

Ultra-Wideband Recording Solution

High-quality recording system with X-Series analyzers

Introduction

Keysight's Ultra-Wideband Streaming and Recording solution combines Keysight's X-Series analyzers with RAID storage to deliver up to 2 GHz of fully corrected IQ streaming. The industry-leading recording solution and Keysight's N6880A Record and Playback Manager software combine for easy configuration and control of the recording setup.



X-Series Ultra-Wideband Streaming and Recording Workflow

The S7961A/S7962A streaming and recording solution is preconfigured to include a comprehensive workflow with flexibility to address your specific recording requirements. The X-Series analyzers provide a high-fidelity front end, capturing gapless 14-bit fully-corrected IQ data. This data is streamed over Optical Data Interface (ODI) to a PXIe RAID array for file storage. The ODI is passed through to an FPGA where real-time FFTs are presented for live viewing of the recording. RPM can snip and export parts of the recorded file directly into PathWave Vector Signal Analysis software (89600 VSA) for detailed measurement and analysis.

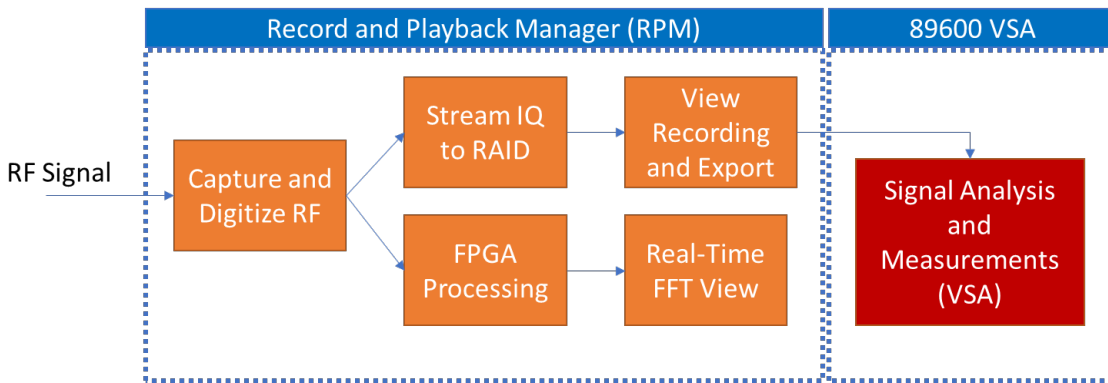


Figure 1. RF Recording Workflow

Streaming and Recording Hardware

The record and streaming setup includes an X-Series analyzer as a front end to the measurement equipment with a frequency range of up to 50GHz of RF input¹. The signal is passed via Optical Data Interface (ODI) with up to 2GHz gapless 14-bit fully corrected IQ data to a PXIe RAID array for storage. The data on the ODI stream is also passed through to an FPGA on a workstation PC. The FPGA provides a real-time view of the wideband spectrum.

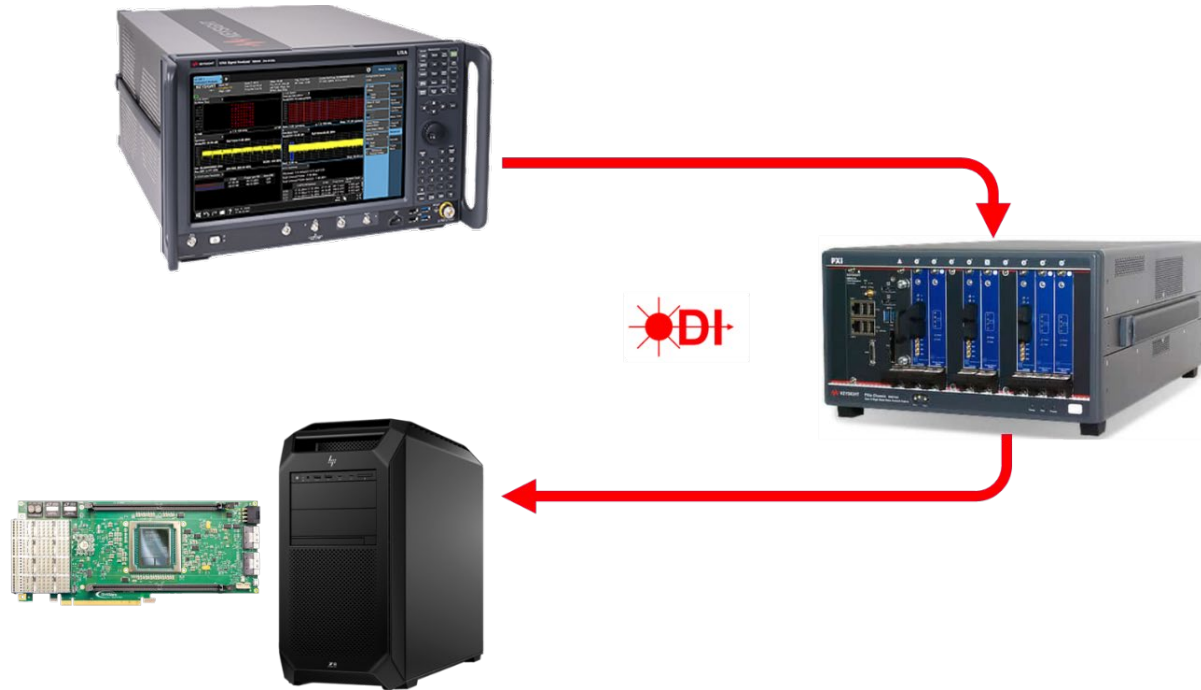


Figure 2. Recorder hardware with S-Series analyzer, PXIe RAID storage and Workstation PC FPGA

X-Series analyzer

The signal is received on Keysight's PXA (N9032B) or UXA (N9042B). This hardware is an industry leading signal analyzer, providing optimal signal fidelity. The RF signal input is digitized with a 14-bit ADC and converted to a gapless stream of fully corrected IQ data.

At narrower bandwidths, the power dynamic range (effective number of bits) can be extended with processing gains via an arbitrary resampler. This Analyzer provides precision signal capture of bandwidths up to 2 GHz.

¹ The X-Series analyzers can be configured to be used in the record and stream setup and as a general-purpose spectrum analyzer for measurement flexibility.

PXle RAID

The data stream is captured on a PXle chassis RAID array. The optical cable is connected to an FPGA board that stripes the data to neighboring storage modules using PXle peer-to-peer streaming. The storage modules (DM-4M.2-3U) contain four NVME M.2 drives with 3.8 TB of storage each. The modules can scale as needed to meet total storage capacity requirements.




Figure 3. HSS-8324 PXle optical FPGA board **Figure 4.** DM-4M.2-3U storage unit

PC workstation

The recording system is configured and managed from a central workstation. A custom-built HP Z8 PC provides user control over the recording process, management of the recorded files, review of captured data, as well as real-time observation of the signal collection during a recording.

The installed PCIe FPGA computes real-time FFTs on the IQ data, which is passed to the operator’s user interface to provide high-level signal characteristics.

HP Z8 workstation

	Operating system	Windows 11 Pro 64
	Processor	Intel Xeon
	Memory	192 GB DDR4
	SSD storage	1 TB M.2 NVME
	HDD storage	8 TB 3.5" SATA HDD (x2)
	Graphics	NVIDIA T400 4 GB GDDR6
	Display output	Mini display port (x3)

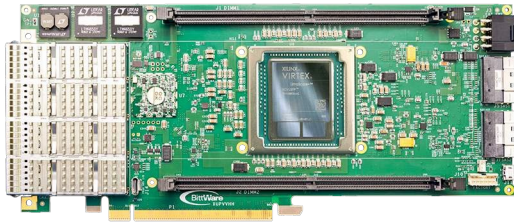


Figure 5. Bittware XUP-VVH PCIe FPGA

Optical Data Interface

High speed signal capture depends on data link infrastructure that can reliably pass a continuous stream of digitized RF. Optical Data Interface (ODI) is a new high-speed interface standard for advanced instrumentation and embedded systems². With speeds up to 80 GB/s, the interface can provide the necessary speeds to transfer ultra-wideband signal data between separate hardware.



Figure 6. Optical cable with ODI-QSFP adapters

ODI uses VITA-49 packetized data formatting. This provides a common, industry-standard data format that minimizes overhead while capturing timestamp and measurement context information.

² AXIe Consortium (axiestandard.org)

Record and Playback Manager Software

Easy to configure and control, the N6880A Record and Playback Manager (RPM)³ software uses an intuitive workflow model that provides a user interface with a sequential tab structure for recorder setup, data view, and file management. The Project Recordings window is viewable on all three workflow tabs providing convenient access to recording file data and the associated controls. You can convert recordings for playback in RF, load files to view, or export files directly to the 89601200C VSA⁴ software from the file management section. 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 initiating 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.

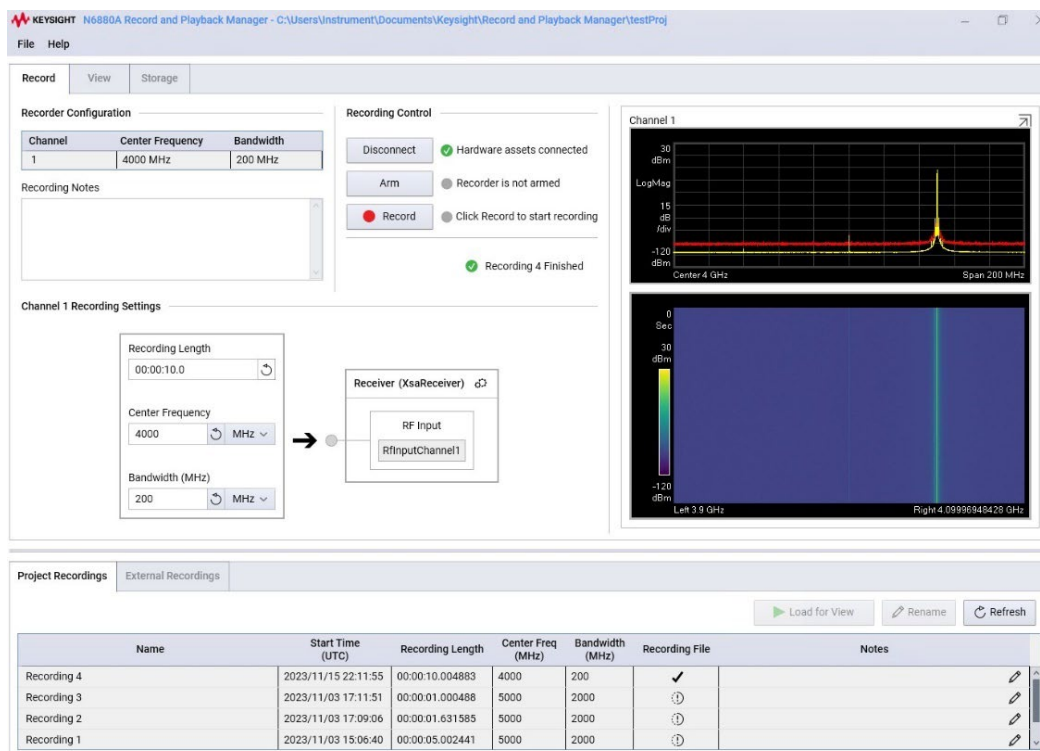


Figure 7. RPM Record tab user interface

³ Playback is not enabled with this setup. If playback is required, contact your Keysight Technologies representative for more information.

⁴ 89601C VSA Software sold separately.

2. The 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.

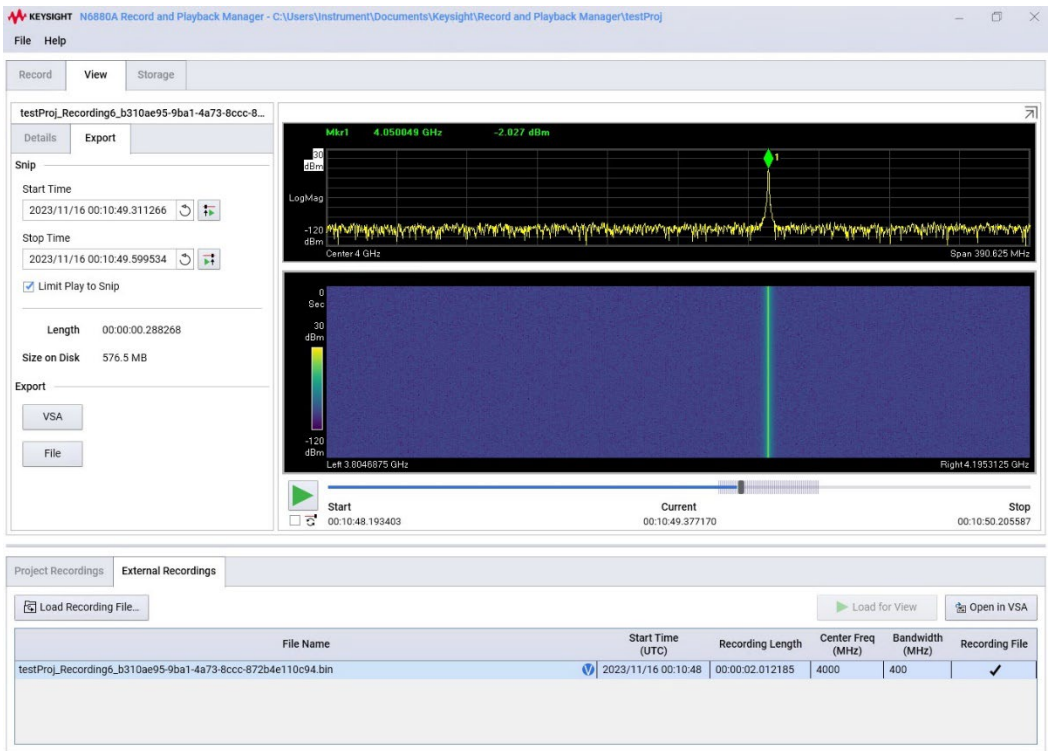


Figure 8. RPM View tab user interface

3. The Storage tab allows the user to browse the recording files stored on the RAID storage system. The RPM Storage tab provides RAID file management where you can view or delete recording files as needed.

KEYSIGHT N6880A Record and Playback Manager - C:\Users\Instrument\Documents\Keysight\Record and Playback Manager\testProj

File Help

Record View **Storage**

Total space used: 63.6 GB Total space remaining: 7.7 TB Refresh Delete Export

Project	Current Project	Recording	File Name	Created Time (UTC)	File Size	Data Size
			TestProj2_Recording7_f0cd263b-2e38-4459-81e5-60939555b152.vita49	2023/11/15 21:37:19	9.7 GB	9.6 GB
			TestProj2_Recording6_4c0959a5-f933-465a-b17b-453c51da3fee.vita49	2023/11/15 21:34:38	9.7 GB	9.6 GB
testProj	✓	Recording 6	testProj_Recording6_b310ae95-9ba1-4a73-8ccc-872b4e110c94.vita49	2023/11/16 00:11:10	4 GB	4 GB
testProj	✓	Recording 5	testProj_Recording5_7de9c858-9b92-4b59-b200-0f4089867d81.vita49	2023/11/15 22:13:23	20.1 GB	20 GB
testProj	✓	Recording 4	testProj_Recording4_c48927b1-096a-4adc-936e-6eb410ce4001.vita49	2023/11/15 22:12:25	20.1 GB	20 GB

Project Recordings External Recordings

Load Recording File... Load for View Open in VSA

File Name	Start Time (UTC)	Recording Length	Center Freq (MHz)	Bandwidth (MHz)	Recording File
testProj_Recording6_b310ae95-9ba1-4a73-8ccc-872b4e110c94.bin	2023/11/16 00:10:48	00:00:02.012185	4000	400	✓

Figure 9. Use the Storage tab to manage recorded files

Additional References

N9032B PXA Signal Analyzer, 2 Hz to 50 GHz

N9042B UXA Signal Analyzer, 2 Hz to 50 GHz

M9019A PXIe Chassis: 18-slot, 3, 24 GB/s, Gen 3

PathWave Vector Signal Analysis (89600 VSA)