

PRELIMINARY StorePak™ NVMe 3U Conduction Cooled VPX



SP306N-VPX: 3U VPX PCIe Connected Removable NVMe SSD Module & Carrier

StorePak™ NVMe 3U CVPX

StorePak NVMe 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™ NVMe 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 NVMe module can provide up to 12 Terabyte (12 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 "hot plug" or "hot swap" their storage without powering down the system. The system to remove or replace the SSD storage. Hot-plug and hot-swap capabilities require a suitably configured host processor operating system, BIOS, and hardware. Contact Critical I/O for additional information on hot swap/plug compatibility.

Multi-Mode Operation

When StorePak is used stand-alone, it provides a high-performance unmanaged DAS capability with optional host-based software RAID 0/1/5. 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.

Host-Based Software RAID

The multiple NVMe SSDs on StorePak can be used in conjunction with host-based software RAID. RAID 0 (striping) is commonly used to aggregate drives for maximum performance. RAID 1 (mirroring) and RAID 5 (parity) are often used for enhanced data protection through redundancy.

StorePak Features:

- **High Performance:** up to 5 GBytes/s per StorePak
- **High Capacity** – up to 12 TB in a single StorePak
- **Removable Solid State Storage Module**
- **3U Air Cooled VPX Form Factor**
- **100,000 insertion cycles** (StorePak storage module)
- **Small SWaP footprint** (size, weight, and power)
- **Rugged conduction-cooled design**
- **Seven 4-lane PCIe Gen3 backplane ports**
- **Data/Expansion plane PCIe connectivity**
- **Low Power:** 35 Watts typical
- **Host based Software RAID support**
- **Scalable & Expandable** (add StorePaks)
- **Air and conduction cooled versions available**



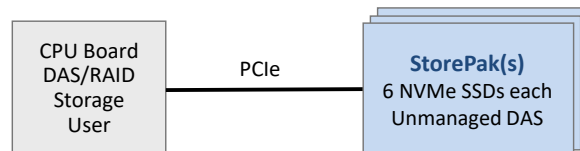
StorePak combines a removable storage module with a fixed carrier base module

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.

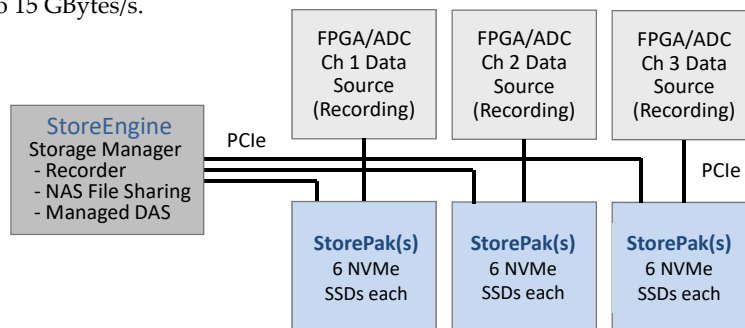
StorePak Stand-alone: Unmanaged Direct Attached Storage with Hardware RAID

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 software-based RAID 0/1/5 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 36 TB of recording capacity, with an aggregate recording rate of up to 15 GBytes/s.

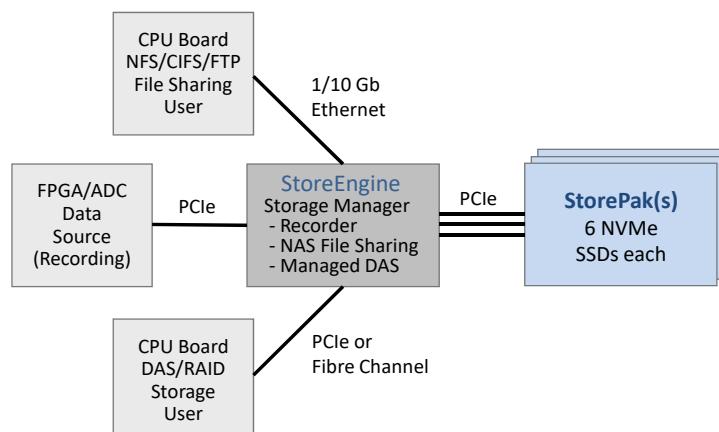


StorePak + StoreEngine: Multi-mode Operation

The StorePak/StoreEngine combination can provide concurrently:

- High performance data recording capabilities at rates of over 5000 MB/s per StorePak.
- NAS file sharing capabilities using NFS, CIFS, or FTP over 1/10/25 Gb Ethernet.
- Fully managed Direct Attached Storage (DAS, aka RAID) capabilities using PCIe or Fibre Channel.
- Support for software-based RAID 0/1/5 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 Backplane Connectivity

The standard SC301P-VPX configuration provides the following PCIe Gen 3 (Gen 2 and Gen 1 also supported) backplane connectivity. These assignments are designed to be generally compatible with selected VPX payload and switch slot profiles.

- P1: 3x - x4 PCIe Gen 3 fat pipes
- P2: 4x - x4 PCIe Gen 3 fat pipes

Flash Media Options

All standard StorePak configurations leverage TLC flash media:

- **SSD-3DTLC – 3D Triple-Level Cell (TLC) Flash Media** – Characterized by highest capacity, lowest cost, moderate write endurance, excellent sequential read/write performance, moderate random read/write performance, and slightly more limited temperature range.

The following additional types of flash media may be available on a special-order basis:

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

Encryption/Security 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 confidentiality 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 defines four levels of security. FIPS Level 1 encompasses the security algorithm implementation and validation. FIPS compliant SSDs also implement AES encryption and password protection.

StorePak and Carrier Model Numbers

StorePak Carrier 3U model number is: **SC300N-CCVPX**.

Standard StorePak 3U model numbers are defined as: **SP306N-CCVPX-YYxxxxxZ**, where:

YY = SSD Class

(3T = 3DTLC)

xxxxx = 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)

Note: Not all model number combinations are valid

Typical StorePak Performance Characteristics (see notes)

PRELIMINARY

DAS (direct block access) Typical Performance

StorePak Model#	Sequential Read (RAID0, 1 MB block)	Sequential Write (RAID0, 1 MB block)	Sequential Write (RAID5, 1 MB block)
SP306N-VPX-3Txxxx	4500 MByte/s	4500 MByte/s	2000 MByte/s

Recording Mode Typical Performance (with StoreEngine)

StorePak Model#	Read (1 MB block)	Write (1 MB block)
SP306N-VPX-3Txxxx	5000 MByte/s	5000 MByte/s

NAS (NFS) Typical 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)
SP306N-VPX-3Txxxx	1200 MByte/s	1000 MByte/s	700 MByte/s	500 MByte/s

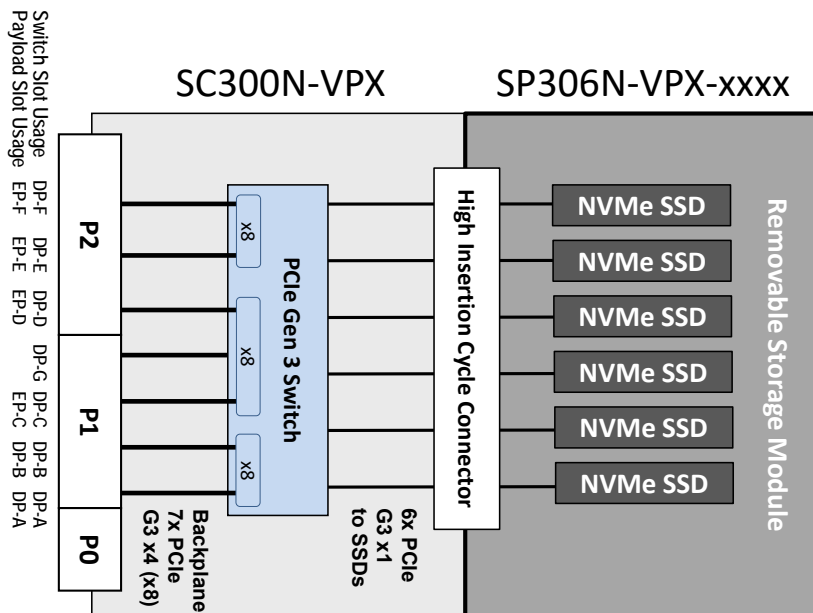
Notes:

- (1) Performance numbers shown are maximums using newly erased SSDs with SC300N-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) Adequate cooling is critical. Thermal performance throttling may occur if StorePak case temperature exceeds 80C.
- (3) Recording mode, RAID, or NAS operation requires use of StoreEngine or another host SBC.
- (4) Performance data is subject to change.

Technical Specifications PRELIMINARY

Architecture	VPX 3U removable storage module/carrier with up to 6 NVMe SSDs
Storage Capacity	Up to 12 TB
Standard Interfaces	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 5000 MByte/s RAID 0 up to 2000 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 Utility (for DAS applications)
Form Factor	3U VPX (1.0" pitch VITA 48) conduction cooled (standard configuration compliant)
Weight (StorePak + Carrier)	TBD
Power Requirements	+12 VDC at 1.5A maximum +3.3VDC at 9A maximum after startup +3.3VDC at 12A maximum for up to 1 second at startup (operational power is dependent on SSD type and aggregate data rate)
Power Consumption	35 Watts (typical, with six SATA SSDs)
Temperature	R1: Operating: -40C to +71C; Storage: -40C to +85C R2: Operating: -40C to +85C; Storage: -55C to +105C
Humidity	Operating: 0-95%, non-condensing, Storage: 0-100%, condensing
Vibration – Random	VITA 47 Class OS2: 40g Peak sawtooth (11ms duration)
Shock	VITA 47 Class V3: 0.1g2/Hz (14.1 grms) 15-2000 Hz
Drive Module Connector	100,000 insertion cycles
Supported Host Processors	x86, PowerPC
OS Software Support	VxWorks, Linux, Windows
Base Model Numbers	SP306N-CCVPX + SC300N-CCVPX (standard configuration) SP306N-CCVPXZ + SC300N-CCVPX (tool-less configuration*)

*The tool-less removal CC StorePak version uses lever type wedgelocks which extend slightly out from the front of the StorePak module and thus exceed the standard VPX conduction cooled space envelope. Contact Critical I/O for additional information.



StorePak (SP306N-VPX / CCVPX) + Carrier (SC300N-VPX / CCVPX) Block Diagram