APEX WAVES

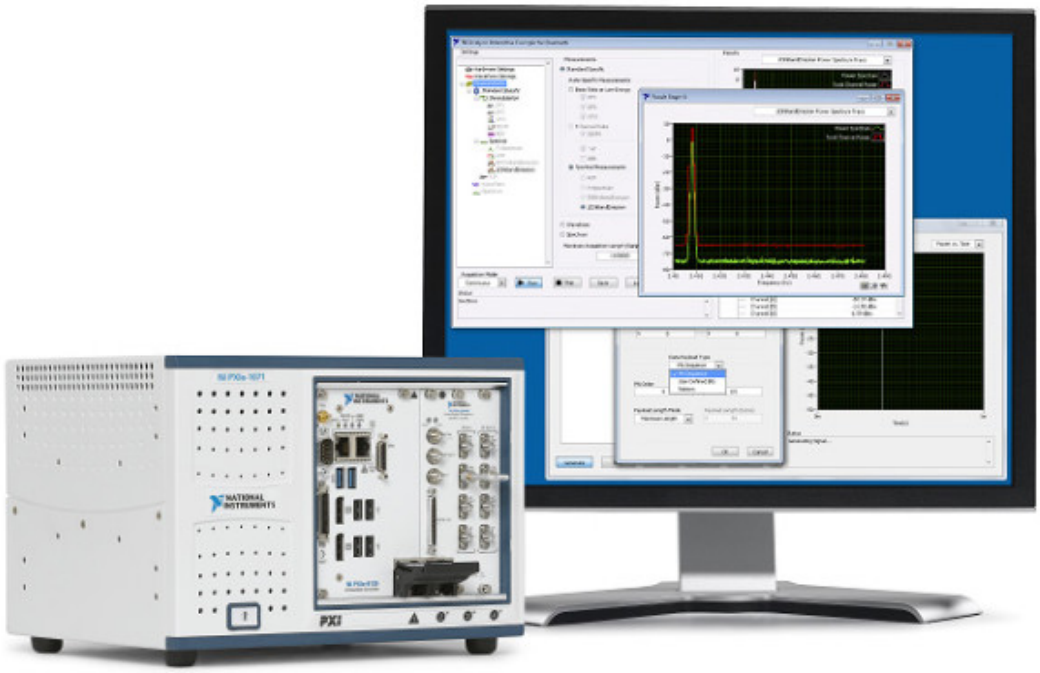
NATIONAL INSTRUMENTS PXIe-5840 Bluetooth Test Toolkit User Manual

PRODUCT FLYER
Bluetooth Test Toolkit

Contents

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 enduser 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.

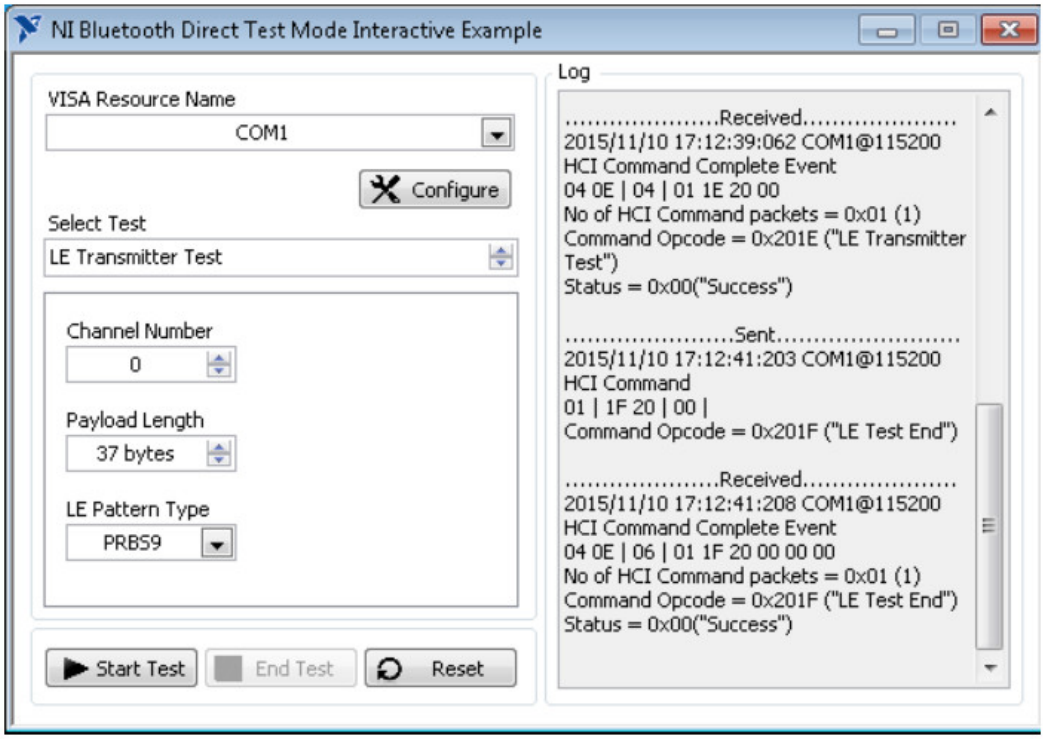


Figure 1. Direct test mode interactive example

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

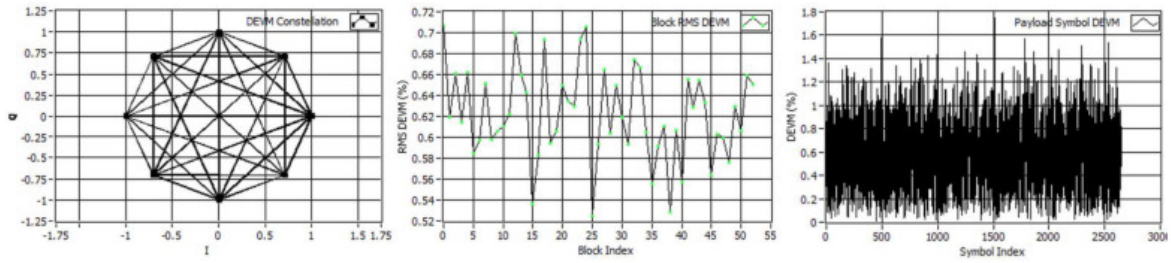


Figure 2. Constellation plot of a 3-DH5 signal; RMS DEVM measurement; payload symbol DEVM (%)

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

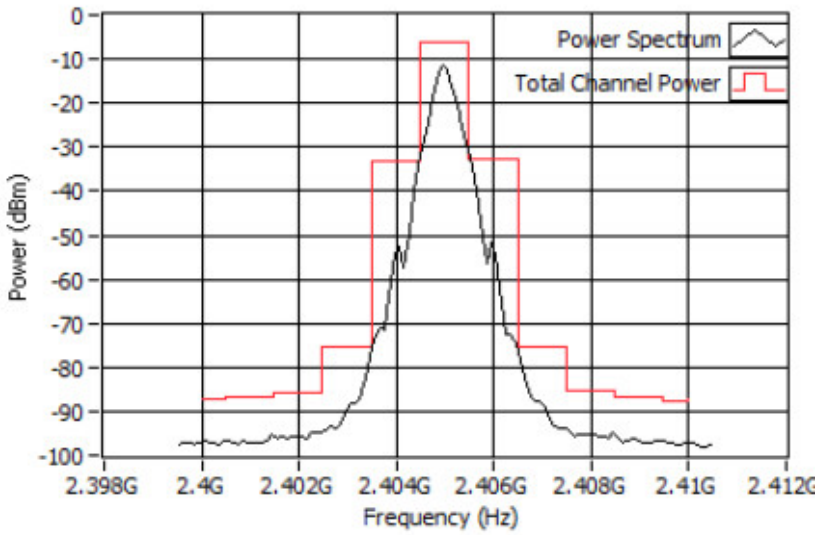


Figure 3. Tx output power spectrum measurement

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.

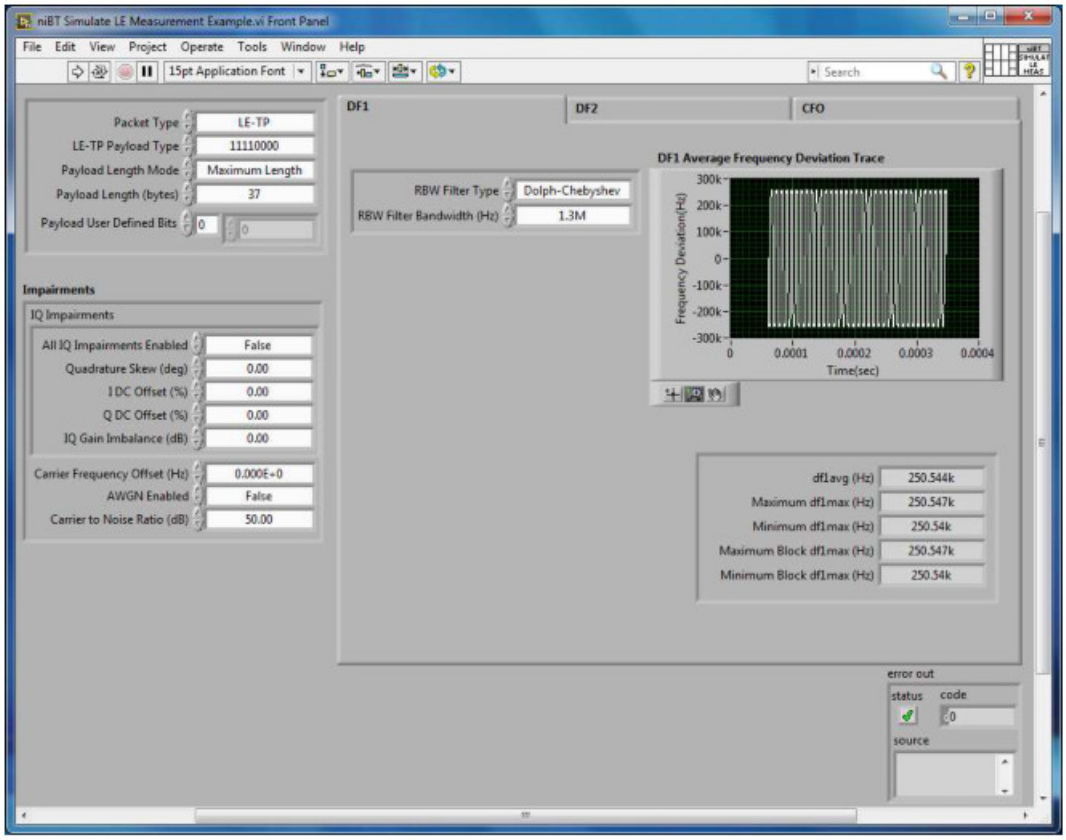


Figure 4. Code to simulate the effects of hardware impairments on the BT signal

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.

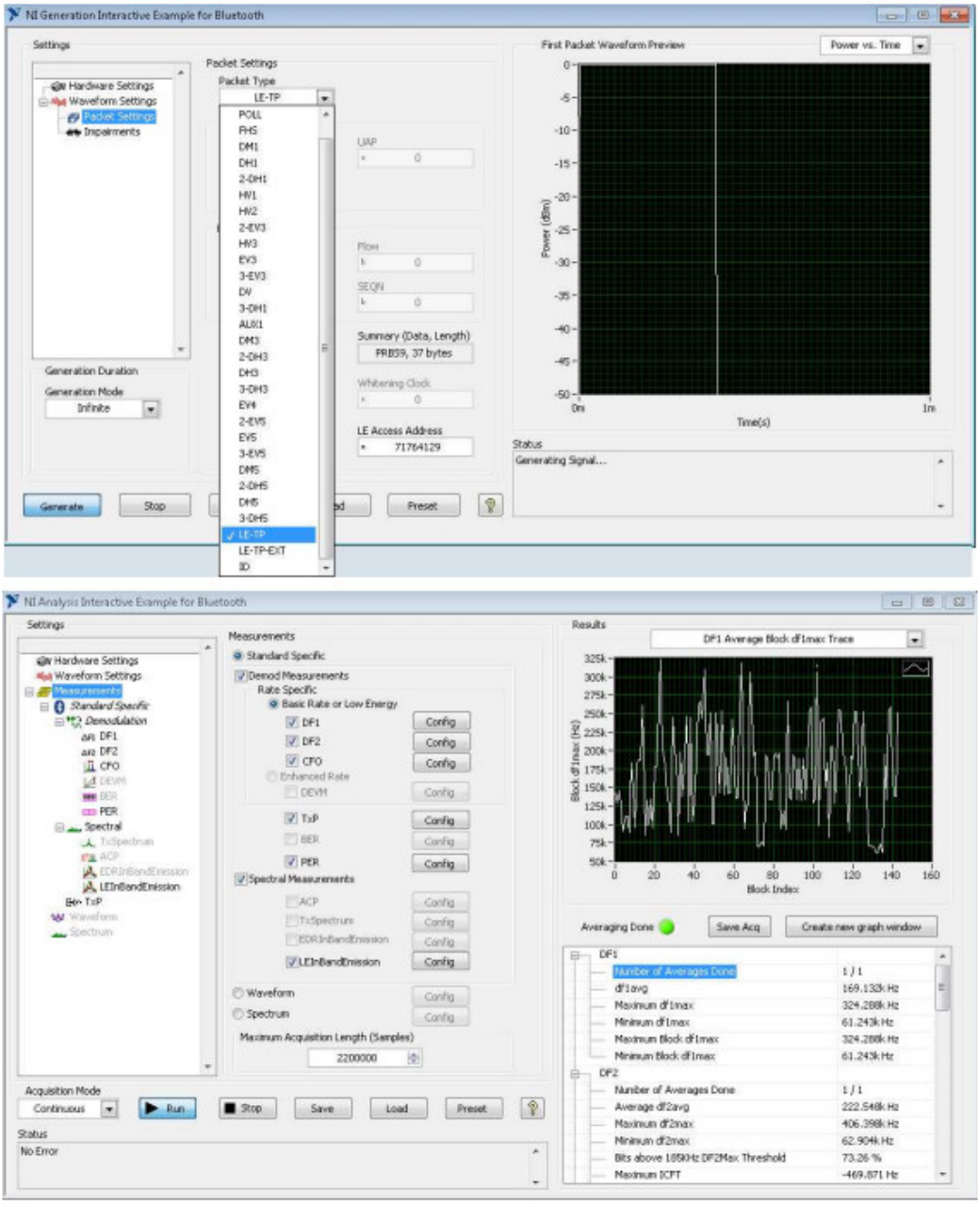


Figure 5. Bluetooth generation and analysis soft front panels

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.

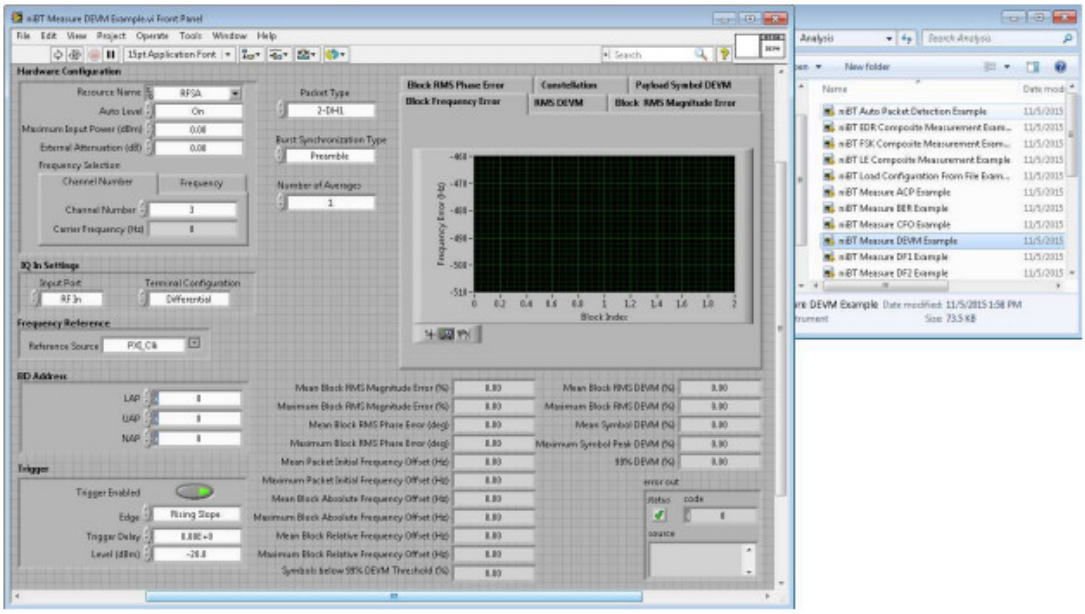


Figure 6. Example of a custom LabVIEW front panel for waveform analysis

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

Total Average Power	Access Code and Header Average P ower	Payload Relative Power
Maximum Average Power	Payload Average Power	
Minimum Average 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 FrequencOffset (Hz) Maximum Block Absolute Frequency Offset (Hz) Mean Block Relative FrequencyOffset (Hz) Maximum Block Relative Frequency Offset (Hz) Symbols below 99% DEVM Threshold (%)	Impairments: IQ Gain Imbalanc(dB) Impairments: Quadrature Skew(deg) Impairments: I DC Offset (%) Impairments: Q DC Offset (%) BER (%) Sample Population Used FER % Number of Frames Used

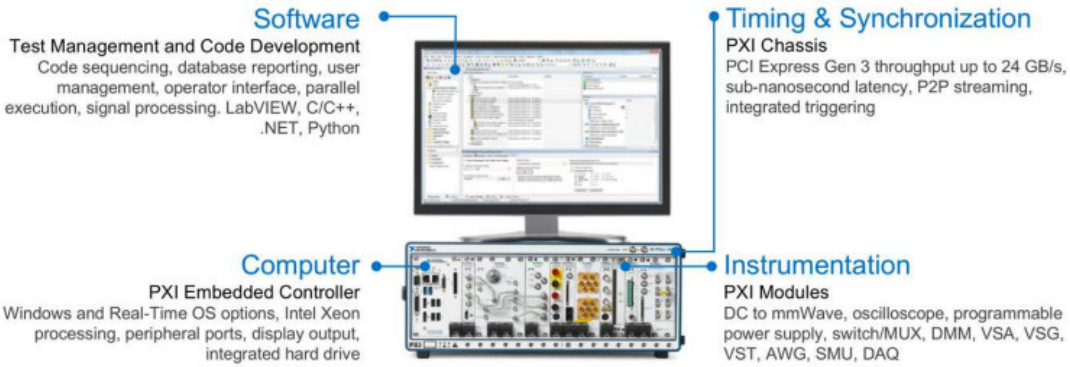
Spectral Measurements

Peak Power	TxSpectrum	aw IQ Data
TxP Average	ACP	Waveform Spectrum
Power versus Time	EDRInBandEmission	
Bandwidth	LEInBandEmission	

Platform-Based Approach to Test and Measurement

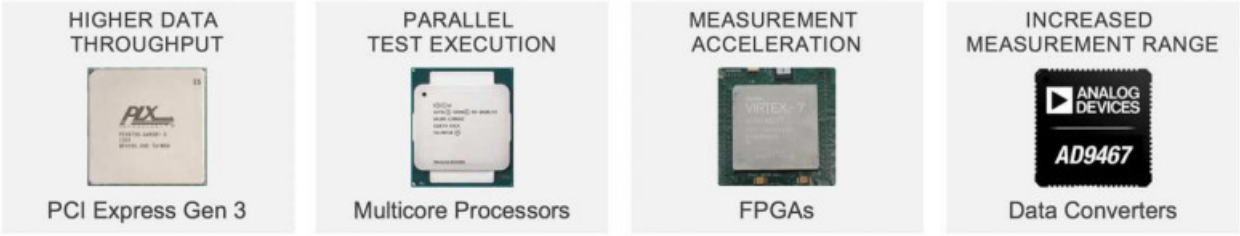
What Is PXI?

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 highperformance 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.

	**What Are PXI Oscilloscopes? – NI** Sample at speeds up to 12.5 GS/s with 5 GHz of analog bandwidth, featuring numerous tr iggering modes and deep onboard memory
	**What Are PXI Digital Pattern Instruments? – NI** Perform characterization and production test of semiconductor devices with timing sets a nd per channel pin parametric measurement unit (PPMU)

	**Frequency Counters** Perform counter timer tasks such as event counting and encoder position, period, pulse, and frequency measurements
	**Power Supplies & Loads** Supply programmable DC power, with some modules including isolated channels, output disconnect functionality, and remote sense
	**What Are PXI Switches? – NI** Feature a variety of relay types and row/column configurations to simplify wiring in autom ated test systems
	**GPIB, Serial, & Ethernet** Integrate non-PXI instruments into a PXI system through various instrument control interf aces
	**What Are PXI Digital Multimeters? – NI** Perform voltage (up to 1000 V), current (up to 3A), resistance, inductance, capacitance, a nd frequency/period measurements, as well as diode tests
	**Waveform Generators – Electronic Test and Instrumentation – NI** Generate standard functions including sine, square, triangle, and ramp as well as user-def ined, arbitrary waveforms
	**What Are PXI Source Measure Units? – NI** Combine high-precision source and measure capability with high channel density, determi nistic hardware sequencing, and SourceAdapt transient optimization

	**FlexRIO Custom Instruments & Processing** Provide high-performance I/O and powerful FPGAs for applications that require more than standard instruments can offer
	**What Is a PXI Vector Signal Transceiver? – NI** Combine a vector signal generator and vector signal analyzer with FPGA-based, real-tim e signal processing and control
	**Data Acquisition Modules** Provide a mix of analog I/O, digital I/O, counter/timer, and trigger functionality for measuri ng 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 Duratio n	3 or 5 year s	3 or 5 years	Length of service program
Extended Repair Coverage	●	●	NI restores your device's functionality and includes firmware upd ates and factory calibration.
System Configur ation, Assembly, and Test[1]	●	●	NI technicians assemble, install software in, and test your system per your custom configuration prior to shipment.
Advanced Repla cement[2]		●	NI stocks replacement hardware that can be shipped immediately if a repair is needed.
System Return M aterial Authorization (R MA)[1]		●	NI accepts the delivery of fully assembled systems when perform ing repair services.
Calibration Plan (Optional)	Standard	Expedited [3]	NI performs the requested level of calibration at the specified cali bration 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 ni.com/en-us/shop/services/software.html membership. NI has more than 400 support engineers available around the globe to provide local upport in more than 30 languages. Additionally, take advantage of NI's award winning Support – NI and communities.

18 August 2017

COMPREHENSIVE SERVICES

We offer competitive repair and calibration services, as well as easily accessible documentation and free downloadable resources.

SELL YOUR SURPLUS

We buy new, used, decommissioned, and surplus parts from every NI series. We work out the best solution to suit your individual needs. Sell For Cash Get Credit Receive a Trade-In Deal

OBSOLETE NI HARDWARE IN STOCK & READY TO SHIP

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References

- Engineer Ambitiously - NI
- Product Documentation - NI
- Hardware Services - NI
- RFmx for Bluetooth® Test - NI
- Engineer Ambitiously - NI
- NI Community - National Instruments
- Contact Us - NI

- What Are PXI Digital Pattern Instruments? - NI
- What Are PXI Digital Multimeters? - NI
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