Satellite Test and Integration Solutions

Aerospace, Defense, and Goverment

Accelerating Space Program Lifecycles

Satellite Bus Testing and AI&T

Satellite Payload Testing

Hardware

Software

NI Services and Support

ni.com

Accelerating Space Program Lifecycles

NI is dedicated to equipping engineering teams with cutting-edge tools and solutions that accelerate every step in the design, validation, production, and launch of both vehicles and satellites. With a firm commitment to your success, NI is on your side to help you achieve an uncompromising pace and performance.

Achieve a Competitive Advantage Manufacturing Satellites

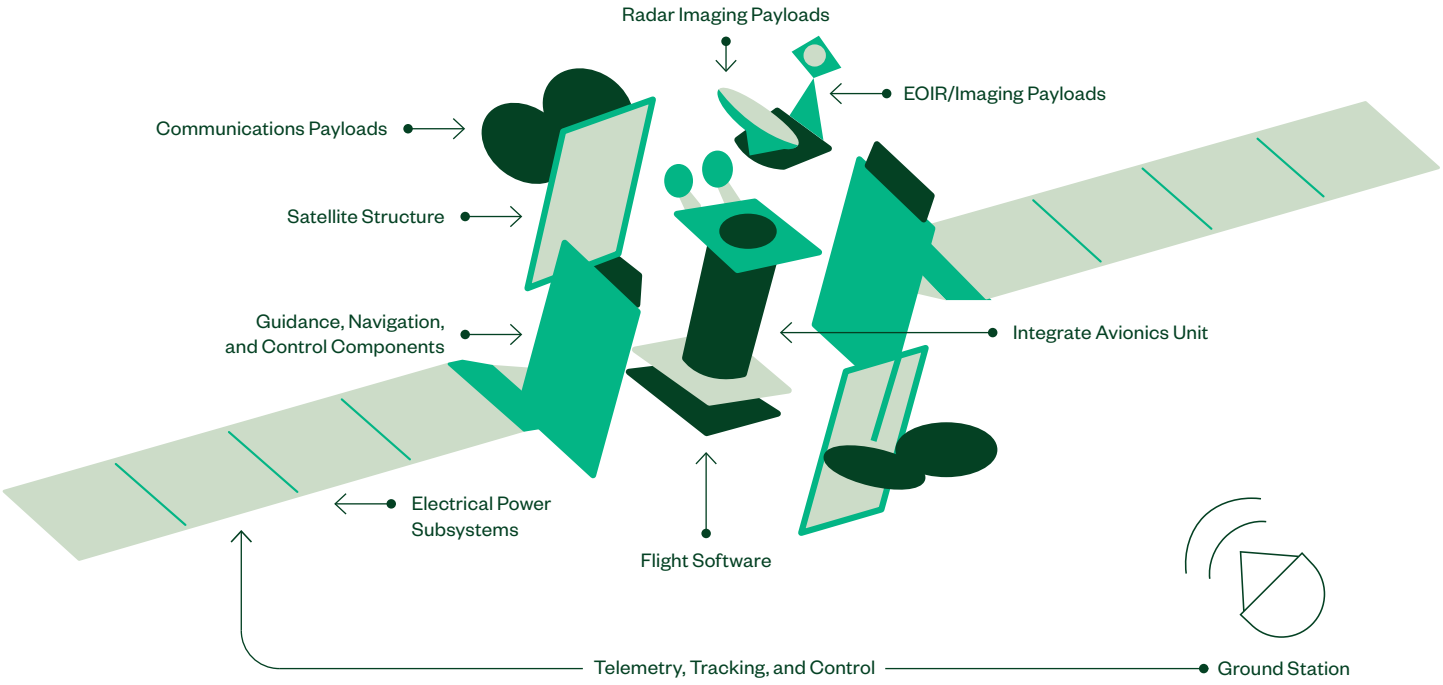
The satellite industry is undergoing rapid transformation as the new space race has fueled an unprecedented amount of satellite constellations for applications such as Earth observation, global communication, scientific research, and national defense. The proliferation of satellites in low Earth orbit (LEO) and medium Earth orbit (MEO) has led to technology advancements for humankind, new space-based business opportunities, and more satellite companies than ever before.

This industry transformation also represents an evolution in how companies must approach the development of the various subsystems and technologies needed for satellites to operate in space as well as the need to manufacture these systems at scale successfully. Satellite companies face a growing number of business and technology challenges that program teams and engineering organizations must overcome.

NI Provides Solutions from Satellite Design to Launch

The NI approach to satellite test optimizes organizational efficiency and improves the quality and reliability of satellites by using integrated hardware and software tools, as well as test automation. This approach also enables engineering managers to make data a key part of their test strategy. Whether your team is emulating a mission payload, strategizing how to scale component manufacturing test, or testing satellite-to-ground data links, NI can help your team achieve accelerated mission timelines. We offer a comprehensive suite of hardware and software solutions that seamlessly connect engineering endeavors spanning the entire vehicle lifecycle, saving you hundreds of hours, and keeping you ahead of the competition.

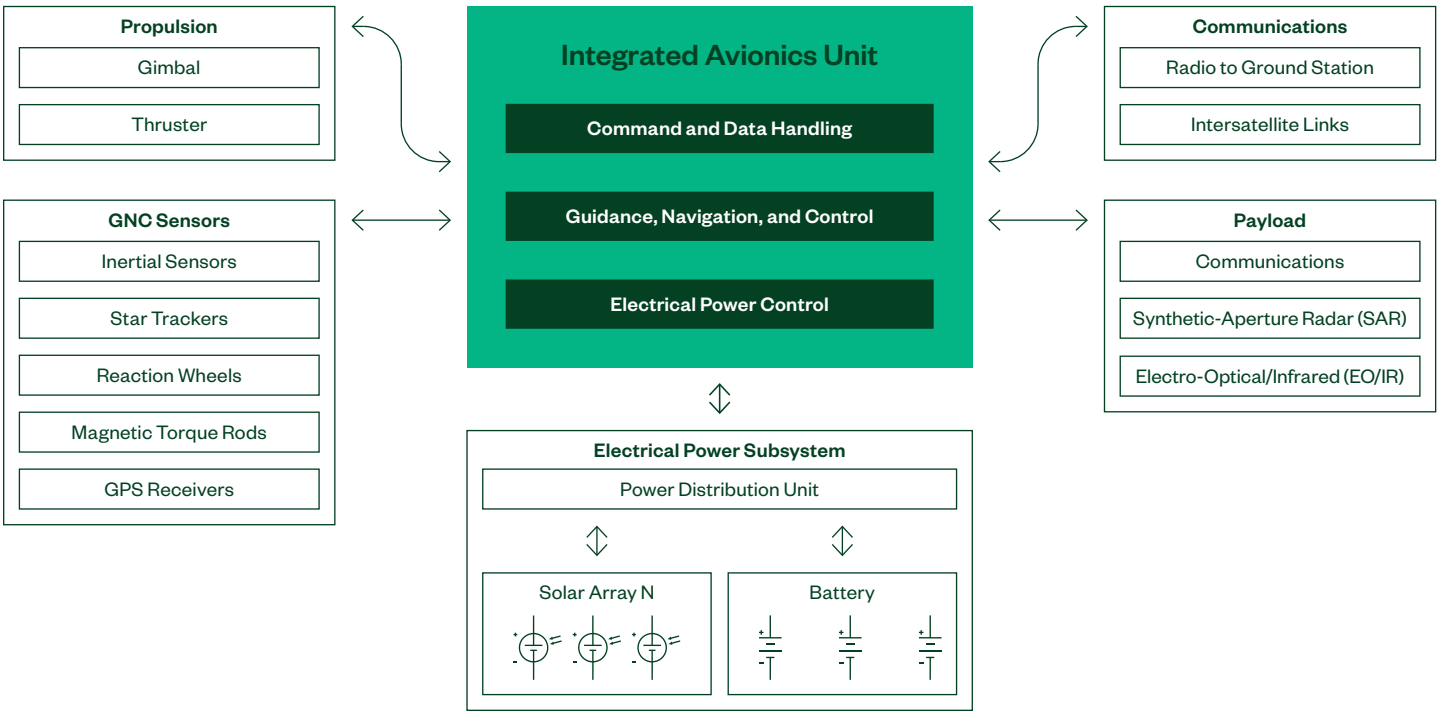
Satellite Bus Testing and AI&T



Satellites are composed of various sensors, avionics subsystems, power electronics, communication systems, and a unique mission payload.

Satellites are complex vehicles that comprise various components, including control avionics; electronic power systems; propulsion; communications; and guidance, navigation, and control sensors. These subsystems require thorough testing, from the initial component design to the final vehicle assembly and integration. With NI's comprehensive suite of hardware and software automation solutions, you can seamlessly perform validation, hardware-in-the-loop, and functional tests across the entire satellite lifecycle or across multiple programs.

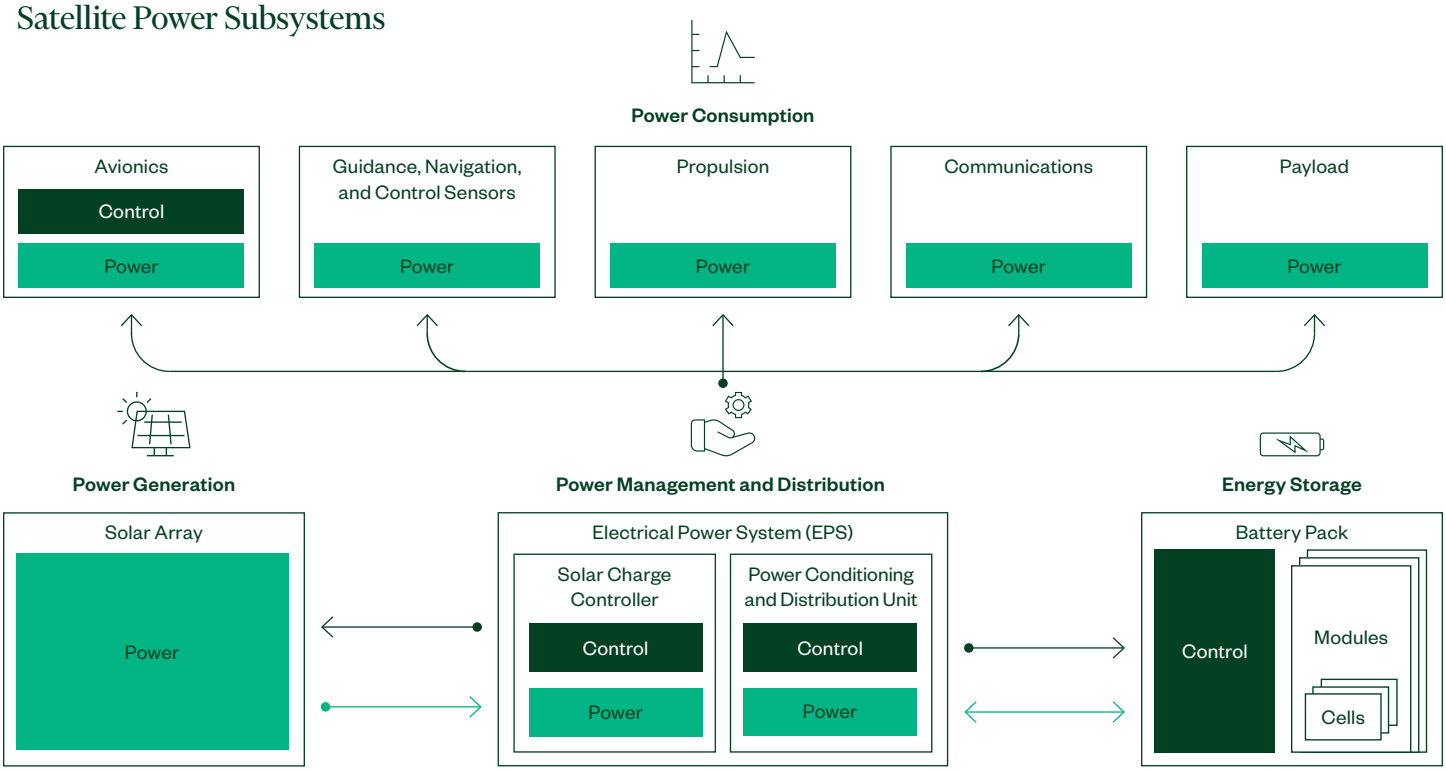
Anatomy of a Satellite



Integrated Avionics Unit Testing

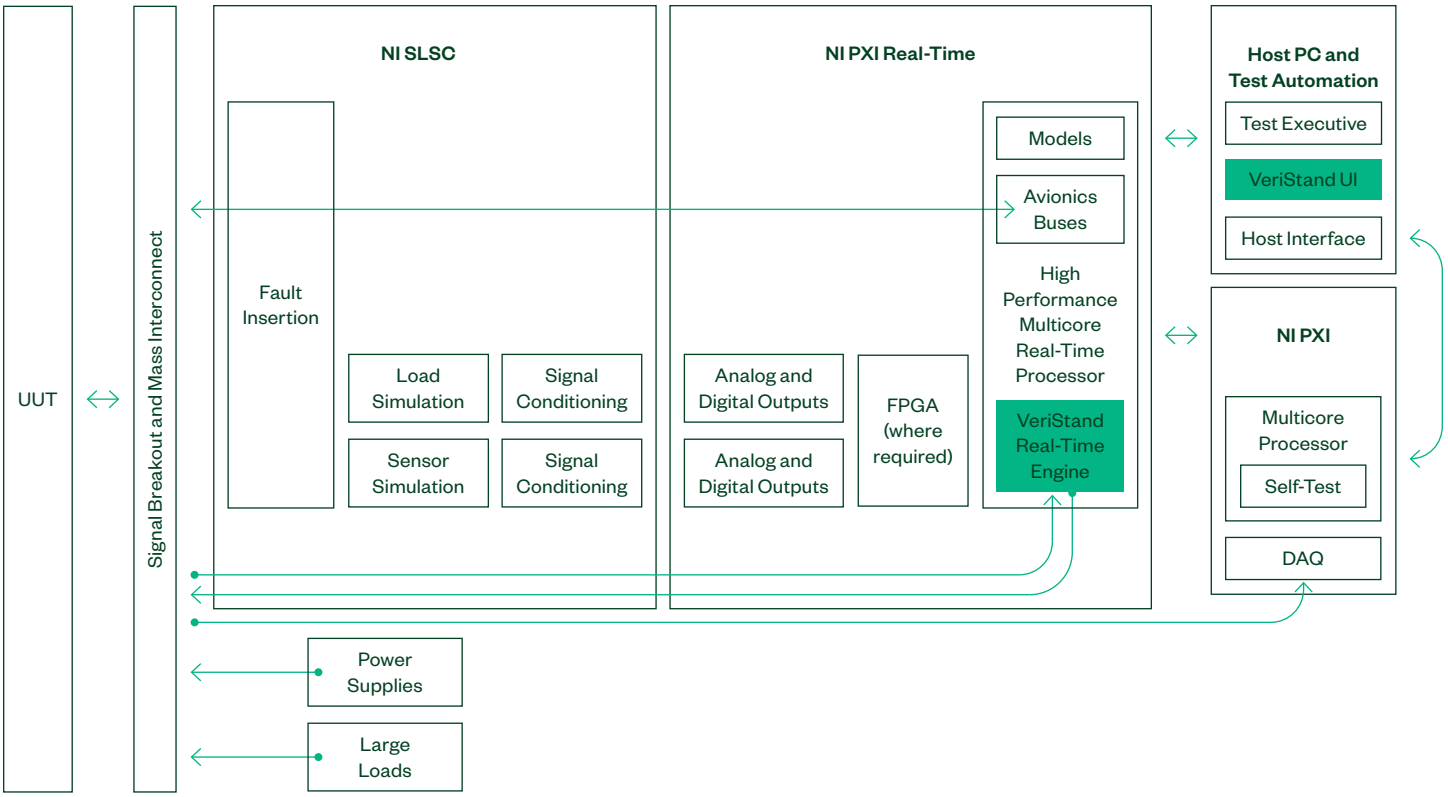
Avionics engineering organizations responsible for board or box-level avionics production and vehicle AI&T must build increasingly complex systems at higher volumes and on shorter timelines. Satellite avionics need to support a variety of signal types, including power, command and data handling, sensor I/O, and payload interfaces while also collecting more data from a larger number of connections. NI's broad PXI portfolio supports the vast array of avionics signal types, while NI's automation tools enable production volumes to scale across the product lifecycle.

Satellite Power Subsystems



Satellite Electrical Power Systems Test

Power engineers building the next generation of satellite electronics must be able to design, test, and integrate the electrical power subsystems of satellites quickly and efficiently to minimize the risk of failure while meeting accelerated market windows. These engineers need to simulate solar array power sources to test the electrical power systems, meet dynamic requirements for battery storage, and ensure robust functionality of power management and distribution components to support a variety of mission payloads. NI's growing portfolio of electronics loads and power supplies enables testing of these various satellite power subsystems.

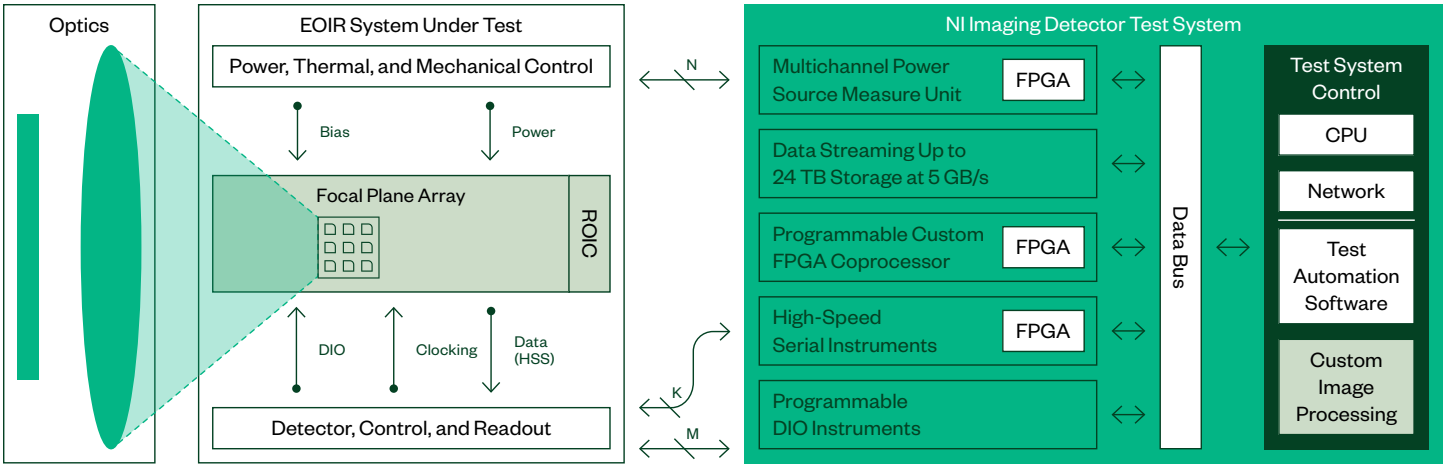


Flight Software and Hardware-in-the-Loop Test

Engineers have less time for flight software and system validation because requirements evolve as designs are finalized. As satellite missions become more complex and program timelines compress, engineers must optimize validation systems for limited resources, time, or budget. The NI LRU HIL test systems comprise a series of different modular, COTS-based hardware and software components, including PXI, the Switch Load and Signal Conditioning (SLSC) platform, and VeriStand. NI's hardware platform adds a new type of COTS-based modularity and standardization that simplifies the implementation of the complex cabling and wiring required for these types of validation systems. VeriStand real-time execution software enables import control algorithms, simulation models, and other tasks from both LabVIEW and third-party environments.

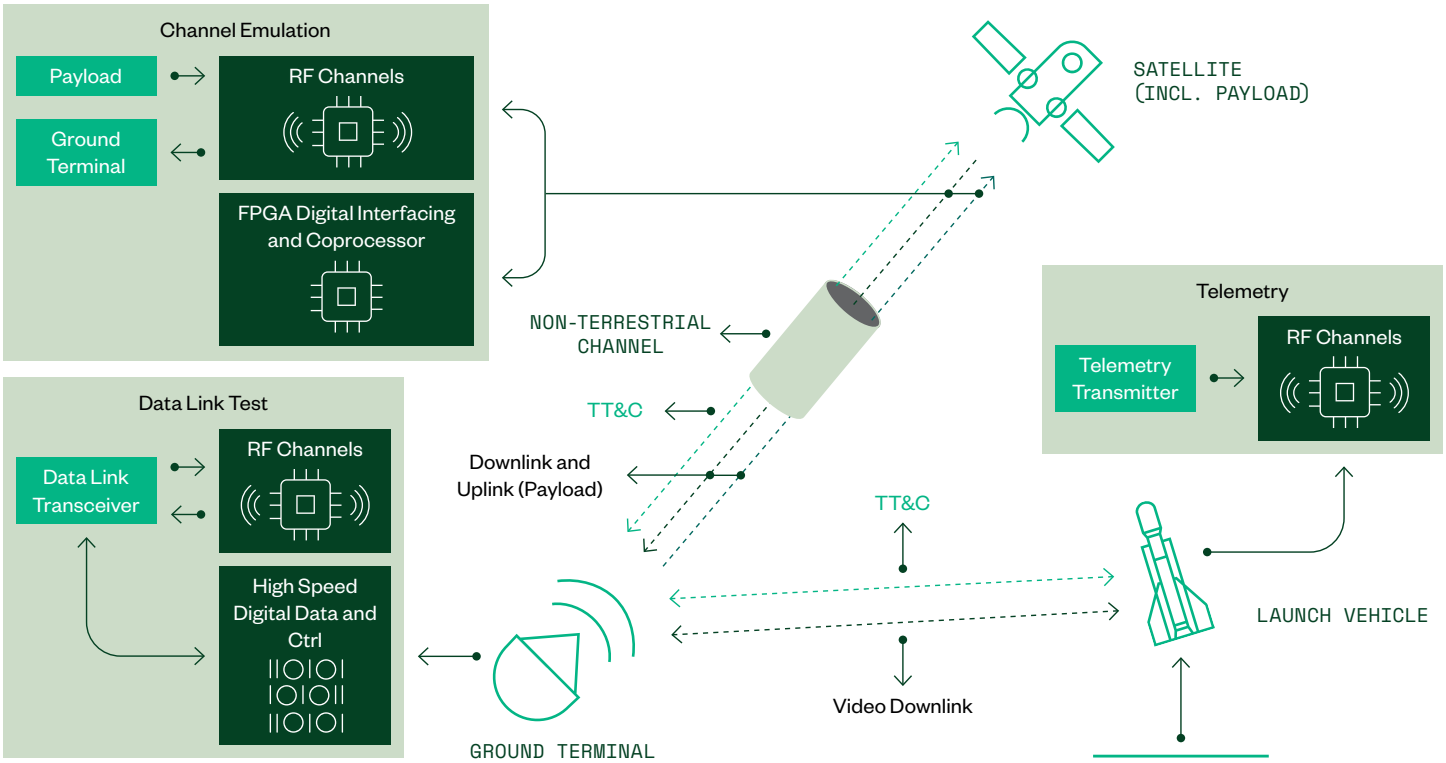
Satellite Payload Testing

The various types of satellite payloads support a multitude of applications, ranging from navigation, Earth observation, global communications, scientific, and national defense. Program teams designing mission payloads need to support a wide array of technologies, including optical and infrared, varying RF bands for space-based communications, radar generation, and more. NI offers a robust portfolio of modular PXI instruments to help in early prototyping, system validation, target emulation, or functional testing before these mission-critical systems are launched.



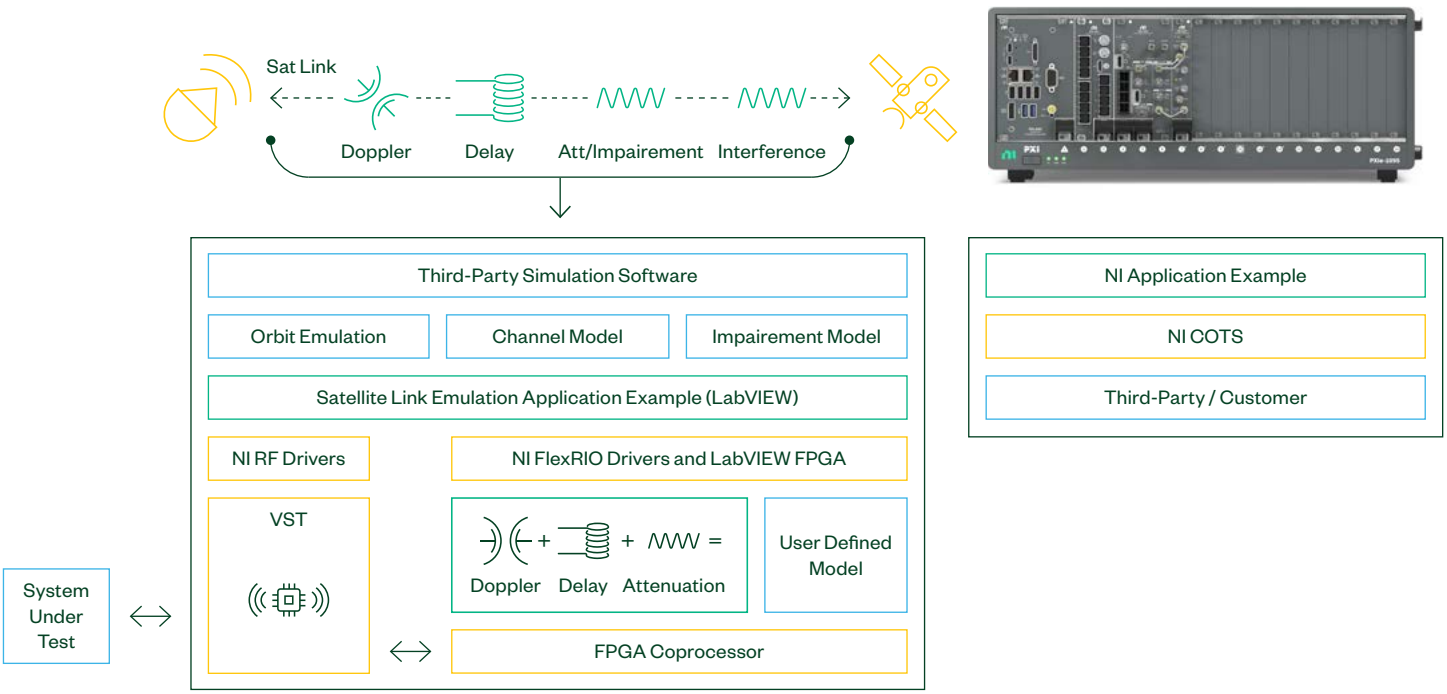
Electro-Optic and Infrared Imaging Systems

Modern EO/IR systems provide critical sensing capabilities across a range of signal wavelengths. In space, these sensors perform a variety of functions, including Earth observation, remote sensing, and surveillance. Because space-based EO/IR systems have many requirements, including high resolution, high reliability, and high sensitivity, test is a critical step in the process. To deliver on time, engineers must find efficient ways to design, test, and adapt to these and other requirements. At the same time, they must balance the need to customize with the need to standardize. Engineers designing advanced focal plane arrays (FPAs) need to perform precise testing with ultra-low noise voltage sources for biasing to custom protocols for testing digital readout IC (ROIC) interfaces.



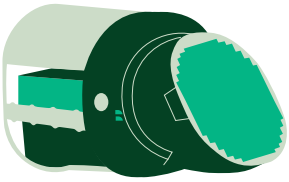
Satellite Communications Data Link and Telemetry Validation System

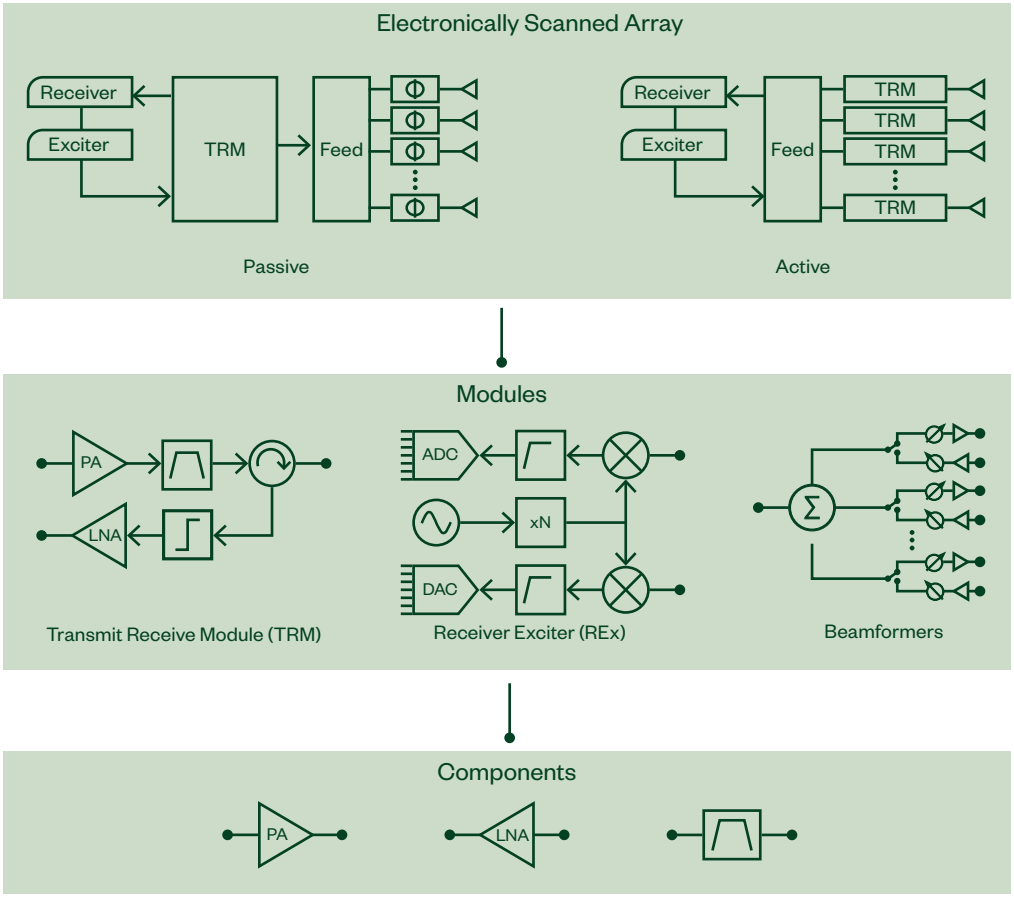
The small satellite constellations being deployed to facilitate new applications can range from one to several thousand in size, each rapidly orbiting Earth. This dynamic nature presents a challenge for communications and connectivity for both intersatellite and ground station data links. Engineers must characterize the functionality and performance of the physical transmitters and receivers under a wide range of channel frequencies, bandwidths, and beam configurations. The core of the NI solution for SATCOM and telemetry systems validation consists of the Vector Signal Transceiver (VST) to transmit and receive TT&C or SATCOM data link signals. The VST can be augmented with a FlexRIO module with FPGA for inline signal processing, channel modeling, or digital system test with a digital front-end configuration. This architecture of software defined RF instrumentation, open FPGA, and flexible software tools can address RF signal fidelity, system-level validation, and digital system test requirements.



Satellite Link Emulation System

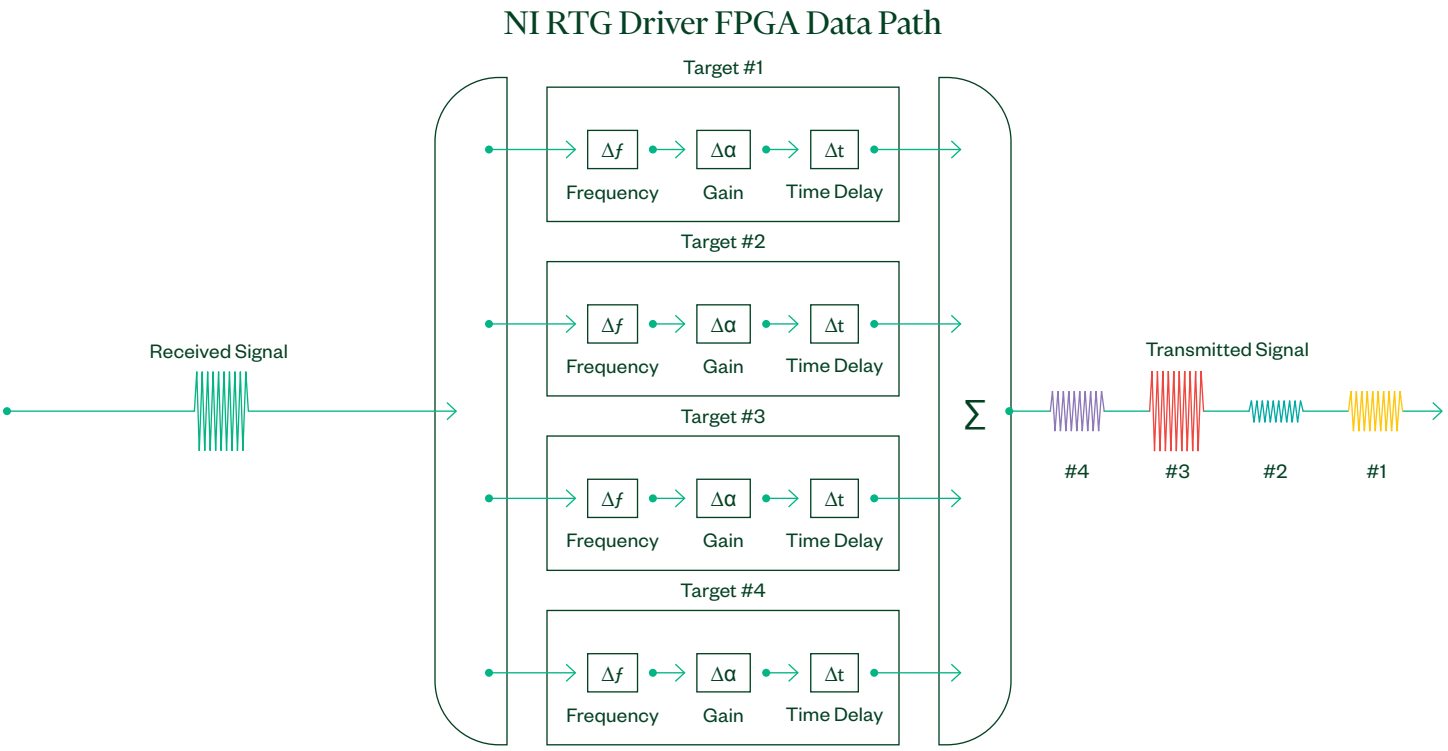
Engineers building the next generation of satellite communication hardware must be able to emulate, design, and test real-life and challenging conditions prior to the satellite launch to model and evaluate system performance. NI's software defined RF instrumentation enables next-generation satellite link testing by connecting simulation software with real-time HIL test. This combination enables emulation of satellite orbit and payload characteristics, such as the antenna model and beam configuration, as well as emulation of ground system settings, such as the antenna configuration, visibility area, and downlink characteristics.





Electronically Scanned Array Characterization System

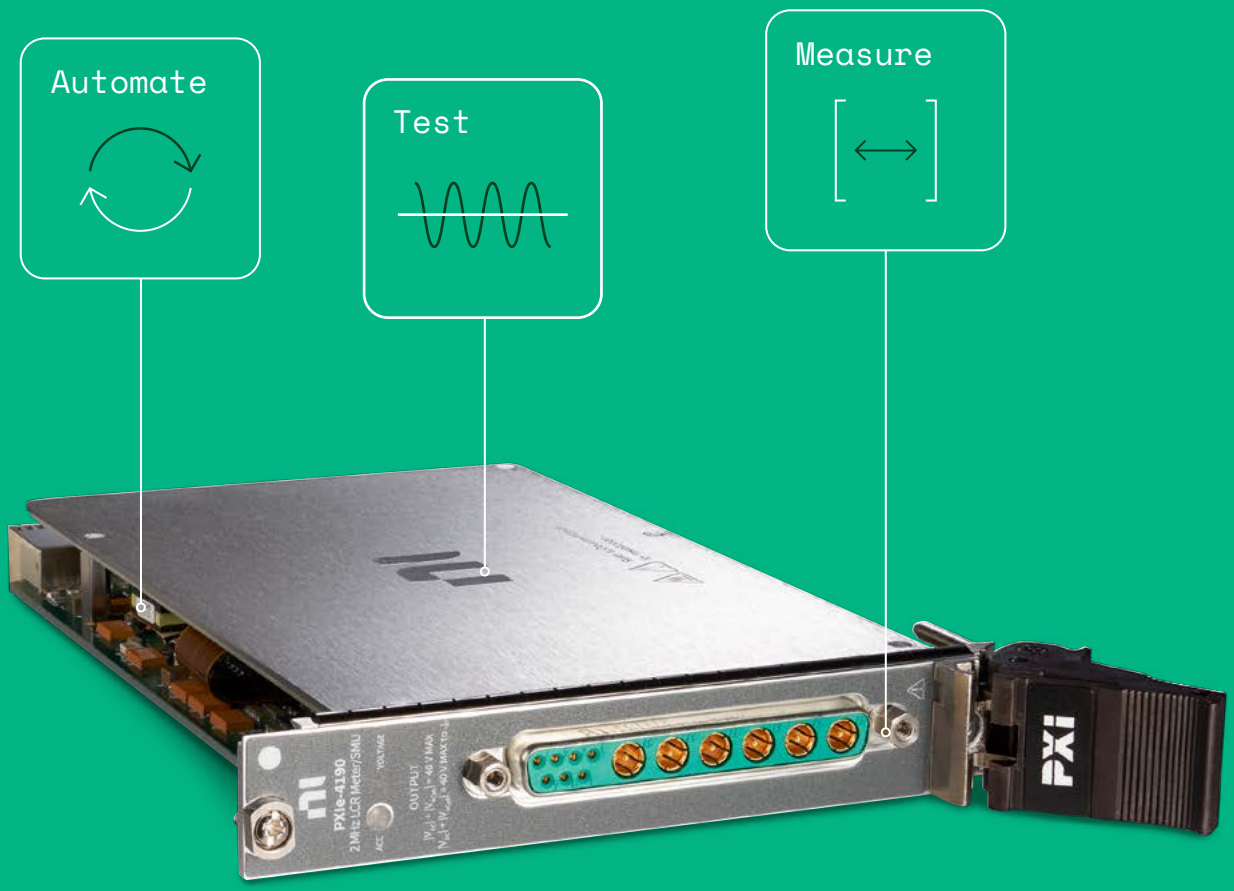
Passive and active electronically scanned arrays (ESAs) play a critical role in harnessing and defending the electromagnetic spectrum in modern SATCOM applications. Mission success revolves around the characterization and production test of the RF and microwave semiconductor components within these systems. NI's Electronically Scanned Array Characterization Reference Architecture covers a wide range of DC, RF, and digital interface needs for mixed-I/O testing applications and has scalable configurations for component, module, and subassembly test.



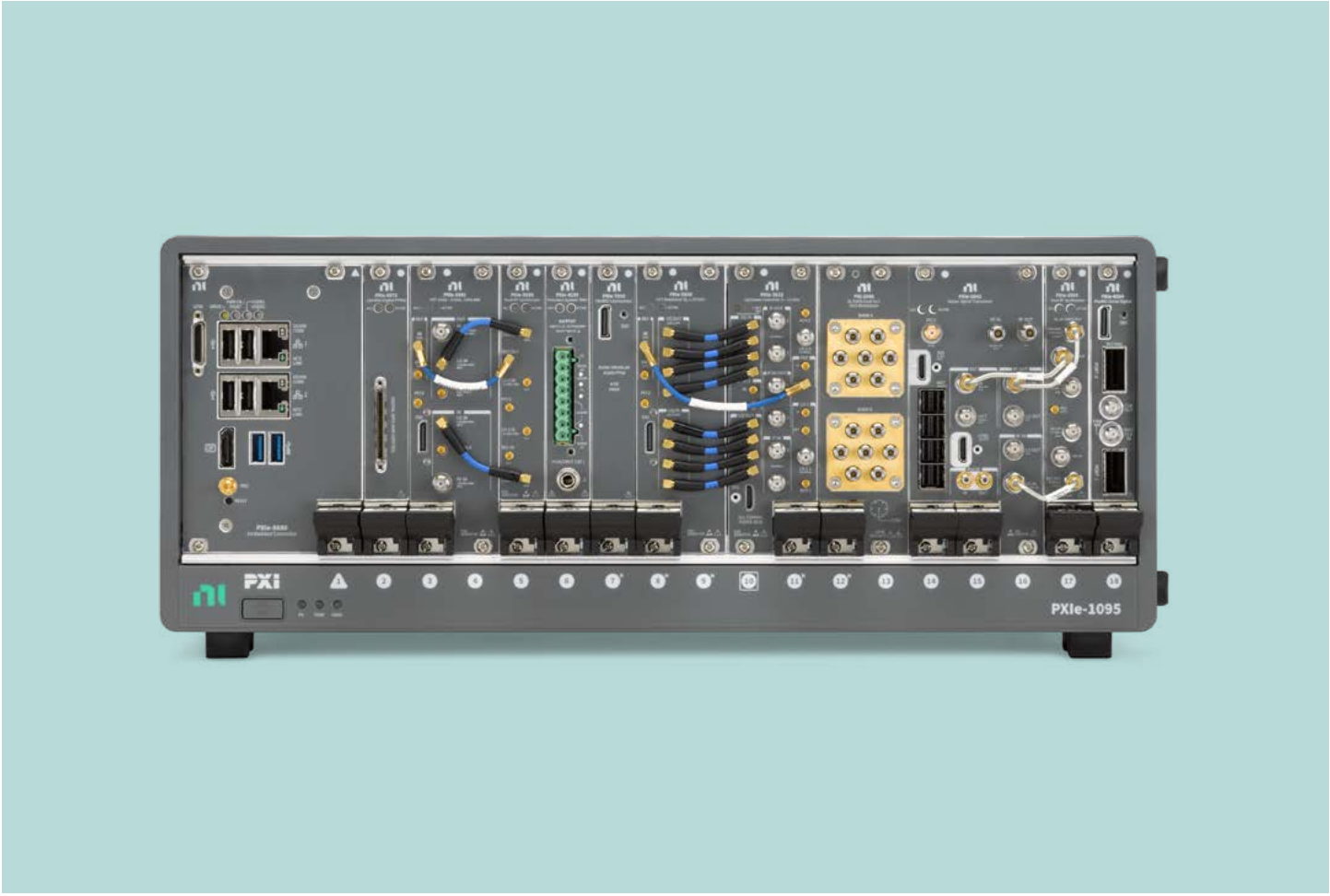
Radar Target Generation System

Radar test engineers must test realistic scenarios to evaluate system-level performance. Target generators are often used to simulate targets during system-level tests. However, the increasing complexity of modern radar and their operating environments make it challenging to achieve adequate test coverage through simulation, especially space-based radar. The application-specific tnature of radar systems means test requirements can vary widely from system to system. The NI solution to system-level radar test uses the PXI Vector Signal Transceiver with an optimized digital software package specifically designed for radar target generation. Whether you need a precision calibrated point target or advanced full RF environment emulation and response, this NI solution is scalable and adaptable to a wide range of space-based radar test requirements.

Hardware



NI offers a comprehensive suite of innovative hardware products. Whether you are performing design, validation, hardware-in-the-loop, or functional tests on your systems, our instruments allow you to accelerate your time to market.



PXI

PXI is a PC-based industrialized system that combines PCI Express electrical bus features, a modular chassis, and I/O synchronization technology with user-defined or application-specific test software. PXI is an open industry standard governed by the PXI Systems Alliance, a group of more than 70 global test companies. NI was one of the pioneer companies in the formation of PXI and is recognized as a leader in PXI test and measurement devices. Instrumentation available in PXI/PXI Express form factor includes:

- Signal generator
- Spectrum analyzer
- Signal analyzer
- Vector Signal Transceiver (VST)
- Analog and digital I/O
- Digital multimeter
- Oscilloscope/digitizer
- Switch and timing/synchronization
- Source Measure Unit (SMU)
- Programmable DC power supply
- Electronic load
- Instrument control and synchronization
- FPGA processing boards

Vector Signal Transceiver

The PXI Vector Signal Transceiver (VST) combines a vector signal analyzer and vector signal generator with a user-programmable FPGA and high-speed serial and parallel digital interfaces for real-time signal processing and control. With up to 2 GHz of instantaneous RF or complex I/Q bandwidth, the NI VST is ideally suited for a wide range of applications, including RFIC validation and production testing, radar prototyping and system-level validation, SATCOM telemetry and data link validation, satellite link emulation, and other RF wideband test scenarios. The VST product line provides the high performance necessary to support lab design and validation applications and incorporates the fast measurement speed and small form factor required to scale to production test applications. You can use VST instruments throughout the design cycle, from design to validation to production test, minimizing measurement correlation errors and improving efficiency with test software reuse. Test engineers can leverage the modular PXI platform to configure systems with multiple VSTs to support multiple input, multiple output (MIMO) applications. This platform simplifies synchronization between instruments thanks to shared timing and synchronization resources in the PXI chassis.

Source Measure Units

NI's Source Measure Units (SMUs) are optimized for building automated test systems, with hardware features to reduce test execution time and tight software integration to reduce development effort. Built on the modular PXI platform, NI SMUs can be combined with other instruments, such as oscilloscopes, Vector Signal Transceivers, and digital instruments, to build mixed-signal test systems. Additionally, given the modularity and channel density of these instruments, you can build systems that test multiple devices in parallel and improve the throughput of each tester. Because NI SMUs combine power, precision, and speed into a single instrument, you can use the same instrument for both high-power sweeps and low-current measurements. Plus, with the addition of a high-speed update and sampling rate, you can use the instrument in non-traditional ways, such as generating and measuring a waveform. These modules also include traditional SMU features, such as output disconnect relays to isolate the instrument from your circuit, remote sense to compensate for lead drop, and guard to minimize leakage current in small signals.

Vector Signal Analyzer

PXI Vector Signal Analyzers (VSAs) feature a wide frequency range, real-time signal analysis, and advanced signal processing. These instruments can perform measurements for a broad range of wireless technologies with select models featuring a LabVIEW-programmable FPGA that you can customize for advanced measurement applications. PXI VSAs are ideal for microwave test, wireless test, radar test, spectral monitoring, software defined radio (SDR), radio monitoring, interference detection, signals intelligence, and other applications. NI's VSA portfolio is highlighted by the PXIe-5668, which offers up to 765 MHz of instantaneous bandwidth (up to 26.5 GHz with industry-leading dynamic range) and best-in-class measurement performance and speed.

RF Analog Signal Generator

PXI RF Analog Signal Generators deliver the functionality of RF signal generators to the modular, compact PXI form factor. These modules support frequency ranges from 250 kHz to 20 GHz. You can combine PXI RF Analog Signal Generators with other PXI modular instrumentation to design automated test systems for radar and RF integrated circuits (RFICs).

High-Speed Serial Instruments

PXI High-Speed Serial Instruments help engineers validate, interface through, and test high-speed serial protocols. They consist of Xilinx Kintex-7 or Virtex-7 FPGAs and are programmable in LabVIEW FPGA for maximum application-specific customization and reuse. These instruments use FPGA multigigabit transceivers (MGTs) to support line rates up to 12.5 Gbps and up to 24 TX and RX lanes. As part of the PXI platform, they benefit from PXI clocking, triggering, and high-speed data movement capabilities, including streaming to and from disk, as well as peer-to-peer (P2P) streaming at rates up to 3.2 GB/s.

Programmable Power Supply

PXI Programmable Power Supplies feature multiple channels that you can combine for higher voltage or current capabilities. Some modules include isolated channels and an output-disconnect functionality so that you can isolate from the DUT when not in use and remotely sense to correct for losses in system wiring.

Source Measure Units

PXI Source Measure Units (SMUs) provide high-precision source and measure capability with features designed to reduce test time and increase flexibility. 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.

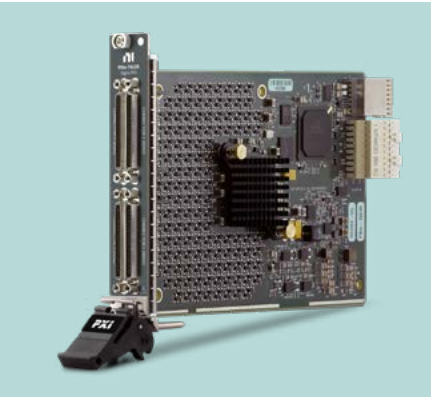
Oscilloscopes and Digitizers

PXI Oscilloscopes and PXI Digitizers are flexible, software-defined instruments that are versatile enough for both time- and frequency-domain measurements. They feature up to eight channels that can sample at speeds up to 12.5 GS/s with 5 GHz of analog bandwidth. You can synchronize multiple oscilloscopes with other instruments at picosecond-level accuracy for high-channel-count and mixed-signal applications.

Digital

High-Speed Serial

PXI High-Speed Serial Instruments include a user-programmable FPGA with access to multigigabit transceivers to implement various standard and custom high-speed serial protocols. They are programmable in LabVIEW FPGA for maximum application-specific customization and reuse. PXI High-Speed Serial Instruments also benefit from PXI clocking, triggering, and high-speed data movement capabilities, including streaming to and from disk as well as peer-to-peer streaming. These devices are ideal for high-speed communication protocols such as Serial RapidIO,® Fire Channel, ARINC-818, and more.



Digital Reconfigurable I/O

PXI Digital Reconfigurable I/O Modules feature a user-programmable FPGA for onboard processing and flexible I/O operation. You can completely control the synchronization and timing of all signals and operations along with custom onboard decision making. The PXI Digital Reconfigurable I/O Module is suited for a wide variety of single-ended applications, such as high-speed waveform generation, custom communications protocols, bit error rate testing, and other applications requiring precise timing.

FlexRIO

PXI FPGA Modules for FlexRIO offer large onboard FPGAs for signal processing. You can pair the module with a Digital I/O Adapter Module for FlexRIO, which offers up to 54 channels of configurable digital I/O that can interface with single-ended, differential, and serial signals at a variety of voltage levels.

Avionics Communications Buses

PXI Avionics Interface Modules support full-function test, simulation, and operational uses of avionics data buses. With extensive error detection and generation capability, these modules are well-suited for production and system test. They integrate the triggering and system clock features of PXI with MIL-STD1553 and ARINC 429 standards.

Power, Loads, and Signal Conditioning

SLSC

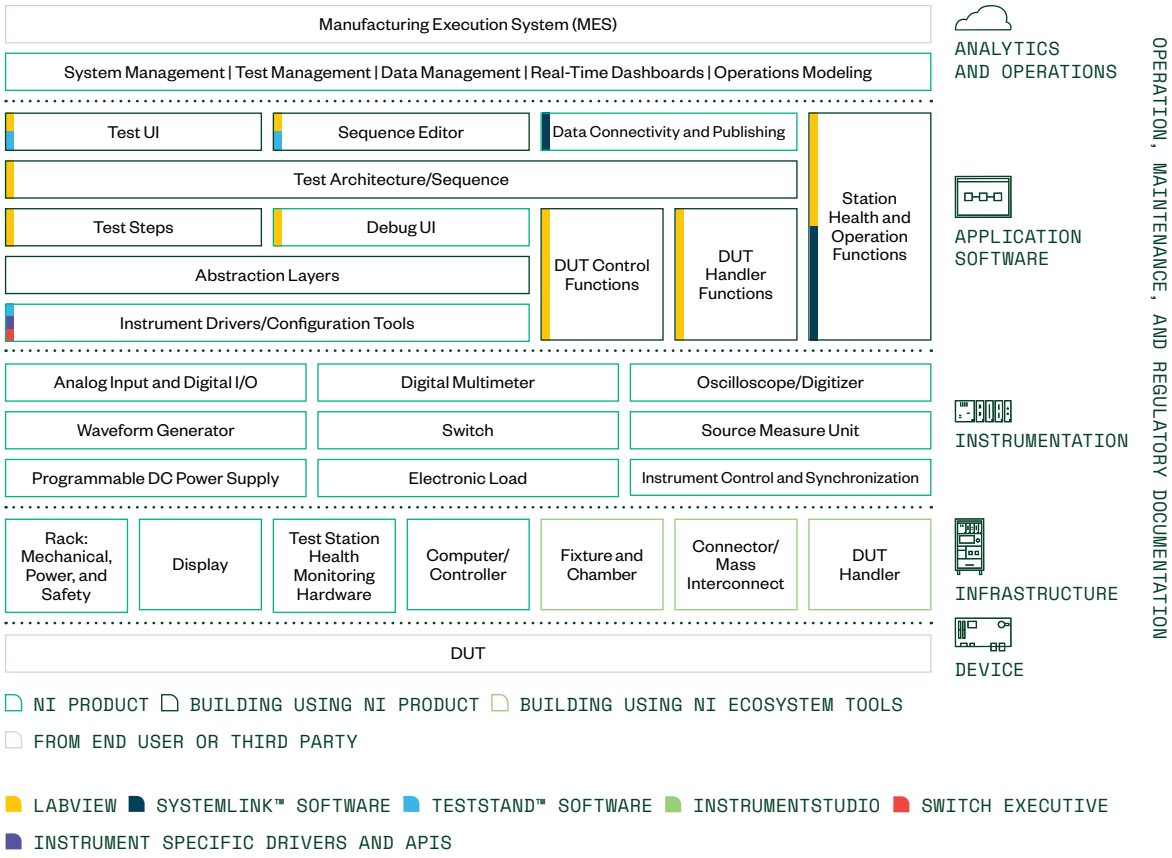
SLSC is add-on hardware that integrates with PXI and CompactRIO systems. It standardizes connectivity, minimizes point-to-point wiring, and provides a modular approach to signal conditioning, fault insertion, and other test needs.

Electronic Loads

Electronic Load Devices can sink power at various current and voltage levels for power-supply design, quality inspection, and functional tests. They feature buttons and knobs for interactive use as well as USB or RS232 interface options for automated use. You can connect multiple loads in parallel to increase your system's overall power capacity.

Programmable Power Supply

The Programmable Power Supply Device is a single-channel, rack-mount DC power supply. It offers up to 1,500 W of power with options up to 650 V DC or 150 A, so you can use it for test systems that require large amounts of power with a broad range of voltage and current values. Some models can source hundreds of watts in a compact 2U, 1/6 rack-width design, making them ideal for test systems that need multiple power rails. Additionally, the Programmable Power Supply Device offers buttons and knobs for interactive users as well as USB, LAN, RS232, and analog control options for remote or automated users.

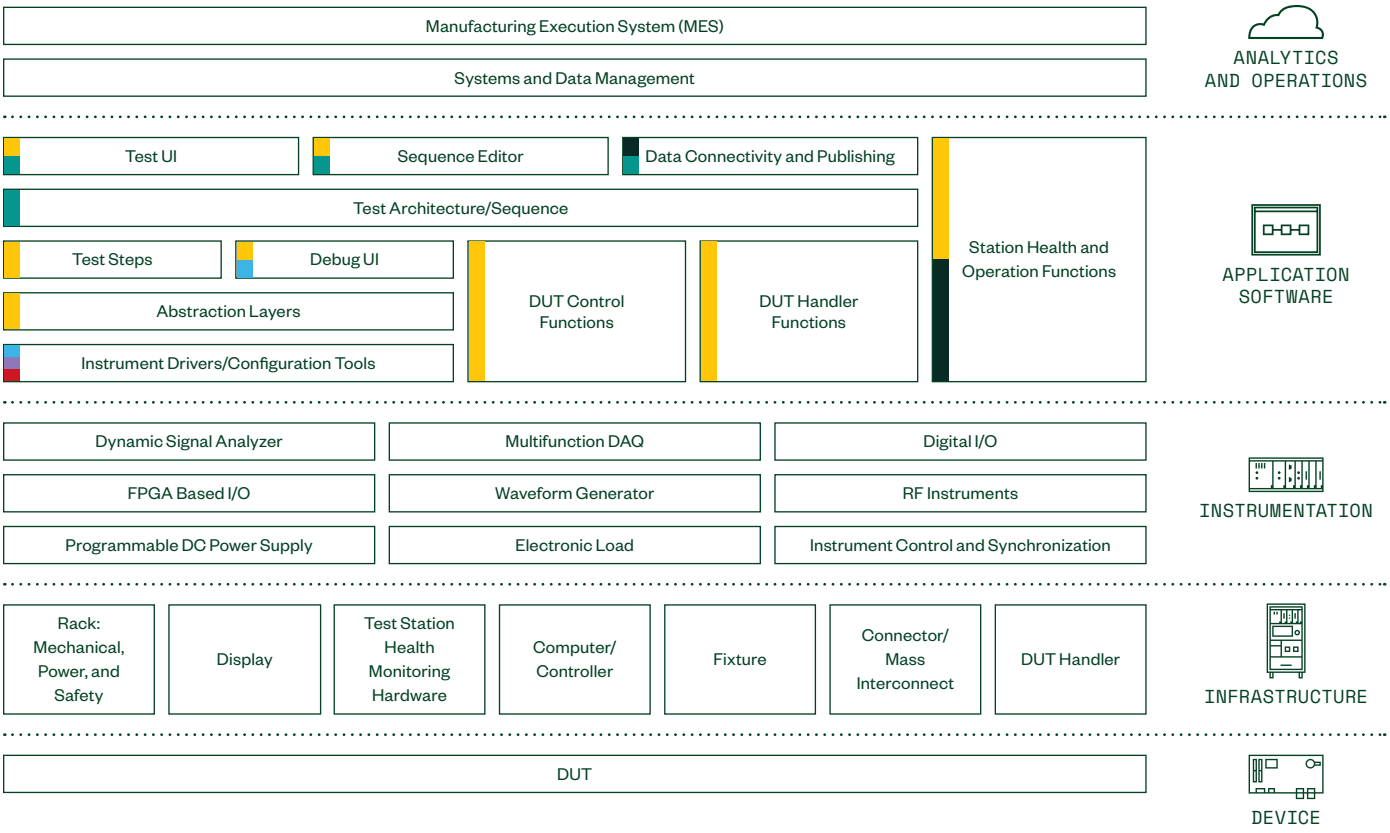


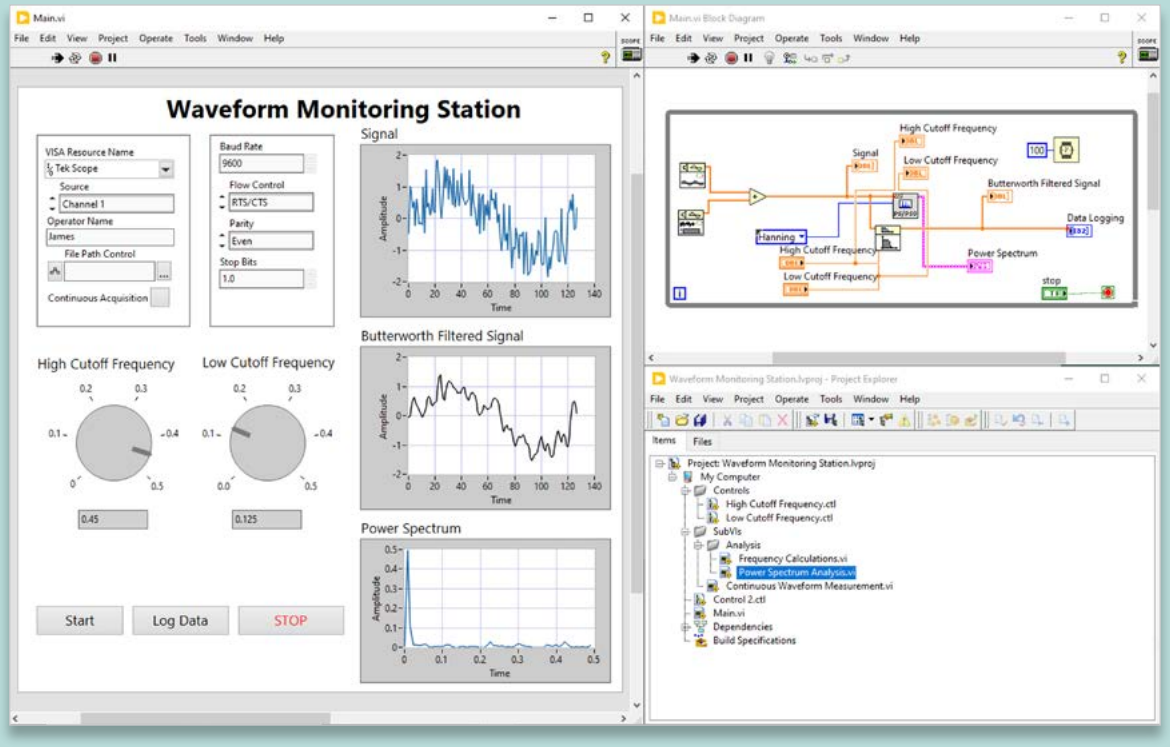
ATE Core Configurations

The ATE Core Configurations can help you accelerate system design, reduce integration burden and risk, and reduce time to deployment for an automated test system. These systems have scalable mechanical and power profiles to cover applications ranging from basic validation bench design to high-power, high-reliability, globally deployed test stations. These out-of-the-box systems provide the ultimate balance in standardized core components to simplify design and documentation, along with the layout flexibility for PXI, CompactDAQ, and other instrumentation.

Software

NI offers a comprehensive software ecosystem. Whether you are performing design, validation, or production test, our advanced and flexible software tools allow you to easily implement your tests and accelerate your development and characterization process.


Manufacturing Execution System (MES)
Systems and Data Management
ANALYTICS AND OPERATIONS
Test UI
Sequence Editor
Data Connectivity and Publishing
Test Architecture/Sequence
Test Steps
Debug UI
Abstraction Layers
Instrument Drivers/Configuration Tools
DUT Control Functions
DUT Handler Functions
Station Health and Operation Functions
APPLICATION SOFTWARE
Dynamic Signal Analyzer
Multifunction DAQ
Digital I/O
FPGA Based I/O
Waveform Generator
RF Instruments
Programmable DC Power Supply
Electronic Load
Instrument Control and Synchronization
INSTRUMENTATION
Rack: Mechanical, Power, and Safety
Display
Test Station Health Monitoring Hardware
Computer/ Controller
Fixture
Connector/ Mass Interconnect
DUT Handler
INFRASTRUCTURE
DUT
DEVICE
LABVIEW
SYSTEMLINK™ SOFTWARE
TESTSTAND
INSTRUMENTSTUDIO™ SOFTWARE
INSTRUMENT SPECIFIC DRIVERS AND APIS
SWITCH EXECUTIVE
Operation, Maintenance, and Regulatory Documentation



LabVIEW

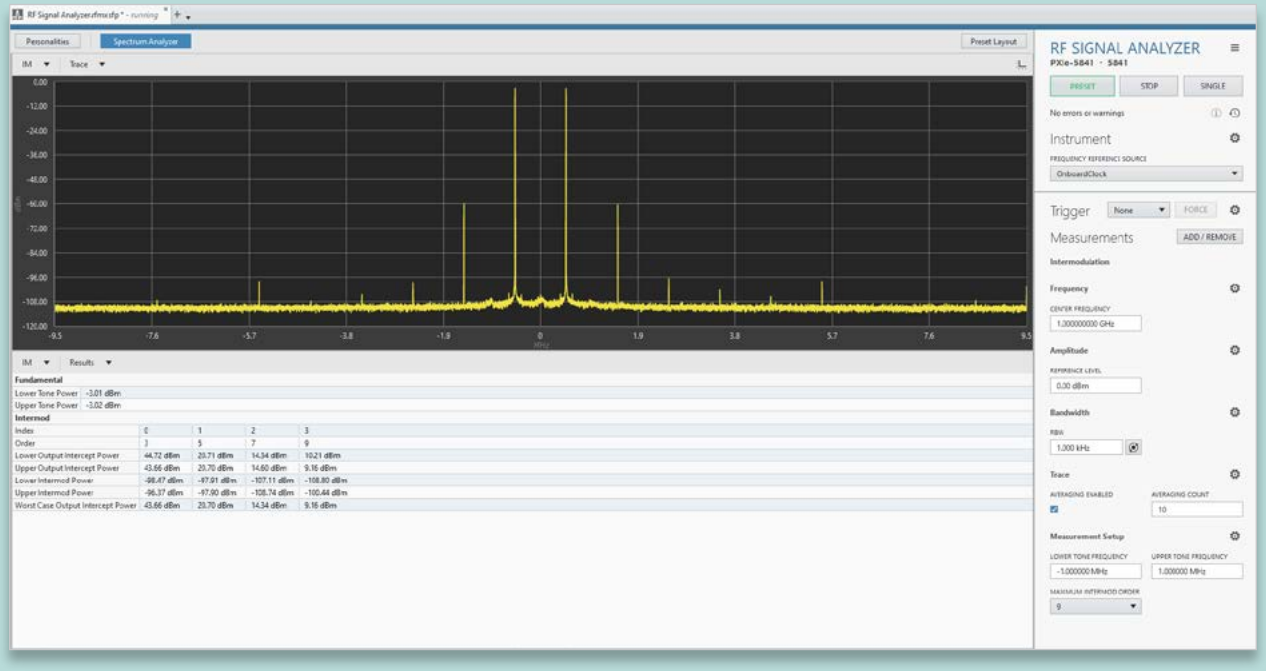
LabVIEW is a graphical development platform engineers can use to create customized test solutions. It provides thousands of analysis functions, configurable display elements, drivers to interface to instruments and data acquisition equipment, and connectivity to other programming languages and protocols.

TestStand

TestStand is ready-to-run test management software designed to help engineers quickly develop and execute test routines from test plans. Engineers build TestStand test sequences that integrate code modules written in a variety of programming environments, including LabVIEW, C/C++, .NET, and Python. TestStand also provides extensible plugins for reporting, database logging, and connectivity to other enterprise systems. Engineers can deploy test systems to production with easy-to-use operator interfaces.

VeriStand

VeriStand validates hardware and performs embedded software test for hardware-in-the-loop applications. Accelerate the product development lifecycle with model integration, real-time stimulus generation, and an extensible software environment. VeriStand provides a user interface to simplify I/O channel configuration, data logging, and stimuli generation. Gain full sight of your HIL system with graphical elements that allow you to control configurations and display runtime results.



RFmx

RFmx is a set of interoperable software applications that optimize NI RF instrumentation for general-purpose, cellular, connectivity, and aerospace/defense test applications. RFmx streamlines test system development by accelerating setup, measurement, and performance. Soft front panels provide an intuitive interface for connecting to hardware, enabling users to efficiently perform measurements and debug automated tests. Composite measurement functionality and parallelized execution ensure maximum instrument utilization for test time reduction. You also can perform and debug measurements with interactive software front panels, create and playback open, unlocked waveforms with the included RFmx Waveform Creator, and speed up automated testing with the performance-optimized API. And with dedicated personalities for conventional spectrum analysis, modulated signals, and standard defined signals, RFmx is tailored to your application.

SystemLink™ Software

SystemLink is an intelligent systems and data management environment that connects the test facility to the rest of the organization. Designed for engineering use cases, SystemLink combines focused applications and data services that accelerate time to knowledge and time to market by leveraging comprehensive real-time information. From engineering teams to enterprises, SystemLink helps organizations achieve peak performance.

Operational Intelligence and Product Analytics Test

By integrating valuable performance insights derived from test operations data with machine and process data, NI enables real-time analysis and drives intelligent actions uniquely tailored to each product.

NI Services and Support

NI provides several services and support options to help ensure your short-term and longer-term success with our products. We've partnered with many aerospace and defense companies to offer extended, long lifecycle support that can span decades. You can select from NI's array of services and support options to design a system management approach that meets your budget, risk, and resource needs.

Hardware Services

Minimize downtime, reduce maintenance costs, and simplify logistics with our world-class repair, calibration, sparing, and long-life system service programs for hardware.

Training and Certification

Enhance productivity by developing 50 percent faster and spending 43 percent less time on code maintenance with our online, classroom, and on-site training courses. Also, validate your expertise with NI certifications.

Technical Support

Get started with NI products faster or troubleshoot challenging issues by contacting NI applications engineers who are ready to help you via phone and email.

Consultation and Integration

Leverage our extensive network of NI Partners and systems engineers for assistance with prototyping, feasibility analysis, consulting, and systems integration.

Software License Programs

Streamline NI software management by accessing multiple levels of training, technical support, and tools through your software license.

Technical Resources

Access volumes of self-help information at ni.com, including application tips, example programs, and developer communities.

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