Eight Channel, Phase Coherent RF Player and Arbitrary Waveform Generator

Benefits

+ Reproduce arbitrary waveforms with unlimited complexity and lengths extending into hours or days

+ Simulate the output from a multi-element phased array receive antenna

+ Playback multi-channel field recordings while preserving inter-channel relationships

+ Regression test RF receive hardware in a realistic spectral environment without the expense and limited repeatability of field tests

Features

+ Eight Channels of Phase Coherent Arbitrary Waveform Generation

+ 50MHz – 6.6GHz Output Frequency Range

+ 100MHz/CH Maximum Output Bandwidth

Applications

+ Beamforming Signal Generation

+ MIMO Test & Evaluation

+ Electronic Warfare Research

+ Direction Finding Receiver Test

Instrument Overview

Instrument Function	Eight channel, phase coherent, frequency agile RF Player and Arbitrary Waveform Generator (AWG)
Instrument Architecture	National Instruments Modular RF Instruments in PXI Express Form Factor High Speed Disk Storage Subsystem High Performance Quad-Core Embedded CPU with Windows 7 O.S.

Signal Storage

High-Speed Non-Volatile Storage Capacity & Type	Qty = 2, 6TB RAID, spinning disks (additional options available)
Duration of Stored Signal(s)	50 mins at 100MHz/chan signal bandwidth 1 hr 40 min at 50MHz/chan signal bandwidth 3 days, 11 hrs at 1MHz/chan signal bandwidth *See charts below for storage durations at other signal bandwidths*
High-Speed Non-Volatile Storage Filesystem	Microsoft NTFS (Direct plug-in compatibility with MS Windows)
High-Speed Native Playback File Format	SL Standard 001, Raw Binary Essence, IQ Time Series SL Standard 002, Raw Binary Essence, IQ Time Series SL Standard 003, National Instruments TDMS, IQ Time Series
Off-Line Storage Types	Import from external storage devices (e.g. HDD, memory stick, DVD-ROM) using USB 2.0 or USB 3.0 interface. Import from any network file share, SAN storage, or FTP server using standard Windows networking technologies and tools.
File Formats Imported From Off-Line Storage	SL Standard 001, Raw Binary Essence, IQ Time Series SL Standard 002, Raw Binary Essence, IQ Time Series SL Standard 003, National Instruments TDMS, IQ Time Series

🔊 Output Signal Characteristics

Signal Output Channels	8
Inter-Channel Electrical Relationships	All Channels Phase Coherent + Center Frequency Locked + Sample Rate Locked + Shared Start Trigger All Channels Deterministically + Calibrated Inter-channel phase relationships are calibrated and deterministic across repeated playback events and system reboots
Inter-Channel Phase Alignment	Phase alignment at any given center frequency: < +/- 0.5 degree across multiple start triggers < +/- 0.1 degree within a single trigger, and with manual tuning by user
Output Signal Types	Arbitrary Waveform, IQ Stream from High Speed RAID, Arbitrary Waveform, IQ Stream from VSG RAM, Continuous Wave Tone (CW
Frequency Range	50MHz-6.6GHz
RF Power Range	-152dBm/Hz to +10dBm
RF Power Resolution	0.1dB
Output Signal Bandwidth Minimum/Maximum	100kHz minimum 100MHz maximum
Output Signal Bandwidth Resolution (IQ Stream Type	Sample rate (and signal bandwidth) automatically adjust to native rate of IQ waveform with resolution of 1 sample/sec. Usable output bandwidth is nominally 0.8 x IQ Rate (e.g. 125MS/s = 100MHz RF BW)
Playback Repeat Modes (IQ Stream Type)	Single-Play Continuous Loop Loop Specified Number of Times

Additional output signal performance specifications per National Instruments PXIe-5673E Specifications, RF Vector Signal Generator document

🔊 SD-BTO-3829 Configuration Matrix

Module	Description	
0101	Spectrum Defender® Reviewer Module	*Included*
0105	Spectrum Defender Player Module	*Included*
0104	Spectrum Defender TCP Remote Control	*Optional*
0401	Primary Storage – 12TB (2x 6TB)	*Included*
0402	Upgrade Primary Storage to 96TB (4x 24TB)	*Optional*
0403	Direct Connect Storage to External PC Workstation	*Optional*
0404	Secondary Storage – 2x 6TB	*Optional*
1001	One Year Hardware Warranty	*Included*
1002	Extend Hardware Warranty to Two Years	*Optional*
1003	Extend Hardware Warranty to Three Years	*Optional*
88XX	Custom Software Extension	*Available – Call Factory*
99XX	Custom Hardware Extension	*Available – Call Factory*

🔊 Output Signal Fidelity

Digital Sample Resolution	32-bits per IQ sample pair (16-bit I, 16-bit Q)
Modulation Quality (Representative)	44dB MER (64-QAM; 6MHz; 825MHz) 34dB MER (64-QAM; 50MHz; 825MHz)
Equalization	Real-time, linear equalization (EQ) of full signal generation bandwidth for optimized frequency response and group delay
Spectral Purity (Phase Noise)	< -105dBc/Hz @ 10kHz offset; 1GHz center frequency

Additional output signal performance specifications per National Instruments PXIe-5673E Specifications, RF Vector Signal Generator document

🔊 Instrument Control Interfaces

Primary User Interface	Microsoft Windows Desktop Application Accessible locally via built-in KVM console or remotely via Windows Remote Desktop Protocol (RDP) over Ethernet
Primary Programming Interface	Native LabVIEW Application Programming Interface (API)
Secondary Programming Interface	ASCII command/response protocol over TCP/IP Interacts with common terminal emulation software or may be automated using any TCP/IP capable programming language
Integrations	System may be integrated to function seamlessly with other manual and automated laboratory test systems via either the LabVIEW native API or the TCP/IP API.

🔊 Physical, Environmental, Power

Form Factor	Roll around instrumentation rack 55" H x 22" W x 33" D (including wheels)
Intended Operating Environment	Office/Lab Environment
Weight	400 lbs. (estimated) Actual weight shall be stated at time of delivery
Power Source	110VAC/60Hz nominal
Power Consumption	With all channels streaming at full bandwidth: 1100 Watts (9.2 amps @ 120VAC)

🔊 Software Functionality

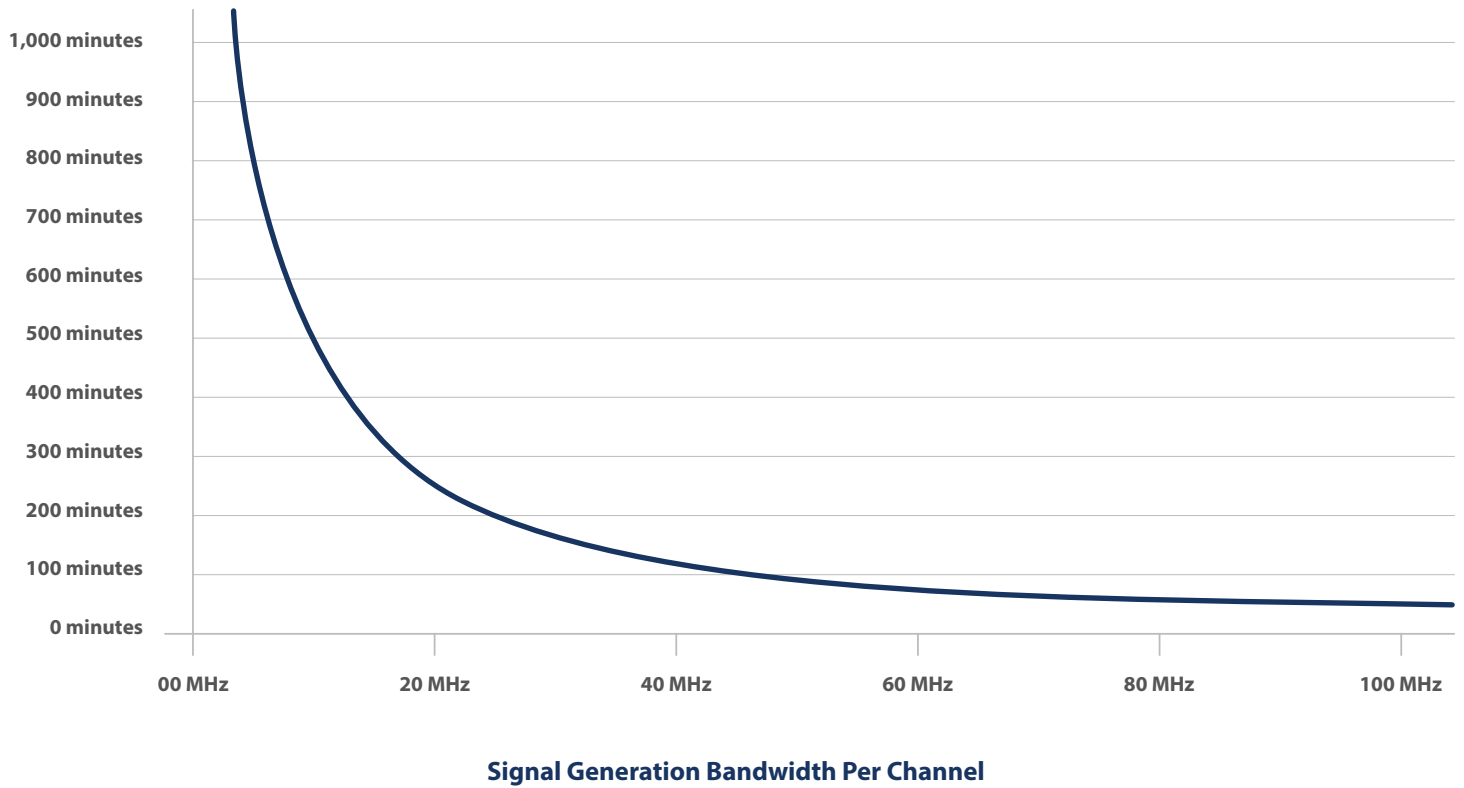|	
Spectrum Defender® Reviewer Module Software Features	**Waveform File Spectrum Analyzer** Select a waveform file and preview it on-screen in a Spectrum Analyzer style user interface. Apply averaging, peak-detection and resolution bandwidth adjustments on a previously recorded/imported waveform. **Freeze-Frame, Slow-Motion, High-Speed Waveform File View Modes** Freeze and manually step through the selected waveform file in time. Preview the waveform file on-screen in either slow motion, normal speed or high-speed. Quickly scan through long signal waveforms, or perform a slow-motion deep dive observation of short duration signal events. **Import Waveform Files** Import files from external storage or network sources for subsequent high-speed playback and waveform streaming. **Trim and Export Waveform Files** Trim a long duration waveform into shorter component parts. Export either the trimmed waveform(s) or the entire original waveform.
Spectrum Defender Player Module Software Features	**Continuous Waveform Streaming** Stream (playback) IQ waveforms from storage subsystem to RF output connector with no dropped samples or "dead time". **Unlimited Duration** Streaming waveform playback may continue indefinitely, without interruption when operating in continuous loop mode. Streaming waveform playback continues without interruption for the entire duration of the stored waveform when operating in single-play mode. **Center Frequency Tracking** Manually select a specific RF output center frequency or configure the system to automatically track the original center frequency used during recording/import. **RF Power Level Tracking** Manually select a specific RF output power level or configure the system to automatically reproduce the waveform at the same RF power level as the original recording/import. **Sequenced Playback** Build a playback sequence consisting of multiple waveforms from the storage subsystem. Initiate autonomous playback of this sequence for unattended testing or repetition of a standard regression test suite.
Spectrum Defender Player Module Software Features	**TCP/IP Remote Control** Remotely initiate and stop waveform playback, output frequency settings, and output power settings over a TCP/IP network connection. ASCII text command interface over TCP sockets. Programmer's Guide documentation included

Max Duration of Stored Signals as a Function of Signal Bandwidth
(Standard Storage Configuration: Option 401)

Signal Generation Bandwidth Per Channel

(y-axis: 0 minutes, 100 minutes, 200 minutes, 300 minutes, 400 minutes, 500 minutes, 600 minutes, 700 minutes, 800 minutes, 900 minutes, 1,000 minutes)

(x-axis: 00 MHz, 20 MHz, 40 MHz, 60 MHz, 80 MHz, 100 MHz)

Spectrum Defender is a product of the United States of America.