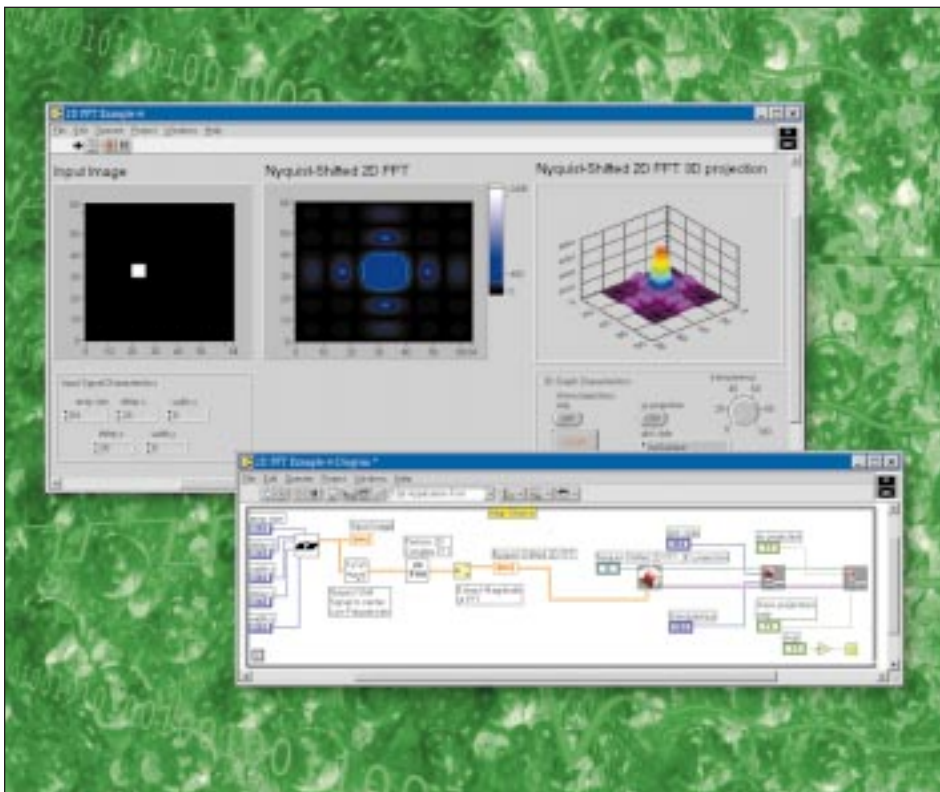


# INSTRUMENTATION NEWSLETTER™

VOLUME 11, NUMBER 2  
SUMMER 1999  
TECHNICAL NEWS FROM NATIONAL INSTRUMENTS

## LabVIEW™ Version 5.1 Simplifies Signal Processing and Analysis



The new 3D graph in LabVIEW 5.1 assists in visualization of analysis results. Here, we show the results of a 2D FFT as both a 2D intensity plot (middle) and a 3D graph (right).

The LabVIEW graphical programming language has long been known as an instrument control and data acquisition software package. What might not be as well known is that using LabVIEW, you can easily implement the signal processing and analysis algorithms that your measurement applications require.

For nearly 13 years, LabVIEW has proven itself as an application development tool for building instrumentation systems. With LabVIEW, you can easily develop applications involving instrument control, data acquisition/display, test sequencing, and sophisticated front panel user interfaces. In addition, you can also develop custom virtual instruments with signal processing and analysis capabilities that leverage the computational power, value, and flexibility of a modern PC.

Your virtual instruments can rival the analysis capabilities that were previously the exclusive domain of expensive stand-alone instruments or custom hardware. For example, you can build applications that perform tasks such as noise reduction, spectral leakage reduction, network analysis, signal detection and separation, interpolation and extrapolation, differentiation and integration of digital data, and trajectory estimation.

### Tools for the Job

To build such capabilities into your LabVIEW applications, you can depend on its extensive library of prebuilt signal processing, math, and analysis routines. These tools tackle such common tasks as curve fitting, digital filtering, linear algebra, numerical analysis, signal generation, statistics, time and frequency-domain analysis, and windowing. With the release of Version 5.1, LabVIEW boasts even more built-in signal processing capability; it gains more than 100 math, analysis, and visualization functions and

*With the release of Version 5.1, LabVIEW boasts even more built-in signal processing capability; it gains more than 100 math, analysis, and visualization functions and tools.*

tools. Highlights include the ability to parse symbolic expressions, solve ODEs, perform optimization, find roots, and perform Laplace transforms.

Despite the complex applications that you can perform with these routines, you will still find them easy to use. As an

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 **NATIONAL  
INSTRUMENTS™**

## Your Measurement and Automation Superstore™

By now, most of you have probably had the chance to visit the National Instruments Web site at [www.natinst.com](http://www.natinst.com). With hundreds of thousands of visits a month, our Web site has become one of the most popular technical Web sites. You can find out about new products, get support on existing products, learn about upcoming training and events, and request any of the thousands of software downloads available online. In 1999, we have launched a number of major Web initiatives, including the most comprehensive e-commerce site for measurement and automation products.

### Easier Navigation and Searching

At the start of the year we debuted a completely new online catalog. This catalog was built from the ground up using the latest relational database technology, to make it much easier for you to navigate

*"The Web will fundamentally change customers' expectations about convenience, speed, comparability, price, and service." Fortune, Dec. 1998*

and search through the hundreds of products that National Instruments offers. This new catalog was just the start of a complete redesign of our Web site that went live in April, which brings performance improvements and easier navigation.

The online catalog now includes a streamlined search capability – now you can find only the products that meet your application requirements. Instead of having to load page after page in your Web browser to find the right products, you can enter in key specifications – including computer bus, number of input channels, sampling rate, and more – to quickly sort and present you with a custom list of products.

### Worldwide Pricing and Ordering

One of the most common requests to National Instruments was to provide worldwide pricing online. We listened to

the feedback and designed our new online catalog to pull live pricing directly from our production systems. In addition, based on your country, the appropriate price is presented – U.S. dollars in the U.S., Canadian dollars in Canada, yen in Japan, and euros for most of Europe. National Instruments is one of the first companies to offer worldwide pricing in this manner, and the feedback has already been tremendous.

But we didn't stop there. As of March, you can now order any standard National Instruments product directly over the Web from any of 20 countries. More than 900 products are available 24 hours a day, 7 days a week. Whether you are paying by credit card, or PO, whether you are in the U.S. or Germany, you can see why we call it "Your Measurement and Automation Superstore."

### Improved Customer Service

If you use our Web site to order products, get technical support information, or just learn more about computer-based measurement and automation, our goal is to provide an efficient and satisfying experience. We have a growing team working on improving our Web site, and we encourage you to stop by often to see new additions, changes, and improvements – most suggested by you. We realize, however, that while some of you prefer to use the Web as your primary source of information, many of you still prefer to pick up the phone. That's why National Instruments continues to invest in our friendly and experienced staff of Applications Engineers, Technical Representatives, and Customer Service Representatives – all eager to help. We hope our Web site is just one more addition to our activities to help ensure your success!

– John Graff, Vice President of Marketing

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For immediate response and easy access, visit our new Web-based reply card at [www.natinst.com/info/news](http://www.natinst.com/info/news). Once here, you can easily download white papers, customer solutions, and more, as well as request that we send you items in the mail.

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## LabVIEW Version 5.1 Simplifies Signal Processing and Analysis

*continued from page 1*

example, consider the Measurement functions – a set of routines that performs common measurements on real-world signals. These routines include:

- AC&DC estimation, calculation of amplitude
- Phase, auto, and cross-power spectrums
- Harmonic analysis
- Impulse response
- Network functions
- Peak detection
- Power and frequency estimates
- Pulse parameters
- Scaling, spectrum unit conversion
- Frequency response

*The LabVIEW block diagram notation is similar to the diagrams that you will find in many engineering texts on signal processing algorithms and systems.*

Visualization is also often an important part of analysis. You can quickly display measurements and analysis results with ready-made graphs, charts, and spreadsheet indicators. The Windows versions of LabVIEW 5.1 gain a 3D-graph display with interactive or programmatic control over facets such as zooming, panning, and rotation (see cover).

In addition to such built-in tools, new HiQ™ and Matlab script nodes give you the ability to invoke scripts written for these math and analysis-oriented packages. With these tools, you can leverage existing script files directly from the LabVIEW block diagram (see right). (HiQ comes bundled with the Windows versions of LabVIEW and is a stand-alone application from National Instruments for analysis, report generation, and data visualization. For more information about HiQ, see [www.natinst.com/hiq](http://www.natinst.com/hiq))

For specific functionality, you can also extend LabVIEW with an add-on toolsets. National Instruments offers several alternatives, including a PID Control Algorithms Toolset that combines PID and fuzzy logic control functions; a Signal

Processing Toolset that bundles LabVIEW functions and stand-alone executables for joint time-frequency analysis, digital-filter design, wavelet and filter-bank design, third-octave analysis, and super-resolution spectral analysis; a System Simulation Toolset with functions for modeling, simulating, and analyzing systems; and a Vision Development Toolset offering functions and stand-alone executables for image processing and analysis. Link to [www.natinst.com/labview/addons.htm](http://www.natinst.com/labview/addons.htm) for more information about these products.

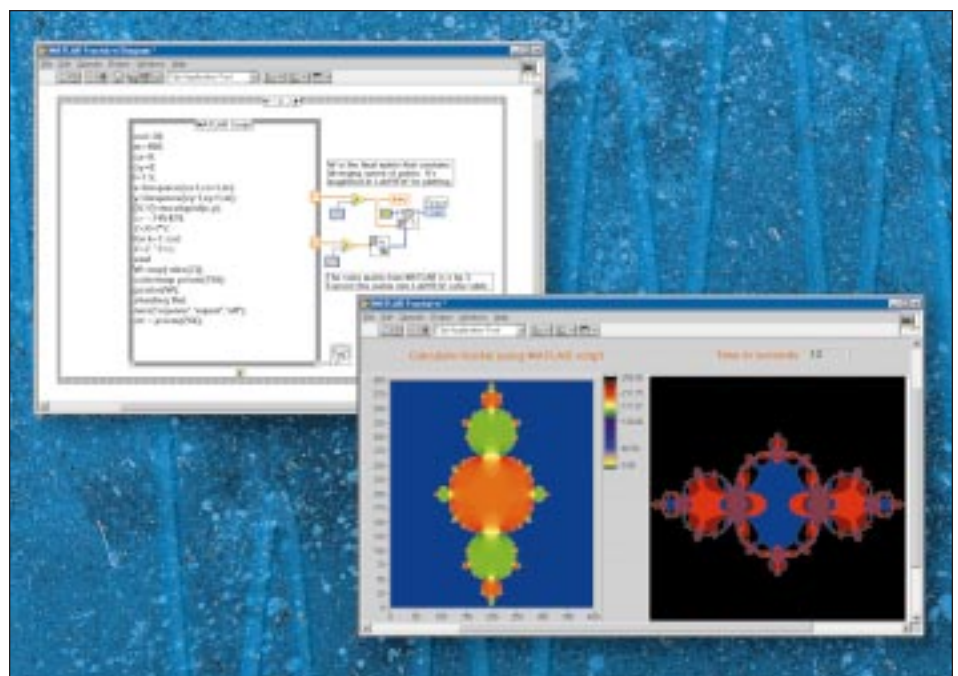
**A Signal Processing Natural**  
The signal processing capability of LabVIEW extends beyond built-in or add-on tools. LabVIEW graphical programming proves ideal when you need to create a custom algorithm for your measurement application. Senior Software Engineer Shie Qian, developer of numerous algorithms for LabVIEW, explains, “LabVIEW gives you the freedom to concentrate on the algorithm rather than the details of implementation during development.” Qian worked exclusively in LabVIEW to develop the algorithms behind the patented joint time-frequency analysis and the super-resolution spectral analysis tools that appear in the Signal Processing Toolset.

With traditional text-based programming languages, algorithm development can prove a daunting task; engineers face such language-implementation issues as tracking data types, memory allocation, and pointers. With LabVIEW, the language automatically handles these issues.

The patented dataflow-programming model of LabVIEW also smoothes development. Lothar Wenzel, National Instruments Software Architect and developer of many new math libraries in LabVIEW 5.1, finds that the dataflow programming model “depicts algorithms in a more natural form” than the sequential notation of a textual programming language. In LabVIEW, you program by connecting function blocks together with wire that represents the flow of data between the blocks. Just as a signal flows through an analog electronic circuit along wire, data flows from one function block to the next.

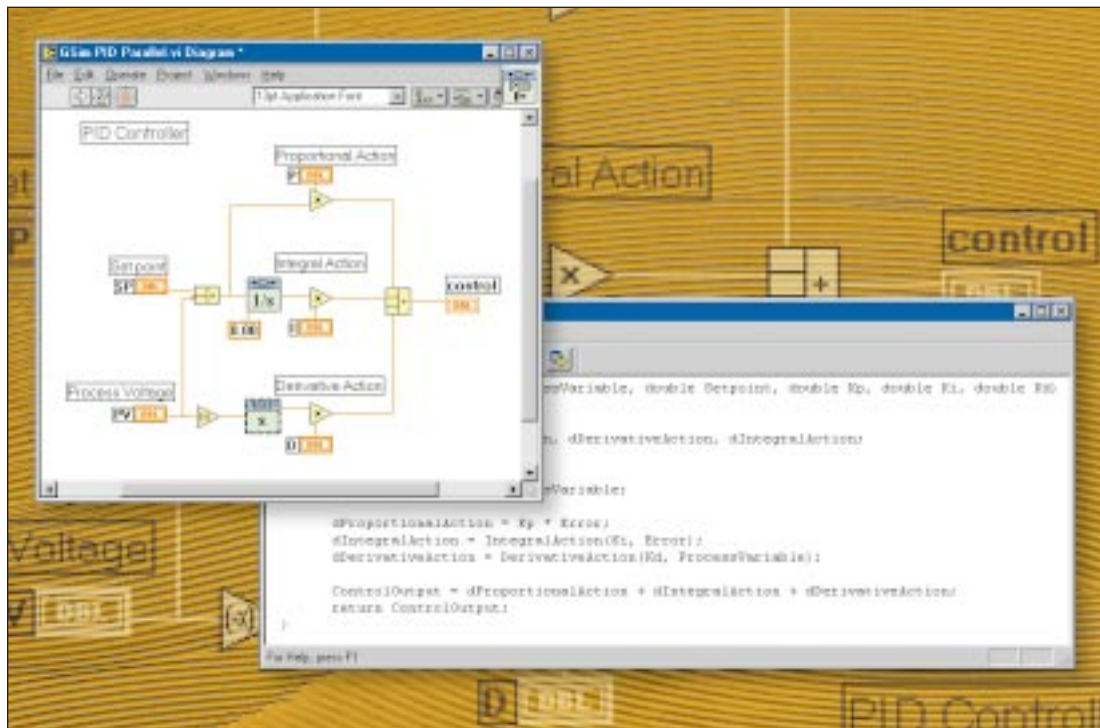
The LabVIEW block diagram notation is also similar to the diagrams you find in many engineering texts on signal processing algorithms and systems. The commonality saves time by relieving you of some of the burden of translating high-

*continued on page 4*



*With the new Matlab formula node, you can invoke Matlab scripts from your LabVIEW programs.*

## LabVIEW Version 5.1 Simplifies Signal Processing and Analysis



Icons depict the proportional, integral, and derivative portions of the PID loop as shown in the LabVIEW code to the left. The depiction is different than the C code for the same operation (right), which does not show the inherent parallelism of the algorithm.

continued from page 3  
level block diagrams into textual descriptions. Wenzel also feels that without this burden, you will find it easy to try out new ideas and experiment with algorithms.

For an example of this commonality, consider the well known proportional integral derivative (PID) loop of control engineering. If you examine the contents of most textbooks that discuss this subject, you note that most contain numerous diagrams that represent elements such as control equipment and associated feedback paths. These diagrams are often similar to the LabVIEW syntax, as shown in the above figure. The above figure also reveals another useful feature of the language – its natural depiction and implementation of parallelism. Notice the icons that depict the proportional, integral, and derivative components of the PID loop. The separation of these icons in the code naturally displays the parallel execution of the components. The parallelism of LabVIEW contrasts text-based algorithm descriptions, which often strip algorithms of their inherent

parallelism by resorting to a set of nested loops for a description. The LabVIEW depiction of parallelism also proves useful in multichannel measurement because you can naturally separate operations on each channel.

*The signal processing capability of LabVIEW extends beyond built-in or add-on tools. LabVIEW graphical programming proves ideal when you need to create a custom algorithm for your measurement application.*

Measurement applications also commonly require sequential program execution as they acquire, analyze, and then store data. You can clearly visualize sequential program execution in LabVIEW code with a Highlight Execution option. The tool animates the execution of LabVIEW diagrams by showing bubbles that traverse the wires connecting the blocks of in the diagram. The bubbles

represent the data of a program as it flows between blocks; data dependency is evident as blocks only execute when all data input is present. Although this capability often serves as a debugging tool, you can also visualize the flow of a signal through a signal processing algorithm.

### Signal Processing and Analysis with LabVIEW

After you examine tools such as these, it is clear that some of the same language features that make LabVIEW ideal for its traditional roles also make it useful for signal processing and analysis. Built-in analysis and signal processing routines give you a set of common operations with which to quickly build custom applications. Built-in

support for data acquisition hardware, instrument drivers, and a host of signal-generation VIs permit the choice of real-world or simulated signals. The LabVIEW graphical syntax also proves helpful because you can depict signal processing and analysis algorithms in a familiar, natural form. ▶

– Sam Shearman, Product Manager  
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**For more information about the signal processing and analysis tools available from National Instruments, visit [www.natinst.com/analysis](http://www.natinst.com/analysis)**

Visit [www.natinst.com/labview](http://www.natinst.com/labview)

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## Readying Systems for Windows 2000

If you follow Microsoft's plans for their next-generation operating system, then you already know that Windows NT is getting a major overhaul. Windows NT is out and Windows 2000 is in. The Microsoft Windows NT family of products name is changing to the Windows 2000 product family.

### Windows 2000 – What's in a Name?

The new Microsoft Windows product family includes Windows 2000 Professional (formerly Windows NT Workstation), the next-generation operating system for products ranging from laptops to powerful desktop computers. Three additional versions, specifically designed for systems ranging from small business servers to mission-critical symmetric multiprocessor (SMP) systems, are called Windows 2000 Server, Windows 2000 Advanced Server, and Windows 2000 Datacenter Server.

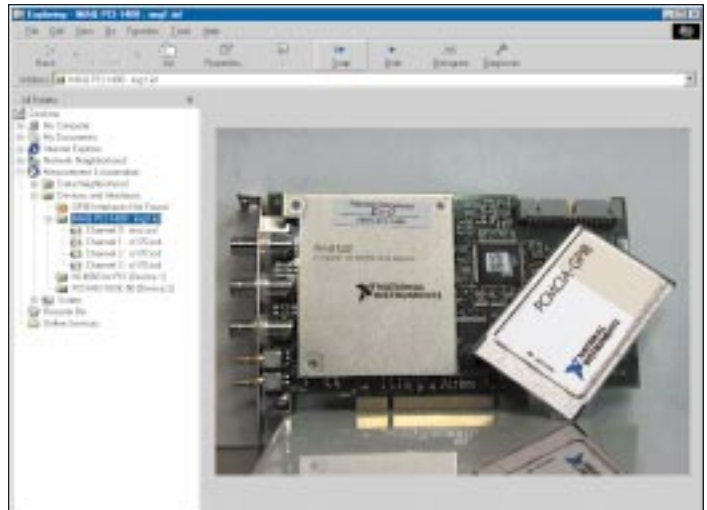
*Microsoft is positioning Windows 2000 as the single operating system that will replace all earlier versions of Windows.*

Microsoft's transformation of Windows NT into Windows 2000 signals more than just a simple name change. Windows 2000 Professional is an operating system that can be used by a wide variety of users and applications. Microsoft is positioning Windows 2000 as the single operating system to replace all earlier versions of Windows. What is so special about Windows 2000 that makes it the Windows NT and 9.x successor?

### Windows 2000 Overview

Based on the Windows 2000 Beta 2.0 software and information Microsoft has released, Windows 2000 contains an impressive array of new features, including ease of use, expanded support for a broad set of next-generation hardware devices, legacy applications, and network connectivity.

- Windows 2000 handles Plug and Play, making new hardware installations go much easier than with NT. It will also support PCs based on the new Advanced Configuration and Power Interface (ACPI) specification. ACPI provides advanced power management capabilities, such as Wake On LAN, the capability to power on a PC when it is accessed from another computer over the network, and Wake On Modem, when an incoming phone call or FAX is detected.
- Support for modern buses and high-speed interfaces, such as PCI, PC Card, CardBus, Universal Serial Bus (USB), and IEEE 1394, which will provide higher bandwidth connections for high-performance devices such as DAQ boards and cameras.
- Windows 2000 will provide extensive connectivity, security, and management options for integrating systems into a mixed network of Windows NT Servers and Unix systems. The new Windows 2000 management console is customizable and gives users the ability to configure and control computer and peripheral parameters as well as user and account security settings.
- Windows 2000 works with the FAT32 file system, which makes it easy to dual-boot between Windows 98 and Windows 2000. It also provides a new file system called New Technology File System (NTFS) 5. NTFS 5 has the option to turn on the Encrypted File System option, which gives users the ability to set a password for all data on their disk drive.



*The Measurement & Automation Explorer integrates fully into the new Windows 2000 technology.*

### Is your PC ready for Windows 2000?

To run Windows 2000 Professional, Microsoft recommends a 300 MHz Pentium II or faster desktop computer or a 233 MHz laptop computer with 64 MB of RAM. Microsoft encourages customers to purchase PCs that meet the PC97 requirements, have Y2K compliance, and include ACPI support for laptops.

### What should you do to take advantage of this technology?

Microsoft recommends that anyone planning to migrate to Windows 2000 should migrate first to Windows NT 4.0. Moving from Windows NT 4.0 will be the simplest migration path to Windows 2000. Migrating from Windows 3.1 will be more difficult. If you are currently using Windows 3.1 and 16-bit applications, now is the time to begin migrating those applications to 32-bit applications to take advantage of Windows 2000. Windows 2000 is still months away from shipping, but if you want to see Microsoft's next-generation operating system, you should get a copy of the Windows 2000 Beta 3 and give it a test drive. ☛

– Don Holley, Industrial Automation Product Manager  
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Visit [www.natinst.com/tech2000](http://www.natinst.com/tech2000)

## Comparing Multifunction DAQ and DMM Systems

Every data acquisition (DAQ) system you purchase has two basic hardware components – digitization hardware and signal conditioning hardware. How these two components are implemented into your system defines your system's architecture and its capabilities.



Look to National Instruments for SCXI-based solutions for multifunction DAQ and DMM systems.

Two popular architectures for DAQ systems are multifunction I/O (MIO)-based systems and digital multimeter (DMM)-based systems. Both systems deliver powerful and economical solutions for a variety of applications. However, understanding the attributes of each system will help you choose the right system for your application.

With an MIO-based system, the role of the MIO board is as a powerful digitizer capable of multiplexing and amplifying voltages. To acquire data from thermocouples, RTDs, strain gauges, high-voltages, or other types of signals, you need additional front-end signal conditioning. Good front-end systems are modular in design, so that you can choose the amount and type of signal conditioning you need for your application.

In comparison, with a DMM-based system, the DMM itself has the digitizer and all of the signal conditioning necessary to acquire many different

signals. To achieve a high-channel count system, you add a multiplexing/switching system as a front end. The switching system does not perform any additional signal conditioning other than to route the different signals to the DMM.

With this basic understanding of each system type, we can now compare and contrast the attributes of each architecture. For any application, you must consider several key characteristics when choosing your system. These characteristics include acquisition rate, resolution, signal/sensor support, channel-granularity, expansion, cost, and maintenance.

### Acquisition Rate

Acquisition rate describes how fast your system can digitize signals; this is the key differentiating factor between MIO-based and DMM-based systems. Multifunction I/O boards are built for dynamic signals. They have mid-resolution A/D converters and amplifiers with fast settling times. Therefore, they typically offer acquisition

rates from 20 kHz up to 5 MHz. DMM-based systems are built for general-purpose use. They typically have high-resolution A/D converters and additional hardware for isolation, which reduces their sampling rate. DMMs typically have acquisition rates from 5 to 100 Hz.

### Resolution

Resolution defines how many discrete levels your system can use to digitize a signal over a particular voltage range. A common point of confusion in comparing MIO-based and DMM-based systems is that each describes their resolution in different terms. An MIO board's resolution is described in "bits," while a DMM is described in "digits." The specific term does not really matter, as long as you compare the number of levels each system offers.

Most multifunction I/O boards offer "12-bit" or "16-bit" resolution. A "12-bit" board can resolve 10 V into 4,096 levels. This means that the smallest incremental voltage change it can measure over this range is 2.44 mV. A "16-bit" board can resolve the same 10 V signal into 65,535 levels, and can also measure changes of 150  $\mu$ V. In comparison, digital multimeters typically offer "5½" or "6½ digits" of resolution. A "5½ digit" DMM can resolve 10 V into 400,000 levels. This is comparable to a 19-bit DAQ board. This means that the smallest incremental voltage change it can measure is 25  $\mu$ V. A "6½ digit" DMM can resolve the same 10 V signal into 4,000,000 levels – effectively a 22-bit DAQ board – and can measure changes of 2.5  $\mu$ V.

It is important not to confuse resolution with accuracy. Accuracy describes how close your system reading is to the actual value. A device's accuracy depends on several factors, including device resolution, amplifier offset and non-linearities, and noise effects. Therefore, higher resolution does not mean higher accuracy.

### Signal/Sensor Support

Signal/sensor support describes the types of signals each system can acquire. Because an MIO-based system separates the signal conditioning from the digitizer, you can choose the type of signal conditioning you

need for various sensor/signal types. In a DMM-based system, the signal conditioning is part of the DMM. Therefore, your signal/sensor support is limited by the capabilities of your DMM. See the table below for a list of supported sensor and signal types for typical systems.

### Channel Granularity

Channel granularity describes the smallest number of channels you must purchase for each sensor/signal types. For an MIO-based system, it depends on the front-end signal conditioning system you choose. Low-channel count systems (16 channels or less) offer sensor/signal support on a per-channel basis. For high-channel count systems (like National Instruments SCXI™),

*SCXI, the most popular signal conditioning front-end for MIO-based systems, also works with DMM-switch based systems.*

you choose on a per-module basis, where each module offers 4 to 32 channels for a given sensor/signal type. Some modules support more than one sensor/signal type.

In comparison, a DMM-based system can digitize any signal-type, supported by the DMM on any channel. Therefore, you simply choose a large enough switching system to handle the number of channels your system needs. However, it is recommended that you keep high-voltage signals separated from low-voltage signals, sensitive equipment, or lines that can come in contact with humans. Most switching systems use electromechanical relays, which

can fail or be programmed incorrectly. Thus, if some relays fail or are closed at the wrong time, your system could pass a high-voltage signal out a different line.

### Expansion

Expansion refers to your system's ability to add additional channels and new sensor/signal types. Both MIO and DMM architectures can offer channel expansion capabilities, depending on the style of system you choose. However, for an MIO-based system, adding a new sensor/signal type simply means purchasing a new signal conditioning module. For a DMM-based system, you upgrade your DMM to include the features you want.

### Cost

In general, an MIO-based system will be more expensive than a DMM-based system. For an MIO-based system, you purchase the signal conditioning for each channel of your system. In a DMM-based system, the signal conditioning comes with the DMM. Therefore, you only pay for it once and add channels via switches, which are generally less expensive.

### Maintenance

Maintenance refers to how often you must replace components of your system. MIO-based systems typically use solid-state parts, which have average lifetimes of 45 years. DMM-based systems use relays, with an average lifetime of 10,000,000 operations. Depending on your acquisition rate and test duration, a relay can last anywhere from 30 days to a lifetime.

### How to Choose

As you can tell, few hard and fast rules exist regarding which system is better for your application. Both systems have their advantages and limitations. For many applications, it can be as simple as a matter of preference. However, there are some general guidelines you can follow.

#### You most likely should choose an MIO-based system if:

- Any channel in your system must be acquired at rates higher than 100 Hz
- You have a large channel-count application where the aggregate sampling rate must be higher than 100 Hz
- You need to acquire sensors/signals not presently supported by scanning DMMs
- You cannot frequently access your system for maintenance

#### You should choose a DMM-based system if:

- All of your signals are slow-changing signals
- Your sensor/signal types are vastly different from one application to the next
- High-resolution is a priority

If you are still undecided, then your best option is to mix both systems into a single solution. SCXI, the most popular signal conditioning front-end for MIO-based systems, also works with DMM-switch based systems. Therefore, you can combine the best of both worlds into a single chassis.✶

– Travis Ferguson, Signal Conditioning Product Manager  
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For more information, download the white paper on our Web site titled "MIO-Based vs. DMM-Based Data Acquisition" from [www.natinst.com/info/news](http://www.natinst.com/info/news)

Visit [www.natinst.com/daq](http://www.natinst.com/daq)

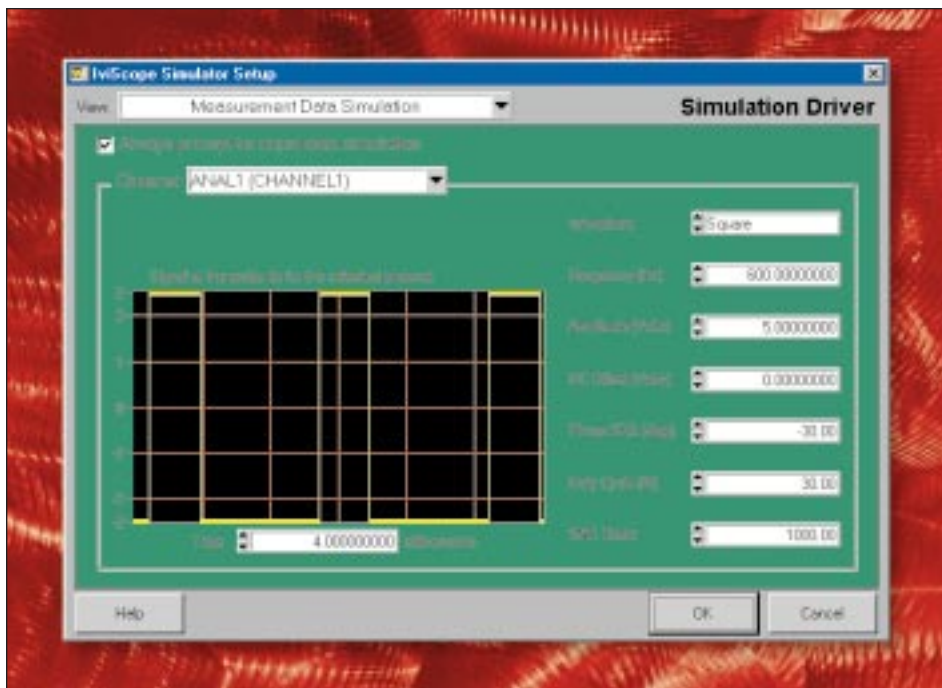
Supported Sensor and Signal Types for Typical Systems

Sensor/Signal	MIO-Based	DMM-Based	Sensor/Signal	MIO-Based	DMM-Based
Thermocouple	✓	✓	Dynamic input signals	✓	
RTD	✓	✓	Voltage output	✓	✓*
Thermistor	✓	✓	Current output	✓	✓*
Strain	✓		Optically isolated digital I/O	✓	✓*
Pressure	✓		High-voltage digital I/O	✓	✓*
Force	✓		Relays	✓	✓*
Load	✓		General-purpose switching	✓	✓*
Millivolt inputs	✓	✓	Matrix switching		✓
Voltage inputs up to 250 V	✓	✓	Frequency (TTL)	✓	✓*
Current (4-20 mA) input	✓	✓	Event (TTL)	✓	✓*
Frequency measurements	✓	✓			

\* Only available in SCXI configurations.

## Instrument Drivers Improve with Broader Industry Support

The formation of the IVI™ Foundation has spurred a flurry of activity since its announcement in August, 1998. Additional major instrument companies have since joined the IVI Foundation, and numerous work groups have formed to evaluate the new technologies, the relationship of IVI with existing instrument-related standards, and the creation of new instrument classes for telecommunications instruments.



*Simulation Drivers help reduce system development costs because the physical instrument does not have to be present in the test system during development.*

To address end-user demand, the IVI Driver Library is now available – we have also established an IVI Developer Network to drive development of IVI-compatible instrument drivers. The IVI Foundation has now grown to more than 20 members committed to fulfilling the user-driven goals of IVI. This combination of open standards, broad industry support, available products, and driver development services provides a solid foundation for the continued success of instrument drivers in automated test.

### What Is the IVI Foundation?

The IVI Foundation is an organization focused on improving instrument drivers. The foundation members are working to address gaps in instrument driver technology, including faster execution

speed, development flexibility, instrument interchangeability, and quality assurance procedures that ensure reliability and help reduce driver maintenance costs.

The IVI Foundation has recently welcomed twelve new members. Hewlett-Packard and Keithley Instruments now join Advantest, Anritsu, LeCroy, Racal Instruments, Rhode & Schwarz, Wavetek, and other major instrument vendors who recognize the value IVI technology brings to test system developers.

### Future Directions for IVI

Five instrument classes have already been defined by the IVI Foundation, including oscilloscopes/digitizers, digital multimeters, arbitrary waveform generators/function generators, switches/multiplexers/matrices, and power supplies.

In addition to basic instruments, class specifications are currently under development for I/O, power meters, spectrum analyzers, and counter/timers. The goals of faster test execution speeds, increased development flexibility, greater robustness, and reduced maintenance costs also have clear ramifications for telecommunications testing.

In addition to supporting a broader range of instrument types, working groups have formed within the IVI Foundation to study the capabilities of new and existing technologies and how they might benefit automated test developers and applications. Among these technologies are Microsoft's common object model (COM) and ActiveX technology, as well as the existing standard commands for programmable instruments (SCPI) standard.

The article titled, "Applying ActiveX to Measurement and Automation Tasks" in our Spring 1999 newsletter provides a brief overview and tutorial of the benefits and usage of COM and ActiveX technology. Because COM and ActiveX are an integral part of National Instruments software products, we are interested in exploring ways of leveraging these technologies to package and expose the capabilities of IVI instrument drivers. The goal is to simplify integration and usage of IVI instrument drivers inside LabVIEW, LabWindows™/CVI, Visual Basic, Visual C++, and other environments compatible with COM/ActiveX.

### New IVI Foundation Members

[www.ivifoundation.org](http://www.ivifoundation.org)

ASCOR  
B Squared Technologies  
CACI-ASG  
Ericsson Radio Systems  
Excalibur Systems  
Hewlett-Packard  
Keithley Instruments  
Neoteric Technologies  
PX Instrument  
Racal Instruments  
Rockwell Collins  
Teradyne

## The IVI Driver Library

The IVI Driver Library for Windows PCs and Sun Solaris 2 is based on standard instrument programming specifications created by the IVI Foundation. It includes standard drivers, simulation drivers, and soft front panels for the five classes of instruments defined by the IVI Foundation. The IVI drivers build on the *VXIplug&play* specifications and are compatible with LabVIEW, LabWindows/CVI, Visual Basic, Visual C++, and other programming environments that can call dynamic link libraries (DLLs).

The IVI Driver Library includes class drivers, which are standard programming interfaces for automating measurements with instruments within particular classes.

*The IVI Developer Network facilitates easy access to companies and individuals providing driver development services.*

Users build their programs by calling the functions in the class drivers. The initial release of the IVI Driver Library includes a class driver for the following classes of instruments:

1. Oscilloscopes/digitizers
2. Digital multimeters
3. Arbitrary waveform generators/function generators
4. Switches/multiplexers/matrices
5. Power supplies

### Certified IVI Driver Developers

[www.natinst.com/ivi](http://www.natinst.com/ivi)

B&B Technologies, Inc.  
 Cal-Bay Systems, Inc.  
 G Systems, Inc.  
 Marconi Integrated Systems  
 (Columbus)  
 Vektrex Electronic Systems, Inc.  
 VI Engineering, Inc.  
 Viewpoint Software Solutions  
 GEC Marconi Avionics LTD.

Class drivers communicate with instruments through a specific driver that is unique to each make and model. Users interchange instruments simply by replacing the instrument and its specific driver in their system without touching the class driver or their test program source code. More than 50 ready-to-use specific drivers are now available at [www.natinst.com/idnet](http://www.natinst.com/idnet). Users can also build specific drivers that plug into the IVI driver architecture using the Instrument Driver Development Wizard in LabWindows/CVI 5.0.

The IVI Driver Library also includes a soft front panel for each class driver for interactively controlling any instrument that fits in the class. For example, developers can use the IVI oscilloscope soft front panel to interactively control any IVI-compatible oscilloscope – regardless of vendor – and verify that it is operating properly.

To improve test system performance, IVI instrument drivers use a state-caching engine to keep track of the state of an instrument's hardware settings. This feature significantly improves performance by intelligently eliminating redundant instrument I/O. For actual benchmarks, go to [www.natinst.com/gpib](http://www.natinst.com/gpib) to view the application note, "Eight Ways to Increase GPIB System Performance."

One of the most frequently asked IVI questions is "How do I get an IVI driver created for my instrument?" To address this need and in the process establish a system that enforces the quality standards for IVI instrument drivers, National Instruments has created the IVI Developer Network to facilitate easy access to companies and individuals providing driver development services. If you can't find an IVI driver for an instrument, contact the IVI Driver Developer Network. IVI Driver Developers are trained and certified by National Instruments on the IVI development tools. In addition, they have access to National Instruments driver testing and validation procedures and specialized technical support channels to ensure that the driver has a consistent level of quality and completeness. ▶

– Amar Patel, ICC Product Manager  
 E-mail [amar.patel@natinst.com](mailto:amar.patel@natinst.com)

## Simulation Saves Time and Money

The IVI Driver Library includes simulation drivers for each class, to simulate the functionality of an instrument and the signals it acquires or generates. Simulating instruments and test signals is a feature long-awaited by instrument driver users. With simulation, users can prototype and test capabilities of their test systems without making large capital investments in test equipment because the instruments and signal sources do not have to be present in the system. The simulation driver works in two modes – interactive simulation and non-interactive simulation.

With interactive simulation, users can configure the simulation driver at run time. Users can also have the driver prompt them to specify the simulated data each time a measurement is taken to inject numerous test cases into the system. The simulation driver simulates status codes, *VXIplug&play* functions such as self-test and query, as well as actual measurement data. The IVI class simulation drivers provide general-purpose simulation features. For applications that require more advanced or specific simulation capabilities, C source code for the simulation drivers are included so that users can further customize the data simulation algorithms to meet specific requirements.

Pete Richardson from Marconi Test Systems comments, "I have found simulation extremely useful. I was able to write some TestStand™ test sequences and debug them at my desktop PC and on a laptop with no hardware. I really like the class driver simulation – it's extremely cool!" ▶

To view an IVI app note, go to [www.natinst.com/info/news](http://www.natinst.com/info/news)

## Perform High-Speed Data Acquisition with USB



Use the DAQ Pad-6020E family of products for the world's fastest USB DAQ transfer rates.

USB is an off-the-shelf PC standard that is ideal for peripherals such as keyboards and mice. At National Instruments, we strive to make the PC more valuable to you by taking standards such as USB and adding instrument-specific capabilities.

Because of inherently slow, single-point transfer latencies, USB is a particularly challenging bus on which to implement instrumentation and measurement capabilities such as high-speed data acquisition. This is why most USB DAQ devices on the market perform at sampling rates less than 1 kS/s. However, the largest segment of DAQ applications (more than 35 percent) that you create is in the 100 kS/s range. With this in mind, we broke through the perceived technical ceiling on

USB transfer rates to deliver a DAQ product that can sustain 100 kS/s!

The DAQPad™-6020E family consists of the world's fastest USB DAQ devices, sustaining continuous analog input data transfers to PC memory at rates up to 100 kS/s. To achieve these phenomenal

rates on USB, we invested in new software architectures to increase interrupt processing and buffered data transfer performance. To specifically address the USB single-point transfer latencies, we implemented a new method for caching register transfers. The result is technology that boosts transfer rates across the USB in our DAQPad-6020E products.

In the end, new PC standards are only as good as they are useful. By solving the technical challenges that USB faced for high-speed data acquisition, National Instruments has made USB a viable bus for measurement solutions and offers the only high-speed measurement devices available. ✎

**For a DAQPad-6020E data sheet, visit [www.natinst.com/info/news](http://www.natinst.com/info/news) or check this option on the reply card.**

Visit [www.natinst.com/daq](http://www.natinst.com/daq)

	Analog Inputs	Resolution	Sampling Rate	Input Range	Analog Outputs	Resolution	Output Rate	Output Range	Digital I/O	Counter/ Timers	Triggers
DAQPad-6020E	16 SE/8 DI	12 bits	100 kS/s	±0.05 to ±10 V	2	12 bits	100 kS/s	up to ±10 V	8	2, 24-bit	Digital

## Wireless Data Acquisition and Control Using FieldPoint™

When cabling is too costly or impossible, you can now easily implement a wireless I/O system using FieldPoint I/O with industrial-grade RF modems. National Instruments now offers a reliable, high-performance spread spectrum modem that easily converts FieldPoint into a wireless data acquisition and control system. You can link one or more remote FieldPoint I/O banks back to a central PC using reliable, wireless technology.

The FieldPoint radio modem features frequency-hopping spread spectrum RF technology for excellent noise immunity, reliability, and performance. Because the FieldPoint radio modems use the 902-928 MHz spread spectrum band, you can operate them without an FCC site license. With high baud rates (up to 115 kb/s), extended temperature range (-40 to 75 °C), and a transmission range of 20 miles with line-of-sight antenna

placement, the wireless FieldPoint modems deliver industrial-grade, reliable wireless communications for I/O and data acquisition systems.

The FieldPoint radio modem works with the FP-1000 network interface module for RS-232, seamlessly converting between RS-232 data and RF data. You can configure wireless FieldPoint systems in point-to-point or point-to-multipoint systems. You can also configure modems as repeaters for longer distances or transmission around obstructions. Modems are delivered to you pre-programmed to work with standard FieldPoint modules according to your particular configuration and topology, simplifying system installation. In addition, operation of the modem is software-transparent, meaning no extra software is required and any FieldPoint software developed for the FP-1000 will work with a wireless system.



You can configure wireless FieldPoint systems for multipoint, distributed applications.

You can also configure the radio modems to work with remote SCXI systems to link one or more RS-232 SCXI chassis to a PC via a reliable wireless link. ✎

\*Available U.S., Canada, most of Latin America

**For more information, download a wireless FieldPoint data sheet at [www.natinst.com/info/news](http://www.natinst.com/info/news)**

Visit [www.natinst.com/fieldpoint](http://www.natinst.com/fieldpoint)

## High-Performance PCI DAQ Delivers 16 Bits at 333 kS/s



The PCI-6052E features high-speed and high-resolution.

National Instruments has expanded the E Series to include high-speed, high-resolution measurement devices. The new PCI-6052E multifunction board features our measurement-ready technologies and delivers 16 bits of resolution at 333 kS/s on 16 single-ended or 8 differential input

channels. The PCI-6052E also features two 16-bit analog outputs, eight TTL digital I/O lines, and two 24-bit counter/timers.

National Instruments data acquisition (DAQ) products use modern technologies to deliver high-performance measurements and maintain measurement accuracy even at high gains and acquisition rates. Because the PCI-6052E is part of the E Series, it also provides advanced timing and multiboard synchronization capabilities for building flexible DAQ systems. Technologies for high-performance measurements include:

- Reduced noise design with shielded planes, split analog and digital ground planes, and multilayer design
- No potentiometers, jumper posts, or address switches means hands-free configuration and calibration

- Our custom NI-PGIA™ amplifier delivers better accuracy and guaranteed settling times at all gains
- The RTSI™ bus synchronizes multiple devices for advanced timing and triggering capabilities
- The DAQ-STC™ ASIC delivers precise timing down to 50 ns
- The PCI MITE™ ASIC transfers your data directly to PC memory with scatter-gather bus master transfers

For a PCI-6052E data sheet, visit [www.natinst.com/info/news](http://www.natinst.com/info/news) or check this option on the reply card.

Visit [www.natinst.com/daq](http://www.natinst.com/daq)

**BUY ONLINE!**

	Analog Inputs	Resolution	Sampling Rate	Input Range	Analog Outputs	Resolution	Output Rate	Output Range	Digital I/O	Counter/Timers	Triggers
6052 E	16 SE/8 DI	16 bits	333 kS/s	±0.05 to ±10 V	2	16 bits	1 MS/s	10 V	8	2, 24-bit	Analog/Digital

## Temperature Sensors Offer a Complete Solution

As part of the continuing commitment of National Instruments to provide customers with solutions, we now offer several new programs designed to help solve your DAQ applications. First, National Instruments now offers thermocouples and resistance temperature detectors (RTDs). For sensors that National Instruments does not yet offer, we suggest you try our new online Sensors Solutions Database, which contains contact information for third-party sensor providers, application notes, and even recommended DAQ hardware. Finally, if you want to learn more about the fundamentals of various sensors, browse our Sensors Fundamentals Web pages.

National Instruments now offers thermocouples and RTDs of various types and form factors. First, we offer field-cuttable thermocouple and RTD probes. Field-cuttable probes are unique in that you can cut them to the desired length. Instead of purchasing different probes for different components of your application, you can now order and stock one style of

temperature probes, reducing cost and downtime. In addition, we offer ready-made thermocouples and RTDs. These sensors are shipped pre-fabricated in 1 and 2 meter lengths. Finally, we also offer spools of thermocouple and extension wire.

### Sensor Solution Database

A wide variety of sensors is available on the market today. Knowing where to find information on various types of sensors can be a daunting task. We have therefore created the Sensor Solution Database. Here, you find information about third-party companies and the sensors they offer. You also find helpful application notes describing how to use many of the sensors. Finally, you can see some recommended products for use with each type of sensor.

### Sensor Fundamentals

For general information about how a particular sensor works, visit our Sensors Fundamental Web page. These pages describe how each sensor works, what



National Instruments offers a variety of thermocouples and resistance temperature detectors (RTDs).

signal conditioning is required for each type of sensor, application tips for using each type of sensor, and possible DAQ system configurations with cost analysis. Specific sensors covered include thermocouples, RTDs, thermistors, strain gauges, accelerometers, LVDTs, and others.

For more information about any of these resources, visit [www.natinst.com/sensors](http://www.natinst.com/sensors)

Visit [www.natinst.com/sensors](http://www.natinst.com/sensors)

**BUY ONLINE!**

## Applications Made Easy with New Counter/Timer Boards for CompactPCI/PXI™

National Instruments has developed the 6602 family of new counter/timer boards. These boards feature eight 32-bit counter/timers and address advanced timing and synchronization demands on measurement and automation solutions. An integral component of these boards is a new proprietary ASIC from National Instruments, the NI-TIO™. Advanced applications and features are now accomplished with ease with features that include:

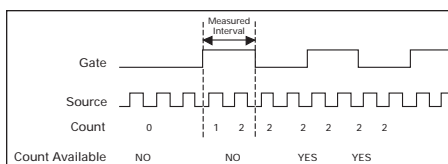
- High-frequency input signals (up to 125 MHz with prescaling)
- Glitch elimination in input signals
- Continuous buffered parameter measurements
- Two-signal, edge-separation measurement
- Hardware triggering of operations
- Frequency shift keying
- Position measurements

*The National Instruments 6602 family of counter/timer boards features eight 32-bit counter/timers that address advanced timing and synchronization demands.*

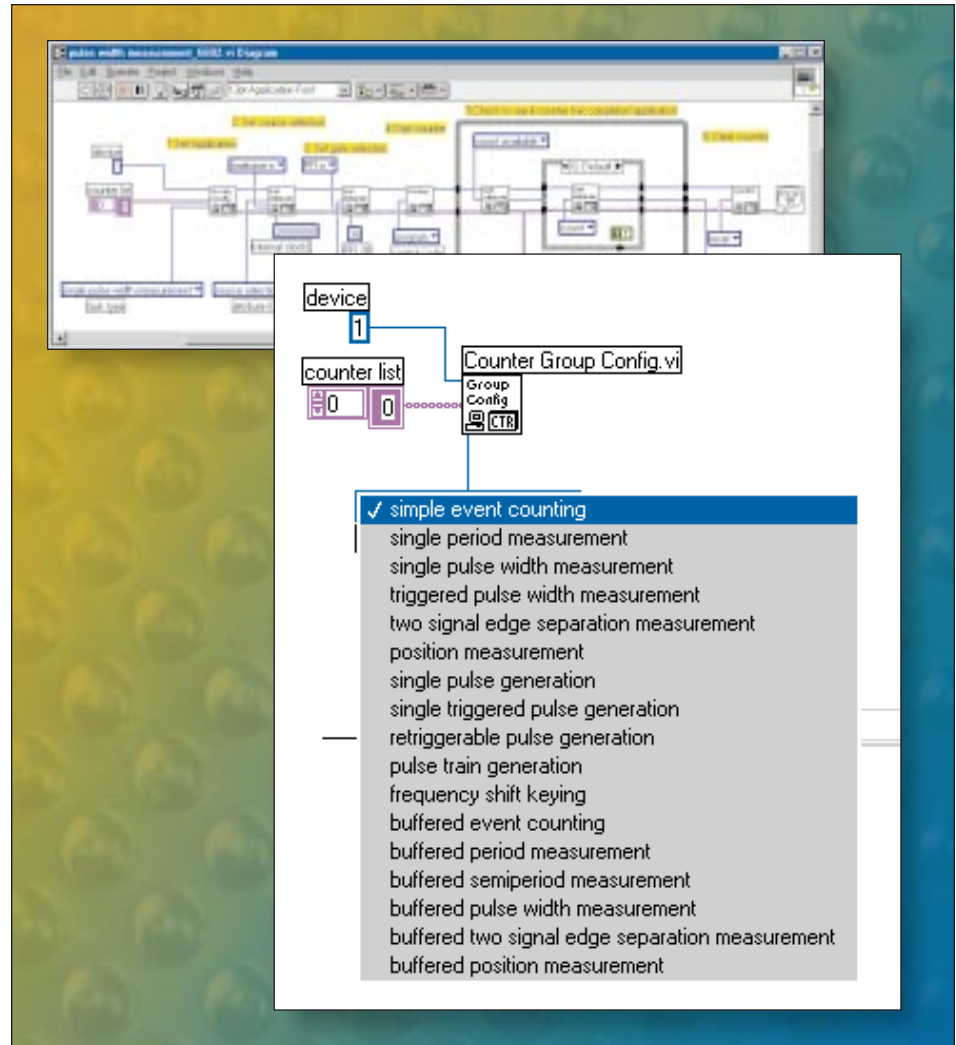
Each counter on the 6602 is comprised of a GATE, SOURCE, OUT, and an UP/DOWN input. Using the UP/DOWN feature, a user can perform position and two-signal edge separation measurements with one counter rather than using two or more counters to accomplish the same task, as is the case with many timer/counter boards.

### Programming in LabVIEW

In conjunction with the release of the 6602, NI-DAQ version 6.5 now provides a new format to programming the board in LabVIEW with the introduction of the Advanced Counter functions or virtual instruments (VIs).



*Timing Diagram for Pulse Width Measurement.*



*Our new counter/timer device features eight 32-bit counter/timers and addresses advanced timing and synchronization demands.*

Programming the counter/timers is now application-centric. You set up the counter/timer from an application point of view, thus making it easier to program. For example, you initially call Counter Group Config.vi and select a task such as "pulse width measurement." This programs the counter to perform pulse width measurement. Then, call Counter Set Attribute.vi to set the attributes of the counter. After setting the attributes, call Counter Control.vi to initiate the counter task. Use Counter Get Attribute.vi to retrieve the results of the counter operation. Finally, use Counter Control.vi to reset the counter. The following timing diagram shows the setup for pulse-width measurement with a single counter using

the new VIs. In a pulse-width measurement, the counter measures the time interval between two transitions of the opposite polarity of the GATE signal.

When creating counter/timer applications, start by deciding what task the counter performs, and proceed from there to set up the counter, initiate operation, retrieve information, and reset the counter.

The 6602 family of counter/timer boards ships with several sample programs that address the above applications and are used directly or as an instructional aid. ▶

**For a PXI/PCI-6602 data sheet, visit [www.natinst.com/info/news](http://www.natinst.com/info/news)**

Visit [www.natinst.com/daq](http://www.natinst.com/daq)

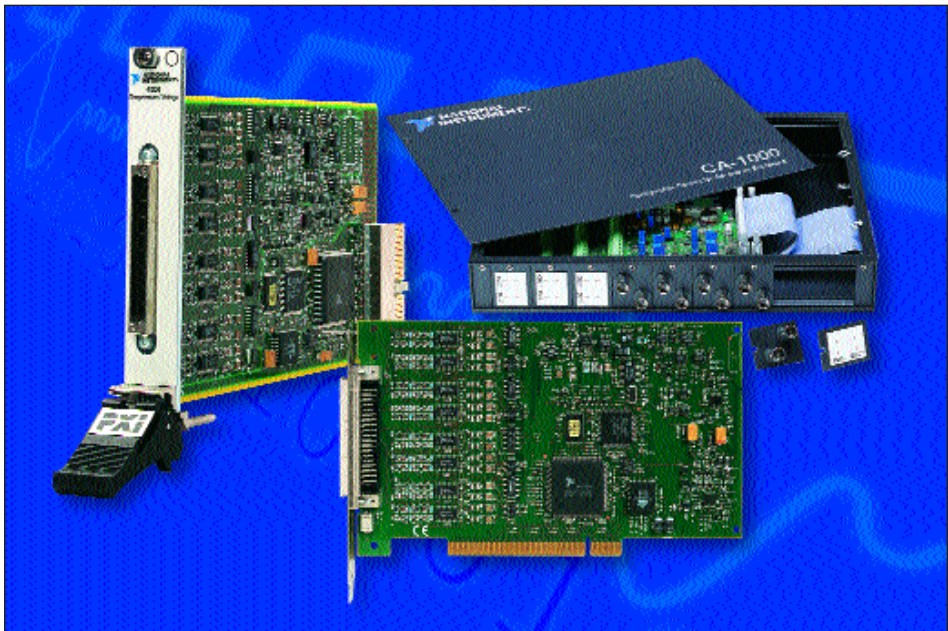
# Make High-Precision Temperature and Voltage Measurements

Now, building low-cost, high-performance temperature and voltage measurement systems is possible using CompactPCI, PXI, or PCI computers. The NI 4351 family is the most accurate computer-based temperature logger available.

**Temperature Measurements**  
 The NI 4351 measures up to 14 temperatures. The temperature instrument rejects power-line noise of 50 and 60 Hz. Thermocouple connector accessories, TC-2190, TBX-68T, and CB-68T, accept the direct connection of standard thermocouple mini-connectors. Each of the inputs of the accessory includes a sensor for cold-junction compensation. The NI 4351 is configurable for open thermocouple detection and ground referencing on a per-channel basis. The table below shows the range of sensor types and the accuracy of measurement from the NI 4351.

Sensor Type	Accuracy
Thermistor	±0.03 °C
RTD	±0.16 °C
Thermocouple	±0.42 °C

*The NI 4351 is a high-accuracy, computer-based instrument for measuring temperature.*



*The NI 4351 family is the most accurate computer-based temperature logger available.*

**Voltage Measurements**  
 In addition to temperature measurements, the NI 4351 measures voltages up to ±15 V with 5 1/2 digit accuracy. Using the general-purpose terminal block accessory, TBX-68, up to 16 unconditioned analog signals, excitation signals, and digital signals are routed to the NI 4351.

Eight digital I/O lines offer discrete input and output for switching relays and

for alarming when measuring voltage, temperature, or both.  
 The NI 4351 for CompactPCI/PXI and PCI makes it possible to create temperature and voltage measurement systems that perform faster, lower costs, and are easy to integrate.✔

Visit [www.natinst.com/instruments](http://www.natinst.com/instruments)

# Optical Character Recognition Software for LabVIEW and BridgeVIEW™

With the new National Instruments IMAQ™ OCR software, you can use LabVIEW and BridgeVIEW to read text from images obtained with image acquisition hardware. The IMAQ OCR software is specially designed to meet the needs of



*Use IMAQ OCR software to read characters along curves or arcs such as aluminum can lot codes, bottle caps, and CD-ROMs.*

industrial vision application developers who need reliable and accurate OCR capabilities. You can use the software in applications ranging from identifying serial numbers on semiconductor wafers to automotive parts, electronic packaging, disk heads, and other small parts. This software, which is a PC-based industrial character recognition tool, is designed to provide high-speed, reliable performance even if there is poor image quality or image degradation from typical industrial process variations.

The IMAQ OCR software operates in four modes to optimize accuracy and speed and can apply a variety of automatic correction methods to improve the recognition quality. The software recognizes images of characters produced

by conventional typesetting, printing, and stamping techniques. In addition, the IMAQ OCR software recognizes common fonts used in electronic, semiconductor, automotive, and pharmaceutical identification applications including OCR-A and OCR-B character sets. Furthermore, the software includes advanced functions for reading characters not written on a straight line, mixed fonts, and numbers and letters on the same line. The OCR Toolkit requires IMAQ Vision and LabVIEW or BridgeVIEW.✔

**For more information on IMAQ, visit [www.natinst.com/imaq](http://www.natinst.com/imaq)**

Visit [www.natinst.com/imaq](http://www.natinst.com/imaq)

## New Wizards Simplify GPIB Installation and Configuration

New Getting-Started and Troubleshooting wizards speed GPIB controller/instrument installation and configuration. In addition, the Measurement & Automation Explorer delivers an intuitive browser interface to access helpful GPIB debugging tools, GPIB system configuration information, and GPIB interactive control utilities.

Measurement & Automation Explorer is not specific to GPIB. It is designed to facilitate fast and easy integration of various National Instruments measurement products. Because hybrid systems are the norm, better configuration tools translate to reduced cost and time spent configuring measurement components.

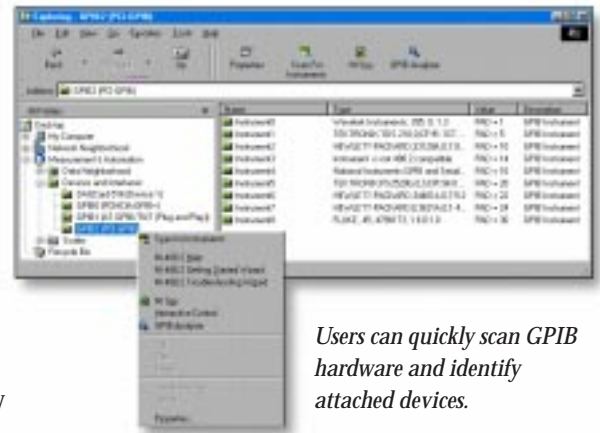
### Getting-Started and Troubleshooting Wizards

Many developers spend a large portion of their time trying to verify that their GPIB controller installation was successful and confirming communication with their measurement devices. To simplify and speed this process, National Instruments

has created a Getting-Started wizard that guides users through a step-by-step installation, configuration, and system diagnostic process to confirm that the NI-488.2™ software and GPIB controller hardware is installed and working properly. The wizard then directs the user to connect and power on the GPIB instruments they plan to use in their system so it can scan the bus and automatically identify attached instruments.

### Powerful Debugging Tools

Another important stage in developing test applications is the debugging process. Measurement & Automation Explorer gives users fingertip access to NI-Spy, a software monitoring utility which monitors, records, and displays NI-488.2 API calls made from an application. NI-Spy is useful for troubleshooting because it sequentially displays function call names, parameters, and GPIB status information in a scrollable window as



Users can quickly scan GPIB hardware and identify attached devices.

calls are executed by their source code.

In addition to a command line-based instrument interactive control utility (IBIC), we now offer a simple GUI communicator tool for new users who want to quickly communicate to their GPIB devices without having to learn the NI-488.2 API. ▶

Visit [www.natinst.com/gpib](http://www.natinst.com/gpib)

## 333 MHz Processors Power PXI/CompactPCI Embedded Controllers

The new PXI-8150B Series embedded controllers for CompactPCI and PXI are now available with 333 MHz AMD-K6-2 processors. Measurement and automation applications using CompactPCI-based systems can now benefit from 40 percent additional processing speed.

The 333 MHz PXI/CompactPCI controllers replace the 233 MHz Pentium-based controllers as the fastest PXI controllers available today. Fortunately, the extra performance does not come at any extra cost, as the 333 MHz controllers have assumed previous pricing levels from the 233 MHz versions. Prices for the 233 MHz controllers have been lowered to match the 166 MHz versions. National Instruments can continue to offer higher performance and lower prices for PXI controllers, because PXI and CompactPCI are completely based on standard PC technology.

The new B Series controllers are form, fit, and function equivalent to the previous revision of controllers. The PXI-8155B

provides SVGA, keyboard, mouse, USB, serial, and parallel ports along with a floppy drive and a 4 GB hard drive. The PXI-8156B includes all PXI-8155B features, plus a second serial port, a GPIB interface, and an integrated Ethernet port. The above features were all available on the PXI-8155 and PXI-8156; however, the new B Series controllers offer several additional features that were not previously available. These new features include:

- Support of both Intel Pentium (233 MHz) and AMD-K6-2 (333 MHz) processors
- Internal interface for control of PXI-1025 MegaPAC and PXI-1020 instrument chassis
- Integrated watchdog timer for mission critical applications
- Synchronous DRAM memory up to 256 MB for memory-intensive applications
- Ultra-DMA hard drive for faster and more efficient data storage

The internal interface for controlling the PXI-1025 MegaPAC portable computer



The PXI-8150B Series embedded computers are high-performance system controllers that are compatible with the PXI specification and with CompactPCI.

and the PXI-1020 instrument chassis includes signals for driving the integrated flat-panel display, CD-ROM, keyboard, and mouse that are built into these two fully integrated chassis. ▶

**For more PXI/CompactPCI and the PXI-8150B Series data sheets, visit [www.natinst.com/info/news](http://www.natinst.com/info/news)**

Visit [www.natinst.com/pxi](http://www.natinst.com/pxi)

## Preparing Your Test and Automation System for the Year 2000

When all those encoded 99s roll over to 00s at the end of this year, you don't have to play a guessing game with your test or automation products, applications, or services. Assessing and preparing your computer-based systems now for Y2K means confidence into the Year 2000.

Byron Radle, Software Verification and Validation Manager for the Measurements Group at National Instruments, understands Y2K testing and the impact Y2K can have on an organization. He supervises a group that uses test software, including National Instruments LabVIEW, LabWindows/CVI, and TestStand, to validate National Instruments data acquisition (DAQ) products. To guarantee his test systems work properly, Radle follows the assessment, test, and remedy plan that has become the standard procedure for Y2K compliance.

### Assess System Software

The first step in ensuring a system is Y2K-ready is assessing the Y2K compliance of your current software. For example, systems running on DOS or Windows 3.1 are more likely to experience Y2K problems.

### Assess Application Software

You should inventory every software product in your system and make note of the software's manufacturer. Today, many manufacturers test their current products and make compliance information available to customers. National Instruments addressed Y2K concerns more than a year ago with extensive testing of its software and hardware product inventory. The complete results of that testing are available at [www.natinst.com/year2000](http://www.natinst.com/year2000)

### Test User Programs

Even if a product alone is Y2K compliant, you must consider the other software packages that are interacting with it. A Y2K problem could originate in an operating system or secondary program in your system. To check the entire system for compliance, Radle suggests testing critical rollover dates by emulating the December 31, 1999 to January 1, 2000 year change in the software. In addition, 2000 will be a

leap year, therefore you must also check leap year compliance and the rollover period from 2000 to 2001.

Radle suggests checking your system with both a static date entry and a rollover event, and if you have access, conduct a "white box" test of the software's underlying code. When you test the code, you include a case-insensitive search for signal characters that could indicate Y2K problems, such as "yearly", "yy", "decade", month names, and days of the week. You can find a more comprehensive list of recommended tests at [www.natinst.com/year2000](http://www.natinst.com/year2000)

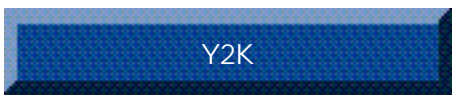
### Remedy Y2K Problems

Upgrades to the latest software versions will most likely remedy major Y2K problems. However, as you test user programs, you may also discover small sections of code that need to be modified for Y2K readiness.

### Write Year 2000 Compliant Applications

Once you've determined that your current system is Year 2000 compliant, you must guarantee that all of your future products or applications can also handle the upcoming date change. Although every product will require different testing methods, here are nine general areas that will cover most Y2K issues:

- Store all date information in fields with four digits
- Check all parsing and processing of date information in your code. These will need to include user-settable as well as machine-settable dates and ranges
- Verify installation/uninstallation functions across critical dates. Remember to check for compatibility during maintenance upgrades
- Check proper operation of time-out functions during critical rollover dates
- Check proper operation of your system if the dates of different computers it shares files with are out of synchronization,




Check the National Instruments Year 2000 Web site for a comprehensive list of our Y2K results and test strings.

especially if they are split before and after critical rollover dates

- Verify proper operation and verification after critical rollover dates of any code that is digitally signed
- Test all application examples you include with your product
- Include demo/evaluation versions in your testing
- Conduct thorough testing of the system hardware, including embedded clocks and stored date/time information

### Summary

Your applications should be ready for the new millennium after following the assessment, test, and remedy method. However, you should also consider the benefits associated with upgrading your system to the latest hardware and software technologies. "For National Instruments, the costs will be high if test programs fail in January 2000," Radle says. "Rather than risk production downtime, delays in testing, and engineering inefficiencies, we have opted to upgrade older DOS and Windows 3.1-based systems to new Pentium-based equipment. Upgrading our systems now gives us the opportunity to improve our test throughput and reliability with modern Pentium and PCI bus technologies running Windows NT." 

Visit [www.natinst.com/year2000](http://www.natinst.com/year2000)

## NEW Video and Arbitrary Waveform Generation Instruments

You can use signal sources in a variety of applications, ranging from network analysis and video signal testing to generating automotive testing waveforms and digital signals. You can also perform tests and diagnostics on serial communication links. National Instruments has added three new signal sources to its line of computer-based instruments, thereby offering more ways for you to increase measurement throughput and lower the cost of making measurements.

### Low-Cost Function Generators

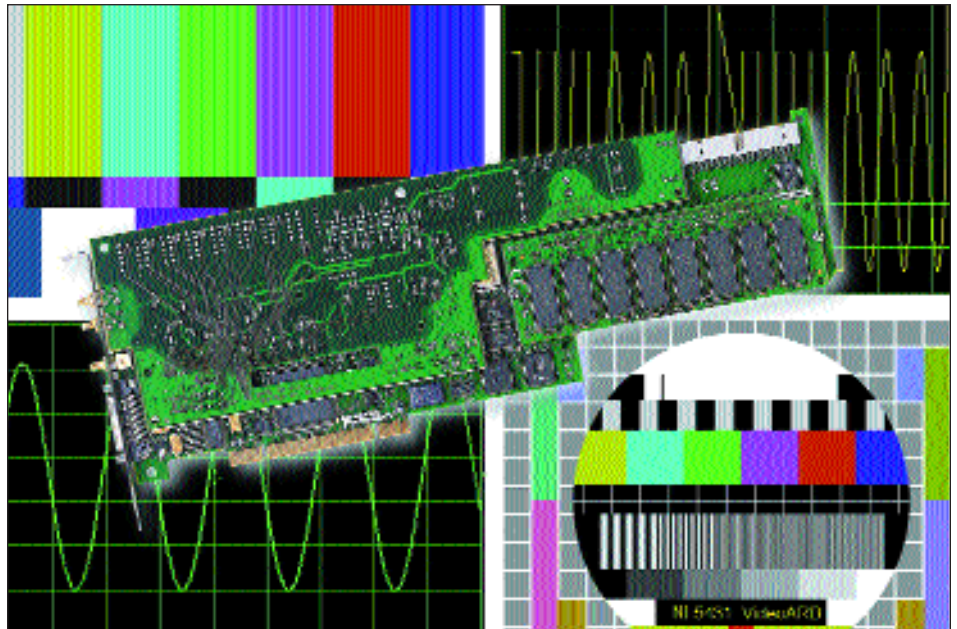
The NI 5401 is a low-cost DDS-based function generator for PCI and PXI/CompactPCI computers. The NI 5401 generates sine, square, triangular, and limited arbitrary waveforms with a minimum frequency resolution of 9.31 mHz. Additional features include 12-bit resolution, sine spectral purity of -60 dBc, and 40 MS/s update rate. Use the NI 5401 when you need a low-cost, modular signal source for your test, measurement, and data acquisition applications.

### Full-Featured Arbitrary Waveform Generator

If you have complex signal generation needs, use the NI 5411, a full-featured arbitrary waveform generator for PCI and PXI/CompactPCI computers. With no compromise in performance or ease of use, the NI 5411 includes all the functionality of arbitrary waveform generators, sweep

*The NI 5411 is ideal for generating complex signals, including ADSL and CDMA communication signals, powerline fault signals, engine control signals, and telephony signals.*

generators, and function generators. The NI 5411 features 40 MS/s sustained waveform generation, 12-bit vertical resolution, 16-bit digital pattern output, 32-bit DDS for up to 16 MHz frequency generation, and 50 and 75  $\Omega$  selectable output impedance. These high-performance characteristics, along with its advanced waveform linking and looping, make the



*The NI 5431 video signal generators for PCI and PXI/CompactPCI are ideal for generating a wide selection of video signals.*

NI 5411 the most versatile arbitrary waveform generator available. The NI 5411 is ideal for generating complex signals, including ADSL and CDMA communication signals, powerline fault signals, engine control signals, and telephony signals.

### Video Signal Generators

If you have the need to generate a wide range of video signals, the NI 5431 for PCI or PXI/CompactPCI is ideal. The NI 5431 is a high-accuracy analog and digital video signal generator with generation capabilities for M-NTSC, B/G-PAL, M-PAL, N-PAL, and SECAM standards. Whether testing televisions, VCRs, or other video-related equipment, you can use the NI 5431 to generate an accurate, reference quality signal source. Built on a 12-bit architecture, the NI 5431 features a sampling frequency of 20 MHz, adjustable in the range of 20.00 to 20.01 MHz to support the chroma frequency of different formats. Other important video generation specifications include -60 dB dynamic range, 8 MHz analog bandwidth, software-selectable output impedance of 50 and 75  $\Omega$ , and 16-bit digital pattern output of which four bits can be used for external synchronization signals – Csync, Hsync, Vsync, and Field.

The NI 5431 is shipped with the Video Test Toolkit for LabVIEW, LabWindows/CVI, Visual C/C++, and Visual Basic. The software is a multichannel test signal editor and generator instrument. Using the toolkit, you can design custom video test patterns or select from a library of standard pre-defined test patterns.

### Instrument Drivers Simplify Programming

If you are building an automated test application or integrating any of the National Instruments signal generation products in your existing measurement systems, then you should use the IVI-compliant NI-FGEN instrument driver. NI-FGEN consists of a collection of software routines for configuring and generating signals from the NI 5401, NI 5411, and NI 5431. Easy-to-understand example programs offer a great place to start your application development.

Computer-based signal generators are the best choice for automated test, measurement and data acquisition applications because they offer lower cost, faster performance, and easy to integrate solutions. ▸

Visit [www.natinst.com/instruments](http://www.natinst.com/instruments)

## Using Computer-Based Dynamic Signal Analyzers to Test Compressors

**The Challenge:** Performing assembly line functional testing of air conditioning compressors by using different test cycles and vibration testing.

**The Solution:** Using an automated, computer-based test system with an NI 4552 dynamic signal analyzer, various data acquisition (DAQ) boards, and LabVIEW to improve test quality and enterprise information connectivity.

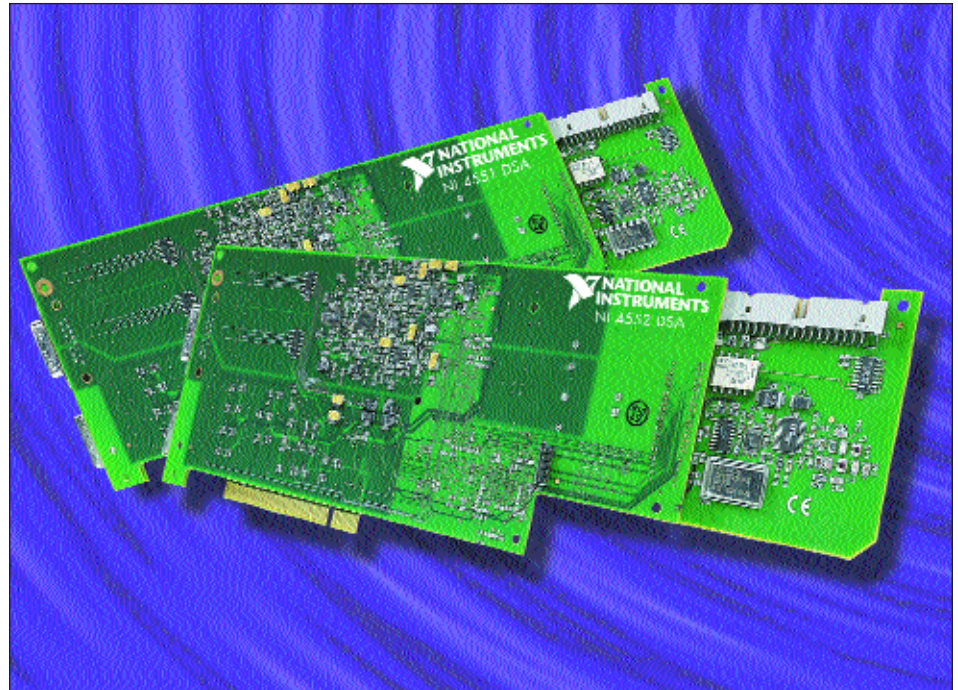
On hot summer days, we expect the air conditioning in our cars to keep us cool. When we buy a car, we want the air conditioning system to last the lifetime of the car. Even though we may take for granted all that goes into building a reliable automobile air conditioner, manufacturers of air conditioning compressors do not. They strive to build high-quality, reliable compressors for use in automobiles.

National Instruments products are used to improve compressor test quality. Compressors move down an assembly line at a fixed rate. Each part enters a test fixture where power lines, voltage and current probes, pressure hoses, and accelerometers are connected to the compressor. The compressor is exercised following a defined procedure, including measurement of isolation and current, and

*The database connectivity tools in LabVIEW simplify the integration of test data into an enterprise-wide database.*

when the compressor is on standby, starting, steady-state, and stopping are measured. Scientists take pressure leakage measurements when the compressor is not operating and starting. In addition, they measure the surface temperature. Finally, a vibration test verifies that no internal problems exist.

Using National Instruments products, a compressor manufacturer can test many more units and interface the test data to a



*Using computer-based instruments, you can improve test quality and enterprise-wide connectivity.*

database. The database connectivity tools in LabVIEW simplify the integration of test data into an enterprise-wide database. In addition, by using real-time frequency analysis methods and LabVIEW analysis routines, users have improved the quality of the vibration tests. Overall, the quality of the product improves, and the company can save thousands of dollars in test equipment.

### Tools Used for the Solution

The tests use a combination of PCI-based multifunction DAQ boards, digital I/O boards, and dynamic signal analyzers to decrease test times, lower equipment costs, and increase the measurement accuracy. Sixteen-bit, 16-channel, 100 kS/s multifunction DAQ boards are used to measure many of the compressor's analog signals. A digital I/O board opens and closes relays to apply different loads to the compressor.

Improvement in vibration measurements come through the use of the NI 4552 for PCI, a four-channel, 95 kHz dynamic signal analyzer with real-time frequency analysis capability. The -90 dB dynamic range helps to accurately identify vibration problems.

Frequency measurements often are the bottleneck in many measurement applications, but because the NI 4552 uses the PCI bus and DSP processors to transfer and analyze the vibration data, users can make measurements 20 times faster than with traditional GPIB-based dynamic signal analyzers.

Through the use of computer-based instrumentation and DAQ products, compressor manufacturers can improve the test quality and deliver more compressors that keep our cars cool so we can drive in comfort. ♣

**- Ed McConnell, Product Manager,  
Computer-Based Instruments**

Visit [www.natinst.com/instruments](http://www.natinst.com/instruments)

# LabVIEW RT – Real-Time Control for Pipe Coupling with Power Tongs

By Steve Conquergood,  
Advanced Measurements Inc.

**The Challenge:** Controlling torque when assembling oil pipes.  
**The Solution:** Using the real-time capabilities of LabVIEW RT to provide deterministic control.

A common real-time task in the oil field industry is controlling torque when assembling oil pipes. The central oil pipe on an oil rig is composed of smaller sections of pipe called “joints.” These joints are connected and assembled on the drill rig using a hydraulically driven tool called a power tong. Because joints are threaded together, users must apply the correct torque to each joint so that it will not leak or loosen over time. Over-torquing damages the pipe connections and results in loss of the pipe sections as well as valuable rig time to remove and replace the segments. With LabVIEW RT, users can deterministically control torque in the pipe joints.

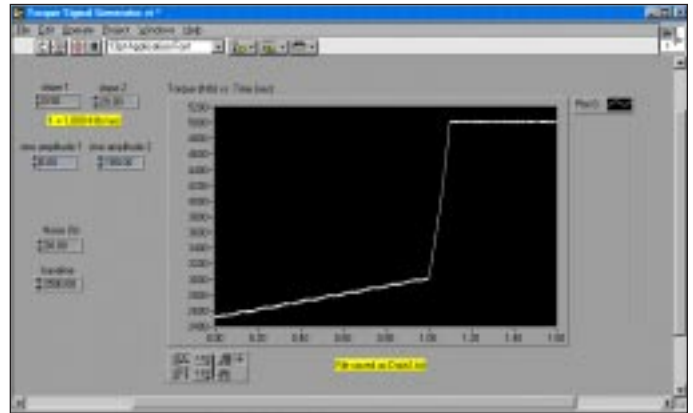
**Torque and Joint Connections**  
The rig operators must achieve a specified torque for each joint connection. Depending on pipe size, this value ranges from 2,400 to 12,000 ft-lb of torque; the allowable tolerance ranges are from  $\pm 20$  ft-lb to  $\pm 100$  ft-lb of torque. Hundreds of connections per day are made on a single operating rig, so users cannot tolerate failures because of the high costs involved. For this particular application, two sections of pipe are spun together at 10 to 30 RPM. The torque during this portion of the operation typically rises at a rate of 500 to 2,000 ft-lb per second because of the tightening of the pipe threads. When

a metal “shoulder” on each of the segments makes contact, the torque jumps upward sharply, rising at rates up to 20,000 ft-lb per second. This is where the control system must determine the correct time to open the solenoid for the hydraulic motor on the power tong, so that correct final torque is achieved. The hydraulic system will have a latency of 15 to 20 ms between solenoid activation and stopping rotation at the final torque value.

*The real-time version of LabVIEW, LabVIEW RT, now gives us the opportunity to build complex applications using very high-level graphical languages with the knowledge that we can achieve robust, reliable, real-time control during every operation.*

A control system for joint coupling has historically been built using a combination of dedicated hardware circuits for control, PC-based software such as LabVIEW for data reporting and storage, and an operator display screen for monitoring both quality and productivity. General-purpose operating systems have not allowed deterministic control with timing in the range of 1 to 10 ms, because of the variety of other tasks they must accomplish, such as networking and file I/O.

**LabVIEW for Reliable Control**  
The real-time version of LabVIEW, LabVIEW RT, now gives us the opportunity to build complex applications using very high level graphical languages, and know that robust, reliable



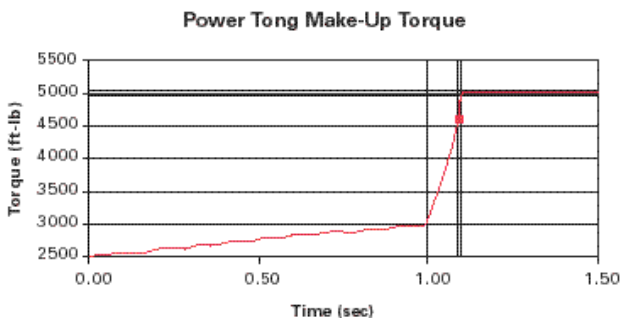
The graph shows how a real-time control system accurately controls torque.

control will be achieved during every operation. The job of the LabVIEW RT software is to calculate the correct time when the solenoid must be opened, so that the final torque value is achieved within the specified range. This requires a software loop operating deterministically at 1 to 2 ms per iteration. In this control loop, we measure the input signal, compute the final torque to be achieved, and generate a control output signal if required. The computation portion of the control loop must cope with widely varying ramp rates, varying signal to noise ratios, and other variations in the overall system. The factors that make LabVIEW RT so well suited for this application are as follows:

- Deterministic timing of software operations down to 1 millisecond resolution
- Simple integration of data acquisition hardware – inputs and outputs
- Complex software operations easily implemented using graphical programming methods
- Easy merging of the real-time control portion of the software, with routine operations such as data storage, display and reporting

**For more information, contact Steve Conquergood, Advanced Measurements Inc., 6205 10th St. S.E., Calgary, AB, T2H 2Z9, Canada, tel (403) 571-7273, fax (403) 571-7279, e-mail [info@advmeas.com](mailto:info@advmeas.com), Web [www.advmeas.com/advmeas](http://www.advmeas.com/advmeas)**

Visit [www.natinst.com](http://www.natinst.com)



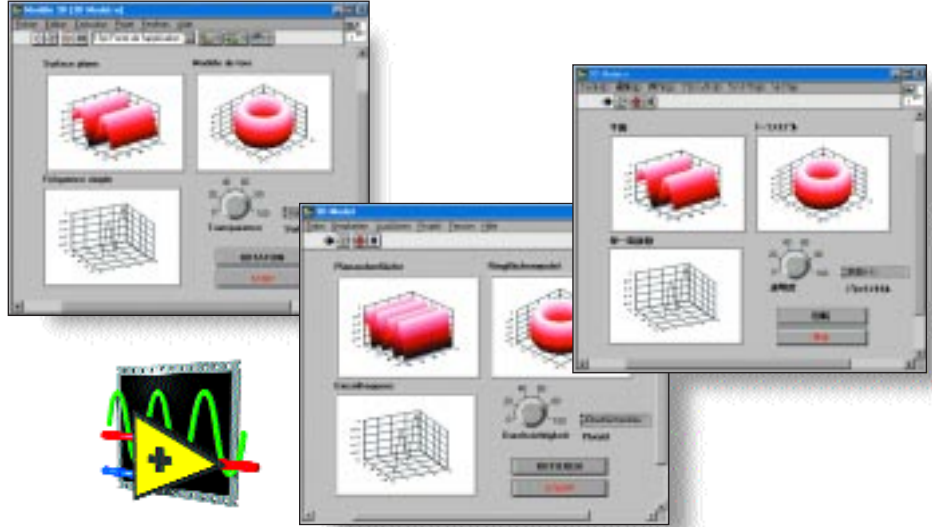
The diagram shows a typical profile of torque vs. time during a pipe connection.

## LabVIEW 5.1 Now Localized in German, French, and Japanese!

National Instruments is proud to announce new localized French, German, and Japanese versions of LabVIEW 5.1. Now, engineers and scientists who speak German, French, and Japanese can improve their productivity using LabVIEW 5.1 in their native language.

A Japanese version of LabVIEW was first introduced in 1997, with French and German versions following in 1998. Thousands of users are now taking advantage of these international versions, speeding and easing their application development.

Professor Norbert Dahmen of the University of Applied Sciences in Krefeld, Germany, says, "A teacher without LabVIEW is like a painter without colors. With the German version of LabVIEW, teaching has become even easier for us. Our experience shows that we can communicate even the most challenging technical phenomena easily. In this regard, the German version of LabVIEW has become indispensable."



National Instruments LabVIEW is now available in French, German, and Japanese.

Hirotake Watashima of Quattro Systems noted that the Japanese version of LabVIEW provides a "great way to learn about instrumentation and analysis. The Japanese (translation) reads much more naturally in this version."

LabVIEW 5.1 French, German, and Japanese localized versions are available on Windows NT/98/95. LabVIEW 5.1 Japanese is also available for the Power Macintosh. ▶

Visit [www.natinst.com/labview](http://www.natinst.com/labview)

## Reusing LabVIEW Code in LabWindows/CVI

LabVIEW and LabWindows/CVI are consistently chosen as the development platform for measurement and automation. As their popularity increases, companies are beginning to incorporate both environments into their development groups. When this happens, code

reusability becomes increasingly important to save time and money. For example, the following paragraph and diagram illustrate how to call a LabVIEW virtual instrument (VI) from LabWindows/CVI.

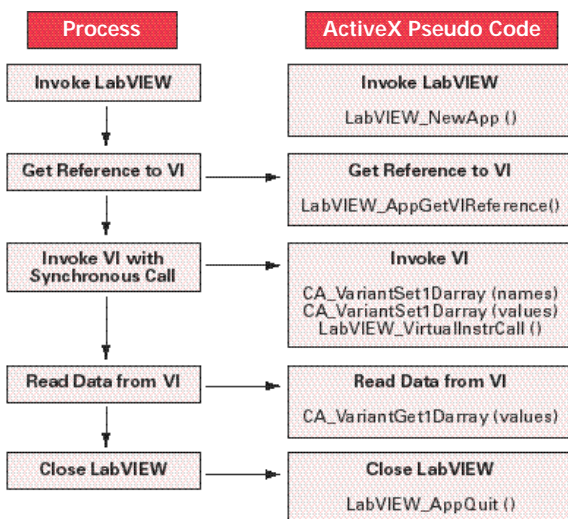
The communication path between LabVIEW and LabWindows/CVI is implemented using ActiveX automation. The process diagram shows the steps needed to communicate with LabVIEW. The pseudocode diagram lists the function calls used to implement each step of the process. Calling a LabVIEW VI requires that you have LabVIEW installed on your machine. The first steps in reusing a VI are invoking the LabVIEW development environment and obtaining a reference to a VI. The next step is to invoke the VI, but before that can happen, you must build two variant arrays. One array includes the parameter

names, and the second array includes the values you are passing to the VI. (A variant is not a data type most programmers are familiar with unless you have previously worked with Visual Basic or ActiveX automation.) You can either synchronously or asynchronously invoke the LabVIEW VI. In this example, we call the synchronous function before we obtain the result from the variant array.

The LabWindows/CVI ActiveX Automation Wizard simplifies ActiveX automation. It converts any registered ActiveX server into an instrument driver, a library integrated into the LabWindows/CVI environment. In this example, the wizard can generate the library used to communicate with LabVIEW. ▶

**For more information about calling LabVIEW code from LabWindows/CVI and examples of safe arrays, go to [www.natinst.com/info/reuse](http://www.natinst.com/info/reuse)**

Visit [www.natinst.com/labview](http://www.natinst.com/labview)



Steps Needed to Communicate with LabVIEW

# Customer Education Goes Online with Expanded Web Site

This spring, National Instruments Customer Education released a new Web site, making it possible for you to quickly find the courses you need.

The Web is a powerful medium for National Instruments Customer Education. Our new search engine gives you the ability to intuitively find courses that meet your needs. Pre-registration for Customer Education courses is also now available, facilitating accurate enrollment in classes after just a few clicks.

In addition, we include a sample of the National Instruments interactive LabVIEW Basics and Advanced CBTs that you can download.

A very exciting new product is the LabVIEW Advanced-Interactive computer-based training (CBT). This new product, in addition to the LabVIEW Basics-Interactive CBT, forms the LabVIEW training suite. We designed this kit to take a user from basic Windows abilities to a full LabVIEW programmer. Because it is self-paced, you can take this course at a pace appropriate to your skills. This suite also provides an excellent refresher for the LabVIEW Basics I, II, and Advanced courses.

This spring saw an explosion of new courses. Many of the newest National Instruments products are taught in our classrooms including TestStand and new features in LabVIEW 5.1. In addition, the National Instruments IVI course made



National Instruments now features online registration via our Web site.



an entrance. For detailed outlines on courses, please see our Web site at [www.natinst.com/custed](http://www.natinst.com/custed)

This spring, we also released a new version of LabWindows/CVI Basics II, with new topics such as OpenGL, Advanced User Interface programming, ActiveX, and dynamic link library (DLL) debugging. This course is designed to

complement the new LabWindows/CVI Basics I course.

In late spring, we introduced LabVIEW Instrument Control, a course structured to help you design your project from sensor to a complete LabVIEW instrumentation program.

Visit [www.natinst.com/custed](http://www.natinst.com/custed)

# Customer Education Courses Offered During NIWeek

Extend your NIWeek experience by attending a National Instruments Customer Education course! We conveniently scheduled courses before and after NIWeek so you can build on the knowledge gained during NIWeek sessions, presentations, and hands-on workshops.

For more information or to preregister for a course, visit our Web site at [www.natinst.com/custed](http://www.natinst.com/custed) or contact us at (800) 433-3488.

Visit [www.natinst.com/custed](http://www.natinst.com/custed)

	Monday	Tuesday	Wednesday	Thursday	Friday
August 9-13	LabVIEW Basics I (3 days)			LabVIEW Basics II (2 days)	
	LabWindows/CVI Basics I (3 days)			LabWindows/CVI Basics II (2 days)	
	G Primer (2 days)		BridgeVIEW (3 days)		
	LabVIEW Basics I en Español (3 days)			LabVIEW DAQ en Español (2 days)	
August 16-20	TestStand (2 days)		LabVIEW Basics I (3 days)		
	LabVIEW DAQ (2 days)				
	Lookout™ (2 days)				
	LabVIEW Machine Vision, and Image Processing (2 days)				
	Lookout en Español (1 day)	Alliance Day	NIWeek 99	NIWeek 99	NIWeek 99
August 23-28	LabVIEW Advanced I (3 days)			LabVIEW Signal Processing (2 days)	
	IVI Development Course (3 days)			TestStand (2 days)	
	LabVIEW Adv. I en Español (3 days)			VXI en Español (2 days)	

## Certification Program Up-and-Running

National Instruments recently validated the first LabVIEW programmers for their knowledge by issuing the National Instruments



Certified Programmer (NICP) certificate to three LabVIEW programmers in the Netherlands. The NICP program gives users the opportunity to

distinguish themselves from others, giving

them the competitive edge. To become a National Instruments Certified Programmer, candidates must first take an exam.

The first National Instruments Certified Programmers are employed by Alliance Program members AIR Technical Automation and INCAA Computers. ▸

**For more information, visit [www.natinst.com/custed/cecp.htm](http://www.natinst.com/custed/cecp.htm)**

Visit [www.natinst.com](http://www.natinst.com)

## National Instruments Opens Greece Branch

To better serve the Mediterranean area with our computer-based measurement and automation tools, National Instruments opened a new branch in mid-March. This creates an opportunity to provide customers in Greece with the same high-quality service and direct support as any other European country.

The branch, located in Piraeus, is led by Michael Petrolekas. ▸

**Contact the National Instruments Greece office at National Instruments Hellas, B' Merarchias 17, 185 35 PIREAS, tel/fax +30 1 42 96 562, e-mail [ni.greece@natinst.com](mailto:ni.greece@natinst.com)**

## LabVIEW Wins Product Awards From T&M World and NASA Tech Briefs



LabVIEW 5.0 graphical instrumentation software won the 1999 Test Product of the Year Award from *Test & Measurement World* magazine. The magazine's editors deem 10 products Best in Test, then the magazine's readers select from the Best in Test winners to choose Test Product of the Year. LabVIEW is the only product in the history of the awards to have been voted Test Product of the Year twice (1999 and 1993).

LabVIEW 5.0 is also *NASA Tech Briefs'* Product of the Year, receiving the gold award for first place. It was also honored as the *NASA Tech Briefs'* Product of the Month for February 1998. Products of the Month are selected by *NASA Tech Briefs* editors, while Product of the Year is selected through a reader poll. ▸



## Worth Reading

"BridgeVIEW-Based System Updates Ford Motor Company Crash Test Simulator," by David Hoadley, Customer Solutions article, February 1999. **A1281**

"BridgeVIEW Expert System Improves Batch Processing Efficiency," by John Van Doren, Customer Solutions article, January 1999. **A1284**

"Lookout Provides Island-Wide Monitoring of Wastewater Systems," by Chris Cunha, Customer Solutions article, January 1999. **A1290**

"Automated Silicon Wafer Measurement Using IMAQ and LabVIEW," by Arin W. Sime, Customer Solutions article, January 1999. **A1287**

"BridgeVIEW Monitors Natural Gas Pipelines," by Thierry Warpelin, Customer Solutions article, January 1999. **A1371**

"How to Choose a Data Acquisition Platform," by David W. Madden and Michael R. Steed, *Desktop Engineering*, September 1998. **A1343**

## High-Speed Data and Images Stream to Disk

**B**oulder Instruments, an Alliance Program member, is now shipping XLRWrite high-speed disk recorders. When combined with National Instruments data and image acquisition products, XLRWrite overcomes the limitations of acquiring data to system disk or memory. XLRWrite can extend acquisition lengths to several minutes or even hours of continuous recording.

Interfacing to XLRWrite is as simple as plugging it into the same PCI bus with the DAQ board. Using function calls from NI-DAQ™, NI-IMAQ™, and the XLRWrite Software Development Kit (SDK), you can easily configure a hardware data transfer to XLRWrite. Once started, the data moves between cards across the PCI bus, isolated from system memory and OS bottlenecks. Once recorded, users can easily retrieve data for playback or analysis.



For example, an XLRWrite D3-X2 can record all four channels from the National Instruments PCI-6110E at 5 MS/s each (40 Mbytes/s) for 30 minutes. With the PCI-6110E in pre-trigger mode, the D3-X2 continuously records data and retains the most recent 30 minutes defined by the trigger. Models are available with sustained rates from 240 Mbits/s to 800 Mbits/s and capacities from 15 GB/s to more than 225 GB/s.

XLRWrite is easily integrated into LabVIEW, LabWindows/CVI, or customer user applications. XLRWrite includes examples for LabVIEW, NI-DAQ, and NI-IMAQ. XLRWrite also includes a Windows dynamic link library (DLL) and drivers for Windows NT and Windows 95.✶

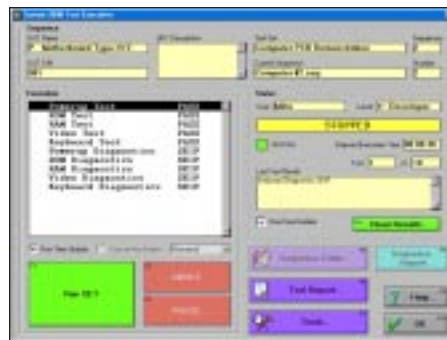
**For more information, contact Boulder Instruments LLC, 1823 Sunset Place, Ste. D, Longmont, CO 80501, tel (303) 440-7327, fax (303) 440-7329, e-mail info@boulderinstruments.com**

## NI-Based Functional Test Platform

**F**or manufacturers of electronics boards, units, and complete systems who want to automate functional test and reduce setup costs, the ATM System 2000TS is a functional test platform that offers test equipment that is easy to program, operate, and configure using PXI, GPIB, TestStand, and LabVIEW or LabWindows/CVI. The ATM System 2000TS is a standard functional test platform with predefined fixture interfaces and a standard software front end.

Using the System 2000TS platform, you can design, debug, and commission complete functional test systems faster than "home-grown" systems. The TestStand software serves as the 'engine' in the System 2000TS, so you can generate test VIs in LabVIEW, LabWindows/CVI, C++, or Basic.

The System 2000TS offers a fully integrated package with diagnostics, results database, SPC, network support, automated handling, vision, and more. The system includes large existing libraries of test



routines for use in many types of industries. You can even customize systems to include a fully automated handling capability using SMEMA conveyors.✶

**For more information, contact David Hall, Advanced Test Methods, Clearglen House, 151 Frimley Road, Camberley, Surrey, GU15 2PS, England, tel (44) 0 1276 692371, fax (44) 0 1276 675910, e-mail atmethods@aol.com, members.aol.com/atmethods/homepage**

## Mini-Lab Simplifies Laboratory Automation

**A**cquired Data Solutions, an Alliance Program member, is offering the SmarTesterPC Mini-Lab, designed for the water, wastewater, chemical, food, and pharmaceutical industries. The Mini-Lab integrates and controls testing that previously required numerous separate instruments. The system can collect data from analog sensors and incorporate wet chemistry testing methodologies. The system displays data in real time, performs historical statistical analysis, and stores data into any popular spreadsheet or database program.

Using LabVIEW and data acquisition (DAQ) hardware in a PL or PXI form factor, the Mini-Lab can accept multiples of eight sensors such as pH, oxygen, temperature, pressure; control multiples of 24 AC and DC relays; and incorporate a precision syringe pump for titrations. Plus, you can configure the unit as a spectrophotometer and/or as a respirometer. The system has built-in sensor calibration routines that you can archive with the test data. If necessary, you can customize the Mini-Lab to control such processes as changing flow, heating/cooling, and stirring.

The Mini-Lab saves and archives test data through ODBC and SQL into more than 30 different database formats. The system has a wide variety of data display options incorporating control charts, process statistics, and Pareto analysis. This includes histograms, X-bar and R Charts, a variety of plots, and calculations.✶

**For more information, contact M. J. Epstein, Acquired Data Solutions, Inc., 807 Summerfield Avenue, Asbury Park, NJ 07712, tel (732) 988-5560, fax (732) 502-0526, e-mail acquiredata@acquiredata.com, www.acquiredata.com**

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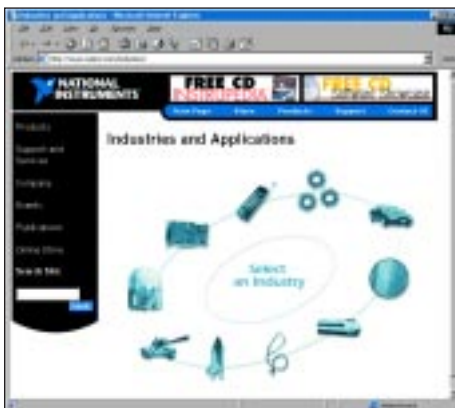
## New Industry Solutions Web Site Highlights Applications and Systems

This spring, National Instruments unveiled a new Industry Solutions section of our Web site, [www.natinst.com/industries](http://www.natinst.com/industries), that highlights computer-based measurement and automation solutions in a wide variety of industries. The new section is designed from the user's perspective, with industries segmented in a useful way to make it easy for you to delve into specific application areas. On the new site, it takes just a few clicks of the mouse for you to familiarize yourself with products and systems available for your particular application.

At the top level, you can choose from 10 different industries, including specific categories such as automotive, telecom, semiconductor, and biomedical, as well as more general categories like electronics, process industries, and manufacturing. Within each category, you will find the industry subdivided into major application areas. For example, the Automotive site is subdivided into powertrain, body and chassis, tires and brakes, and so on. Featured within each subcategory are three additional divisions – customer solutions, NI-based systems, and NI components.

### Customer Solutions

The customer solutions section of each industry feature application stories from your colleagues. For instance, one of the customer solutions in the Automotive, Tire and Brakes section is "Simplified Wheel Spindle Bearing Testing with LabWindows/CVI" by Charles P. Puzemis, Senior Experimental Engineer, Delphi Chassis Systems Division of GM. This, like other customer solutions on the site, discusses a particular measurement



*National Instruments new Industry Solutions Web site provides the opportunity to familiarize yourself with products and systems available for your applications.*



and automation challenge, the solution that was created, the result, and the National Instruments products that helped make the solution a reality.

### NI-Based Systems

Click on the NI-Based Systems section of an industry page, and you will find information on pre-configured systems available from our Alliance Program members. For instance, one of the NI-based systems in the Automotive, PowerTrain section is the DynoLAB dynamometer test cell controller from SAKOR. After you peruse the details of a system, the Web page offers you contact information and a direct link to the system developer's own site for more NI components information.

If you are seeking information for an application you are developing, the NI Components sections of each industry page offer recommended products for particular applications. For instance, the Automotive, Body and Chassis section recommends particular data acquisition

and signal conditioning hardware for building a block cycle controller for hydraulics testing. These pages may also include application notes and examples to help get you started.

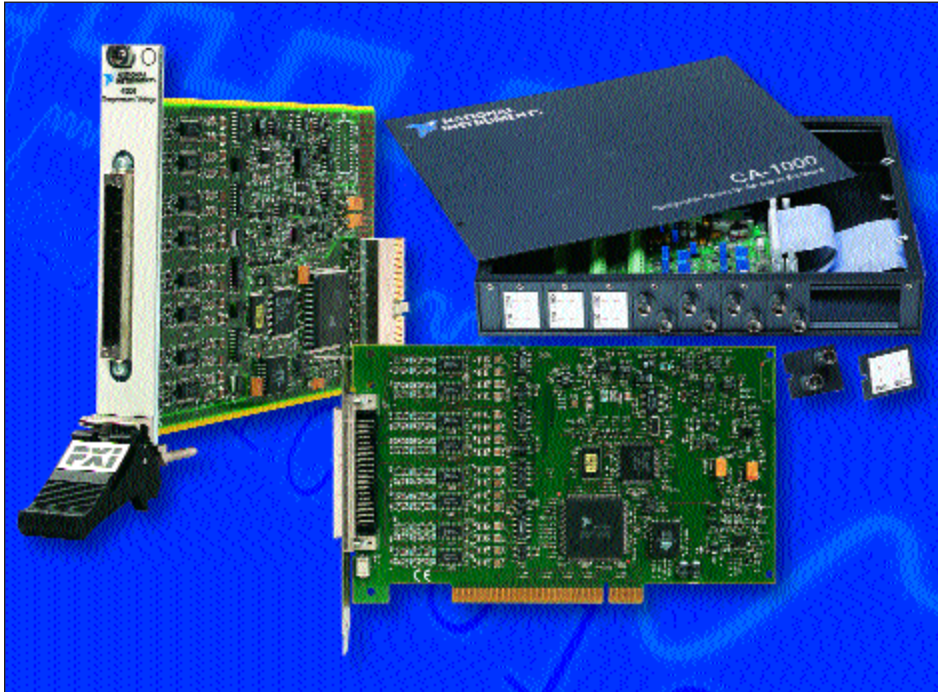
### Just the Beginning

Of course, this new site will continue to expand as we identify additional Customer Solutions, NI-Based Systems, and NI Components. Although the new Industry Solutions site offers a faster, better way to deliver the industry-specific information you're seeking, it is also an excellent opportunity for you to showcase your own applications and solutions. If you are interested in submitting a customer solution or other material for the site or have additional suggestions, please send an e-mail to [industries@natinst.com](mailto:industries@natinst.com) ✎


**For more information, check Customer Solutions packet on the reply card.**

Visit [www.natinst.com/industries](http://www.natinst.com/industries)

## Make High-Precision Temperature and Voltage Measurements



National Instruments NI 4351 family for CompactPCI/PXI and PCI makes it possible to create temperature and voltage measurement systems that perform faster, lower costs, and are easily integrated. **Read more on page 13.**

 This newsletter represents a commitment from National Instruments to the environment.

## National Instruments Founder Named One of "The 50 Best CEOs" in America

*Worth Magazine* has recognized the President and CEO of National Instruments, Dr. James Truchard, as one of the 50 best CEOs in the country. More than 100 Wall Street analysts were asked to submit nominations based on the question, "If you had to entrust your personal nest egg to just one or two CEOs, whom would you give it to?" Truchard was chosen for leading National Instruments sales and products on an "upward slope" and steering the company to its 22nd consecutive year of double-digit growth. Since starting the company in a room behind his garage in 1976, Truchard has built National Instruments into a leader in computer-based measurement and automation.

The *Worth 50* were selected for their integrity, vision, ability to focus, a willingness to take strategic risks, and a belief in themselves and their companies as demonstrated by reinvesting corporate resources and tying their personal fortunes to their enterprises. ▶

## Trade Shows Look for the National Instruments booth at these upcoming trade shows:

<b>Automation Test Instrument Exhibition</b>		<b>MessTechnik</b>		<b>ICACS</b>	
China	June 1-5	Munich, Germany	June 23-24	Denmark	August 7-8
<b>SuperComm</b>		<b>Sound &amp; Vibration</b>		<b>NIWeek</b>	
Atlanta, GA	June 6-10	Denmark	July 5-8	Austin, TX	August 17-20
<b>Nepcon East</b>		<b>Int'l Equipment on Automotive</b>		<b>AutoTestCon</b>	
Boston, MA	June 15-17	Beijing	July 6-10	San Antonio, TX	August 31-Sept. 2
<b>IEEE- MTT-S</b>		<b>Hokkaido Measurement Exhibition</b>		<b>Ineltec Basle</b>	
Anaheim, CA	June 15-17	Japan	July 14-15	Switzerland	August 31-Sept. 3
<b>ASEE</b>		<b>Semicon West</b>			
Charlotte, NC	June 21-23	San Jose, CA	July 14-16		

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