communication to help you complete your instrument control applications faster and easier.*

### Instrument Driver Network: Spotlight on Source Code Drivers

The comprehensive NI Instrument Driver Network (***ni.com/idnet***) contains drivers for more than 2,500 instruments from more than 150 different instrument vendors, NI Alliance members, and developers in the community.

More than 160 new LabVIEW source code instrument drivers have recently been added to the Instrument Driver Network, including:

- 53 analyzer and test system instrument drivers
- 33 oscilloscope instrument drivers
- 25 meter instrument drivers
- 14 source instrument drivers
- 13 power supply instrument drivers
- 3 switch instrument drivers
- 35 more new LabVIEW instrument drivers in various categories

*To download your instrument driver, visit* ***ni.com/idnet****.*

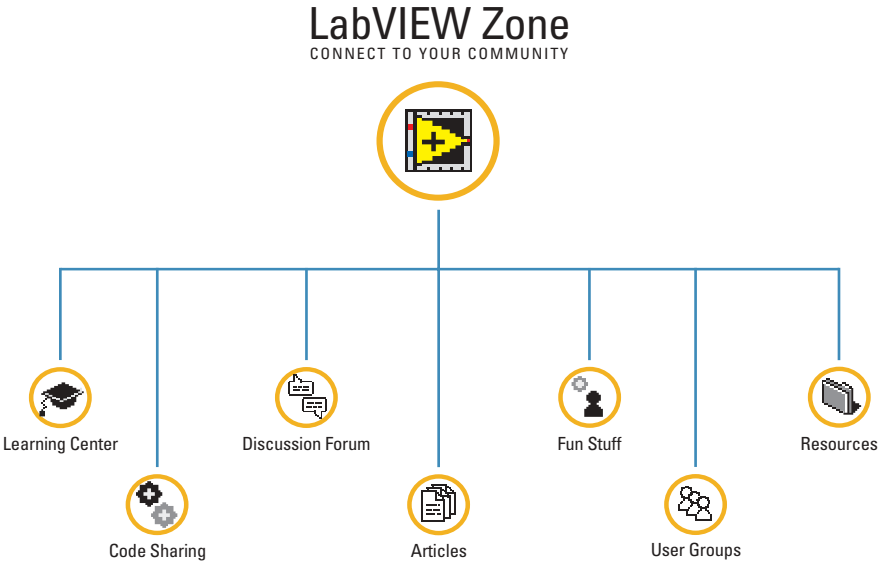
## Be a Stakeholder, Not Just a User

When employing source code instrument drivers, you – the community – have influence over the instrument drivers and their quality. With the Instrument Driver Network, you can download, modify, and submit instrument drivers to share enhancements with others. You also can rate the quality of instrument drivers and share what you have learned from your interactions with the instrument driver. If you do not find an instrument driver that suits your needs, you can easily request one as well. ■

*To download, submit, modify, or request a source code instrument driver, visit ni.com/info and enter* **nsi4220**.

***ni.com/idnet***

# Simplify Large LabVIEW Projects at LabVIEW Zone




*Take advantage of LabVIEW Zone tools to improve the quality of your LabVIEW code.*

You can learn everything you need to know about large LabVIEW application development at LabVIEW Zone. Take advantage of application notes, tutorials, example programs, and a plethora of other tools to help you design, optimize, and improve the quality of your LabVIEW code.

**Architecture:** Developing an efficient architecture is critical to proper software development. Visit the LabVIEW Zone Learning Center to watch "Software Design Architectures in NI LabVIEW," a Web Event on Demand describing the most common design patterns including state machine, producer/consumer, queued message handler, and master/slave. Additional application notes and example VIs further demonstrate how to apply the state machine architecture to your LabVIEW application and improve the performance of your VIs.

With the new NI LabVIEW State Diagram Toolkit, you graphically design state diagrams within LabVIEW. This new tool cuts significant time and cost from your application cycle by automatically generating the LabVIEW code for you.

**Code Optimization:** With large application development, it is also critical that your code is fully optimized. Learn to create more efficient applications by watching the "Optimize Your VI Performance" series of Web events and then downloading the technical presentation, "Optimizing LabVIEW Applications," which focuses on profiling and optimizing your application as necessary.

Use the new VI Analyzer Toolkit to interactively analyze your VIs using 58 different tests to optimize style, performance, and documentation. The toolkit identifies potential problems in your LabVIEW code and then generates ASCII or HTML reports to track code quality over time and reduce documentation tasks.

**Project Management Tools:** VISTA is a new LabVIEW development tool from VI Engineering. It offers configuration management tools, an HTML help file generator, automatic documentation tools, system integrity verification, style guides, class generators, and a library of more than 400 reusable VIs, as well as the ability to link to popular source code control tools. Additionally, as part of this tool, you can have a team of VI Engineering LabVIEW experts and technical trainers conduct a thorough organization assessment and then recommend a customized set of proven best practices and procedures reflecting current industry standards. Learn more about VISTA at ***viengineering.com.*** ■

*To visit LabVIEW Zone today and get involved, enter ni.com/info and enter* **nsi4221**.

## Code Sharing Online

Engineers and scientists also benefit from one another's expertise by sharing VIs on the Internet. With more than 2,500 VIs, the LabVIEW Zone Code Sharing page offers one of the most extensive and easy-to-use online VI collections. It provides fast turnaround on submissions, immediate posting, and gives ratings and feedback to developers. By downloading and using these VIs in your application, you save significant development time. If you have questions about a particular VI, e-mail the developer to learn more about it.

Do not stop at downloading VIs. Share your expertise and receive feedback on your applications by submitting your own VIs. Visit LabVIEW Zone today to share your skills with the LabVIEW Community. ■

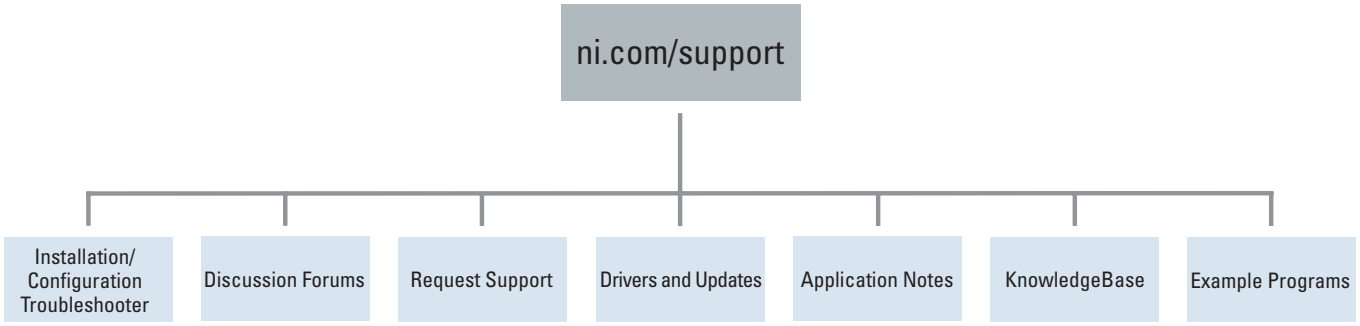
## LabVIEW User Groups Update

While there are many online resources, nothing beats face-to-face discussions with other LabVIEW developers. LabVIEW User Groups are the most effective tool for benefiting from others' expertise. These groups, located in regions wordwide, meet regularly to discuss coding practices, new technologies, LabVIEW features, and more. On LabVIEW Zone, you now can search for User Groups in your area online or register your own. By participating, you improve your LabVIEW development skills and network with other users.

To locate a User Group near you, use the new LabVIEW User Group Directory on LabVIEW Zone. Or, if you wish to start your own User Group, LabVIEW Zone provides numerous resources such as prebuilt presentations and invitation templates. ■

***ni.com/labviewzone***

# Receive Support on Demand from Active Discussion Forums




*Get your questions answered quickly using the wide range of resources on **ni.com/support.***

NI Discussion Forums are the premiere venue for getting your questions answered quickly and accurately by thousands of engineers worldwide. Take full advantage of the NI community by sharing your questions, ideas, and information with engineers developing applications similar to yours. To ensure you get full support, National Instruments engineers monitor these forums and answer all questions in a timely manner. Because these discussion threads are saved, you can search and find answers from previous discussions.

As the volume of activity in the forums continues to grow, new features are constantly added. Whether you are using National Instruments products for the first time or you are a long-time LabVIEW developer, a host of new and improved tools at **ni.com/support** provide you with quicker solutions than ever before. For instance, you now can create subscriptions to particular topics and automatically receive e-mail notifications of related discussions. If you develop Express VIs, you can receive notifications when other developers discuss this new technology.

## New C# Forum

To visit the new C# Industry Forum, go to **exchange.ni.com** and click on For Visual Studio dotNET. This forum brings together leading .NET users, developers, and vendors to help them move forward in test, measurement, and automation .NET application development. Topics discussed at the forum include general .NET framework questions, extensibility guidance, instrument control, .NET application development, data acquisition, .NET development tips, and user interface customization hints.

## Online User Groups

Be on the lookout for the new Online User Groups at **ni.com/support**. Visitors will soon be able to create customized, private Discussion Forums. You can invite your colleagues and friends to participate in a discussion that you moderate.

In the NI Discussion Forums, you leverage the most knowledgeable virtual instrumentation developer network in the world by interacting with industry experts, NI support engineers, and NI developers. If you are developing test and measurement applications, you simply cannot afford to miss out on the Forums.

## Hardware Installation/ Configuration Troubleshooter

The Installation/Configuration Troubleshooter is another new, time-saving tool on **ni.com/support.** Select your hardware, bus type, and operating system information, and you immediately receive customized installation and configuration instructions for your particular test and measurement system, significantly reducing your time and investment.

The Troubleshooter also supplies links to other valuable resources. From this page, you will find the most recent driver software for your device, product manuals, and links to relevant KnowledgeBase articles. Additionally, you receive an extensive list of answers to the most common questions and issues related to your hardware.

## Request Support

The new Request Support tool on **ni.com/support** expedites the support process and gives you quicker access to applications engineers. From the Product-Specific Self Help section, you can quickly find answers to the most common questions for specific products and have access to example programs, application notes, tutorials, and other resources for your software or hardware.

You also can request support from a National Instruments engineer directly from this page to receive priority support. Applications engineers respond to your request before responding to dial-in support requests. On average, customers who create their service requests online speak with an engineer in 20 percent less time than those who called instead of going online first.

*For faster answers to your NI-related questions, visit ni.com/info and enter* **nsi4222**. ■

### NI Discussion Forums

- 28,000 registered engineers, scientists, and developers
- 100 percent of your questions monitored by NI support engineers and developers

"I think [the Discussion Forums] represent a great opportunity for all the people involved in the use of your products. The benefit of being able to exchange information, experiences, and opinions with my colleagues is great." ■

Roberto Bozzolo
Discussion Forums Enthusiast

**ni.com/support**

# Increase Reliability of Expensive-to-Recreate Tests

Real-time platforms deliver increased reliability for critical industrial measurement systems and expensive-to-recreate tests such as those that destroy prototypes, execute for long periods of time, or require the use of expensive resources. While these systems automatically gain additional reliability from the real-time platform, the software program architecture is an equally critical component of delivering a reliable and robust system. Using good programming techniques such as state machines, you can ensure that your system executes flawlessly for long periods of time.

## Robust Systems through State Diagrams

State machines provide a framework for robust systems by creating a well-defined flow for every state of the application. In a state machine diagram, you specify certain operations to execute when your system is in a predetermined state and define the next state to execute based on certain conditions and parameters. For example, if your system establishes communication with a remote device, receives and parses commands, passes appropriate data to other applications, and then waits for the next message, you could implement this using the state machine in Figure 1.

By defining these operations with a state machine, you leave nothing to chance. Using this model, you create states for actions such as error handling, resource allocation, resource release, and system restart. Applying this technique to the communication example, the system in Figure 1 includes a clearly defined state for the system to respond if the connection is suddenly lost. In the disconnected state, the programmer defines cleanup actions such as driving I/O lines to a safe level, resetting program variables to known values, and notifying the system supervisor of the communication failure. By using the state machine architecture, the program is guaranteed to perform these cleanup actions before waiting for the next message.

*Figure 1. Communication code uses a state machine to define execution flow.*

In addition to defining clear program flow, state machines provide a highly flexible framework so you can easily add new functionality to your system. You can insert new functionality into existing state machines by creating a state for the new functions and then adjusting the transitions between states. Using the NI LabVIEW State Diagram Toolkit, you can use the bubble view to easily design and visualize all system states and transitions.

## Independent Nodes with Standard Command Interfaces

Real-time platforms are designed to operate autonomously, requiring no user interactions. A typical real-time system includes a host computer for the user interface connected by Ethernet to the real-time node. This architecture delivers an additional degree of reliability by ensuring that failures on the user interface computer do not interfere with operations on the real-time system.

The most robust architecture for a stand-alone system includes two parallel state machines on the real-time system – one to perform the measurement and control functions, the second to communicate with the host computer. You can see an illustration of this architecture in Figure 2. Each state machine on the real-time target executes with a unique priority and shares data with the other state machine using a reliable deterministic path created with RT FIFO VIs. Because the standard connection between the real-time node and host computer is Ethernet, you can use TCP, UDP, DataSocket, Logos, or VI Server protocols to pass data between machines.

The ideal protocol for each system depends on the complexity of data and commands that the real-time node must recognize and share.


*Figure 2. NI recommends this program architecture for LabVIEW Real-Time applications.*

For systems that need to respond to many variable changes, TCP provides the most flexible structure to create custom communication protocols such as string-based, comma-delimited message formats. While you can quickly implement custom command protocols in LabVIEW, TCP is an open standard that you can access through any program running on the host computer. Because the data content and format is language independent, you can develop host applications using any development tool – NI LabVIEW, NI LabWindows/CVI, Visual Basic, Visual C++, or Microsoft .NET langauges.

## Applying Techniques to Windows Systems

You can use the techniques discussed in this article with Windows or real-time applications. By applying these techniques to Windows applications, you achieve more robust code and provide the right application architecture to easily port the application to a real-time system later. By running robust code on a real-time platform, you achieve even higher levels of reliability because of the framework provided by the real-time operating system. ■

*To learn about programming techniques for robust reliable systems, such as using hardware watchdogs and avoiding memory leaks, visit ni.com/info and enter* **nsi4223**.

**Jenifer Loy**
**LabVIEW Real-Time Product Manager**
**jenifer.loy@ni.com**

**ni.com/realtime**

# LabVIEW FPGA, RIO Technology Speed Biotech Development

By Dmitry Sagtelyan, Applied Biosystems

**The Challenge: Getting to market quickly with an analytical instrument for visual analysis.**

**The Solution: Using NI LabVIEW FPGA and PXI-7831R with RIO technology as a flexible, universal test system to quickly troubleshoot issues and diagnose the causes.**

Applied Biosystems designs and builds analytical instruments for research in areas such as drug development and genomics. One such instrument currently under development includes a 2D scanner that moves a camera over 96 wells containing samples of biological material. The machine rapidly and precisely positions the camera over each well and takes a snapshot. While developing this instrument, we ran into some challenges that we needed to overcome quickly.

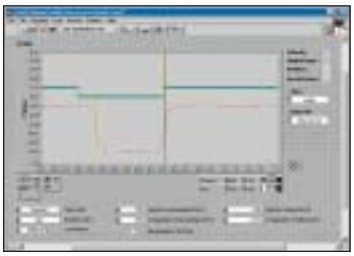


*Image is captured before deceleration completes. Note: Velocity is negative for direction shown.*

One problem we faced involved a malfunction in the autofocus feature. The camera was supposed to continually adjust as the distance from the sample changed, but the controller did not perform to the manufacturer's specifications. We connected the NI PXI-7831R directly to the encoders and measured the motion profile to calculate speeds. Using LabVIEW FPGA and the R Series reconfiguration I/O board, we quickly demonstrated the problem to the controller manufacturer and received a fix.

In addition, sometimes images from the camera appeared smeared. We again measured motion profiles from the encoders, but also recorded the camera control signals synchronously with the encoder signals. By analyzing the velocity and acceleration of the camera along with the synchronized camera signals, we quickly determined why the camera would not decelerate properly and fixed the problem.

With no prior experience with NI LabVIEW FPGA, we were able to configure the NI PXI-7831R in two days and come up with a solution to our problems. ■

*To read the full-length customer solution, visit ni.com/info and enter* **nsi4224**.

**ni.com/success**

# Schlumberger Performs Redundant Drilling with NI Tools

By John Roy, System Integrator, and Lisa Polisar, Technical Writer, B&B Technologies, Inc.

**The Challenge: Creating a monitoring alarm system with control and shutdown capabilities to prevent costly pump damage and environmental hazards and make the job of the pump operator safer.**

**The Solution: Designing a reliable custom control system using NI FieldPoint hardware and LabVIEW Real-Time software.**

Schlumberger Limited is a global oilfield and information services company with a major focus in the energy industry. They wanted to implement an automated backup for their drilling technicians and operators, to provide a backup controller for their computer operations, and to standardize the operator interfaces across different pump equipment.

Schlumberger contracted B & B Technologies, Inc. (BBT) for a solution to this industrial challenge. B & B Technologies is a National Instruments Select Integrator headquartered in New Mexico that designs and produces data acquisition and control systems for a variety of industrial applications.

Because the system required both reliability and a mix of advanced functionality such as data logging and embedded control, we recommended using NI LabVIEW Real-Time running on an NI FieldPoint control bank. We worked with Schlumberger to design a computerized, soft pump integration system to act as a backup controller in the event that the main computer running the operator interface became disabled, idle, or shut down.

This soft pump integration system was composed of five major components – the personal computer, SPI control box, engine, transmission, and pump. The heart of the system is the control box, which we designed using a Comapct FieldPoint 2000 Real-Time module with digital inputs and outputs, analog inputs, two frequency to analog transducers, and a battery-backed up power supply. The custom software, using NI LabVIEW Real-Time, delivered a simple, easy-to-use standard control interface with user-configurable alarm

*B&B Technologies designed this control system for Schlumberger to provide advanced functionality such as embedded control.*

monitoring and data logging capabilities. Schlumberger is using these systems in Alaska and in Malaysia. ■

*To read this full-length customer solution, visit ni.com/info and enter* **nsi4225**.

**ni.com/success**

# Ensure Your Success with NI Service Programs

Subscription to National Instruments service programs is the best way to ensure your success in developing solutions with our products. You receive software maintenance that includes automatic software upgrades, enhanced access to technical support, and a 10 percent discount on training courses and materials.

### Standard Service

As a subscriber to the Standard Service Program (SSP), you can access NI applications engineers one-to-one via phone and e-mail to assist you in developing your solutions. NI also delivers your softwareupgrades automatically – ensuring that you always have the latest advances in productivity and technology at your fingertips. SSP is a fixed, annual cost, making it easier to plan and budget than intermittent, more expensive individual upgrades. A 10 percent discount on all NI training courses and material eases the transition to new technologies.

| Service Level | Software Upgrades | Technical Support | Service Program |
|---|---|---|---|
| Basic Service | Must be purchased separately | Support by NI applications engineers and the user community through online Developer Exchange | Included with every product purchase |
| Standard Service | Automatic upgrades included | Basic Service support, plus support by NI applications engineers through direct phone or e-mail | Standard Service Program (SSP)<br>NI Developer Suite<br>Volume License Program |
| Premier Service | Automatic upgrades included | Standard Service support, plus support by NI applications engineers through direct phone or e-mail with extended hours of operation | Premier Service Program (PSP)* |

**You can upgrade other service programs to PSP .*

## National Instruments Offers Three Service Levels

### Basic Service

National Instruments provides FREE and unlimited world-class support from our applications engineers through NI Developer Exchange (***www.ni.com/devexchange***).
Post your question, browse online resources, or read exciting discussions about developing test and measurement solutions with NI products. NI engineers, experienced users, and novices alike provide a wealth of technical background, application development experience, and development tips. Applications engineers ensure all technical support posts are answered. Individual upgrades must be purchased separately in order to maintain your software versions with Basic Service.

### Premier Service

NI applications engineers are available for extended business hours with guaranteed response times through the Premier Service Program (PSP). All the benefits of Standard Service, including automatic upgrades and training discounts, are included in the PSP. For local availability, please contact your National Instruments branch office.

To access our discussion forms, search online help, or initiate a phone call via the Web, visit our support page at ***ni.com/support***.

## New LabVIEW Training

As a subscriber to an NI service program, take advantage of your training discount by registering for one of the new LabVIEW Intermediate and Advanced courses.

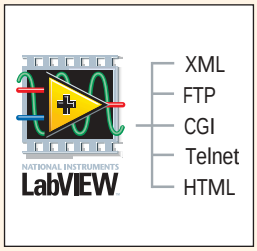
- **LabVIEW Intermediate I** (three days) teaches you structured practices to design, develop, test, and deploy LabVIEW applications.
- **LabVIEW Intermediate II** (two days) builds on Intermediate I and teaches you memory management and performance-enhancing techniques.
- **LabVIEW Advanced Application Development** (four days) prepares you for creating large applications incorporating advanced design features that maximize code reuse and apply standard coding conventions. ■

Courses are delivered at NI corporate and branch offices, regional training centers, or your facility. For detailed course outlines or a course calendar, visit ni.com/info and enter **nsi4227** or call (888) 279-9833.

## Subscribing to SSP

The easiest way to subscribe to SSP is in combination with a new development license or upgrade, with which you receive a discount on your SSP. You also can add SSP to an existing, up-to-date license. Renewing your subscription to SSP is easy – NI will notify you via mail when you need to renew. ■

*For ordering information for service programs for your NI software, visit* ***ni.com/info*** *and enter* **nsi4226**, *or contact your local sales representative at (800) 454-6119.*




**NEW! Internet Toolkit**

You now can write and parse XML documents straight from your LabVIEW VIs with the new Internet Toolkit. A new version of the Enterprise Connectivity Toolkit also includes the Internet Toolkit, as well as the Database Connectivity Toolkit and the Statistical Process Control Toolkit.

Visit ni.com/info and enter **nsi4228** to learn more.

***ni.com/training***

# Mindready Microassembly Combines Motion Technologies

*The microassembly system combines robotics and piezo actuators.*

NI Alliance Partner Mindready Solutions introduces the automated microassembly system, a new system that combines robotics and piezo actuators for microassembly, microwelding, microinspection, and test applications. These two technologies together in one system give you the power and flexibility of a standard industrial robot with the precision and accuracy of piezo actuators. The automatic microassembly system uses an L-Rmate 100 robot and a three-axis piezo actuator. These two motion systems interact seamlessly. You also can integrate additional instruments including a control card, a vision card, or a data acquisition card.

NI hardware products give the microassembly system a compact design, while NI Measurement Studio provides an intuitive user interface. Also, you can control and access all system components through the GUI without using the teach pendant to control the robot or the interface and display of the instruments to access functions and measurements.

The overall system design is flexible, scalable, and user-friendly. Each event sequence is managed in real time, either in an automatic, semiautomatic, or manual mode. This Mindready technology introduces classical industrial robotics into the microassembly world. ■

*To view a video of this microassembly system, to request a quote, or to learn more about the microassembly system, visit ni.com/info and enter* **nsi4229**.

**ni.com/alliance**

# AMI System Tests Ride Quality for Vehicle Manufacturers

NI Select Alliance Partner Advanced Measurements, Inc. (AMI), introduces the Ride Quality Analyzer, a specialized system that measures and records vibration energy during vehicle operations; the system also analyzes recorded data to report ride quality and exposure limits. Vehicle manufacturers can use this system to test the ride quality of their products with real-world stimulus such as loading, road, and weather conditions.

The Ride Quality Analyzer system uses NI LabVIEW and NI hardware for a modular, flexible design with capacity for expansion. With LabVIEW, you can easily acquire, analyze, and present your data. This system logs time domain data to a disk for three accelerometer channels including vertical, lateral, and fore/aft orientations. The system then processes the data using power spectral density and octave analysis. Next, the system reports the total computed energy as a ride quality index value for specific vehicle configuration and input conditions. Finally, the system presents the data graphically so you can compare it to operating limits in different frequency bands. The system also includes a GPS to match the measured vibration data to specific locations and road features.

*The Ride Quality Analyzer includes a Panasonic Toughbook computer and NI data acquisition hardware for field data acquisition.*

NI signal conditioning modules and an NI PCMCIA data acquisition card measure accelerometers, as well as auxiliary channels such as temperature and pressure. The system also uses a Panasonic Toughbook laptop computer to protect its hardware from field testing by design personnel or manufacturing and operations staff. ■

*To learn more about the Ride Quality Analyzer and other automotive vehicle test applications, visit ni.com/info and enter* **nsi4230**.

*To view National Instruments Measurement Ready Systems Advisor, visit ni.com/info and enter* **nsi4231**.

**ni.com/alliance**

# MeasX Inspection System Measures Piston Ring Quality

National Instruments Select Alliance Partner MeasX GmbH Germany introduces the Piston Ring Inspection System, a flexible measuring system that determines the bearing surface and/or flank profile outline of piston rings. Federal Mogul, a global supplier of automotive components, subsystems, and modules, uses this test system for quality control and accuracy detection during production.

During the measurement process, up to two encoders, depending on the measurement type, proceed over the piston ring outline. A third encoder measures the position of the two encoders attached to the linear axle. After you take the measurement, you can plot the determined outline for the piston ring. The inspection results then must pass different criteria until the system accepts the piston ring as "passed" – otherwise it is marked as "failed"

*The Piston Ring Inspection System gives you quality control and accuracy detection during production.*

in the post-measurement screen. The system database stores a graph of the measured values, the computed results, and additional information including user, date, description, and comments. Also, the system is designed with a modular approach so you can add more measurement functions in the future.

The encoders that measure the outline and positioning have an accuracy of +/- 0.2 µm. These encoders connect to an NI PCI-6602 counter board and an NI PCI-6257 board that controls the linear axle. All signals are connected through a customized MeasX connectivity system box. The program is completely written in NI LabVIEW 6.1 and consists of three modules that perform article and administration of orders, online measurement, and offline evaluation. All modules connect to a central ACCESS database that stores all parameters and plots. ■

*For more information about the Piston Ring Inspection System, visit ni.com/info and enter* **nsi4232**.

**ni.com/alliance**

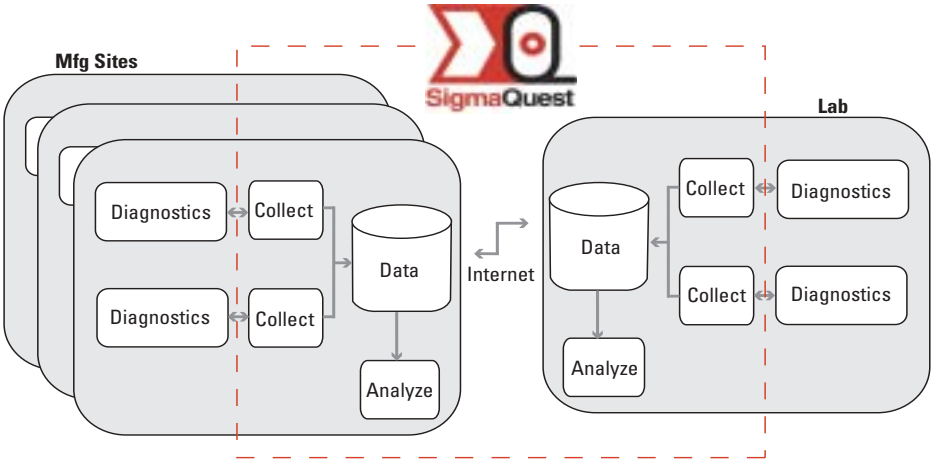
# SigmaQuest Accelerates Product Performance Intelligence

NI Alliance Partner SigmaQuest, Inc., introduces the SigmaSure comprehensive real-time test data management and analytics system. With SigmaSure, distributed manufacturing and test organizations can easily collect, aggregate, and analyze diagnostic data across multiple locations.

NI TestStand and NI LabVIEW users can quickly benefit from this off-the-shelf software solution without incurring time delays and costs associated with developing, integrating, and maintaining applications. SigmaSure readily accepts data directly from TestStand process models and includes VIs that work with LabVIEW. SigmaSure also includes an application program interface for use with other environments such as NI LabWindows/CVI and Visual Studio .NET so you can easily specify which data to collect from your test applications.

Diagnostics data is stored in the adaptive, SigmaSure database designed and optimized for real-time collection and analysis of terabytes of test data. You can locally store and analyze the data or aggregate it with data from other sites for global analysis of entire data sets or subsets of data.

The SigmaSure analytics module supports




*SigmaQuest software helps you reduce the time to find, fix, and avoid product defects.*

complex data analysis and generates reports including dynamic Pareto and scatter chart. With enhanced multidimensional analysis, you can drill down on a Pareto to examine the underlying data via a subsequent Pareto, scatter diagram, or histogram to isolate a problem in minutes. The module also includes statistical process control such as Cp and Cpk.

SigmaSure is Web-architected and platform independent, supporting several operating systems including Windows, Linux, Solaris, and Mac OS. The system is easy to install, easy to use, and has a low cost of ownership. ■

*To download the TestStand/SigmaSure and LabVIEW/SigmaSure data sheets, visit ni.com/info and enter* **nsi4233**.

**ni.com/alliance**

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# Upcoming NI Events in North America

## Upcoming Seminars

### Automated Test Summit

Explore the latest developments in test and measurement at the NI Automated Test Summit, a FREE, full-day event featuring product training, demonstrations, industry experts, NI developers, and integrators. Network with colleagues, build application development expertise, and learn about the latest automated test strategies and techniques through sessions designed for test, process, validation, and manufacturing managers and engineers. Register at ***ni.com/testsummit*** or call (800) 444-3539.

### National Instruments and Edmund Optics Make Machine Vision Work for You

Machine vision experts from National Instruments and Edmund Industrial Optics show you how to use machine vision technology to solve automated inspection applications. Attend this FREE vision event to learn about the fundamentals of imaging and proven strategies for your machine vision applications. Also see a demonstration of the NI Compact Vision System, which *Test & Measurement World* named a "Best in Test" winner and finalist for Test Product of the Year 2004. Register at ***ni.com/visionroadshow*** or call (800) 444-3539.

### Optimizing Test Applications with PXI and PCI Modular Instruments

Learn about the newest features in LabVIEW 7 and modular instrumentation, including the 100 MB/s instruments for mixed-signal test, 6½-digit FlexDMMs, 2.7 GHz RF signal analyzers, and new NI high-density switch modules. Register at ***ni.com/seminars*** or call (800) 444-3539.

### DIAdem Advanced Data Analysis and Report Generation Hands-On Seminar

Test drive NI DIAdem 9.0, the latest DIAdem software release from National Instruments. At this FREE hands-on seminar, learn the broad capabilities of DIAdem interactive test data analysis, report generation, and technical data management for collaborative engineering. Register at ***ni.com/seminars*** or call (800) 444-3539.

## Attend Live Events Via the Web

### NI Web Events

Participate in the "Extend C# Components for Custom Test and Measurement Applications" Web event on February 24 to discover how the architecture of the Measurement Studio .NET tools helps you quickly customize acquisition and presentation capabilities for your application. Attend live Web events and learn about NI products and solutions from knowledgeable presenters and topic experts. See product demonstrations and ask questions via our interactive chat feature. Register for upcoming Web events at ***ni.com/webevents.***

### New Web Events on Demand

View data acquisition Web Events on Demand. Check out "Benefits of the New NI Data Acquisition Interface: NI-DAQ 7" and "Build a PC-Based Data Acquisition System in 10 Minutes." In these videos, see demonstrations of NI market-leading PC-based data acquisition devices. With more than 75 topics to choose from, get the in-depth knowledge you want by visiting ***ni.com/webevents/archive.***

## Register Today for National Instruments 10th Annual NIWeek

For 10 years, NIWeek conference and exhibition attendees have discovered the most recent developments in virtual instrumentation. Using NI measurement and automation tools such as LabVIEW software and PXI modular hardware, attendees gain efficiency at each stage of the research, design/simulation, verification/validation, and manufacturing processes.

Do not miss this opportunity to meet face-to-face with buyers from industries including:

- Biomedical
- Automotive
- Manufacturing and functional test
- University/academic
- Embedded systems
- Design

### Exhibitor Information

Exhibit with other industry leaders applying virtual instrumentation to test, measurement, automation, design, and control applications.

### Who Should Exhibit?

- System integrators, value-added resellers who integrate NI products into their solutions
- Product vendors involved in design, test, measurement, and control areas including:
  - Embedded systems
  - PXI/modular instrumentation
  - Motion
  - Sensors
  - Vision

### New Exhibition Hours

| | |
|---|---|
| Tuesday, August 17 | 11:00 a.m.-7:00 p.m. |
| Wednesday, August 18 | 11:00 a.m.-7:00 p.m. |
| Thursday, August 19 | 11:00 a.m.-5:00 p.m. |

**National Instruments Tradeshow Calendar**

| Month | Start Date | End Date | Show Name | Location | City | State |
|---|---|---|---|---|---|---|
| February | 2/23/04 | 2/26/04 | National Manf. Week | McCormick Place | Chicago | IL |
| | 2/24/04 | 2/26/04 | APEX | Anaheim Convention Center | Anaheim | CA |
| | 2/24/04 | 2/26/04 | OFC | Los Angeles Convention Center | Los Angeles | CA |
| March | 3/8/04 | 3/11/04 | PITTCON | McCormick Place | Chicago | IL |
| | 3/8/04 | 3/11/04 | SAE World Congress | Cobo Center | Detroit | MI |
| | 3/8/04 | 3/10/04 | Wireless Systems | San Diego Convention Center | San Diego | CA |
| | 3/30/04 | 4/1/04 | Embedded Systems Conference | Moscone Center | San Francisco | CA |
| May | 5/3/04 | 5/6/04 | OTC (Offshore Technology Conference) | Reliant Center | Houston | TX |
| | 5/4/04 | 5/6/04 | The Vision Show East | Hynes Convention Center | Boston | MA |
| | 5/11/04 | 5/13/04 | AM Greenville | Palmetto Convention Center | Greenville | SC |
| | 5/15/04 | 5/28/04 | Microsoft Tech Ed | San Diego Convention Center | San Diego | CA |
| | 5/16/04 | 5/27/04 | MARTS (Maintenance Technology) | Donald E. Stevens Convention Center | Chicago | IL |

### 2004 NIWeek Conference Dates

Austin Convention Center, Austin, TX USA
Alliance Day, August 16
NIWeek, August 17-19

*To register for NIWeek 2004, visit* ***ni.com/info*** *and enter* ***nsi4234****.*

***ni.com/events***

# PCI Express Technology Offers New Levels of Performance

*PCI Express improves performance for demanding DAQ and instrumentation applications.*

For the past 10 years, the PCI bus has served the PC well by unifying the large number of buses that were prevalent at the time of its introduction. Though this stability has yielded long-term compatibility, the bus has not kept up with the rapid developments in the rest of the PC, such as processor clock speed, memory bandwidth, or increased networking and I/O speed.

PCI Express is an exciting change to the ubiquitous PC and offers a new level of performance for demanding data acquisition (DAQ) and instrumentation applications, facilitating higher bandwidth data transfers, lowering CPU overhead, guaranteeing bandwidth, and familiarizing system software models.

PCI Express, the evolutionary successor to PCI, offers a low-voltage differential serial (LVDS) interconnect at an initial signaling rate of 2.5 GHz. PCI Express can be thought of as serialized PCI – it maintains the PCI software usage model, facilitating easy software migration from PCI to PCI Express.
PCI Express is scalable in lane count, from one to 32 lanes, yielding a theoretical bandwidth of 16 GB/s. Because PCI Express is a point-to-point connection, multiple interconnects can all run at full speed from peripheral card to peripheral card or peripheral card to PC memory simultaneously. In addition, PCI Express supports an isochronous mode, guaranteeing bandwidth, a useful feature in data acquisition applications. Advanced switching delivers peer-to-peer communication. Finally, PCI Express features advanced error reporting and correction as well as flexible power-management features to improve system reliability and reduce power consumption.

The ratio of PCI to PCI Express slots will change slowly over the next five to 10 years as overall system performance further improves; nonetheless, PCI Express is an exciting new technology. As a leader in applying PC technology to measurement and automation, NI will release PCI Express-based measurement hardware as the technology rolls out. ■

*To download a PCI Express white paper, visit ni.com/info and enter* **nsi4235**.

**ni.com**

## More Information and Resources

- For a complete listing of recent newsletter issues in PDF format, other resources, and new product information, visit **ni.com/info** and enter **newsletter**
- To view our current training schedule, visit **ni.com/info** and enter **nsiedu**
- To subscribe to our FREE monthly customized e-mail newsletter, *NI News*, visit **ni.com/info** and enter **nsinews**
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