

# Engineer Ambitiously.



## Body and Chassis HIL Brochure

Test at the Pace of Innovation

### Body and Chassis HIL Solution Advantages

- Minimize cost and ensure reliability with hardware-in-the-loop (HIL) simulation, reducing the need for costly real-world tests.
- Maximize system reuse with a flexible test solution designed to be extended and customized to meet your changing requirements.
- Reduce development time and quicken startup by taking advantage of customized HIL solutions available through the NI Partner Network.

## Body and Chassis HIL

As vehicles become increasingly connected, automated, and electrified, body and chassis systems are being transformed to maintain inter-functionality and meet user’s changing demands. The complexity and number of electronic control units (ECUs) within vehicles continues to grow—from active suspension, brake by wire, and emergency steering to seat control, rearview mirror ECUs integrated with infotainment systems, and passive safety systems like airbags or seat belts. Engineers need a fast, accurate, and automated way to systematically test functionality while eliminating potential points of failure before production starts. This solution must be capable of:

- Adapting to inevitable changes in signal lists and I/O requirements
- Conducting fault insertion and signal conditioning
- Integrating models, third-party devices, and toolkits to accurately simulate the full system

NI’s body and chassis HIL test architecture serves as the foundation of a powerful software-connected system that adapts quickly to new requirements and enables rapid iteration.

NI’s powerful, real-time controllers, including CompactRIO and open PXI systems, offer high-performance modular instrumentation and a broad range of I/O modules connected directly to the FPGA for testing with higher fidelity through high-speed deterministic execution.

NI Switch Load and Signal Conditioning (SLSC) is a functional extension for NI data acquisition that standardizes connectivity and provides a modular approach to signal conditioning, fault insertion, and other test needs. This greatly simplifies adding devices under tests (DUTs) to your system by utilizing common interfaces that facilitate easy swapping of interface modules for different test objectives.

Test setup and execution are streamlined using VeriStand, NI’s configuration-based test software. With VeriStand, it’s never been easier to configure I/O channels, create test sequences, and import real-time models with associated stimulus profiles to conduct automated system integration testing.



Figure 1. A body and chassis HIL system built on NI’s modular, off-the-shelf components offers the ultimate in flexibility.



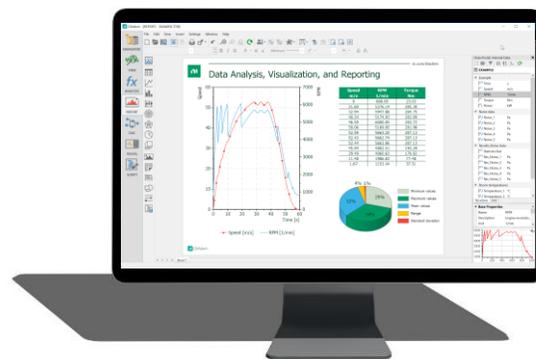
## Recommended Architecture

### Software

Successful engineering enterprises share characteristics such as consistent data logging, analysis, and effective data management. This is especially true of HIL test applications where design and test teams must collaborate to ensure embedded software and mechanical system product quality. Implementing a standard, automated means of data analysis and report generation helps you view data in a consistent way, improves test efficiency, and makes data much easier to find and interpret.

#### DIAdem

DIAdem is a single software tool that you can use to quickly locate, load, visualize, analyze, and report measurement data collected during data acquisition and/or generated during simulations. It's designed to help you quickly access, process, and report on large volumes of scattered data in multiple custom formats to make informed decisions. You can use VeriStand's UI tools with DIAdem to log data, perform post-processing, and generate reports quickly and easily.



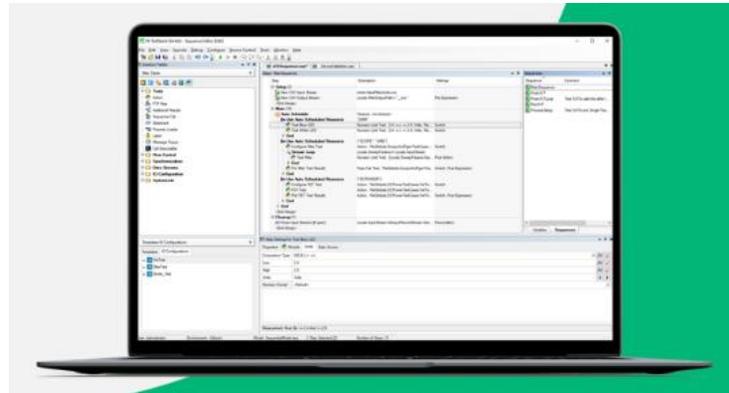
#### TestStand

TestStand is a ready-to-run test management software designed to help you develop automated test and validation systems faster. You can use TestStand to develop, execute, and deploy test system software. In addition, you can develop test sequences that integrate code modules written in any test programming language. Sequences also specify execution flow, reporting, database logging, and connectivity to other enterprise systems.

You can use TestStand to automate an HIL test application by calling the VeriStand .NET-based execution API. TestStand can also manage hardware and software from multiple platforms in a single TestStand sequence. For example, it can automate VeriStand real-time sequences running on an NI PXI real-time controller while simultaneously controlling a third-party instrument using its native IVI driver support. After you run your test, you can log test result information in a customizable report or database automatically. Additionally, systems written in TestStand can be integrated with existing source code control, management requirements, and data management systems.



You can also integrate TestStand into third-party test management and test generation software platforms to create not only a system to automate test but also a system capable of automatically generating unit tests to make your ECU fail. This helps you focus on testing embedded software instead of writing new test scripts from scratch.



## VeriStand

VeriStand is a software environment for configuring real-time test and HIL applications. It can help you construct a multicore-ready real-time engine to execute tasks such as real-time stimulus generation, data acquisition for high-speed and conditioned measurements, and calculated channels and custom channel scaling—out of the box!

VeriStand can also import control algorithms, simulation models, and other tasks from both LabVIEW and third-party environments. You can monitor and interact with these tasks using a run-time editable user interface that includes tools for value forcing, alarm monitoring, I/O calibration, and stimulus profile editing. Although you don't need programming knowledge to use VeriStand, you can customize and extend it with a variety of software environments such as LabVIEW, ANSI C/C++, ASAM XIL, and others for modeling and programming.

VeriStand is architected to have a real-time engine that runs independently from the user interface to ensure the determinism of the system you're running.



## Hardware

### CompactRIO

CompactRIO is a rugged hardware design in a compact form factor that is ideal for most harsh environments as well as lab settings that require a small physical footprint. Although typically providing lower computational performance than PXI, CompactRIO offers high-performance processing and heterogeneous computing elements, including ARM-based Xilinx Zynq SoCs, quad-core Intel Atom processors, and Xilinx Kintex-7 FPGAs. CompactRIO also includes signals with measurement specific signal conditioning, built-in isolation, and industrial I/O.

CompactRIO is an ideal fit for benchtop HIL systems. It doesn't have as many I/O options as PXI, but the compact form factor and lower price make it a great choice for unit testing of ECUs that require integrated processing and FPGA performance such as ECU testing.

### PXI

A major benefit of the PXI platform for HIL is the wide range of I/O options that can be integrated into the test system. As the automotive industry evolves to incorporate new technologies, HIL systems must also evolve to verify the safe operation of these technologies. The PXI platform is uniquely positioned to meet the demands of these new test requirements.

In most cases, PXI is the best solution for HIL testing. It provides high channel count and density, the broadest availability of I/O, and the highest processing capability available. In addition to high-performance hardware, PXI also offers the best software experience for HIL testing, as it supports most modeling environments and seamless DAQ hardware support.



### SLSC

SLSC extends PXI and CompactRIO measurement hardware with high-power relays for signal switching, power loads, and additional inline signal conditioning capability. The system consists of a chassis with built-in active cooling that can host 12 modules. SLSC plug-in modules can operate in the chassis in three different modes: standalone, pass through, or cascaded. You can use cascaded mode to implement functionality like signal fault insertion.



SLSC is designed to simplify overall system integration, reducing system point-to-point wiring by accumulating signals and using standard cables. Each SLSC chassis consists of an SLSC digital bus that is used to discover, configure, and set parameters on the individual modules. Signals pass through SLSC modules either from the front connector or the rear expansion connector. You have the flexibility to design your own secondary backplanes to reduce system wiring using a custom application-specific backplane integrating the signal flow.



## NI Body and Chassis ECU HIL System

With NI's open, flexible HIL solutions, you have the power to easily customize the test system to fit your specific needs. Using a modular architecture, you can easily upgrade the platform with added functionality to future-proof your test systems and meet the requirements of the most demanding embedded software test applications.

Compared to competitors, NI's performance capabilities make it the best option for testing innovative control systems.

Figure 2 shows an example of how the various hardware and software components are assembled into a body and chassis HIL system. The system includes software for data management and test automation in addition to the HIL test execution and interface. The PXI hardware for modular I/O and SLSC that is used for application-specific switching, loads, and signal conditioning is then connected to the DUT through various connectivity options, depending on the device.

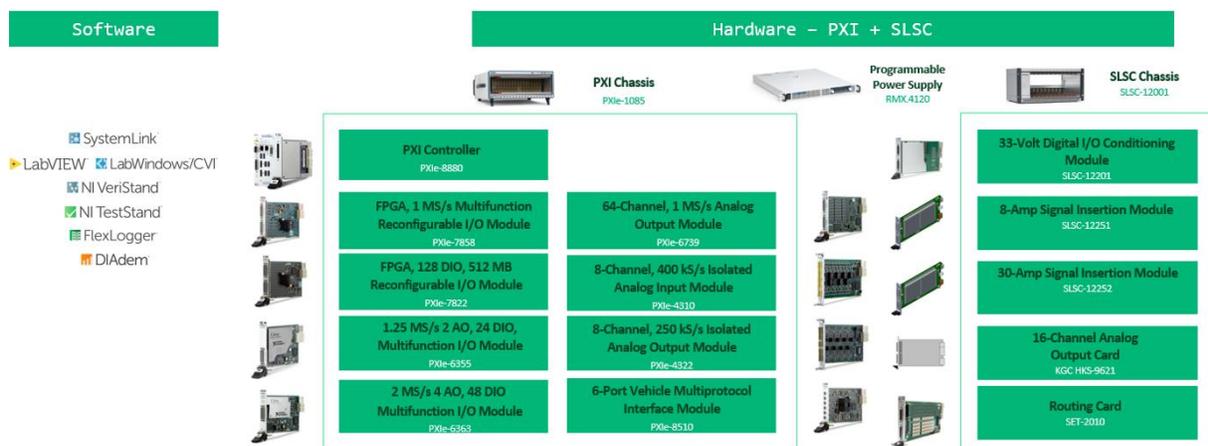


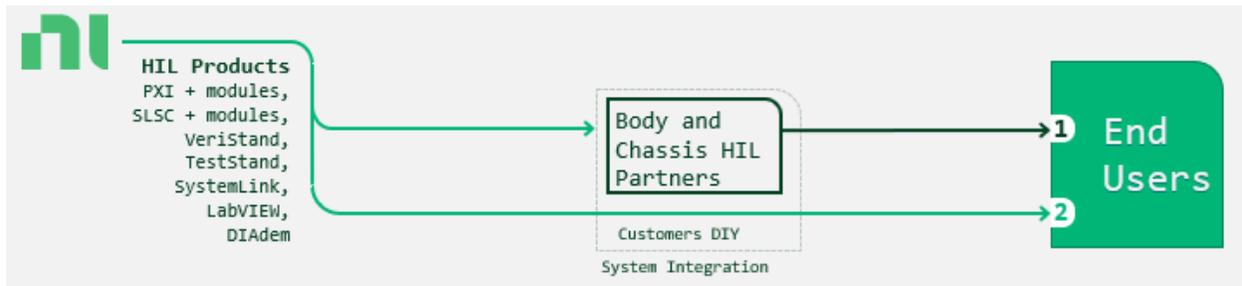
Figure 2. Body and Chassis ECU HIL System Example



## Committed To Your Success

With industry-leading customizability, NI HIL systems help you easily adapt to changing test requirements and system integration so you can find more ECU defects faster.

We offer a variety of solution integration options customized to your application-specific requirements:



Buy from...	...does 2 <sup>nd</sup> level Integration	...provides services
Partner	Partner	NI & Partner
NI	Customer	NI

## NI Partner Network

By working with NI Partners that specialize in automotive HIL, you can drastically reduce your time development costs. Receive full support and delivery with a customizable turnkey solution based on NI tools that fits your exact application requirements. These systems are built to integrate into your existing workflow while still giving you the flexibility to adapt to future requirements.

*“By using NI’s highly adaptable platform, we were able to scale from the Electric Parking Brake HIL tester to the Durability tester that helped a Global Automotive Brake Manufacturer substantially reduce their nonrecurring engineering costs.”*

*Todd VanGilder, Sr. Vice President of Business Development, Genuen*

Our partners have extensive experience in integrating NI hardware and software as well as the vertical application expertise of HIL in automotive. These systems are built to exact specifications and architectures defined by NI and on NI components to ensure consistent quality and user experience anywhere in the world. Contact your account manager or NI at (888) 280-7645 or [info@ni.com](mailto:info@ni.com) to get help selecting an automotive HIL partner that can best serve your business needs.



## Services and support program

Our service programs go beyond the included one-year warranty to help you save time and reduce long term, operational costs. Advanced replacement, technical support and training help you avoid hassle, improve uptime, and keep your maintenance costs under control over the life of your system.

The offered Services and Support Programs provide coverage at module level for NI-provided components.

	Standard Service Program	Premium Service Program	Uptime Service Program	CUSTOM  Scope to be defined with customer on a case-by-case basis
<b>Repair and Replacement</b> Minimize downtime	2-3 Weeks Repair	3-5 Days Replacement	<24h Replacement	
<b>Technical Support</b> Resolve issues quickly			Technical Support 8x5	
<b>Optional Training</b> Ensure user success	NI Body and Chassis HIL Learning Path			

### NI Body and Chassis HIL Learning Path

Learn faster, on your own or with an NI expert, and build skills for this project and the next:

- [On-Demand 24/7 access to our NI Learning Center](#)
- [Public Training: Virtual or in a Regional Training Center](#)
- Private Training: Virtual or on-site at your company [AMER](#), [APAC](#), [EMEA](#)



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