PRODUCT FLYER

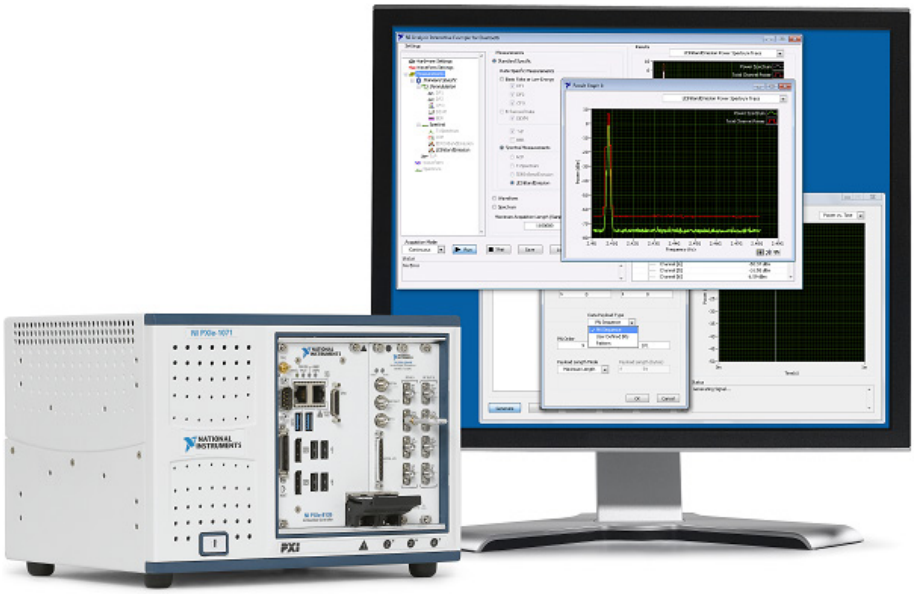
Bluetooth Test Toolkit

CONTENTS

Bluetooth Test Toolkit
Key Features
Soft Front Panel
Application Programming Interface (API)
Supported Hardware
Supported Measurements
Platform-Based Approach to Test and Measurement
PXI Instrumentation
Hardware Services

Bluetooth Test Toolkit

Learn more about Bluetooth Test Toolkit



- Generate and analyze Bluetooth: 1.x, 2.x+EDR, 3.x+HS, 4.2, LE, and 5.0 LE (2 Mbps data rate)
- Characterize performance of Bluetooth design with easy-to-use soft front panels
- Automate Bluetooth measurements with comprehensive LabVIEW and C APIs
- Integrate with PXI Vector Signal Transceiver (VST), or separate PXI Vector Signal Generators (VSGs) and PXI Vector Signal Analyzers (VSAs)

Built for Bluetooth Characterization Test and Measurement

The Bluetooth Test Toolkit gives you direct and fine control over the generation and analysis of Bluetooth waveforms with industry-leading speed and accuracy. Use the Bluetooth Test Toolkit to characterize a variety of Bluetooth connectivity products, such as RF front end components, wireless modules, and end-user devices.

The Bluetooth Test Toolkit gives you the flexibility to control your measurement system manually with the toolkit's generation and analysis soft front panels, as well as to automate your bench with an extensive system design software API for LabVIEW, C, or .NET. You will benefit from a large collection of available example code when programming and automating your Bluetooth measurement systems.

Characterize your device with the toolkit's comprehensive support for the latest features of the Bluetooth standard, including Low-Energy, extended payload, and long-range packets that are part of the Bluetooth 5.0 standard.

Key Features

Bluetooth Classic, Low-Energy, and Direct Test Mode

The Bluetooth standard now defines specific Bluetooth Low-Energy (BLE) RF PHY Test Cases and a new Direct Test Mode (DTM) for DUT control to make sure that Bluetooth Low-Energy devices from all manufacturers operate properly. This standardization also verifies that a basic level of system performance is guaranteed for all BLE products. With both DTM and a more relaxed RF PHY specification for Bluetooth Low-Energy, fewer PHY test cases and optimized test case implementations contribute to much shorter BLE RF PHY test times.

The NI Bluetooth Test Toolkit supports these BLE measurements and the new packet types associated with them, such as:

- LE Packet
- LE Extended payload packet (255 bytes)
- LE-Enhanced (1 and 2 Mbps)
- LE-Long range (125 and 500 kbps)

Additionally, the toolkit ships with a Direct Test Mode Interactive Example to help you control and test BLE DUTs easily.

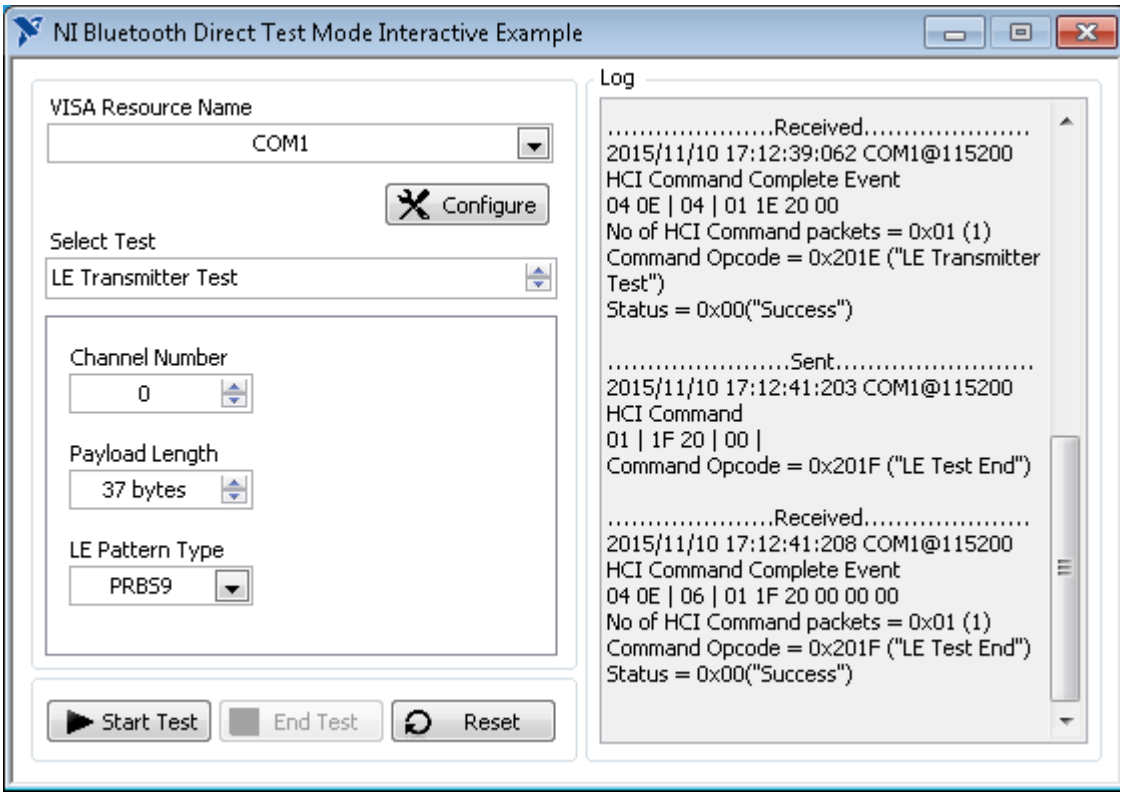


Figure 1. Direct test mode interactive example

Fast and Accurate Measurements

Combine the Bluetooth Test Toolkit with a VST to achieve industry-leading modulation and spectral measurements; the average time for a DEVM measurement is less than 33 ms.

Modulation

Table 1. Mean Block EVM in loopback using a VST

Tx Power Level	Mean Block RMS EVM (%)	Mean Block RMS Magnitude Error (%)
0	0.59	0.41
-5	0.56	0.40
-10	0.54	0.38
-15	0.52	0.36

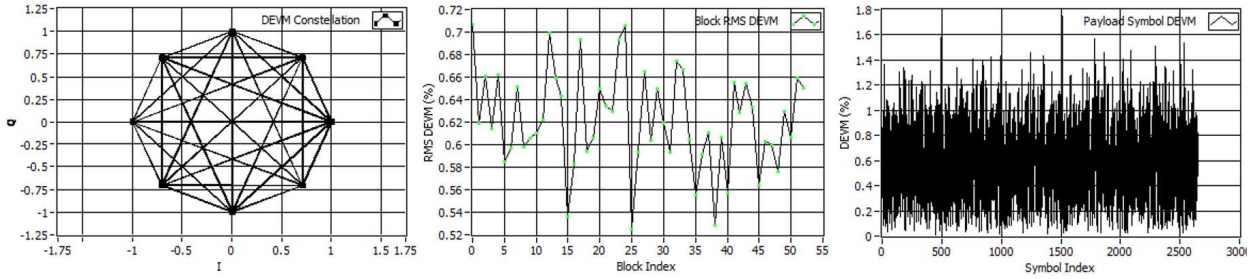


Figure 2. Constellation plot of a 3-DH5 signal; RMS DEVM measurement; payload symbol DEVM (%)

Spectral

Table 2. Spectrum measurement speeds using the NI Bluetooth Suite and the VST

Type of Measurement	Value	Measurement Time
ACP (79 channels 3-DH5 packet type -25 dBm main ch power)	-79 dBm	< 330 ms
ACP (10 channels, 3-DH5 packet type, -25 dBm main ch power)	-79 dBm	< 170 ms
DF1 (DM1 packet type)	Df1avg = 80.87 KHz	< 8 ms
-15	0.52	0.36

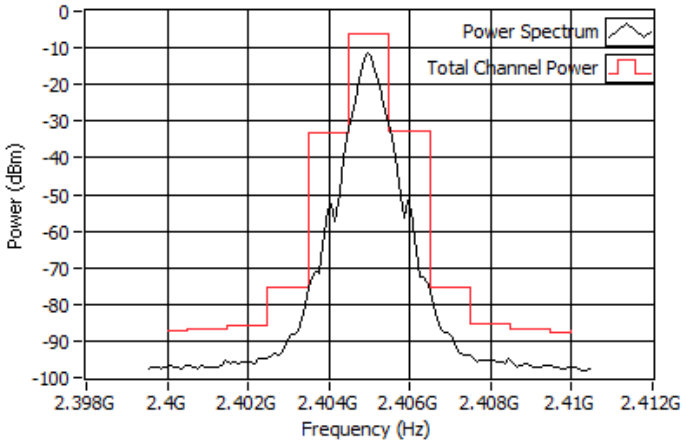


Figure 3. Tx output power spectrum measurement

Simulation

The Bluetooth Test Toolkit enables you to simulate and manipulate Bluetooth signals. You can also inject various impairments to characterize effects on the resulting signal measurements.

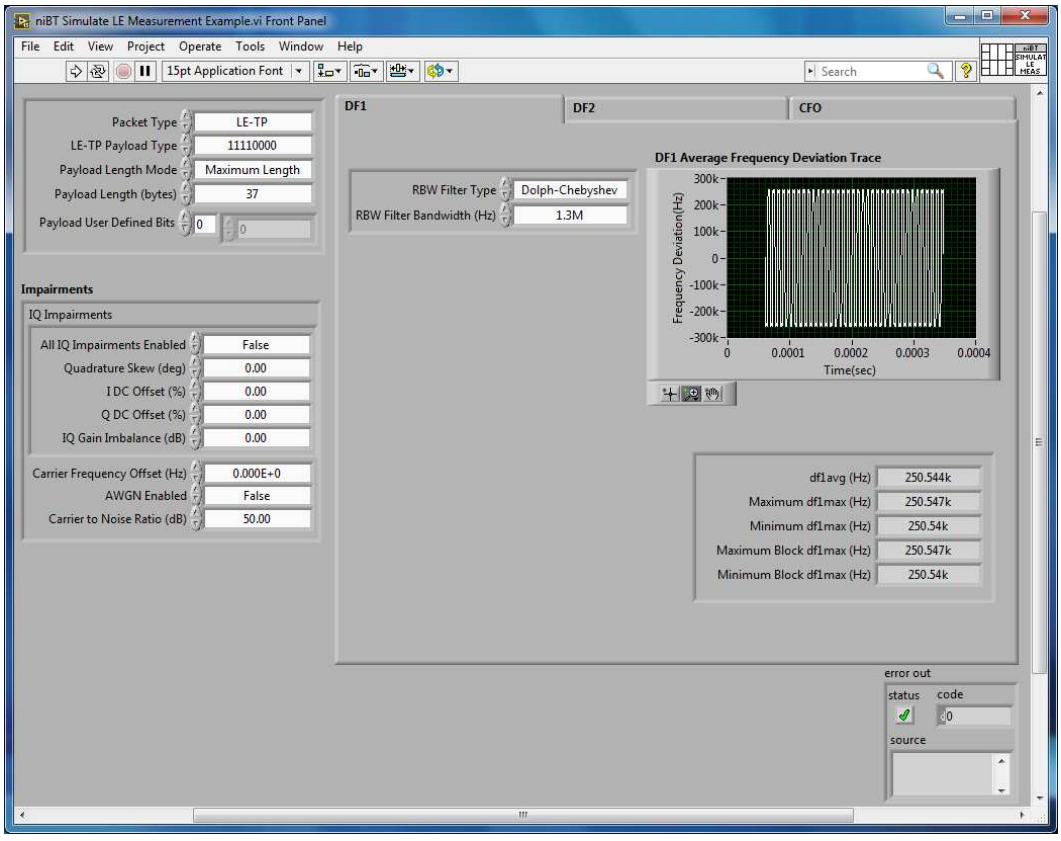


Figure 4. Code to simulate the effects of hardware impairments on the BT signal

Soft Front Panel

Use soft front panels (SFPs) to generate and analyze Bluetooth signals, define custom payloads, and inject signal impairments such as noise, IQ imbalance, skew, and DC offset. Furthermore, the SFPs allow you to save waveforms and measurements for either later modulation and spectral analysis or for loading equivalent settings into the programmable API.

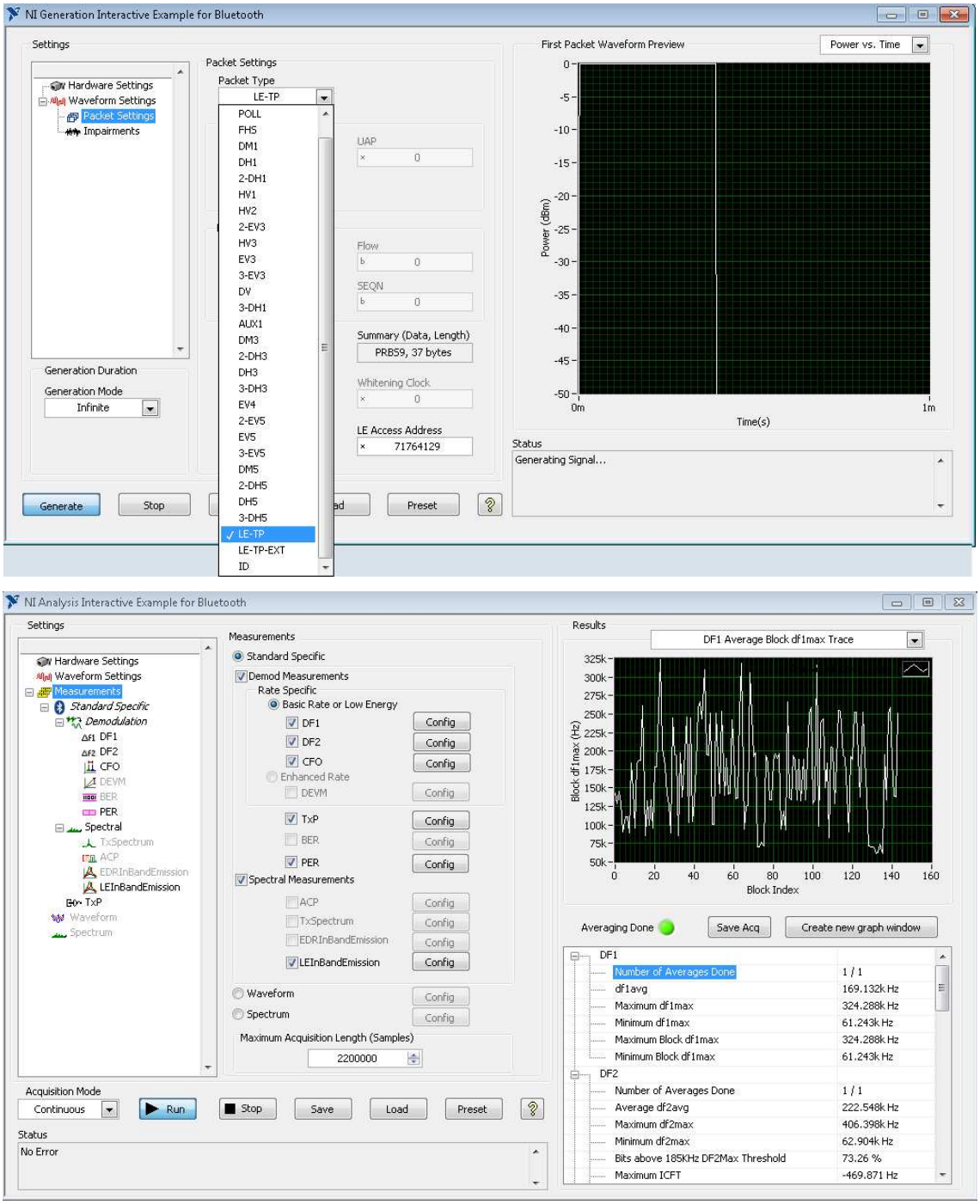


Figure 5. Bluetooth generation and analysis soft front panels

Application Programming Interface (API)

The Bluetooth Test Toolkit includes an API for LabVIEW, C, and .NET, with which you can create custom code for all kinds of test scenarios or custom settings. The API gives you fine control over the Bluetooth packets and it includes an extensive library of example code to get you started quickly on the many different Bluetooth measurements for the various types of packets, including Bluetooth Low Energy.

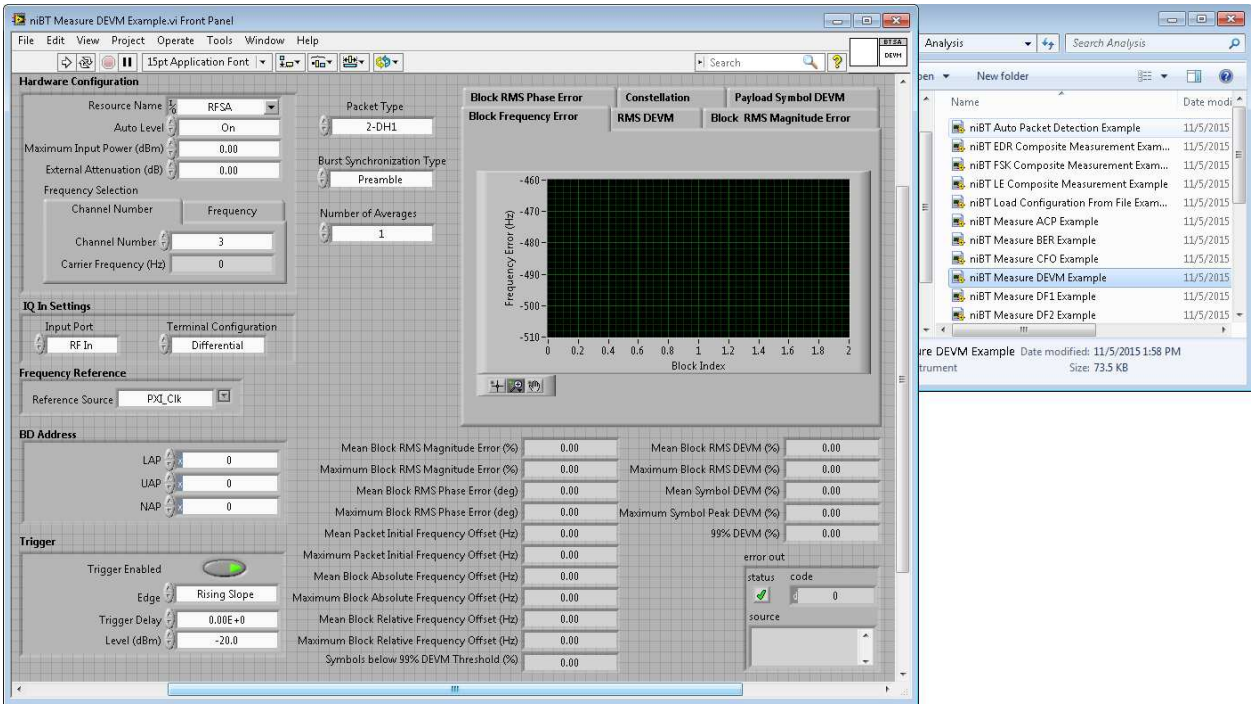


Figure 6. Example of a custom LabVIEW front panel for waveform analysis

Supported Hardware

The Bluetooth Test Toolkit is compatible with several RF VSTs and certain VSAs, so you can choose a device based on the specific needs of your application.

Table 3. NI hardware compatible with the Bluetooth Toolkit

Instrument	Real-Time Bandwidth
PXIe-5644 VST	Up to 80 MHz
PXIe-5645 VST with Baseband IQ Input and Output	Up to 80 MHz
PXIe-5646 VST	Up to 200 MHz
PXIe-5840 VST	Up to 1 GHz
PXIe-5668 VSA	Up to 765 MHz

Supported Measurements

Transmit Power

Total Average Power

Maximum Average Power

Minimum Average Power

Access Code and Header Average Power

Payload Average Power

Payload Relative Power

Demodulation Measurements

DF1 Average Block df1max

DF1 Average Frequency Deviation Trace

DF2 Average Block df2max Trace

DF2 Average Frequency Deviation Trace

Max ICFT

Max Carrier Drift

Max Carrier Drift/50us

Bits above 185kHz DF2Max Threshold (%)

Max Payload Block Frequency Offset

Max Carrier Drift / 55us

DF2 Block Frequency Offset Trace

DF2 Maximum Block df2max Trace

DF2 Minimum Block df2max Trace

CFO Block Frequency Offset

CFO Payload Frequency Deviation

Max ICFT

Max Carrier Drift

Max Carrier Drift / 50us

Max Payload Block Frequency Offset (Hz)

Max Carrier Drift / 55us

DEVM

Mean Block RMS DEVM (%)

Maximum Block RMS DEVM (%)

Mean Symbol DEVM (%)

Maximum Symbol DEVM (%)

99% DEVM (%)

Mean Block RMS Magnitude Error (%)

Maximum Block RMS Magnitude Error (%)

Mean Block RMS Phase Error (deg)

Maximum Block RMS Phase Error (deg)

Mean Packet Initial Frequency Offset (Hz)

Maximum Packet Initial Frequency Offset (Hz)

Mean Block Absolute Frequency Offset (Hz)

Maximum Block Absolute Frequency Offset (Hz)

Mean Block Relative Frequency Offset (Hz)

Maximum Block Relative Frequency Offset (Hz)

Symbols below 99% DEVM Threshold (%)

Impairments: IQ Gain Imbalance (dB)

Impairments: Quadrature Skew (deg)

Impairments: I DC Offset (%)

Impairments: Q DC Offset (%)

BER (%)

Sample Population Used

FER %

Number of Frames Used

Spectral Measurements

Peak Power

TxP Average

Power versus Time

Bandwidth

TxSpectrum

ACP

EDRInBandEmission

LEInBandEmission

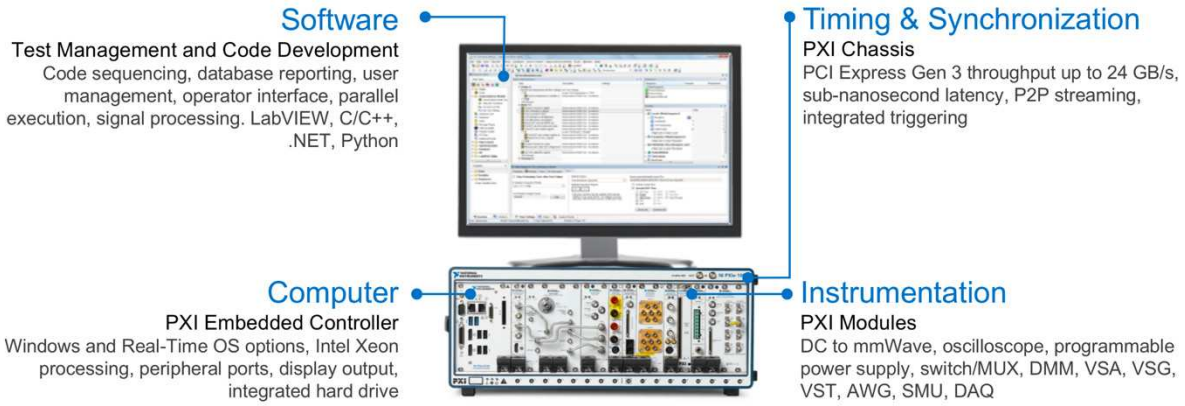
Raw IQ Data

Waveform Spectrum

Platform-Based Approach to Test and Measurement

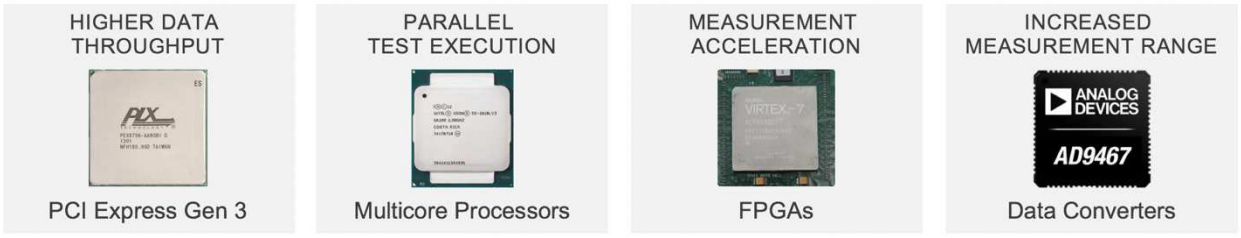
What Is PXI?

Powered by software, PXI is a rugged PC-based platform for measurement and automation systems. PXI combines PCI electrical-bus features with the modular, Eurocard packaging of CompactPCI and then 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.



Integrating the Latest Commercial Technology

By leveraging the latest commercial technology for our products, we can continually deliver high-performance and high-quality products to our users 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 to 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.



PXI Instrumentation

NI offers more than 600 different PXI modules ranging from DC to mmWave. Because PXI is an open industry standard, nearly 1,500 products are available from more than 70 different instrument vendors. With standard processing and control functions designated to a controller, PXI instruments need to contain only the actual instrumentation circuitry, which provides effective performance in a small footprint. Combined with a chassis and controller, PXI systems feature high-throughput data movement using PCI Express bus interfaces and sub-nanosecond synchronization with integrated timing and triggering.

Oscilloscopes

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

Digital Multimeters

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

Digital Instruments

Perform characterization and production test of semiconductor devices with timing sets and per channel pin parametric measurement unit (PPMU)

Waveform Generators

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

Frequency Counters

Perform counter timer tasks such as event counting and encoder position, period, pulse, and frequency measurements

Source Measure Units

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

Power Supplies & Loads

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

FlexRIO Custom Instruments & Processing

Provide high-performance I/O and powerful FPGAs for applications that require more than standard instruments can offer

Switches (Matrix & MUX)

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

Vector Signal Transceivers

Combine a vector signal generator and vector signal analyzer with FPGA-based, real-time signal processing and control

GPIB, Serial, & Ethernet

Integrate non-PXI instruments into a PXI system through various instrument control interfaces

Data Acquisition Modules

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

Hardware Services

All NI hardware includes a one-year warranty for basic repair coverage, and calibration in adherence to NI specifications prior to shipment. PXI Systems also include basic assembly and a functional test. NI offers additional entitlements to improve uptime and lower maintenance costs with service programs for hardware. Learn more at ni.com/services/hardware.

	Standard	Premium	Description
Program Duration	3 or 5 years	3 or 5 years	Length of service program
Extended Repair Coverage	•	•	NI restores your device's functionality and includes firmware updates and factory calibration.
System Configuration, Assembly, and Test[1]	•	•	NI technicians assemble, install software in, and test your system per your custom configuration prior to shipment.
Advanced Replacement[2]		•	NI stocks replacement hardware that can be shipped immediately if a repair is needed.
System Return Material Authorization (RMA)[1]		•	NI accepts the delivery of fully assembled systems when performing repair services.
Calibration Plan (Optional)	Standard	Expedited[3]	NI performs the requested level of calibration at the specified calibration interval for the duration of the service program.

[1]This option is only available for PXI, CompactRIO, and CompactDAQ systems.
[2]This option is not available for all products in all countries. Contact your local NI sales engineer to confirm availability.
[3]Expedited calibration only includes traceable levels.

PremiumPlus Service Program

NI can customize the offerings listed above, or offer additional entitlements such as on-site calibration, custom sparing, and life-cycle services through a PremiumPlus Service Program. Contact your NI sales representative to learn more.

Technical Support

Every NI system includes a 30-day trial for phone and e-mail support from NI engineers, which can be extended through a Software Service Program (SSP) membership. NI has more than 400 support engineers available around the globe to provide local support in more than 30 languages. Additionally, take advantage of NI's award winning online resources and communities.