SOLUTION BROCHURE

# Aerospace and Defense Electronics Manufacturing Test

Production Test Solutions for Board Electronics, System Controllers, and Electromechanical Systems

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# Solution Overview

## Mitigate Risk with a Proven Strategy for Test Program Set Development

Test engineering leaders must manage cost and risk when building test capability and overseeing legacy programs. Aerospace and defense organizations around the world are being asked to learn and integrate new technologies, manage new and often unbudgeted corporate or government mandates, and maintain legacy test equipment for years longer than originally planned.

For decades, the aerospace and defense industry has used NI's modular instrumentation and application software to reduce the overall cost and risk associated with the test and support of its products. NI's solution for automated test equipment (ATE) and test program set development (TPS) scales to meet your current and future electronic and electromechanical test needs.



Figure 1. NI's solution for ATE and TPS development scales to meet your current and future electronic and electromechanical test needs.

**System Benefits**

- Take advantage of a solution developed by NI, the only vendor to offer a full suite of tried-and-tested modular software components, from world-class hardware integration to development environments and test executives to system management and manufacturing execution system (MES) integration.

- Develop comprehensive hardware and measurement abstraction layers, code modules, and fully customizable sequencing engines and automation frameworks with LabVIEW, LabWindows™/CVI, TestStand, and world-class hardware integration tools such as Switch Executive. All are designed for automated test applications.

- Create deployment packages, manage system configurations, streamline data aggregation and insight, and connect to MESs using SystemLink™ software.

- Integrate hardware from different vendors and code from different languages into a single TPS.

- Monitor and interactively debug system errors using InstrumentStudio™ software.

- Accelerate your learning with NI's user community and company-specific and geographic user groups. Also build proficiency with extensive online and in-person training options for both new users and certified architects in NI tools.

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# A Platform-Based Approach to TPS Development

## What Is PXI?

Powered by software, PXI is a rugged PC-based platform for measurement and automation systems. It combines PCI electrical-bus features with the modular, Eurocard packaging of CompactPCI and then adds specialized synchronization buses and key software features. PXI is both a high-performance and low-cost deployment platform for applications such as manufacturing test, military and aerospace, machine monitoring, automotive, and industrial test. Developed in 1997 and launched in 1998, PXI is an open industry standard governed by the PXI Systems Alliance (PXISA), a group of more than 70 companies chartered to promote the PXI standard, ensure interoperability, and maintain the PXI specification.
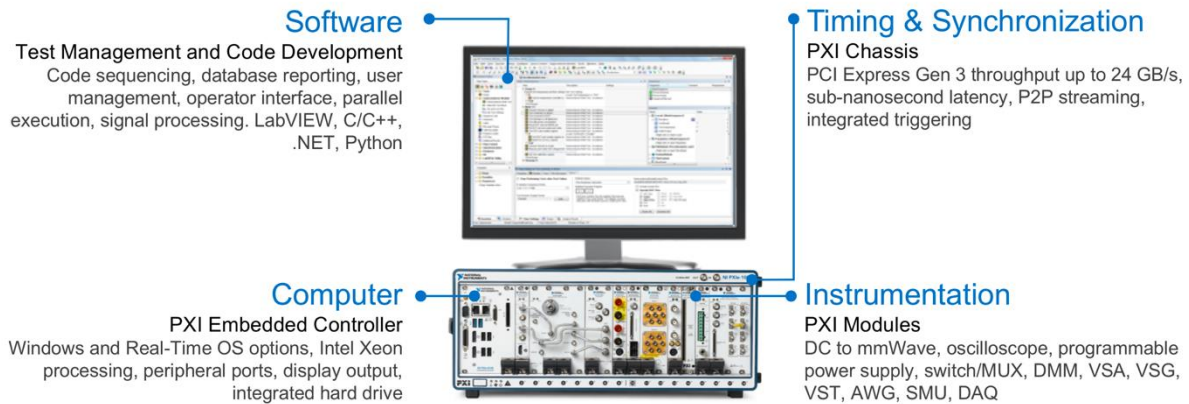


**Software**
Test Management and Code Development
Code sequencing, database reporting, user management, operator interface, parallel execution, signal processing. LabVIEW, C/C++, .NET, Python

**Timing & Synchronization**
PXI Chassis
PCI Express Gen 3 throughput up to 24 GB/s, sub-nanosecond latency, P2P streaming, integrated triggering

**Computer**
PXI Embedded Controller
Windows and Real-Time OS options, Intel Xeon processing, peripheral ports, display output, integrated hard drive

**Instrumentation**
PXI Modules
DC to mmWave, oscilloscope, programmable power supply, switch/MUX, DMM, VSA, VSG, VST, AWG, SMU, DAQ

*Figure 2. PXI Platform*

## Integrating the Latest Commercial Technology

By leveraging the latest commercial technology for its products, NI can continually deliver high-performance and high-quality products to you at a competitive price. The latest PCI Express Gen 3 switches deliver higher data throughput, the latest Intel multicore processors facilitate faster and more efficient parallel (multisite) test, the latest FPGAs from Xilinx help push signal processing algorithms to the edge to accelerate measurements, and the latest data converters from TI and ADI continually increase the measurement range and performance of NI instrumentation.
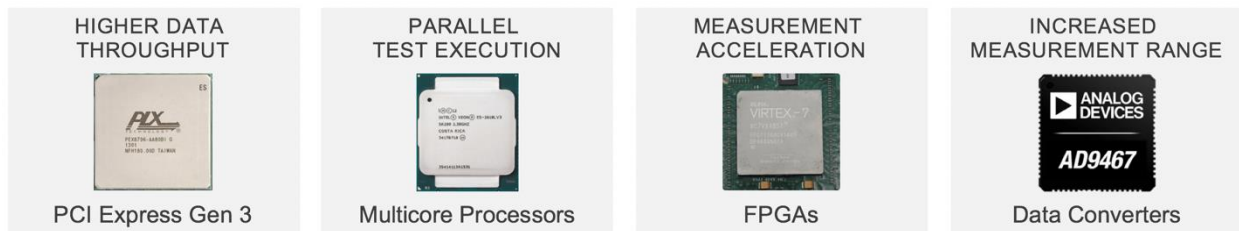


| HIGHER DATA THROUGHPUT | PARALLEL TEST EXECUTION | MEASUREMENT ACCELERATION | INCREASED MEASUREMENT RANGE |
|---|---|---|---|
| PCI Express Gen 3 | Multicore Processors | FPGAs | Data Converters |

*Figure 3. NI products feature the latest commercial technology to accelerate your measurements.*

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# PXI Instrumentation

NI offers more than 600 different PXI modules ranging from DC to mmWave. Because PXI is an open industry standard, nearly 1,500 products are available from more than 70 different instrument vendors. With standard processing and control functions designated to a controller, PXI instruments need to contain only the actual instrumentation circuitry, which provides effective performance in a small footprint. Combined with a chassis and controller, PXI systems feature high-throughput data movement using PCI Express bus interfaces and sub-nanosecond synchronization with integrated timing and triggering.

## Oscilloscopes
Sample at speeds up to 12.5 GS/s with 5 GHz of analog bandwidth; leverage numerous triggering modes and deep onboard memory

## Digital Multimeters
Perform voltage (up to 1000 V), current (up to 3A), resistance, inductance, capacitance, and frequency/period measurements, as well as diode tests

## Digital Instruments
Perform characterization and production test of semiconductor devices with timing sets and per channel pin parametric measurement units (PPMUs)

## Waveform Generators
Generate standard functions including sine, square, triangle, and ramp as well as user-defined, arbitrary waveforms

## Frequency Counters
Perform counter timer tasks such as event counting and encoder position, period, pulse, and frequency measurements

## Source Measure Units
Combine high-precision source and measure capability with high channel density, deterministic hardware sequencing, and SourceAdapt transient optimization

## Power Supplies & Loads
Supply programmable DC power, with some modules including isolated channels, output disconnect functionality, and remote sense

## FlexRIO Custom Instruments & Processing
Provide high-performance I/O and powerful FPGAs for applications that require more than standard instruments can offer

## Switches (Matrix & MUX)
Feature a variety of relay types and row/column configurations to simplify wiring in automated test systems

## Vector Signal Transceivers
Combine a vector signal generator and vector signal analyzer with FPGA-based, real-time signal processing and control

## GPIB, Serial, & Ethernet
Integrate non-PXI instruments into a PXI system through various instrument control interfaces

## Data Acquisition Modules
Provide a mix of analog I/O, digital I/O, counter/timer, and trigger functionality for measuring electrical or physical phenomena

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# Electronics Manufacturing Test Solutions

Electronics manufacturing test in aerospace and defense can be broken into three main device under test (DUT) categories that each build on the previous category.

- Board Electronics—The PCBA/CCAs that have electrical interfaces and make up the functional systems in aircraft, vehicles, vessels, satellites, weapons systems, and instrumentation systems.

- Flight and System Controllers—A collection of board electronics connected to a single-board computer to perform a specific function. Examples include full authority digital engine controllers (FADECs), flight control computers (FCCs), and power management controllers (PMCs).

- Electromechanical Systems—Systems that combine the system controller with its mechanical actuator(s). Examples include landing gear control systems and flap/slat control systems.
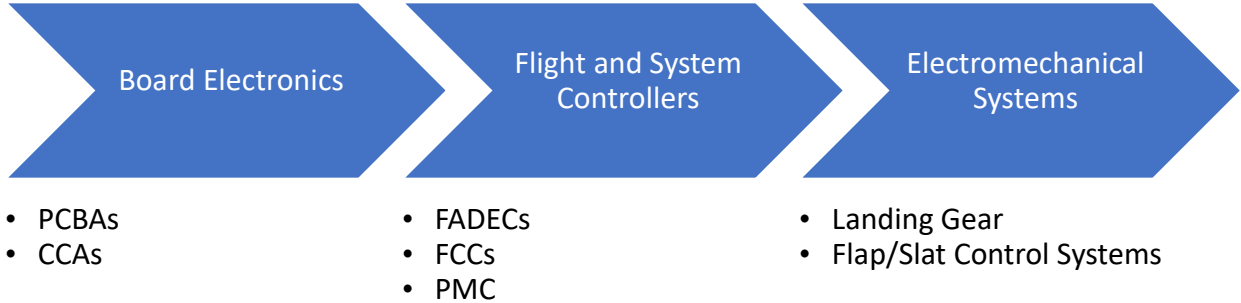
| Board Electronics | Flight and System Controllers | Electromechanical Systems |

- PCBAs
- CCAs

- FADECs
- FCCs
- PMC

- Landing Gear
- Flap/Slat Control Systems

*Figure 4. Electronics manufacturing test can be broken into three main DUT types.*

Each of these DUT categories can be further broken down into the test types conducted on each DUT: electrical measurements, digital communications, and physical measurements.

| DUT Type | Electrical Measurements | Digital Communications | Physical Measurements |
| --- | --- | --- | --- |
| Board Electronics | Yes | Possible | No |
| Flight and System Controllers | Possible | Yes | No |
| Electromechanical Systems | No | Possible | Yes |

Regardless of the electronic equipment you are testing and the types of tests you are conducting, the typical TPS architecture for electronics manufacturing test is largely the same. The instrumentation and test steps, however, vary depending on DUT requirements. Because of the modular nature of PXI, you can scale your test station to test a wider variety of devices by adding new instrumentation to your TPS.

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# Board Electronics

When testing board electronics, you primarily focus on the electrical measurements you need to perform parametric tests to determine manufacturing quality and ensure key specifications are met. The typical instrumentation for this configuration includes digital multimeters, switches, programmable power supplies, source measure units, and scopes and/or digitizers.
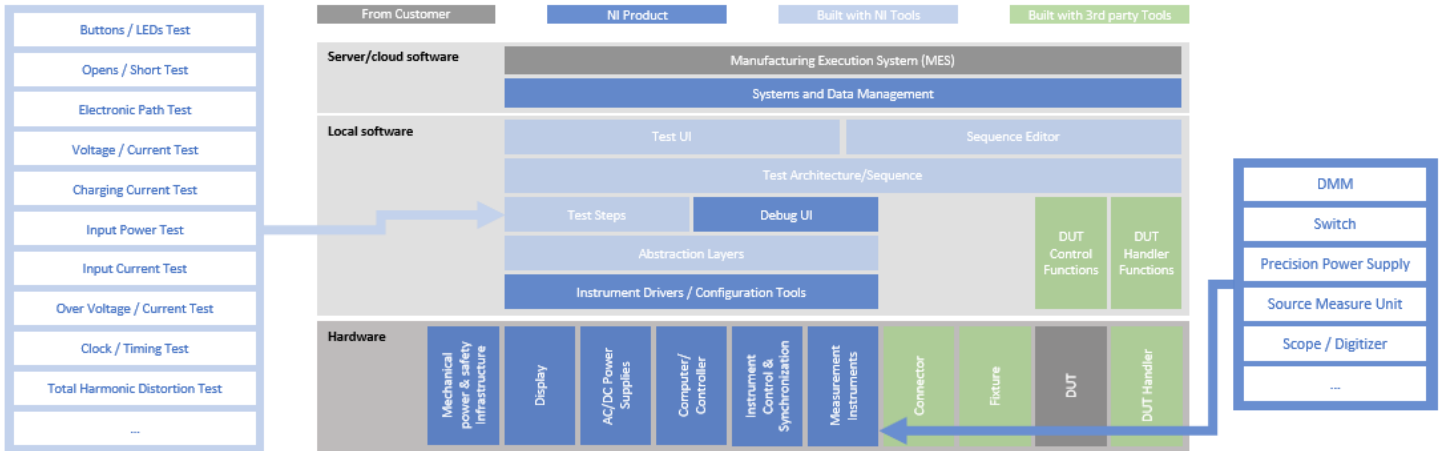


*Figure 5. You need this typical architecture, these test steps, and this instrumentation for board electronics manufacturing test.*

## Digital Multimeter

PXI Digital Multimeters, or DMMs, feature AC/DC voltage, AC/DC current, 2- or 4-wire resistance, and frequency/period measurements, as well as diode tests. You can also choose a PXI DMM with an isolated, high-voltage digitizer that can acquire waveforms at sample rates up to 1.8 MS/s at full input range, up to 3 A or 1,000 V. Additionally, you can choose a PXI DMM that can perform basic inductance and capacitance measurements.



*Figure 6. PXIe-4081 7½ Digit DMM*

| | |
|---|---|
| **DC Voltage Range** | Up to ±1,000 V |
| **DC Current Range** | Up to ±3 A |
| **Digits of Resolution** | Up to 7½ |
| **Max Sample Rate** | Up to 1.8 MS/s |

# Switches

PXI Multiplexer Switch Modules are ideal for high-channel-count applications that require connecting measurement or signal generation instruments to various test points on devices or units under test. These modules use a variety of relay types, including electromechanical armature relays, reed relays, field-effect transistor (FET) relays, and solid-state relays, each with its own benefits, so you can choose a multiplexer that fits your requirements.



| | |
|---|---|
| **Max DC Switching Voltage** | Up to 600 V |
| **Max DC Switching Current** | Up to 12 A |
| **Channels** | Up to 196 |

*Figure 7. PXI-2530B Multiplexer Switch Module*

PXI Matrix Switch Modules are organized into rows and columns and provide maximum flexibility for switching systems by allowing you to connect any channel to any other channel. They use a variety of relay types, including electromechanical armature relays, reed relays, FET relays, and solid-state relays, each with its own benefits, so you can choose a matrix that fits your TPS requirements.



| | |
|---|---|
| **Max DC Switching Voltage** | Up to 150 V |
| **Max DC Switching Current** | Up to 2 A |
| **Crosspoints** | Up to 544 |

*Figure 8. PXIe-2532 Matrix Switch Module*

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# Programmable Power Supply

PXI Programmable Power Supply modules feature multiple channels that you can combine for higher voltage or current capabilities. Some modules include isolated channels and an output disconnect functionality that allows isolation from the DUT when not in use and remote sense to correct for losses in system wiring.



| | |
|---|---|
| **DC Voltage Range** | Up to 0 V to 60 V |
| **Max DC Current** | Up to 6 A |
| **Total Output Power** | Up to 120 W |

*Figure 9. PXIe-4112 Programmable Power Supply*

# Source Measure Units

PXI Source Measure Units (SMUs) provide high-precision source and measure capability with features designed to reduce test time and increase flexibility. These features include high channel density for building parallel SMU test systems, deterministic hardware sequencing for minimizing software overhead, and high-speed update and sample rates for quickly changing setpoints and acquiring data. Additionally, the flexible sample rate and streaming capability of PXI SMUs allow you to use the instrument as a digitizer to capture transient behavior, and the digital control loop gives you the ability to adjust the transient response of the instrument to reduce the settling time and minimize overshoot and oscillations.



| | |
|---|---|
| **DC Voltage Range** | Up to -200 V to 200 V |
| **DC Current Range** | Up to -3 A to 3 A |
| **Current Sensitivity** | Up to 10 fA |
| **Number of Channels** | Up to 24 |

*Figure 10. PXIe-4135 Source Measure Unit*

# Oscilloscopes and Digitizers

PXI Oscilloscopes and PXI Digitizers are flexible, software-defined instruments that are versatile enough for both time- and frequency-domain measurements. They feature up to 8 channels that can sample at speeds up to 12.5 GS/s with 5 GHz of analog bandwidth. You can synchronize multiple oscilloscopes with other instruments at picosecond-level accuracy for high-channel-count and mixed-signal applications.



*Figure 11. PXIe-5162 Oscilloscope*

| | |
|---|---|
| **Max Bandwidth** | Up to 5 GHz |
| **Max Sample Rate** | Up to 12.5 GS/s |
| **Analog Resolution** | Up to 14 bits |
| **Number of Channels** | Up to 8 |

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# Flight and System Controllers

When testing flight and system controllers, you may conduct some parametric tests, but you typically focus on the digital communications testing to perform the functional tests you need to determine manufacturing quality. The instrumentation usually required for this configuration includes digital reconfigurable I/O, FlexRIO, high-speed serial, and avionics communications devices.
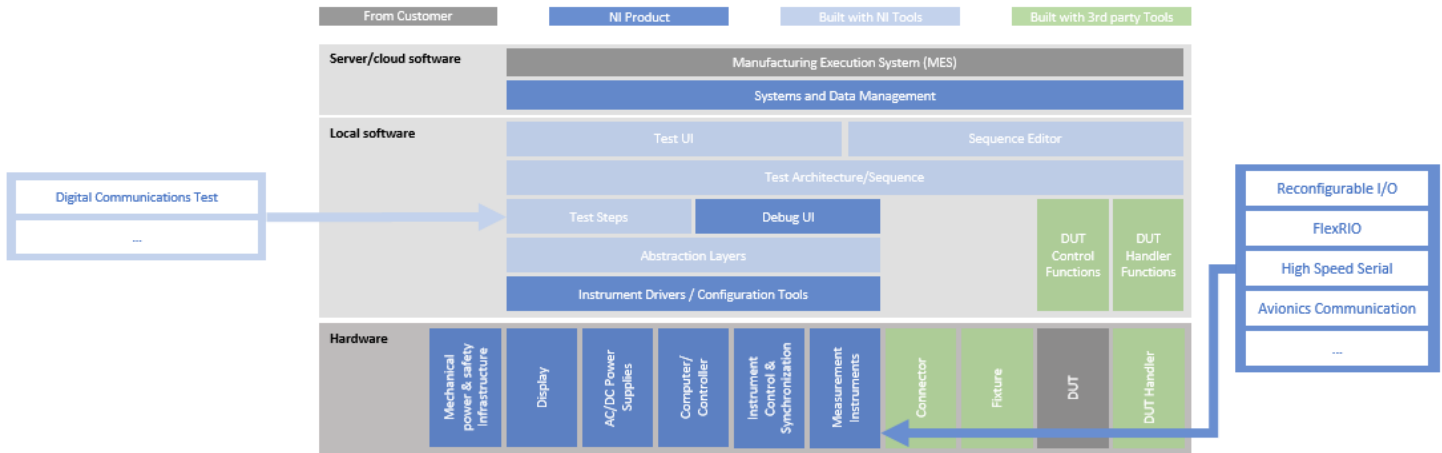


*Figure 12. Typical architecture, test steps, and instrumentation needed for flight and system controller manufacturing test.*

## Digital Reconfigurable I/O

PXI Digital Reconfigurable I/O Modules feature a user-programmable FPGA for onboard processing and flexible I/O operation. You can completely control the synchronization and timing of all signals and operations along with custom onboard decision making. The PXI Digital Reconfigurable I/O Module is suited for a wide variety of applications, such as high-speed waveform generation, custom communications protocols, bit error rate testing, and other applications requiring precise timing.



*Figure 13. PXIe-7822 Digital Reconfigurable I/O Module*

| | |
|---|---|
| **FPGA** | Up to Kintex-7 325T |
| **Max Data Rate** | Up to 80 MHz |
| **Logic Levels** | 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V |
| **Number of Channels** | Up to 128 |

# FlexRIO

PXI FPGA Modules for FlexRIO offer a large onboard FPGAs for signal processing. You can pair the module with a Digital I/O Adapter Module for FlexRIO which offers up to 54 channels of configurable digital I/O that can interface with single-ended, differential, and serial signals at a variety of voltage levels.



*Figure 14. NI-6581 Digital I/O Adapter Module for FlexRIO*

| | |
|---:|:---|
| **FPGA** | Up to Kintex-7 410T |
| **Max Data Rate** | Up to 1 Gbps |
| **Number of Channels** | Up to 54 |

# High-Speed Serial

PXI High-Speed Serial Instruments include a user-programmable FPGA with access to multigigabit transceivers to implement various standard and custom high-speed serial protocols. They are programmable in LabVIEW FPGA for maximum application-specific customization and reuse. PXI High-Speed Serial Instruments also benefit from PXI clocking, triggering, and high-speed data movement capabilities, including streaming to and from disk as well as peer-to-peer streaming.



*Figure 15. PXIe-7902 High-Speed Serial Instrument*

| | |
|---:|:---|
| **FPGA** | Up to Virtex-7 485T |
| **Max Data Rate** | Up to 12.5 Gbps |
| **Number of Channels** | Up to 24 |

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# Avionics Communications Buses

PXI Avionics Interface Modules support full-function test, simulation, and operational uses of avionics data buses. With extensive error detection and generation capability, these modules are well suited for production and system test. They integrate the triggering and system clock features of PXI with MIL-STD-1553 and ARINC 429 standards.



*Figure 16. LV-222-555-442 Avionics Module*
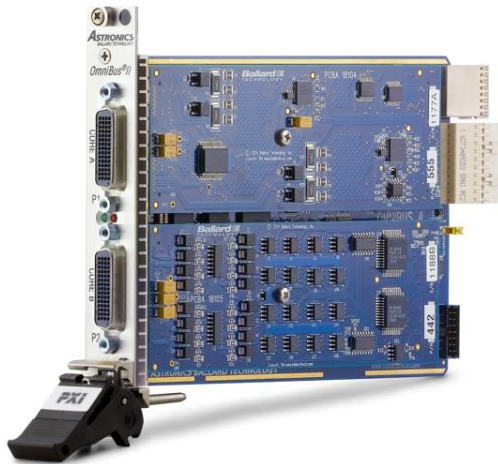
| | |
|---|---|
| **Available Interfaces** | MIL-STD-1553, ARINC 429 |

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# Electromechanical Systems

When testing electromechanical systems, you primarily focus on the physical measurements to determine that the system has been integrated properly. The typical instrumentation for this configuration includes switch, load, and signal conditioning (SLSC) hardware, programmable loads, power supplies, and sensor-specific instruments.
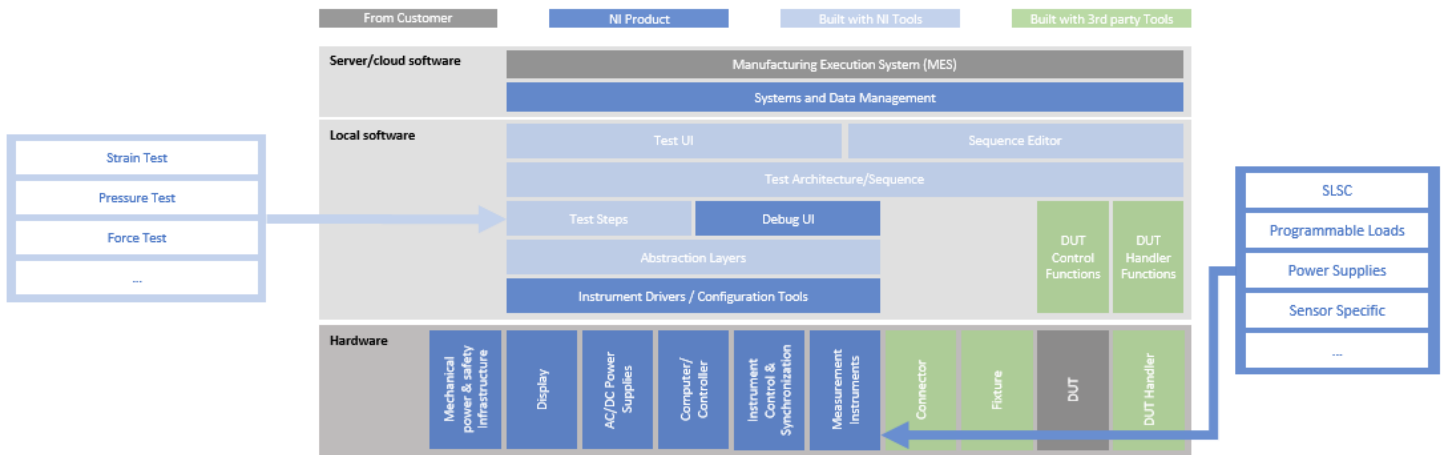


*Figure 17. You need this typical architecture, these test steps, and this instrumentation for electromechanical system manufacturing test.*

## SLSC

SLSC is add-on hardware that integrates with PXI and CompactRIO systems. It standardizes connectivity, minimizes point-to-point wiring, and provides a modular approach to signal conditioning, fault insertion, and other test needs.



*Figure 18. SLSC Chassis and Modules*

| Module Types | Power, Digital, Loads, ARINC, MIL-STD-1553 |
|---|---|

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# Electronic Loads

Electronic Load Devices can sink power at various current and voltage levels for power supply design, quality inspection, and functional tests. They feature buttons and knobs for interactive use as well as USB or RS232 interface options for automated use. You can connect multiple loads in parallel to increase your system's overall power capacity.



| | |
|---|---|
| **DC Voltage Range** | Up to 0 V to 500 V |
| **Measure Current** | Up to 0 A to 70 A |
| **Max Input Power** | Up to 350 W/ch |
| **Number of Channels** | Up to 2 |

*Figure 19. RMX-4006 Electronic Load*

# Programmable Power Supply

The Programmable Power Supply Device is a single-channel, rack-mount DC power supply. It offers up to 1,500 W of power with options up to 650 V DC or 150 A, so you can use it for test systems that require large amounts of power with a broad range of voltage and current values. Some models can source hundreds of watts in a compact 2U, 1/6 rack-width design, making them ideal for test systems that need multiple power rails. Additionally, the Programmable Power Supply Device offers buttons and knobs for interactive users as well as USB, LAN, RS232, and analog control options for remote or automated users.



| | |
|---|---|
| **DC Voltage Range** | Up to 0 V to 650 V |
| **Max DC Current** | Up to 150 A |
| **Total Output Power** | Up to 1,500 W |

*Figure 20. RMX-4101 Rack-Mount Power Supply*

# Strain, Pressure, and Force

PXI Strain/Bridge Input Modules feature up to 8 channels that support quarter-, half-, or full-bridge sensors at speeds up to 102.4 kS/s. The modules provide increased accuracy, high data throughput, and a range of synchronization features. Optional features include remote sensing, internal bridge completion, and shunt calibration options per channel.



| Max Sample Rate | Up to 102.4 kS/s |
|---|---|
| Bridge Configurations | Full, Half, Quarter |
| Number of Channels | Up to 8 |

Figure 21. PXIe-4339 Strain/Bridge Input Module

# Displacement

PXI Displacement Input Modules support 4-, 5-, and 6-wire AC linear variable differential transformer (LVDT) and AC rotary variable differential transformer (RVDT) measurements. They simultaneously sample each analog input and set the excitation frequency and voltage for each channel independently. You can set different timing, triggering, and sampling modes for each channel. Diagnostic features include self-calibration, overcurrent detection, and open coil detection.
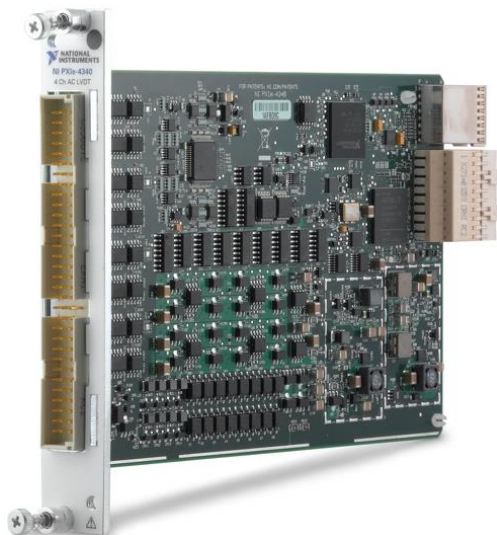


| Resolution | Up to 24 bits |
|---|---|
| Number of Channels | Up to 4 |

Figure 22. PXIe-4340 Displacement Input Module

# Software Architecture for Electronics Manufacturing Test

Reference solutions for electronics manufacturing test include a combination of PXI modular instruments and measurement, automation, and data and systems management software that provides a balance of customization and short time to measurement.  NI is the only vendor to offer a full suite of tried-and-tested modular software components, from world-class hardware drivers and integration tools, to code module development environments and test executives, to systems management and MES integration.
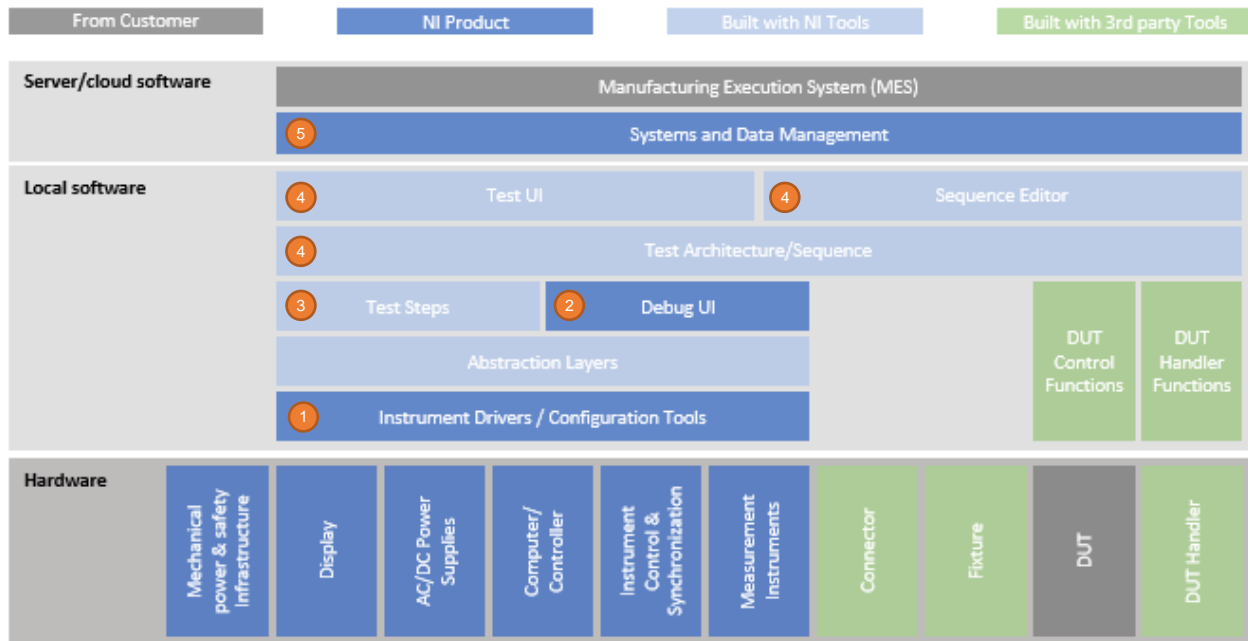


*Figure 23. Typical TPS Software Architecture of an Electronics Manufacturing Test System*

1. **Instrument-Specific Drivers and APIs**—Quickly and directly control any modular instrument to customize test parameters with instrument-specific drivers and APIs.

1. **Switch Executive**—Use a point-and-click graphical configuration environment with automatic routing capabilities to easily design your switch system.

2. **InstrumentStudio**—Unify your display, export instrument configurations to code, and monitor and debug your TPS.

3. **LabVIEW**—Leverage a graphical programming environment that helps you visualize every aspect of your application, including hardware configuration, measurement data, and debugging.

3. **LabWindows/CVI**—Use for ANSI C development with built-in libraries for measurement, analysis, and engineering UI design.

4. **TestStand**—Optimize test development times with high-level test executive software for automating complex test sequences written in many development languages.

5. **SystemLink**—Manage tasks such as software deployment, device configuration, health and test monitoring, and data management and visualization.

# Instrument-Specific Drivers and APIs

NI measurement driver software includes best-in-class APIs that work with a variety of development options including LabVIEW, C, C#, and Python. To ensure long-term interoperability of NI instruments, the driver APIs are the same APIs used for all past and current instruments. The driver software also provides access to help files, documentation, and dozens of ready-to-run shipping examples you can use as a starting point for your application.
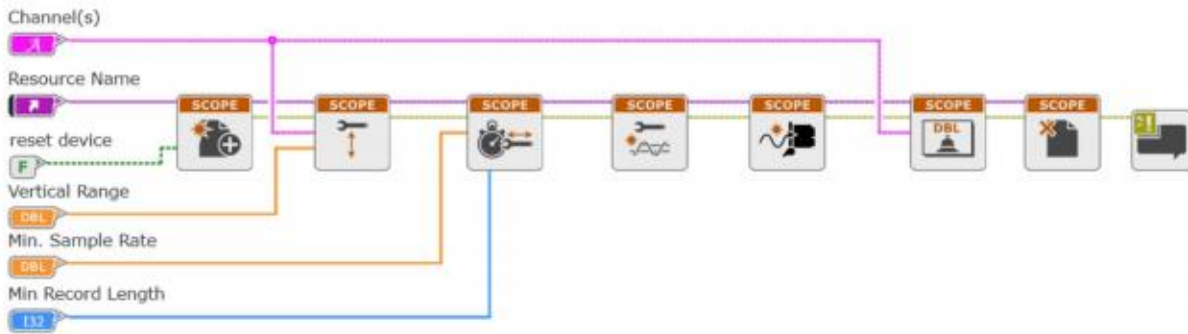


*Figure 24. LabVIEW API for NI-SCOPE*

```
// DAQmx analog voltage channel and timing parameters

  DAQmxErrChk (DAQmxCreateTask("", &taskHandle));

  DAQmxErrChk(DAQmxCreateAIVoltageChan(taskHandle, "Dev1/ai0", "", DAQmx_Val_Cfg_Default, -10.0,
10.0, DAQmx_Val_Volts, NULL));

DAQmxErrChk(DAQmxCfgSampClkTiming(taskHandle, "", 10000.0, DAQmx_Val_Rising,
DAQmx_Val_FiniteSamps, 1000));

// DAQmx Start Code

 DAQmxErrChk(DAQmxStartTask(taskHandle));
// DAQmx Read Code

 DAQmxErrChk(DAQmxReadAnalogF64(taskHandle, 1000, 10.0, DAQmx_Val_GroupByChannel, data, 1000,
&read, NULL));
// Stop and clear task
```

*Figure 25. C API for NI-DAQmx*

# Switch Executive Application Software

While the NI-SWITCH driver provides all the low-level functionality required to program switch actions, Switch Executive is application software for intelligent switch management and routing that accelerates development and simplifies maintenance of complex switch systems. The point-and-click graphical configuration and automatic routing capabilities make it easy to design your switch system. Using intuitive channel aliases and route names keeps your system documented for future modifications. Save time and increase test code reuse by integrating your system with TestStand, LabVIEW, LabWindows/CVI, and Measurement Studio.

**Key Benefits**

- Graphically configure routes and route groups

- Develop reusable switching code and integrate it into TestStand or LabVIEW

- Automatically route signals between switch endpoints

- Scale switch configuration using Microsoft Excel

- Maintain switch configuration using route validation, reporting and debugging features
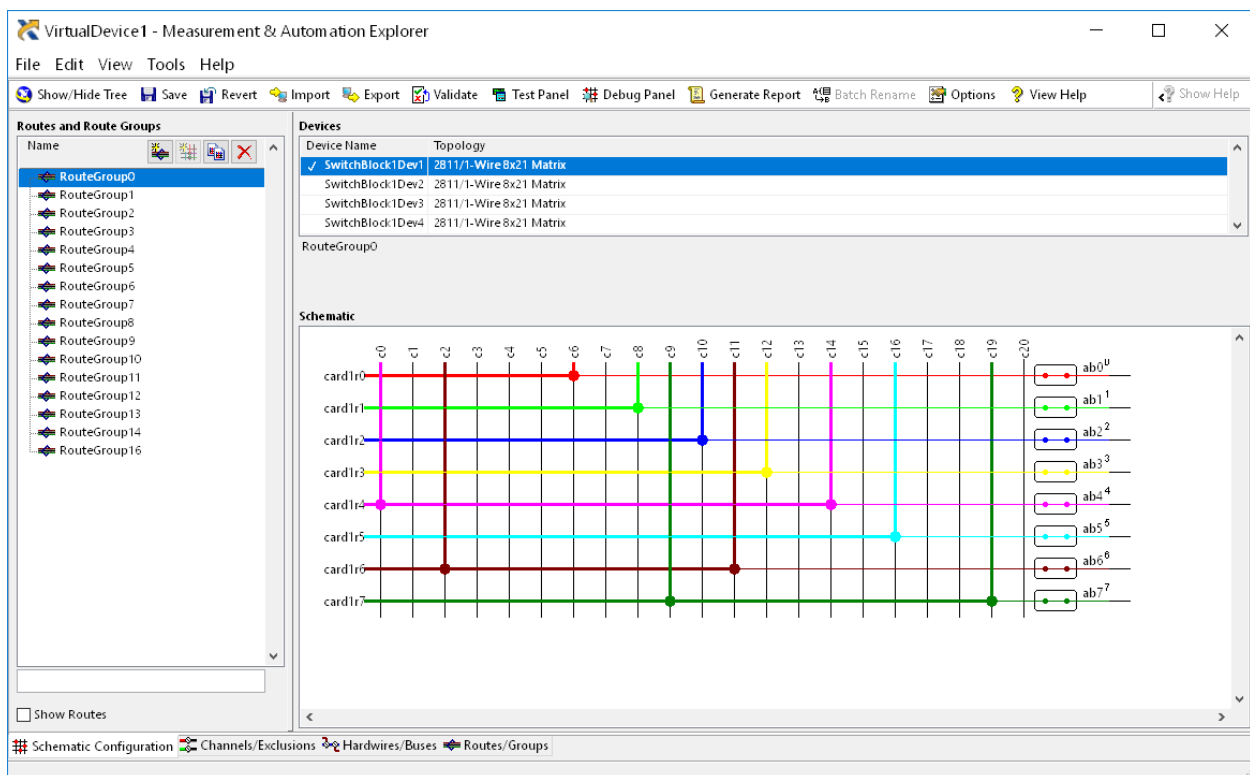


*Figure 27. Switch Executive is a point-and-click graphical configuration environment with automatic routing capabilities making it easy to design your switch system.*

# InstrumentStudio Software for Interactive Measurements

InstrumentStudio helps you unify your display, export instrument configurations to code, and monitor and debug your automated test system. You can view data on unified displays with large, high-resolution monitors and then capture multi-instrument screenshots and measurement results. Save project-level configurations for easier test repeatability with specific DUTs or export instrument configurations to programming environments to simplify your code and guarantee measurement correlation. You can also use InstrumentStudio in parallel with your code to monitor and debug running test applications. InstrumentStudio is free software included with NI-SCOPE, NI-FGEN, NI-DMM, and NI-DCPower driver downloads 18.1 and later.

**Key Benefits**

- Integrate your instruments into a single view

- Capture multi-instrument screenshots, measurement results, parameter configurations and UI layouts for broader insight and instant repeatability

- Export instrument configurations to code

- Guarantee correlation by replicating instrument configurations using a single API function call

- Monitor the state of your instruments while they are running, or take control of them interactively for debugging
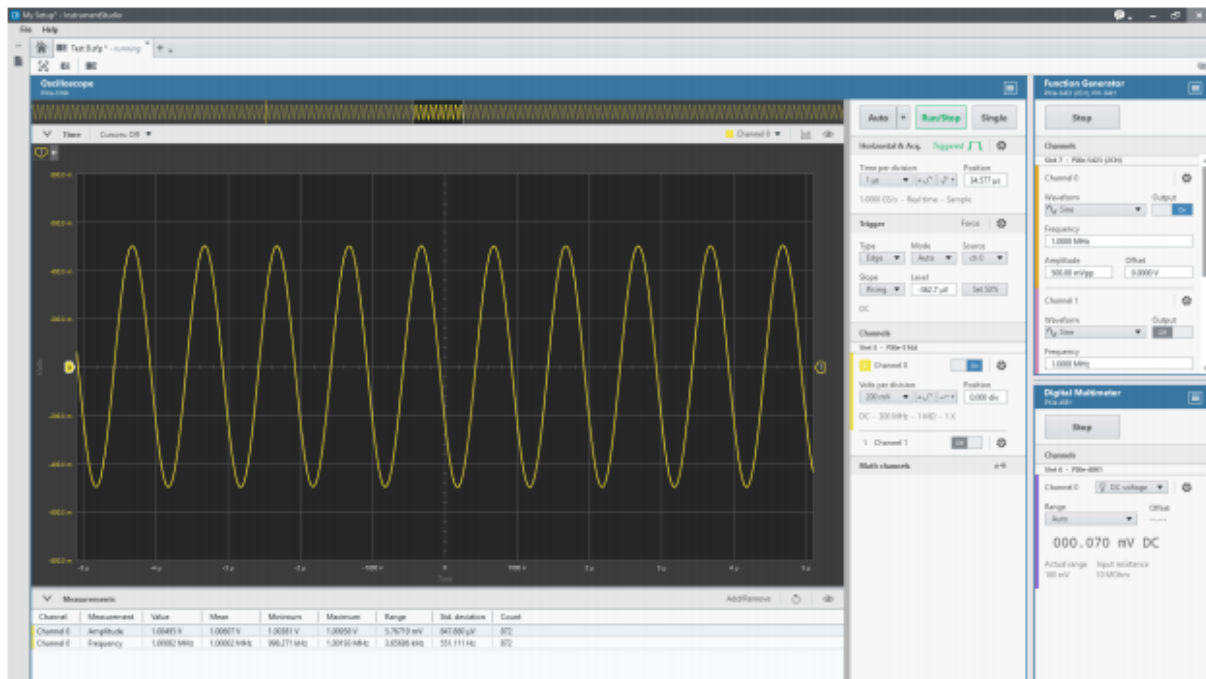


*Figure 26. InstrumentStudio helps you unify your display, export instrument configurations to code, and monitor and debug your automated test system.*

# LabVIEW

LabVIEW offers a graphical programming approach that helps you visualize every aspect of your application, including hardware configuration, measurement data, and debugging. This visualization makes it simple to integrate measurement hardware from any vendor, represent complex logic on the diagram, develop data analysis algorithms, and design custom engineering user interfaces.

**Key Benefits**

- Reduce system setup with access to thousands of instrument drivers, example programs, and documentation to connect to virtually any modular or traditional box instrument

- Use hundreds of instrument-specific example code modules and included measurement libraries to reduce development time

- Reuse existing code libraries from languages like C/C++/C#, .NET, Python, and MathWorks MATLAB®

- Quickly create professional user interfaces to visualize test outcomes

- Build proficiency with extensive online and in-person training options for both new users and certified architects in NI tools.
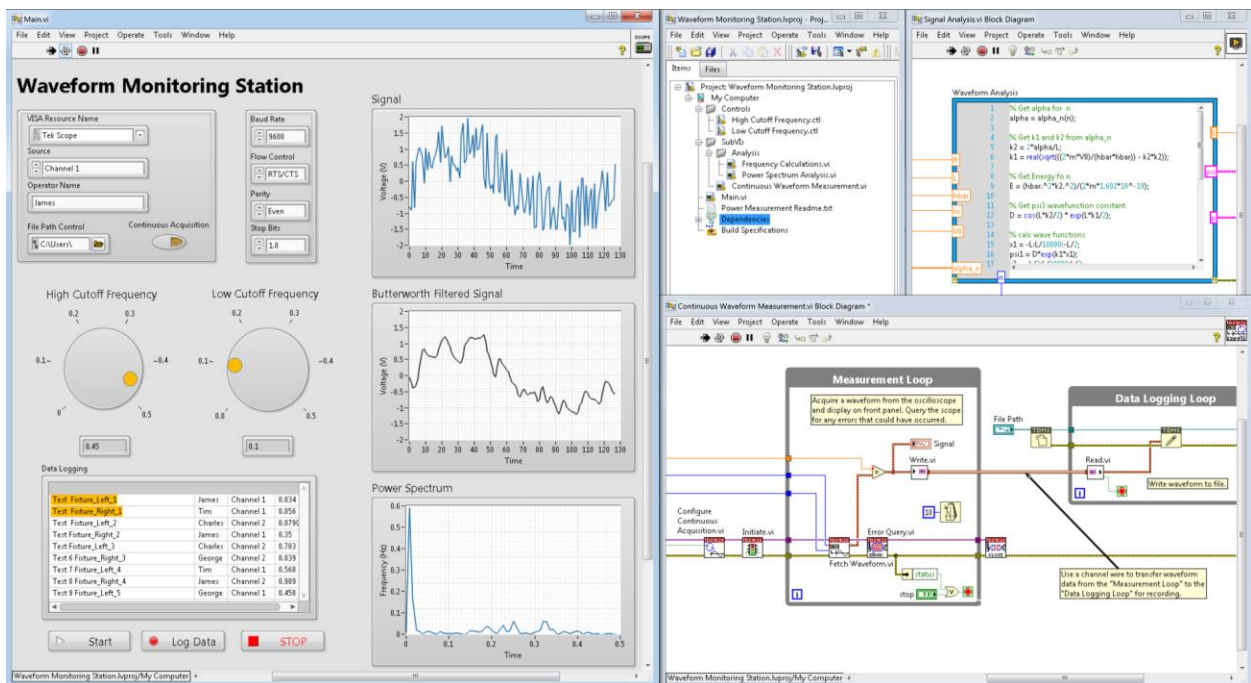


*Figure 28. LabVIEW reduces the cost of test by helping you stay ahead of the evolving needs of your production test systems with the flexibility to connect to virtually any instrument, reuse existing code, and quickly design user interfaces.*

# LabWindows/CVI

LabWindows/CVI is a proven ANSI C integrated development environment and engineering toolbox. For decades, test engineers in the aerospace and defense industry have relied on LabWindows/CVI to create stable, high-performance applications for manufacturing test. Take your concept to hardware faster with built-in hardware libraries, analysis functions, and a GUI builder with engineering UI components.

**Key Benefits**

- Develop, debug, deploy, and manage large scale TPSs

- Find and fix bugs with advanced tools for memory leak detection, conditional breakpoints, and just-in-time debugging

- Quickly acquire data from GPIB, USB, serial, Ethernet, PXI, VXI, and FPGA instruments using the built-in instrument I/O libraries or built-in instrument drivers

- Draw meaningful results from your data with hundreds of built-in, engineering-specific functions
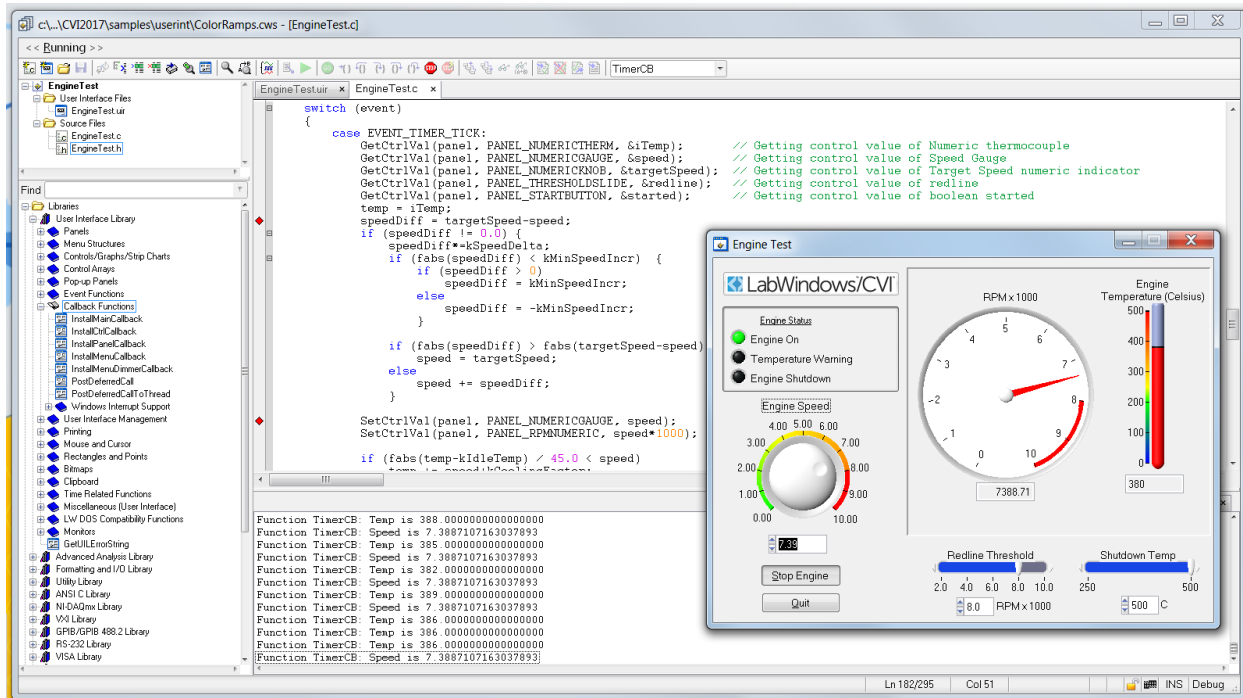


*Figure 29. For decades, test engineers in the aerospace and defense industry have relied on LabWindows/CVI to create stable, high-performance applications for manufacturing test.*

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# TestStand

TestStand is ready-to-run test management software that is designed to help you quickly develop and execute TPS software. You can extend the functionality of your TPS by developing test sequences in TestStand that integrate code modules written in a variety of programming languages including G in LabVIEW, C/C++, .NET, and Python. TestStand also provides extensible plug-ins for reporting, database logging, and connecting to other enterprise systems. You can deploy test systems to production with easy-to-use operator interfaces.

**Key Benefits**

- Customize test sequences to meet every requirement

- Automate saving and reporting test data

- Increase test throughput with parallel testing

- Efficiently replicate and deploy test systems

- Troubleshoot test systems with integrated debugging tools

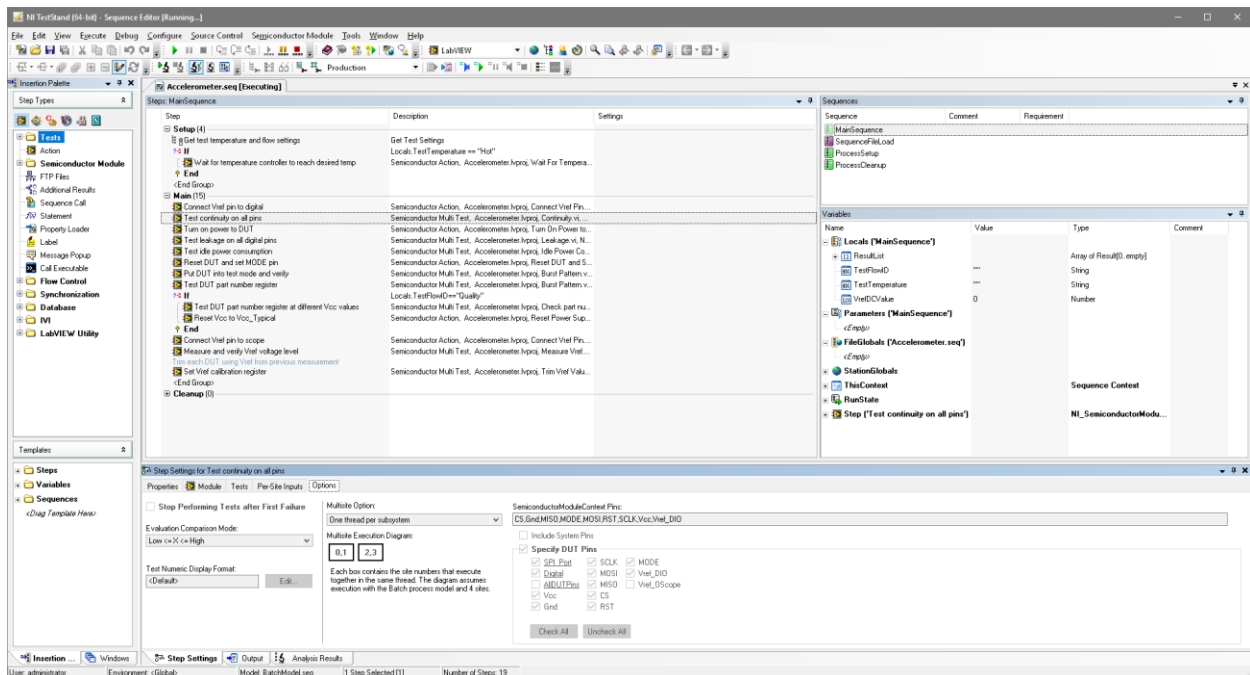- Customize user interfaces to meet testing needs



*Figure 30. TestStand is ready-to-run test management software that is designed to help you quickly develop and execute TPS software.*

# SystemLink

SystemLink software manages tasks such as software deployment, device configuration, health and test monitoring, and data management and visualization. It delivers measurable improvements in operational efficiency and productivity by providing you with a centralized network-based management interface for connected devices, software, and data. SystemLink also offers an open architecture for incorporating a wide range of third-party software and hardware technologies.

**Key Benefits**

- Centrally manage distribution software

- Optimize your software deployment process

- Perform remote device configuration and diagnostics

- Manage TPS performance health with alarms management, notifications, and calibration reporting

- Automatically prepare your data from multiple sources for queries and analysis

- Quickly access and search measurement data across TPSs

- Intelligently analyze files and generate reports automatically
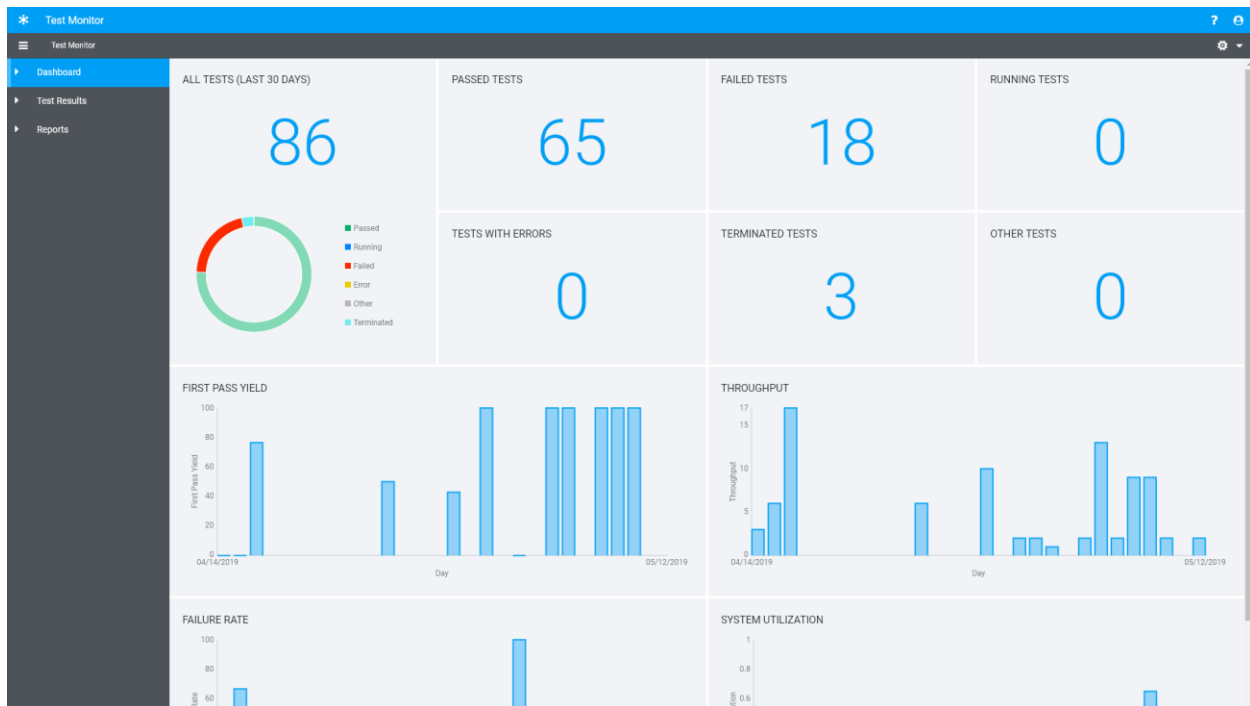


*Figure 31. SystemLink software manages tasks such as software deployment, device configuration, health and test monitoring, and data management and visualization.*

# Hardware Services

All NI hardware features a one-year warranty for basic repair coverage and includes calibration in adherence to NI specifications prior to shipment. PXI systems also include basic assembly and a functional test. NI offers additional entitlements to improve uptime and lower maintenance costs with service programs for hardware. Learn more at ni.com/services/hardware.

| | Standard | Premium | Description |
|---|---|---|---|
| Program Duration | 1, 3, or 5 years | 1, 3, or 5 years | Length of service program |
| Extended Repair Coverage | ● | ● | NI restores your device's functionality and includes firmware updates and factory calibration. |
| System Configuration, Assembly, and Test[1] | ● | ● | NI technicians assemble, install software in, and test your system per your custom configuration prior to shipment. |
| Advanced Replacement[2] | | ● | NI stocks replacement hardware that can be shipped immediately if a repair is needed. |
| System Return Material Authorization (RMA)[1] | | ● | NI accepts the delivery of fully assembled systems when performing repair services. |
| Calibration Plan (Optional) | Standard | Expedited[3] | NI performs the requested level of calibration at the specified calibration interval for the duration of the service program. |

[1]This option is available only for PXI, CompactRIO, and CompactDAQ systems.
[2]This option is not available for all products in all countries. Contact your local NI sales engineer to confirm availability.
[3]Expedited calibration includes only traceable levels.

## Long-Life Service Program
Reduce obsolescence risk and ensure the long-term serviceability of your TPS with NI's Long-Life Service Program.

## Technical Support
Every NI system includes a 30-day trial for phone and email support from NI engineers that you can extend through a Standard Service Program (SSP) membership. NI has more than 400 engineers around the globe to provide local support in more than 30 languages. Additionally, you can take advantage of NI's award-winning online resources and communities.

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# Long-Life Service Program

Reduce obsolescence risk and ensure the long-term serviceability of your TPS. Collaborate with NI on a service program that extends the life cycle of your NI products for up to 20 years. You can use this preconfigured program as is or customize it to meet your specific application needs.

**Same-Model Repair or Replacement**

Ensure your products are repaired or replaced with the same model for up to 20 years.

**Single Point of Contact**

Streamline hardware maintenance with a single point of contact for all hardware services.

**Annual Program Management Review**

Eliminate surprises with comprehensive reviews and consultative engagements to help you plan ahead.

| Service Offerings | Up to 20 Years |
|---|---|
| Single Point of Contact for Services | ✓ |
| Products Eligible for Detailed Repair Reports | ✓ |
| Same-Model Repair or Replacement | ✓ |
| Annual Program Management Review | ✓ |
| Reserved Product Inventory | Optional |
| Standard, Expedited, or On-Site Calibration Plan | Optional |
| Annual Preventative Maintenance | Optional |
| Advanced Replacement | Optional |
| NI-Managed Sparing | Optional |

*"CACI selected many NI instruments for the core of the CBATS test system based on the relationship with the company and the quality of its products. CACI's relationship with NI has grown to a level of mutual trust as we work together to deliver high-quality sustainable test solutions at affordable prices." —Paul Pankratz, CACI*

## Technical Consulting Services for Life-Cycle Management
Whether you are planning for a new long-life application or a technology refresh, NI provides technical consulting services to ensure long-term success including migration assessment, upgrade assistance, architecture/code reviews, and design assistance.

6 August 2019

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