

SOLUTION
BROCHURE

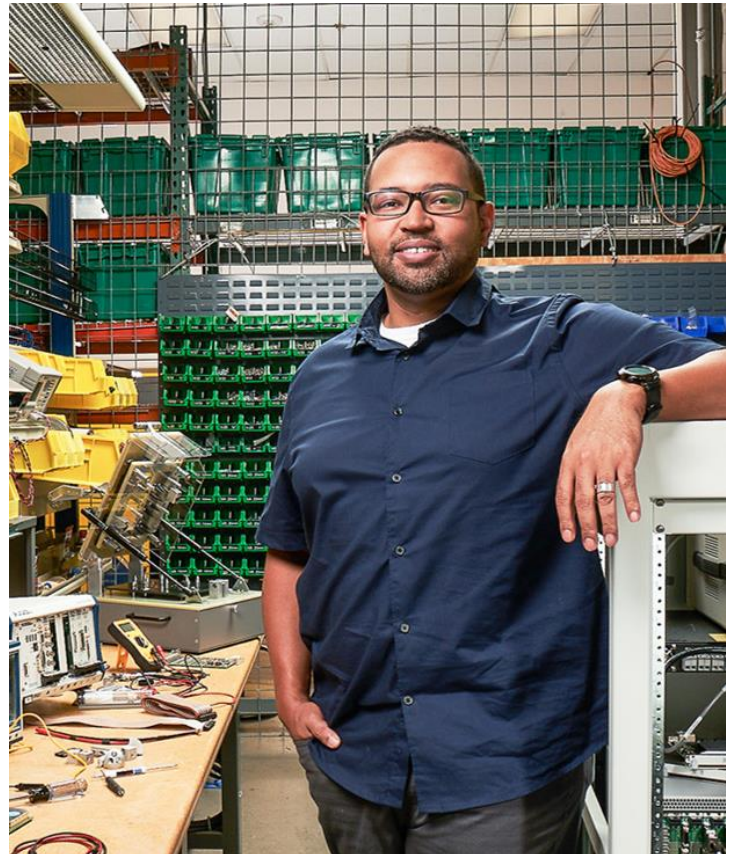
Electrical Functional Test Station

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Introduction

Traditionally, test teams have been pressured to achieve maximum coverage in minimum cycle time. However, higher expectations are enforcing shorter development schedules, longer station longevity, tighter regulatory compliance, and comprehensive data management. Across the world, manufacturing teams are looking to execute a cohesive test strategy that balances these pressures, choosing NI as the test platform that provides a complete software offering with modular hardware architecture. Use the following brochure to explore the foundation of functional test, available partners and services, and explore NI's answer to the diverse needs of functional test.



Test Station Architecture and Requirements

A functional test station is an integrated set of hardware and software that measures, analyzes, and publishes data confirming that a product or component has been manufactured in accordance with predefined specifications.

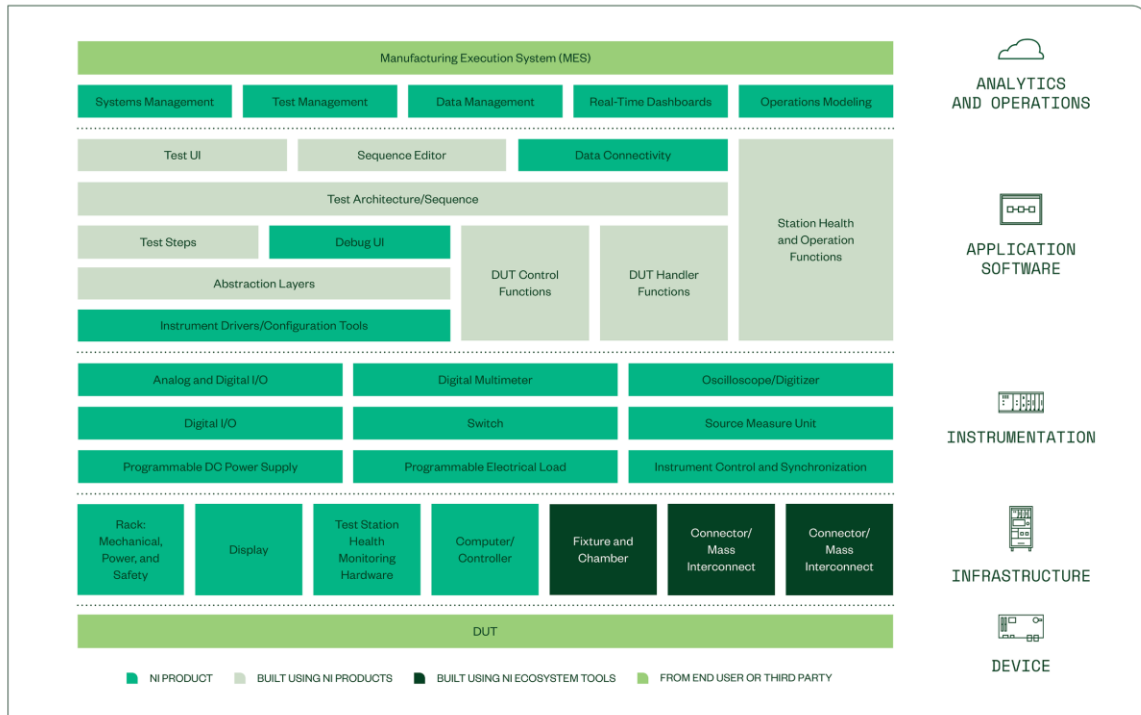


Figure 1. Test Station Architecture

Test stations are complex applications constructed of four fundamental elements: hardware infrastructure, instrumentation, application software, and server/cloud software. Each test station requires unique steps and types of instrumentation, however many other architectural elements remain common.

Test stations must:

- Meet test coverage requirements
- Be maintainable throughout the product's market lifetime
- Adapt to changes in product to meet new capabilities
- Efficiently meet deadlines in a production schedule
- Be certified and documented to meet regulatory standards
- Automatically generate data accessible by all departments



NI Test Platform Benefits

Customize to Deliver Results

The NI test platform is optimized for production test. No matter the pressures on you and your test program, the NI test platform's breadth of hardware, software, and services means that you can customize it to meet specific needs.

- **Product Quality:** Industry-leading accuracy, repeatability, and reliability ensures that your test is never compromised—just like your trust in the product.
- **Product Complexity:** The industry's widest breadth of instrumentation supports measurements including voltage, current, digital signals, audio, RF, visual inspection, and more—ensuring complete test coverage.
- **Station Longevity:** Modular instrumentation manufactured and documented with life-cycle management in mind; along with a robust service program, keeps production lines running longer with less reengineering work and less recertification.
- **Production Volume:** Built-in automatic test parallelism and FPGA processing that facilitates multi-up test architectures reduces cycle time and results in increased throughput on your line.
- **Regulatory Compliance:** Complete documentation, experienced system integration partners, and tools designed for long-term deployment ease regulatory certification and recertification processes.
- **Development-Optimized Software:** Test-specific software tools can save more than 50 percent of your development time,¹ reducing the risk of missing tight schedule deadlines.
- **Intuitive Guidance:** Systems-management software ensures fast and error-free software deployment, minimizing delays in large or remote updates.
- **Data Insight:** Out-of-the-box enterprise data-management software collects, analyzes, and reports test data and station health, delivering greater insights into throughput, yield, station or component utilization, and overall operational efficiency..

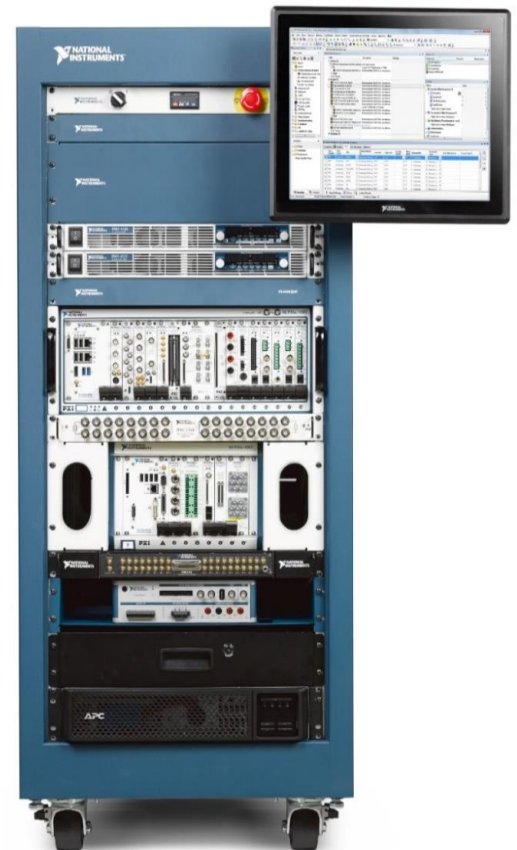


Figure 2 NI Test Platform

¹Sub-Zero Group, Inc., Page 4

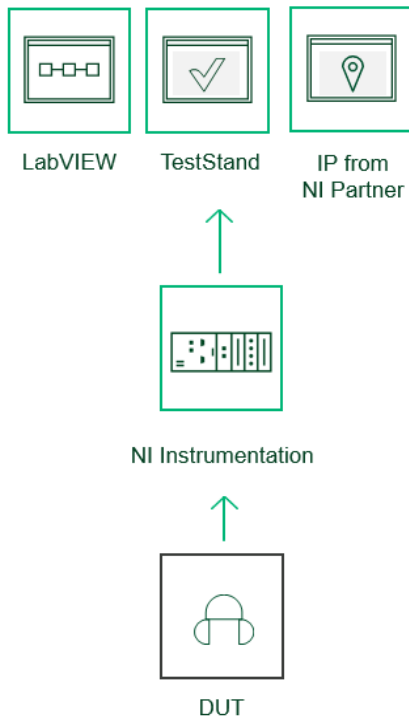


Utilizing a Standardized Approach

Unlocking the Full Value of Test

A consistent approach to test offers a way to shift talent wherever and whenever necessary. Engineers know how to use similar tools, so moving talent among projects and locations is easy. This flexibility also can increase employee engagement, decrease burnout, and reduce the risk of developing tribal knowledge that's lost when an employee leaves the organization.

A test solution that integrates fully with compatible hardware and software can ensure a cohesive strategy that limits development time and promotes optimization between organizations. When test groups rely on mostly in-house-created technology, each group must operate



differently and approach its test designs based on its own preferences and needs.

Using a standardized approach to the entire test cycle, engineers can consistently compare data at each stage of the test journey and move test earlier in the development cycle. This approach also allows test engineers to delve deeply into their areas of expertise without worrying about other groups because a consistent platform ensures that the output of one group is a compatible input for the next. Finally, test organizations can more fully realize their financial investment because they can reuse test systems from one group to the next. This outcome is also possible with a custom approach, but that requires an in-house governing body and is often unsustainable and inefficient.

Fully interconnected hardware and software make it easy to customize, update, and review data across organizations. By utilizing a standardized solution, test organizations can maximize efficiency without compromising on labor or cost.

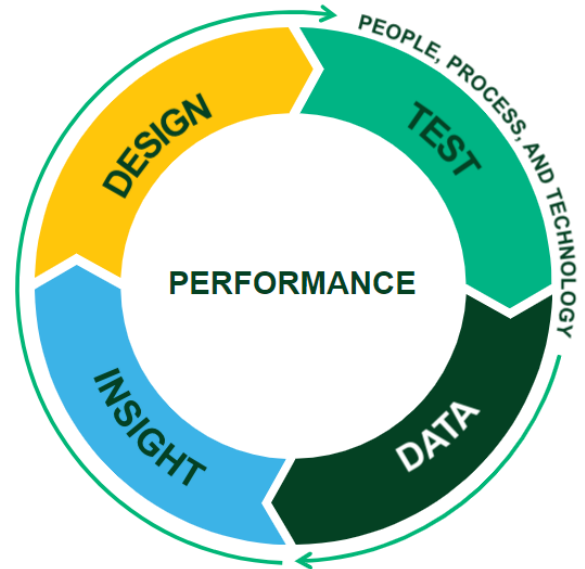


Figure 3. Chart of Overlap Between Different Aspects of Test

“We have developed a standard hardware platform based on NI’s offerings that allows us to rapidly deploy new equipment. We do the same with LabVIEW code, which allows us to deploy a system probably 50 percent quicker than in the past.”

Dave Gilmore, Project Engineering Manager, Sub-Zero Group, Inc.

Support Your Business Initiatives Through Test

The NI test platform is optimized for production test. NI is committed to reach beyond a vendor/client relationship and support you by delivering the value your business requires. Most large organizations have corporate-led initiatives designed to drive efficiency or differentiate through new technology or processes. By aligning test strategy to these initiatives, best-in-class test directors ensure visibility and success of both their department and overall business.

- **Digital Transformation:** Using system-management tools to deliver improved test coverage insight and significant utilization improvements can help revolutionize test management. The NI approach helps businesses focus on areas of greatest value without having to make an all-or-nothing investment decision.
- **Internal Proficiency:** A single integrated NI software toolchain that applies to multiple engineering disciplines and applications, connected by a thriving developer community. NI's software resources encourage test proficiency both at the individual and team level while providing support and training up to the corporate level.
- **Outsourcing Return on Investment (ROI):** By combining consultation, support, and full integration services, reach an in-house versus outsource balance without putting deadlines or build quality at risk.
- **Operational Expense:** Industry-renowned reliability, production-optimized test and data management software, and comprehensive services and support ensure minimized downtime, real-time operational insight, and cost-effective sustaining strategies
- **Capital Expense:** Scalable, future-proof architectures, multi-up test capability, and high-channel-count instrumentation maximize return on capital investments and protect against large, unexpected costs.

“Best-in-class production test teams don’t just build test stations—they execute against a test strategy that actively supports their business. With our industry-leading systems and services, NI powers the world’s most effective test organizations.”

Kyle Voosen, Director, Electronics Production Test, National Instruments



NI Tool Architecture

The NI test platform includes a complete set of products, including modular hardware, development software, and management applications, to help you develop and operate functional test stations. NI and its global network of NI Alliance Partners offer integration and technical services to ensure success in designing, developing, and sustaining test stations.

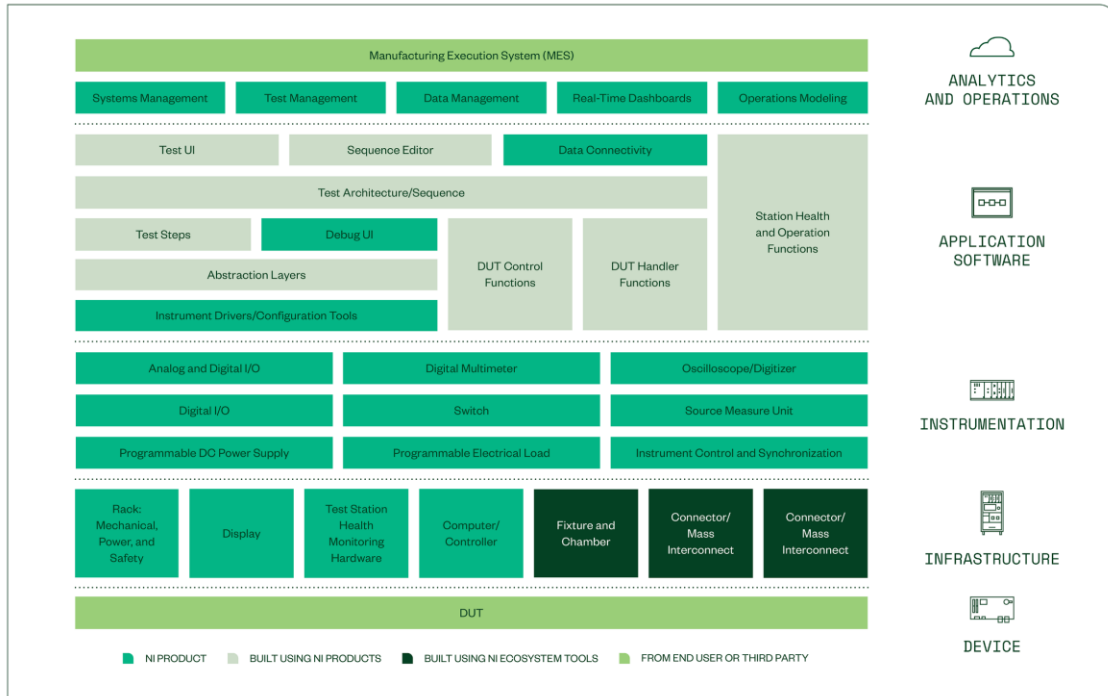


Figure 5. NI Tool Architecture

- **Instrumentation:** PXI instrumentation ensures complete and accurate test coverage with a modular architecture mounted in a robust PXI chassis. For applications that prioritize a smaller form factor and simpler measurements, TestScale offers a compact solution to high-volume production test.
- **Local Software:** TestStand and LabVIEW software provide a way to rapidly develop complex test steps and sequences by integrating seamlessly with hardware and providing an intuitive interface.
- **Server/Cloud Software (Enterprise):** SystemLink™ software eliminates manual software deployment tasks and elevates reports and test data trends, driving operational efficiency.
- **Infrastructure:** PXI systems conserve floorspace due to their small, light form factor. Order the completed rack preassembled and installed using NI ATE Core Configurations.
- **Services and Support:** The NI Partner Network offers integration and hardware services and software architecture support to ensure your short- and long-term success.



Instrumentation

From precise low-voltage measurements to custom digital protocols and battery simulation, PXI instruments operate across tens of thousands of manufacturing lines worldwide. Chosen for their complete and accurate test coverage, with a flexible, modular architecture, you can control the instruments via PC either remotely or mounted alongside the modules in an ultrareliable PXI chassis. The chassis also provides timing, triggering, and synchronization across a high-throughput backplane. You can rack-mount larger-format instruments alongside the PXI chassis.

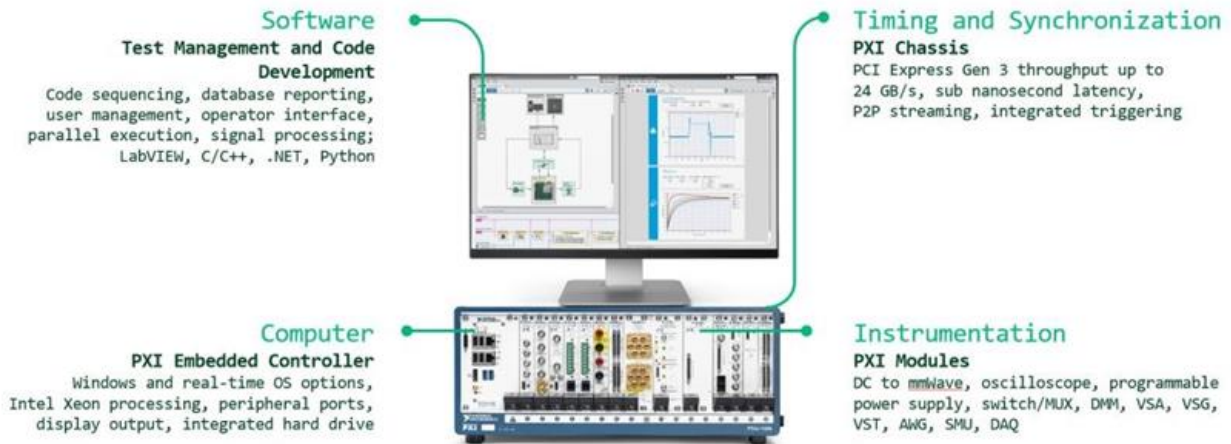


Figure 6. PXI Chassis Configuration

PXI Platform Design

PXI is a rugged, PC-based platform that combines PCI electrical-bus features with modular CompactPCI packaging and adds specialized synchronization buses and key software features. NI is the PXI test and measurement market leader, offering an unrivaled breadth of instrumentation. The NI PXI platform uniquely fast-tracks development, seamlessly integrating with NI test software as well as achieving open compatibility with third-party hardware and software. PXI is an open industry standard governed by the PXI Systems Alliance, a group of more than 70 global test companies.

Examples of instrumentation offering:

- Analog and digital I/O
- Digital multimeter
- Oscilloscope/digitizer
- Waveform generator
- Switch and timing/synchronization
- Source measure unit (SMU)
- Programmable DC power supply
- Electronic load
- Instrument control and synchronization

“PXI chassis are a staple of our test systems, as is LabVIEW.”

Anthony Lambert, Engineer, Abbott Laboratories



PXI Instrumentation

NI offers more than 600 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 contain only the actual instrumentation circuitry, achieving 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, featuring 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 semiconductor device characterization and production test with timing sets and per-channel pin parametric measurement unit (PPMU)



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; and make 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



Programmable Power Supplies and Loads

Supply programmable DC power (including some modules with isolated channels, output disconnect functionality, and remote sense)



FlexRIO Custom Instruments and Processing

Provide high-performance I/O and powerful FPGAs for applications that offer flexibility similar to custom hardware



Multiplexer and Matrix

Utilize 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, and Ethernet

Integrate non-PXI instruments into a PXI system through various instrument control interfaces



Data Acquisition Modules

Measure electrical or physical phenomena with a mix of analog I/O, digital I/O, counter/timer, and trigger functionality



TestScale

For a Functional Test solution optimized for scalability, cost-effectiveness, and space efficiency, NI offers TestScale for high-volume production test. With a COTS architecture, TestScale offers a compact backplane design with interchangeable modules of different applications to fit changing needs.

To improve functionality and decrease the potential points of failure on the test setup, TestScale is optimized to connect directly to the DUT itself. Without the need for a mass interconnect, full test rack, or other fixtures, the path of measurement becomes simplified, allowing the engineer to quickly locate maintenance needs. TestScale is a premier option for saving on space and upkeep constraints.

Backplane

Choose this option to reduce floor space and cost by removing the need for a test rack. The backplane option can attach to the pan of the fixture by wiring to the interposer and using a variety of mounting bracket



Figure 8. TestScale Core Module

options—or it can connect directly to the interposer to further reduce the signal path and failure points.

Core Module

The core module is equipped with 8 DIO channels as well as includes necessary functionality to the backplane.



Figure 7. TestScale Backplane

Available Modules:



Analog Input Module

Use for single-point voltage, waveform voltage, current, resistance, frequency, or voltage accuracy. Features up to 32 channels at a rate of 250kS/s.



Digital I/O Module

Perform TTL input/output, basic LED test, event counters, button test, open/short test, relay drivers, or PWM. Up to 5V, 32 channels.



Analog Output Module

Utilize for programmable voltage reference, a waveform generator, or a tone generator to generate a sinusoid at a particular frequency. Up to 10V, 4 channels



Digital Output Module

Drive digital output for higher voltage components or if your test application requires a low-side relay. Has 60 VDC capability, 32 channels



Programmable Power Supply

Utilize this 6V DC power supply if your test application requires power measurements, basic resistance measurements, CV or CC modes, or if you need current accuracy and resolution as a function of device specifications and averaging/aperture.



Programmable Power Supply Devices

Built for automated test, **rack-mount power supplies** provide programmable DC power in either full or 1/6 rack-width, rack-mount form factors. The RMX-412x models offer up to 1500 W of power in a 1U, full-rack form factor with flexible voltage and current limits ranging up to 650 VDC or 150 A, making them ideal for test systems that require large amounts of power with a broad range of voltage and current values. For applications requiring more than the specified voltage or current limits, you can combine up to two devices in a series for higher voltage and up to four devices in parallel for higher current. The RMX-410x models can source hundreds of watts in a compact 2U, 1/6 rack-width design that makes them ideal for test systems that need multiple power rails. Additionally, both series offer buttons and knobs for interactive use, as well as USB, LAN, RS232, and analog control options for remote or automated use.



- **Software:** API support for LabVIEW with shipping examples; SCPI-compliant for use with NI-VISA and text-based languages
- Up to 1,500 W options
- Output up to 650 V or 150 A, depending on model
- Combine multiple devices for higher voltage/current
- Calibration software utility included

Figure 9. Power Supply Devices

Electronic Load Devices

Built for automated test and measurement, **Electronic Load Devices** can sink power at various current and voltage levels for power supply design, quality inspection, and functional tests. Their modular design and multiple operating modes help them simulate the real load that a power source sees in its actual application. They also feature buttons and knobs for interactive use, as well as USB or RS232 interface options for automation. You can connect multiple loads in parallel to increase your system's overall power capacity.



- **Software:** API support for LabVIEW with shipping examples; SCPI-compliant for use with NI-VISA and text-based languages
- One- and two-channel options
- Sink up to 350 W
- Up to 500 V
- Up to 70 A
- Stack multiple channels and link multiple mainframes for higher power and parallel operation

Figure 10. Electronic Load Device



Instrumentation Hardware Services

Test station development and deployment is only half of the story. Best practice dictates that you consider station sustaining and maintenance from day one. NI's hardware service programs offer additional time-saving entitlements to help you avoid hassle, improve uptime, and maintain traceability at the lowest price.

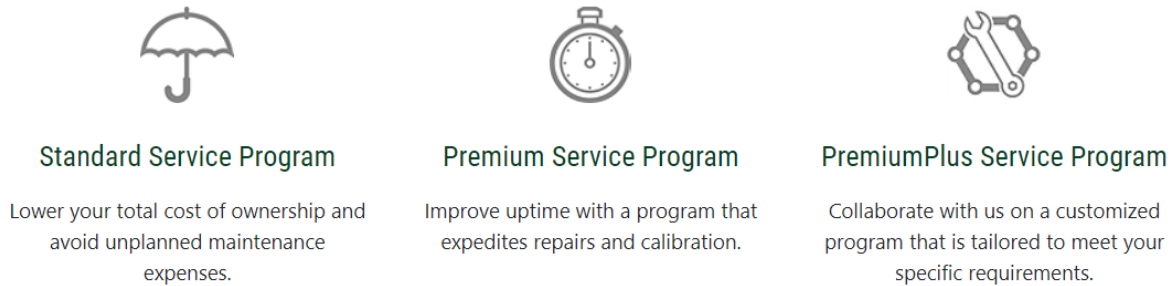


Figure 11. Instrumentation Hardware Service Levels

- **Budget Control:** Predict operational costs and avoid unforeseen maintenance expenses.
- **Minimize Downtime:** Get your systems back up and running within days, hours, or minutes with sparing programs, advance replacement services, and repair contracts.
- **Manage Lifecycle Changes:** Manage technology refreshes and product obsolescence with roadmap consulting and life-cycle services programs encompassing one to twenty years.
- **Simplify Logistics:** Simplify hardware maintenance logistics and overhead with NI support.
- **Maintain Standards:** Utilize ISO 9001-traceable calibration and ISO/IEC 17025-accredited calibration services delivered on-site and through expedited shipping for confidence and convenience.
- **Speed Deployment:** Get up and running with custom installation that includes app software, custom documentation generation, individual logo/labeling, and system recovery images.
- **Quickly Troubleshoot:** Minimize development delays by consulting with experienced applications engineers based in more than 40 countries to meet your local needs in your local language.

“In the 25+ years I’ve been dealing with NI, I’ve always found their personnel to be uniformly bright, enthusiastic, and genuinely concerned with helping their customers succeed.”

Cary Long, Software Engineer

Application & Development Software

Because software development monopolizes the majority of test-project development labor, software tool and architecture choices significantly impact deployment schedules. Adopting a standard software approach across a team or organization increases both efficiency and proficiency, lowering the risk of missed deadlines and improving test quality and reliability.

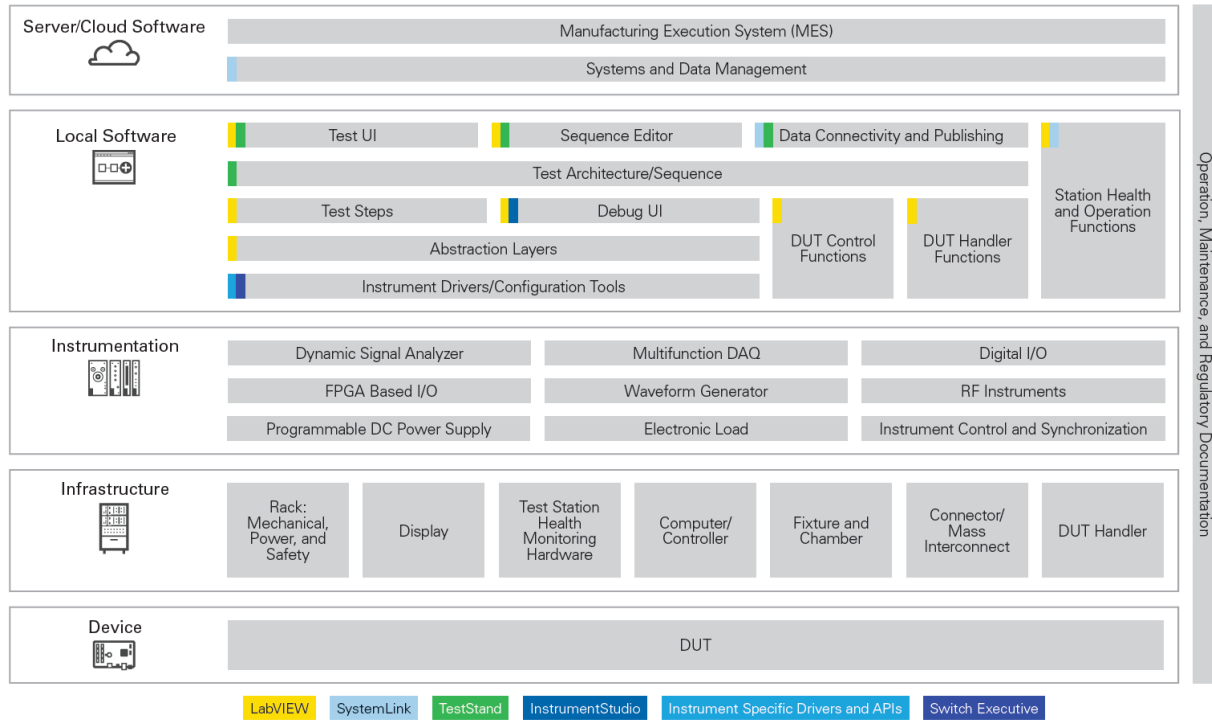


Figure 12. Test Station Software

Engineers worldwide choose NI software for its rapid development environment, open architecture, and throughput-enhancing features, such as automatic parallel test-step execution. NI test software is the most complete engineering toolchain on the market, consisting of TestStand, LabVIEW, SystemLink software, InstrumentStudio™ software, and more.

NI test software is open and compatible with most other development languages, including C, C#, and Python, so that teams can reuse existing IP within test steps and sequences without sacrificing NI software platform-development benefits.

“The NI platform (especially LabVIEW and TestStand) has greatly increased our productivity and is a department standard. It probably saves us at least 40 hours on each project.”

Makenna Shaske, Test Development Engineer, Benchmark Electronics



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 instrument.
- Use hundreds of instrument-specific example code modules and included measurement libraries to reduce development time.
Reuse existing code libraries from languages including C/C++/C#, .NET, and Python, as well as MathWorks® MATLAB® software.
- Quickly create professional user interfaces to visualize test outcomes using an intuitive VI.
- Build proficiency with extensive online and in-person training options for both new users and certified NI tool architects.

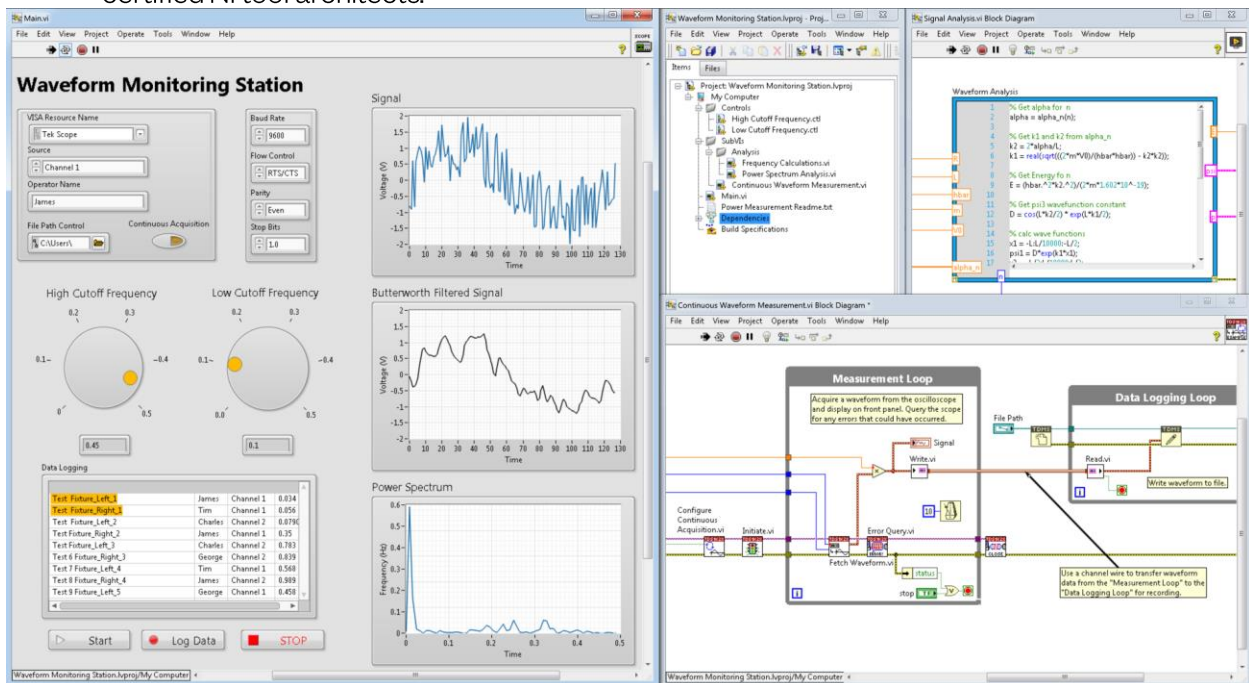


Figure 13. LabVIEW Software Interface

“Our team uses a common hardware platform across testing of numerous products. Reusability of common hardware configurations and utilization of common LabVIEW code simplifies development of new test systems.”

Brian Teschendorf, Software Engineer, Boston Scientific Corporation



TestStand

TestStand ready-to-run test management software is designed to help you quickly develop and execute transaction processing system (TPS) software. You can extend TPS functionality by developing TestStand test sequences 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 connectivity to other enterprise systems. You can deploy test systems to production with easy-to-use operator interfaces.

Key Benefits:

- Call and execute tests written in LabVIEW, Python, C/C++, or .NET
- Perform complex tasks, such as parallel testing, sweeping, looping, and synchronization
- Create custom operator interfaces and integrate tools for specific applications
- Carry out unit tracking, creating automated reports, and storing results to local or network databases
- Troubleshoot test systems with integrated debugging tools

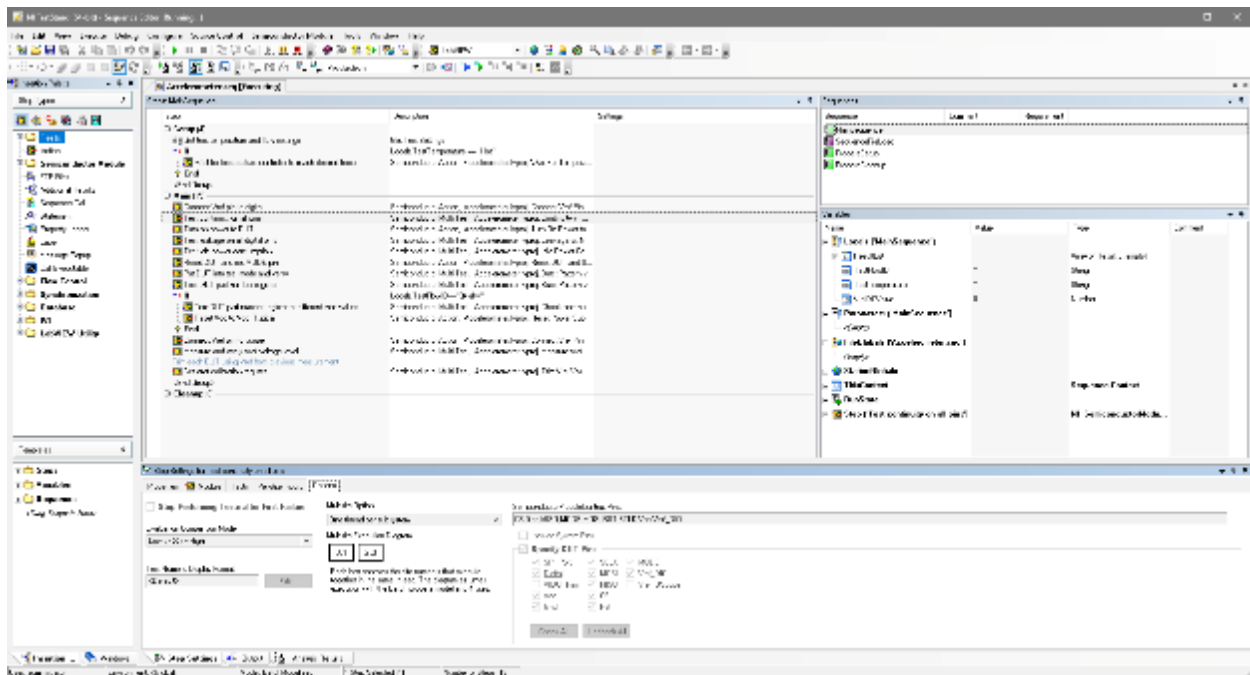


Figure 14. TestStand Software Interface

“TestStand has helped to decrease the time spent testing product and gets it to the market faster.”

Jared Smith, Test Engineer, Schneider Electric



InstrumentStudio Software for Interactive Measurements

InstrumentStudio software 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 and capture multi-instrument screenshots and measurement results. Save project-level configurations for easier test repeatability with specific devices under test, or export instrument configurations to programming environments to simplify your code and guarantee measurement correlation. You also can use InstrumentStudio software 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

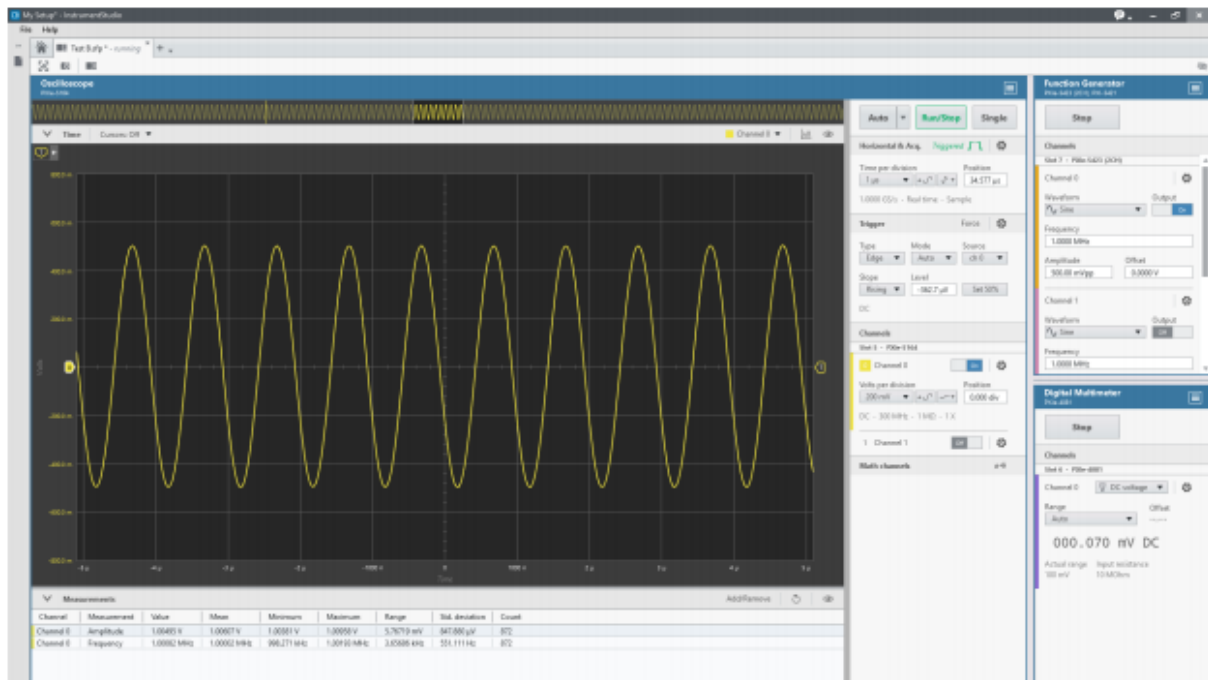


Figure 15. InstrumentStudio Software User Interface



Switch Executive Application Software

While the NI-SWITCH driver provides all low-level functionality required to program switch actions, Switch Executive is application software for intelligent switch management and routing that accelerates development and simplifies complex switch-system maintenance. Its 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 software, 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

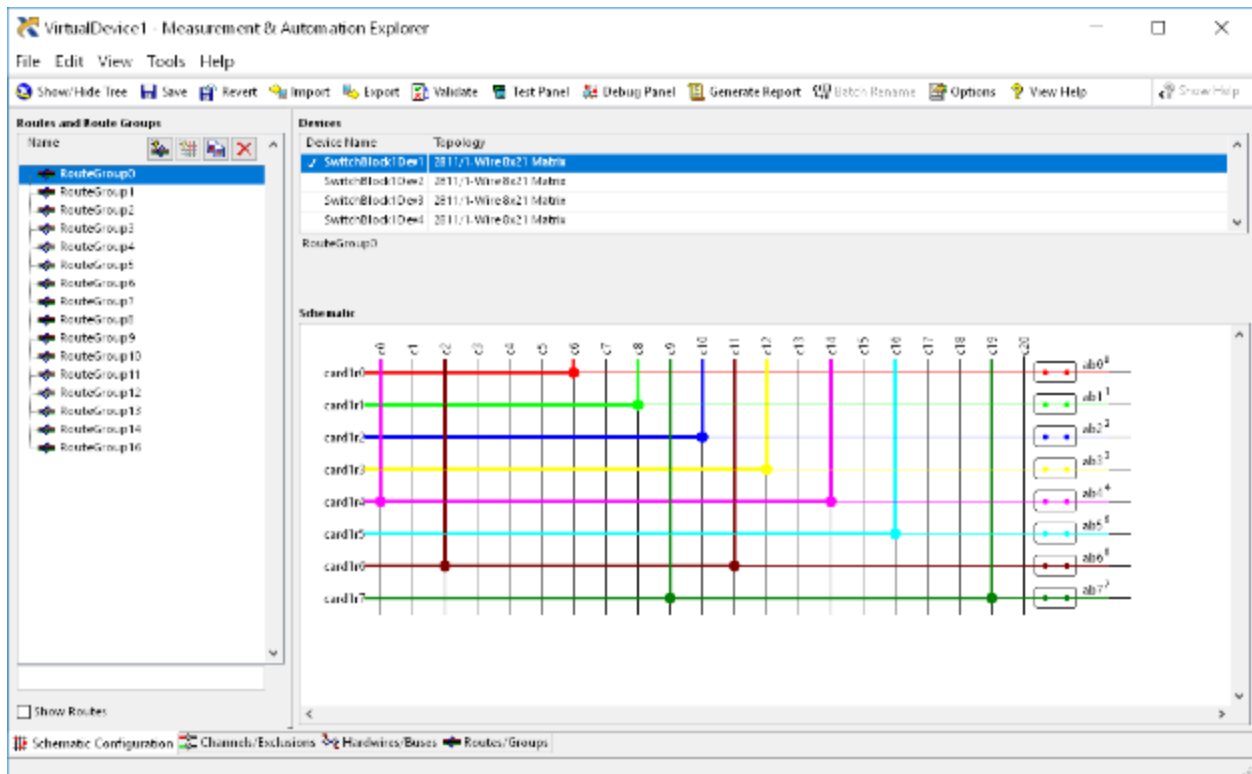


Figure 16. Switch Executive Software Interface



Instrument-Specific Drivers and APIs

NI instrument driver software includes best-in-class APIs that work with a variety of development languages, such as LabVIEW, C, C#, Python, and others. To ensure long-term interoperability of our instruments, the driver APIs run the most current data while offering backwards compatibility with older versions. 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 on either Windows or Linux-based systems.

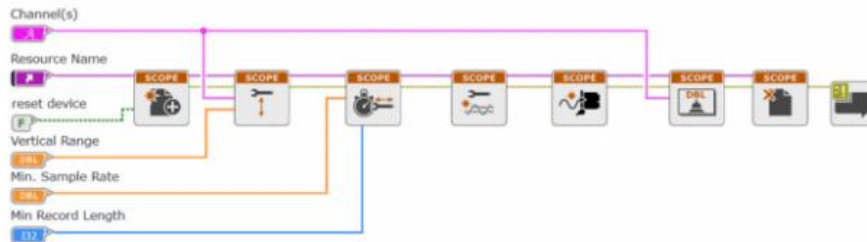


Figure 17. LabVIEW API for NI-SCOPE

```
// 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 18. C API for NI-DAQmx

```
import niscopes
with niscopes.Session("Dev1") as session:
    session.channels[0].configure_vertical(range=1.0, coupling=niscopes.VerticalCoupling.AC)
    session.channels[1].configure_vertical(range=10.0, coupling=niscopes.VerticalCoupling.DC)
    session.configure_horizontal_timing(min_sample_rate=50000000, min_num_pts=1000, ref_position=50.0,
    with session.initiate():
        waveforms = session.channels[0,1].fetch(num_records=5)
        for wfm in waveforms:
            print('Channel {0}, record {1} samples acquired: {2:,}\n'.format(wfm.channel, wfm.record, len(wfm)))

    # Find all channel 1 records (Note channel name is always a string even if integers used in channel)
    chan1 = [wfm for wfm in waveforms if wfm.channel == '0']

    # Find all record number 3
    rec3 = [wfm for wfm in waveforms if wfm.record == 3]
```

Figure 19. NI-SCOPE Code Example Capture in Python



Server/Cloud Software (Enterprise)

Test data visibility is increasingly in demand. Best-in-class companies realize that scrutinizing their functional test data provides real-time insight into changes in manufacturing yield, throughput, line health, and product quality.

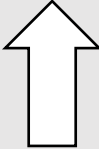
Data Insights	Team Requesting Data	Data Usage Need
Enterprise Data Requirement  Basic Data Requirement	Company Leadership	Business Operations Insight
	Product Returns Team	Fault Traceability
	Product R&D Team	Product Design Improvement
	Test Development Team	Tester Improvement and Optimization
	Manufacturing Floor Operations Team	Utilization and Line-Balancing Operations
	Local Test Operator	Test-Station Status

Figure 20. Instrumentation Hardware Service Levels

Home-grown test data management solutions are prevalent. But effectively developing and maintaining these solutions requires expertise in domains misaligned with test engineering workflows, including database connectivity, web services, IT systems, security, and visualization. Because these areas often do not contribute to key metrics by which test organizations are measured, these aspects are often ignored and thus hurt productivity.

To offset this, test organizations are moving towards COTS systems and data management solution in which test engineers work within the areas that add the most business value.

NI SystemLink software is a leading solution that addresses this issue, as well as expands the capabilities of systems and data management tools far beyond what most engineering teams have experienced. SystemLink software integrates seamlessly with NI TestStand software and PXI hardware and offers an open architecture to effectively manage a wide range of third-party data and instruments.

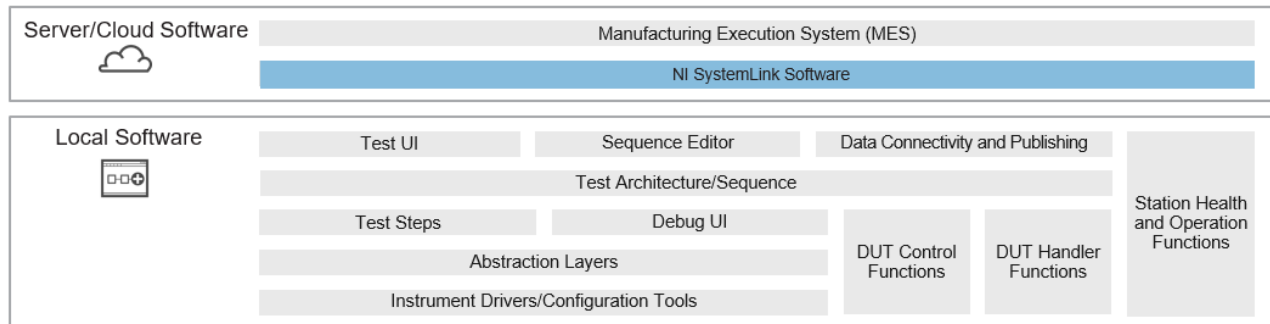


Figure 21. Software Architecture Highlighting NI SystemLink software



SystemLink Software

SystemLink software eliminates the manual tasks related to keeping test systems current and healthy. From automating software updates to monitoring system health, SystemLink software delivers key information that improves situational awareness and test readiness. Leveraging an automation and connectivity framework, SystemLink software aggregates test and measurement data from all test systems into a centralized data repository. Users have ready access to asset utilization, calibration forecasts, and test-result history, trends, and production metrics data to make proactive decisions on capital expense, maintenance events, and test or product modifications.

SystemLink software is comprised of four modules: Software Configuration, Asset, Test, and TDM Data Finder. These modules provide application-specific capabilities that use the SystemLink server for data communication, transmission, and movement, as well as services for managing NI and non-NI instruments, software packages, alarms and notifications, and dashboards.

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 query and analysis sources
- Quickly access and search measurement data across TPSs
- Intelligently analyze files and generate reports automatically

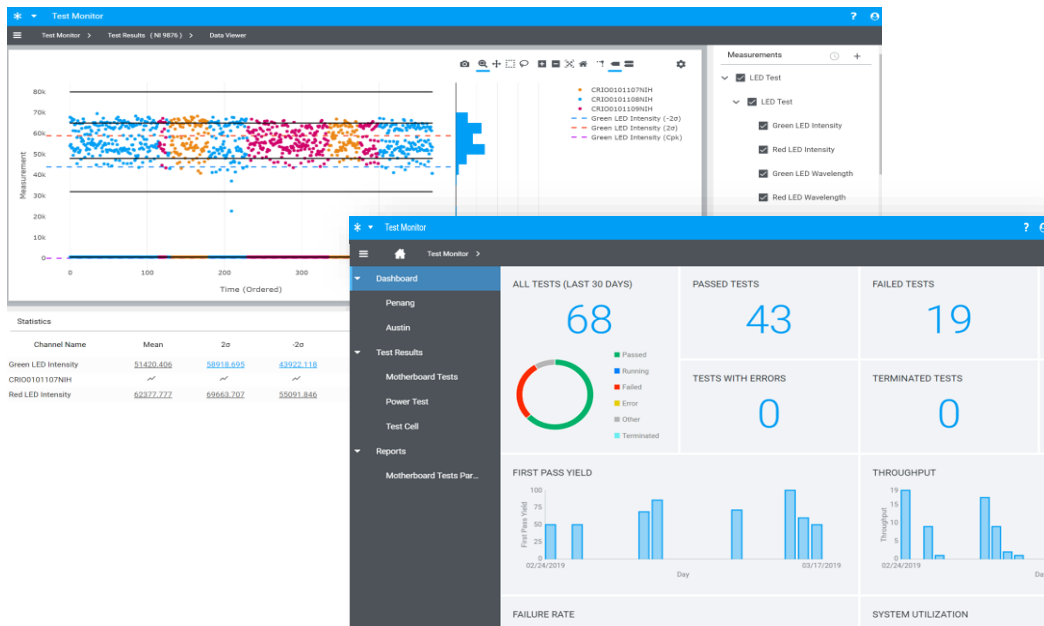


Figure 22. SystemLink Software



Infrastructure Elements for Functional Test

While the infrastructure around a test station isn't typically recognized in test coverage specifications, it plays a vital part in ongoing test-station operation. Carefully considering test infrastructure component quality, practicality, and functionality ensures long-term test-station success. NI provides many of the key infrastructure elements and partners with an ecosystem of trusted vendors to make recommendations on how to complete a fully operational deployed system.

Instrument Chassis

The PXI chassis, the backbone of a PXI system, equates to a desktop PC mechanical enclosure and motherboard. It provides power, cooling, and a communication bus to the system, and supports multiple instrumentation modules within the same enclosure. PXI uses commercial PC-based PCI and PCI Express bus technology while combining rugged CompactPCI modular packaging, as well as key timing and synchronization features. Chassis range in size from two to 18 slots to fit the needs of any application, whether its intentions are to be a portable, benchtop, rack-mount, or embedded system.



Controllers

PXI embedded controllers eliminate the need for an external PC and provide a high-performance, compact, in-chassis embedded computer. These embedded controllers have extended temperature, shock, and vibration specifications and include the latest integrated CPUs, hard drive, memory, Ethernet, video, serial, USB, and other peripherals.



Figure 24. PXI Controllers

Controllers come preconfigured with LabVIEW Real-Time or Microsoft Windows and all device drivers preinstalled. NI's embedded controllers also include managed life-cycles and vendor support to ensure test system longevity and compatibility with the PXI ecosystem.

Industrial PC (IPC) Link

- Connects the PXI chassis to an external controller such as a rack-mounted industrial PC through a software-transparent link that requires no additional programming
- Creates synchronized, data-connected, multichassis PXI systems with up to 13.7 GB/s of sustained data throughput
- Optimizes costs



Mechanical, Power, and Safety Infrastructure

Not all racks are created equally: Rack vendors seeking to reduce costs can compromise accessibility, durability, mobility, and reliability. NI has standardized a mechanical, power, and safety infrastructure for deploying rack-based automated test systems with trustworthy, high-quality components in a flexible, easy-to-maintain system.

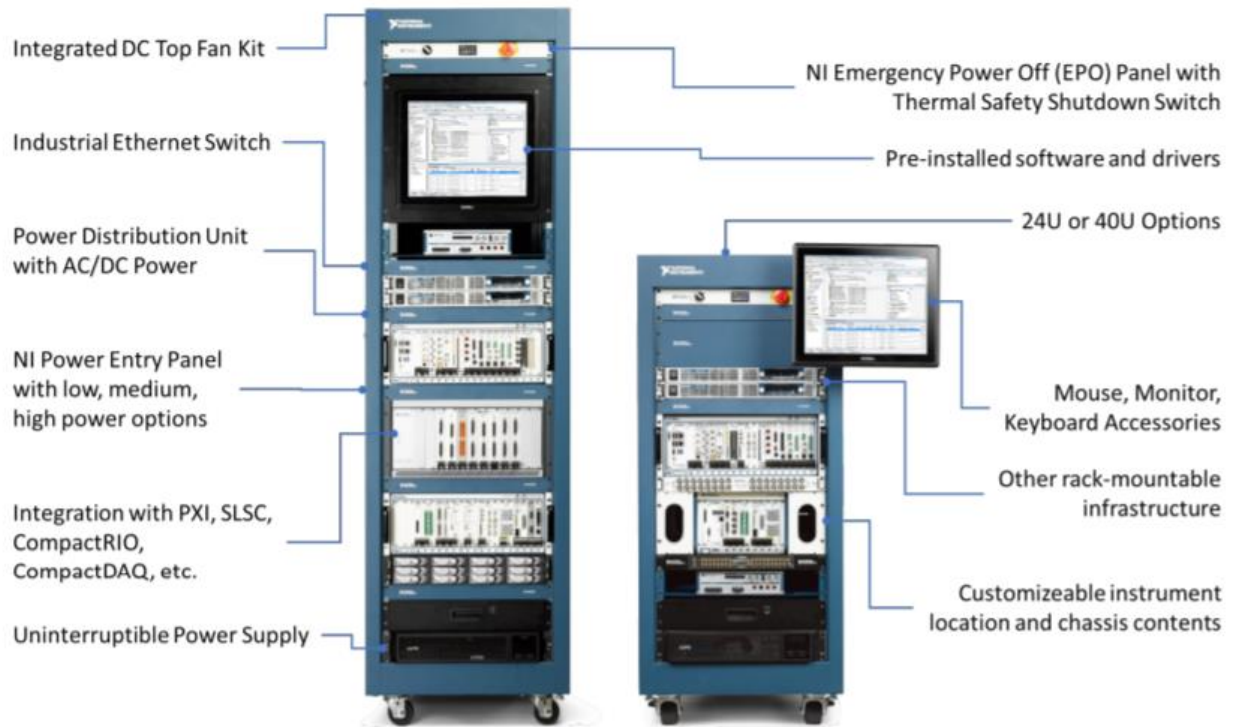


Figure 25. Rack

Streamline your automated test-system procurement and control costs and timelines with a single-vendor expedited preassembled, configured systems delivery. Reduce time and cost associated with multiple purchase orders by acquiring a full tester from one vendor, and having it shipped directly to your site anywhere in the world (IEC 61010-01-compliant). Each system is delivered with reusable packaging materials ideal for future redeployment.

Benefit from a single warranty covering your system, repair and replace parts from a single source, and trust NI's single service program to sustain your entire system. NI-configured systems save time and money while accelerating system deployments.

“By standardizing on NI’s ATE core configs, we were able to reduce the time it takes to build new testers by 40%.”

Chris Becher, Engineering Manager, Alstom Signaling



Mass Interconnect

Product life cycles decrease as new features and options roll out. To ensure positive ROI, engineers are deploying customizable modular test systems to meet the coverage needs of multiple DUTs and SKUs. This modular best practice includes both the instrumentation and the test interface.

Interfaces must:

- Allow rapid system changeover through a standardized approach
- Not compromise test coverage by supporting a full range of signals from the DUT
- Minimize downtime and reduce maintenance with reliable long-term operation

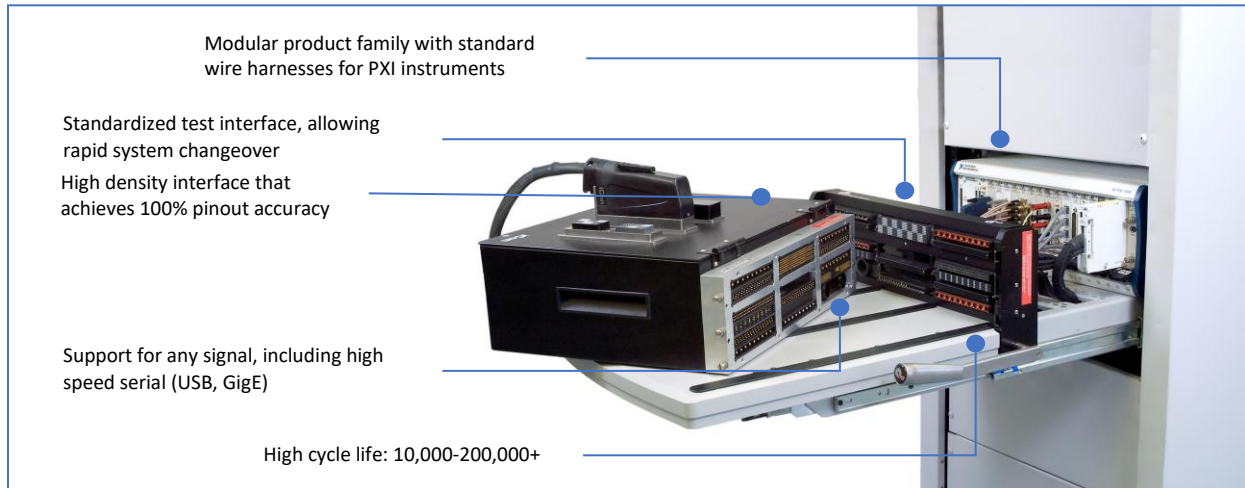


Figure 25. Mass Interconnect Characteristics

Featured Product Partner: Virginia Panel Corporation (VPC)

For almost 60 years, dedicated VPC employees have provided reliable mass interconnect solutions. VPC designs, manufactures, and markets interface connector products for commercial, consumer electronic, medical, telecommunications, aerospace, and automotive applications.

For more information, email info@vpc.com.



Fixtures

Functional test typically applies full operational power to a loaded printed circuit board to determine whether the printed circuit board assembly (PCBA) functions as designed. Most functional test stations require custom-built test equipment and custom test fixturing.



Figure 27. Custom Test Fixture

Fixture architecture depends on product volume and the frequency with which you change the model of DUT being tested. Fixture can represent a significant capital expenditure as cost is proportional to the number of tested SKUs rather than the number of testers, but because connectivity in the fixture is a leading cause of false failures, best practice dictates that this is not a test system element on which to compromise quality. Although many high-volume lines are moving to in-line architectures due to labor cost, manual or pneumatic architectures are still common. If volumes are low, you can use personalized drop-in plates within the fixture to minimize capital expense over time. Programming heads for flashing embedded software should be integrated into the fixture, as longer cables and multiple connections commonly introduce errors. During this process, embedded software security should also be considered to avoid further complications later in the test process. NI partners with trusted fixture vendors across the world as an experienced fixture manufacturer is crucial for mechanically durable and ergonomic functionality.

Choose the right Alliance Partner to meet your fixturing needs by visiting ni.com/alliance.

Learn more about our featured electrical functional test Alliance Partners on pages 23 – 25.

Services and Support

Change initiatives are common within test teams. Whether building a new test strategy, driving a technology refresh, or extending the life cycle of an existing project, product schedules and budgets often come with high risks. Managing this risk is a tricky balance between meticulous planning and agile design choices.

Utilizing consultation, educational resources, and ongoing support programs can mean the difference between a culture of missed deadlines and budgetary strain, and a culture of on-time, on-target delivery. NI consultation, integration, and education services offer guidance and industry expertise to help build and execute a practical plan to achieve your business and operational outcomes.

Methodology Consulting Services

With more than 40 years' test experience, NI is an expert in test-related processes and strategies. NI provides a framework to help you evaluate your people, processes, and technology, and recommends a test strategy appropriately customized to your business. Work with NI to solidify a business case that articulates your future state and expected program ROI to secure the funding you need.

Planning and project management consulting helps build a project-execution plan that keeps teams on track to hit major development milestones. Work together with NI to establish priorities, identify the right resources, and make trade-offs to optimize cost without putting projects at risk.

Integration Engineering Services

With global solution centers and NI engineers in more than 40 countries supported by more than 900 Alliance Partner companies, NI delivers design and development assistance in every region and industry. NI engineers help you mitigate risk, develop faster, and reduce costs through project management, architecture development, and system documentation to deliver an integrated solution.

Education Services

Test teams new to NI software and seasoned veterans of the platform alike benefit from investing in their education through learning resources designed for personal and team proficiency. NI provides a comprehensive customer education program designed to increase productivity, reduce development time, and improve your team's ability to engineer robust, maintainable applications with NI products.

Tailor the experience to fit any schedule with online, in-person, and flexible programs.

Engineers who have adopted NI education services save time in development and maintenance and learn faster.

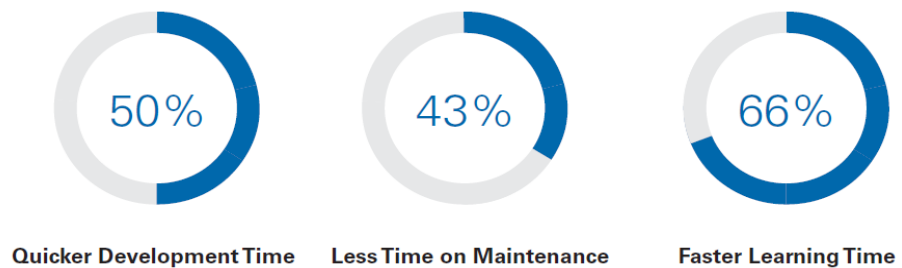


Figure 28. Save Time and Effort with NI Products and Services



Featured Alliance Partners

Best-in-class test engineering teams realize that there is seldom a simple question of in-house development versus outsourced development. Instead, they realize how complex it is to decide how to balance development teams to optimize for deployment schedule, bandwidth, domain specific expertise, proficiency development, and available budget.

NI Alliance Partners are uniquely positioned to support your business with the service that it requires, including strategic design, system integration, specialist tools, software IP, and ongoing support. More than 1,000 NI Alliance Partners, each certified and vouched for by NI and positioned globally, stand ready to consult with you on projects and provide complete solutions based on NI's productive software and modular hardware.

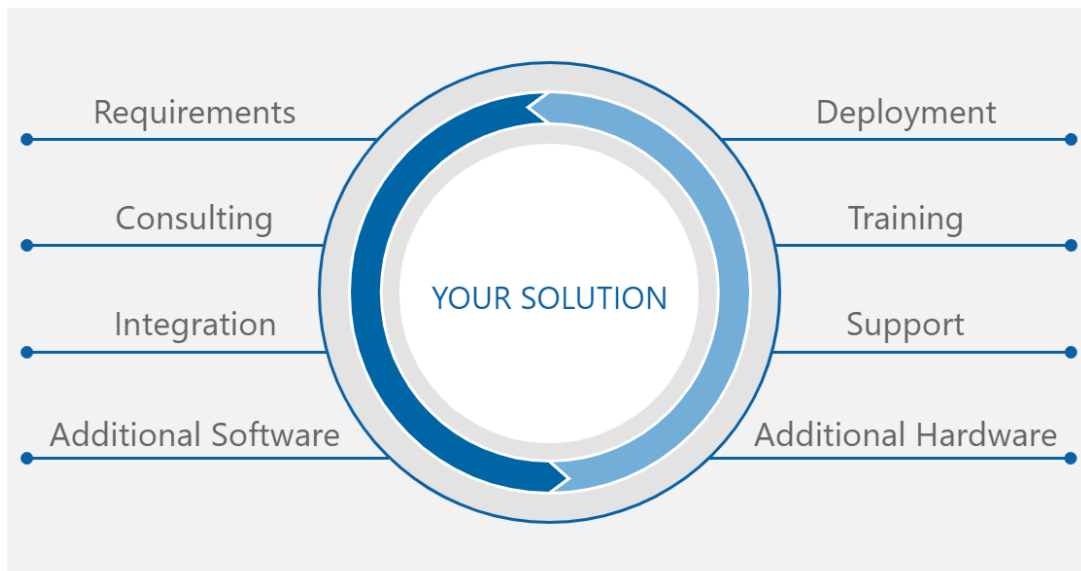


Figure 29. Alliance Partners Can Help Ensure Your Success

Partnering in Your Success

- **Integrators:** These Alliance Partner integration companies offer certified production test specialists to help reduce development time and cost by providing expertise and complete solutions.
- **Consultants:** These hourly consultants help mitigate risk and shorten design cycles through software architecture design, code review, and individual or team training.
- **Tools and Apps:** Build specialist IP into your solution to add functionality or reduce development time. The LabVIEW Tools Network offers hundreds of add-ons, toolkits, and reference applications compatible with NI and industry platforms.

Featured Alliance Partner: Circuit Check

Circuit Check is a leading provider of automated test systems and interfacing solutions (test fixtures and interface test adapters) for complex industrial, medical, automotive, military/aerospace, and computer networking industry electronic products. Circuit Check specializes in rapidly designing and deploying complex systems, including, automation, vision, and user-interface testing. Design staff includes electrical, software, and mechanical engineers. Each project has a dedicated project manager to ensure successful test system completion throughout the United States, Canada, Mexico, Europe, Malaysia, and China.

- Reduce project delivery risk with a proven record in mission critical projects with turnkey solutions built to the highest quality and reliability.
- Augment your experience and knowledge, not just bandwidth: In-house design teams deliver successful, well-thought-out solutions that work first time.
- Reduce the cost of test by optimizing test measurement design through design for testability (DFT) consulting and requirements-specification development and build best practices.
- Scale efficiently when deploying large numbers of stations distributed across multiple sites.
- Receive support throughout your test station life cycle, from design to development, deployment, start-up, and sustainability.

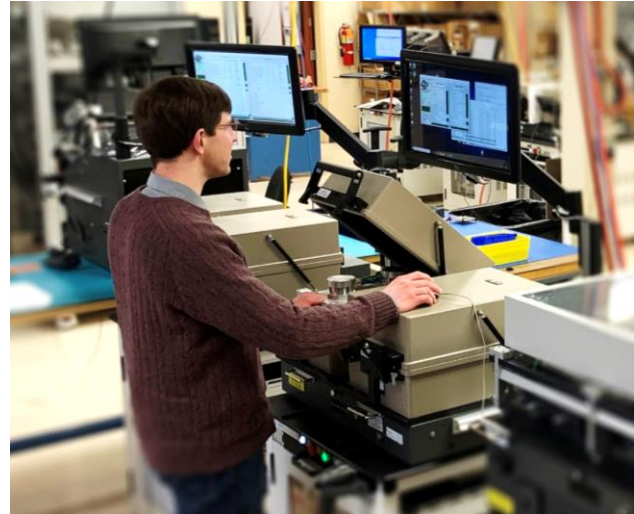


Figure 30. Development at Circuit Check

Circuit Check stands out as a system integrator by providing a personal consultative service to every test project—big or small. This service includes:

- Dedicated project managers to ensure successful test system completion. Communicate with one point of contact through the entire project.
- A full test system documentation package (including a bill of material, system overview, hardware setup, operator manual electrical schematic, and test results).
- A customer documentation review and update (including customer mechanical and electrical design documents for testability).

To learn more, visit circuitcheck.com or call (763) 694-4100.



Featured Alliance Partner: Booster

Booster is a professional and dedicated manufacturing test development and test automation solutions provider based in China with a worldwide service and support network.

- Scale to any size project with more than 110 test development and design engineers who cover most of the product catalog test development, design knowledge base, and required capabilities.
- Minimize costs and lead times with in-house high-quality fixture design and fabrication, including RF and audio/acoustic chamber expertise.
- Receive support for your entire test line—from DFT and early-stage test-strategy consultation, through development, to sustaining.
- Take advantage of timely worldwide service and support.



Figure 31. Test Station with Fixtures

General Electric named Booster one of only three WW Certified Test Development Systems Integrators based on quality of service and international presence.

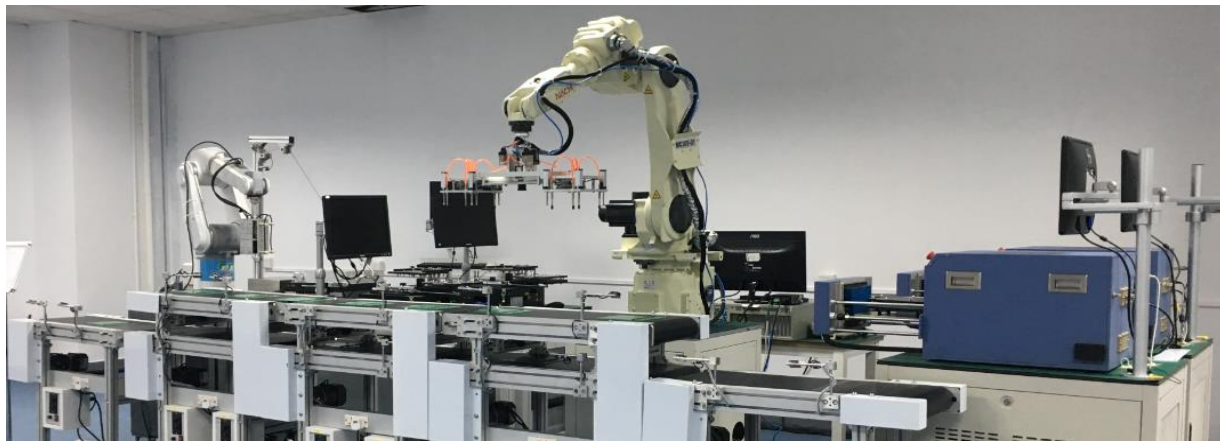


Figure 32. In-line Test Station with Automation

Visit boostertech.cn/m/en/ to learn more.

Email: andy.zhang@bcd-autotest.com

Sales Email: sales@bcd-autotest.com

Mobile: +86 18688150629



Featured Alliance Partner: Avera

Avera is a premier test-solutions provider for technology innovators worldwide. As an NI Platinum Alliance Partner, Avera's test expertise spreads from consumer electronics, telecom, and life sciences to aerospace, defense, and automotive.

With more than 20 years in business, Avera has a proven record in helping clients accelerate product development, reduce manufacturing costs, achieve uncompromising test coverage, and solve supply-chain issues.



Figure 33. Deployed Automated Test Solution

- Undertake projects of any size with the support of more than 240 globally located engineers and software experts—including more than 140 NI-certified architects, developers, and instructors.
- Build with confidence assured by Avera's track record of more than 6,000 successful projects.
- Solve complex problems with accredited specialty product support for NI tools, including RF/wireless and SystemLink software.
- Meet production volume requirements with mechanical design that scales from simple manual fixtures to fully automated inline installations.

Learn more at insight.avera.com/request-for-information-avera.



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