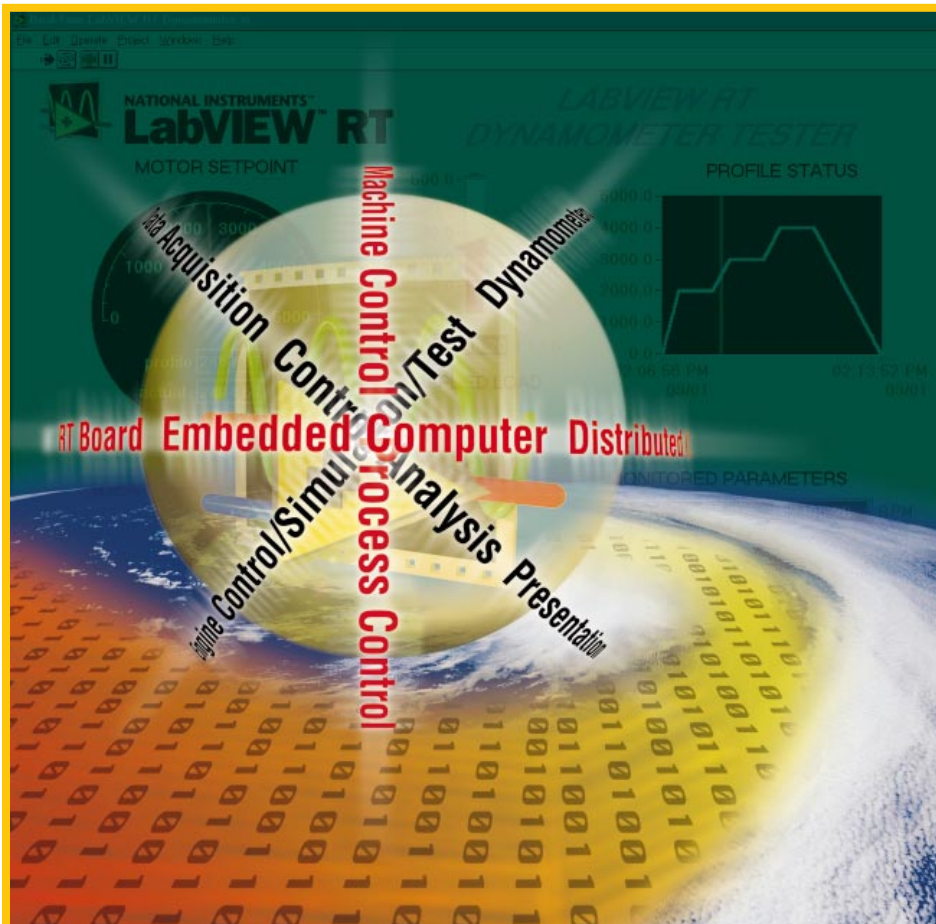


Instrumentation newsletter™

Technical News from National Instruments

Fourth Quarter 1999



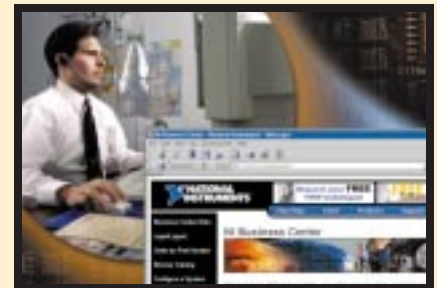
Real-Time and Embedded Technologies Enter Mainstream with LabVIEW™ RT

LabVIEW graphical programming, an integral technology in the Measurement Revolution, is now part of our strategy to deliver ease of use and scalability to real-time and embedded development.

More than a decade ago, virtual instrumentation began changing the landscape of measurement and automation, moving the industry from stand-alone proprietary systems to computer-based, off-the-shelf solutions. National Instruments LabVIEW RT and RT Series data acquisition (DAQ) hardware comprise the initial step in a long-term plan to deliver the best productivity possible for real-time and embedded measurement and automation.

For many companies, deterministic real-time control and embedded systems often generate the most expensive development costs of an application. Developing these applications – for engine control, machine monitoring, process control, and so on – requires in-depth knowledge of deterministic real-time and embedded tools, expert development in register-level programming, and custom hardware. This solution is difficult to maintain,

continued on page 4



The Measurement Revolution Reaches the Web

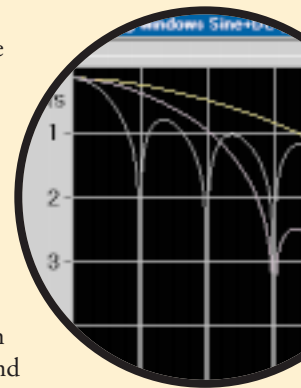
The Web is more than online product brochures and contact information – it is a vital communications link between you and the companies with which you do business. National Instruments introduces the NI Business Center™ – your online resource when conducting

continued on page 6

Fast, Accurate DC and RMS Measurements

While it is widely understood that there is a tradeoff between measurement speed and accuracy, it is less clear how they can vary depending on your choice of measurement techniques.

Here, we focus on techniques for DC and RMS measurements. You use DC measurements for static or slowly moving signals, such as temperature,



continued on page 8



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Here's What You Missed...

- Reading how the Measurement Revolution transformed test and measurement
- Learning about a cost-effective and time-saving design architecture for measurement and automation
- Comparing network measurements systems appropriate for various situations

...If You Missed the Last Issue.

For more information, check the appropriate past newsletter issue on the reply card.

www.ni.com/reference

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ni.com – The Source for Computer-Based Measurement and Automation

Over the past year, many changes have occurred in the measurement and automation world. By this time, many companies including National Instruments, are focusing more heavily on the Web.

We continue to look to the Web to provide better service and support for our customers. In October, we successfully launched www.ni.com, the “new” address for computer-based measurement and automation information, solutions, and support. Our former address, www.natinst.com, will continue to work indefinitely, but we encourage you to bookmark ni.com for future visits to the National Instruments Web site. At our NI Business Center, www.ni.com/business, you can check the status of your order, support request, and more (see pages 6 and 7 for more information).

Serving Our Global Measurement and Automation Community

We are committed to providing the best tools for measurement and automation

worldwide. In 1999, we launched our online store at www.ni.com/store where you can buy products 24 hours a day, seven days a week, in dollars, euro, or yen. In November, we took the store to the next level. We

A fully localized user interface makes it easy for Japanese customers to navigate through our Online Store and obtain product, pricing, and shipping information.

announced the localization of National Instruments Japan Online Store – www.ni.com/jp/store A fully localized user interface makes it easy for Japanese customers to navigate through our Online Store and obtain product, pricing, and shipping information. In addition, we offer complete instructions in Japanese on how to purchase National Instruments products. To learn more about these products, customers can view specifications and Japanese data sheets on our popular products such as LabVIEW, GPIB, and data acquisition. We have integrated our online product catalog with the Online Store, so our Japanese customers have the information they need at their fingertips.

Japanese customers can use the Online Store to easily purchase National Instruments computer-based measurement and automation products to:

- Increase productivity
- Save time
- Save money

As usage of the Internet grows, the localization of the National Instruments Japan Online Store is one more way that ni.com has become the source for measurement and automation. ▶

John Graff, VP Marketing



View specifications and order products in Japanese from our localized National Instruments online store.

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Building an Integrated Measurement Machine

When you need to combine diverse measurements, analysis, imaging, and motion control to make a system or machine that manufactures, tests, and measures, National Instruments helps you do this with PC technology.

Several key technologies can simplify your measurement integration. The best way to understand how they work together is to consider the development process.

Step 1. Install Hardware, Software, and Connect

A consistent software installer and simple connectivity are important in creating a measurement machine. If you need to synchronize data acquisition with motion control or image acquisition, you can connect the real-time system integration (RTSI™) bus across the hardware. Triggering and synchronization between measurements can be challenging and the key to implementing many advanced applications. For example, using the RTSI bus, you can trigger a move with a motion control board and then route a trigger to the DAQ board to take a signal measurement.

Step 2. Is It Working?

With National Instruments hardware, such as GPIB, data acquisition, image acquisition (IMAQ™), and motion control, you can use the Measurement & Automation Explorer (MAX) to quickly test connectivity, acquisition, and control. In addition, you can rapidly display signal, image, and data results. You can use MAX to configure the features

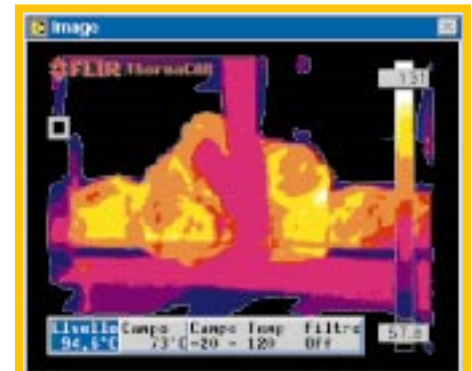
of your boards in a consistent manner – for data acquisition this may mean setting the input for differential signals and for IMAQ this could mean setting the board for RS-170 camera input. The goal of MAX is delivering a consistent interface for managing and configuring all your measurement devices.

Step 3. Start Programming

LabVIEW and our driver software give you a common software platform for numerous types of measurements. For example, the NI-DAQ™ and NI-IMAQ™ driver software application programming interfaces (API) are very similar. If you know how to use our DAQ driver software, you can use this knowledge with product lines such as IMAQ, motion control, and GPIB. In addition, our driver software is scalable. The same function, IMAQ Snap, can acquire an image from a low-cost monochrome camera, a color camera, and a high-resolution digital camera. MAX simplifies configuration and test and reduces code rewrite when you want to move between hardware products in the same product line. In addition, your integrated measurement environment needs to have an open architecture. From LabVIEW you can call dynamic link libraries (DLLs) and interface ActiveX controls. Other programming benefits include logically named functions and consistent parameter names, attributes, examples, and error handling.

Step 4. Call One Company for Technical Support (If Necessary)

When you choose National Instruments motion control, vision, and DAQ products,



LabVIEW, DAQ, and IMAQ control plastic manufacturing.

you have one source to answer all your technical questions. National Instruments offers technical support on the Web and over the phone.

Creating Your Own Measurement Machine

The overall benefits of an integrated measurement system are simple:

- Higher performance
- Lower cost
- Better systems integration
- Increased developer productivity

John Hanks, Vision and Motion Product Manager
E-mail john.hanks@ni.com

For more information, check PC-Based Vision Solutions Booklet on the reply card.

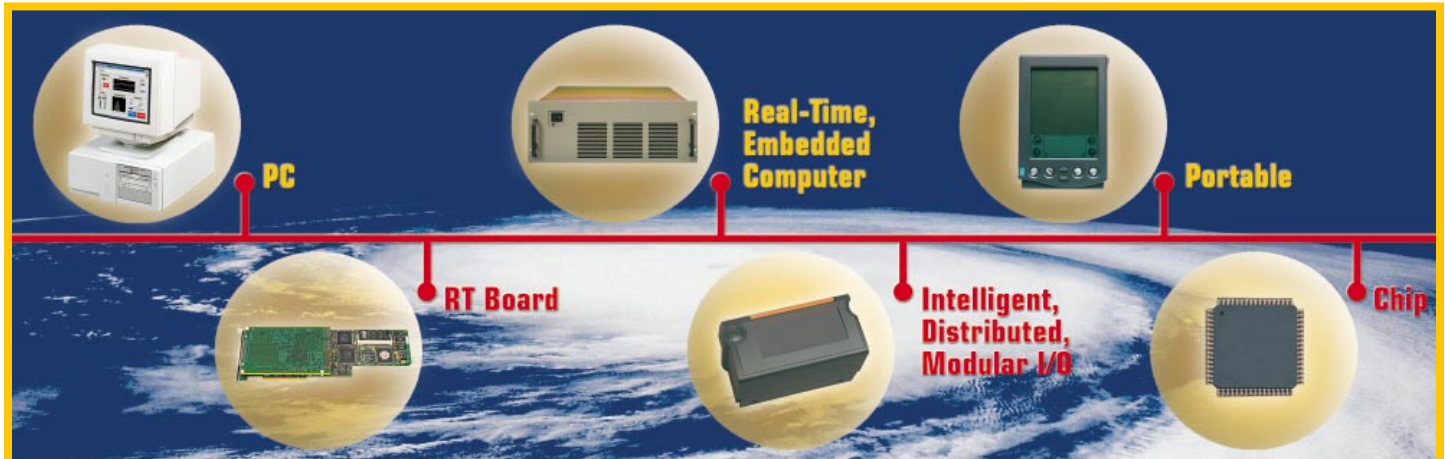
www.ni.com/vision

DAQ, Motion Control, and Vision Working Together

When you put all of these steps together, you have an integrated system. For example, Ignazio Piacentini, an Alliance Program member in Italy, recently developed a measurement machine for automating the manufacturing of plastic sheets. The NI-based system uses a FLIR Systems infrared thermal camera and IMAQ hardware to measure the amount and temperature of plastic placed in amorphous blobs onto two rolling pins and DAQ hardware to measure the temperature of the rolling pins. A PID

loop controls the amount and temperature of the plastic placed on rolling pins. Gravity pulls the raw plastic blob through the rolling pins, producing plastic sheets. National Instruments motion control hardware precisely controls the spin needed. The system, which uses DAQ hardware, measures the pressure between the rolling pins and the temperature of the pins, both critical to the manufacturing process. This system is accurate and reliable, reducing overall cost and improving product quality.

Real-Time and Embedded Enter Mainstream with LabVIEW RT



As we expand our product offering, we focus on seamless integration, scalability, productivity, and ease of use.

continued from page 1

hard to integrate with other systems, and cannot easily scale for future use.

Companies should expect development tools to adapt to changing requirements. National Instruments computer-based measurement and automation tools meet these needs by transforming real-time and embedded development with easy-to-use scalable solutions that take advantage of the power of industry standards driven by PC technology.

Develop with Easy-to-Use Software

Faster software development requires easy-to-use, high-level software tools such as LabVIEW. The simplicity of LabVIEW graphical programming overlays a powerful, 32-bit multithreaded compiler and a deep language structure to solve the

LabVIEW RT software scales across measurement options, platforms, performance, and more to meet diverse real-time and embedded requirements.

most complex applications for measurement and automation. With the advent of LabVIEW RT, you can now use this same programming paradigm to solve real-time measurement and automation applications. Just as LabVIEW makes powerful technologies such as multithreading and

ActiveX simple to use, LabVIEW RT automatically takes care of many of the programming details of real-time development. The development environment handles the intricacies so you can concentrate on solving the application.

Not only does easy-to-use software increase the productivity of engineers currently developing real-time and embedded applications, but it also empowers more engineers to do the same. Engineers familiar with LabVIEW development can take care of real-time needs.

Integrate Seamlessly with Hardware

Another advantage of LabVIEW RT is its strong integration with measurement hardware. Programming National Instruments intelligent processor-based RT Series DAQ boards is the same as programming desktop data acquisition in LabVIEW. You can quickly extend your existing experience developing computer-based measurement and automation systems into real-time and embedded development. As we expand our product offering in this arena, we continue to focus on integrating seamlessly with a variety of measurement and automation hardware to give you the flexibility you need to solve any custom application.

Take Advantage of Open Architecture and Industry Standards

LabVIEW open architecture delivers connectivity to a multitude of hardware and software industry standards, including the Internet, ActiveX, OLE for process control (OPC), PCI, RS-485, and many more. As networking and connectivity increase in PC-based measurement and automation, real-time and embedded components more frequently face integration issues. The connectivity of LabVIEW can effortlessly solve these integration issues, as development of real-time and embedded components is included in its open standard environment.

In addition, personal computing technologies continue to shift. Microsoft targets real-time and embedded with its next generation Windows CE and Windows NT Embedded (NTE) operating systems (see page 18 for more details). An emerging standard in embedded systems is the Intel Pentium-class processor. National Instruments hardware and software continue to take advantage of industry-standard PC technologies to bring you the best possible solution for your needs.

Maintain, Scale, and Expand with Ease

Often, developing custom hardware and software for real-time and embedded applications can result in systems difficult to maintain for a long-term investment. For example, creating hardware from low-level components can require dependence on the

life cycles of chips. The initial cost of goods for various chips and I/O components may be less than the off-the-shelf solution that LabVIEW RT and RT Series hardware offer. However, the development cost and long-term maintenance and scalability of the

provide a better long-term investment.

Because you often develop software for a specific real-time application, any hardware design change or update can require a complete rewrite. With LabVIEW RT, you can integrate hardware and software and scale your application to various platforms. In the future, we expect to easily scale from the desktop systems and intelligent boards we have today to embedded real-time computers distributed modular rugged I/O; hand-held targets;

National Instruments LabVIEW RT and RT Series DAQ hardware comprise the initial step in a long-term plan to deliver the best productivity possible for real-time and embedded measurement and automation.

custom system can cost much more. Debugging and troubleshooting these custom systems or simply installing them may require expert knowledge. With LabVIEW RT and RT Series hardware, you have ease-of-use and off-the-shelf tools that

and much more. The LabVIEW RT software works across measurement options, platforms, performance, and more to meet diverse real-time and embedded requirements without sacrificing the ease of expandability for the future.

Simplify Application Development

LabVIEW RT and RT Series hardware are easy to use and offer seamless integration, scalability, and increased productivity. Moreover, the open architecture environment provides connectivity to a variety of industry standards, making it the best choice for real-time, embedded control. ✎

Norma Dorst, Embedded and Real-Time Product Manager
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For more information, check the LabVIEW RT brochure on the reply card.

www.ni.com/realtime

Easy Real-Time Development with LabVIEW RT

With LabVIEW RT, you can develop your application using graphical programming in the familiar Windows environment and then download your code to run embedded on an independent real-time target. Today, that real-time target is an intelligent DAQ board that plugs into a standard desktop PC or PXI™/CompactPCI system.

Because LabVIEW is a multithreaded platform that makes parallel execution of code intuitive and easy, it is a natural step to divide your application into non-real-time components and mission-critical real-time components. You can develop your Windows application as usual to display data, store data to files, share data across the Internet using the LabVIEW built-in Web server, and other tasks. At the same time, because you can download LabVIEW code to run on a real-time target, you can have critical control code running on the processor of the DAQ board itself. The board runs your LabVIEW program using the LabVIEW RT core execution engine running on a real-time operating system, completely independent of desktop Windows. However, because it is LabVIEW, you have seamless integration with the real-time I/O. You can debug and communicate with the board in the same way that you have always done with LabVIEW. Using Application Builder, or the LabVIEW RT

Professional Development System, you can also deploy stand-alone executables with your intelligent real-time DAQ boards, free of charge.

The operation of your real-time code not only gives you deterministic real-time control with accuracy on the order of microseconds for every loop cycle, but also provides the reliability of an independent processor. You can crash and reboot your host desktop machine executing the non-real-time components of your application while your real-time code continues to run on the board.

The ease of use of LabVIEW graphical programming, combined with its tight integration to a wide range of hardware, makes it ideal for extending to real-time and embedded development for computer-based measurement and automation. ✎

For more information, check the LabVIEW RT brochure on the reply card.

www.ni.com/labviewrt

The Measurement Revolution Reaches the Web



for purchase directly over the Internet.

In our Online Store, you can browse product specifications, compare products, and if you are not sure which products meet your needs, speak with a technical representative via online chat (or telephone). Using a purchase order or credit card, customers throughout the world can purchase in local currency and receive shipments directly from local National Instruments offices. Furthermore, we have secured the Online Store using Secure Sockets Layer (SSL), an industry-standard technology that encrypts sensitive information such as your credit card number. National Instruments has taken these security measures so you can be confident in the safety of your online transactions.

The Online Store is an interactive catalog where you can enter your required specifications and get a list of products that meet your needs. Because of rich searching capabilities, you can search for products by keyword, model name, or part number. The Online Store also includes “common configuration” tables that help

you order the correct cables and accessories. Links to related products – for example, links to signal conditioning products from data acquisition pages – help you build complete computer-based measurement and automation solutions. Once you have added products to your shopping cart, you can submit your order online, print and fax your order, or save your shopping cart if you need more time to make a purchasing decision. Within a few minutes, you receive an e-mail explaining how to retrieve your shopping cart, which you can then share with your purchasing agent, National Instruments sales representative, or a colleague.

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Top Industry Site

Discover for yourself why we received an A rating from *Business Marketing* magazine in its annual evaluation of the Top 200 Business-to-Business Web sites, placing National Instruments in the 11-50 group with Dell, Microsoft, and Compaq. And join the design engineers who participated in a recent *EDN Magazine* survey – results found the National Instruments Web Site the second most popular in the U.S. and Europe – ahead of Motorola, Texas Instruments, Lucent, and Microsoft. ✎

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Try a System Configurator

To help you find exactly what you need, we offer several system configurators online – DAQ Designer, PXI Configurator™, and Upgrade Advisor. Using these revolutionary Web-based tools, you can configure an entire measurement system or upgrade to the latest software for your application. Once you have completed the configurator, we present a list of recommended products, their specifications, and ordering information. Try our system configurators via the NI Business Center or access them directly at www.ni.com/config

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To help you find exactly what you need, we offer several system configurators online – DAQ Designer, PXI Configurator, and Upgrade Advisor.

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Fast, Accurate DC and RMS Measurements

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pressure, power supply voltage levels, and so on. Root mean square (RMS) measurements are used for dynamic signals and measure the energy present in noise, vibration, power in a load, and so on.

We can improve DC measurements by increasing the measurement time and averaging the measurements. However, you must evaluate the tradeoff in measurement time against the gain in measurement accuracy. Consider the following example. You can measure a DC signal of approximately 1 V corrupted by a sine tone in the 58 to 62 Hz range with a 100 mV peak to peak amplitude accurately to 1 ppm by averaging, but each measurement takes more than 10 minutes to complete. You can avoid this tradeoff with the proper measurement techniques. In this article, we introduce techniques that improve accuracy without sacrificing measurement time.

DC Error Sources

- **Noise** – this can be environmental noise, including the hum of power lines. Generally, noise is any AC signal that may be part of the nominal DC signal you are trying to measure.
- **Drift** – this refers to the drift in a signal caused by time and temperature variances between measurements.

RMS Error Sources

- **Offset error** – this is a DC signal that may be part of the dynamic signal you are trying to measure. Generally, amplifier offsets introduce this in the signal chain.
- **Noise** – this can be random noise, power line hum, or spikes caused by switching electronics in the environment.

Gathering information about your signal along with appropriate measurement techniques can help you improve your measurement speed and accuracy.

DC Measurements

For DC measurements, you should use an integration or averaging technique to improve your accuracy. In this case:

$$V_{dc} = 1/(t_2-t_1) \int_{t_1}^{t_2} V(t)dt,$$

where t_2-t_1 represents the integration or measurement time.

If your signal is a DC signal corrupted by a sine tone, such as power line frequency hum, you get the correct result from integrating or averaging measurements over an integer number of sine periods. However, you get the worst case error if you integrate

or average either $N + 0.5$ periods.

This error, caused by measurements over a fractional number of periods, decreases as the number of cycles used for integration, or measurement time, increases. The relationship between relative accuracy and measurement time is linear in this case. For example, to gain an extra digit of relative accuracy, you must increase the measurement time by 10X. The example on the left

has a DC input of 1 V corrupted by an AC sine tone of 0.5 V amplitude. The chart shows how the accuracy of integration changes as a function of the number of periods used for measurement.

A better approach for measuring DC signals corrupted by sine tones is to apply a window or weighting function to the signal before integration or averaging. For example, with a Hanning window applied to the acquired signal before integration, the measurement time only needs to

be increased by 2.15X to gain an extra digit of accuracy. Using a low-side-lobes (LSL) window, you can improve the accuracy even more quickly. With this method, you can get six-digit accuracy by only using five periods and speed improvement over a pure integration or averaging technique is significant. You can now perform the previous measurement example that required 10 minutes of integration to achieve 1 ppm accuracy in only 100 ms using an LSL window.

RMS Measurements

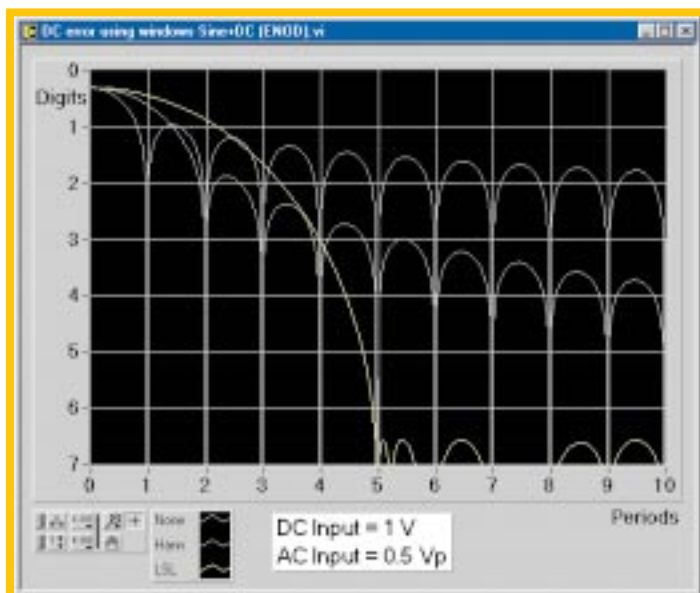
RMS measurements also benefit from similar considerations. The figure to the right shows the accuracy versus number of periods used for measurement both with and without windowing. As you can see, the accuracy improves more quickly with windowing applied to the signal than without.

The LSL window achieves six digits with increasing accuracy after more than eight periods. Notice this is a longer measurement time than the DC case because of the slower roll off curve.

Considerations in Applying Windows to DC and RMS Measurements

Applying windowing to signals before integration can improve measurements, but you need to be careful. You must consider the appropriate window to use as well as proper scaling for DC and RMS.

A side-effect of the windowing function is the scaling of the measured



The accuracy of a DC measurement depends not only on the integration time, but also on the used window.

RMS by a constant factor known as equivalent noise bandwidth. The factor depends on the window used. Equivalent noise bandwidth does not affect DC signal measurements.

Equivalent noise bandwidth of Hanning window = 1.5

For an LSL window, the equivalent noise bandwidth is 2.215. The actual RMS equals the measured RMS for a windowed signal divided by the square root of the equivalent noise bandwidth.

You should not use windowing to help reduce random noise because the equivalent noise bandwidth increases noise in the measurements.

Parallel Measurements for Reducing Test Times

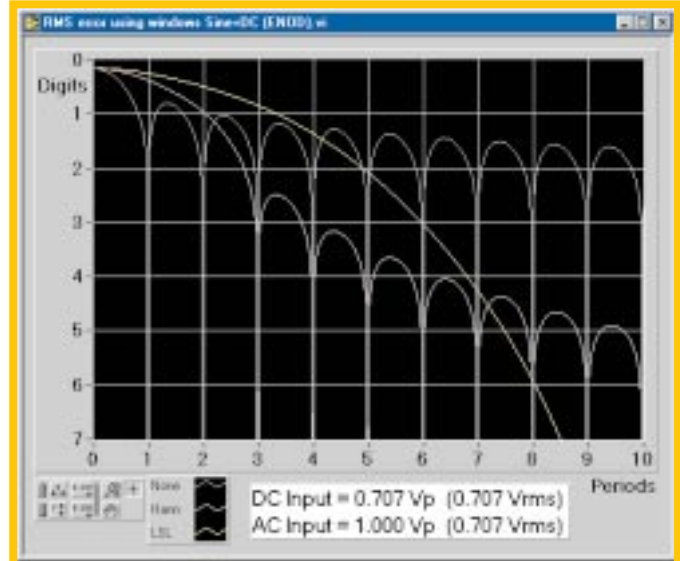
Notice that all the techniques described rely on integration over a number of cycles to improve measurement. This technique is commonly used for precision test and measurement equipment such as high-

16.67 ms for 60 Hz). This constrains the measurement time to at least 16.67 ms/measurement and possibly much longer if you need integration over several periods. In a test involving 10 measurements, the test time is at least 166.7 ms. In many cases, you can reduce this test time by a factor of 10X when deploying parallel measurement techniques.

For the above example, you can perform simultaneous acquisition and integration over all 10 channels, effectively performing all 10 measurements in the same time as a single measurement.

One of the benefits of multichannel, high-speed scanning DAQ systems – such as the National Instruments E Series DAQ boards, is the ability to perform pseudo-simultaneous data acquisition on a large number of channels. Coupled with our NI-DAQ driver software

and the ability to acquire and process data in a continuous streaming fashion, this provides fast, multichannel measurements with integration. An E Series board with 64 channels delivers up to 64 measurements with integration over power line cycles in



As with DC measurements, RMS accuracy depends on integration time and the used window.

the same time it takes a traditional DMM to take a single measurement – or up to 64X faster.

For both DC and RMS measurements, you can improve the speed and accuracy of your measurements by applying the appropriate measurement technique for your signal. ✎

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For more information, download the Make Fast, Accurate DC/RMS Measurements and Fast Frequency Measurements paper at www.ni.com/info/news

An E Series device with 64 channels takes up to 64 measurements in the same time a traditional DMM takes a single measurement – or up to 64X faster.

accuracy DMMs. In tests involving a number of measurements, the period of the signal you are trying to reject primarily governs the test time.

To illustrate this, consider a power line frequency rejection example (period =

How to Take DC and RMS Measurements

Error Source		
DC	Periodic signal	Consider integration over integer number of cycles of the periodic signal or use a window
	Many periodic signals	Consider windows and/or increased measurement time
	Noise (broad band)	Use lowpass filtering or increased measurement time. Do not use windows!
Signal Type		
RMS	Periodic signal +DC	Consider integration over integer number of cycles of the periodic signal or use a window
	Many periodic signals	Consider windowing and/or increased measurement time
	Non-deterministic (like noise)	Increase measurement time

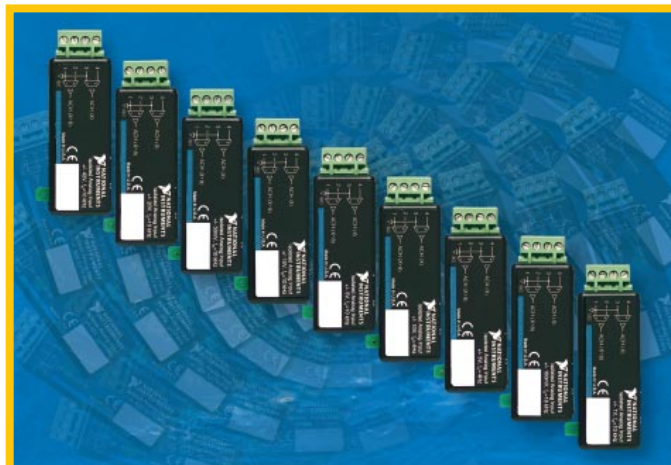
SCC Modules Offer Strain and Isolated Analog Input Solutions

Signal Conditioning Components (SCC) is a low channel count, front-end signal conditioning system for computer-based DAQ systems. With SCC, you choose your signal conditioning on a per-channel basis. Presently, SCC modules are available for thermocouples, voltage attenuation, 0-20 mA current inputs, filtering, isolated digital input, isolated digital output, and breadboarding. Now, National Instruments offers two new series of modules, the SCC-SG Series for strain gauges and the SCC-AI Series for analog input signals requiring isolation.


The SCC-SG Series modules are four dual-channel modules for conditioning 120 Ω quarter-bridge and 350 Ω quarter-bridge, half-bridge, and full-bridge strain gauges. Each analog input channel has an instrumentation amplifier and a 1.6 kHz lowpass filter. In addition, each module has a 2.5 V excitation source and per-channel

potentiometers for individual bridge balancing adjustments. You can also add the SCC-SG11 dual-shunt calibration module to any SCC-SG Series module. This module inserts into the second stage of an SCC system. You programmatically enable or disable the 301 k Ω shunt resistors of the SCC-SG11 with digital lines of the E Series DAQ board.

The SCC-AI Series consists of nine dual-channel modules for conditioning analog input signals that require isolation. We designed these modules for specific input ranges from ± 50 mV up to ± 42 V. Each analog input channel includes an amplifier and a lowpass filter. The lowpass filter cutoff frequencies are specific to each module, either 4 Hz or 10 kHz. In addition, these modules are bank-isolated, so each one is isolated



Use SCC to choose your signal conditioning on a per-channel basis. New modules offer strain gauge and isolated input solutions.

from other modules and ground. Isolation is important for applications where high common-mode voltages are present. Isolation also prevents signal errors from ground loops. Finally, isolation protects your system from possible transient voltages in your signal or incorrect wiring. All SCC-AI Series modules are rated for Category II locations and offer a safety working isolation of up to 300 V. 

For more information about these new SCC modules or help configuring an SCC system, visit our Web site at www.ni.com/sigcon

www.ni.com/sigcon

National Instruments New SCC Modules

Screw Gauges	Description	Isolated Analog Input	Description
SCC-SG01	120 Ω quarter-bridge strain	SCC-AI01	± 42 V, 10 kHz
SCC-SG02	350 Ω quarter-bridge strain	SCC-AI02	± 20 V, 10 kHz
SCC-SG03	Half-bridge strain	SCC-AI03	± 10 V, 10 kHz
SCC-SG04	Full-bridge strain	SCC-AI04	± 5 V, 10 kHz
SCC-SG11	Shunt calibration	SCC-AI05	± 1 V, 10 kHz
		SCC-AI06	± 100 mV, 10 kHz
		SCC-AI07	± 50 mV, 10 kHz
		SCC-AI13	± 10 V, 4 Hz
		SCC-AI14	± 5 V, 4 kHz

New Analog Input Modules for SCXI™

National Instruments now offers four new modules for the SCXI signal conditioning platform. These modules give you more choices for thermocouple applications, greater flexibility for isolated analog input applications, and two new choices for programmatically lowpass filtering applications.

The SCXI-1112 is an 8-channel analog input module designed for thermocouples. Its features include an independent amplifier and 2 Hz lowpass filter per channel, open-thermocouple detection LEDs, per-channel thermistors for cold-junction compensation,

and minithermocouple connectors for direct signal connectivity. In addition, this module has an onboard calibration source, permitting calibration without connecting external signals. Finally, this module can handle random scanning, the ability to scan any channel in any order. Target applications for the SCXI-1112 include lower channel count thermocouple

New Analog Input Modules for SCXI

Product Name	Description
SCXI-1112	8-channel thermocouple input module with direct connectivity
SCXI-1125	8-channel isolated analog input module with programmatically input range and filter settings
SCXI-1142	8-channel lowpass filter module with Bessel filter response
SCXI-1143	8-channel lowpass filter module with Butterworth filter response

applications or applications where direct connectivity is desired.

The SCXI-1125 is a new 8-channel isolated analog input module. Each analog

input has an independent, programmatic isolation amplifier and lowpass filter, permitting programmatic change of module settings before or during acquisition. In addition, this module is rated for Category II installations and offers 300 V of safety working isolation. Isolation is important for applications where high common mode voltages are present or where possible transients in your signal could damage your system. Isolation also prevents noise generated from ground loops. Finally, this module works with random scanning. The SCXI-1125 offers condition solutions for low voltage, high voltage (up to 300 V_{rms}), 0-20 mA current input, and thermocouples signals where isolation is required.



New Analog Input Modules for SCXI

The SCXI-1142 and SCXI-1143 are 8-channel programmatic lowpass filter modules. These modules have instrumentation

amplifiers and 8-pole lowpass filters on each input channel. You can programmatically set the filter cutoff frequency on each module to one of 10,000 settings, from 10 Hz to 25 kHz. The SCXI-1142 offers Bessel filter response, ideal for maintaining signal phase integrity. The SCXI-1143 offers Butterworth filter response, which provides maximum flatness in the passband. ▸

For more information about these modules or help in configuring your own SCXI system, visit our Web site at www.ni.com/sigcon

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PCI Bus Mastering Recharges Data Acquisition



Perhaps one of the most important features of today's PCs for data acquisition is PCI bus mastering because it delivers greater data transfer

speed and independence. DAQ board and driver design are key to using this powerful PC feature. With bus mastering, PCI data acquisition delivers new levels of performance and solutions previously unobtainable.

What is PCI Bus Mastering?

PCI bus mastering is a combination of bus architecture and PCI plug-in card functionality that yields performance and independence advantages. The result of bus mastering is the ability to deliver data from the plug-in board – in this case a DAQ board – into PC memory at high speeds. Up to 132 Mbytes/s are burst from the device into memory, while up to 80 Mbytes/s are continuously obtainable. In addition, you can transfer this data into memory without requiring any interaction from the microprocessor. Bus mastering completely handles the transfer of the data from the device into allocated memory blocks while the microprocessor is free to perform other tasks, improving performance.

How is Bus Mastering Implemented?

The architecture of the PCI bus and components on the PCI device require bus mastering. Control of the entire PCI bus is relinquished by the microprocessor and granted to the PCI board plugged into the bus. Once the PCI board has control of the bus, its onboard circuitry has full control and throughput rate capability to transfer data over the bus into PC memory. During this time, no other devices have control or can transfer data over the bus.

How Much Does It Cost?

Bus mastering does not cost more to implement if it uses volume components. We use our MITE™ chip technology to implement scatter-gather bus mastering – this technology is used across almost every PCI plug-in board we deliver, including DAQ and vision boards.

What New Applications Are Possible?

In the automotive industry, engine control unit (ECU) testing requires data collection, analysis, and output concurrently. Data is continually collected from the ECU via analog input channels. This data is transferred into a buffer in PC memory. Once in the buffer, the microprocessor can access it to analyze information and

determine response. Because the microprocessor is not busy acquiring the data, it can efficiently process and then rapidly produce results that it sends back to the ECU. At the same time, a second access channel in the bus master circuitry transfers data from a second memory block to the PC's analog output channels, where the bus mastering circuitry of the DAQ board automatically picks up the data and analyzes it. In this way, the system can acquire, analyze, and respond to the ECU, creating an entire test system on a single PC. With common, high-performance technologies, plug-in PCI-based data acquisition is one of the most efficient systems creating state-of-the-art solutions. ▸

For more information, check the Doing PCI Right – The Advantage of MITE-Based Data Acquisition white paper on the reply card, or visit www.ni.com/info/news

www.ni.com/daq

Low-Cost, Isolated, Digital I/O for High-Voltage Applications

National Instruments expands its DAQ digital I/O line with two new isolated digital I/O devices. The NI 6527 devices for PCI and PXI/CompactPCI include 24 optically isolated digital inputs and 24 lines of solid-state relay digital output. You can interface to TTL and non-TTL level digital signals with the input lines and switch relatively high voltages or currents. Enhanced features such as change detection on digital inputs and overcurrent protection on digital outputs make the NI 6527 devices an excellent choice for your high-voltage digital applications.



NI 6527 devices have 48 bits of isolated digital I/O.

Solid-State Relay Digital Outputs

Using 24 solid-state relay digital output lines, the NI 6527 devices can switch currents of up to 120 mA or use voltages as high as 60 VDC (30 V_{rms}), including standard TTL levels. With protective current-limiting circuitry, each relay remains open in excessive current situations, providing you with an added level of safety and reliability.✔

For more information, download the 6527 data sheet from www.ni.com/info/news or circle the item on the reply card.

Optically Isolated Digital Inputs

The NI 6527 devices provide you with 24 optically isolated static digital inputs that read voltages up to 28 VDC. Combined

with easy-to-use programmable change detection on any input line as well as digital filtering to protect from noise glitches, the NI 6527 devices provide a flexible interface for your digital input needs.

www.ni.com/daq

NI 6527 Specifications Overview

Family	Bus	Digital I/O	Transfer Rate	Logic Levels	Isolation	Handshaking	Pattern I/O	Change Detection	Triggers
6527	PCI, PXI/CompactPCI	48	Static I/O	0 to 28 VDC input, 0 to 60 VDC (30 V _{rms}) output	60 VDC	-	-	✔	-

NI-DAQ is Translated into French, German, and Japanese

With the release of NI-DAQ 6.6, National Instruments DAQ devices include a new Quick Start guide translated into French, German, and Japanese, in addition to translated software examples, online help, and MAX. This short guide walks you through the steps to install, configure, and

use your DAQ board. The guide also includes I/O connector diagrams of our most popular devices for easy reference.

These documentation localization efforts solidify our commitment to improving ease of use for our customers.✔

Call National Instruments at (512) 794-0100 or your local branch office for information on how to get a copy of the newest version of NI-DAQ.

www.ni.com/nidaq

