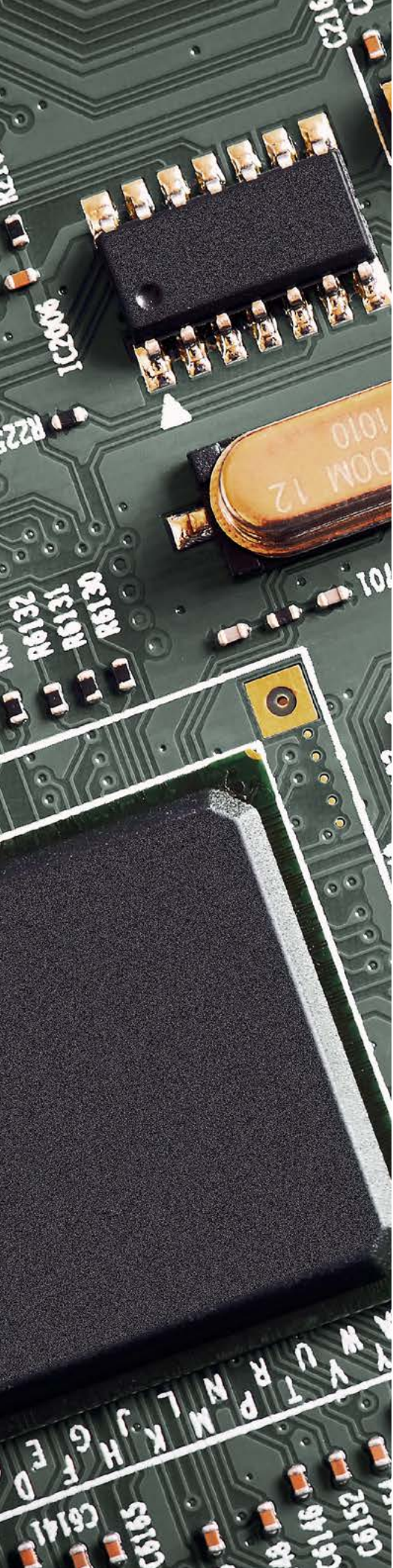




Solution Brochure

Power Performance Validation Solution



POWER PERFORMANCE VALIDATION SOLUTION

Explore NI's Solutions

As the demand for energy efficiency grows, engineers struggle to quickly measure, analyze, and react to power consumption and performance data. Traditional instrumentation such as oscilloscopes and DMMs are too expensive to scale, and low-cost data acquisition solutions aren't always accurate enough.

Faced with this difficult decision, some organizations choose not to fully analyze power efficiency, leaving them at risk of missing market windows or losing competitive opportunities.

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Solution Overview

NI's Power Performance Validation solution for semiconductors and electronics provides an easy-to-use, modular, accurate, and scalable system that helps shorten evaluation times. With it, you get a quicker path to finding and fixing bugs via a user-friendly software interface, improve data management, and gain real-time visualization to help you get to market faster.

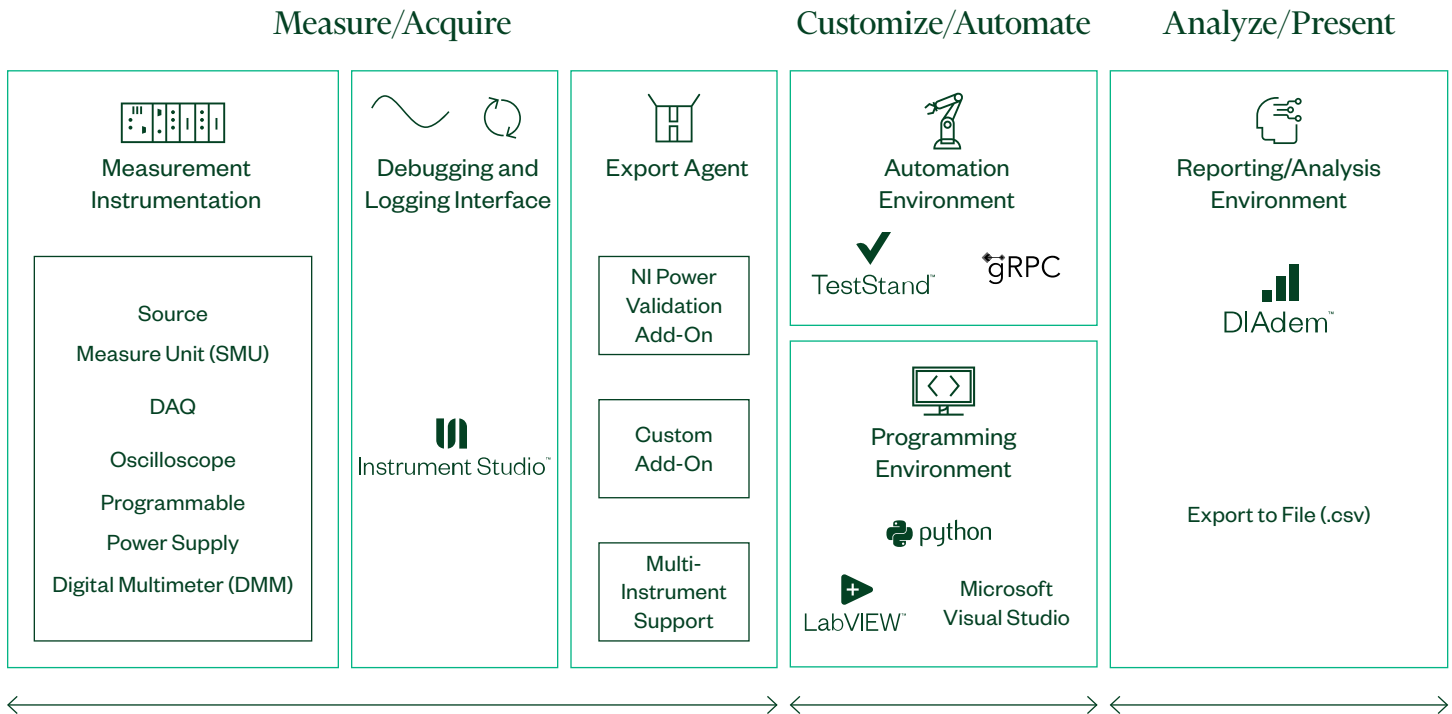


FIGURE 01
NI Power Performance Validation Solution Overview

“There isn’t another offering for the high-sensitivity measurements that we do. If NI hadn’t built these tools, we would have to build them ourselves, which would take years of effort. NI allows us to focus on what we need to do.”

Hardware Engineer, Leading Technology Company

THE NI ADVANTAGE

- Acquire reliable and consistent power measurements for design feedback, customer enablement, and competitive insight.
- Scale from a few channels to hundreds of channels in a compact form factor.
- Gain the insight needed to optimize power efficiency and performance for the target market segment.
- Accelerate time to market with an off-the-shelf solution that fits any workflow.
- Maximize the efficiency of design and validation teams with a complete solution for power measurements.

Power Validation Hardware Setup Example

In many cases, the DUT is embedded in some type of system or operating environment, such as an evaluation board or load board, and operates under normal end-use conditions. In order to measure the power consumption on each power rail, two measurements are required: A single-ended or ground-referenced voltage measurement and a differential voltage measurement across a sense resistor, which is used to calculate current. Using the data collected from these two measurements, instantaneous power is calculated by multiplying the voltage and current values.

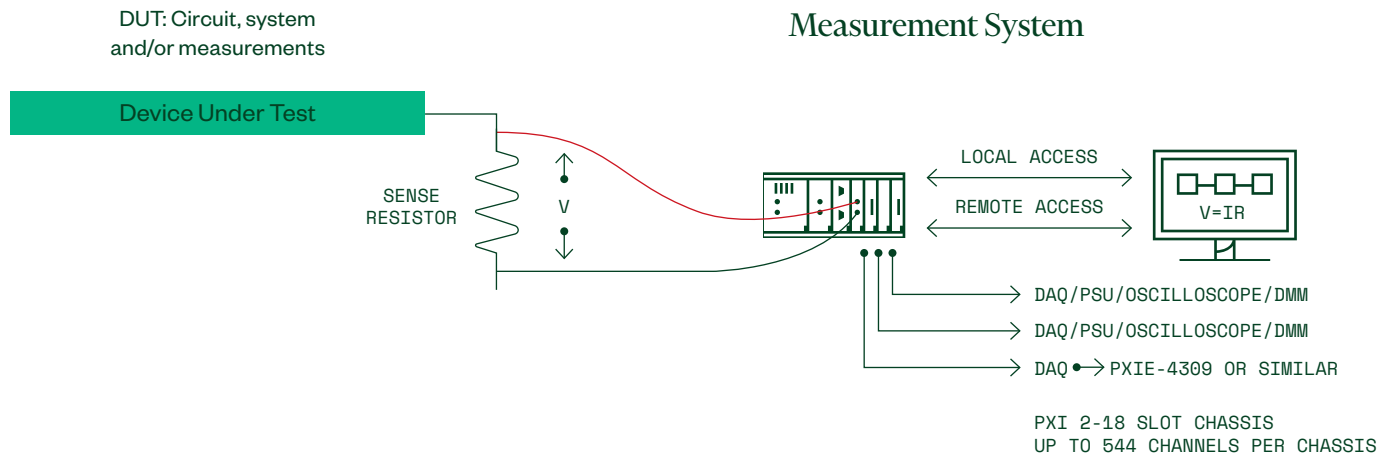


FIGURE 02

High-performance instrumentation with a flexible channel count helps you make voltage- and shunt-resistor-based current measurements across dozens or even hundreds of power rails—all in a compact form factor.

Power Performance Validation Solution Overview

SOFTWARE

- Interactive instrument interface via [InstrumentStudio™](#) software
- Power Validation Add-On for InstrumentStudio software for no programming power analysis or set up with [LabVIEW](#), Python and or [C#](#) for custom flow
- Quickly setup, visualize, debug, and log measurement data
- Standard metadata for test configuration and result traceability

HARDWARE

- Optimized for low-level voltage measurements across sense resistors
- Simultaneous sampling and synchronized measurements
- Configurable channel count ranging from 8 to 32 channels per PXI slot
- Up to 28-bit resolution or 2 MS/s sample rate per channel (18-bit resolution)
- Onboard signal averaging, filtering, auto-zero, and more for high accuracy measurement
- Scalable channel count with chassis options ranging from 2 to 18+ slots

PXI Power Performance Validation Reference Solution

OPTION NAME	PART NUMBER	DESCRIPTION
BASE CONFIGURATION	866574-05B	5-SLOT SYSTEM ¹ WITH THUNDERBOLT 3 REMOTE CONTROLLER, 32 HIGH-RESOLUTION ANALOG INPUT CHANNELS, 4 UNUSED PXI EXPRESS SLOTS.
ADDITIONAL 32-CHANNEL OPTION	866574-02P	32 HIGH-RESOLUTION ANALOG INPUT CHANNELS, OPTION (DAQ PXIE-4309)
PRECISION POWER SOURCE OPTION	866574-03P	SOURCE MEASURING UNIT WITH SOURCEADAPT TECHNOLOGY, OPTION (SMU PXIE-4139)
MULTIMETER OPTION	866574-04P	7 1/2-DIGIT MULTIMETER (DMM) AND 1,000 V DIGITIZER (DMM PXIE-4081)
OSCILLOSCOPE OPTION	866574-05P	8-CHANNEL, 60 MS/S, 12-BIT OSCILLOSCOPE W/ 512 MB ONBOARD MEMORY (SCOPE PXIE-5105)
ACCESSORIES	CONTACT NI	POWER CORD (BY REGION)
	784584-35	LABVIEW PROFESSIONAL (CUSTOM WORKFLOWS)
	788556-35	POWER VALIDATION ADD-ON (NO PROGRAMMING)
	788372-35	TESTSTAND (AUTOMATION SEQUENCER)
	INSTRUMENTSTUDIO SOFTWARE	INSTRUMENTSTUDIO SOFTWARE (INTERACTIVE INTERFACE)
	SERV-PX6552799	STANDARD SERVICE PROGRAM FOR PXI SYSTEMS FOR 3 YEARS

¹See Specifications Documents PXIe-1083 and PXIe-4309 for more details.

Powerful Software Application

InstrumentStudio software helps you unify your display, export instrument configurations for a higher-level starting point, and monitor and debug your automated test system. You can view data on unified displays with large, high-resolution monitors, and then capture multi-instrument screenshots and measurement results. Save project-level configurations for easier test repeatability with specific devices under test, or export instrument configurations to programming environments or directly to TestStand to simplify your code and parametric sweeps. You also can use InstrumentStudio software in parallel with your code to monitor and debug running test applications.

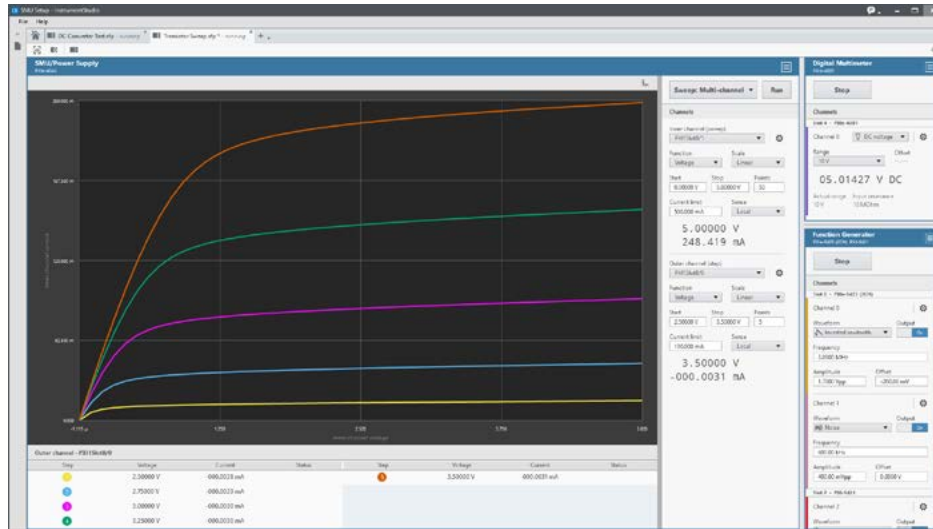


FIGURE 03

InstrumentStudio software provides an easy-to-use, configuration-based workflow—no programming required!

THE NI ADVANTAGE

- **ALL OF YOUR INSTRUMENTS IN A SINGLE APPLICATION**—Take advantage of high-resolution monitors rather than small, integrated displays
- **CAPTURE SCREENSHOTS AND EXPORT DATA**—Store screenshots and measurement results from all your instruments with a single click
- **SHARE PROJECTS WITH COLLEAGUES AND BETWEEN SYSTEMS**—Projects store your layout and instrument configuration for instant repeatability
- **EXPORT CONFIGURATIONS FOR PROGRAMMATIC USE**—Minimize code development and guarantee measurement correlation
- **MONITOR AND DEBUG AUTOMATED TEST SYSTEMS**—Pause test sequences for debug or simply monitor your instruments while they are running

Power Validation Add-On for InstrumentStudio Software

NI recommends combining the PXIe-4309 instrumentation with InstrumentStudio software and Power Validation Add-On for powerful, interactive measurements and data-logging. This option provides an easy-to-use, configuration-based workflow so that you quickly can configure, execute, visualize, and log measurement data. Unlike discrete benchtop instruments (DMMs, scopes, DC power analyzers, and SMUs), the NI Power Validation solution delivers automated, modular power measurements in a compact and adaptable system in less time and with lower cost per channel.

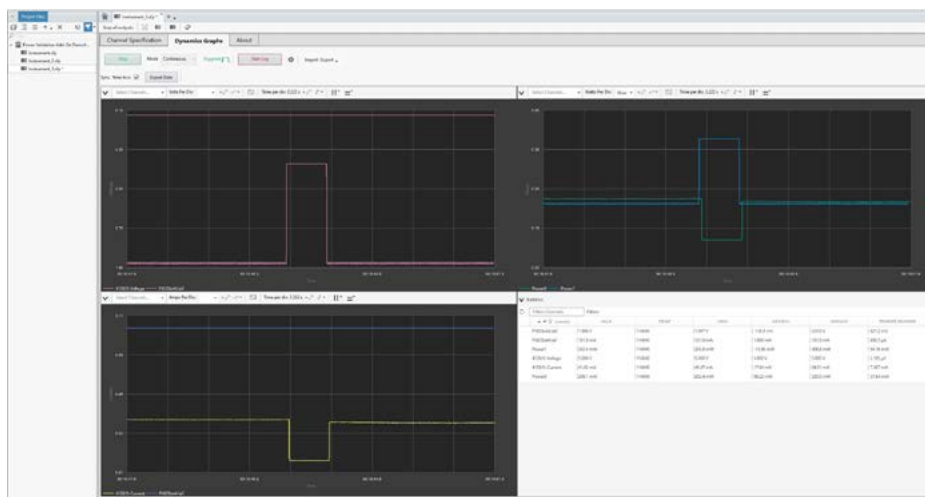


FIGURE 04
InstrumentStudio software provides an easy-to-use, configuration-based workflow—no programming required!

THE NI ADVANTAGE

- Take advantage of easy-to-use, configuration-based workflow—no programming required!
- Quickly set up, analyze, and log power measurement data across multiple channels
- Utilize calculated measurement channels (e.g., $P = I * V$)
- Automatically view and synchronize measurements across multiple instruments
- Capture comprehensive metadata for test configuration and result-traceability
- Natively log measurement data to TDMS (binary file format with comprehensive metadata) or CSV
- Minimize the time to develop an automated system
- Make additional customizations (such as adding third-party equipment support) with the Plugin Development Kit
- Achieve quick time to market test workflow with Power Validation Add-On

TestStand

TestStand is test-executive software that accelerates system development and deployment for engineers in validation and production. TestStand is ready-to-run test management software that simplifies the automation of validation test systems with interactive workflows for hardware configuration, built-in debugging tools, and automatic report generation.

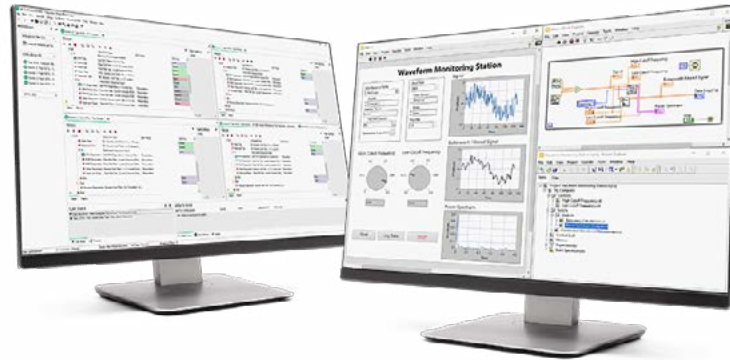


FIGURE 05
TestStand Sequence and Visual Interface

THE NI ADVANTAGE

- Quickly set up your test with little-to-no code development. View data, analyze, and create shareable reports to communicate results to your team.
- Integrate code developed in any modern programming language to a sequencer for a functional test system. When scaling to production, optimize throughput with native parallel testing.
- Automate repetitive tests using tools for instrument control, communication, data acquisition, and logic. Connect your system to the web and monitor test status from anywhere in the world.
- Test new technologies and evaluate design concepts with data-focused tools that let you interactively query and analyze results from different test runs.
- Connect to any NI or third-party instrument. Measure temperature, strain, sound and vibration, RF signals, and more. Analyze all of your data.

High-Performance Instrumentation

The PXIe-4309 is a flexible analog input instrument designed for low-level power validation measurements, capable of delivering an effective 28 bits of resolution. It offers DMM-like features such as filtering, averaging, auto-zero, and chopping to compensate for error sources and provide repeatable nanovolt measurements. With up to 32 channels in a single PXI slot and flexible PXI chassis options ranging from two slots to 18+ slots, you can configure a system that meets your application requirements and scale to meet unknown future requirements. The combination of high accuracy and high channel density makes it ideal for semiconductor device power validation, such as for CPUs, GPUs, AI-specific processors, high-end microcontrollers, FPGAs, SoCs, and other IC functional blocks.



FIGURE 06

The PXIe-4309 is a one-slot instrument capable of sampling up to 32 differential channels using an internal multiplexer and eight isolated, simultaneously-sampling ADCs.

THE NI ADVANTAGE

- Flexible resolution: 18–28 bits, depending on sample rate
- Up to 8 simultaneous, differential analog input channels (up to 2 MS/s/ch sample rate)
 - 18 bits at 2 MS/s/ch
 - 20 bits at 500 kS/s/ch
 - 28 bits at 2 S/s/ch
- Built-in optional multiplexer so that each of the 8 ADCs can connect to 4 input channels for up to 32 total input channels (up to 100 kS/s/ch)
- Four input ranges: ± 15 V, ± 10 V, ± 1 V, ± 0.1 V
- Built-in DMM-like signal conditioning features, including filtering, averaging, auto-zero, and chopping
- Best-in-class common mode rejection ratio (CMRR) for higher absolute accuracy
 - >120 dBc CMRR at 100 Hz signal input
- Flexible connectivity options including front-mounting screw terminal blocks and multiple cable options
- PXI Express bus provides tight synchronization across instruments and a modular, expandable platform

PXI Digital Multimeters

PXI Digital Multimeters (DMMs) perform high-precision voltage, current, resistance, temperature, inductance, capacitance, and frequency/period measurements as well as diode tests.

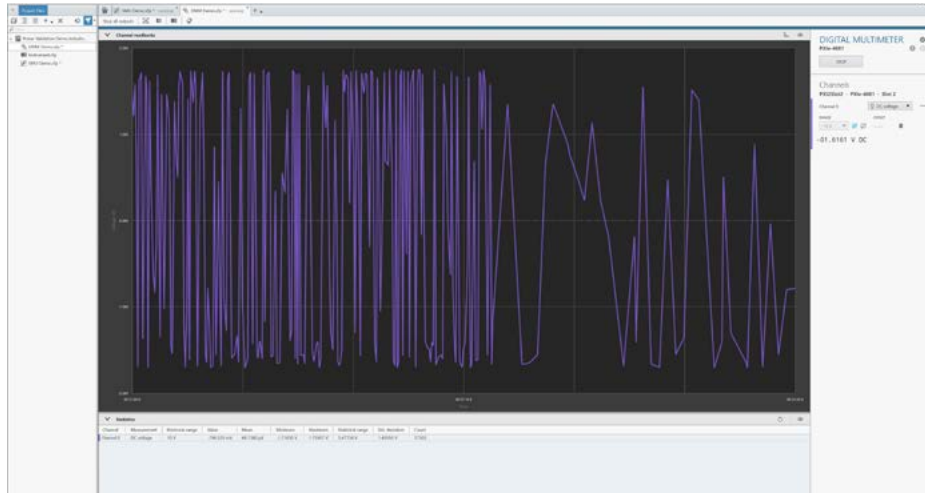


FIGURE 07
PXI Digital Multimeter Readings in InstrumentStudio Software

THE NI ADVANTAGE

- PXI DMMs ship with an interactive soft front panel called InstrumentStudio software for ready-to-run configuration and measurements.
- The most accurate 7.5-digit DMM offers 26 bits of resolution and high-stability, metrology-class measurements that range from 10 nV to 1,000 V, 1 pA to 3 A, and 10 W to 5 GW—the PXIe-4081 outperforms traditional box DMMs.
- Customizable measurement settings give you the ability to prioritize speed or accuracy by programmatically adjusting ADC calibration, auto-zero, settling time, and aperture time using the NI-DMM device driver API.
- With excellent measurement quality, NI DMMs combine the functionality of a traditional DMM and an isolated, high-voltage (1,000 V) digitizer mode with sample rates up to 1.8 MS/s—36X faster than traditional DMMs (50 kS/s).
- Combine PXI DMMs with a wide selection of PXI switches to cost-effectively scale the number of channels and synchronize with PXI switches.

PXI Oscilloscopes

PXI oscilloscopes are flexible, software-defined instruments that are versatile enough for both time- and frequency-domain measurements and feature numerous triggering modes, deep onboard memory, and a driver software API that includes data streaming and analysis functions.

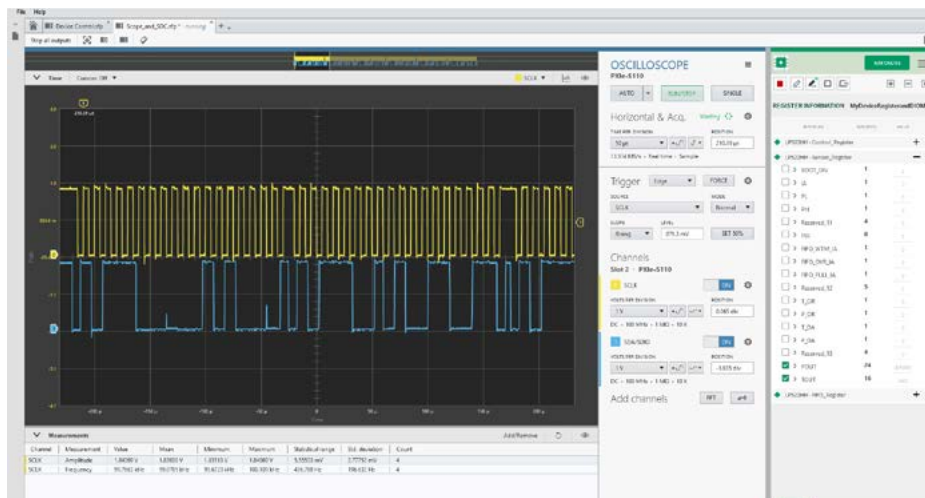


FIGURE 08
PXI Oscilloscope Reading in InstrumentStudio Software

THE NI ADVANTAGE

- Synchronized Instruments—PXI oscilloscopes of the same model automatically are hardware-synchronized across multiple devices in InstrumentStudio software to serve applications requiring high channel density.
- CableSense™ Technology—Using principles similar to a traditional time-domain reflectometer (TDR) on a real-time oscilloscope within your test system, you can detect changes from a known, golden setup without having to alter the connections themselves.
- Deep Onboard Memory—PXI oscilloscopes feature deep onboard memory capable of storing multiple acquisitions from single channels or parallel acquisitions from multiple channels on the same device, and also benefit from the high-speed streaming capabilities of the PXI platform.
- InstrumentStudio Interactive Software—PXI oscilloscopes ship with an interactive, multi-instrument soft front panel called InstrumentStudio software for ready-to-run configuration and measurements.

Flexible Connectivity Options

NI offers three connectivity options ranging from screw terminal blocks to specialized cables




SINGLE LARGE CABLE PER INSTRUMENT CONNECTED TO LOAD BOARD	UP TO 4 SMALL CABLES PER INSTRUMENT CONNECTED TO LOAD BOARD	SCREW TERMINAL BLOCK FOR MANUAL WIRING
<p>Advantages</p> <ul style="list-style-type: none"> Simple, off-the-shelf solution NI manages twisting and shielding signal pairs Single cable solution 	<p>Advantages</p> <ul style="list-style-type: none"> Simple, off-the-shelf solution NI manages twisting and shielding signal pairs Available PCB mating connector options Smaller, more flexible cables 	<p>Advantages</p> <ul style="list-style-type: none"> Simple, off-the-shelf solution Easily modify signal connections No special PCB design considerations Great for prototyping
<p>Consideration</p> <ul style="list-style-type: none"> Requires PCB design work to integrate connector into load board Large, less flexible cable 	<p>Consideration</p> <ul style="list-style-type: none"> Requires PCB design work to integrate connector into load board Requires mass terminal block Multiple cables per instrument 	<p>Consideration</p> <ul style="list-style-type: none"> Least performant option Places burden on user to ensure proper wiring (twisted and shielded pairs) Requires bare wires to be manually soldered to load board at sense resistors
		
<p>CABLE OPTION: SH-96-96-2 CABLE (*1 METER) *LONGER CABLE OPTIONS ARE AVAILABLE, BUT NOT RECOMMENDED PART NUMBER: 157350-01</p>	<p>TB-4309 TERMINAL BLOCK FOR PXIE-4309 (WITH VHDCI CONNECTORS) PART NUMBER: 784957-01 SHC68-68-EPM CABLE (*1 METER) *LONGER CABLE OPTIONS ARE AVAILABLE, BUT NOT RECOMMENDED. OTHER CABLE OPTIONS AVAILABLE, CONTACT NI. PART NUMBER: 192061-01</p>	<p>TB-4309 TERMINAL BLOCK FOR PXIE-4309 (WITH SCREW TERMINALS), PART NUMBER: 784956-01</p>

TABLE 01

NI offers various connectivity solutions so that you can choose the best option for your setup.

Cabled Options

For optimal signal integrity, NI recommends using NI-designed cables between the PXIe-4309 instrumentation and the evaluation module or load board. NI cable options are designed with the application in mind, ensuring that the wires for each signal pair are properly twisted and shielded. To use this option, customers should design the appropriate signal paths and mating connectors into their PCB designs, cabling directly from the instrumentation to the PCB. Mating connectors can be purchased directly from NI or from the connector manufacturer. Furthermore, NI recommends using the shortest cable options possible, as cable length can impact measurement performance despite proper wire management and shielding.

Connectivity Best Practices

- When possible, use a direct cable solution to maximize signal integrity and ease of use
- Engage PCB design teams early enough to design in mating connectors for desired cable option
- Keep all cables or wires as short as possible and avoid external noise sources
- Contact your NI salesperson for PCB mating connector part numbers and pricing information

Platform-Based Approach

What Is PXI?

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

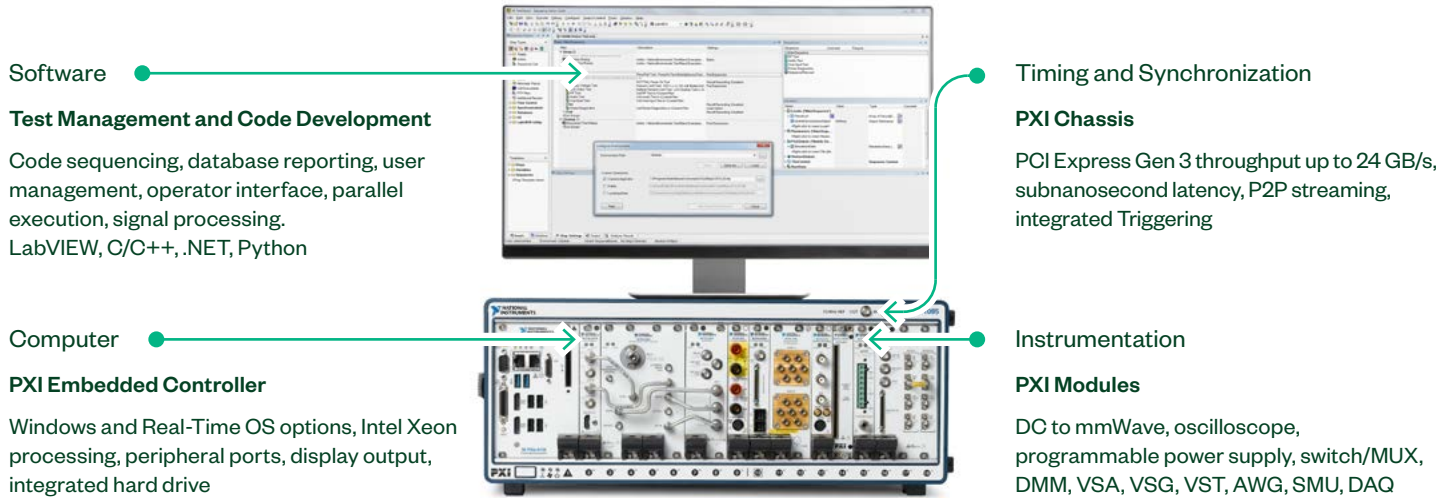


FIGURE 09

PXI is a modular PC-based platform for measurement and automation systems.

Integrating the Latest Commercial Technology

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





HIGHER DATA THROUGHPUT	PARALLEL TEST EXECUTION	MEASUREMENT ACCELERATION	INCREASED MEASUREMENT RANGE
			
PCI EXPRESS GEN 3	MULTICORE PROCESSORS	FPGAS	DATA CONVERTERS

TABLE 02

Leverage the latest commercial technology to maximize system performance and quality.

What Is CompactDAQ?

CompactDAQ is a portable, flexible data acquisition platform consisting of a CompactDAQ chassis and C Series Input and Output (I/O) modules. It combines signal connectors, integrated signal conditioning, and converters in a single package to deliver higher accuracy measurements by eliminating error-prone cabling and connectors and reducing the number of components in a measurement system.

Any Bus, Any Form Factor

Choose from USB, Ethernet, and wireless bus options or stand-alone controllers to meet your application needs in either the lab or field.

Accurate Conditioned Measurements

Take advantage of more than 60 sensor-specific modules to directly connect to your sensor or signal.

Precise Timing and Synchronization

Easy timing customization for each sensor or signal with up to seven hardware-timed clocks per chassis.



Truly Customizable Software

Tailor the automation of your data acquisition, analysis, visualization, and reporting to meet specific application needs with LabVIEW software.

Accurate Conditioned Measurements

Distribute measurements closer to the sensor or signal using rugged form factors with -40°C to 70°C temperature ranges and fanless operation.

Increased Streaming

Increase data streaming over the same bus with NI signal streaming and the TDMS binary file format.

FIGURE 10

PXI is a modular PC-based platform for measurement and automation systems.

THE NI ADVANTAGE

- With flexibility to meet changing requirements, you can use CompactDAQ as a modular platform to meet the demands of your future applications. By simply changing to a different chassis or controller, you can add new functionality, like an integrated processor or extended operating temperature range. With 1-, 4-, 8-, and 14-slot chassis options, you can scale systems to higher channel counts by moving to a larger chassis or synchronizing multiple chassis.
- CompactDAQ is a modular system, so you can add more measurement types and channels to the system by simply plugging in additional modules. All modules are automatically detected and synchronized to the clock in the backplane of the chassis. CompactDAQ has multiple timing engines that you can use to run multiple hardware-timed operations simultaneously with independent rates for analog input.
- CompactDAQ and all C Series I/O modules are constructed from A380 cast aluminum to withstand operating temperatures from -20°C to 55°C and up to 30 g of shock.

High-Precision Voltage or Current Sourcing

PXI source measure units (SMUs) combine high-precision source and measure capability with features designed to reduce test time and increase flexibility and are perfect for power performance validation. These features include high channel density for building parallel SMU test systems, deterministic hardware sequencing for minimizing software overhead, and high-speed update and sample rates for quickly changing setpoints and acquiring data. Additionally, with the flexible sampling rate and streaming capability of PXI SMUs, you can use the instrument as a digitizer to capture transient behavior, and the digital control loop gives you the ability to adjust the transient response of the instrument. The ability to change the transient behavior of the SMU, called SourceAdapt, reduces SMU settling time and minimizes overshoot and oscillations, even with highly capacitive loads.

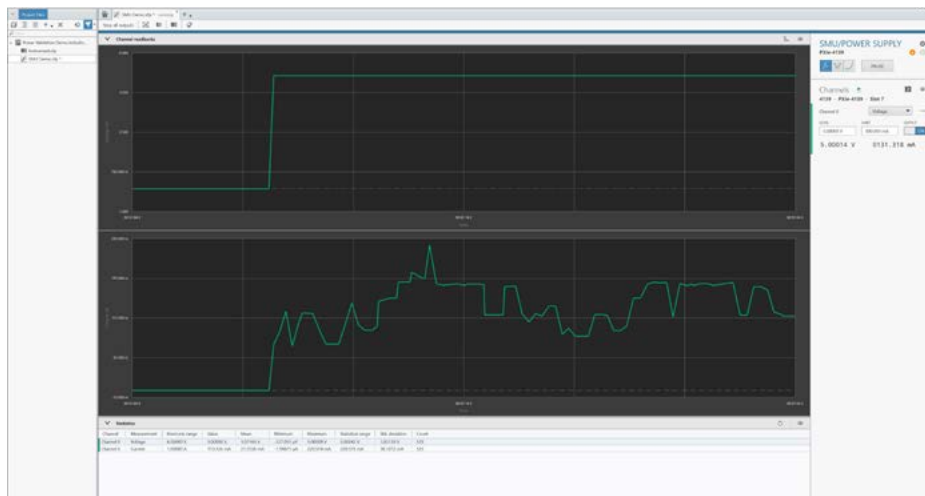


FIGURE 11
SMU Current and Voltage Reading in InstrumentStudio Software

THE NI ADVANTAGE

- Unmatched Channel Density—Reduce test time, increase throughput, and meet today's manufacturing requirements by reducing a full rack to a few inches of physical space.
- Custom Transient Response—Digitally control the transient properties of PXI SMUs to maximize stability, reduce overshoot, and decrease test times with NI SourceAdapt, a patented technology on PXI SMUs that helps you avoid custom circuitry.
- Built-In IV Sweep—Reconfigure and repurpose the same SMU across test cases with configuration-based IV sweeps in InstrumentStudio software and a path to automation.
- Hardware-Timed Sequences—Get your results faster by removing the communication latency between the host computer and SMU among each measurement of a sequence.
- High-Power Pulsing—Operate beyond the basic DC power boundary of PXI SMUs by pulsing current or voltage instead of supplying a constant DC source, meaning that you can test at high instantaneous power with limited or no heat sink infrastructure.



System Integration on Your Terms

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 NI 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



Global Support



Turnkey Solution Delivery and Support



Prototyping and Feasibility Analysis



Repair and Calibration



Training and Certification

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