

LabVIEW Graphical Programming

LabVIEW

Graphical programming
Rapid development tools
Easy to use and learn
Integrated libraries for
Data acquisition
Instrument control
Analysis
Networking
and more...
Complete flexibility and functionality
Open environment
Compiled for fast execution
Multiplatform
Windows
Mac OS
Sun
HP-UX
Concurrent PowerMAX
Numerous add-on tools

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Better Productivity



LabVIEW is a highly productive graphical programming environment that combines easy-to-use graphical development with the flexibility of a powerful programming language. It offers an intuitive environment, tightly integrated with measurement hardware, for engineers and scientists to quickly produce solutions for data acquisition, data analysis, and data presentation.

Integrated Hardware

LabVIEW has built-in compatibility with hardware libraries for:

- GPIB/VXI/PXI/Computer-based instruments
- RS-232/485 protocol
- Plug-in data acquisition
- Analog/digital/counter timer I/O
- Signal conditioning
- Distributed data acquisition
- Image acquisition and machine vision
- Motion control
- PLCs/data loggers

Powerful Analysis

LabVIEW features comprehensive analysis libraries that rival those of dedicated analysis packages. These libraries are complete with statistics, evaluations, regressions, linear algebra, signal generation algorithms, time and frequency-domain algorithms, windowing routines, and digital filters. See page 70 for more details.

Open Development Environment

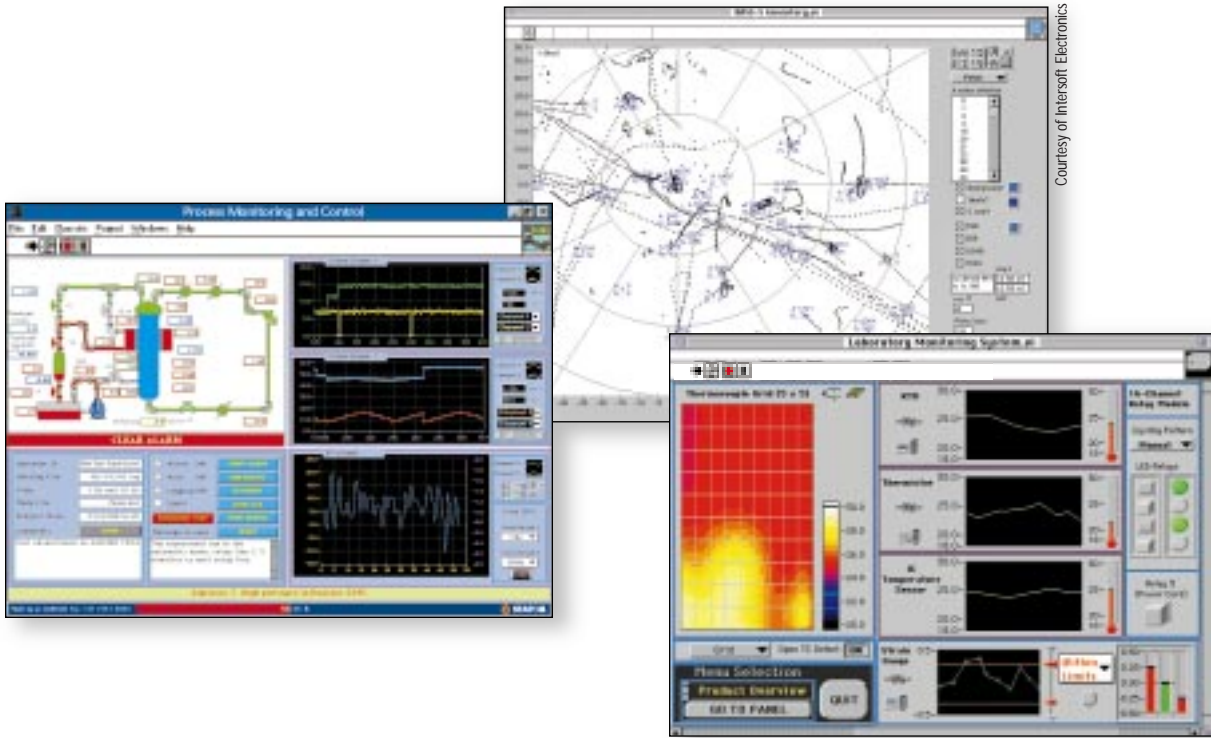
With the open development environment of LabVIEW, you can connect or communicate to any other application through ActiveX, the Internet, DLLs (dynamic linked libraries), shared libraries, SQL (for databases), DataSocket, TCP/IP, DDE, and numerous other protocols.

Optimal Performance

All LabVIEW applications execute at compiled speed for optimal performance. With the LabVIEW Professional Development System or Application Builder, you can also build stand-alone executables for secure distribution to operator stations and the production floor.

LabVIEW Competitive Advantage

LabVIEW



Instrumentation and
Analysis Software

Your Competitive Advantage with LabVIEW

Faster Development

LabVIEW accelerates development by a factor of 4 to 10 over traditional programming. With the modularity and hierarchical structure of LabVIEW, you can rapidly prototype, design, and modify systems in a short amount of time.

Better Investment

As application needs change, LabVIEW virtual instrumentation systems have the flexibility to be modified easily without the need for new equipment. Using a LabVIEW system, each user has access to a complete instrumentation laboratory at less than the cost of a single commercial instrument. LabVIEW is also cross-platform compatible, so that you can always port your systems to the best platform for you. And, National Instruments ensures backward compatibility, so VIs you develop today will be compatible with technologies tomorrow.

Easier Solutions

LabVIEW empowers engineers, scientists, and technicians to design and implement their own systems. Because the LabVIEW programming paradigm is very similar to standard flowchart notation, LabVIEW is extremely intuitive and easy to learn.

Complete Environment

LabVIEW has extensive acquisition, analysis, and presentation capabilities available within a single package, so you can seamlessly create a complete solution. In addition, LabVIEW features an optimized graphical compiler to maximize system performance. Thus, LabVIEW simplifies development and produces reusable code that executes at compiled execution speeds. LabVIEW can create true compiled, royalty-free, stand-alone executables that run on a target machine without a LabVIEW development system.

Simplified Tasks

Numerous LabVIEW add-on software packages simplify complex tasks such as sending data to the Internet, image acquisition, and database programming, by integrating these tools into the LabVIEW development environment.

Ensured Success

By using LabVIEW, you join a large community of successful users who take advantage of a variety of National Instruments programs, services, and support that are designed to make your solution a reality.

LabVIEW Resources

www.natinst.com/labview

Software

Evaluation software
Instrument drivers
Software updates/Beta software
Example programs
Measurement driver software and more...

Support

KnowledgeBase – searchable database of tips, common questions and more...
Application notes and white papers
LabVIEW Wishlist – On-line suggestion forum
On-line catalog and store, and more...

Events

Technical Seminar Series
LabVIEW user group meetings
Trade shows/Product demonstrations
NIWeek – Annual National Instruments developer conference

Training

Course schedules, descriptions, and registration information
Self-Paced training information
Certification Program, and more...

Independent Electronic User Forum

Subscribe: info-labview-request@pica.army.mil
Posts only: info-labview@pica.army.mil

Independent User FTP Site

<ftp.pica.army.mil/pub/labview>

The LabVIEW Library

LabVIEW For Everyone: Graphical Programming Made Even Easier

Lisa Wells and Jeffrey Travis
ISBN 0-13-268194-3

Includes CD-ROM, sample LabVIEW software and hands-on activities to help the user progress from beginner to advanced.

LabVIEW Graphical Programming: Practical Applications in Instrumentation and Control

Gary W. Johnson • ISBN 0-07-032915-X,
In-depth, engineering-level guide to LabVIEW graphical programming. Includes sample software for creating instrumentation, data acquisition, automated test, imaging, sound/video, networking, and other measurement solutions. Includes CD-ROM.

LabVIEW Applications

R. Jamal and H. Picklik • ISBN 0-13-096423-9
Learn how LabVIEW is used in industrial automation, mathematics and simulation, image processing, quality management, and more. Includes CD-ROM.

LabVIEW Signal Processing

M. L. Chugani, A. R. Samant, and Michael Cerna • ISBN 0-13-972449-4

A practical, intuitive guide to LabVIEW signal processing and control system capabilities. Hands-on tasks include arbitrary waveform generation, signal separation, product cost prediction, and more. Includes CD-ROM.

LabVIEW Power Programming

Gary W. Johnson • ISBN 0-07-913666-4
A compilation of advanced programming techniques used by leading LabVIEW developers around the world, from LabVIEW applications in space to LabVIEW-based cryptography. Includes CD-ROM.

Joint Time-Frequency Analysis: Method and Application

Shie Qian and Dapang Chen
ISBN 0-13-254384-2
This book provides a practical, comprehensive introduction to joint time frequency analysis with dozens of samples. Includes CD-ROM.

Sensors, Transducers and LabVIEW: An Application Approach To Virtual Instrumentation

Barry E. Paton • ISBN 0-13-081155-6
This book is packed with devices and circuit problems demonstrating the use of LabVIEW to measure and analyze real-world phenomena for physics, chemistry, mathematics, engineering and medical sciences. Numerous sensors and transducers are introduced. Includes CD-ROM.

LabVIEW Technical Resource Newsletter

By LTR Publishing • www.ltrpub.com
Quarterly publication presenting power tips and techniques to novice and experienced LabVIEW users. Each issue also includes a disk of LabVIEW VIs and utilities that implements methods described in that issue.

See page 853 for ordering information and more details.

LabVIEW Solutions

LabVIEW



Courtesy of Raychem

LabVIEW Applications

LabVIEW systems are implemented in test and measurement, as well as process monitoring and control applications throughout the world. These applications vary widely from transportation systems monitoring, to university laboratory classes; from automated parts testing to industrial process control.

Test and Measurement

LabVIEW has become an industry-standard development tool for test and measurement applications. With TestStand, graphical test programs, and the industry's largest instrument driver library, you have a single, consistent development and execution environment for your entire system.

Process Control and Factory Automation

LabVIEW is well-suited for basic process monitoring and control applications. For larger industrial automation applications, we recommend BridgeVIEW, a specialized product in the LabVIEW family, designed specifically for the industrial automation world. Please see page 179 for details on the BridgeVIEW development environment.

Research and Analysis

The powerful LabVIEW analysis library provides everything you need in an analysis package integrated into the LabVIEW development environment. Scientists and researchers have used LabVIEW to analyze and compute real results for biomedical, aerospace and energy research applications, and in numerous other industries. The signal processing, filtering, windowing, and curve-fitting functions available are all listed on page 71. For specialized analysis, such as joint time-frequency analysis, wavelets, and digital filter design, LabVIEW offers the specially designed Signal Processing Toolset. See page 97 for information on the Signal Processing Toolset.



Courtesy of Datepli, Inc.

"Our LabVIEW-based in-vehicle data acquisition system has been a big hit with our customers. LabVIEW has provided the functionality, creative license, and tools to design systems that meet the cutting-edge requirements of our customers in the automotive industry."

John Date, Vice President Engineering, Datepli, Inc.

Instrumentation and
Analysis Software

User Solutions Articles

The following chart lists just a few of the LabVIEW applications available. These articles describe complete LabVIEW applications spanning numerous industries and technologies, including the ones listed below. You can find a complete listing, and order or download the articles from the Internet or from our automated fax-on-demand system, or contact us for more information.

World Wide Web

www.natinst.com/labview

Fax-on-demand

(800) 329-7177 (U.S./Canada)

Manufacturing and Production	
360318A-01	Raychem Reduces Manufacturing Costs with Graphical Programming
360509A-01	Automating Chromium Waste Treatment with LabVIEW
360542A-01	LabVIEW-Controlled Next-Generation Gas Delivery System for Semiconductor Manufacturers
360643A-01	Automated Cell Tracking Engine Manufacturing

Automotive	
360544A-02	PC-Based Simulation and Monitoring of Automotive Electronic Control Modules
360567A-01	Real-Time Dynamometer Control with LabVIEW
360820A-01	LabVIEW Helps Ford Test Autos in Desert Heat, Automating Physical Testing At Ford

Research	
360482B-01	Measuring Music and More with LabVIEW
360559A-01	Using LabVIEW for Physiological Research
360704A-01	Test System Captures Heart Valve Sounds Using LabVIEW and DAQ Boards
360798A-01	LabVIEW – Our Choice for Cardiothoracic Research

Automated Test	
360331-01	Detecting Intermittent Faults of 757 Aircraft Flap and Slat Controls During Thermal and Vibration Cycling
360432A-01	Simulation-Based Testing of Industrial Gas Turbine Control Systems Using LabVIEW and VXI
360433A-01	SCXI and LabVIEW Test Traulsen Refrigerators and Freezers
360508A-01	Using LabVIEW PID Controller to Assure Electronic Reliability Tests
360519A-01	Testing Submarine Sonar Systems with LabVIEW
N/A	Arco Uses LabVIEW to Test Dashboard Destruction
N/A	Dow Tests Creep in Polymer Plastics with LV/DAQ

Telecommunications	
360937A-02	Detecting Signature Patterns in a Broadcast Message
360581A-31	AT&T Monitors Remote Sites Using LabVIEW System
361054A-02	Developing a LabVIEW-Based, Enterprise-Wide Test Management System

“LabVIEW’s functional test design environment enables rapid development of cost-effective ATE solutions.”

Hugh Williams, Test Equipment Design Leader
British Aerospace (Systems and Equipment) Limited – BASE

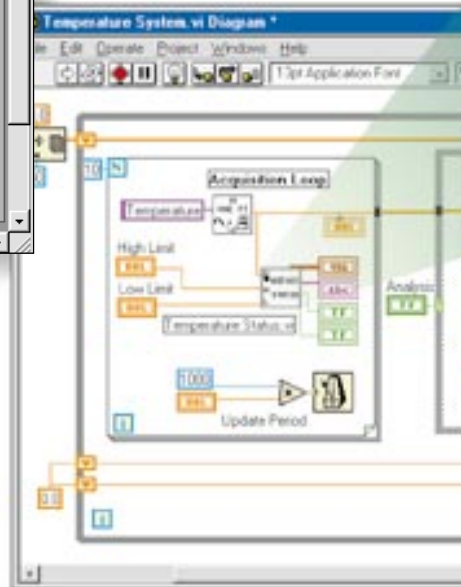
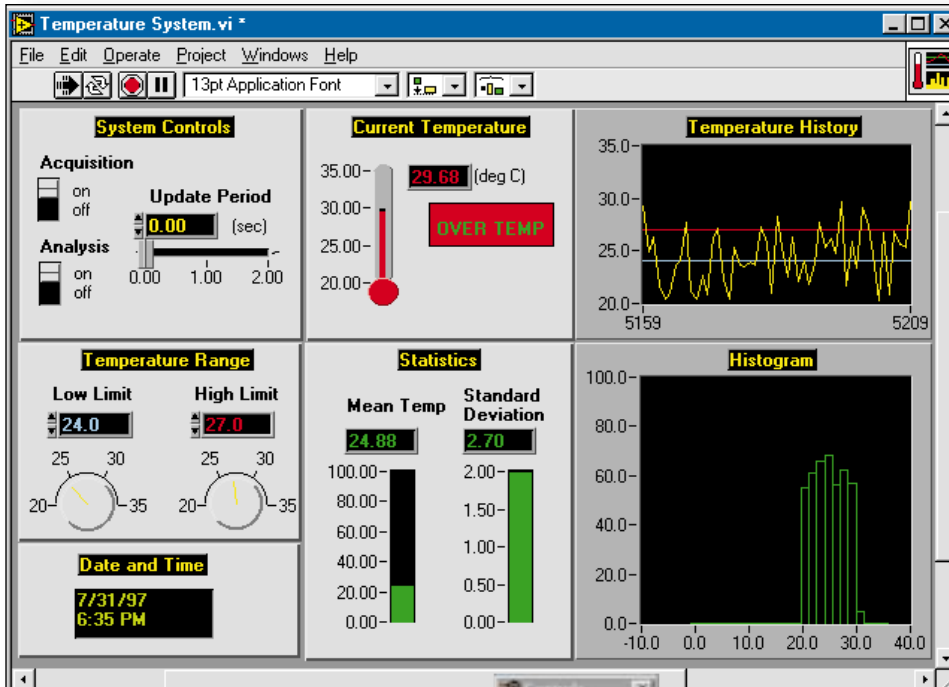
“At CERN, LabVIEW is widely used by scientists and engineers. It does an excellent job in different fields, like testing modular instruments, controlling test benches, and monitoring power equipment.”

Fabio Soso, LabVIEW Software Administrator CERN,
European Organization for Nuclear Research

Monitoring and Control	
360354A-01	Real-Time Control and Monitoring of a Bearing Test Stand with LabVIEW
360407-30	SCXI and LabVIEW Monitor Hydrogen-Powered Eureka Motor Bus
360409-01	LabVIEW Goes into Space Onboard Columbia Shuttle Mission
360496A-01	LabVIEW Delivers a Cross-Platform Interface for the York International Energy Management System
360706A-01	The Use of LabVIEW to Automate Commercial Irrigation
360771A-01	A Gas Sensor Control System in LabVIEW
360779A-01	Temperature Control for Measuring Electronic Circuits Using LabVIEW
360809A-01	High-Speed Remote Process Control with LabVIEW
360812A-01	Radio-Linked Environmental Monitoring and Display System Using LabVIEW
360817A-01	LabVIEW Controls Capture and Display of Four “Live” Video Images
360844A-01	LabVIEW-Based System Puts Dallas Transit on Track
360872A-01	Monitoring Magnetic Resonance Imaging Experiments with LabVIEW

Education	
360480B-01	LabVIEW Helps Teach Physics Lab
360514A-01	Integrated Laboratory Instruction with LabVIEW – Adopting the LabVIEW Standard
360799A-01	Creating Curriculum-Wide Systems for Mechanical Engineering Labs
360802A-01	Teaching Instrumentation in the 21st Century with LabVIEW
360803A-01	LEGO Building Blocks and LabVIEW Teach Laboratory Skills

LabVIEW Graphical Programming



Draw Your Own Solution

With LabVIEW, you build VIs instead of writing programs. You quickly create front panel user interfaces, giving you the interactive control of your software system. To specify the functionality, you intuitively assemble block diagrams – a natural design notation for engineers and scientists.

Create the Front Panel

On the front panel of your VI, you place the controls and data displays for your system by choosing objects from the Controls palette, including numeric displays, meters, gauges, thermometers, tanks, LEDs, charts, graphs, and more. When your VI is complete, you can use the front panel to control your

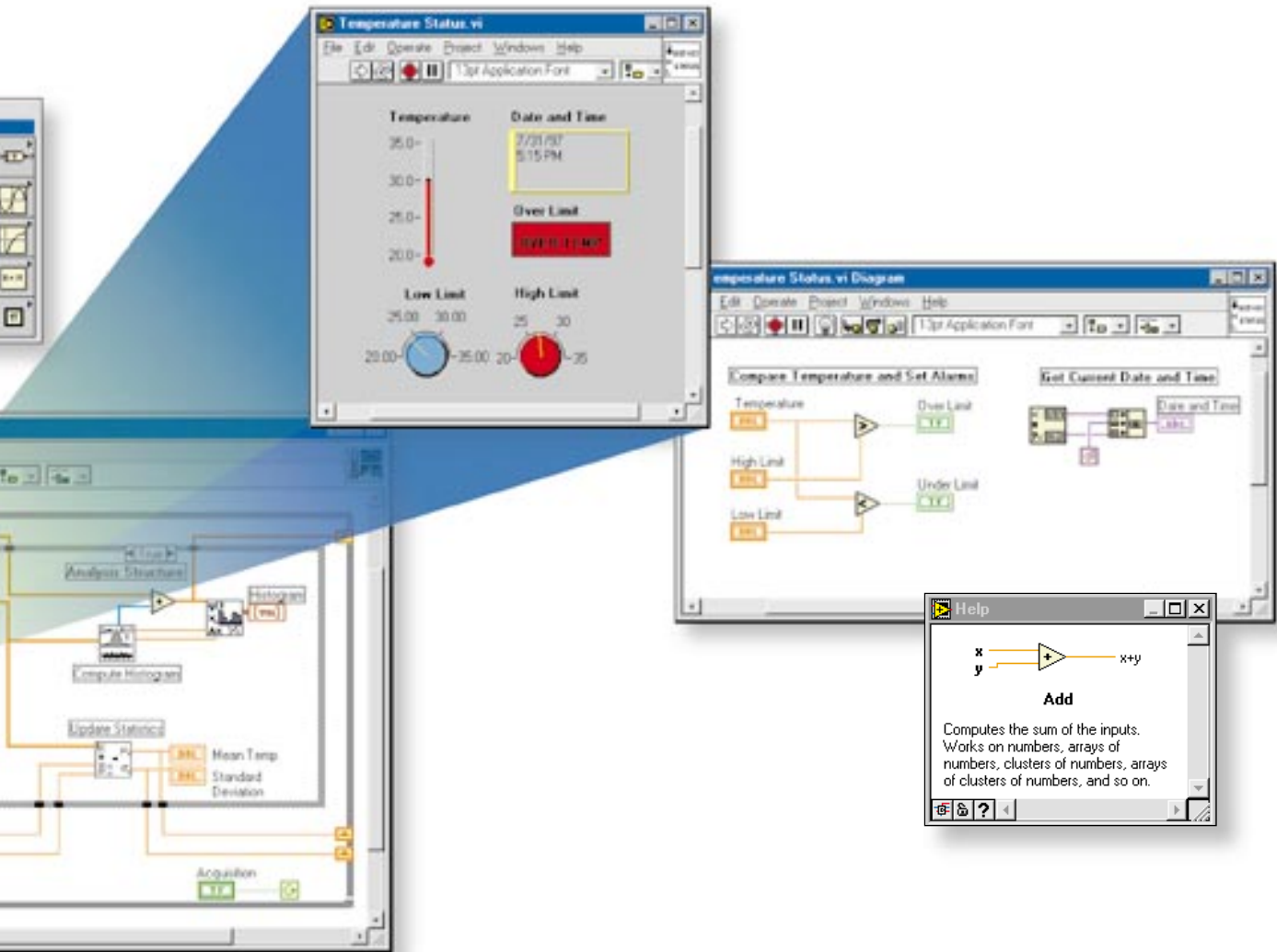
system – while the VI is running – by moving a slide, zooming in on a graph, entering a value from the keyboard, and more.

Construct the Graphical Block Diagram

To program the VI, you construct the block diagram without worrying about the many syntactical details of conventional programming. You select objects (icons) from the Functions palette and connect them with wires to pass data from one block to the next. These blocks range from simple arithmetic functions, to advanced acquisition and analysis routines, to network and file I/O operations.

LabVIEW

Graphical Programming



Dataflow Programming

LabVIEW uses a patented dataflow programming model that frees you from the linear architecture of text-based languages. Because the execution order in LabVIEW is determined by the flow of data between blocks, and not by sequential lines of text, you can create diagrams that have simultaneous operations. Consequently, LabVIEW is a multitasking system – running multiple execution threads and multiple VIs.

Modularity and Hierarchy

LabVIEW VIs are modular in design, so any VI can run by itself or be used as part of another VI. You can even create an icon for

your own VIs, so you can design a hierarchy of VIs and subVIs that you can modify, interchange, and combine with other VIs to meet your changing application needs.

Graphical Compiler

In many applications, execution speed is critical. LabVIEW is the only graphical programming system with a compiler that generates optimized code with execution speeds comparable to compiled C programs. With the built-in Profiler, you can even analyze and optimize time-critical sections of code. Consequently, you can increase your productivity with graphical programming without sacrificing execution speed.

LabVIEW

Graphical Programming

The list below covers only part of the functionality available in the complete LabVIEW development system. Contact us for free fully functional LabVIEW Evaluation software, or complete a request form over the web at www.natinst.com/labview

Controls and Indicators

- Buttons/switches/LEDs
- Slides/digital displays
- Gauges/dials/knobs
- Tanks/thermometers
- Graphs/charts
- Tables/arrays
- Intensity plots
- Menus/lists/rings
- Text boxes
- Decorations
- Custom controls, and more...

Instrument Control

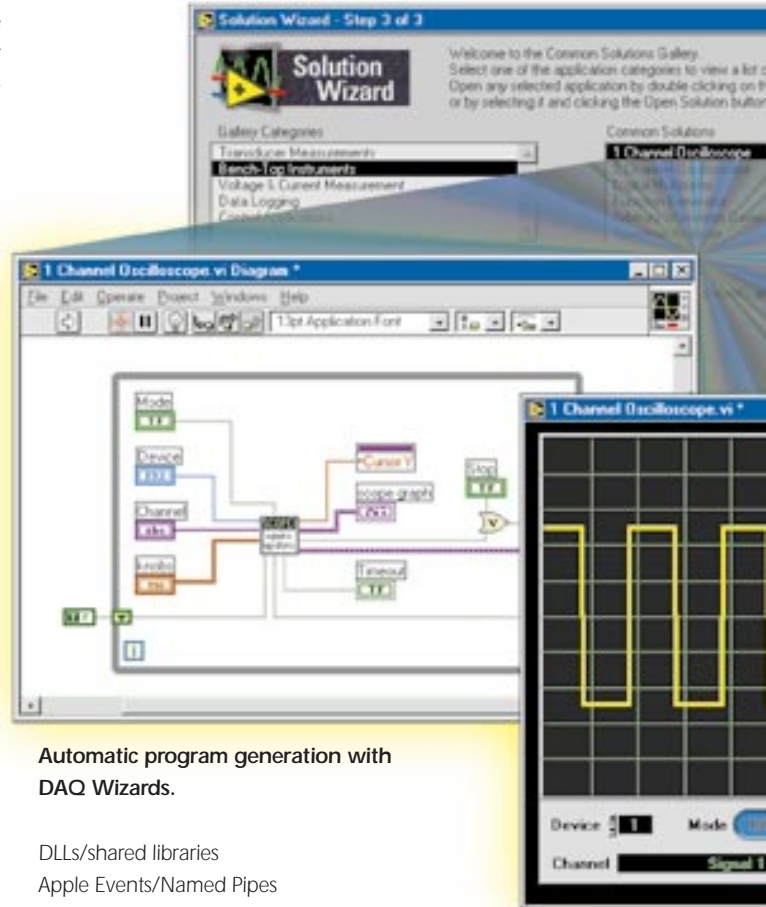
- GPIO/CAMAC/VXI/PXI
- Serial/RS-232
- PLC
- More than 650 instrument drivers

File I/O

- Spreadsheet
- Binary/ASCII

Open Connectivity

- Internet
- SQL*
- DataSocket
- TCP/IP
- ActiveX/DDE



Automatic program generation with DAQ Wizards.

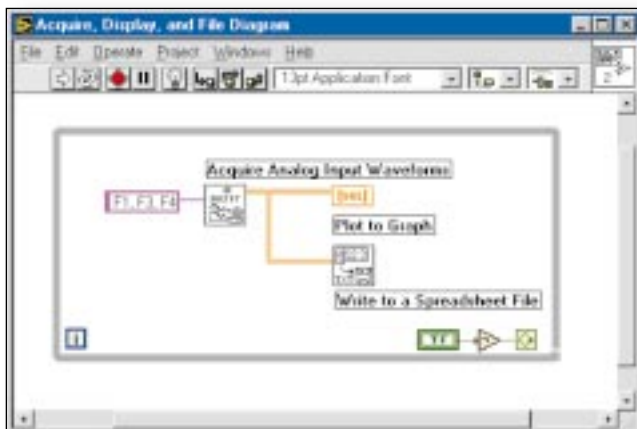
- DLLs/shared libraries
- Apple Events/Named Pipes

Data Acquisition

- DAQ Wizards
- Single point input/output
- Waveform acquisition/generation
- Image acquisition*
- Motion control*
- Signal conditioning
- Triggering/timing
- TTL/CMOS input/output
- Digital pattern generation
- Digital handshaking
- Pulse generation
- Event counting
- Edge detection
- Period and pulsewidth measurement, and more...

Programming Structures

- While loops/For loops
- Case structures
- Sequential structures



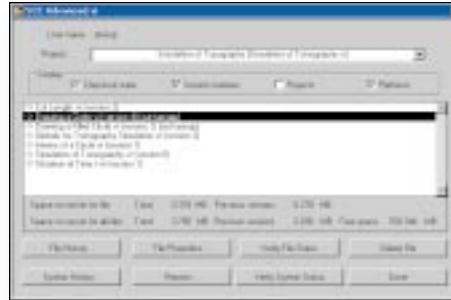
Acquire data, display, and write to file.

LabVIEW

Graphical Programming

Programming Fundamentals

- Numeric computation
- Boolean logic
- Array/String manipulation
- Time & Date functions
- Multi-datatype structures
- Custom subroutines



Visualization

- 3D plots**
- Surface mesh/Contour plots**
- Custom graphics/animation**

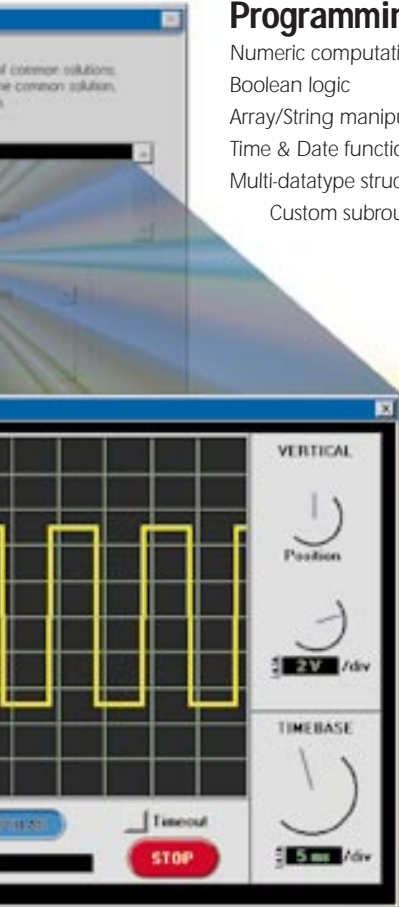
Optimization and Applications Management

- Profiler for memory usage and execution time tracking
- True compiled performance on all platforms
- Multithreading
- Source code control/Complexity metrics***
- Hierarchy window
- Print documentation set
- Report generation**
- Documentation for quality standards***

Debugging

- Breakpoints
- Probes/custom probes
- Single-step mode
- Execution highlighting
- Help window
- Online Help

- * See LabVIEW Add-On Toolsets for details
- ** Included in the Full and Professional Development Systems
- *** Included in the Professional Development System

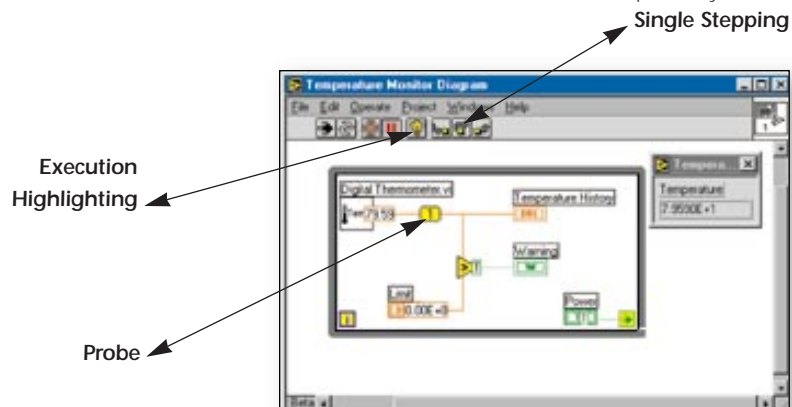


Signal Processing

- Signal generation**
 - Signal processing**
 - Image processing*
 - Curve fitting
 - Windowing**
 - Filtering**
- See page 70 for more details.

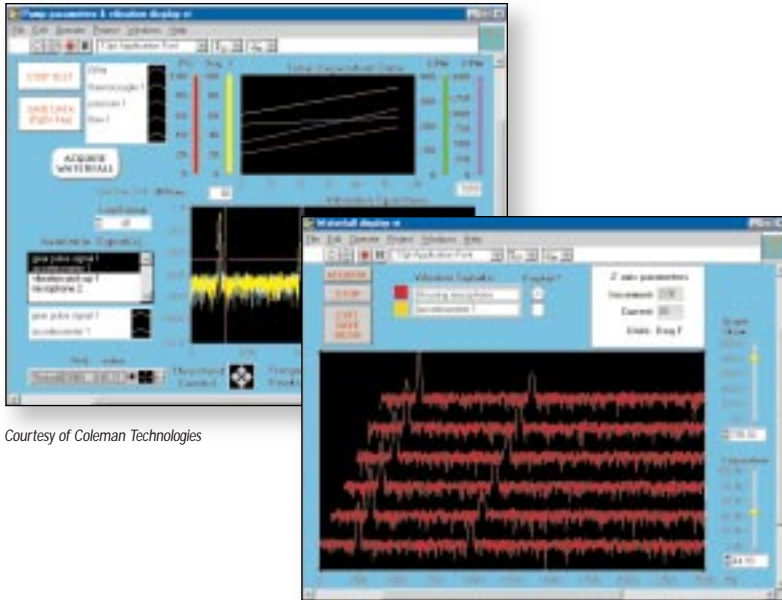
Math

- Text-based formula nodes
 - Ordinary differential equations**
 - Optimization methods**
 - Root solving**
 - Gamma/Bessel/Jacobi/Beta and other functions**
 - Linear algebra
 - Statistics and more...
- See page 70 for more details.



LabVIEW Analysis

LabVIEW



Courtesy of Coleman Technologies

Courtesy of Coleman Technologies

Instrumentation and
Analysis Software

Built-in Analysis

With LabVIEW, you have the built-in analysis capabilities you need to eliminate noise, and to condition and transform the signal for your measurements.

Signal Processing Fundamentals

The following is a quick tutorial of some signal processing fundamentals to help you create your analysis applications.

Smoothing Windows

Smoothing windows are used in spectral analysis to reduce the spectral leakage that results from using the FFT on a block of discrete data called a time record. The underlying assumptions of the Fourier transform algorithm can create unwanted spikes or "spectral leakage" in the frequency domain transformed data. You can reduce the spectral leakage by selecting the correct smoothing window for your application.

Smoothing windows, such as the Blackman-Harris window, minimize the spectral leakage in signals acquired from a DAQ board. The dynamic signals are analyzed by magnitude/phase response, power spectrum, correlation, impulse response, and transfer function. Windowing functions reduce distortion in the spectra. LabVIEW windowing functions are specified on page 71.

Digital Filters

Digital filters are used to remove unwanted frequency components in a signal caused by noise effects between electrical components, or environmental effects such as a 60 Hz power supply. In addition to removing unwanted frequency components from signals, filters can be used to separate a signal into a frequency band of interest. LabVIEW has three types of filters – infinite impulse response (IIR), finite impulse response (FIR), and nonlinear filters. Digital filters have several advantages over analog filters – they are software programmable, do not drift with temperature or humidity or require precision components, and they have a superior performance-to-cost ratio.

Once you know the filter coefficients, you can easily create your own FIR and IIR filters with LabVIEW. Plus, you can interactively design digital filters using the Signal Processing

Toolset (see page 97). The toolset can output the filter design so that you can implement the filter within LabVIEW.

Frequency Domain Transforms

Spectral analysis functions are typically used to calculate the frequency components of signals. Frequency content reveals information that is not available with traditional time domain analysis. The Fast Fourier Transform (FFT) is the most common transform, but other functions such as power spectrum, Hartley, and Hilbert transforms are also used.

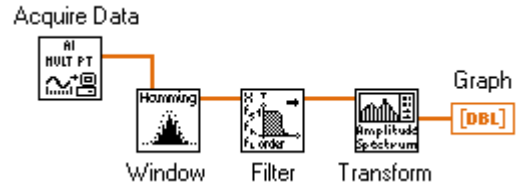
For example, spectral analysis functions could be used for testing the strength of materials used in airplane propellers. A propeller blade is struck with a small hammer and the resulting vibration signal is detected with a strain gauge, and transformed into the frequency domain with the Power Spectrum function. The peaks in the spectrum and their decay rates are helpful in detecting failure modes in the propeller.

Measurement Functions

Functions for measuring total harmonic distortion (THD), impulse responses, frequency response, amplitude spectrum, cross spectrum, and power spectrum are part of LabVIEW. These functions make it easy to make complex analysis measurements using DAQ hardware.

LabVIEW Data Analysis and Math Libraries

Listed below are the Analysis libraries available for the LabVIEW Full Development System and the Professional Development System. For additional information on LabVIEW add-on analysis tools, please refer to our add-on software guide starting on page 74.



Measurement

AC & DC Estimator
 Amp & Freq Estimate
 Amplitude and Phase Spectrum
 Auto Power Spectrum
 Cross Power Spectrum
 Harmonic Analyzer
 Impulse Response
 Network Functions (avg)
 Power & Frequency Estimate
 Scaled Time Domain Window
 Spectrum Unit Conversion
 Transfer Function

Signal Generation

Arbitrary Wave
 Chirp Pattern
 Gaussian White Noise
 Impulse Pattern
 Periodic Random Noise
 Pulse Pattern
 Ramp Pattern
 Sawtooth Wave
 Sinc Pattern
 Sine Pattern
 Sine Wave
 Square Wave
 Triangle Wave
 Uniform White Noise

Windowing

Blackman Window
 Blackman-Harris Window
 Cosine Tapered Window
 Exact Blackman Window
 Exponential Window
 Flat Top Window
 Force Window
 General Cosine Window
 Hamming Window
 Hanning Window

Kaiser-Bessel Window
 Triangle Window

Filters

Bessel Filter
 Butterworth Filter
 Cascade->Direct
 Coefficients
 Chebyshev Filter
 Elliptic Filter
 Equi-Ripple Filter
 FIR Filter
 FIR Narrowband Filter
 FIR Windowed Filter
 IIR Cascade Filter
 IIR Filter with I.C.
 IIR Filter
 Inverse Chebyshev Filter
 Median Filter
 Parks-McClellan

Statistics

1D, 2D, and 3D ANOVA
 Chi Square Distribution
 Contingency Table
 erf(x) and erfc(x)
 F Distribution
 General Histogram
 Histogram*
 Inv Chi Square Distribution
 Inv F Distribution
 Inv Normal Distribution
 Inv T Distribution
 Mean*
 Median*
 Mode*
 Moment about Mean
 MSE
 Normal Distribution
 Polynomial Interpolation
 Rational Interpolation
 RMS
 Spline Interpolant

Spline Interpolation
 Standard Deviation*
 T Distribution
 Variance

Signal Processing

AutoCorrelation
 Convolution
 Cross Power
 CrossCorrelation
 Decimate
 Deconvolution
 Derivative x(t)
 Fast Hilbert Transform
 Fast Hartley Transform
 Integral x(t)
 Inverse Real and Complex FFT
 Inverse Fast Hilbert Transform
 Inverse FHT
 Peak Finding
 Power Spectrum
 Pulse Parameters
 Real and Complex FFT
 Threshold Peak Detector
 Unwrap Phase
 $Y[i]=Clip\{X[i]\}$
 $Y[i]=X[i-n]$

Curve Fitting

Exponential Fit
 General LS Linear Fit
 General Polynomial Fit
 Linear Fit
 Nonlinear Lev-Mar Fit
 1D and 2D Linear Evaluation*
 1D Polar to Rectangular
 1D and 2D Polynomial Evaluation*
 1D Rectangular To Polar
 Numeric Integration
 Polar To Rectangular

Quick Scale 1D and 2D
 Rectangular To Polar
 Scale 1D and 2D
 Find Polynomial Roots

Linear Algebra

A x B*
 A x Vector*
 Determinant*
 Dot Product*
 Inverse Matrix*
 Linear Equations
 Normalize Matrix and Vector
 Outer Product*
 Trace
 Unit Vector
 LU Factorization
 Cholesky Factorization
 QR Factorization
 SVD Factorization
 Eigen Vectors and Eigen Values
 Matrix Condition Number
 Matrix Norm and Rank
 Pseudo Inverse Matrix
 Complex LU Factorization
 Complex Cholesky Factorization
 Complex QR Factorization
 Complex SVD Factorization
 Complex Inverse Matrix
 Solve Complex Linear Equations
 Complex EigenVectors and Values
 Complex Determinant
 Complex Matrix Condition Number
 Complex Matrix Norm and Rank
 Complex Pseudo Inverse Matrix

Complex A x B
 Complex A x Vector
 Complex Dot Product
 Complex Outer Product
 Complex Vector Norm
 Generate a Special Matrix
 Test Positive Definite Matrix

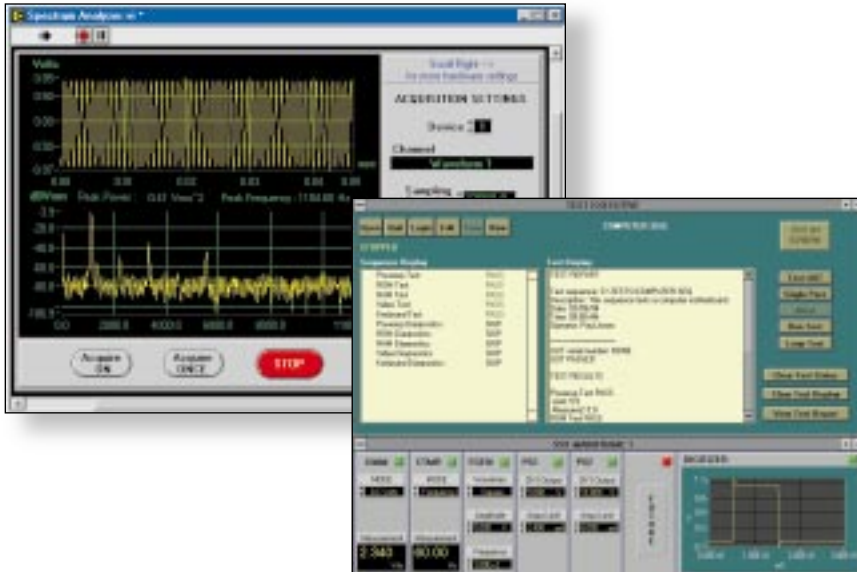
Mathematics

Ordinary Differential Equations
 Euler Method
 Runge Kutta
 Cash Karp
 Linear Systems
 And more...
 Optimization
 Levenberg Marquardt
 Linear Programming
 Brent Derivative
 Downhill Simplex
 Root Solving
 Strurms Chain
 Newton Raphson
 Ridders
 Integration
 Differentiation
 Laplace Transform
 Wavelet Daubechies Transform
 Functions
 Gamma
 Bessel
 Jacobi
 Beta
 Chebyshev Polynomial
 Binomial Coefficient
 And many more...

*Denotes Base Analysis VIs

LabVIEW Professional Tools

LabVIEW



Source Code Control

With the built-in source code control utilities, you can easily check your VIs out of a development project to begin development work, and later, check those VIs back in to the project, ensuring that no two developers modify a VI at the same time. In addition to regulating changes made to VIs, these source code control utilities also help you maintain version control of your applications. You can either take advantage of the built-in source code control utilities, or you can integrate with other standard source code control packages, such as Microsoft Visual SourceSafe. Contact National Instruments for a compatibility list of additional third-party source code control tools.

LabVIEW Professional Development System

The LabVIEW Professional Development System (PDS) includes tools for developers of stand-alone applications as well as high-end, large-scale applications. These professional features particularly help developers who work in teams, users developing large suites of VIs, and programmers needing to adhere to stringent quality standards.

Stand-Alone Applications

You can create stand-alone executables from your VIs with a simple selection from the menu. The executable will run, but cannot be edited. Stand-alone applications are an efficient way to package and distribute proprietary VIs as turnkey systems and factory floor applications. Stand-alone applications execute at the same high performance rates as VIs in the development system.

No Licensing Fees

You may distribute stand-alone applications with no licensing fees. If you distribute executables using LabVIEW add-on tools, please consult the add-on tools section for additional licensing information.

Graphical Differencing

You can use the graphical differencing features to compare two LabVIEW applications to determine both the cosmetic and functional differences between them. You can compare two VIs or two hierarchies of VIs and clearly see the differences, making it easier for you to track changes in similar code.

Complexity Measurements

When designing large suites of VIs or bidding on projects, it is often important to estimate the amount of time it will take to complete a project, as well as to determine the complexity of your application. You can use the code complexity utilities to examine the complexity of existing VIs and use that information to estimate the amount of development time needed to complete future projects.

Software Engineering with LabVIEW

The LabVIEW PDS includes a manual detailing how to apply software engineering practices to the development of LabVIEW applications. This information helps programmers design large applications and build organized, well-structured suites of VIs. These programming standards are useful for development teams to help ensure consistency of interfaces and structure throughout the application. Users at all experience levels will find the techniques in these standards to be useful in building high-quality LabVIEW applications.

Quality Standards

Large LabVIEW applications must often adhere to strict quality standards to achieve ISO 9000 and FDA approval, and adhere to internal regulations. The Professional Development System includes a discussion of the steps LabVIEW users must follow to meet such standards. Case studies of actual customer applications are discussed, and tips and techniques are presented.

Instrumentation and
Analysis Software

LabVIEW Development Systems

LabVIEW

	LabVIEW Professional Development System	LabVIEW Full Development System	LabVIEW Base Package [†]
Controls and indicators	Green	Blue	Purple
Programming structures and fundamentals	Green	Blue	Purple
Instrument control	Green	Blue	Purple
Data acquisition	Green	Blue	Purple
File I/O and report generation	Green	Blue	Purple
Debugging	Green	Blue	Purple
Multithreading	Green	Blue	Purple
ActiveX [†] , TCP/IP, DDE [†] , DataSocket	Green	Blue	Purple
Linear algebra and array operations	Green	Blue	
Probability and statistics	Green	Blue	
Curve fitting	Green	Blue	
Fourier, Hilbert, and other transforms	Green	Blue	
Amplitude/phase/power spectra	Green	Blue	
Pattern/noise generation	Green	Blue	
Impulse response	Green	Blue	
Peak detectors	Green	Blue	
IIR/FIR filters	Green	Blue	
Butterworth/Chebyshev and other nonlinear filters	Green	Blue	
Windowing	Green	Blue	
Interpolation algorithms	Green	Blue	
Ordinary differential equations	Green	Blue	
Optimization algorithms	Green	Blue	
Root solving	Green	Blue	
Integration/differentiation	Green	Blue	
Gamma/Bessel/Jacobi and other functions	Green	Blue	
Surface mesh/contour plots	Green	Blue	
Custom graphics and animation	Green	Blue	
Report generation tools	Green	Blue	
Stand-alone executables	Green		
Create installation tools [†]	Green		
Graphical differencing	Green		
Source code control	Green		
Complexity metrics	Green		
Large project documentation tools	Green		
Software engineering with LabVIEW documentation	Green		
Quality and programming standards documentation	Green		
[†] Available only for Windows platforms			

Instrumentation and Analysis Software

LabVIEW

Add-On Toolsets

Add-On Software for LabVIEW

LabVIEW also offers additional tools specifically designed to help make your application development easier for specialized tasks. All of the following tools integrate seamlessly into LabVIEW so you can continue to work in a single, consistent, easy-to-use development environment.

Third Party Add-On Software Tools

In addition to the many add-on products available from National Instruments, numerous other add-on software tools are available from third party companies. For more information and an on-line shopping guide of third-party add-on software tools, check out the VMarket at www.vimarket.com

Application Area	Add-On Toolset	Features
Automated Test	Automated Test Toolset	TestStand Automated test sequencer Access through multiple user profiles SQL database connectivity SPC for quality control Complete IVI driver library
Enterprise Connectivity	Enterprise Connectivity Toolset	SQL database connectivity SPC for quality control Internet-enabled applications
PID and Fuzzy Logic Control	PID Control Toolset	PID control algorithms including autotuning, lead/lag, setramp calculations, and more Fuzzy logic control algorithms including membership functions and defuzzification methods Integration with NI-DAQ and DAQ hardware
System Simulation and Design	System Simulation and Design Toolset	Simulation and control of nonlinear systems Direct connection to National Instruments hardware Ready-to-use control elements for PID, relays, filters, and more Manager, synchronizer, and monitor for real-time behavior Bode, Nyquist, and root locus plots
Advanced Signal Processing	Signal Processing Toolset	Joint time-frequency analysis Digital filter design Wavelet and filter bank design Third-octave analyzer and analysis libraries Super-resolution frequency analysis
Vision/Imaging	Vision Development Toolset	IMAQ Vision image processing libraries Vision Builder
Motion Control	Motion Control Tools	Control National Instruments motion control boards More than 300 powerful VIs High-level examples Set-up file save-to-disk feature Motion function libraries

For more details on the above add-on software tools, please refer to the LabVIEW Toolsets section beginning on page 86.

LabVIEW Instrument Drivers

Instrument Drivers – The Key to Productive Test Development

Instrument drivers are the key to improving your test programming productivity. An instrument driver is a set of high-level, intuitive functions for controlling a GPIB, VXI, RS-232/485, or computer-based instrument. The instrument driver functions handle the instrument command syntax, I/O interface protocol, data parsing, and scaling for you. LabVIEW has drivers for more than 650 instruments from all major instrument manufacturers.

Instrument drivers not only save you programming time and effort but also apply an important modular coding structure to your test programs. LabVIEW instrument drivers package instrument capabilities as a set of standard VIs. Each VI corresponds to a programmatic operation, such as configuring, reading from, writing to, and triggering the instrument. LabVIEW instrument drivers reduce your test program development time and simplify instrument control by eliminating the need to learn the complex, low-level programming protocol for each instrument.

The VXIplug&play Systems Alliance has endorsed LabVIEW instrument drivers as a core technology and a basis for industry standardization. LabVIEW is fully VXIplug&play compliant and can run all graphical and C-based instrument drivers that are VXIplug&play compliant. LabVIEW can automatically detect and load any VXIplug&play driver that is installed on your system

IVI (Interchangeable Virtual Instruments)

IVI is a new architecture for building advanced instrument drivers. IVI instrument drivers are designed to handle the more rigorous requirements of production test systems for speed, flexibility, and long-term reusability. With IVI, you can build hardware and protocol-independent (GPIB, VXI, or RS-232) test programs, so you can preserve your investment in test software as your instruments and instrumentation platforms change. In addition to interchangeability, IVI drivers provide instrument simulation and high-speed state caching. See page 87 for more details on IVI instrument drivers.



Instrument Driver Network

You can download any of our LabVIEW and LabWindows/CVI Instrument Driver Libraries from the Instrument Driver Network, on the World Wide Web at www.natinst.com/idnet. Refer to page 81 for details.



The LabVIEW Instrument Wizard detects your instruments, installs instrument drivers, and generates an example program in a few mouse clicks.

LabVIEW Drivers for Industrial Automation



Courtesy Analabs, Inc.

Courtesy Allen-Bradley, Inc.

PLC and Device Servers

Some applications have real-time control needs or harsh environmental conditions that require use of PLCs or other devices. Our Industrial Automation Servers, described in detail on page 187, provide a standard programming interface to a range of PLCs, process controllers, analyzers, and industrial device networks. A device server is comprised of software components that perform basic I/O, provide the necessary communication protocol to exchange data and status information from a device, and manage the resources required for communications. For systems requiring continuous data updates from external devices as well as the remote control and resource management of multiple PLCs, and other factory-floor hardware and protocols, the Industrial Automation Servers combined with corresponding VI libraries provide an easy-to-use configurable interface between LabVIEW and BridgeVIEW, and numerous industrial automation devices.

Distributed I/O

LabVIEW also controls the National Instruments FieldPoint distributed I/O system, described on page 463, using the software server included free of charge. FieldPoint modules include discrete analog and digital I/O as well as RS-232/485 network modules.

These I/O modules mount onto either a screw terminal or spring terminal base. Adjacent terminal bases connect, forming a high-speed local bus, and mount directly onto a DIN rail or panel. FieldPoint features designed specifically for industrial automation include programmable power up, watchdog timers, a compact DIN rail package, and so on.

Industrial Communications Interfaces

National Instruments also offers industrial communications products to interface with networks such as FOUNDATION Fieldbus, PROFIBUS, CAN, and DeviceNet. In addition, RS-232/485 serial interfaces for ISA, PCI, and PCMCIA provide standard connections to the PC from devices using those serial protocols. These products are programmable through LabVIEW VIs that communicate with driver level software. Please see page 806 for more information.

BridgeVIEW

For systems communicating with PLCs, National Instruments FieldPoint, or large numbers of channels of data acquisition, National Instruments recommends BridgeVIEW. BridgeVIEW begins with the LabVIEW development system and adds to it an event-driven engine that simplifies development of industrial monitoring, alarm management, and networking applications. BridgeVIEW combines the graphical programming language of LabVIEW with additional features for the industrial automation market. These additional features include OPC connectivity, security, and automation symbols. See page 179 for details on BridgeVIEW.

Industrial Communications Products	Description
AT-DNET, PCMCIA-DNET, PCI-DNET	Interfaces to DeviceNet
AT-CAN, PCMCIA-CAN, PCI-CAN	Interfaces to CAN
AT-FBUS, PCMCIA-FBUS	Interfaces to FOUNDATION Fieldbus
PC1500PFB	Interface to PROFIBUS
AT-485, AT-232, PCMCIA-485, PCMCIA-232, PCI-485, PCI-232	Interfaces to RS-485 and RS-232

Table 1. National Instruments Industrial Communications Interfaces

LabVIEW Localized Graphical Programming

LabVIEW



Localized Versions – Japanese, French, and German

Engineers and scientists, regardless of their primary language, conceptualize work in block diagrams, not text, so the programming methodology of LabVIEW matches this familiar style. Localized versions of LabVIEW give engineers and scientists from around the world a more natural and comfortable programming environment for developing applications in their native language. National Instruments offers versions of LabVIEW specifically for the Japanese, French, and German markets.

The LabVIEW Japanese version features completely localized software, documentation, and on-line help. It works with the Japanese versions of Windows NT/98/95/3.1, NEC Windows, and Japanese versions of Mac OS for the PowerPC processor.

The LabVIEW German and French versions each currently feature translated documentation and software. They work with Windows NT/98/95/3.1. In addition, all LabVIEW development systems have built-in tools to help ease the process of translating applications from one language to another.

Worldwide Commitment to Success

National Instruments is committed to the continued success of LabVIEW programmers worldwide. These fully localized versions in German, French, and Japanese, with translated manuals and reference materials, will help more LabVIEW users develop faster and achieve success. The LabVIEW software environment that includes localized menus, virtual instrument (VI) libraries, dialog boxes, and numerous examples, eases development and optimizes performance.

For a free evaluation version or for ordering information, please contact your local National Instruments office.



Instrumentation and
Analysis Software

LabVIEW

Cross-Platform Compatibility




LabVIEW




System Requirements

You can use LabVIEW on the operating system of your choice without sacrificing portability or reusability. The LabVIEW development system recompiles VIs on any of the platforms listed below so that you have the flexibility to work with the operating system that makes the most sense for your task, and still retain the ability to transfer and reuse VIs across your enterprise.

Instrumentation and
Analysis Software

Operating System	System Requirements
Windows NT/98/95	
	16 MB RAM, 32 MB recommended 486/DX, Pentium recommended For Windows NT users: Version 4.0, or later 85 MB disk space for full LabVIEW installation
Mac OS (PowerPC)	
	24 MB RAM Mac OS 7.12 or later 120 MB disk space for full LabVIEW installation
Solaris	
	32 MB RAM Solaris 2.4 or later XWindow System Software 75 MB disk space for full LabVIEW installation

Operating System	System Requirements
HP-UX	
	32 MB RAM HP 9000 workstation, Model 700 Series HP-UX 10.0 or later HP-VUE/CDE 75 MB disk space for full LabVIEW installation
Concurrent PowerMAX	
Available for:	Night Hawk systems Power Hawk systems PowerMAXION systems Power Stack systems

Contact National Instruments for additional platform information.

LabVIEW for Windows NT/98/95

Development Systems	Part Number	Page
Full Development System (CD)	776670-03	73
Professional Development System (CD)	776678-03	73
Base Package (CD)	776671-03	73
Application Builder (3.5 in.)	776675-01	85
Add-On Software and Services		
Automated Test Toolset.....	777868-03	86
Enterprise Connectivity Toolset	777871-03	89
PID Control Toolset	777874-03	93
Vision Development Toolset	777859-03	102
Signal Processing Toolset	777136-01	97
System Simulation and Design Toolset	777553-03	95
Motion Control Tools		
FlexMotion VIs	777629-01	105
ValueMotion VIs.....	777628-01	105
Automation Symbols Toolkit	777372-01	106

LabVIEW for Mac OS

Full Development System (CD)	776690-03	73
Professional Development System (CD)	776698-03	73
Application Builder (3.5 in.)	776695-01	85
Add-On Software		
Test Executive Toolkit	776731-21	60
Enterprise Connectivity Toolset	777871-23	89
PID Control Toolset	777874-23	93
IMAQ Vision	777413-03	102
Motion Control Tools		
ValueMotion VIs.....	777628-21	105
Automation Symbols Toolkit	777372-21	106

LabVIEW for Sun

Full Development System (CD)	776680-031	73
Professional Development System (CD)	776688-03	73
Application Builder	776685-01	85
Add-On Software		

Contact your local National Instruments office for ordering information or visit www.natinst.com/labview

LabVIEW for HP-UX

Development Systems	Part Number	Page
Full Development System (CD)	777010-031	73
Professional Development System (CD)	777018-03	73
Application Builder	777015-01	85

Add-On Software

Contact your local National Instruments office for ordering information or visit www.natinst.com/labview

LabVIEW for Concurrent PowerMAX

Full Development System (DAT Tape)	777020-041	73
Add-On Software and Services		
Application Builder (DAT Tape)	777025-04	85
PID and Automation Symbols Toolkit (DAT Tape)	776634-04	93

LabVIEW Service and Support

Windows

LabVIEW Software		
Subscription Program	930000-02	834
Basics I Training Course	910013-xx'	845
Basics II Training Course	910017-xx'	845
Advanced Modules Course	910514-xx'	845

Mac OS

LabVIEW Software		
Subscription Program	930000-01	834
Basics I Training Course	910013-xx'	845
Basics II Training Course	910017-xx'	845
Advanced Modules Course	910514-xx'	845

Sun

LabVIEW Software		
Subscription Program	930000-031	834

HP-UX

LabVIEW Software		
Subscription Program	930000-051	834

Part numbers listed denote single-user licenses. For multiuser licenses contact National Instruments.

*Please refer to Customer Education section to complete the part number.