StorePak™ 3U OpenVPX

SP306R-VPX: 3U VPX PCIe Connected Removable SSD Module & Carrier

StorePak™ 3U VPX

StorePak is a single slot **removable** SSD (solid state drive) module designed to be used either stand-alone as Direct Attached Storage, or in conjunction with Critical I/O's StoreEngine storage manager. The StorePak™ removable SSD module is specifically designed for easy removal and replacement of on-board storage. Since there are no tools needed to remove StorePak, it is ideal for applications where removal of onboard storage must be accomplished quickly. StorePak provides high performance and high-capacity rugged solid state storage all within a small size, weight, and power (SWaP) footprint. StorePak supports high bandwidth data recording, file serving, and general-purpose RAID applications where quick and simple removal of on board SSDs is essential.

High Density

A single StorePak module can provide up to 6 Terabytes (6 TB) of solid state storage in one 3U slot. Multiple configurations of StorePak are available which feature various storage capacities, performance capabilities, and SSD types.

Scalable Storage

StorePak can be easily scaled by aggregating multiple StorePaks to offer even greater capacities and performance. StorePaks can operate independently or as a single storage resource.

Hot Swap & Hot Plug

StorePak allows the user to "hotplug" or "hotswap" their storage without powering down the system. This is ideal for applications where it is not feasible or desired to power down the system in order to remove/replace the SSD storage.

Multi-Mode Operation

When StorePak is used stand-alone, it provides a high performance unmanaged DAS capability with hardware RAID 0/1. When used in conjunction with a StoreEngine storage manager module, StorePak also provides high performance data recording/playback capability, fully managed Direct Attached Storage (RAID), as well as a NAS file sharing capability.

Hardware Based RAID 0/1/10/1E

StorePak supports hardware RAID 0 (striping, for highest performance), RAID 1 (mirroring), or RAID 10/1E (mirroring/striping) for additional data protection. Sustained RAID 0 data rates of up to 2.2 GBytes/sec can be achieved using a single StorePak, and multiple StorePaks may be combined to achieve even higher rates. StorePak SSDs can also be used as individual drives (non-RAID) or with host based RAID 5.

StorePak Features:

- **High Capacity – up to 6 TB in a single StorePak**
- **Removable Solid State Storage Module**
- **3U Air Cooled VPX Module**
- **100,000 insertion cycles (StorePak storage module)**
- **Small SWaP footprint (size, weight and power)**
- **Rugged Design**
- **Six 4-lane PCIe backplane ports**
- **Data plane and expansion plane PCIe connectivity**
- **Low Power: 35 Watts typical**
- **High Performance: up to 2.2 GBytes/s per StorePak**
- **Hardware RAID 0/1/10/1E (or host based RAID 5)**
- **Scalable & Expandable (add StorePaks)**
- **Air and conduction cooled versions available**

StorePak Usage Models

StorePak can be used stand-alone as a unmanaged Direct Attached Storage (DAS) attached to a host CPU board using a PCIe connection to the host. StorePaks may also be used in conjunction with a StoreEngine storage manager blade to provide a flexible set of storage capabilities including recording and NAS file sharing.

StorePak Stand-alone: Unmanaged Direct Attached Storage with Hardware RAID

When used stand-alone, StoreEngine provides a simple unmanaged DAS capability (i.e. raw drives), which are connected to a host CPU board using PCIe. Individual drive images can be exposed to the host, or hardware RAID 0/1/10/1E can be configured.
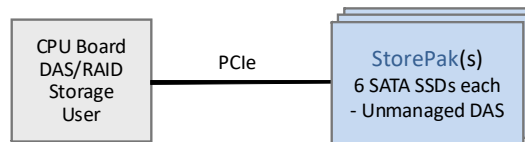
StorePak + StoreEngine: Multi-Channel Data Recorder

A more complex application of StorePak/StoreEngine combination is shown below. Here one StoreEngine is managing three StorePaks, each StorePak receiving a different channel of data. This example system provides up to 18 TB of recording capacity, with a recording rate of up to 6 GBytes/s.
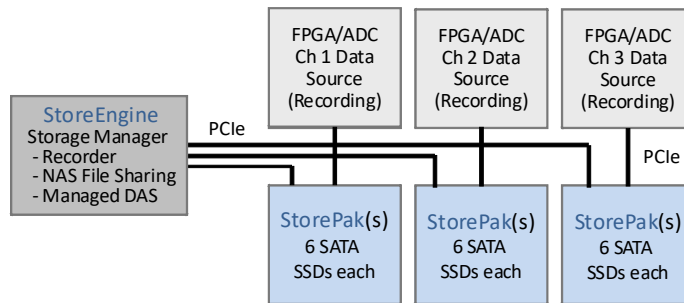

StorePak + StoreEngine: Multi-mode Operation

The StorePak/StoreEngine combination can provide concurrently:
- High performance data recording capabilities at rates of over 2000 MB/s per StorePak.
- NAS file sharing capabilities using NFS, CIFS, or FTP over 1/10 Gb Ethernet.
- Fully managed Direct Attached Storage (DAS, aka RAID) capabilities using PCIe or Fibre Channel.
- Hardware based RAID 0/1/10/1E for all modes of operation.

An example of using the StorePak/StoreEngine combination is shown below. In this example StorePak/StoreEngine is being used concurrently for three different modes of operation: NAS file sharing, high performance data recording, and DAS RAID.
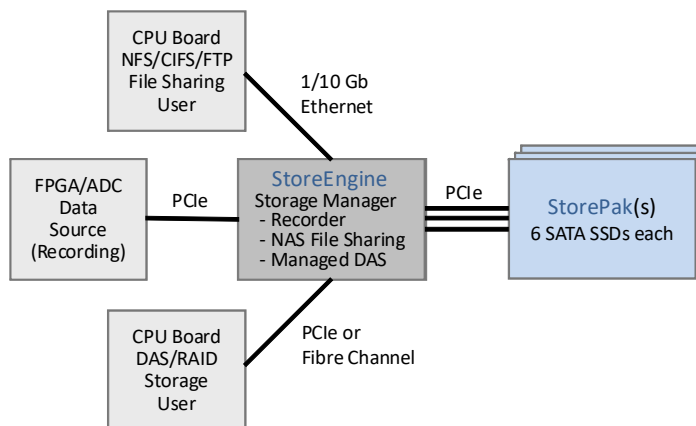
PCIe Connectivity

The standard SC301P-VPX configuration provides the following PCIe backplane connectivity. This is designed to be compatible with selected VPX payload slot profiles.

- P1: 3x - x4 PCIe fat pipes (factory build option for **4x** - x4 on P1 for improved VPX **switch** slot compatibility)
- P2: 3x - x4 PCIe fat pipes

Flash Media Options

All standard StorePak configurations leverage MLC flash media:

- **SSD-MLC - Multi-Level Cell (MLC) Flash Media –** Characterized by slightly lower reliability, lower write endurance, excellent sequential read/write performance, moderate random read/write performance, high storage capacity, and lowest cost.

The following additional types of flash media are available on a special order basis:

- **SSD-SLC - Single Level Cell (SLC) Flash Media –** Characterized by highest retention and reliability, highest write endurance, very good sequential and random read/write performance, but lower storage capacity and highest cost.

- **SSD-eMLC - Enhanced Multi-Level Cell (eMLC) Flash Media –** Characterized by excellent retention and reliability, very good write endurance, excellent sequential read/write performance, moderate random read/write performance, and high storage capacity.

- **SSD-TLC - Triple-Level Cell (TLC) Flash Media –** Similar to MLC, but with higher capacity and lower write endurance and a more limited operating/storage temperature range.

Encryption Capabilities

The following data protection options are available for StorePak:

- **Password Protection** - All StorePak SSD options implement a user definable drive password. The password is required to unlock the SSD and gain access to data. Drives that implement password only capability are resistant to a casual attempt to gain access to stored data.

- **AES-256 Full Drive Encryption** - AES Full Drive Encryption SSDs (FDE, also known as Self Encrypting Drives or SEDs) also implement a password (aka Authentication Key) but in addition they implement an encryption mechanism based on a Media Encryption Key which is used to encrypt all data stored on the SSD, using an AES-256 encryption algorithm.

- **TCG/Opal** - The Trusted Computing Group (TCG) Opal specification defines standards specifically for the implementation of security features for self-encrypting drives (SEDs). These standards are designed to protect the confidentially of data stored on the SSD device. The TCG/Opal specification encompasses key aspects of security implementation, including Cryptographic features, Authentication features, and Access Control features. TCG/Opal compliant SSDs implement AES encryption and password protection in a standardized manner.

- **FIPS 140-2 Level 1** - The Federal Information Processing Standard (FIPS) Publication 140-2 defines requirements to validate cryptographic modules. FIPS-140-2 goes beyond TCG-Opal in that, in addition to defining security functional requirements (as does TCG-Opal) it also defines a certification process to which the implementation must be subjected prior to claiming FIPS compliance. FIPS-140-2 provides four levels of security. Level 1 encompasses the security algorithm implementation and validation. FIPS compliant SSDs implement AES encryption and password protection.

StorePak Model Numbers

Standard StorePak 3U model numbers are defined as: SP306R-VPX-YYxxxxZ, where:

YY = SSD Class
 (MC = MLC "C" speed grade, MB = MLC "B" speed grade)
xxxx = aggregate raw StorePak capacity in GBytes
Z = Encryption (blank = password only, E = AES-256, T = TCG/Opal AES, F = FIPS 140-2 level 1 AES)

Not all model number combinations are valid

Typical StorePak Performance Characteristics (see notes)

DAS (direct block access) Performance

StorePak Model#	Sequential Read (RAID0, 1 MB block)	Sequential Write (RAID0, 1 MB block)	Sequential Write (RAID5, 1 MB block)
SP306R-VPX-MCxxxx	2200 MByte/s	2000 MByte/s	1100 MByte/s
SP306R-VPX-MBxxxx	1800 MByte/s	1600 MByte/s	800 MByte/s

Recording Mode Performance (with StoreEngine)

StorePak Model#	Read (1 MB block)	Write (1 MB block)
SP306R-VPX-MCxxxx	2200 MByte/s	2000 MByte/s
SP306R-VPX-MBxxxx	1800 MByte/s	1600 MByte/s

### NAS (NFS) Performance (with StoreEngine and 10GbE)

StorePak Model#	Sequential Write (RAID0, 1 MB block)	Sequential Write (RAID0, 1 MB block)	Sequential Write (RAID5, 1 MB block)	Random Read/Write (RAID5, 64 KB block)
SP306R-VPX-MCxxxx	1200 MByte/s	1000 MByte/s	500 MByte/s	250 MByte/s
SP306R-VPX-MBxxxx	1100 MByte/s	900 MByte/s	400 MByte/s	250 MByte/s

Notes:
(1) Performance numbers shown are maximums using newly erased SSDs and SC300-VPX carrier board. Actual performance can vary greatly, and depends on the specifics of the application. Contact Critical I/O to discuss performance expectations.
(2) Recording mode, RAID5 or NAS operation requires use of StoreEngine or other host SBC.
(3) Performance data is subject to change.

Technical Specifications

Architecture	VPX 3U removable SSD storage module/carrier with up to 6 SATA SSDs
Storage Capacity	Up to 6 TB
Standard Interfaces	3 or 4 – PCIe x4 via P1 Backplane (data plane, can be merged into x8) 3 – PCIe x4 via P2 Backplane (expansion plane)
RAID 0 Performance (RAID 5 with StoreEngine)	up to 2200 MByte/s RAID 0 up to 600 MByte/s RAID 5
Storage Security	Optional AES, TCG/Opal, or FIPS-140 full drive encryption
Management	Web based GUI (for StoreEngine based applications) StorePak Manager utility (for DAS applications)
Form Factor	3U VPX (1.0" pitch VITA 48) air cooled
Weight (StorePak + Carrier)	21 oz
Power Requirements	+5VDC at 5A maximum +3.3VDC at 9A maximum (maximum power is dependent on SSD type and aggregate data rate)
Power Consumption	35 Watts (typical, with six SATA SSDs)
Temperature	Std: Operating: 0C to +55C; Storage: 0C to +70C ET: Operating: -20C to +55C; Storage: -40C to +85C ET1: Operating: -40C to +71C; Storage: -40C to +85C
Humidity	Std: Operating: 10-90%, non-condensing, Storage: 5-95%, non-condensing ET: Operating: 0-95%, non-condensing, Storage: 0-100%, condensing ET1: Operating: 0-95%, non-condensing, Storage: 0-100%, condensing
Vibration – Random	0.01 g2/Hz (100-1000 Hz)
Shock	20g Peak sawtooth, 11ms duration
SSD Module Connector	100,000 insertion cycles
Supported Host Processors	x86, PowerPC
OS Software Support	VxWorks, Linux, Windows
Base Model Numbers	SP306R-VPX + SC300P-VPX (PCIe optimized for VPX payload slot) SP306R-VPX + SC300-VPX (PCIe optimized for VPX switch slot)
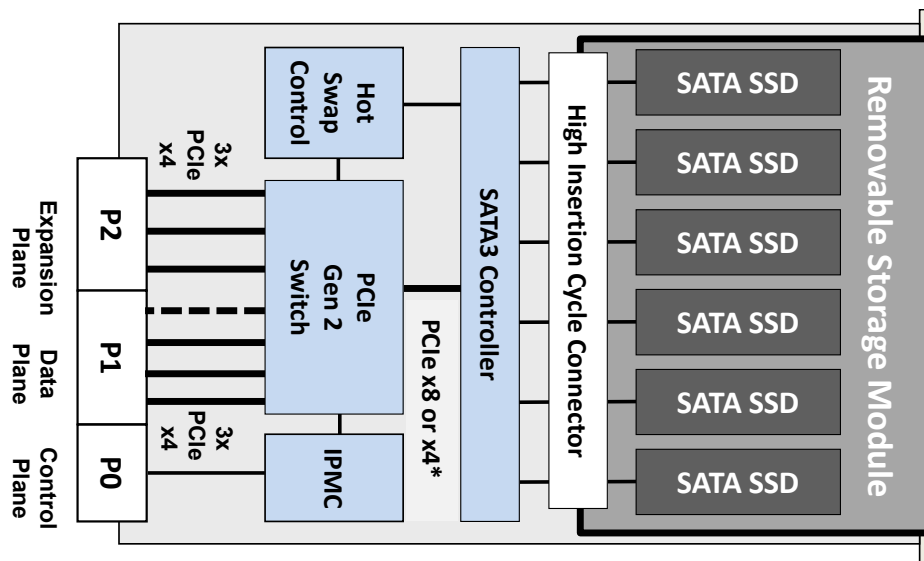
Dashed PCIe x4 connection is present in SC300 version only
* PCIe x4 in SC300 version, PCIe x8 in SC300P version

StorePak (SP306R-VPX) + Carrier (SC300P-VPX or SC300-VPX) Block Diagram