StreamStor® Cobra ODI Configuration Guide

Introduction

This ODI Configuration Guide has been developed by Conduant Corporation to support Keysight Technologies' internal teams by providing a clear, detailed overview of how recorders can be configured for various applications along with Keysight PXIe chassis and controllers for high-speed data acquisition and streaming applications.

The modular Cobra recording system is engineered to maximize data recording performance and capacity, offering sustained streaming rates up to 160 Gbps per ODI interface. When configured properly, these systems allow Keysight hardware to meet the demanding throughput requirements common in advanced test and measurement applications.

This document is especially relevant for Keysight professionals engaged in customer-facing roles across high-performance verticals such as aerospace, defense, communications, and research, segments where customers often require large-scale data capture and playback. The systems are designed to integrate seamlessly with Keysight equipment with ODI interfaces—such as the M8131A Digitizer and M8121A AWG, making it highly adaptable to a range of real-world applications.

Compatible Keysight Products:

- **M8131A** 16/32 GSa/s Digitizer
- **M8132A** 640 Gbps Digital Signal Processor
- **M8121A** 12 GSa/s Arbitrary Waveform Generator
- **N9042B** UXA Signal Analyzer
- **M9484C** VXG Vector Signal Generator

Why This Document Matters:

- **Enablement:** Helps internal Keysight teams understand how to configure and communicate the value of Conduant systems when collaborating with customers.
- **Integration Confidence:** Shows tested compatibility with Keysight's PXIe controllers (e.g., M9038A) and chassis (e.g., M9010A, M9046A), ensuring reliable joint deployments.
- **Sales Pathway Support:** Equips customer-facing teams with knowledge that may unlock new solution-based sales opportunities for high-throughput and streaming data customers.
- **Marketing Synergy:** Clarifies the architecture and use cases for collaborative campaigns and customer-facing collateral.
- **Scalability & Flexibility:** Highlights the customizable, chainable architecture that supports a variety of customer data capture needs, both real-time and memory-buffered.

Conduant welcomes collaboration with Keysight professionals to support customer-specific requirements, ensure optimal system integration, and co-develop new solution architectures when needed.

StreamStor® Cobra Recording System

The StreamStor® Cobra recording system (Rapids) is a modular recording system built using PXI Express (PXIe) components including chassis and controllers from Keysight Technologies, FPGA and storage boards from Conduant and a cabled PCI Express non-transparent bridge board set from Dolphin ICS.

Once configured the system should be considered a **closed environment** that will not be populated with additional PXI Express boards or installed software. This is to ensure that the system will operate at the intended performance levels required for ODI streaming applications. Exceptions are possible if care is taken to prevent or control system activity that might interrupt the crucial transactions required to stream data to storage at these high rates. Conduant can consult and assist to provide converged systems when additional functionality is required.

Command / Control / Download Connectivity

The control and data access path for a recording system is provided to a customer host system using either an Ethernet or cabled PCI Express (PCIe) non-transparent bridge. The PCIe connection requires the installation of a PCIe board into a x16 or x8 slot in the users computer. This connection provides up to 64 Gbps performance over copper cables up to 5 meters or optical cables up to 100 meters. The Keysight controller (M9038A) used in the recording systems provides dual Ethernet connections of 1 Gb or 10 Gb.

Dolphin MXH930
PCIe Gen4 x16
Connect up to 4 recording systems

Dolphin MXH918
PCIe Gen4 x8
Connect up to 2 recording systems

Host Computer

Nearly any host computer should be compatible with the StreamStor Cobra system if using a Windows 10/11 or recent Linux operating system. When using the PCIe cabled connection it is recommended that a single processor system be used although many dual processor implementations have also been deployed successfully. Conduant recommends the HP Z4 G5 workstations.

Host Software

The StreamStor Cobra SDK is available for Windows or Linux x64 systems. On Windows the library supports .NET programming environments or “C” based calls. On Linux the library supports “C” calls only. There is also a Python module available that provides “ctypes” translations for Python calls. If using a Dolphin cabled PCIe connection you must install drivers for the host board. This software is available from Conduant support or from Dolphin (https://dolphinics.com)

Recording System Software

The recording system runs on the Windows operating system as supplied with the Keysight controller. All recording system software is pre-installed and configured and should not require user interaction. By default the PXIe controller will use DHCP to connect to a customers network.

The installed software includes drivers and a server application that is started automatically at power-on. The server startup process is managed by a Windows service named “CobraMonitor” that is set to auto start at power-on. Events from this service are output to the Windows event viewer (under “Applications and Services Logs”). This service also monitors the server process once per minute and attempts to restart the server if it has unexpectedly stopped. The server will write log files by default to the system user AppData folder although this location can be changed with registry entries. All log files are available for download using the the software on the users host computer.

The various configurations that are possible with the StreamStor recorders are defined by an XML file that is specified to the server at startup by a registry entry. This file must be located in the root directory for the server software at “C:\program files\Conduant\Cobraserver”. This file defines each recorder element, assigns storage resources, and defines grouping for chained recorders. Typically this file is prepared by the system installer to match customer requirements. It is also possible to change configurations by specifying a different file using software commands.

The storage for the recorders is provided by NVME solid state devices. These storage devices directly connect to the PCI Express fabric for maximum performance. They are mounted to the OS in a subdirectory on the system drive (c:\ssrecorders) without using any Windows RAID software such as striping or mirroring. They are also formtted using the default Windows NTFS file system. The data is written to these devices in parallel using peer-to-peer transactions over the PCIe fabric from the Cobra FPGA board. Download of recorded data utilizes the PXIe system controller where the server software reconstructs the data stream for transfer over Ethernet or cabled PCI Express. More information about the organization of data in the recording files is available by contacting Conduant support.

Updates to the server or the Cobra FPGA firmware can be performed from user software or example software provided by Conduant. Customers can login to the recording system using Remote Desktop or by attaching a monitor, keyboard and mouse to the front panel of the PCIe controller. It is recommended that any changes to the system only be performed with guidance from Conduant support.

Detailed configuration instructions are provided through Conduant support for Keysight personnel when configuring a system. System can also be pre-configured and tested by Conduant prior shipment.

Defining a System Configuration

Defining a recording system configuration requires an understanding of the data rates and duration for the application. The basic building block is a recording element that consists of an FPGA board and one or more storage boards depending on the required duration. Each element is capable of recording or playback at 5 GB/s (40 Gbps). Four elements (chain) are required to support the full rate of a single ODI data stream of 20 GB/s (160 Gbps).

The following pages describe the various components used to create recording systems with some included example configurations. The examples are only a subset of the possibilities so please contact Conduant if there are unique requirements for your application. The system is very flexible and additional software and/or hardware customizations are always possible to adapt the system to meet those needs.

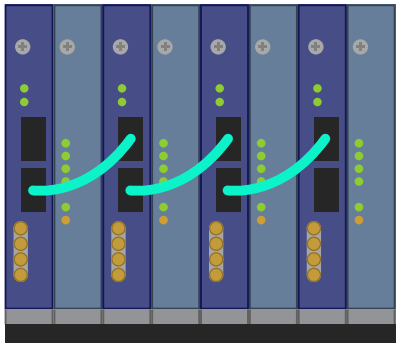
Building Blocks

Basic Recorder Element

- Cobra FPGA board (HSS8324)
- One or more storage boards (M.2 or U.2 NVME)
- 5 GB/s record/playback rate

Chains

- Combine recorder elements to support higher data rates. Data rate is base rate of element (5 GB/s) times number of elements.
- Support for 2, 3 or 4 elements per chain
- Elements connected by ODI cables (24 fiber MPO)
- Storage resource must be the same for each element in a chain

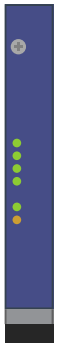


PXIE-8324 FPGA Board (Cobra)

- Programmable logic with peer-to-peer data engines
- 8GB Data buffer
- Dual MPO 24 fiber connections
- 4x external MMCX signal connectors
- PXIe backplane trigger and clock connections

M.2 NVME Storage Board

- Provides 4 NVME M.2 storage drives
- Supports 80 and 110 mm devices
- Capacity up to 32 TB (consumer drives)
- Capacity up to 15.3 TB (enterprise drives)
- Single board (4 drives) supports 5 GB/s record with approved drives



Building Blocks (cont)

U.2 Removable NVME Storage Board

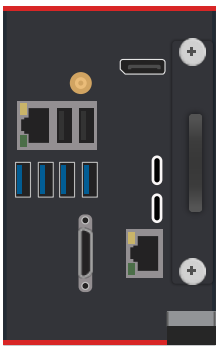
- Provides single, removable NVME U.2 storage drive
- Capacity up to 15.3 TB
- Minimum of 2 boards required to support 5 GB/s data rate with approved drives
- Drives are not removable while powered
- **Data safe version** available (internal M.2 to protect data from becoming inaccessible due to drive connector wearout failure)

U.2 NVME Storage Board (non-removable)

- Provides single NVME U.2 storage drive
- Capacity up to 60 TB
- Minimum of 2 boards required to support 5 GB/s data rate with approved drives

Keysight M9038A PXIe Controller

- Support for up to 8 recorder elements
- Provides Gbit and 10 Gbit network interfaces
- Pre-installed software
- Headless operation (no mouse/keyboard/monitor required).



Keysight M9010A PXIe Chassis

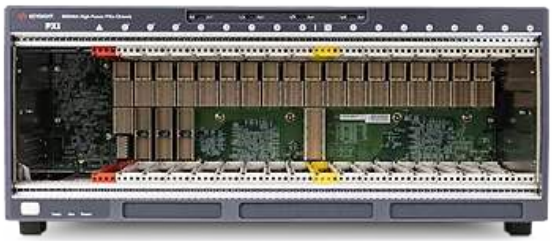
- Provides 9 available PXIe slots
- Support for up to 4 recorder elements
- Common switch segment: Slots 2-5 and 6-10

Keysight M9019A PXIe Chassis

- Provides 17 available PXIe slots
- Support for up to 6 recorder elements
- Common switch segment: Slots 2-9 and 10-18

Keysight M9046A PXIe Chassis

- Improved power and cooling over M9019A
- Provides 17 available PXIe slots
- Support for up to 8 recorder elements
- Common switch segment: Slots 2-9 and 10-18



Dolphin MXP908 PXIe NTB Host Adapter

- Provides x4 or x8 Gen3 cabled PCI Express host connection
- Improved over Gb or 10 Gb Ethernet for command/control and data access.

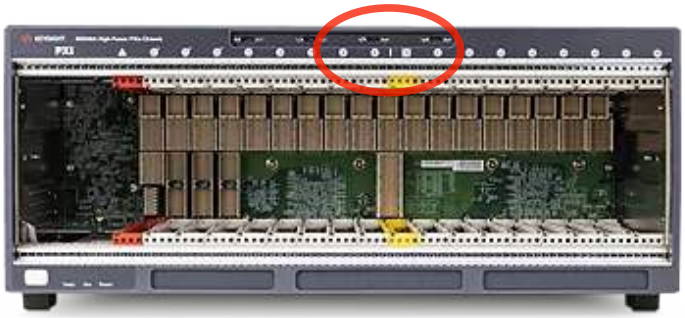
Chassis Configuration

Recorders can be populated in a chassis in any combination of chains or single recorders up to the limits of the chassis. Consideration should be given to the power draw of the components added to the chassis. The FPGA board is usually the largest power drain at approximately 40W. In general a configuration of over 6 elements should use the M9406A chassis.

An optional cabled PCI Express board can be used to create a non-transparent bridge (NTB) to the users host computer for high speed command/control and data download.

Variations can include adding additional types of storage for removability or extending the capacity of a recorder.

Elements (Cobra + Storage) should reside in the same switch fabric if possible. See chassis description for common switch segment slots. The split between switch segments is indicated on the chassis slot numbering overlay as a vertical bar.

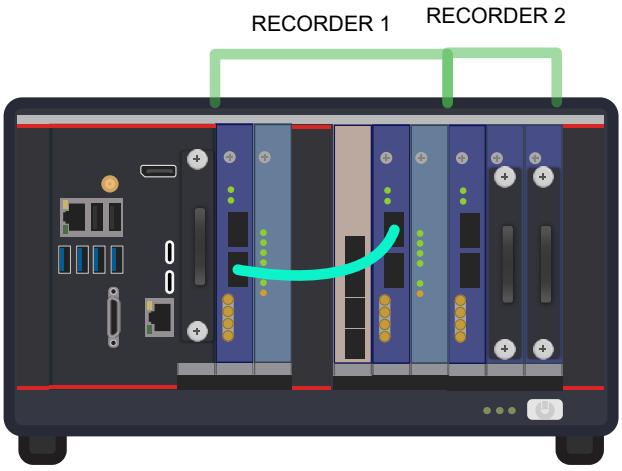


Expansion Chassis

If a configuration becomes limited by the number of slots available in a chassis it is possible to utilize PXIe expansion cabling to create a transparent bridge to a second chassis. The tested limit for the number of recorder elements for each PXIe controller is currently limited to 8. The use of an expansion chassis to allow increased storage capacity is supported but each of these configurations need to be reviewed and tested by Conduant.

Multi-Chassis

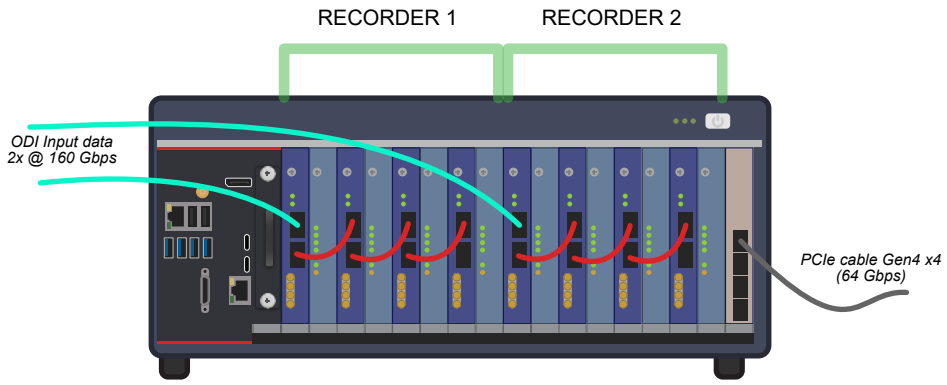
Multi chassis configurations (multiple PXIe controllers/chassis) connecting to a single host computer can be supported with both network and cabled PCIe connections. The cabled PCIe option is limited to 4 connections per PCIe slot on the host computer.



Example of system with 2 recorders.

Recorder #1 - Dual element chain (10 GB/s) with 2 DM-4M.2 storage boards (8 drives).

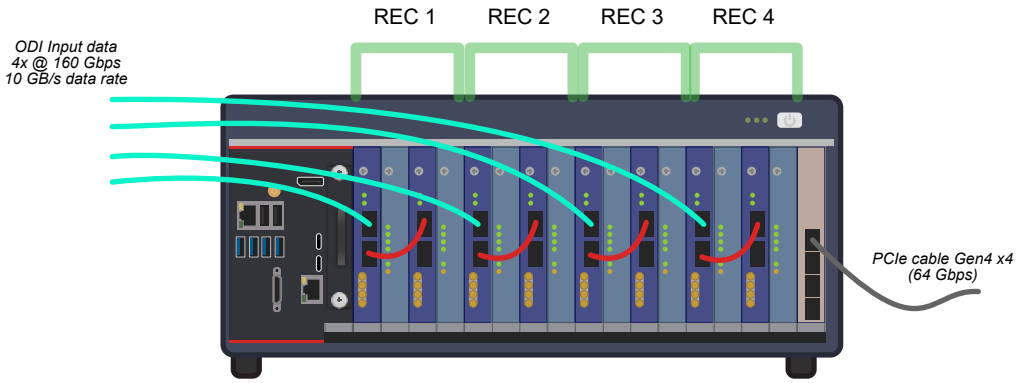
Recorder #2 - Single element recorder with dual DM-U.2 removable drives (5 GB/s)



Example of a system to support a single full speed channel from an M8131A digitizer. At 32 GS/s the M8131A outputs channel data on 2 ODI ports (160 Gbps or 20 GB/s each) with each 10 bit data sample alternating between the 2 ODI streams.

The recorder is configured as 2 chained recorders of 4 elements each with 4 NVME M.2 storage devices (one PXIe board) per element. There is a total of 8 Cobra boards and 8 DM-4M.2 boards and the chassis must be the Keysight M9046A to support the power requirements of this many FPGA and storage boards.

This system configuration can also be used for 2 channels at 16 GS/s. Always consult the user manual for the actual ODI data rate of the various modes and speeds available in the M8131A.



Example of a system to support 4 channels at a reduced data rate. The source might be an M8131A digitizer with decimation or DDC enabled. This configuration might also be used for the output of an N9042B at 10 GB/s. The bit rate of the ODI connection is still 160 or 150 Gbps but the actual data rate is limited to 10 GB/s (80 Gbps).

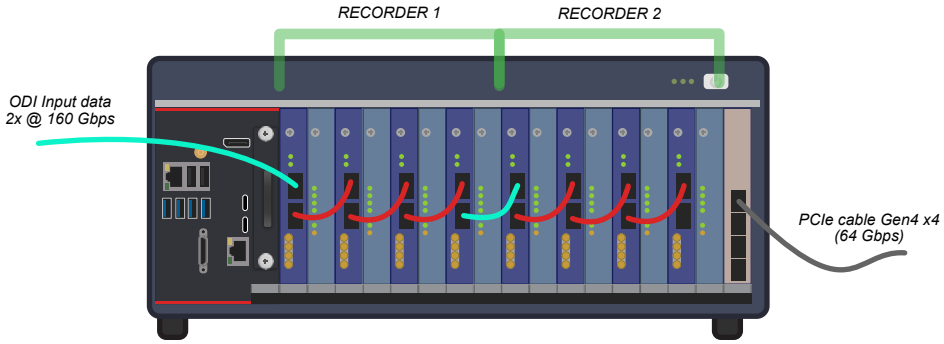
The recorder is configured as 4 chained recorders of 2 elements each with 4 NVME M.2 storage devices (one PXIe board) per element. There is a total of 8 Cobra boards and 8 DM-4M.2 boards and the chassis must be the Keysight M9046A to support the power requirements of this many FPGA and storage boards.

Flow Through

The Cobra recording system is designed to allow flow-thru data from the input to the output regardless of whether or not the recorder is actively recording.

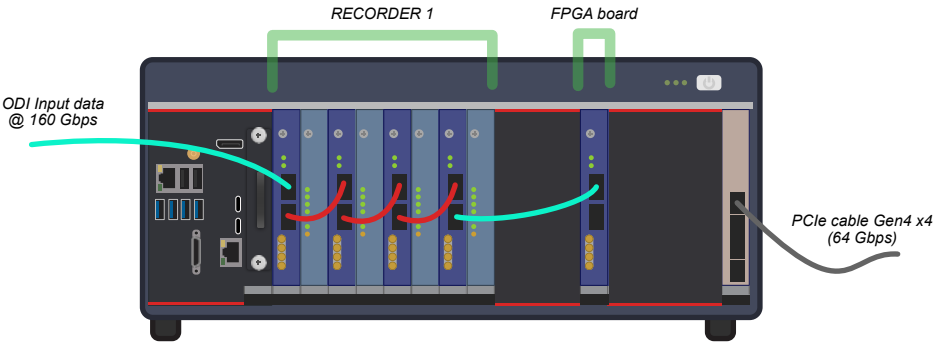
Here this feature is being used to record to a redundant recorder.

- This can be used for critical data backup
- Or to allow a recorder to be stopped for data review, analysis or download.



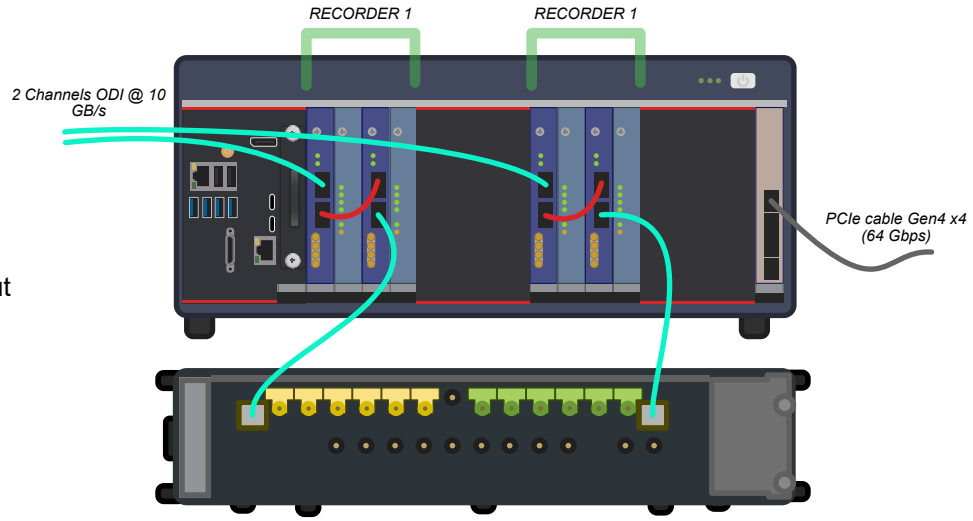
Here this feature is being used to record and/or stream to an FPGA board.

- This can be used for real-time processing.



Here this feature is being used to record and/or stream to a Keysight M8121A AWG.

- This can be used for real-time output to the AWG with or without recording enabled.
- The data could also go through an FPGA board as above and then to the AWG.

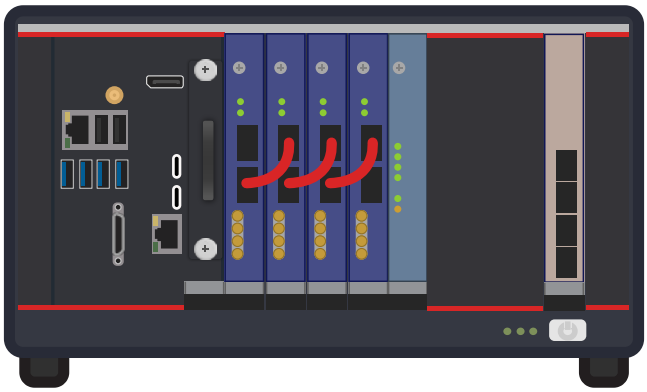


Memory Recorder

A Cobra recording element has the ability to stream from an incoming ODI data stream to on-board memory at the full rate of 160 Gbps if the data is not being simultaneously written to storage. This is only possible because the memory buffer is not also servicing the storage read requests simultaneously as would be the case when recording for long durations.

For applications that only require the capture of short duration data bursts this capability can be utilized to reduce the size and cost of the recording system. The StreamStor software has been designed to recognize when the requested recording size is smaller then the on-board memory available to enable this feature. The system operation does not change from the users perspective except that writing to storage is delayed until after the full recording has been captured in on-board memory. The write to disk still occurs but is performed post data capture to avoid bottlenecks when accessing the memory buffer.

A memory recorder configuration does not require multiple storage drives since the data is not being written in real-time as it is received. The available on-board memory is approximately 8GB and recorders can still be chained to increase this capacity in 8GB steps. A single storage device is required per FPGA board.



In this example, a chain of 4 Cobra FPGA boards is used to provide 32GB of storage maximum for each recording. A single M.2 NVME board provides one storage device for each recorder element. Multiple bursts can be recorded with a short latency between captures while the data is written to storage.

Customization

The base FPGA board in the Cobra recording systems can be easily customized along with the controlling software to provide various features such as triggers, virtual channels, etc. Conduant also has experience delivering various streaming protocols using the AMD Aurora protocol or the Interlaken protocol. We can vary the bit rates, protocol features, fiber bonding and other parameters to meet unique requirements. The FPGA boards available from Conduant can also be used to add hardware based signal processing and can include pre-configured ODI interfaces to connect with Keysight hardware.