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Solution Brochure

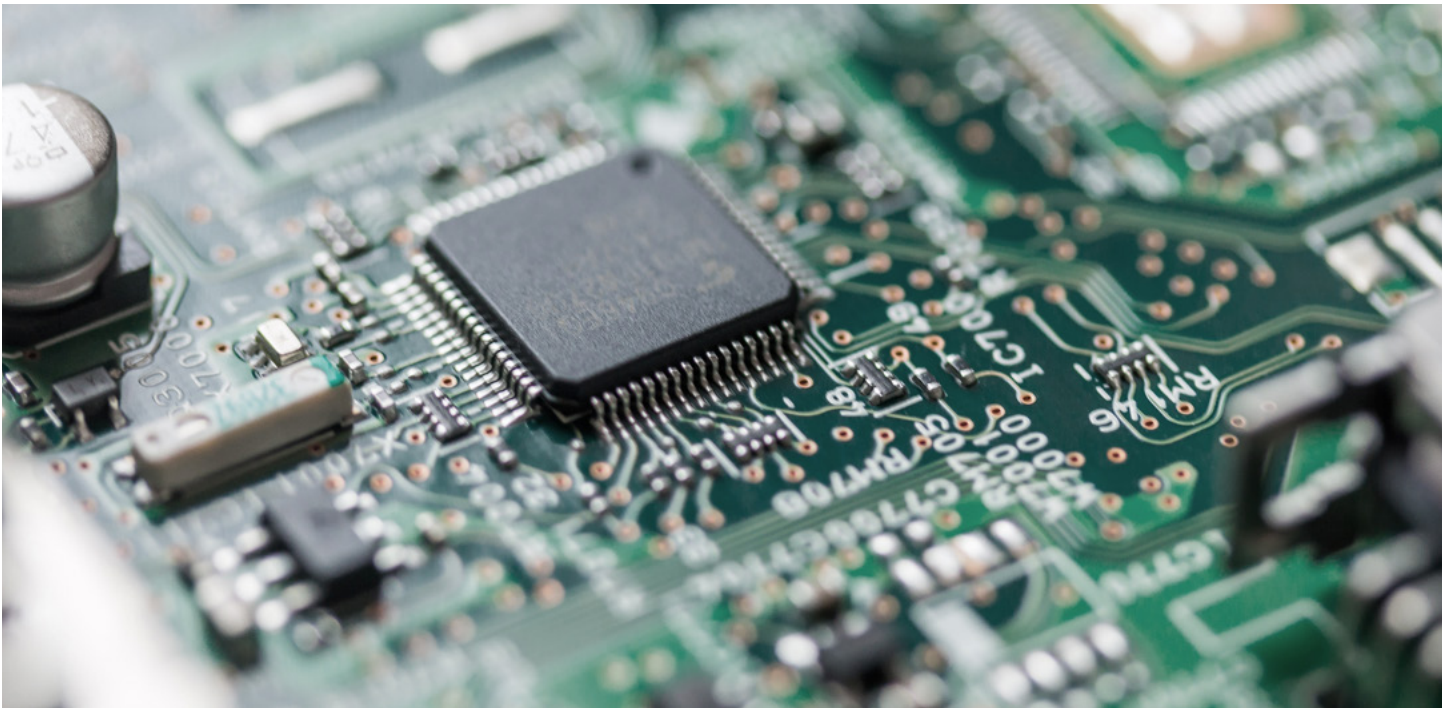
# Protocol Suite

# Explore NI's Solutions

NI Protocol Suite combines the power of NI InstrumentStudio™ software that provides an integrated approach to interactive PXI measurements, the ability to monitor and debug test systems, streamlined connections to automated test applications, and Semiconductor Device Control Add-On with PXI Digital Pattern Instruments for seamless semiconductor testing.

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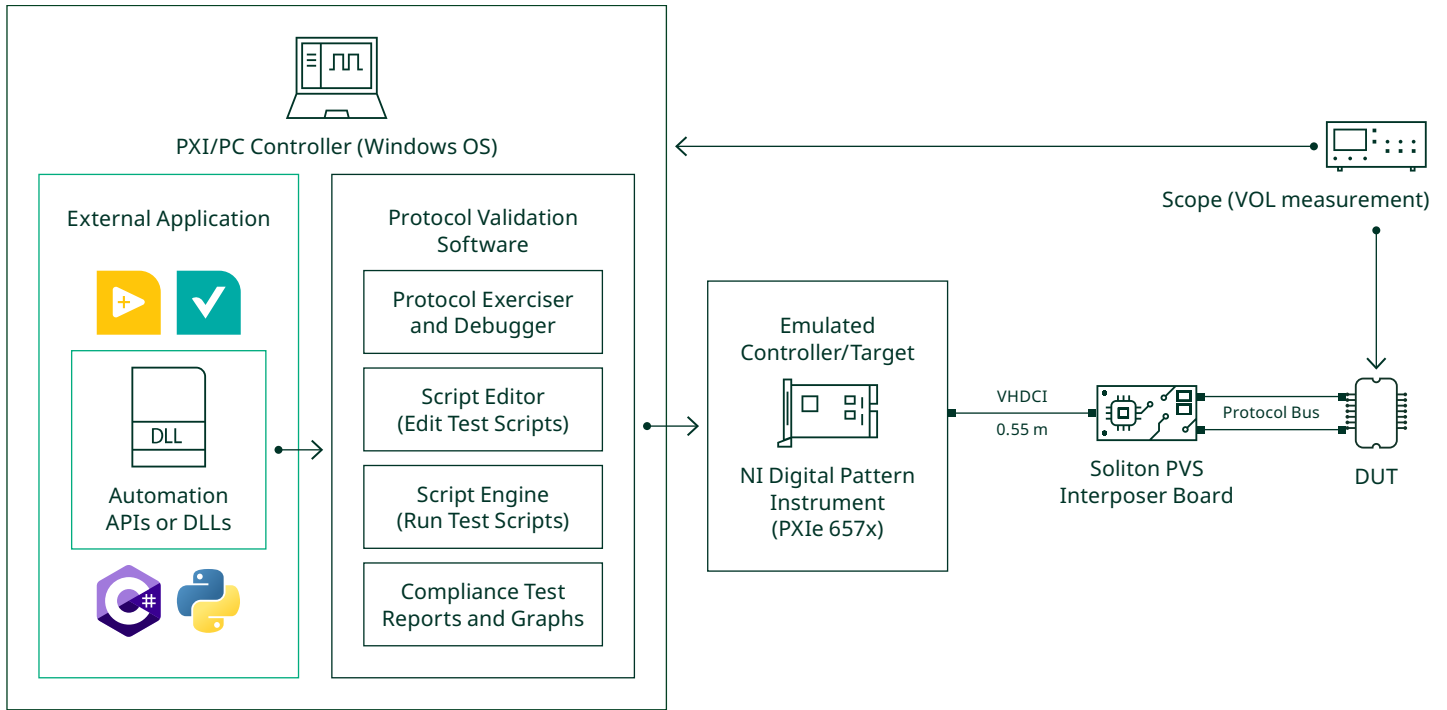




## Solution Overview

Our integrated solution combines InstrumentStudio software and the Semiconductor Device Control Add-On with PXI Digital Pattern Instruments for streamlined semiconductor testing interfaces like I2C, SPI, MIPI I3C®, MIPI RFFESM, MIPI SPMISM, I2S, and TDM. This solution allows you to control semiconductor devices effortlessly with the intuitive InstrumentStudio interface, which supports standard digital protocols. PXI Digital Pattern Instruments provide ATE-class capabilities for comprehensive testing of RF and mixed-signal ICs. Together, these tools ensure efficient device control and testing, shortening time to market with reliable results.

- Perform interactive register read/write operations using standard digital protocols, such as MIPI I3C, I2C, SPI, or RFFE, or custom protocols using [Semiconductor Device Control Add-On](#).
- Test digital interface for MIPI I3C, I2C, MIPI SPMI, SPI, and MIPI RFFE target devices using [Soliton Protocol Validation solutions](#).
- Easily verify semiconductor device communication in a system with [Protocol Analyzer Software for MIPI I3C and Protocol Analyzer Software for I2C](#), run with InstrumentStudio software.
- Leverage NI's high-performance modular PXI hardware and Digital Pattern Instruments.
- Monitor and debug test systems interactively using InstrumentStudio software.
- Automate easier with NI LabVIEW, C#, Python APIs, and NI TestStand sequencing software.



**FIGURE 1**  
Protocol Suite Overview

## SOLUTION ADVANTAGES

### 01

Serves as a comprehensive information hub that enables access to all details about Semiconductor Device Control, Protocol Validation Solution, and Protocol Analyzer in one centralized location.

### 02

Enhances productivity by enabling code reduction, allowing teams to concentrate more on validation through an interactive protocol validation tool.

### 03

Simplifies decision making with the consolidated overview that makes it easier to match requirements to the right product, enhancing the development process.

### 04

Achieves exceptional test coverage, surpassing 90 percent for each protocol, ensuring robust and thorough validation.

### 05

Facilitates scalability without the need to alter hardware systems, enabling seamless expansion of the solution to support additional protocols.

### 06

Uses PXI Digital Pattern Instruments to deliver ATE-class digital to the industry-standard PXI platform with optional 500+ modules of instrumentation including oscilloscope, programmable power supply, electronics load, switch/MUX, DMM, AWG, SMU, DAQ, DIO, and more.

# Application Examples

A protocol suite is highly versatile and suitable for many applications due to several key factors: interoperability, scalability, flexibility, reliability, security, compatibility, and adaptability.

Industry	Applications	Products	Key Protocols
Semiconductor	Computing	Microcontrollers	All Protocols
		FPGAs	All Protocols
		SoCs	All Protocols
		DSPs	All Protocols
	Storage	Flash Memory	I2C, SPI
		EEPROMs	I2C, SPI
	Wireless Communication	RFFE	RFFE
	Mixed Signal	Audio	I2C, TDM
		Data Converters	I2C, SPI
		PMICs	I2C, SPI, MIPI SPMI
		Regulators	I2C, SPI
	Bus Management	Isolators	I2C, SPI
		IC Switches	I2C, SPI
		Logic Translators	I2C, SPI
		Extenders	I2C, SPI, MIPI I3C
		Hubs	I2C, SPI, MIPI I3C
Industrial, Automotive, and Consumer Applications	Sensors	I2C, SPI, MIPI I3C	
	MEMS	I2C, SPI, MIPI I3C	
System Management	Battery Management		PMBus, SMBus
	Server Management		PMBus, SMBus
	Power Management		PMBus, SMBus, MIPI SPMI
Data Storage	SSDs		MIPI I3C, SPI, MIPI I3C
	DDRs		MIPI I3C, SPI, MIPI I3C
	RAM		I2C, SPI
Communication	Fiber Optics		OSFP, I2C
	Display	Display Controllers	I2C
	Camera Interfaces		I2C, MIPI I3C
	Networking		I2C, SPI, MIPI I3C

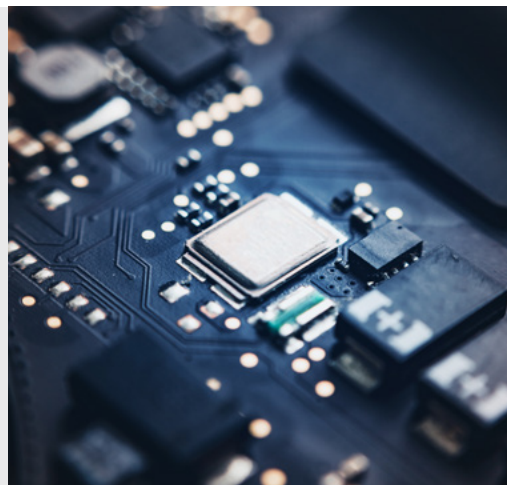
**TABLE 1**  
Protocol Suite Application Examples

# Example Configuration

## Revolutionizing Semiconductor Validation

“With our new platform based on PXI, we’ve maintained both measurement and performance integrity while achieving 3X cost reduction and 10X improvement in semiconductor validation throughput.”

Douglas Laing  
Principal Validation Engineer, Vesper Technologies, Inc.



Option Name	Part Name	Quantity	Description
Base Configuration	784781-01	1	PXIE-1092 9-slot 3U PXI Express Chassis
	787567-01	1	PXIE-8861 2.8 GHz Quad Core Controller
	786777-01	1	8 GB DDR4 SO-DIMM RAM, non ECC
	784183-01	1	PXIE-5164 PXI Oscilloscope
	786320-02	1	(Required) PXIE-6571, 1-slot, 100 MVector/s PXI Digital Pattern Instrument, 8 CH
	786320-01	1	(Optional) PXIE-6571, 1-slot, 100 MVector/s PXI Digital Pattern Instrument, 32 CH
	763830-01	1	AC Power Cord 125 V, 15 A (For USA only, varies based on region)
	781013-01	1	Shielded Digital Cable, 68-pin VHDCI Male to 68-pin VHDCI Male (.5M)
	778592-01	1	Connector Block, Single Ended Digital Waveform I/O
	783629-01	1	SP500X Single Ended Passive Probes, 500 MHz, 300 VDC, 10:1 Attenuation
Software	InstrumentStudio	1	(Required) InstrumentStudio (Visual Interface)
	787812-35	1	(Required) Semiconductors Device Control for InstrumentStudio
	Multiple	1	Protocol Validation Solution (MIPI I3C, I2C, MIPI SPMI, SPI, and MIPI RFFE)
	Multiple	1	Protocol Analyzer (MIPI I3C, I2C)
	784584-35	1	LabVIEW (Custom Interface)
	788372-35	1	TestStand (Automation)

TABLE 2

An example protocol suite hardware configuration. Only one digital pattern instrument is required; choose based on channel needs.

# Testimonials

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“When Vesper added an I2C interface to our microphones, we knew that comprehensive validation of the interface would be critical to customers. We turned to Soliton and their I2C validation tool. Instead of spending months to develop an in-house solution, we were up and running in a matter of days. The tool was easy to integrate with our existing test hardware and provides 100 percent spec coverage. Using the automation extensions provided, our final test setup requires minimal operator intervention to fully validate the I2C interface across a wide range of conditions.

Soliton was an excellent partner at all stages of the system development. The documentation was easy to read and very helpful. Their support team provided prompt responses to my questions, both via email and online chat. We are very satisfied with the results and feel the Soliton I2C validation tool provides excellent value to our organization.”

Douglas Laing  
Principal Validation Engineer at Vesper Technologies, Inc.

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“Thank you so much for providing a great tool to validate I2C and I3C interfaces. The Soliton Validation Suite is simple and easy to use. Setup takes about 15 minutes and validation of a working device is just a few hours. Support has been exceptional as issues are acknowledged and resolved very quickly!

Prior to our procurement of the SVS platform, we used off-the-shelf host adapters to test, validate, and characterize our devices. These are good for functional testing but not designed to test I2C and I3C compliance to the spec. Spec compliance was tested with a patchwork of custom test setups and equipment. This required a lot of time to set up, execute, and record test results. Soliton SVS provided a unified test platform with simple pass/fail status reporting for validation. The simplified hardware setup and testing has reduced our engineering costs significantly and improved the quality of the product. Use of the SVS has saved approximately \$100K of NRE in the first year of application.

Validation of I3C is particularly advantageous due to the newish nature of the I3C standard. Compared to I2C, I3C is significantly more complicated and requires a steep learning curve. This presents a hurdle for testing. Using SVS leverages the I3C knowledge from Soliton and enables immediate validation of an I3C device.”

Hung Mai  
Senior Staff Engineer at Semtech Corporation

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# Automation Capabilities

Soliton's digital protocol solutions facilitate automation through DLLs, enabling seamless integration into automation frameworks. These tools feature automation endpoints, streamlining user workflows by automating various tasks ranging from configuring the tool to executing test scripts.

Automation examples are available for TestStand, LabVIEW, C#, and Python. Visit NI.com to [view automation examples](#).

## Technical Specifications

PXI Digital Pattern Instruments (DPIs) deliver ATE-class digital to the industry-standard PXI platform. They are designed for testing a broad range of RF and mixed-signal ICs from RF front ends and power management ICs to transceivers and Internet of Things systems on chip with built-in connectivity and sensors. A comparison of PXIe-6571 Series Digital Pattern Instruments of eight channels and 32 channels follows. For more details, see the latest [DPI datasheets](#).



**FIGURE 2**  
Digital Pattern Instrument Modules

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### DPI 8-CH (P/N 786320-02)

- 1 PXIe slot
- 8 channels
- 100 MHz max clock rate
- 200 Mbps max data rate
- SMA cable optimized for 8 channels

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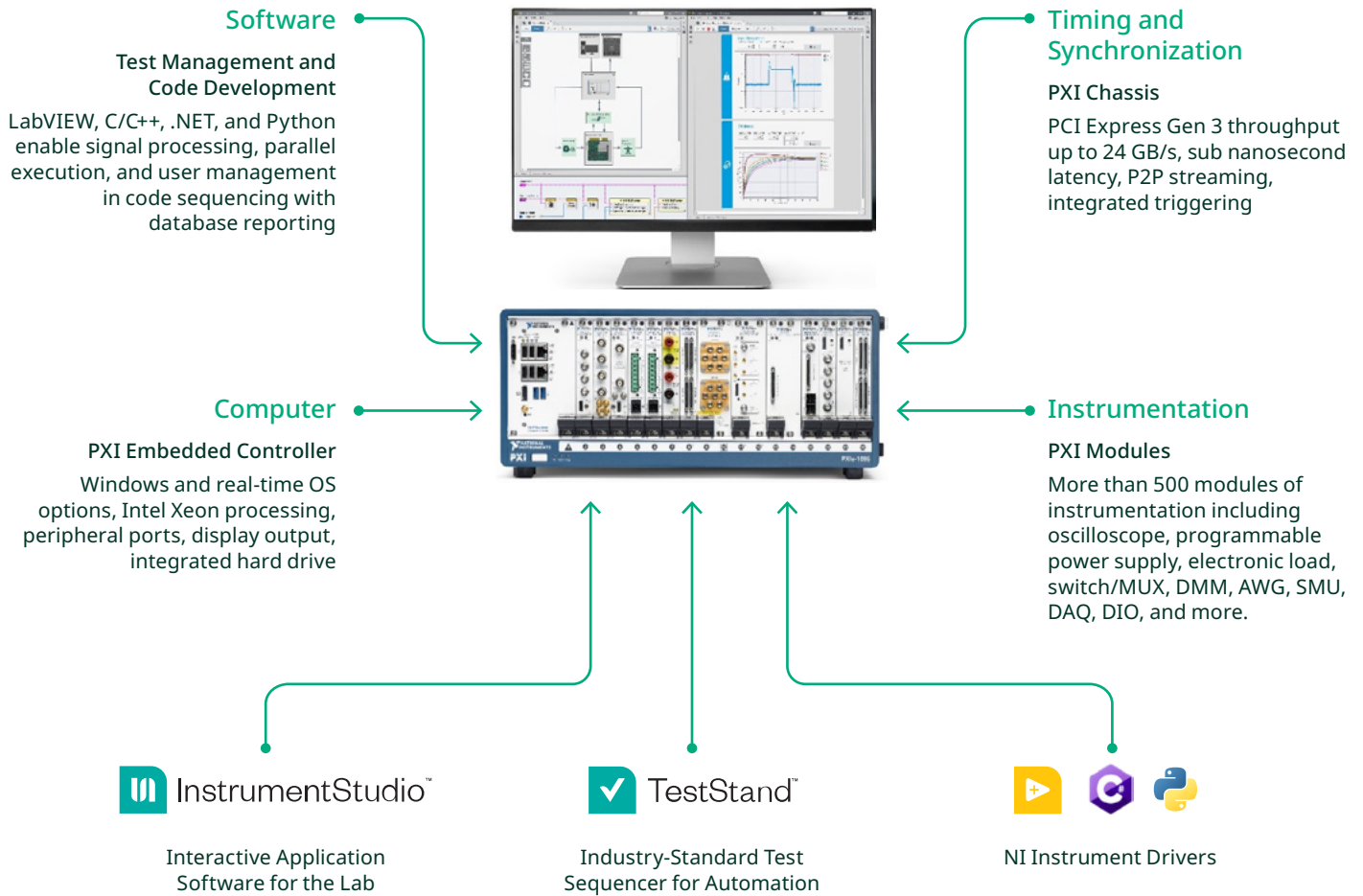
### DPI 32-CH (P/N 786320-01)

- 1 PXIe slot
- 32 channels
- 100 MHz max clock rate
- 200 Mbps max data rate
- SMA cable optimized for 32 channels



# PXI Systems

## Anatomy of a PXI Test and Measurement System

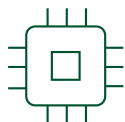


## PXI Hardware Overview

- **Chassis:** 2 to 18 slot options with up to 8 GB/s per-slot dedicated bandwidth
- **Controller:** up to 18 core with 512 GB NVMe SSD storage
- **DC Source and Capture:** high-performance, low-noise options up to 300 W including built-in digitizer and waveform generation modes
- **AC Source and Capture:** broad portfolio of arbitrary waveform generators and oscilloscopes
- **Digital Source and Capture:** digital pattern instrumentation for DUT communication and register R/W operations



AUTOMATION



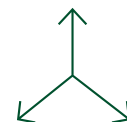
CHARACTERIZATION



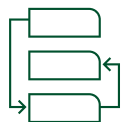
EFFICIENCY



SPEED



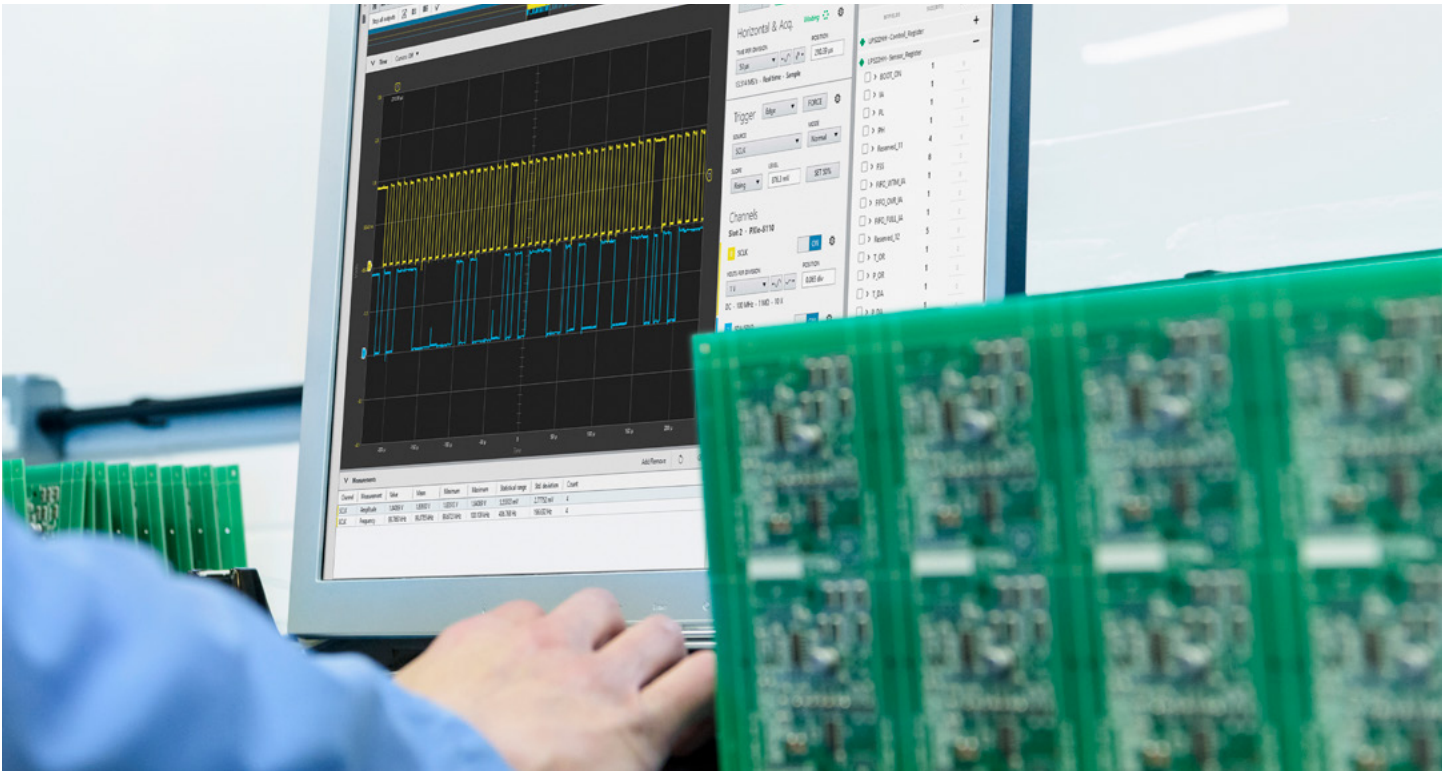
FLEXIBILITY



INTEGRATION

FIGURE 3

Anatomy of a PXI Test and Measurement System



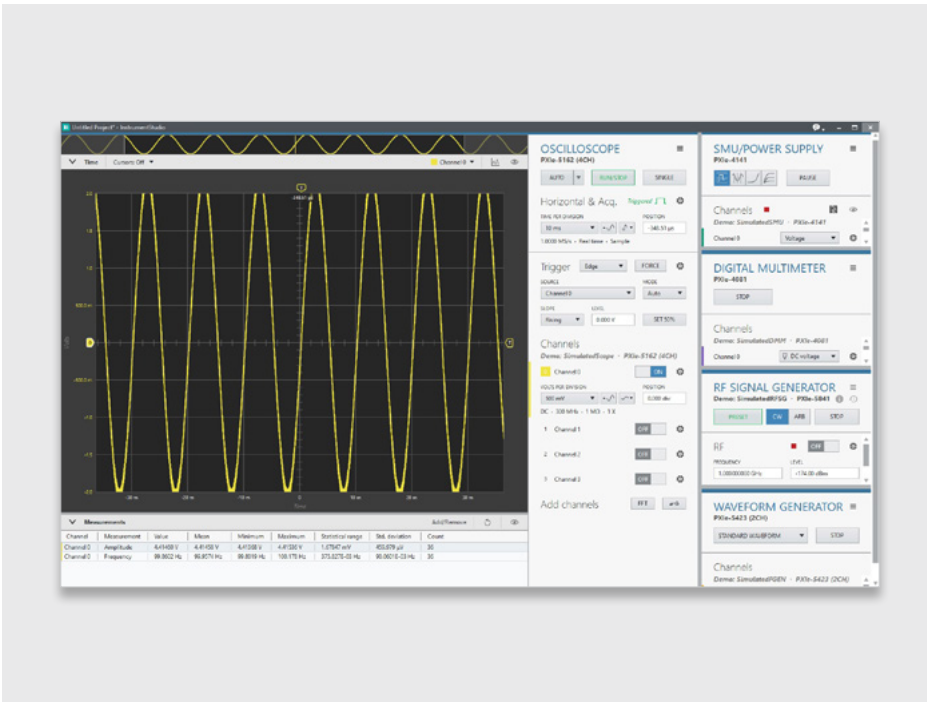
## How to Get Started

The installation, hardware setup, and usage of the tool are simple. Here is a quick overview of steps to get started. [More detailed instructions are available on NI.com.](#)

- Obtain the [stand-alone executable from NI.com](#) and follow the provided installation guide to install the software along with necessary prerequisites like instrument drivers.
- Refer to the Interfacing to the Digital Pattern Instrument or Digital Waveform Instrument using the VHDCI Connector application note. Go to [ni.com/info](#) and enter the Info Code **rdinwa** to locate the application note.
  - a. Connect the VHDCI cable from the PXIe 6570/71 card to the Soliton PVS Interposer board.
  - b. Power up the Soliton PVS Interposer board using either a USB-C cable or an SMU/power supply.
  - c. Establish a simple connection to the Device Under Test (DUT) by connecting the protocol lines from the Interposer Board to the DUT's protocol pins.
- Open the software and activate the software license.
- Configure the protocol specifications and hardware on the Device Configuration screen.
- Test communication using the tool's Debug screen.
- Execute pre-created template scripts from the Run screen.
- Review reports generated in the Report Viewer screen.
- Create custom scripts using the Test Plan Editor screen.

# What Is InstrumentStudio Software?

InstrumentStudio is application software that provides an integrated approach to interactive PXI measurements, the ability to monitor and debug test systems, and streamline connections to automated test applications.



**FIGURE 4**  
InstrumentStudio Software Provides Integrated, Interactive Measurements

InstrumentStudio software provides an integrated environment for instrument configuration that simplifies quick, interactive measurements and augments automated production test systems.

- Interact with multiple instruments simultaneously on intuitive, customizable front panels
- Monitor and debug automated test systems by taking control of API directly from InstrumentStudio
- Connect a wide range of DC, analog, digital, RF, and NI instruments
- Export instrument configurations to your choice of API
- Access RFmx Spectral Analysis and other wireless standards like 5G, WLAN, and Bluetooth

# What Is Semiconductor Device Control?

The Semiconductor Device Control Add-On for InstrumentStudio is a software add-on that helps you perform interactive register read/write operations using standard digital protocols, such as MIPI I3C, I2C, SPI, or RFFE, or even custom protocols. You can save your InstrumentStudio projects or export setups for automated validation in LabVIEW, Python, .NET, or TestStand. You can also use InstrumentStudio in parallel with automated applications to monitor and debug device control tasks in real time. The Semiconductor Device Control Add-On for InstrumentStudio works with the I2C/SPI Interface Device (USB) and the PXI Digital Pattern Instrument to help you execute tasks when performing interactive and automated semiconductor validation.

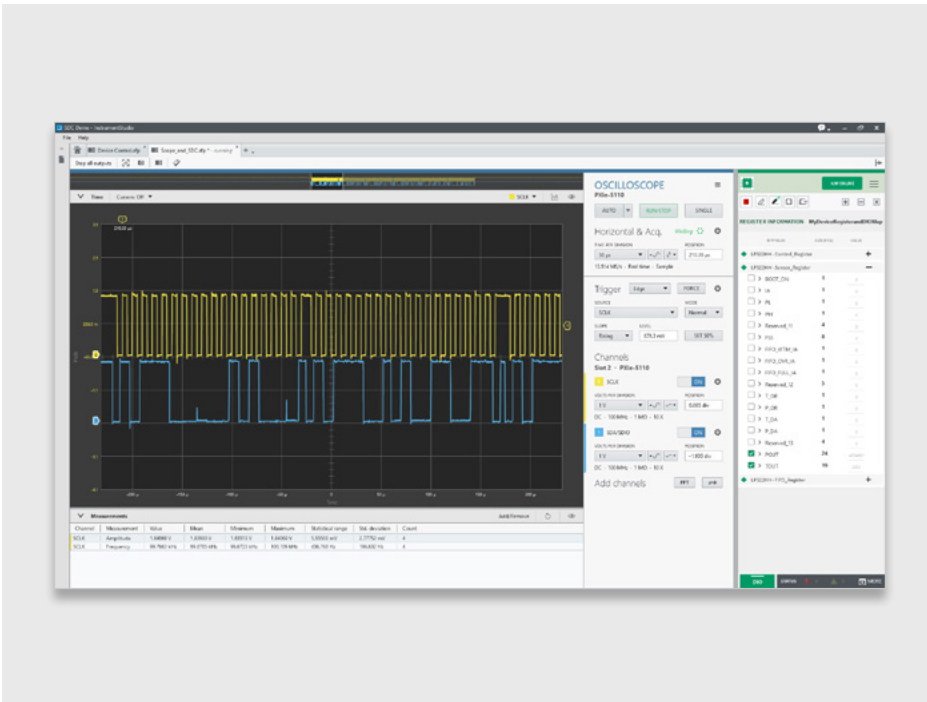


FIGURE 5  
Semiconductor Device Control Add-On for InstrumentStudio

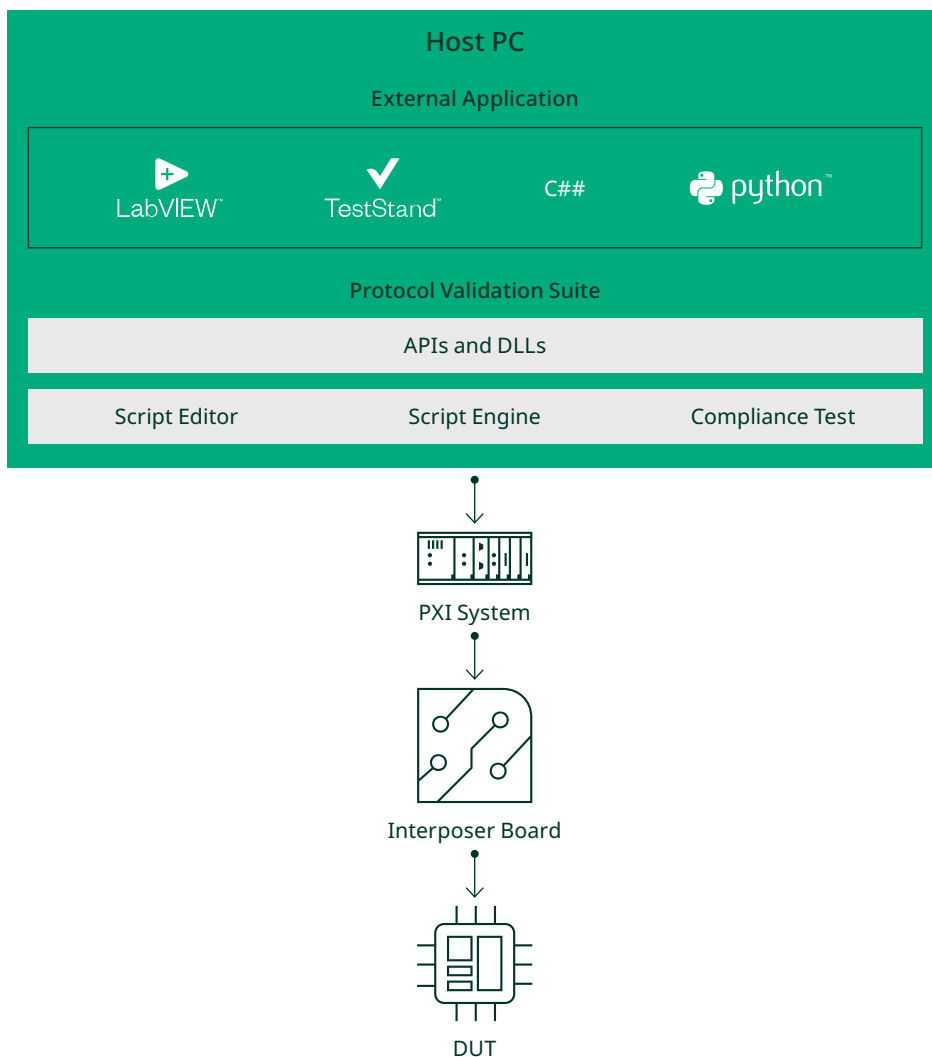
## What Can You Do With the Semiconductor Device Control Add-On?

You can use InstrumentStudio software to perform device register read/write operations using I2C/SPI or custom digital protocols (compatible with MIPI I3C, I2C, SPI, RFFE, and more) alongside your instrumentation measurements for interactive device bring up and debugging. Then you can quickly transition from interactive to automated validation programs.

# What Is the Soliton Protocol Validation Solution?

Increasingly complex digital interfaces and protocols often require engineers to go beyond functional compliance checks and as far as validating against full parametric, functional, voltage, and timing characteristics. Researching the protocol standards, designing appropriate measurement IP, developing an appropriate user interface, and reporting results require a lot of effort. As a result, many in-house protocol validation tools often end up being slow, expensive, and difficult to maintain.

- Turnkey solution for interactive and automated validation of common device control protocols, such as I2C, MIPI I3C, SPI, MIPI SPMI, and MIPI RFFE
- Quickly perform parametric, functional, and reliability measurements
- Sweep bus timing/voltage parameters, induce packet formation faults, induce glitches/spikes in the protocol waveform, and measure timing parameters
- Simple interface for manual tasks and automation
- Easy to maintain and capable of evolving with changing market requirements



## PROTOCOL VALIDATION SOLUTION

- Easily perform compliance test with turnkey protocol validation software for MIPI I3C, I2C, MIPI SPMI, SPI, and MIPI RFFE target devices.
- Leverage NI's high-performance PXI Digital Pattern Instruments and PXI Oscilloscopes.
- Interactively configure parametric, functional, and reliability tests against industry standards.
- Use the built-in script editor for easy automation.
- Export configurations and integrate protocol validation tasks into external automation programs using APIs and DLLs for Python, C#, LabVIEW, and TestStand.

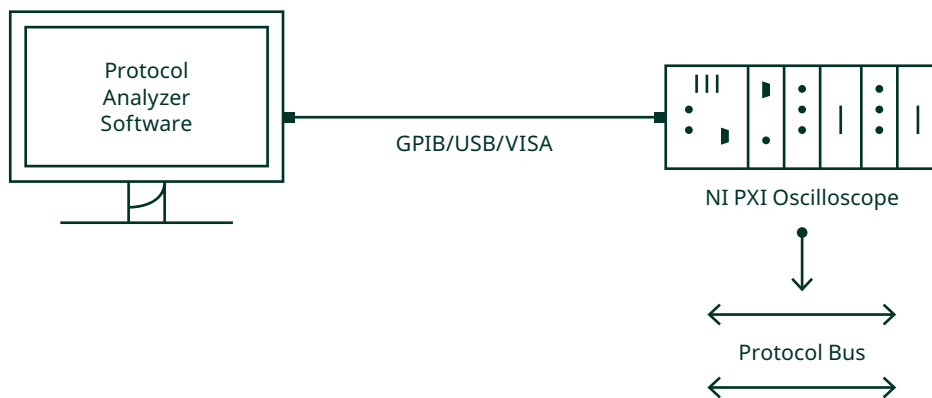
FIGURE 6

Example of Soliton Protocol Validation Solution Workflow

# What Is Protocol Analyzer?

Semiconductor validation engineers face a challenging job with digital communication validation, which includes analyzing the digital protocols, interpreting the message, and verifying that it meets the needs using a logic analyzer or an oscilloscope. In addition to the manual work, it also requires a very strong understanding of the digital protocol. These tasks can become very time consuming and prone to human analysis error. To be more efficient and accurate, we need:

- Simplified solution to interpret digital protocol waveforms and messages
- Automated electrical parameters measurement to help validate signal quality and reliability
- Easy-to-use interface for interactive tasks and automation
- Ability to perform analysis without having to use a specialized, expensive oscilloscope



**FIGURE 7**  
Example Protocol Analyzer Configuration

## PROTOCOL VALIDATION SOLUTION

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## SOLUTION ADVANTAGES

**01**

Reduce time decoding digital protocols and measuring electrical parameters

**02**

Easily analyze protocols without needing to have deep protocol understanding

**03**

Validate signal integrity and reliability within a few clicks

**04**

Simple automation from external programming environments through APIs

**05**

Easy to use, low-cost protocol bus analyzer and sniffer

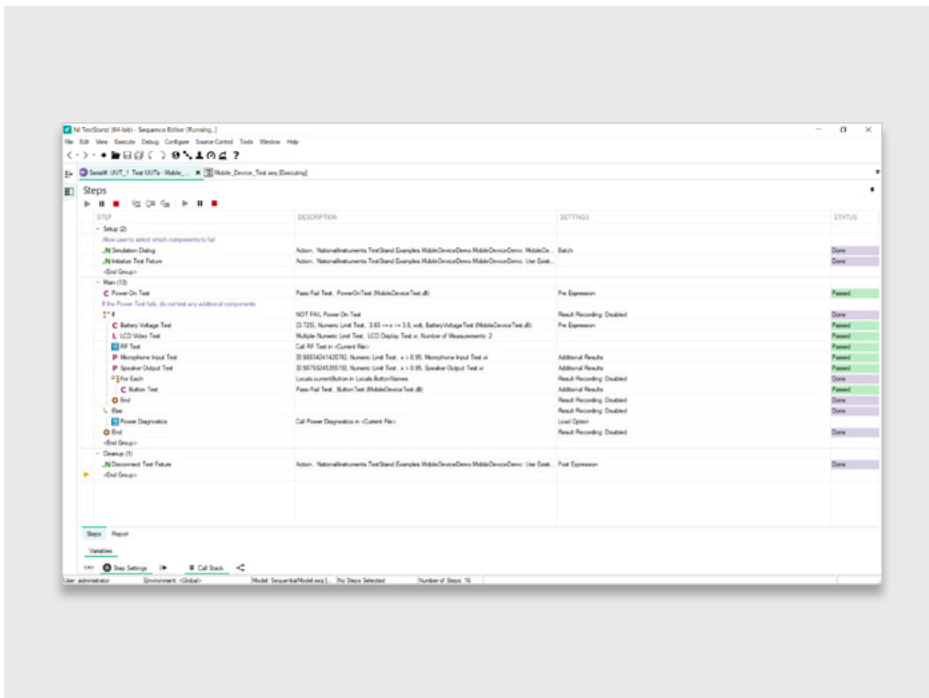
# What Is TestStand?

TestStand is a test executive software that accelerates system development and deployment for engineers in validation and production.

## Validation and Production Test Automation

TestStand automates, accelerates, and standardizes the overall test process across all of your testers with native functionality for:

- Calling and executing tests written in LabVIEW, Python, C/C++, or .NET
- Complex tasks, such as parallel testing, sweeping, looping, and synchronization
- Creating custom operator interfaces and robust tools for deployment and debugging
- Unit tracking, creating automated reports, and storing results to local or network databases



**FIGURE 8**  
Example TestStand Sequence

## PROTOCOL VALIDATION SOLUTION

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Low-cost, easy-to-use protocol bus analyzer and sniffer

[Learn more about TestStand at NI.com](https://www.ni.com)

# What Are Digital Pattern Instruments?

PXI Digital Pattern Instruments deliver ATE-class digital to the industry-standard PXI platform. They are designed for testing a broad range of RF and mixed-signal ICs from RF front ends and power management ICs to transceivers and Internet of Things systems on chip with built-in connectivity and sensors.



**FIGURE 9**  
Digital Pattern Instruments shown.

## Digital Pattern Editor

The Digital Pattern Editor is an interactive tool for importing, editing, or creating test patterns. The software integrates editing sheets for device pin maps, specifications, and patterns to develop or edit imported digital test vectors and patterns.

## Tools to Debug Digital Test Patterns

The Digital Pattern Editor includes tools like Schmoos plots to provide a deeper understanding of DUT performance across variation. The editor also offers debugging tools such as overlaying pattern failures on a pattern or using digital scope for an analog view of the pin data.

## Programmatic Pattern Bursting

The NI-Digital Pattern Driver in LabVIEW, C, or .NET development tools offers the ability to develop test code to interact with PXI Digital Pattern Instruments.

## TestStand Semiconductor Module

The TestStand Semiconductor Module works in conjunction with the Digital Pattern Editor and NI-Digital Pattern Driver with native pin map support and multisite, DUT-centric programming of Semiconductor Test Systems (STSs).

[Learn more about DPI at NI.com](https://www.ni.com)





# 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](mailto: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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