

Wideband Streaming Solutions

Recording Solutions S7960A-002, -020, and -044

Introduction

Modern RF systems are in a rapid state of change. Wireless designers need a comprehensive assessment of the signal environments that will stress their designs to assure they survive in target markets. The new Keysight S7960A Record solution enables quality recording of live signal environments and in-depth analysis in a convenient, transportable package. The intuitive software guides the user through a structured workflow that turns a complex process into an easy setup and execution. You can quickly and easily record long signal duration files, preview the data, and select the portions of interest. Additionally, you can export files to the 89601200C Vector Signal Analysis software or N6820VRXE Virtual Receiver search and classification software.

The FieldFox model B operates as a microwave downconverter with 120 MHz of instantaneous bandwidth for frequencies as low as VLF up through 5G NR FR2. The heart of the hardware system is a combination of PXIe components that form an IF (or baseband) streaming record system. For work at frequencies below 2 GHz, the M9203A ADC input offers recording bandwidths up to 320 MHz via a tunable DDC.

Whether your work is on the bench, in a test chamber, or in the field, the S7960A Record solution accurately represents your signal environment to accelerate your test processes.



RF/ μ W Recording Solutions

The S7960A wideband RF/ μ W recording solution provides users with intuitive software for configuration, setup, signal preview, and file management. This combination of well-integrated instruments, conversion utilities, and easy-to-use workflow make the S7960A Record solution a valuable tool for a wide variety of recording applications.

Key features

- Intuitive operation and workflow
- Reliable, transportable package
- Quick and easy-to-use integrated file viewer with trimming tool for isolation of file segments for analysis or playback
- Strong preselection (FieldFox) and advanced ADC alignments for quality off-the-air recording
- Precision time stamping

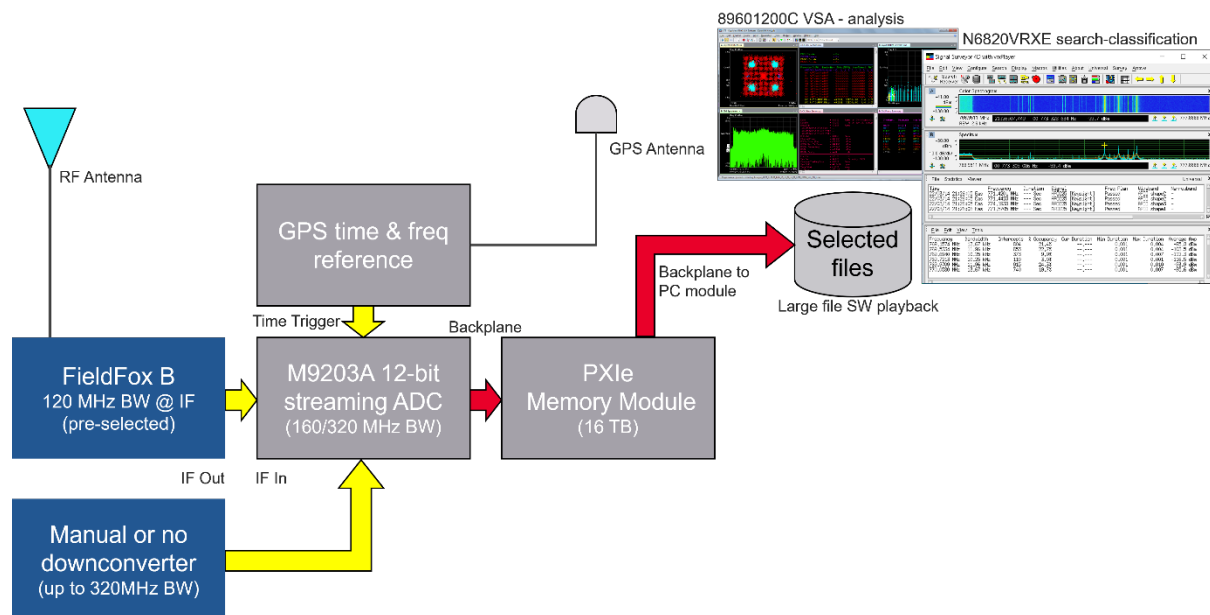


Figure 1. Block diagram of S7960 recording solutions

Solution descriptions

S7960A-002

The S7960A-002 is an IF/baseband wideband recorder integrated into an M9010A PXIe 10-slot Gen 3 chassis which delivers flexibility, compatibility, and performance in a smaller form-factor ideal for a range of applications. It has 8 PXIe hybrid slots providing flexibility to mix and match the number and location of PXIe and hybrid-compatible modules. The ultra-high performance, PCIe® switch fabric can operate up to Gen 3 providing up to 24 GB/s of system data bandwidth needed for the S7960A's high bandwidth streaming feature. The new cooling design provides exceptional per-slot cooling while producing much less fan noise. The S7960A-002 includes these modules:

- A pre-configured M9203A analog-to-digital converter module with the CB2 bundle is provided that includes the options described below. This bundle provides a guaranteed recording specification of up to 320 MHz bandwidth, with tunable intermediate frequency. It also includes data throughput optimization (I/Q samples with 32-bit, 16-bit, or 12-bit mode). Refer to the M9203A technical data sheet for more details.
 - SR2: 1.6 GSa/second sampling rate
 - F10: Full bandwidth
 - M40: 4 GB acquisition memory
 - DDC: Digital downconverter that provides a tunable IF frequency
- An NI 6638H Time and frequency reference module provides a GPS time reference and trigger to the system enabling precision time stamping of the digitized data. The module also provides a GPS-disciplined local oscillator output (10 MHz) to the M9300A. All system triggering is initiated by the 6638H module.
- An M9300A frequency reference is a PXIe modular instrument that can be used in various solutions as a 10 MHz or 100 MHz reference. A single M9300A can be shared with up to four sub-systems in one PXI chassis. Instrument control is provided through a soft front panel and programmatic interfaces. The M9300A is used to distribute a common frequency reference to all the components in the S7960A solution.
- A Conduant DM-4M.2 PXIe storage module configured with 15.2 TB of memory based on NVME SSD devices. The host interface is PCI Express x8 Gen3 (8GB/s) providing a sequential read of 7.1 GB/s and sequential write of 7.1 GB/s. Multiple units can be combined for additional storage capacity.
- An M9037A PXI host PC configured with options W16 (Microsoft Windows 10 IoT Enterprise LTSC (64-bit)) and M16 (Memory upgrade from 4 GB RAM to 16 GB RAM). The M9037A is a four-slot PXIe embedded PC controller with Windows 10 operating systems designed for high-performance, complex, multi-chassis systems. It is also well suited for secure environments due to its front-panel, removable solid-state drive (SSD). The embedded controller is built upon a high-performance, low-power Intel i7-4700EQ 2.4 GHz processor with 8-threads supported through 4 cores and hyper-threading.
- Cables: The S7960A-002 includes all front panel cables and adapters for connection of the modules as well as a GPS antenna with 1m cable. The solution will arrive with all connections made and ready for operation. Use a remote desktop PC to connect to the embedded PC or, connect a separate KVM device (not supplied).

S7960A-020

The S7960A-020 adds an N9938B FieldFox analyzer to the configuration as a microwave downconverter extending the frequency range to 26.5 GHz. The FieldFox includes Type-N input/output connectors, an AC/DC adapter-charger, a localized power cord, a rechargeable Li-ion battery, a LAN cable, a soft carrying case with backpack and shoulder straps, and a Quick Reference Guide. Additional cables are supplied as part of the S7960A-020 including a 30-foot LAN cable, a 3-foot SMA-SMB cable for connecting the FieldFox external reference to the M9300A module, a 2-foot SMA-SMB cable for connecting the FieldFox IF output to the M9203B input, and a 3-foot Type-N cable. The N9938B is configured with the following options:

- B10 Adds 120 MHz instantaneous bandwidth
- 235 Adds wideband pre-amplifier
- 350 Adds Real-time spectrum analyzer mode

S7960A-044

The S7960A-044 adds an N9961B FieldFox analyzer to the S7960A-002 configuration extending the frequency range of the Recorder up to 44 GHz and includes the same options, cables, and accessories as listed above except the Type-N cable is replaced by a rugged 2.4 mm cable. The N9961B connectors are 2.4 mm.

Solution Software

All S7960A software is pre-installed on the M9037A PXI host PC and includes the following:

- N6880AR01 Record Playback Manager (RPM) software. A perpetual, node-locked license for the application is installed. A software subscription service can be purchased to receive updates to the application.
- Keysight IO Libraries are installed to manage the PXI modules but do not need user interaction for normal operation of the RPM software.
- Soft Front Panel (SFP) applications for each of the installed Keysight modules (M9203A, M9300A). These enable the manual operation of the modules. For more information, refer to the technical data sheets for the modules.
- 89601C200 Vector Signal Analyzer (VSA) software is installed but licensed separately. The S7960A solution does not include a license for the VSA software.

Use cases

RF field test validation

The Keysight recording solution is ideal for easy transport to the field, and quick setup. It comes as a complete solution ready to go to work recording RF environments important to your test needs – whether for validation of an operational scenario (ground truth), signal development efforts, or in situ wireless recording. Once you have acquired and validated the recordings, you can load them into an analysis or search tool to report on the results. The system is also beneficial in test chambers or lab use for RF playback of files with high fidelity.

In situ wireless or interference recording

New wireless formats have wider bandwidths and aggregated carriers which may require geographically separated time-synchronous acquisition. The S7960A makes this possible with its compact profile and precision time-enabled recording features. Keysight's analytic tools can load recordings and start the investigation right away. With the Keysight recording solutions you can use either manual or automated analysis tools to discover the signal content of the file.

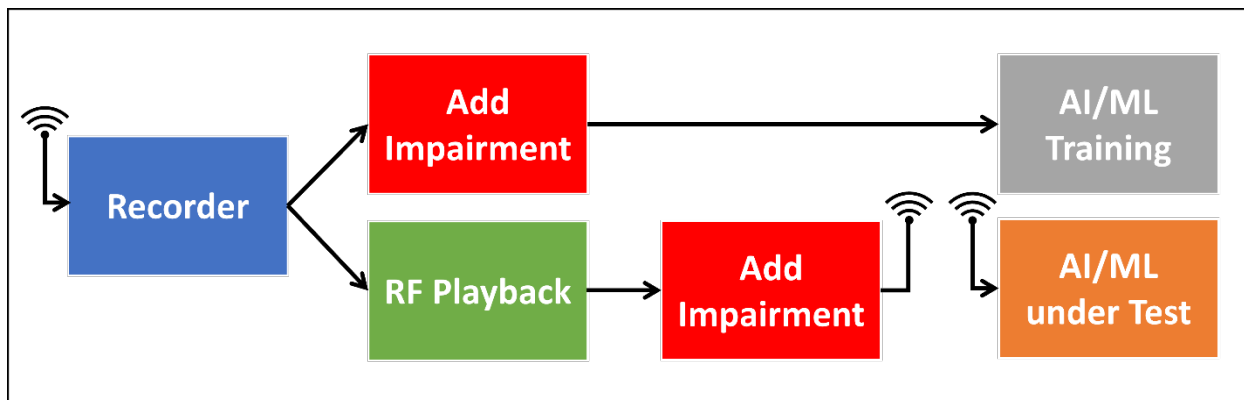
Algorithm training

The Record and Playback system can be used to train and test Artificial Intelligence / Machine Learning (AI/ML) algorithms. AI/ML development requires copious amounts of training data, and the closer to reality the training data is, the better the potential of success for the algorithm. Today, AI/ML engineers spend the first phase of their research and development accumulating or producing data to train their AI/ML. Depending on the problem at hand, it may entail developing a software simulation to produce data. For example, if the task is to build an AI/ML to control a power system, one might first develop a software simulation of a power system to customize the training data more easily.

The issue with heavy reliance on simulated data is the practical difference between simulation and reality. And this difference directly affects the quality of the AI/ML to be trained.

In the category of problems having to do with wireless communications signals, many AI/ML are created to classify signals or make decisions on signals received off the air. For these cases, record/playback solutions can be used to increase the fidelity of the training data because these systems are used to record *real-world* signals off-the-air.

The figure below illustrates how to use the record/playback solution for training and testing AI/ML. The recorder is used to record real-world signals off-the-air, and then impairments are added in software. These impairments could include multipath propagation, noise, or signal interferers. Software tools that could be used to do this include MATLAB, Keysight SystemVue, or one's own program. The impairments need to be varied to provide extensive amounts of training data which are functions of real-world recording. Then this data is used to train the AI/ML.

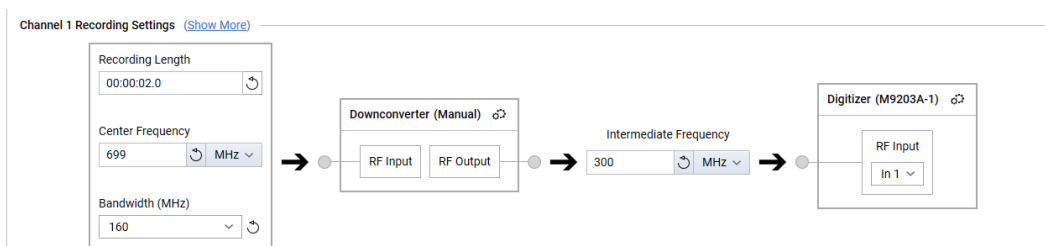


Once trained, the AI/ML can be tested in a similar fashion. The recorded data has impairments added, then the Playback solution transmits the signal to RF. The AI/ML is put within its host receiver, processes the transmitted test signal, and makes decisions. In this way, the Record and Playback solution becomes a vital part of the AI/ML workflow.

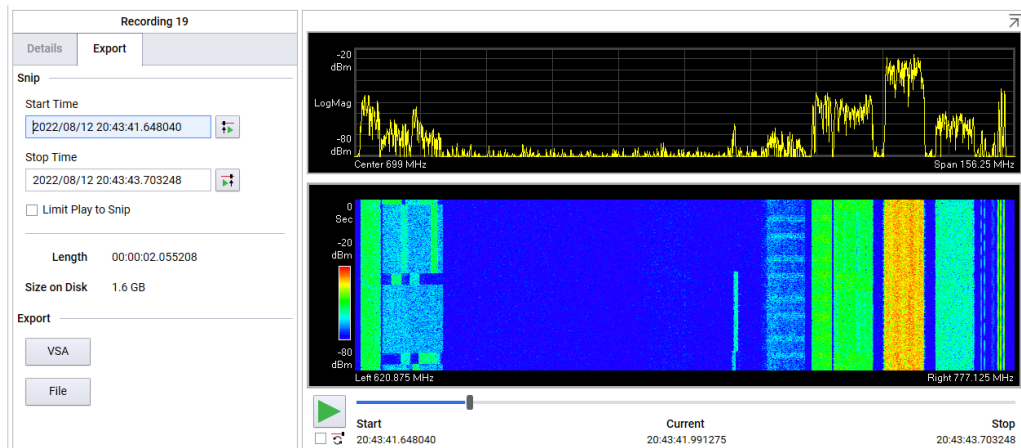
Record and Playback Workflow

Easy to configure and control, the N6880A Record and Playback Manager (RPM) software uses an intuitive workflow model that provides a user's interface with a sequential tab structure starting with recorder setup, data view, and then playback. The Project Recordings (file management) window is viewable on all three workflow tabs providing convenient access to recordings file data and the associated controls. You can convert recordings for playback in RF, load any file to the view, or export files to the 89601200C VSA software from the file management section available on all three tabs. Key functions for each tab include:

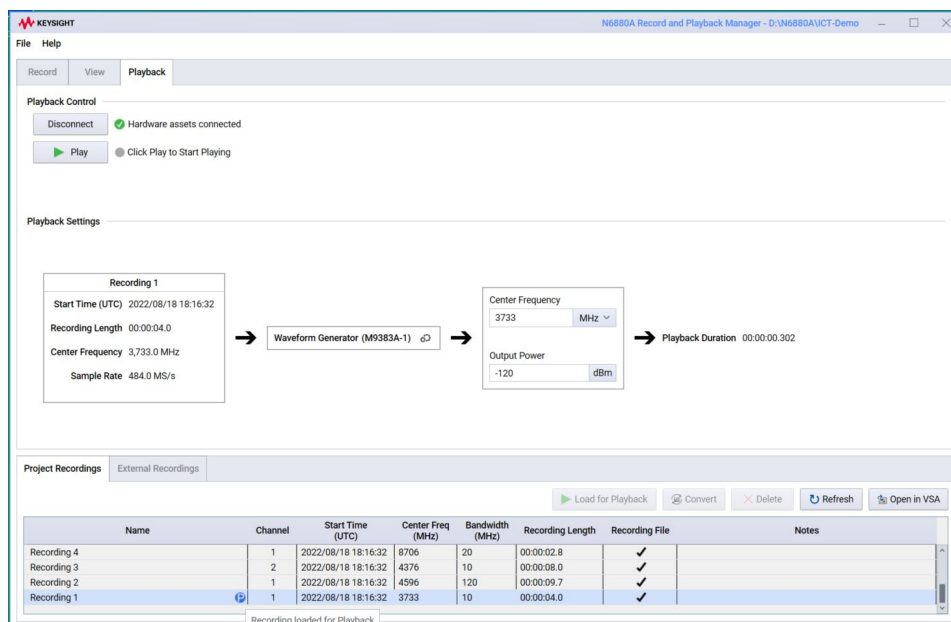
1. The recording session begins with the Record tab. The menu guides you through connecting to the hardware, adjusting settings to meet your specific signal conditions, arming, and starting the recording. During this process, the analog-to-digital converter can run a self-calibration that aligns the I and Q to remove any residual DC component or distortions that may appear in the recording. The result is a high-fidelity recording ready for analysis or playback.



- View tab enables you to preview the recording to ensure it contains the desired signal content. You can load the file data in the spectrum and spectrogram trace displays for quick verification of the content and use the precision time tags to move to areas of particular interest within the file. A subset of the recording file can be selected and saved as another, smaller file, or exported to the 89601200C VSA software for detailed analysis.



- Playback tab – Users can playback recordings using the solution's M9383A vector signal generator by connecting the Playback hardware and loading a file for playback. Next, users can adjust the playback parameters such as the center frequency, amplitude, and sample rate. The flexible playback settings enable the user to get the most out of previously recorded files for their specific application.



Recording Performance Expectations

Description	Performance expectation
Frequency	
Tuning range	S7960A-002: DC to 2 GHz (no FieldFox) S7960A-020: 5 kHz to 26.5 GHz S7960A-044: 5 kHz to 44 GHz
Recording bandwidth (max.)	320 MHz (full band directly into M9203A ADC) 120 MHz with FieldFox downconverter (Actual acquisition bandwidth is 160 MHz, limited by the FieldFox IF filter)
Tuning resolution	1 Hz
Frequency reference	GPSDO or external 10/100 MHz reference
Frequency reference accuracy	± 20 ppb (with internal GPS reference)
Amplitude	
Analog-to-Digital converter	12-bits at 400 Msamples/second (complex)
Dynamic range	64 dB
Input range	DANL to +20 dBm
Amplitude	± 3 dB
Displayed average noise level (DANL)	1 GHz -155 dBm/Hz 10 GHz -150 dBm/Hz 20 GHz -150 dBm/Hz 30 GHz -152 dBm/Hz 40 GHz -149 dBm/Hz DANL values are measured. Refer to FieldFox datasheet for additional guidance.
Attenuation range	0 to 30 dB in 5 dB steps
Inputs and outputs	
RF input connector	SMA (female) 50 ohm on M9203A SMA (female) 50 ohm on 26.5 GHz FieldFox APC 2.4mm (female) 50 ohm on 44 GHz FieldFox
FieldFox Model B Intermediate frequency	225 MHz filtered IF
Recording memory	15.2 TB Over 5 hours at 120 MHz bandwidth Over 2 hours, 30 minutes at 320 MHz bandwidth
File Formats	*.bin, 89601200C software provides files conversions

Configuring your solution

Refer to the [Wideband Streaming Solutions configuration guide](#) to select the right hardware and software configuration to support your unique system requirements.

Support Options

KeysightCare for Solutions Support services

KeysightCare for Solutions is your priority-one connection for your teams, providing committed repair and calibration turnaround times and access to technical experts. This premium service can help you stay ahead of the curve and accelerate the win. See the [KeysightCare for S79x0A Wideband Streaming Solutions flyer](#) for service details.

Keysight Extended Warranty and Calibration Plans

Ensure accurate measurements and achieve greater peace of mind with every new instrument purchase

- Extend your peace of mind and eliminate budgetary surprises for up to 5 years with an Extended Warranty.
 - Lock in OEM-quality calibration at the lowest price, with the peace of mind that your equipment will perform at its original specification with calibration plans
 - To learn more, see www.keysight.com/find/services.

Education services

Measurement challenges are intensifying as standards and technologies constantly evolve. Build confidence and gain new skills to make accurate measurements through our flexible [Education Services](#) developed by Keysight experts.

Consulting services

Technology acceleration and evolving standards are driving the relentless pace to bring breakthrough products to market faster, and at a lower cost. Our experts know advanced test methods and standards and can help through consulting services. Using the latest hardware and software, we analyze your specific measurement needs and work with you to achieve optimized test strategies. Whether you need consulting on characterization or compliance measurements or want to automate your test system, we deliver the technical expertise and programming support you are looking for. A few examples of [Keysight's consulting services](#) include:

- Accelerate Multichannel Measurements for RF and mmW
- Achieve Wideband Device Characterization
- Attain High-Speed Digital Test Compliance
- Get the Most out of Your 5G/CV2X Device Test Solution
- Accelerate Replicating RF Environments
- Expedite Device Modeling
- Get the Most from PathWave Design Software

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.



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