

SOLUTION
BROCHURE

Audio and Acoustic Functional Test Station

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Jabra headset designed
and manufactured by
GN Audio, tested with NI.



Audio and Acoustic Functional Test Station

Audio and Acoustic Functional Solution for Analog and Digital Production Test

As Internet of Things (IoT) devices experience worldwide growth, many electronics products are adopting a voice-command user interface, bringing new acoustic and audio functional test challenges. Test teams must follow the New Product Introduction schedule, meet extended test coverage requirements, and maximize high-volume/high-mix production test throughput with multiple devices under test (DUT) and revisions.

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Solution Overview

As Internet of Things (IoT) devices experience worldwide growth, many electronics products are adopting a voice-command user interface, bringing new acoustic and audio functional test challenges. Test teams must follow the new product introduction schedule, meet extended test coverage requirements, and maximize high volume and mix production test throughput with multiple devices under test (DUT) and revisions.

The NI Electronics Analog and Digital Audio & Acoustics production solution provides an easy-to-use modular, scalable system that enables shorter evaluation time, improves data management, and offers real-time visualization. Audio and acoustic test reference architecture provides PDM and I2S acquisition, generation APIs using NI RIO and DSA, TestStand™ sequence template for audio analysis test steps, and system-level design guide to maximize test throughput, accelerate test development process, and optimize engineering time.

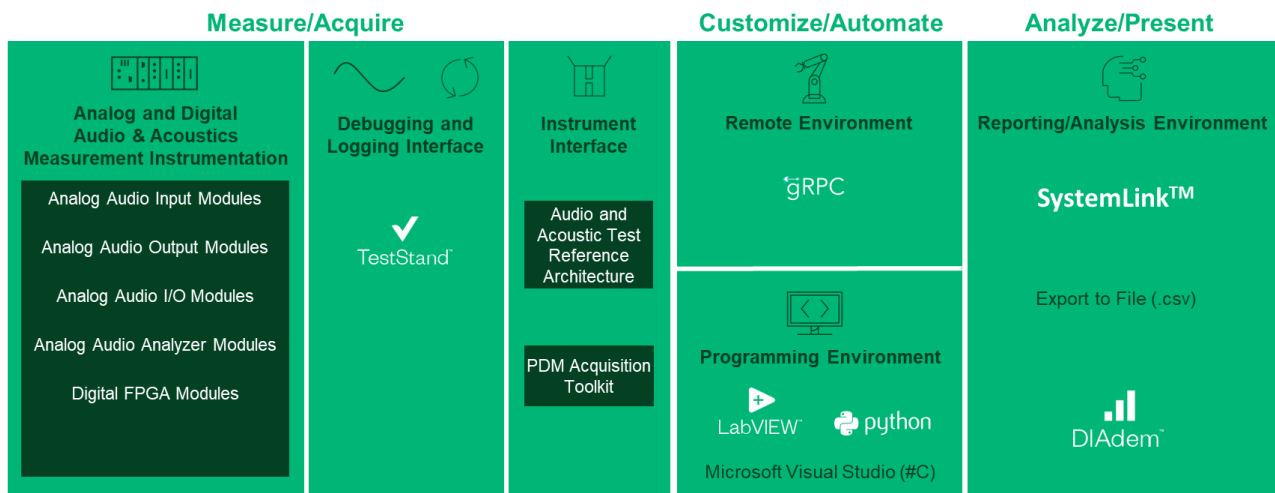


FIGURE 01: NI ELECTRONICS POWER VALIDATION SOLUTION OVERVIEW

Solution Advantages

- High-accuracy hardware that supports both analog & digital audio testing
- Modular, smaller footprint system with broad I/O coverage
- Rapidly develop complex test steps and sequences using TestStand™ & LabVIEW™
- Accelerate test development process with Reference Architecture
- Fast measurement speed and built-in parallel testing to increase throughput
- Maximize yield with data analytics and systems management configurations using SystemLink™

“As MEMS microphone production ramps up, AAC plans to evaluate a standard solution based on the PXI platform to cover MEMS analog microphone and digital microphone test, along with including ultrasound microphone test.”

Quote Author: Yujie Liu, Test Manager, AAC

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.

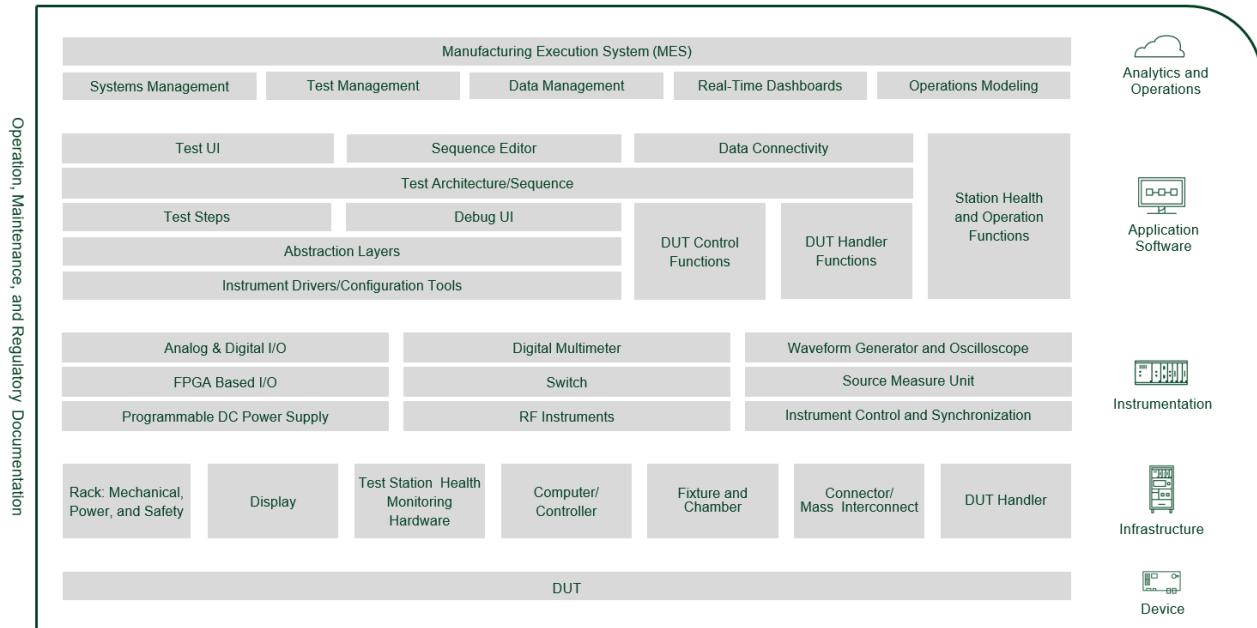


FIGURE 02: TEST STATION ARCHITECTURE

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

Test stations must:

- Meet test coverage requirements
- Be maintainable throughout the product's market lifetime
- Operate within a cycle-time requirement
- Develop in time to meet a production schedule
- Be certified and documented to meet regulatory standards
- Deliver test data in a format accessible to all requesting departments
- Physically and operationally fit into existing manufacturing processes
- Be purchased within a test budget

NI Test Platform Benefits

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.
- **Development Schedule:** Test-specific software tools can save more than 50 percent of your development time,¹ reducing the risk of missing tight schedule deadlines.

Systems-management software ensures fast and error-free software deployment, minimizing delays in large or remote updates.

- **Regulatory Compliance:** Complete documentation, experienced system integration partners, and tools designed for long-term deployment ease regulatory certification and recertification processes.
- **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 03: EXAMPLE OF ACOUSTIC TEST STATION USING NI TOOLS

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.

- **Standardization:** NI's modular hardware and software is ideal for standard platform development; components can be easily reused and expanded, as you can easily reuse and expand components with minimal redesign for wide-range functionality.
- **Digital Transformation:** Utilizing the IoT for test is not a futuristic idea—you can do it today using systems-management tools to deliver improved test coverage insight and significant utilization improvements. 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 NI software toolchain that applies to multiple engineering disciplines, combined with a thriving global developer community, encourages test proficiency both at the individual and team 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, along with 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 Overview

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 integration partners offer technical services to ensure customer success in designing, developing, and sustaining test stations.

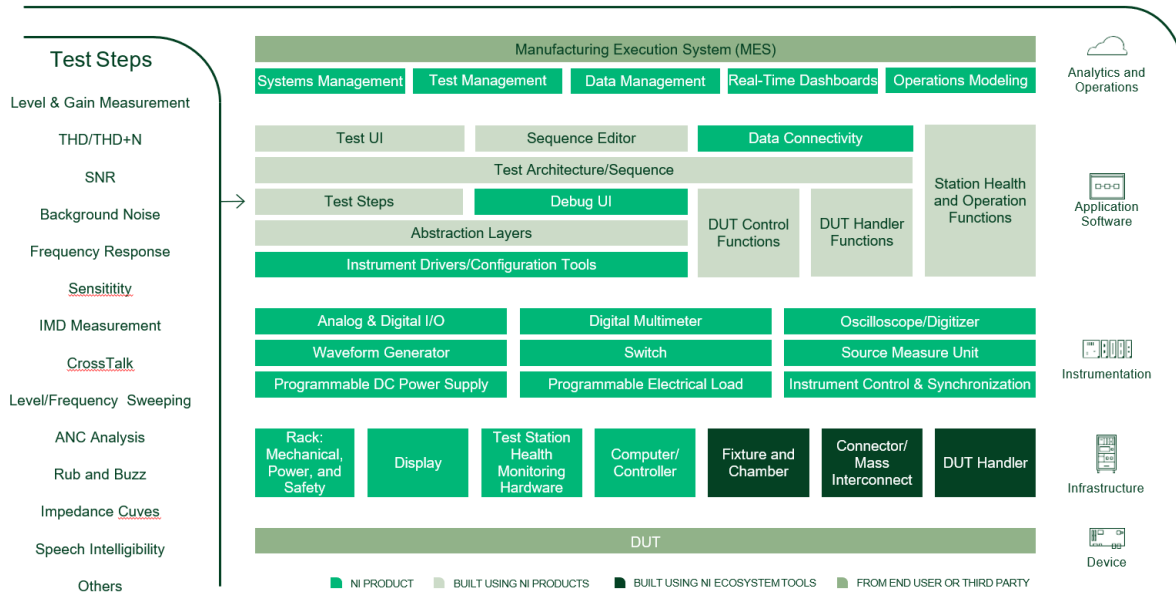


FIGURE 04: NI TOOL ARCHITECTURE

- **Instrumentation:** PXI instrumentation and software support the latest emerging audio and acoustic test requirements, ensuring complete and accurate test coverage.
- **Instrumentation:** FPGA and synchronization technology improve high-volume/high-mix production test throughput via low-price-per-channel multi-up test stations.
- **Software:** TestStand and LabVIEW software rapidly deploy complex test steps and sequences. SystemLink software eliminates manual software deployment tasks and elevates reports and test-data trends, driving operational efficiency.
- **Services and Support:** Integration partners, hardware services, and proficiency programs ensure both your short- and long-term success.

“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.

NI Tool Architecture: Analog Audio Test

NI’s analog audio solution provides better measurement accuracy, rapid test development, and better resilience to changes. Quickly adapt to new requirements with an open, modular architecture, increase throughput with fast measurement speed, and maximize yield with data analytics and systems-management configurations.

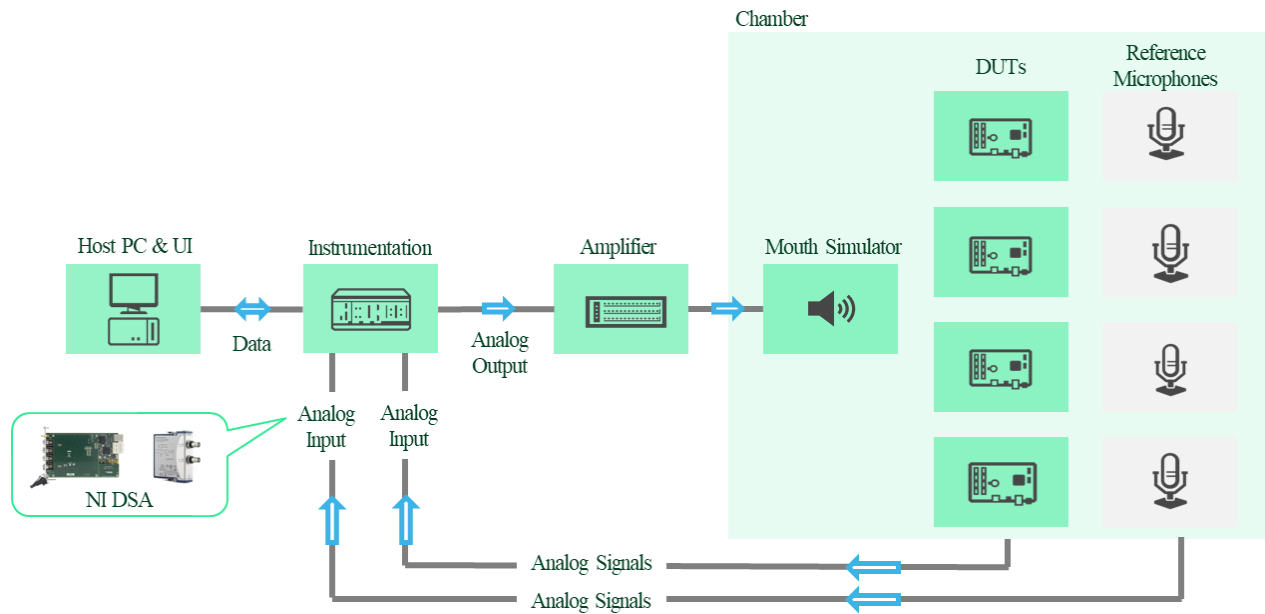


FIGURE 05: SIGNAL PATH DIAGRAM FOR ANALOG MICROPHONE TEST

The diagram shows a typical hardware setup for an analog microphone test with/without a reference microphone. For analog microphone test, you can test either with or without reference microphones.

	CompactRIO or CompactDAQ Chassis			PXI Chassis		
	NI-9250	NI-9251	NI-9260	PXI-4468	PXIe 4464	PXIe-4463
Module	NI-9250	NI-9251	NI-9260	PXI-4468	PXIe 4464	PXIe-4463
Description	Audio Input	Audio Input	Audio Output	Audio Analyzer AI/AO	Audio Input	Audio Output
Number of Channels	2	2	2	4 (2AI/2AO)	4 (2AI/2AO)	2 4 (1AI/1AO)
AI Voltage Range (V)	±5 Vpk	±4.243 Vpk (3Vrms)	-	±42 Vpk (-20dB Gain)	±42 Vpk (-20dB Gain)	-
AO Voltage Range (V)	-	-	±4.243 Vpk (3Vrms)	±10 Vpk	±3.45 Vpk	±10 Vpk
Maximum Sample Rate	102.4 kS/s	51.2 kS/s	102.4 kS/s	203 kS/s	204.8 kS/s	51.2 kS/s
Smart TEDS sensor compatibility	Yes	-	-	Yes	Yes	No
Maximum Calibration Cycle	2-year	2-year	1-year	2-year	1-year	2-year
Bus Connector	USB, Ethernet	USB, Ethernet	USB, Ethernet	PCI	PCI	PCI
Connectivity	BNC	mini XLR	BNC, mini XLR	SMB, BNC	SMB, BNC	SMB, BNC

FIGURE 06: ANALOG AUDIO TEST MODULE OVERVIEW

NI Tool Architecture: Digital Microphone Test

Digital microphones are becoming more prevalent in electronic devices due to their increasing accuracy, small size, and low cost. This presents a challenge for test engineers as most components use PDM modulation to communicate their output, which must be demodulated and compared with reference signals (usually analog) to verify their operation. The low cost and high-volume demand for these components also favors a multi-up architecture to be implemented.

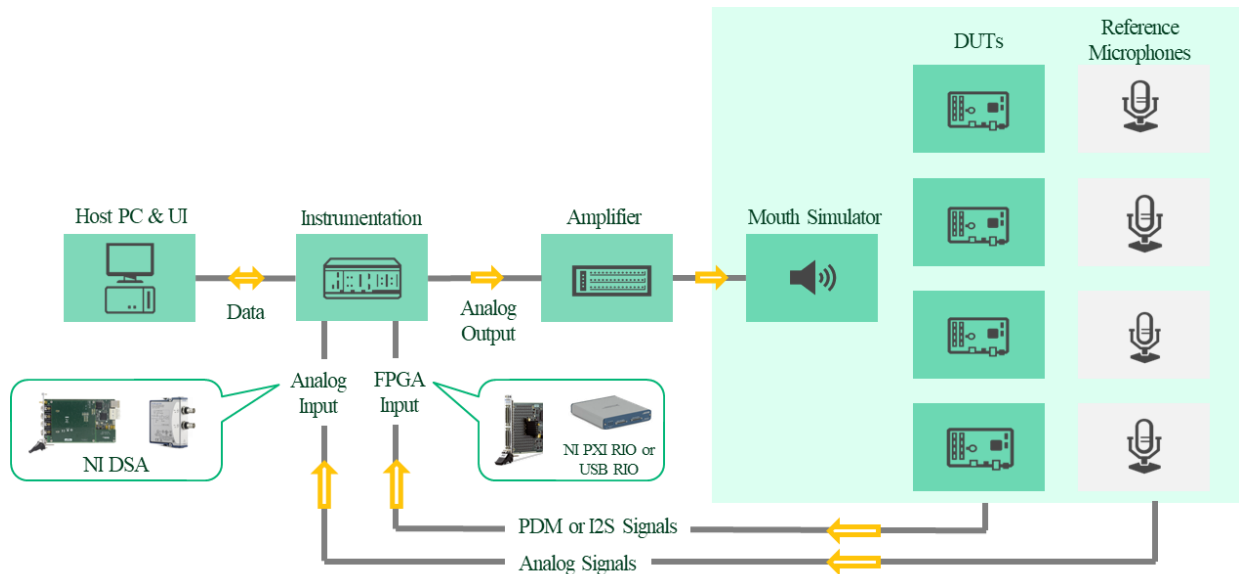


FIGURE 7: SIGNAL PATH DIAGRAM FOR DIGITAL AUDIO TEST

	USB		PXI Chassis	
	USB-7845	USB-7846	PXI-7820	PXIe-7821
Description	FPGA Input	FPGA Input	FPGA Input	FPGA Input
Number of Channels	48	48	128	128
AI Voltage Range (V)	3.3	3.3	3.3	3.3
Maximum Frequency	80 MHz	80 MHz	80 MHz	80 MHz

FIGURE 08: DIGITAL AUDIO TEST MODULE OVERVIEW

Using an FPGA-based NI data acquisition card, digital signals can be directly input and demodulated at hardware-level speed and reliability. The **LabVIEW PDM Acquisition Toolkit** ensures rapid development of custom measurements or test steps.

- Never be limited by I/O channel count, with up to 128 digital lines per card.
- Improve measurement accuracy and simplify your signal path with direct digital acquisition (no digital-to-analog converter).
- Insulate station investment from specification changes by updating test steps with DUT specific parameters such as clock speed and voltage level in software.

High Performance Instrumentation

From wearable devices to headsets, smart speakers, and hearing aids, 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.

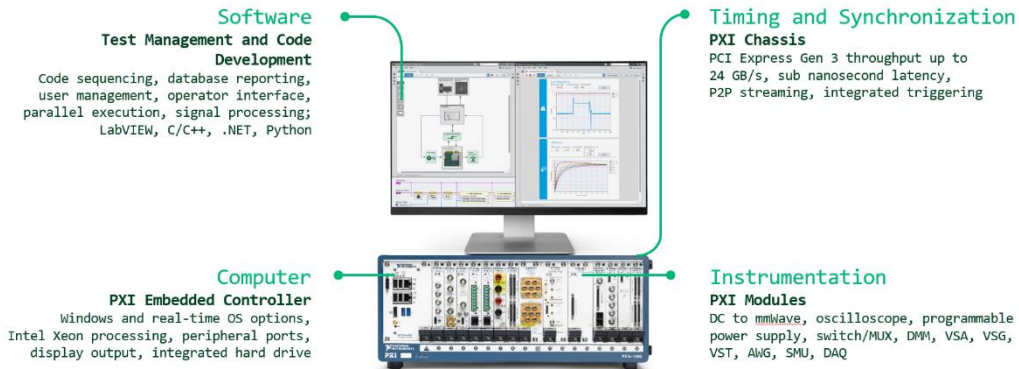


FIGURE 09: PXI CHASSIS CONFIGURATION

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.

Choose from the following instrumentation:

- PXI Sound and Vibration Module
- Multifunction DAQ
- Digital Multimeter
- Oscilloscope/Digitizer
- Waveform Generator
- Switch and Timing/Sync
- Source Measure Unit (SMU)
- Programmable DC Power Supply
- RF Instrument Control and Synchronization

“Our solution uses LabVIEW and PXI modular instruments, including dynamic signal acquisition, to achieve our test system cost target, meet performance and quality requirements, and improve test throughput by 33 percent.”

Koh Chee Lit, Manufacturing Test, Sony EMCS

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.

PXI Sound and Vibration Modules are designed specifically for applications such as audio test and measurement; noise and vibration diagnostics; machine condition monitoring; automotive test, noise, vibration, and harshness analysis; and laboratory research. They provide software-configurable AC/DC coupling, antialiasing filters, and IEPE conditioning to ensure precision measurements with microphones, accelerometers, and other transducers with large dynamic ranges.



Oscilloscopes

Sample at speeds of up to 12.5 GS/s with 5 GHz of analog bandwidth, featuring numerous triggering modes and deep onboard memory



Data Acquisition Modules

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



Power Supplies and Loads

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



SMUs

Combine high-precision source and measure capability with high-channel-density, deterministic hardware sequencing, and NI SourceAdapt technology transient optimization



Switches (Matrix and MUX)

Feature a variety of relay types and row/column configurations to simplify automated test system wiring



FPGA Data Acquisition

High channel count acquisition of digital signals with inline demodulation for efficient digital microphone communication



Digital Multimeters

Perform voltage (up to 1000 V), current (up to 3 A), resistance, inductance, capacitance, and frequency/period measurements, as well as diode tests ramp as well as user-defined, arbitrary waveforms



Waveform Generators

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

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.

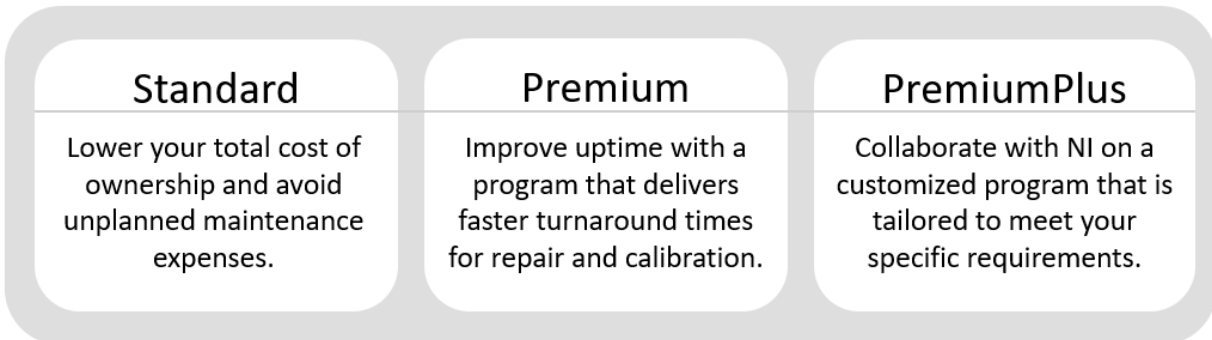


FIGURE 10: INSTRUMENTATION HARDWARE SERVICE LEVELS

- **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 Life-Cycle 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 and Development Software

Because software development monopolizes most of the 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.

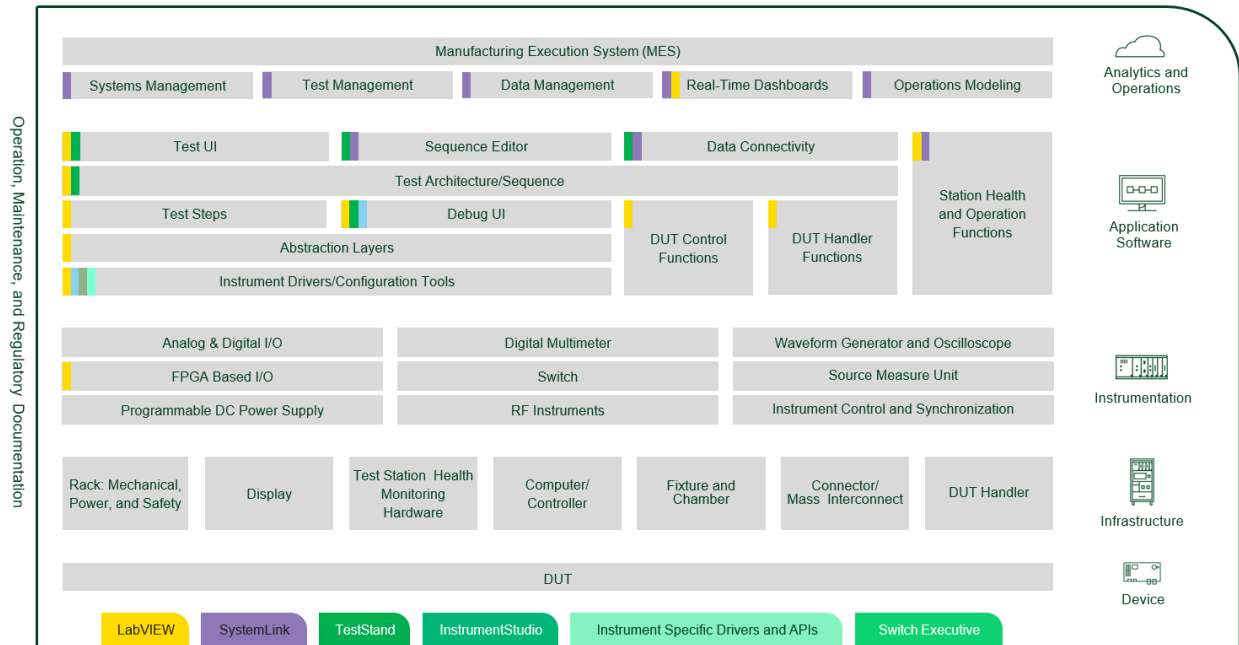


FIGURE 11: TEST STATION SOFTWARE

Tens of thousands of 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 decrease development time.
- Reuse existing code libraries from languages including C/C++/C#, .NET, Python, and MathWorks® MATLAB® software.
- Quickly create professional user interfaces to visualize test outcomes.
- Build proficiency with extensive online and in-person training options for new users and certified NI tool architects.

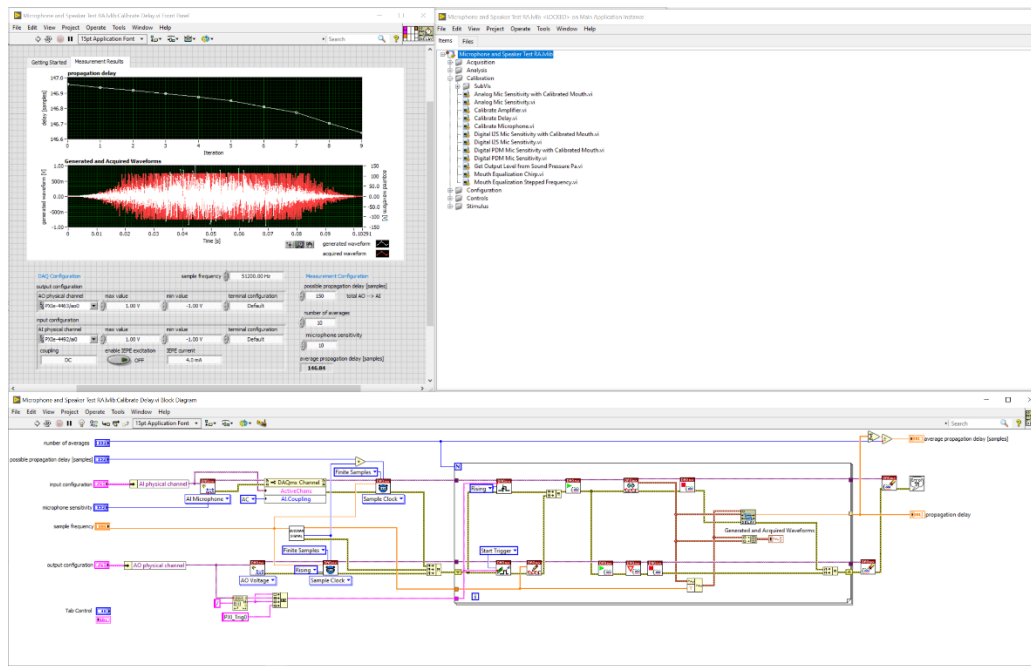


FIGURE 12: LABVIEW SOFTWARE INTERFACE

“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 plugins 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:

- 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

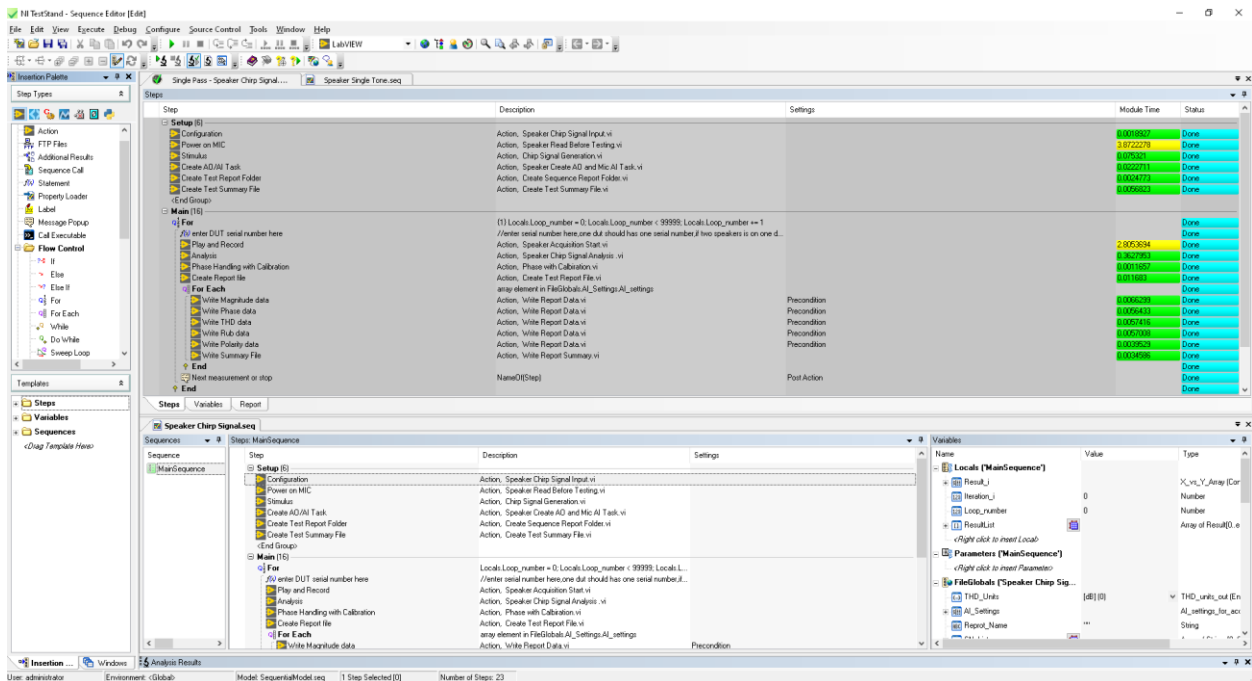
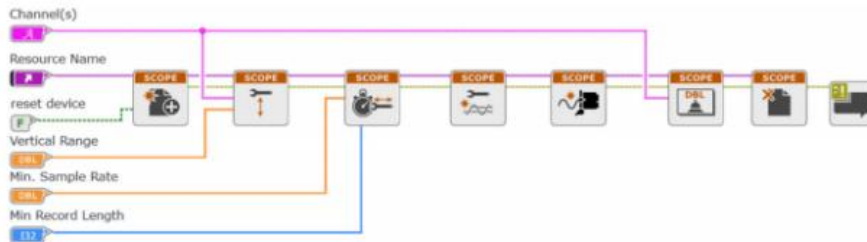


FIGURE 13: TESTSTAND SOFTWARE INTERFACE

“TestStand has helped to decrease the time spent testing product and gets it to the market faster.”
Jared Smith, Test Engineer, Schneider Electric

Instrument-Specific Drivers and APIs

NI measurement driver software includes best-in-class APIs that work with a variety of development options, such as LabVIEW, C, C#, Python, and others. To ensure long-term interoperability of our instruments, the driver APIs are the same 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 14: 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 15: C# API FOR NI-DAQMX

```
import nscope
with nscope.Session("Dev1") as session:
    session.channels[0].configure_vertical(range=1.0, coupling=nscope.VerticalCoupling.AC)
    session.channels[1].configure_vertical(range=10.0, coupling=nscope.VerticalCoupling.DC)
    session.configure_horizontal_timing(min_sample_rate=50000000, min_num_pts=1000, ref_position=50.0, r
    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(w

    # 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 16: NI-SCOPE CODE EXAMPLE CAPTURE IN PYTHON

Analytics and Operations Software

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.

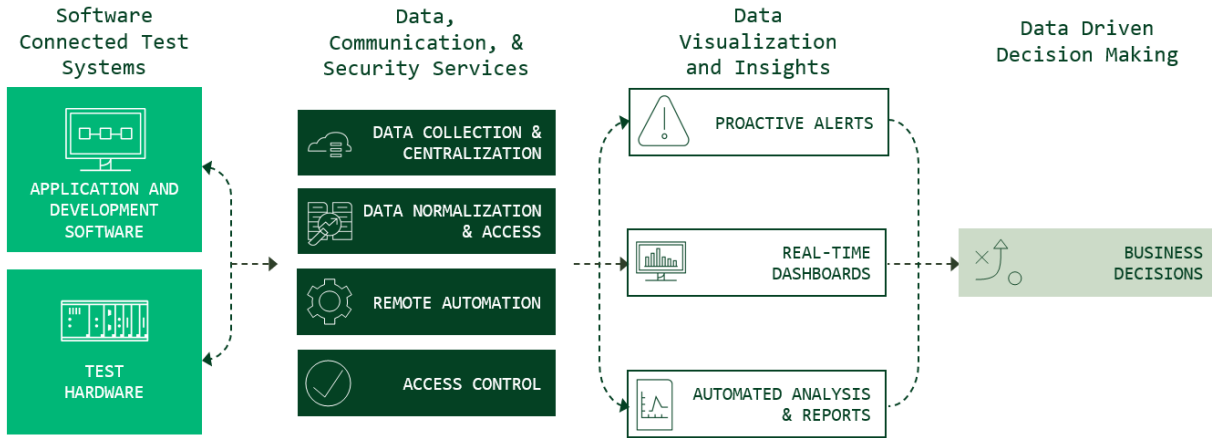


FIGURE 17: ARCHITECTURE FOR EFFECTIVELY UTILIZING TEST DATA WITHIN MANUFACTURING

Homegrown 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, they detract from the team’s success.

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

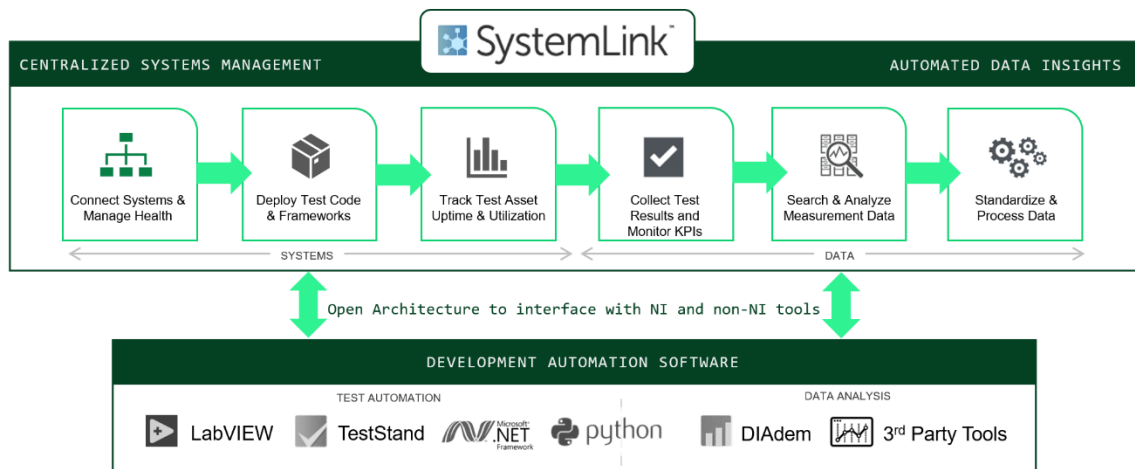


FIGURE 18: ARCHITECTURE FOR EFFECTIVELY UTILIZING TEST DATA USING SYSTEMLINK

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 delivers key information that improves situational awareness and test readiness. Leveraging an automation and connectivity framework, SystemLink aggregates test and measurement data from all test systems into a centralized data repository. Users have ready access to asset utilization, calibration forecasts, 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

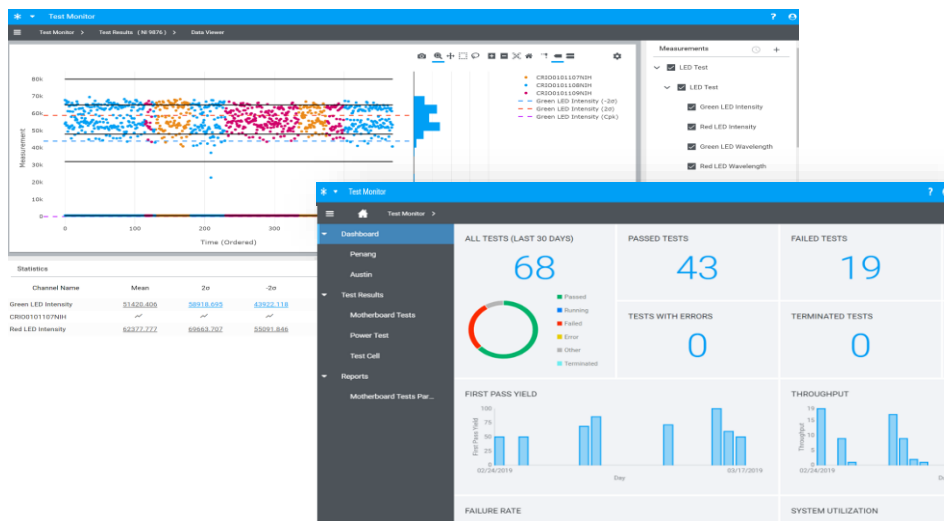


FIGURE 19: SYSTEMLINK SOFTWARE

Infrastructure 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 four to 18 slots to fit the needs of any application, whether its intentions are to be a portable, benchtop, rack-mount, or embedded system.



FIGURE 20: PXI CHASSIS

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. 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.



FIGURE 21:
PXI CONTROLLERS

Industrial PC 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, multi-chassis 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.

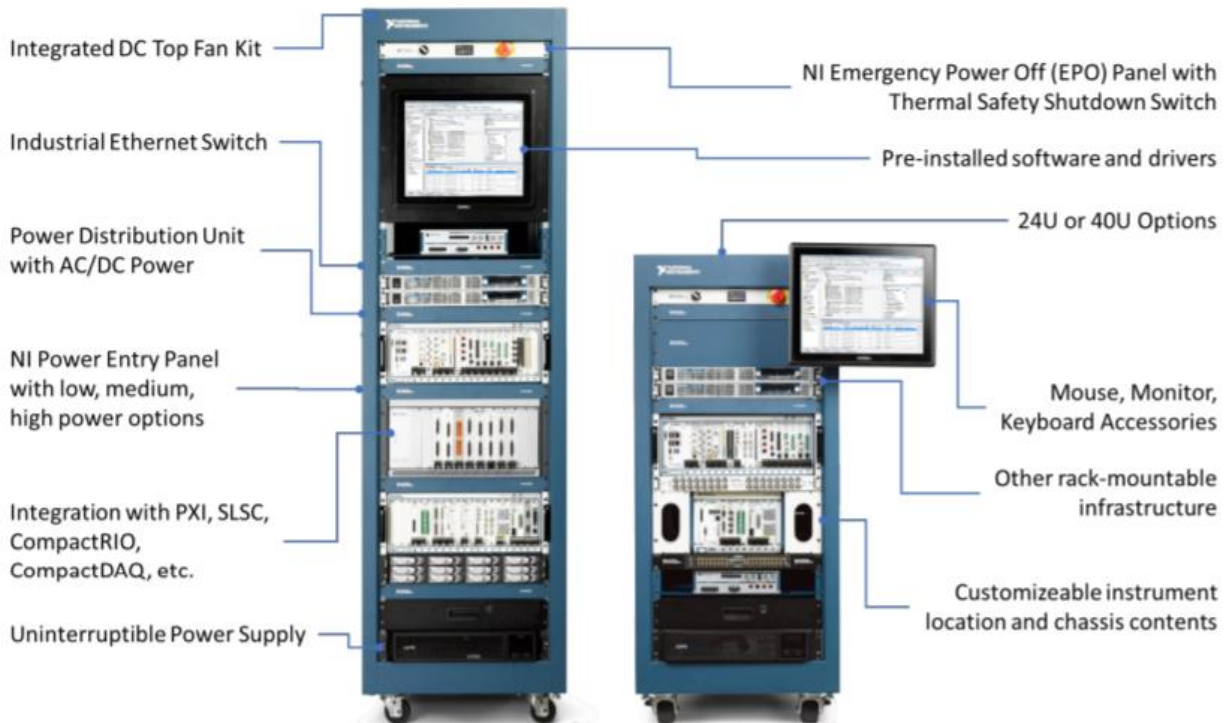


FIGURE 22: RACK EXAMPLES WITH PXI CHASSIS AND MODULES

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 percent.”

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

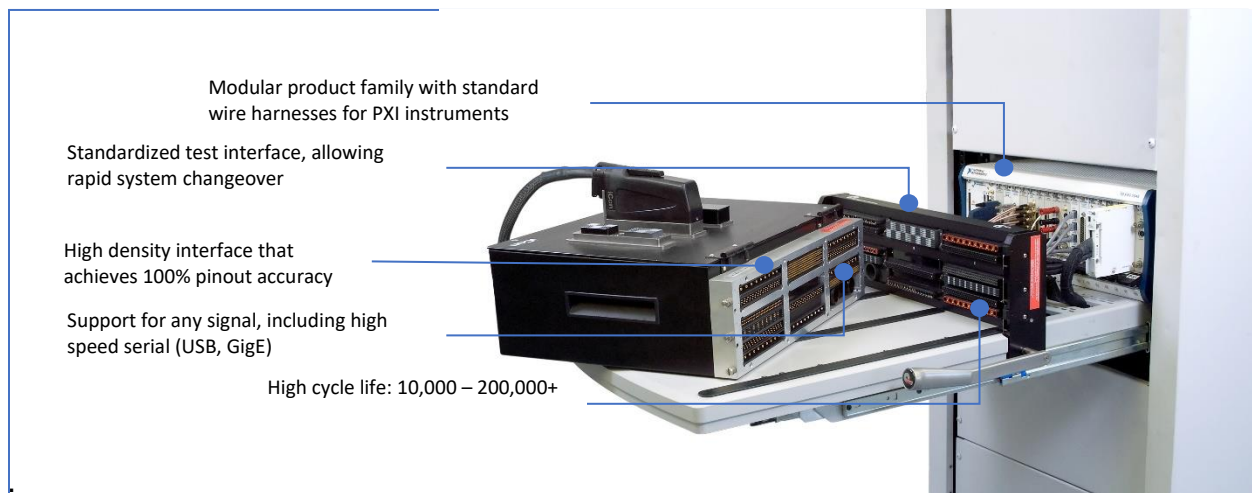


FIGURE 23: RACK EXAMPLES WITH PXI CHASSIS AND MODULES

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 24: 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 inline architectures due to labor cost, manual or pneumatic architectures still are common. If volumes are low, you can use personalized drop-in plates within the fixture to minimize capital expense over time.

Most audio and acoustic testers will also require a chamber within which to locate the DUT during tests. Ensuring true noise reduction for accurate tests can be a challenge, and specialist expertise in audio test is recommended. 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 NI Partner to meet your fixturing needs by visiting ni.com/partners.

Learn more about our featured electrical functional test partners on pages 23 – 30.

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 are often high risk. 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 of 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 tradeoffs 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 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.

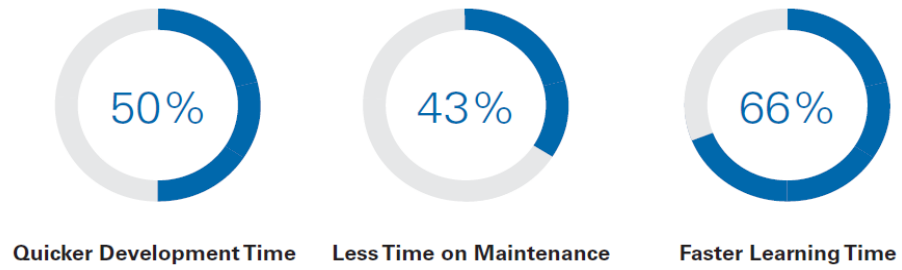


FIGURE 25: SAVE TIME AND EFFORT WITH NI PRODUCTS AND SERVICES

Featured NI 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 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 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.

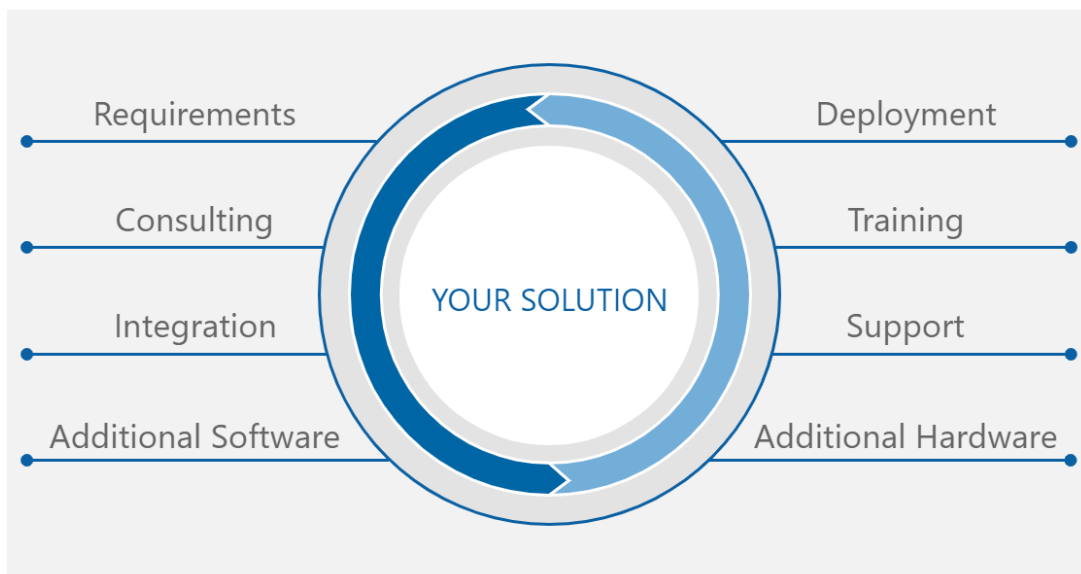


FIGURE 26: NI PARTNERS CAN HELP ENSURE YOUR SUCCESS

Partnering in Your Success

- **Integrators:** These NI 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 addons, toolkits, and reference applications compatible with NI and industry platforms.

Featured NI Partner: NOFFZ technologies GmbH

NOFFZ Technologies develops and produces industry-leading test systems and solutions that span from prototyping and validation to high-volume production. Founded in 1989 and headquartered in western Germany, NOFFZ now employs more than 150 people at eight locations worldwide.

The requirements for high-quality audio and acoustic test have increased substantially over recent decades, with ever-evolving new bus, chamber, and simulation expectations. NOFFZ has a track record of full solution support, meeting the needs of these market challenges and building long-term partnerships with their clients.

One recent example of this is the evolution of digital busses to A2B (Automotive Audio Bus). Capabilities of the A2B bus in particular are revolutionizing the market—it offers simple wiring with a manifold of functions (multiple microphones, 24 loudspeakers, vibration and noise cancellation, and more). In this case, NOFFZ expanded on their strength in analog and digital testing by developing their own A2B bus analyzer to solve current and future testing requirements leveraging this technology.



FIGURE 27: TEST STATION BY NOFFZ

Application Specialties

- High-volume applications with a requirement for automation
- High-mix applications where variant management, exchangeable fixtures and flexible sequencing are required
- Custom solutions with unique chamber, fixture, and loads such as amplifier testing

Benefits of NOFFZ solution

- Test concepts from manual to automated due to extensive experience in test system based on the UTP concept
- UTP suite native variant management combined with a state-of-the-art A2B bus analyzer to facilitate audio testing
- Set up into operation and integrate into custom environment (database, automation, reporting)
- Worldwide calibration and onsite service with maintenance and adaption to customers' requirements



FIGURE 28: THE LEADERSHIP TEAM AT NOFFZ

To learn more, contact sales@noffz.com.



Featured NI 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 29: ACOUSTIC TEST STATION

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

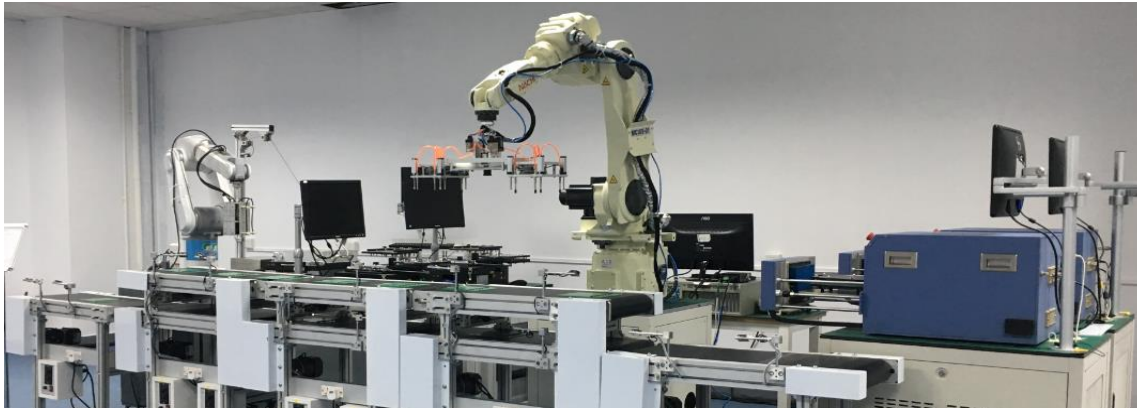


FIGURE 30: INLINE TEST STATION WITH AUTOMATION

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

Email: andy.zhang@bcd-autotest.com
Sales Email: sales@bcd-autotest.com
Mobile: +86 18688150629



Featured NI Partner: CIM.AS

CIM specializes in computer and electronic engineering for automated test and measurement, acoustical testing, IoT, medical, and vision systems. A National Instruments Gold Partner with 20+ years of experience and high numbers of NI Certified developers and architects, CIM is trusted by companies across Europe and is known for high-quality software development and effective use of NI tools such as LabVIEW, TestStand, and PXI.



FIGURE 31: PCBA TEST STATION WITH RF AND ELECTRO-ACOUSTIC TESTING CAPABILITIES

Application specialties

- CIM Audio Test Software (CATS): electro-acoustic testing functions as built-in TestStand steps
- Electro-acoustic test consultancy for automated R&D validation and production testing
- Integrating electro-acoustic testing into final production testing flow
- Engaging test strategy and digital transformation discussion with the customer

Key Benefits

- 15+ years of sound and vibration experience as well as COTS electro-acoustic testing software for automated test environment
- One-stop shop test solution provider offering T&M software, hardware, and IIoT products and services
- Business-level engagement with customers, focusing on COT and ROI



FIGURE 32: CIM IS BASED IN DENMARK; THEY HAVE A HIGHLY EXPERIENCED ENGINEERING TEAM.

“In our partnership with CIM.AS, we found a group of engineers who specialize in production and acoustical testing and were willing to spend the time to understand our business, our application, and our test coverage. Together with NI, they provided tools and consultation that kept us at the cutting edge of technology and supported our goals.”

Christian Wolf, Global Test Manager, GN Audio

To learn more, visit cim.as, email info@cim.as or call +45 96 84 05 00.



Featured NI Partner: MegaSig

Located in Shenzhen Nanshan, MegaSig focuses on test and measurement instrument design and application. With dedicated teams devoted to a series of audio and vibration standard software and hardware products, MegaSig has a proven track record in providing both components and fully integrated solutions.

- Focus on sound and vibration test solutions
- Proficient in sensor, data acquisition, and software technology
- Products include sensors, conditioning hardware, and application software

AudioExpert Software

AudioExpert is a single software platform designed for use from R&D through to production that includes support for sequence editing, remote control, and electro-acoustic products.

It provides an extensive algorithm portfolio including:

- | | | |
|------------------------------|---------------------------|--|
| • Level and gain measurement | • Wave Recall Analysis | • ANC gain adjust (supports AMS, BES chipsets) |
| • Frequency response | • Octave analysis | • Similarity analysis |
| • THD/THD+N | • Phase response | • Noise measurement |
| • SNR | • FFT/spectrum | • Rub and buzz |
| • Sensitivity | • Stepped level swept | • Impedance curve |
| • Crosstalk | • Stepped frequency swept | • Thiele-Small |
| • IMD | • Chirp frequency swept | |
| | • ANC analysis | |

“AudioExpert is an ideal tool for ANC manufacturing calibration; the speed and the accuracy are outstanding.”

Ming Zhou, Acoustics Engineer, Harman

Application Specialties

- Bluetooth earphone regulation audio test
- ANC earphone audio calibration

To learn more, visit www.megasig.com, email xushun.chen@megasig.com, or call +86.186-8875-5756.



FIGURE 33: AUDIOEXPERT SOFTWARE UI



FIGURE 34: MEGASIG PRODUCT PORTFOLIO

Featured NI 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. Its 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 the 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, startup, and sustainability.

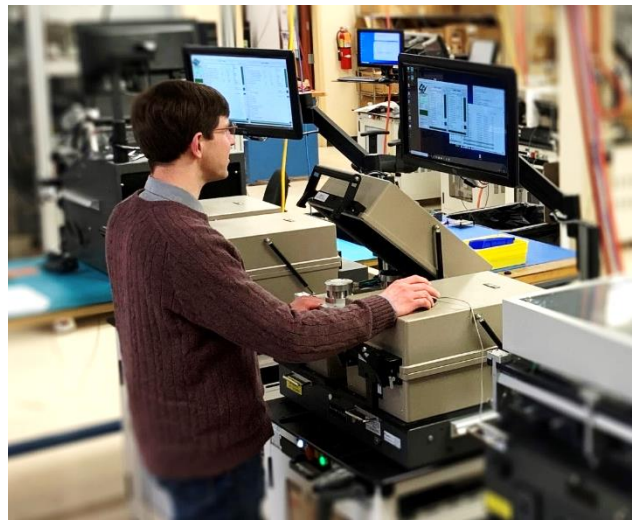


FIGURE 35: DEVELOPMENT AT
CIRCUIT CHECK

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.





NI Services and Support

NI offers a variety of solution integration options customized to your application-specific requirements. You can use your own internal integration teams for full system control or leverage the expertise of our worldwide network of Alliance Partners to obtain a turnkey system.

Contact your account manager or call or email us to learn more about how NI can help you increase product quality and accelerate test timelines at (888) 280-7645 or info@ni.com.

NI Services and Support



Consulting and Integration



Turnkey Solution Delivery and Support



Repair and Calibration



Global Support



Prototyping and Feasibility Analysis



Training and Certification

ni.com

