

## Use LabVIEW and IMAQ Vision for Thermal Imaging

Traditionally, thermal image measurements have been valuable to research and development departments needing exact temperature measurements. Now, with National Instruments software for LabVIEW and IMAQ Vision, you can easily take thermal measurements on the manufacturing floor.

### Infrared Cameras Make Your Application Easier

Infrared cameras measure the reflection of thermal, or infrared, energy that the naked eye cannot detect. Hotter temperatures reflect or radiate more infrared energy, and the cameras measure these differences and display them in varying colors.

**The huge drop in thermal camera prices makes it much more viable to put several cameras on the production line for process control.**

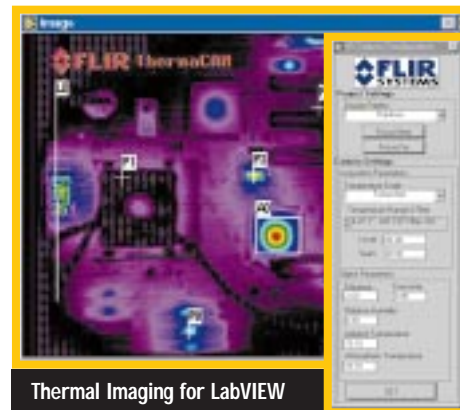
– *Dino Farina, Image Therm Engineering*

Infrared cameras are especially useful in quality control applications. On the production line, you can use them to

measure and evaluate products inside opaque packaging or other materials.

With LabVIEW, you can now use a computer to automatically measure thermal images. You can then use IMAQ Vision tools, such as pattern matching and blob analysis, to test for quality and consistency. For example, if the thermal image of oil inside a compressor (reflecting a darker color than its surrounding material because it has a cooler temperature) does not match the template image stored by IMAQ Vision, the compressor fails and the production line rejects it. Today's infrared cameras are well suited to the production line because they have the look and feel of traditional visible light cameras but do not need complicated lighting schemes.

In anticipation of the growing demand for thermal imaging in process control applications, National Instruments offers software for performing thermal imaging with LabVIEW. National Instruments is collaborating with FLIR Systems Inc., a major infrared camera vendor based



Thermal Imaging for LabVIEW

in Portland, Oregon, to develop the thermal imaging add-on software for use with LabVIEW.

FLIR Systems cameras work with National Instruments PCI-1408, 1407, and 1411 Series IMAQ boards.✎

*Download the IMAQ Vision thermal imaging software at [www.ni.com/vision](http://www.ni.com/vision)*

[www.ni.com/vision](http://www.ni.com/vision)

## Acquire Images Quickly with New PXI/CompactPCI Modules

National Instruments offers three new high-speed, high-accuracy IMAQ modules that deliver flexible machine vision and image processing to PXI/CompactPCI computers.

Ideal for vision applications such as silicon wafer inspection, electronic component testing, and automotive parts inspection, the new, low-cost IMAQ PXI-1407 module acquires images from RS-170 and CCIR monochrome cameras. It offers single, high-accuracy monochrome video input, external triggering capabilities, and easy-to-use IMAQ driver software. Because it speeds image processing with region-of-interest acquisition, you can acquire a portion of an image, which reduces the number of pixels processed by the PXI/CompactPCI controller.

For digital area and line scan cameras, National Instruments offers two versions of the IMAQ PXI-1422 module. Built with 16 MB of memory, each version can buffer large images and acquire large, high-resolution images at rates up to 80 Mbytes/s from color and gray-scale digital cameras. One version of the board is compatible with RS-422 communication specifications and the other with the low voltage differential signaling (LVDS) specification. Both versions feature region-of-interest acquisition for fast image processing and are compatible with Basler, Cohu, Dalsa, Hamamatsu, Kodak, Pulnix, and other digital cameras. See [www.ni.com/vision](http://www.ni.com/vision) for a list of compatible cameras.

Take advantage of high-quality analog color acquisition and low cost with the new IMAQ PXI-1411 module. Offering on-the-fly color conversion to hue, saturation, and luminance (HSL), the PXI-1411 is a unique color frame-grabber that speeds color matching in applications such as color LED, automotive parts, and pharmaceutical inspection. It also offers partial image acquisition with programmable region-of-interest. To help you quickly and easily start your applications without programming at the register level, we package the modules with NI-IMAQ driver software at no charge.✎

*For more information, check PC-Based Vision Product Guide on the reply card.*

[www.ni.com/vision](http://www.ni.com/vision)

## NI 5112 Brings 100 MHz Digitizing Speed to PXI

In response to industry demand, National Instruments announces the availability of the NI 5112 for PXI, a new 100 MHz, 8-bit, 100 MS/s, single-slot, dual-channel scope for PXI systems.

### More Speed, More Measurement Options

The NI 5112 represents a major advancement in the digitizing product offering from National Instruments. It features dual-channel input with simultaneous sampling via two high-speed analog-to-digital converters. With simultaneous sampling, you preserve the phase relation between the two acquired channels.

### The NI 5112 takes advantage of the PXI star trigger bus to improve the synchronization of PXI instruments with matched length trigger lines, reducing trigger skew between boards.

The NI 5112 sampling frequency reaches 100 MS/s. The bandwidth of the input stage has been elevated to 100 MHz – you now have the opportunity to acquire and analyze signals at very high rates without losing frequency content.

In addition, the maximum random interleave sampling frequency is now 2.5 GS/s – a rate unattainable with any other National Instruments product.

### Deep Onboard Acquisition Memory

The NI 5112 for PXI also features the deepest acquisition memory available for a scope in this class. Each of the two channels has 16 MB of memory – this means that 16 million 8-bit samples are stored for each channel. When sampling at a maximum speed of 100 MHz, you can store 160 ms of acquisition time in the onboard memory, enough to satisfy even the most demanding users. The input impedance of the NI 5112 is selectable between 50  $\Omega$  and 1 M $\Omega$ .

### Analog Input Features

Another important feature of the NI 5112 is the DC offset capabilities of the analog input stage. The NI 5112 can produce a DC offset of up to  $\pm 25$  V. This feature is particularly useful when you want to observe the variable portion of a signal superimposed on a DC signal.

The DC offset capability eliminates the DC component, and you can take advantage of the 8-bit resolution of the instrument around the voltage level of interest.

The NI 5112 also handles multiple record acquisition, much like the NI 5911 flex-converter. You can divide the 16 MB of memory for each channel into an arbitrary number of records that are then

filled with acquisitions triggered in hardware without any software intervention. You can exploit this characteristic to start several acquisitions with an external trigger without reprogramming the instrument

via software. The dead time between acquisitions is less than 500 ns.

### Synchronization Capabilities

You can synchronize several instruments, such as the NI 5112 and the NI 5411 arbitrary waveform generator, to the same clock and avoid phase drift, which can adversely affect the qualities of your measurements.

With the NI 5112, you can take advantage of a wide variety of triggering options including analog edge, hysteresis, and digital. The trigger source can come from one of the two analog input channels, a dedicated analog trigger input, the PXI trigger lines, or the PF1 and PF2 inputs. The NI 5112 takes advantage of the PXI star trigger bus to improve the synchronization of PXI instruments with matched length trigger lines, reducing trigger skew between boards. The NI 5112 is the first National Instruments PXI product that you can use as a star trigger controller.



The NI 5112 features simultaneous sampling and dual-channel input.

The NI 5112, like other high-speed instrumentation products, can easily expand its channel count using high-bandwidth switches such as the NI 2590 for PXI.

The NI 5112 ships with VirtualBench™ – Scope, a ready-to-run software package you can use to interactively control the board without any additional programming, as well as NI-Scope, an IVI-compliant instrument driver that works with LabVIEW, LabWindows™/CVI, and Visual C programming environments.

### New Possibilities for Your Applications

With this new set of advanced features, you can count on the NI 5112 to further expand the spectrum of applications for computer-based instruments to higher frequencies at a competitive cost-per-channel.

The integration between hardware, software, and the use of computer-based technologies continues to deliver unmatched advantages and performance, lowering total system cost and improving systems integration. ▶

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*For more information, please check the NI 5112 data sheet on the reply card or visit [www.ni.com/info/news](http://www.ni.com/info/news)*

[www.ni.com/instruments](http://www.ni.com/instruments)

# Calibrating Computer-Based Instruments, Part I

As the number of instrumentation products integrated with the personal computer continues to grow, more companies are uncovering the need to calibrate these systems. Today, the majority of companies have procedures in place to calibrate a stand-alone – or traditional – instrument, but lack the experience in calibrating computer-based instruments. In this part of the series, we look at the internal calibration process on traditional and computer-based instruments and discuss the effects of the PC environment on the accuracy of your measurements.

## Defining Calibration

A definition of terms can help get you started. *Calibration* refers to three separate actions – verifying, adjusting, and reverifying instruments. First, you must verify that the device is measuring within its specifications – this verification covers all possible measurement ranges. Then, you need to adjust the device's

a high- accuracy, onboard voltage source, compares the reading to a known value, and stores the correction factor in the onboard calibration eeprom. This onboard voltage source is calibrated to a known standard, such as NIST. The main purpose of performing an internal calibration is to compensate for changes in the operating environment, such as temperature variances and other factors that may affect measurements.

National Instruments computer-based instruments, like traditional instruments, can perform an internal calibration. Internal calibration on a computer-based instrument is initiated by a software function call that calibrates all the vertical ranges on the instrument. This can lead to reduced test times because you can take measurements instantly and avoid waiting for internal calibration to occur each time the vertical range is adjusted.



calibration compensates for temperature variations in the operating environment.

## National Instruments computer-based instruments, like traditional instruments, work with internal calibration.

measurement circuitry if it is not measuring within specification. Finally, you must reverify the device's measurements to ensure that all measurements are within specification.

*Traceability* refers to an unbroken chain of comparisons between your measurements and a national or known standard. In the United States, NIST maintains the national standards. With traceability, you can determine the maximum uncertainty associated with your measurements. As with most stand-alone instruments, all National Instruments computer-based instruments are shipped with NIST-traceable calibration certificates.

## Internal Calibration

If you have used an instrument such as an oscilloscope, then you have performed an internal calibration. In fact, on most oscilloscopes, when you change the vertical range setting, the instrument performs an internal calibration. The instrument digitizes

## Factors Affecting Calibration

Computer-based instruments are housed in environments such as your desktop computer, PXI/CompactPCI chassis, or VXI chassis. Because computer-based instruments are installed in this wide variety of computing environments, you must design them with the following precautions in mind – computer-based instruments must withstand electromagnetic interference (EMI) and voltage supply variations, as well as operate under a wide temperature range. The most basic schemes to protect against EMI include separate ground planes for digital and analog signals, localized filtering of power signals, and shielding of sensitive components. To compensate for voltage variations, DC-DC converters boost the power supply level, voltage regulators control the onboard power supply levels, and bulk capacitors stiffen onboard power supply. As mentioned above, internal

Many users wonder if a computer-based instrument can move from one computer to another without affecting the calibration. The answer is yes, because we design our instruments with the criteria mentioned above and calibration remains valid. Computer-based instruments, like traditional instruments, are typically calibrated in a metrology lab. The operating temperature of this lab usually differs from the manufacturing floor or design lab. Moving your computer-based instrument to a new computer is similar to moving your traditional oscilloscope from one lab to another. The calibration remains intact because the instrument was designed to withstand changing environments.

In the next issue of *Instrumentation Newsletter*, we plan to discuss external calibration, which is the process of calibrating the high-accuracy, external voltage sources. We also discuss the specific options you have to perform this external calibration. ✎

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*For more information, download the Essential Technologies for Measurements You Can Count On white paper at [www.ni.com/info/news](http://www.ni.com/info/news)*

[www.ni.com/calibration](http://www.ni.com/calibration)

## IVI Foundation Finalizes Instrument Driver Specifications

The Interchangeable Virtual Instruments (IVI) Foundation finalized specifications for the initial set of instrument drivers classes at meetings that occurred July 26-29, 1999 in Columbus, Ohio. The new standards build on previous versions by defining a more robust and complete architecture for interchanging instruments of the following five classes – digital multimeter (DMM), oscilloscope, DC power supply, arbitrary waveform/function generator, and switch. At the meetings, the Foundation also began work on a new set of instrument classes and continued to investigate the application of ActiveX/COM technologies to the IVI standards.

### Maintaining Backward Compatibility

The IVI Foundation released its initial instrument driver specifications in 1998. IVI members have worked with user beta sites to test both the specifications and vendor implementations. As a result, the IVI

**The goal of the Foundation is to define ActiveX/COM application programming interfaces (API) for the IVI specifications while accommodating traditional C APIs.**

Foundation has addressed issues as they have arisen. The revised specifications adhere to the Foundation's original goals of maximizing interchangeability and software reuse for users.

IVI Instrument Classes		
Finalized Instrument Classes	Instrument Classes in Progress	New Instrument Classes
DMM	Power meter	RF signal generator
Oscilloscope	Spectrum analyzer	Scanning DMM
DC power supply	Counter/timer	AC power supply
Arbitrary waveform/function generator	Digital test instruments	
Switch		

### What Is Next?

Updating the specifications is an important step toward creating interchangeable instruments. "As instrumentation evolves, so too must IVI Foundation specifications, if we are to maximize the advantages of interchangeability and software reuse for our users," said Scott Rust, Chairman of the IVI Foundation. Now that the primary instrument classes are defined, the IVI Foundation has turned its sights toward completing instrument class definitions already in progress and defining new

instrument classes. The instrument class definitions currently under development include power meter, spectrum analyzer, counter/timer, and digital test instruments. The

Foundation has also begun work on the new instrument classes, which encompass RF signal generator, scanning DMM, and AC power supply.

### ActiveX and COM

The Foundation continued discussions concerning the role of ActiveX and COM technologies for IVI instrument drivers. ActiveX and COM are exciting technologies the Foundation believes can benefit both users and instrument vendors.

The goal of the Foundation is to define ActiveX/COM application programming interfaces (APIs) for the IVI specifications while accommodating traditional C APIs and the LabVIEW interface. This gives users the opportunity to develop and maintain their systems regardless of whether a particular instrument driver has an ActiveX/COM, ANSI C, or LabVIEW interface. ✎

*For more information, visit the IVI Foundation Web site at [www.ivifoundation.org](http://www.ivifoundation.org) or check IVI flyer on the reply card.*

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

## IVI Foundation Continues to Grow in Membership



At the July meeting, the IVI Foundation approved membership

applications for six new members. These new companies include:

- Serco Test Systems (Voting Member)
- The MathWorks, Inc. (Associate Member)
- CERP-AIGER Program (Associate Member)

- Shaanxi Hitech Electronic Co. Ltd. (Associate Member)
- Allied Signal (Associate Member)
- SIRT I (Associate Member)

Since the IVI Foundation was formally announced in 1998, it has grown to more than 33 members. The membership comprises both major instrument vendors and customers, including Boeing, Hewlett-Packard, Lockheed Martin, Lucent Technologies, National Instruments,

Northrup Grumman, Rohde and Schwarz, and Tektronix. ✎

*For more information on the IVI Foundation, please visit [www.ivifoundation.org](http://www.ivifoundation.org) or check IVI flyer on the reply card.*

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

# Common Test Software for Cellular Base Stations

by Jim Morrison and Chuck Patterson,  
Motorola – Network Solutions Sector

**The Challenge:** Developing a modular, adaptable, single-test software application that can test a wide variety of Motorola's cellular base station products with differing test procedures and specifications.

**The Solution:** Creating a test specification and procedures database in ORACLE and a database-driven test application with interchangeable instrument and product driver technology using National Instruments TestStand™, LabVIEW, and the SQL Toolkit.

## Introduction

The Motorola Fort Worth Integration Test and Certification (ITC) and Assembly Test Engineering (ATE) test software groups developed a common solution with the intention of bolstering software innovation and maximizing collective reuse among the two groups. Using National Instruments TestStand and LabVIEW, ITC and ATE together developed a database-driven, standardized test executive with common software classes. The test application adapts to various test environments and products.

**We chose TestStand – which provides many necessary services such as login with definable permission levels, report generation, a sequence development environment, and database integration – for its maximum flexibility.**

## Requirements

Motorola recently embarked on a software process improvement effort within test software groups. This effort, coupled with a desire for standardization and conformity, resulted in the idea of common test software for all Motorola cellular base station products. The goals of the project were to:

- Create one common set of core software
- Standardize the software process
- Maximize reuse while minimizing duplicated effort

- Create effective training and documentation
  - Reduce manpower per product test capability
  - Dramatically reduce future time-to-test
  - Construct a technology roadmap for test applications
- After representatives from both groups reviewed several test applications, we drew the following conclusions:

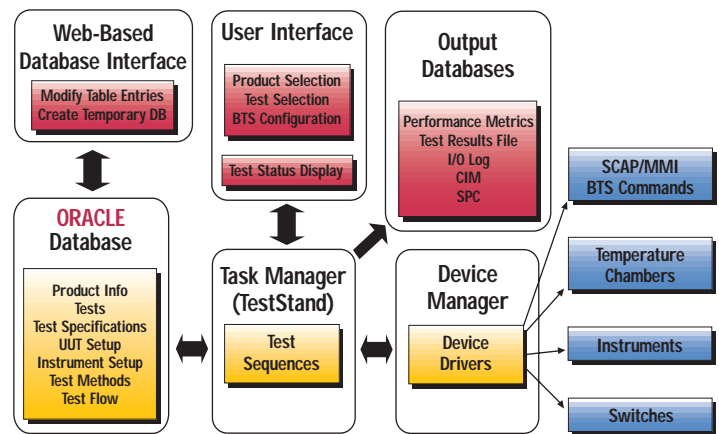
- We needed a common test executive
- Product and test station personalities must remain external to the test software
- Looping structures must be adaptable and interchangeable
- Differing brands or models of like instrumentation must be interchangeable without software modification
- We needed to implement state-caching

## Software Model

The conclusions led to the development of a common test software model. Key components include a centralized test executive, a smart task manager for looping, interchangeable device and product drivers, and an external database for product information and test specifications.

We chose TestStand – which provides many necessary services such as login with definable permission levels, report generation, a sequence development environment, and database integration – for its maximum flexibility. TestStand is an ActiveX-based test executive with test module adapters for LabVIEW, LabWindows/CVI, Visual Basic, and C-based dlls.

The ITC and ATE test groups, already proficient programmers with National Instruments LabVIEW, thought the program was best tailored for test automation because of the



Common Cellular Base Station Test Software Model

many built-in functions that make LabVIEW ideal for developing tests. LabVIEW also offers built-in multitasking, multithreading, GPIB communication, serial communication, statistical processing, and synchronization objects such as notifiers, semaphores, rendezvous, and queues.

## Estimated Return on Investment

By combining our efforts and developing a single modular test application, we reduced the combined annual maintenance costs for the ITC and ATE groups from \$700K to \$400K and the annual projected new product test development costs from roughly \$200K to \$25K. The combined development and maintenance savings total per year is \$475K.

## Conclusions

With commercial off-the-shelf (COTS) software, we could concentrate on developing tests rather than test executives. By developing this common test software solution, we:

- Reduced future cost
- Eliminated duplication of effort
- Centralized specifications and procedures
- Developed a common training course
- Placed all test software development under configuration management
- Reduced time-to-test for product spins and new tests

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## Machine Vision Solutions Wizard Simplifies Imaging

To help start your first or next vision application, National Instruments Vision Builder software includes a vision solutions wizard to guide you in inspection, matching, counting, and other applications. The software has an intuitive interface and logically named functions for rapid application development. The following steps outline a new development approach that significantly reduces the time and cost needed to develop a vision application.

**Feature 1.** You can interactively prototype and test your vision strategy in Vision Builder. The solution wizard offers typical solutions for automotive, electronics, and biomedical applications. It provides a working example you can modify for your custom application.

**Feature 2.** With Vision Builder, you produce a script that you can test against a sample set of images. In an industrial manufacturing application, this sample set should include flawed and good components. Once a Vision Builder script is created, you



Vision Builder simplifies software development.

can step through each vision function, immediately see the resulting image, and interactively change the control parameters as needed.

**Feature 3.** Vision Builder then generates a “builder file,” which lists in detail the vision function calls and control parameters. The builder file is used to develop a vision application in LabVIEW, LabWindows/CVI, Visual Basic, or Visual C/C++.

Vision Builder offers other important features such as a performance meter that benchmarks the speed of your vision algorithm. You also can use the color matching software to precisely match colors in inspection applications. National Instruments new pattern matching locates objects even if the objects vary in orientation or when appearance is degraded, poorly illuminated, or partially hidden from view. IMAQ Vision users can purchase Vision Builder at a reduced price when upgrading to the Vision Development Software. ❧

*For more information, download the Vision Builder white paper from [www.ni.com/info/news](http://www.ni.com/info/news)*

[www.ni.com/vision](http://www.ni.com/vision)

## Microsoft Developments

### Microsoft Windows NT Embedded

Microsoft is shipping a new embedded operating system designed to boost OEM productivity. The latest offering in the Windows NT family – Microsoft Windows NT Embedded 4.0 (NTE) – is specifically designed for use in embedded products and devices.



Windows NTE is appropriate for a wide variety of application areas, including telecommunications equipment, test and measurement equipment, industrial control, and manufacturing automation systems.

The main difference between Windows NTE and standard Windows NT is that

only OEMs such as National Instruments can license Windows NTE to build dedicated, fixed-function devices – Microsoft does not sell Windows NTE directly to users. With Windows NTE, OEMs can configure systems with a smaller memory footprint and handle devices that boot from solid-state memory and do not have a monitor, keyboard, or mouse. Unlike Windows CE, Windows NTE does not add any new real-time capability when compared to standard Windows NT.

Microsoft Windows NTE and CE platforms are rapidly gaining popularity with embedded systems developers because they provide support for the Win32 API, Visual C/C++, and Visual Basic development tools. Windows NTE and Windows CE also provide a wide range of built-in networking and connectivity options and are equally suited for connecting to devices on the factory floor or enterprise databases. ❧

[www.ni.com/tech2000](http://www.ni.com/tech2000)

## Windows 2000 Update

Microsoft Windows 2000 software progresses steadily. Microsoft is currently shipping Windows 2000 beta software to interested companies through the Corporate Preview Program.

Microsoft still anticipates the release of Microsoft Windows 2000 by the end of the year. National Instruments is busily testing the compatibility of many of our hardware and software products with Windows 2000 beta software. We plan to release Windows 2000-compatible products to coincide with the final release of Microsoft Windows 2000 next year.

Windows 2000 is not available to the general public until early 2000, but you can order a preview copy of Windows 2000 beta software at [www.microsoft.com/windows/professional/beta](http://www.microsoft.com/windows/professional/beta) ❧

[www.ni.com/tech2000](http://www.ni.com/tech2000)

# Components for Measurement and Automation

As you develop measurement and automation applications, you face many challenges, including strict requirements, more requested features, and shorter schedules. National Instruments software takes advantage of component architectures giving you the opportunity to integrate and create software components to help you handle these challenges. By developing measurement and automation software as components, you gain four software development advantages – reusable software components, easy access to your components, development language and application independence, and enterprise integration.

## Software Reuse

National Instruments software promotes developing your measurement and automation software as components, where each component has a distinct interface and functionality. In LabVIEW, you develop components as VIs, while ComponentWorks™

**By developing components, you can integrate with many business applications and share your measurement and automation information throughout your enterprise.**

provides a collection of components through well defined ActiveX controls.

Reusing components provides significant advantages over reusing source code. To begin with, copying source code fragments is error-prone. Source code fragments removed from their original context may not function as desired because they may need the context of the original program. Additionally, updating software becomes much easier using components. As you need to enhance functionality or fix bugs, you can release a new version of a component without redeploying the entire system.

## Simplified Software Access

As you develop software, you need to access low-level DAQ or instrument I/O drivers

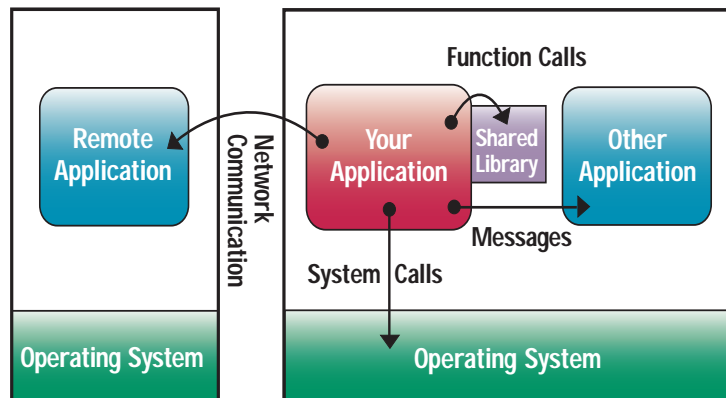
as well as other applications on your local or remote computers. Traditionally, each requires different types of software calls – shared library calls to DAQ or instrument I/O drivers, software messages sent to other applications, or remote procedure calls

to applications on other computers. Through COM, distributed COM (DCOM), and the LabVIEW VI Server, you can access these components with one mechanism, regardless of whether it is a local component or distributed in your enterprise. COM, DCOM, and VI Server transparently manage connections to your software

components from numerous applications, threads, or computers with no special protocols required. You can access National Instruments instrument I/O, analysis, and data acquisition through GPIB, serial, VISA, data, and IMAQ ActiveX controls. Many National Instruments products also have OPC servers, which is an industry standard for COM components that communicate with industrial automation devices.

## Application and Development Environment Independence

With applications you develop using National Instruments tools, you can take advantage of standard technologies to communicate with any component, regardless of what application created the component. For example, both LabVIEW and LabWindows/CVI can use ActiveX automation to integrate an ActiveX or COM measurement component constructed in Visual Basic or Visual C++. Visual Basic, Word, and Excel also handle ActiveX



Access applications on remote computers using COM and DCOM.

automation, so you can access applications created by LabVIEW or LabWindows/CVI using their ActiveX automation servers. Because you can implement and access components from the environment that suits your needs, you can achieve true application and development language independence.

## Enterprise Integration

By developing components, you can integrate with many business applications and share your measurement and automation information throughout your enterprise. In business systems, your measurement and automation application becomes a component in the enterprise strategy. For example, imagine your application tests electronic components and reports production yields. Your application shares that production information with members of your sales organization so they can accurately forecast product delivery times, creating a more efficient business operation. ♣

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*To see how you can use National Instruments software and hardware with COM, download the COM and Computer-Based Measurement and Automation white paper at [www.ni.com/info/news](http://www.ni.com/info/news)*

[www.ni.com/cworks](http://www.ni.com/cworks)

# Take Control with the PID Algorithm and LabVIEW

The RT Series DAQ boards are an exciting addition to the National Instruments DAQ plug-in hardware line. These plug-in boards use a LabVIEW-programmable embedded processor for easy graphical programming, determinacy on the order of microseconds, and isolation from host operating system crashes and latency. With such features, the

often employ feedback, meaning that they modify the output in an attempt to minimize the difference (error) between it and a reference signal or set point. The proportional integral device (PID) algorithm is a feedback-based strategy with three parameters – gain, rate, and reset time – that designate the response of the controller. By choosing appropriate

parameters, you can set how the algorithm adjusts the output (rise time), overshoot, and settling time.

There are several options for implementing a PID controller in LabVIEW. First, because LabVIEW

## One highlight of the PID Control Toolset is autotuning, a technique that tunes the controller parameters to improve such response characteristics as rise time and overshoot.

RT Series DAQ boards are ideal for control applications. Because you program the RT Series hardware with standard LabVIEW graphical code, this topic also applies to LabVIEW and standard DAQ hardware.

### PID-Based Control

Most engineers are familiar with the basic elements of a control system. Each system accepts input and generates output to regulate itself or another system. Input is often a measurement from one or more sensors and output often comes from one or more control voltages. Automatic control systems

is a general-purpose graphical programming language, you can implement and customize the algorithm yourself. To help you get started, LabVIEW ships with several examples and a basic PID algorithm that you can deploy in your own program.

### PID Toolset Extends Control

For more extensive control requirements, you can augment LabVIEW with the PID Control Toolset. The toolset is a collection of VIs, examples, and documentation for PID and fuzzy logic-based control. The functions of the toolset are implemented in LabVIEW without any code interface nodes (CIN) and include source code. You can customize the toolset without the need to write conventional text-based code.

One highlight of the toolset is PID autotuning, a technique that tunes the controller parameters to improve such response characteristics as rise time and overshoot.

The technique employs a proprietary algorithm that offers several advantages over traditional autotuning methods. It preserves closed-loop P or PI control during the tuning process, thereby maintaining stability of the controlled system.

Other techniques often involve testing the system under open-loop conditions with the controller switched off to identify parameters. In addition, the integral action of the existing controller causes phase lag that ensures sufficient phase margin and stability of the control system.

PID Control Toolset	
<b>Features</b>	
Proportional (P); proportional integral (PI);	
proportional derivative (PD); and proportional	
integral derivative (PID) algorithms	
Gain-scheduled PID	
PID autotuning	
Error-squared PID	
Lead-lag compensation	
Setpoint ramp generation	
Multiloop cascade control	
Feedforward control	
Override (minimum/maximum selector) control	
Ratio/bias control	

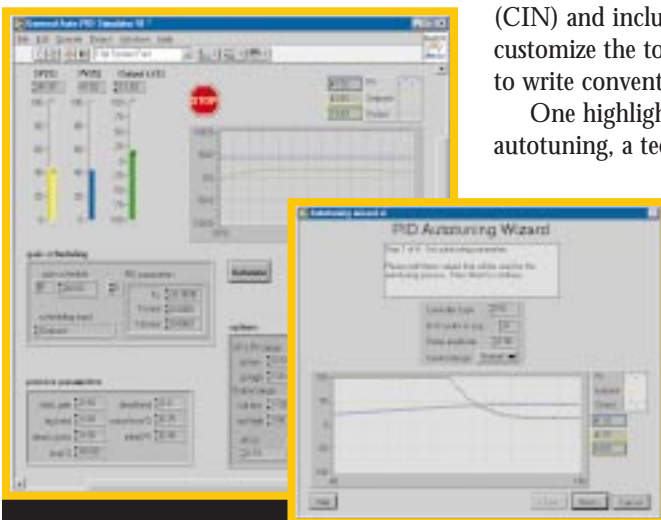
Another highlight of the toolset is gain scheduling – with this tool you can apply different sets of PID parameters to various operating regions of your controller. Gain scheduling is useful because most processes are nonlinear – PID parameters that produce a desired response at one operating point are not necessarily satisfactory at another.

### Flexible Control

When combining these and other features of the PID Control Toolset – the built-in functionality of LabVIEW and either DAQ or the RT Series hardware – you have the flexibility necessary to assemble custom PID control systems. ✎

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*For more information about the PID Toolset and other software for signal processing and analysis, visit [www.ni.com/analysis](http://www.ni.com/analysis)*



With autotuning, you can automatically adjust PID parameters to optimize controller response. An autotuning wizard (right) guides you through the process.

[www.ni.com/analysis](http://www.ni.com/analysis)

## National Instruments Opens Two New Direct Sales Offices in Poland and Portugal

National Instruments opened two new offices in Poland and Portugal, which increases the total number of worldwide offices to 30. With these branch openings, we want to show our commitment to better serve our customers with their computer-based measurement and automation needs. It is our goal to give Polish and Portuguese customers the same high-quality service and direct support for which we are known around the world.

Pedro Alves and Paul Hoerner de Roithberg are managers of the Portugal and Poland offices, respectively. ✎

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[www.ni.com/worldwide](http://www.ni.com/worldwide)

## Test Drive the NI 5911 on the Internet

You can now test drive the NI 5911 variable resolution digitizer via the Internet. Using Internet Explorer or LabVIEW, you can interactively experiment with NI 5911 capabilities. With this demo, you can control the measurement setup (oscilloscope, spectrum analyzer, frequency counter, RMS voltmeter, or calculate resolution), the resolution mode (oscilloscope or flex resolution), and the sample rate. In the calculate resolution mode, you can see how the board's resolution increases as the sample rate



Use LabVIEW to test drive the NI 5911.

decreases. Your requests are sent to a server at National Instruments, which returns real data acquired from the NI 5911. ✎

[www.ni.com/testdrive](http://www.ni.com/testdrive)

## Learn to Create Remote Applications

Take the next step in creating fully networked measurement and automation solutions by publishing snapshots of your experiment over the Internet. Learn how to create remote applications and Web pages with faster updates and full interactive control using DataSocket™ technology. At the virtual Armadillo Manufacturing Company, you can easily share live measurements between LabVIEW,

LabWindows/CVI, ComponentWorks, and interactive Web pages.

Visit [www.ni.com/armadillo](http://www.ni.com/armadillo) to discover how the Armadillo Manufacturing Company and you can use National Instruments DataSocket technologies in manufacturing, testing, and engineering processes. ✎

[www.ni.com/armadillo](http://www.ni.com/armadillo)

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# Ready-to-Run Measurement Systems Available Now

National Instruments-Based Systems		
Automotive	Electronics/Telecom/Semiconductor	Process/Manufacturing
Airbag burst tester – Microsys	Automated recorder tester – Vektrex	Batch Processing System – Signature Control
Airbag deployment tester – Microsys	Functional tester – Advanced Test Methods	Chemical Processing System – Acquired Data Solutions
Block-cycle tester – MTS	GSM tester – Logos	High-speed Image Streaming System – Graftek
Engine test cell controller – SAKOR	POTS tester – Wintek	Strain Measurement System – Stress Engineering
NVH tester – Datepli	User interface inspection system – ETC	Temperature Chamber Monitoring System – t.e.s.t.
Seat belt pretension tester – Microsys		Thermal Imaging System – Image Therm
Tire and brakes tester – Datepli		

At NIWeek™ 99, National Instruments highlighted 18 NI-based systems. National Instruments works with Alliance Program members to create these systems to address common problems within specific industries. NI-based systems consist of National Instruments hardware and software products and are developed by Alliance Program members.

These base systems are developed for applications in targeted industries such as telecommunications, automotive, semiconductor, biomedical, and others. Because these base systems typically solve 80 percent of the application, NI-based systems remain flexible enough to meet the needs of several companies in the same industry.

National Instruments works with our Alliance Program members to foster these NI-based systems. For instance, we identify potential NI-based systems and candidates to build the systems. We then consult on the content and implementation of the system. After qualifying the system, we market these systems and direct customer inquiries to the Alliance Developer of that system. The Alliance Developer then sells the system, customizes it as needed, and supports the customer.

One example of this successful partnership between National Instruments and our Alliance Program members is DisplayCheck, an NI-based system created by Engineering Technology Center (a subsidiary of Anteon

Corporation), which inspects leading-edge microdisplay products such as pagers and cellular phones. Three-Five Systems, Inc. of Tempe, Arizona, recently purchased several DisplayCheck systems to save time and money by eliminating the need to create its own inspection system.✔

*For more information on these NI-based systems, visit our Web site at [www.ni.com/industries](http://www.ni.com/industries) and [www.ni.com/alliance](http://www.ni.com/alliance)*

[www.ni.com/alliance](http://www.ni.com/alliance)

## Select Integrators Ensure Customer Success

During the NIWeek 99 Alliance Day, National Instruments recognized the 1999 Select Integrators from the company's Alliance Program. Select Integrators are distinguished members of the Alliance Program with broad product knowledge and extensive application experience.

In addition to their status as top purchasers of National Instruments products, Select Integrators work closely with National Instruments Sales, Marketing,

R&D, and Technical Support to ensure satisfaction of our mutual customers. By developing in-depth knowledge of National Instruments products, Select Integrators use their application expertise to choose the best products for their customer applications and integrate these into solutions.

Exemplifying the success of our Select Integrator relationships, Data Science Automation received a Pittsburgh

Technology 50 award, presented to the 50 fastest-growing technology companies in Western Pennsylvania and the surrounding eleven counties. The award for top-growth companies, sponsored by the Pittsburgh Technology Council, was based on financial performance over a three-year period, audited by Arthur Andersen. During the three-year period from 1996 through 1998, DSA revenues increased by 852%. Richard Brueggman, president of DSA, credits his staff and his relationship with National Instruments as primary reasons for their success.✔

*For more information about these Select Integrators, visit [www.ni.com/alliance](http://www.ni.com/alliance)*

[www.ni.com/alliance](http://www.ni.com/alliance)

1999 Alliance Program Select Integrators	
Advanced Measurements, Inc.	B&B Technologies, Inc.
Bloomy Controls, Inc.	Datapli, Inc.
Data Science Automation, Inc.	MicroCraft Corporation
Quantum Controls, Inc.	Radical Systems Engineering
Stress Engineering Services, Inc.	Symtx
VI Engineering, Inc.	Viewpoint Software Solutions

## DVP Creates Hand-Held Virtual Instrumentation Platform

DVP offers the OmniMeter™, a hand-held virtual instrumentation platform that works with National Instruments data acquisition PCMCIA cards. With the OmniMeter, a Windows CE-based hand-held platform, you can rapidly configure hand-held measurement devices. The OmniMeter fosters high-productivity hardware and software development for instrument designers and fills a significant void in the



creation of custom and automated devices for use in mobile and field environments.

The combination of the OmniMeter and National Instruments DAQCards™ offer an excellent platform for hand-held measurement solutions. The OmniMeter addresses important issues for hand-held use, such as extra long battery life, rugged packaging, and custom hardware support.

National Instruments DAQCards give you a variety of capabilities for creating solutions.

Currently, the OmniMeter works with the DAQCard-5102 oscilloscope, the E Series DAQCard-AI-16XE-50, and the DAQCard-4050 digital multimeter, with other cards planned for the future. Additionally, DVP includes a full-featured demonstration program in source code format so you can rapidly create custom instrumentation applications. ❧

*For more information, contact DVP, Inc., 2401 Research Blvd., Suite 200, Rockville, MD 20850, tel (301) 670-9286, e-mail [OmniMeter@dvpin.com](mailto:OmniMeter@dvpin.com), [www.omnimeter.com](http://www.omnimeter.com)*

## NI-Based System for Hearing Aid Testing

MicroLEX, an Alliance Program member, has introduced HearMaster, a new line of high-performance test systems for the engineering and production of advanced mixed-signal hearing aids. The HearMaster system, ideally suited for professional manufacturers and buyers of hearing aid instruments, incorporates electrical as well as acoustical testing to create leading edge solutions that yield high efficiency.

Based on LabVIEW, HearMaster is not only easy to use and learn but also offers minimum program development time and high flexibility. At the same time, HearMaster handles application-specific measurements



such as auditory testing ANSI or IEC standards. Available with either VXI or PCI hardware from National Instruments, HearMaster offers a high-performance

system for production testing as well as a low-cost PC solution for R&D applications. The software, compatible between the two domains, yields flexibility, portability, and cost management.

The HearMaster modular test system offers the optimum solution for testing hearing aids, audiometers, and loudspeakers. ❧

*For more information, contact MicroLEX Systems A/S, Dr. Neergaards Vej 5 C, DK-2970 Hoersholm, Denmark, tel +45-45 76 21 00, fax +45-45 76 22 00, e-mail [bsc@microlexsys.com](mailto:bsc@microlexsys.com), [www.microlexsys.com](http://www.microlexsys.com)*

## HRV Offers SECS Toolkit for LabVIEW

HRV Technologies, Inc., an Alliance Program member, has released FABTalk, a SECS-I/SECS-II communications add-on for LabVIEW. Used widely in the semiconductor equipment industry, the SEMI Equipment Communications Standard (SECS) is a coordinated pair of standards for the semiconductor industry that defines a serial communications interface between a piece of equipment and a host.

With the SECS toolkit at the heart of FABTalk, you can rapidly deploy mission-

critical host or equipment applications. The SECS toolkit includes online documentation, tutorials, and comprehensive application examples to help guide LabVIEW users. In addition, FABTalk contains a built-in SECS spy and monitor with which you can capture SECS message traffic between the host application and target equipment.

With FABTalk, you create custom SECS applications with the convenience and power of LabVIEW. FABTalk can help you quickly build applications to improve throughput

and yield, reduce equipment downtime, eliminate operator errors, reduce contamination, and improve the overall operating process. ❧

*For more information, contact HRV Technologies, Inc., 105 South Stapley, Mesa, AZ 85204, tel (480) 733-1666, [www.hrvtech.com](http://www.hrvtech.com)*



## National Instruments Web Site Tops Nationwide List

National Instruments has the best Web site among nearly 1,000 midsized manufacturers in the United States, according to RSM McGladrey Inc.

RSM McGladrey, one of the nation's largest accounting, tax, and business consulting firms serving midsized businesses, announced Tuesday that National Instruments Web site at **www.ni.com** won the manufacturing division in its first "Outstanding Midsized Business Web Site Awards." The awards were cosponsored by AT&T and the National Association of Manufacturers.

"National Instruments has designed a Web site that excels in providing information, customer service, design, quality, and connectivity, which are factors vital to a successful Internet presence," said Robert Larson-Hughes, national leader of RSM McGladrey e-business service. 🦋

See how the Web is changing the face of measurement on page 1.



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

CIA – Singapore, Singapore	Nov 30-Dec 3	MT Essen – Essen, Germany	Feb 16-17
Photonics West – San Jose, CA	Jan 25-27	Embedded Systems – Nürnberg, Germany	Feb 16-18
Teknik & Data – Denmark	Feb 9-11	BIAS 2000 – Milan, Italy	Feb 23-26
IPOT Exhibition – Birmingham, UK	Feb 16-17	Nepcon West – Anaheim, CA	Feb 29-Mar 2
MTEC Exhibition – Birmingham, UK	Feb 16-17		



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