

StoreEngine™ OpenVPX



SE300-VPX Data Sheet: 3U VPX Solid State Storage Blade – Recorder/File Server/Embedded RAID

StoreEngine 3U VPX and 3U CVPX

StoreEngine is a scalable storage manager blade designed for high performance embedded systems. StoreEngine can be combined with one or more StorePak XMC or 3U StorePak SSD storage modules to concurrently support these storage functions:

- Data recording/playback (PCIe/Ethernet/Fibre Channel)
- Serving DAS (block) data (like a disk drive or RAID system)
- Serving NAS (file) data (like a NFS/CIFS file server)

StoreEngine is designed to manage SSD storage that is hosted via either StorePak XMCs or StorePak 3U VPX storage blades. This combination provides ultra-high performance and high capacity storage within a small size, weight, and power (SWaP) footprint.

StoreEngine is available with on-board SSD storage (as provided by StorePak XMCs), or StoreEngine can be used with one or more backplane PCIe connected 3U VPX StorePak modules.

On-board SSD Storage with StorePak XMC

Up to 12 TB of high speed NVMe SSD storage is provided by each optional StorePak XMC. Multiple StorePak XMCs can optionally be “stacked” for increased storage capacity.

Removable Storage with StorePak 3U VPX

StoreEngine may also be used in conjunction with StorePak 3U VPX modules. Each 3U StorePak module provides up to 6 TB of hot-swappable SSD storage, and multiple StorePaks can be aggregated for increased capacity. Note that a backplane PCIe connection is required between StoreEngine and StorePak(s). See the StorePak 3U VPX data sheet for more information.

Scalable Data Recording/Playback

StoreEngine provides fully turnkey data recorder functionality. This provides a flexible and scalable recording platform to record or playback high bandwidth data streams from PCIe connected ADCs, DACs, FPGAs, video streams, and 1/10GbE or Fibre Channel sources, at rates of up to 6 GB/s*.

Network File Server - NAS

StoreEngine’s NAS (Network Attached Storage) provides file-level access to its onboard RAID volume for applications that require file-level and shared access to data among multiple clients at more moderate access rates using protocols such as NFS and CIFS. StoreEngine NAS supports data rates of over 1 GB/s.

Embedded DAS/RAID

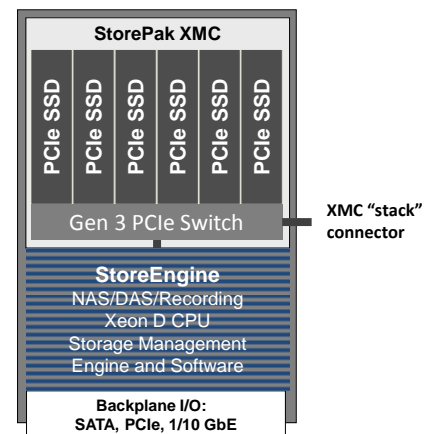
StoreEngine’s embedded RAID provides block-level access to its onboard storage via PCIe or Fibre Channel interfaces at rates of over 2GB/s. Access to storage is provided via standard VPX backplane PCIe or Fibre Channel with an optional FC XMC.



StoreEngine Air Cooled SE306-VPX is shown with one optional StorePak XMC (SSD storage) module

3U StoreEngine VPX Features:

- Intel Xeon based Storage Management Module
- Linux based storage management software stack
- Optional StorePak SSD Storage XMC– up to 12 TB
- High Performance: up to 6 GB/s*
- Turnkey Scalable High Speed Recording
- NAS Network File Server (NFS/CIFS) functionality
- Concurrent Embedded RAID & NAS operation
- RAID 0/1/5/10 (with StorePak XMC)
- Xeon D Processor, 8 GB DDR4-2133 (34 GB/s)
- Built-in PCIe and 1/10 GbE backplane I/O
- Optional XMC I/O: 1/10 GbE or Fibre Channel
- Scalable & Expandable (add StorePaks)
- 40 Watts typical (without StorePak XMC)
- 55 Watts typical (with one StorePak XMC)
- Air or Conduction cooled rugged versions



Critical I/O's StoreEngine provides secure, reliable, high performance Recording, NAS, and DAS capabilities, with optional on-board high capacity StorePak SSD storage.

*StorePak XMC sustained SSD data rate may be thermally limited. Maximum rate with 3 SSD StorePak XMC is lower.

3U VPX StoreEngine Version Matrix

Base Model Number	Cooling	Includes StorePak XMC (SSD Storage)	Includes XMC "Stack" Connector	Peak Storage Performance	Maximum SSD Storage Capacity	Accommodates Standard I/O XMCs
SE300-VPX-ND	Air	No	n/a	n/a	n/a	Yes
SE303-VPX-	Air	3 SSD XMC	No	3 GB/s	6TB	No
SE306-VPX-	Air	6 SSD XMC	No	6 GB/s	12TB	No
SE306S-VPX-	Air	6 SSD XMC	Yes	6 GB/s	12TB	No
SE300-CCVPX-ND	Conduction	No	n/a	n/a	n/a	Yes
SE303-CCVPX-	Conduction	3 SSD XMC	No	3 GB/s	6TB	No
SE306-CCVPX-	Conduction	6 SSD XMC	No	6 GB/s	12TB	No
SE306S-CCVPX-	Conduction	6 SSD XMC	Yes	6 GB/s	12TB	No



*StoreEngine 3U Air Cooled VPX
SE300-VPX-ND accomodates standard I/O XMCs*



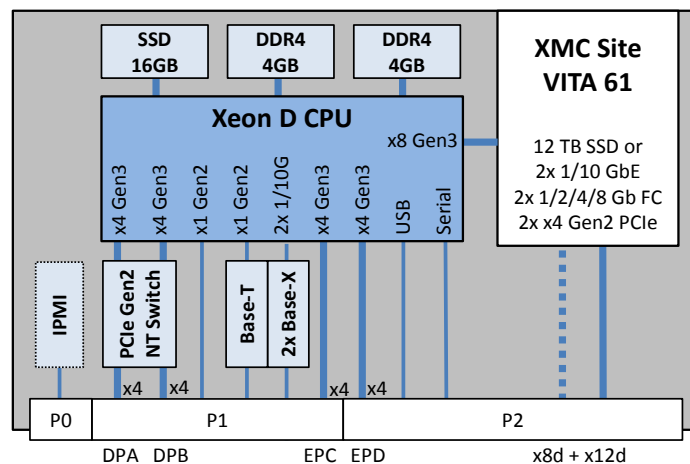
*StoreEngine 3U Conduction Cooled VPX
SE300-CCVPX-ND accomodates standard I/O XMCs
via a removable front panel/heat frame element*



*StoreEngine 3U Air Cooled VPX
SE306-VPX includes one 12TB StorePak XMC
(XMC shown includes optional XMC "stack" connector)*



*StoreEngine 3U Conduction Cooled VPX
SE306-CCVPX includes one 12TB StorePak CCXMC
(XMC shown includes optional XMC "stack" connector)*



Flexible Storage Interfaces

StoreEngine VPX supports a wide variety of standard and optional I/O. I/O expansion is available XMC modules.

- Backplane I/O – P1, P2
 - 2x 1/10 GbE KX/KR (supports NAS, recording)
 - 1x 1GbE Base-T (supports NAS)
 - 2x PCIe G2/3 x4 (supports DAS, recording)
 - 2x PCIe G2 x4 (supports DAS, recording)
 - 2x PCIe G2 x1 (for RTM and control connections)
 - 2x PCIe G2 x4 (with optional I/O Expansion module)
- Optional XMC I/O Expansion (displaces StorePak XMC)
 - 2 xPCIe G2 x4 backplane I/O
 - 2x XAUI 10Gb Ethernet backplane I/O
 - 2x 1/2/4/8Gb Fibre Channel (supports DAS, Recording)
 - 2x 1/10 GbE optical (supports NAS, Recording)

Flexible StoreEngine Usage Models

StoreEngine supports a flexible set of usage models. In general, storage usage models are typically divided into three categories: 1) High Performance Recording/Playback, 2) Direct Attached Storage (DAS), which provides *block level* storage access (including RAID), and 2) Network Attached Storage (NAS), which provides *file level* shared storage access.

High Performance PCIe, FC, or 1/10GbE Recording/Playback:

Critical I/O's Data Recorder software is hosted on StoreEngines which provides an ultra high speed scalable recording system. The recorder software implements a recording file system that supports recording rates of up to 6 GB/s. It also provides unified playback of recorded data, allowing multiple StoreEngines and StorePaks to appear as a single data source when data is replayed, as well as NFS network access to recorded data.

Record/playback data sources may be a streams from PCIe connected devices such as an ADCs, DACs, or FPGA boards, or a processor board with PCIe, or UDP/TCP data streams. Many variations of recording architectures and modes are supported; contact Critical I/O for more details.

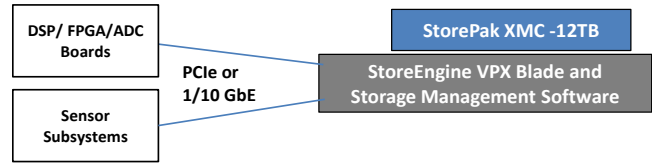
Fibre Channel or PCIe DAS: In these modes, the client utilizes StoreEngine storage in a low level block mode. The client processor hosts a file system that is provided by the client's own local operating system. The allocation and use of these low level SSD storage blocks is controlled completely by the client file system, thus DAS stored data cannot typically be shared between clients. Achievable data transfer rates for DAS storage are typically over 2 GB/s.

1/10 GbE NAS: Client access to storage is provided via network file access protocols such as NFS and CIFS. Because storage access is file based, NAS stored data can be shared among multiple clients. StoreEngine hosts a local file system, and thus it fully controls the low level allocation and use of SSD storage blocks. Data transfer rates for NAS storage are more moderate, typically 1 GB/s maximum.

StoreEngine Connectivity

Several StoreEngine connective examples are shown in the figures below.

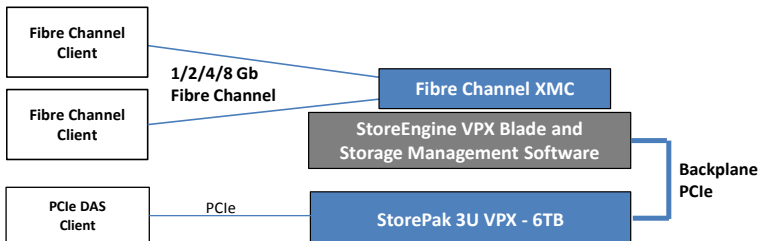
High Speed Recording PCIe and/or 1/10 GbE



For PCIe data recording, the StoreEngine SE303/SE306 recorder blades, along with the data source(s), are typically hosted in a VPX rack, and are interconnected using a VPX PCIe mesh or VPX switched backplane.

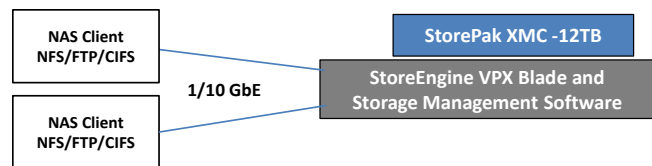
For 1/10 GbE data recording, the StoreEngine recorder blade(s) may be connected via backplane Ethernet or using optional optical 1/10 Gb Ethernet XMCs.

Fibre Channel or PCIe DAS/RAID and/or Fibre Channel Recording



For Fibre Channel recording or DAS/RAID operation, the StoreEngine SE300-VPX-ND recorder blade(s) are typically connected through the use of optical Fibre Channel XMCs

1/10 Gb Ethernet NAS



NAS clients are connected to StoreEngine SE303/SE306 via an 1/10 Gb Ethernet network, with connections made via backplane Ethernet. Connections may also be made using optional 1/10 GbE optical XMC modules.

NAS clients leverage standard network file access protocols such as NFS and CIFS to access the StoreEngine controlled SSD storage, which provides file level data sharing among all connected clients.

Stacking StorePak XMCs (optional)

StorePak XMC is unique in that it *optionally* features a second XMC “stack” connector on the “back” of the XMC that allows two or more StorePak XMCs to be stacked together for increased storage capacity (figure 1). Stacked XMC configurations need extra space and generally require that an adjacent card slot be left empty. In very limited situations it may also be possible to stack a StorePak XMC with an interface XMC (with a top/back optical transceiver) such as Fibre Channel or 1/10 GbE XMC (figure 2). Note that the standard shock, vibration, and power specifications do not apply to stacked configurations.

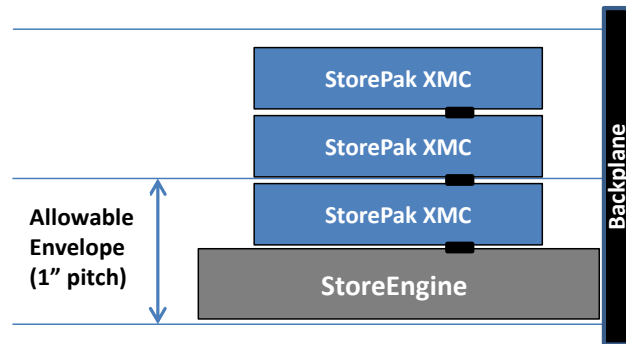


Figure 1. Stacking StorePak XMCs

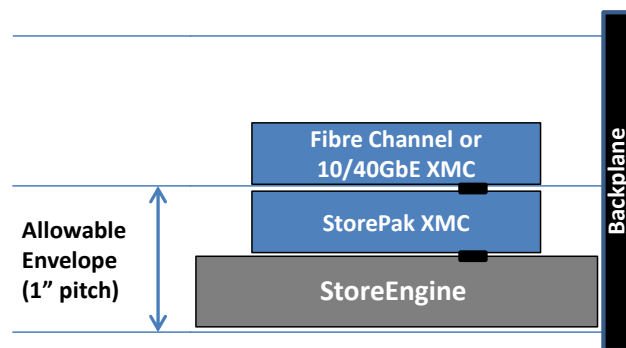


Figure 2. Stacking with an Interface XMC

StorePak XMC Thermal Considerations

Special attention must be paid to thermal factors when using StoreEngine with one or more StorePak XMCs, as both the StoreEngine and StorePak XMC power dissipation can be significant in performance applications.

The information provided in this section is intended highlight the various thermal factors, to help you decide if your application may be affected by thermal limitations. While the StoreEngine and StorePak XMC will function over their full specified temperature range, SSD data rates and/or StoreEngine CPU clock rates may be throttled at temperatures near the upper end of the operating temperature range.

SSD power varies significantly with read/write rate. Higher rates result in higher power. SSDs may thermally throttle (reduce) data rates if high temperature limits are reached.

Exacerbating this is the fact that most components (including the StorePak XMC’s SSDs and its internal PCIe switch) dissipate higher power levels at elevated temperatures.

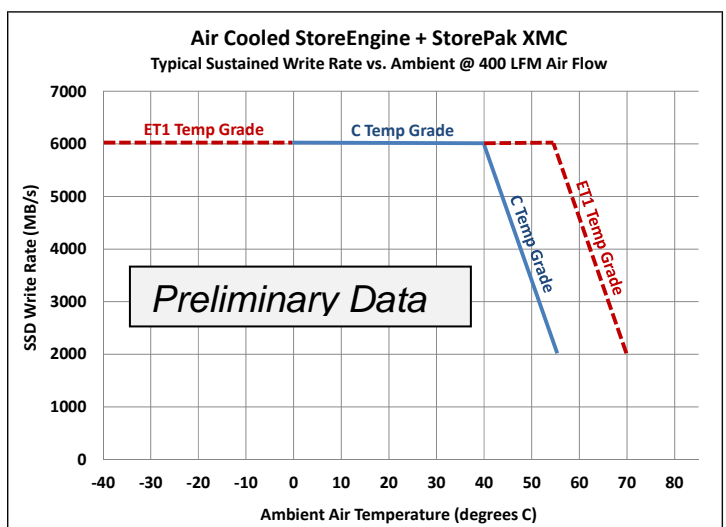
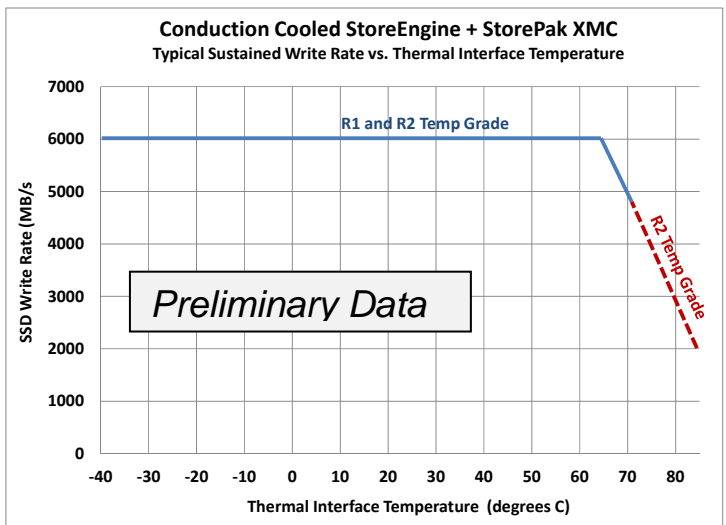
Several specific thermal factors should be evaluated:

- 1) Air or thermal interface temperature
- 2) SSD read/write rates and duty cycle
- 3) StoreEngine CPU loading/power

The thermal interface temperature is a critical factor for high performance applications. To avoid SSD or CPU throttling in these applications it is good practices avoid positioning the StoreEngine/XMC adjacent to high power VPX cards thus minimizing the air or thermal interface temperature.

It can also be useful to adjust StoreEngine power management parameters to minimize StoreEngine power and heat load. Please reference our White Paper: “Tuning StoreEngine and StorePak XMC for Minimum Power Operation” for a more detailed discussion of power reduction techniques.

The charts below show typical StorePak XMC maximum sustained write performance vs. temperature for the different air and conduction StoreEngine + StorePak XMC versions.



StorePak XMC SSD Options

StoreEngine supports the use of several standard different types of NVMe SSDs, depending on specific application requirements. Other SSD types such as eMLC or SLC may be available on a special order basis. Contact Critical I/O.

- **SSD-MLC** – Two Level Cell (MLC) SSDs provide high storage reliability, endurance, and performance.
- **SSD-3DTLC** – 3D Triple-Level Cell (TLC) SSDs provide similar reliability and endurance but with higher storage capacity as compared to MLC SSDs.
- **StorePak SSD count** – StorePak XMCs may be configured with either 3 or 6 SSDs. 6 SSDs StorePaks provide higher capacity and performance; 3 SSD StorePaks provide lower cost and power.

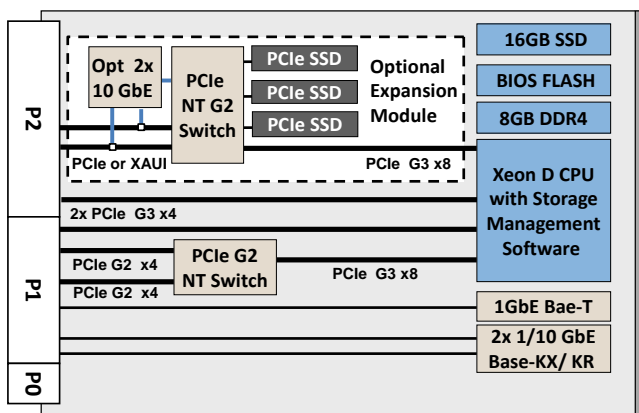
RAID Options

In any of the DAS or NAS modes of operation, StoreEngine storage can be configured as RAID 0/1/5/10/1E. All RAID levels are implemented in software (leveraging Linux md layer) when StoreEngine is used with StorePak XMC. When StoreEngine is used with one or more StorePak 3U VPX blades, hardware based RAID 0/1/10/1E is also supported

StorePak XMC SSD Security Options

The following data protection options are available:

- **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.
- **AES-256 Full Drive Encryption** - SSDs implement password protection and full drive encryption of all data stored on the SSD, using an AES-256 encryption algorithm.
- **TCG/Opal** - SSDs implement AES encryption and password protection in a standardized manner as defined by the TCG/Opal specification.



The optional I/O Expansion XMC module provides either 10GbE XAUI backplane I/O or additional PCIe backplane I/O, along with up to 2TB of SSD storage

Unified Web Based Management

StoreEngine provides a comprehensive web based management interface. This allows monitoring of status information, and configuration of interfaces, operating modes, and storage options.

Control/Management Capabilities

- BIT status (self test, voltages, currents, temperatures)
- Storage and protocol configuration
- Recorder configuration and control
- Storage status (available/used capacity, status, errors)
- Network statistics
- Interface Status (link status, errors)
- Performance monitor and benchmark
- Enable/Disable protocols & features
- Security, encryption, and permissions
- System Configuration Snapshots
- Quick Config and Config Restore
- Secure Erase

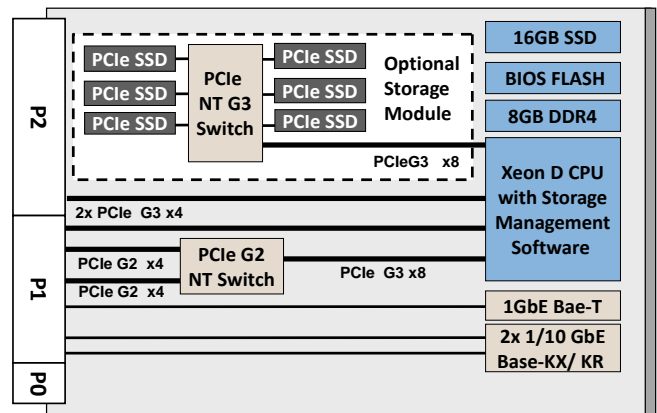
Built-In Test (BIT)

StoreEngine's standard Power-On Self-Test (POST) performs a test of the processor, cache, DDR4 memory, interfaces, and data paths. StoreEngine also runs a continuous basic BIT routine (CBIT), monitoring board/drive health. On-board temperatures, and power supply voltages and currents are also continuously monitored.

The condition of StorePak SSD drives, including errors and performance levels is also continuously monitored, allowing users to be notified in the event that drive performance or life expectancy begins to degrade.

Optional I/O Expansion and Storage XMCs

StoreEngine supports the use of optional I/O Expansion and StorePak XMC modules. These XMCs are illustrated within the dashed line area in the figures below.



The optional StorePak XMC module provides up to 12TB of ultra high performance PCIe connected NVMe SSD storage

Air Cooled StoreEngine Technical Specifications (preliminary)

Controller Architecture	Storage Controller with optional StorePak XMC (SSD Storage XMC)
Form Factor	3U VPX (1.0" pitch VITA 48) air cooled
Storage Software	StoreEngine Storage Management/Recording software (Linux based)
DRAM	8GB Dual Channel DDR4-2133 (34GB/s raw aggregate bandwidth)
Backplane Interfaces	2x PCIe x4 G2 2x PCIe x4 G2/3 (additional 2x PCIe x4 G2 with optional I/O Expansion XMC) 1x 1000Base-T GbE 2x 1/10G Base-KX/KR
XMC Site	VITA 61 XMC site. PCIe Gen3 x8 capable. (contact Critical I/O for VITA 42 XMC site availability)
Optional Interface XMCs	2x 10Gb Ethernet Optical (front I/O) 2x 1/2/4/8 Gb Fibre Channel Optical (front I/O) 2x XAUI 10Gb Ethernet (backplane I/O)
Performance	Recorder mode: up to 6 GB/s (up to 3 GB/s for 3 SSD StorePak XMC) Direct Attached Storage (DAS) mode: up to 2 GB/s File Server (NAS) mode: up to 1GB/s
Optional SSD Storage (StorePak XMC)	Up to 6TB with 3 SSD StorePak XMC Up to 12TB with 6 SSD StorePak XMC
DAS Protocol Support	PCIe DAS, Fibre Channel
NAS Protocol Support	NFS, FTP, CIFS/SMB, UDP Direct
Storage Security (StorePak XMC)	Std: ATA security (password), no encryption E: AES-256 full drive encryption T: TCG/Opal AES-256 full drive encryption F: FIPS-140-2 Level 1 full drive encryption
Management	Web GUI, Network Management Protocol
Power Requirements	+12VDC at 5A (no XMC) or 6A (with 3 SSD XMC) or 7A (with 6 SSD XMC) +3.3VDC at 0.5A
Power Consumption (Preliminary)	40 Watts (typical, no StorePak XMC) 50 Watts (typical, with 3 SSD StorePak XMC) 55 Watts (typical, with 6 SSD StorePak XMC)
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)	VITA 47 Class V2: 0.04g ² /Hz (100-1000 Hz)
Shock	20g Peak sawtooth (11ms duration)
Weight	SE300-VPX_ND: SE303-VPX or SE306-VPX
Supported Client Platforms	Intel, PowerPC
Client Software Support	Drivers for VxWorks, Linux, Windows (protocol/mode support varies by OS, contact Critical I/O)
Base Model Number	SE303-VPX – Configuration with 3 SSD StorePak XMC SE306-VPX – Configuration with 6 SSD StorePak XMC SE300-VPX-ND – Configuration without StorePak XMC
Model Description	3U VPX StoreEngine, embedded storage controller (optional PCIe Solid State drives on StorePak XMC), air-cooled 3U VPX, RoHS LEAD FREE

*Non-powered extended storage at high temperatures may result in reduced data retention duration

Air Cooled 3U VPX StoreEngine Model Numbers (Not all option combinations are valid)

StoreEngine with no XMC: SE300-VPX-ND
 StoreEngine with 3 drive XMC: SE303-VPX-YYxxxxW-ZZZ
 StoreEngine with 6 drive XMC: SE306-VPX-YYxxxxW-ZZZ (XMC does not have "stack" connector)
 StoreEngine with 6 drive XMC: SE306S-VPX-YYxxxxW-ZZZ (XMC has "stack" connector)

where: YY: SSD Class (MC = MLC, 3T = 3D TLC NAND)
 xxxxx: aggregate raw StorePak XMC capacity in GBytes
 W: SSD security option (blank = password, E = AES-256, T = TCG/Opal, F = FIPS140-2)
 ZZZ: temperature range (blank = 0C to +50C, ET = -20C to +55C, ET1 = -40C to +71C)

Example: SE306-VPX-MC12000E-ET1
 3U VPX Air Cooled StoreEngine with 6 SSD 1200GB MLC StorePak XMC, AES-256, -40C to +71C

Conduction Cooled StoreEngine Technical Specifications (preliminary)

Controller Architecture	Storage Controller with optional StorePak XMC (SSD Storage XMC)
Form Factor	3U VPX (1.0" pitch VITA 48) conduction cooled
Storage Software	StoreEngine Storage Management/Recording software (Linux based)
DRAM	8GB Dual Channel DDR4-2133 (34GB/s raw aggregate bandwidth)
Backplane Interfaces	2x PCIe x4 G2 2x PCIe x4 G2/3 (additional 2x PCIe x4 G2 with optional I/O Expansion XMC) 1x 1000Base-T GbE 2x 1/10G Base-KX/KR
XMC Site	VITA 61 XMC site. PCIe Gen3 x8 capable. (contact Critical I/O for VITA 42 XMC site capability)
Optional Interface XMCs	2x 10Gb Ethernet Optical (front I/O) 2x 1/2/4/8 Gb Fibre Channel Optical (front I/O) 2x XAUI 10Gb Ethernet (backplane I/O)
Performance	Recorder mode: up to 6 GB/s (up to 3 GB/s for 3 SSD configurations) Direct Attached Storage (DAS) mode: up to 2 GB/s File Server (NAS) mode: up to 1GB/s
Optional SSD Storage (StorePak XMC)	Up to 6TB with 3 SSD StorePak XMC Up to 12TB with 6 SSD StorePak XMC
DAS Protocol Support	PCIe DAS, Fibre Channel
NAS Protocol Support	NFS, FTP, CIFS/SMB, UDP Direct
Storage Security (StorePak XMC)	Std: ATA security (password), no encryption E: AES-256 full drive encryption T: TCG/Opal AES-256 full drive encryption F: FIPS-140-2 Level 1 full drive encryption
Management	Web GUI, Network Management Protocol
Power Requirements	+12VDC at 5A (no XMC) or 6A (with 3 SSD XMC) or 7A (with 6 SSD XMC) +3.3VDC at 0.5A
Power Consumption (Preliminary)	40 Watts (typical, no StorePak XMC) 50 Watts (typical, with 3 SSD StorePak XMC) 55 Watts (typical, with 6 SSD StorePak XMC)
Temperature	R1 Operating: -40C to +71C; Storage: -40C to +100C* R2 Operating: -40C to +85C; Storage: -40C to +100C*
Humidity	Operating: 0-95%, non-condensing, Storage: 0-100%, condensing
Vibration (random)	VITA 47 Class V3: 0.1g2/Hz (14.1 grms) 15-2000 Hz
Shock	VITA 47 Class OS2 40g Peak sawtooth (11ms duration)
Weight	SE300-CCVPX_ND: SE303-CCVPX or SE306-CCVPX:
Supported Client Platforms	Intel, PowerPC
Client Software Support	Drivers for VxWorks, Linux, Windows (protocol/mode support varies by OS, contact Critical I/O)
Base Model Number	SE303-CCVPX – Configuration with 3 SSD StorePak XMC SE306-CCVPX – Configuration with 6 SSD StorePak XMC SE300-CCVPX-ND– Configuration without StorePak XMC
Model Description	3U VPX StoreEngine, embedded storage controller (optional PCIe Solid State drives on StorePak XMC), conduction-cooled 3U VPX 1", RoHS LEAD FREE

*Non-powered extended storage at high temperatures may result in reduced data retention duration

Conduction Cooled 3U VPX StoreEngine Model Numbers (Not all option combinations are valid)

StoreEngine with no XMC: SE300-CCVPX-ND
 StoreEngine with 3 drive StorePak XMC SE303-CCVPX-YYxxxxW-ZZZ
 StoreEngine with 6 drive StorePak XMC SE306-CCVPX-YYxxxxW-ZZZ (XMC does not have "stack" connector)
 StoreEngine with 6 drive StorePak XMC SE306S-CCVPX-YYxxxxW-ZZZ (XMC has "stack" connector)

where: YY: SSD Class (MC = MLC, 3T = 3D TLC NAND)
 xxxxx: aggregate raw StorePak XMC capacity in GBytes
 W: SSD security option (blank = password, E = AES-256, T = TCG/Opal, F = FIPS140-2)
 ZZZ: temperature range (R1 = -40C to +71C, R2 = -40C to +85C)

Example: SE306-CCVPX-MC12000E-R1
 3U VPX Conduction Cooled StoreEngine with 6 SSD 12000GB MLC StorePak XMC, AES-256, -40C to +71C