# StoreEngine-R™ OpenVPX

**SER302-VPX/CCVPX Data Sheet**: 3U VPX Solid State Storage Blade with Removable SSD Storage
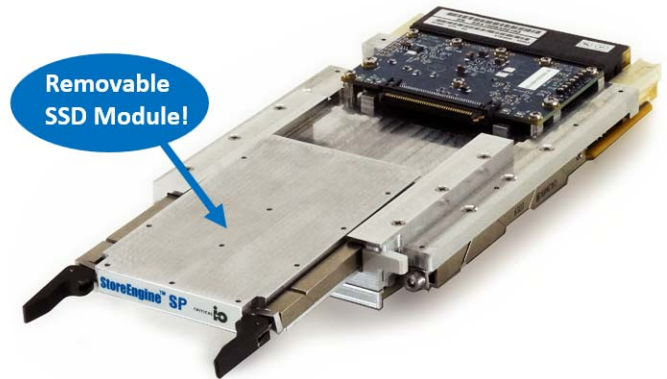
## StoreEngine-R 3U with Removable Storage

StoreEngine-R is a scalable storage manager blade designed for high performance embedded systems.  StoreEngine-R hosts a removable SSD storage module of up to 8TB capacity.  StoreEngine_R can concurrently support these storage functions:

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

StoreEngine-R manages SSD storage that is hosted via on-board SSD storage, and optionally in conjunction with one or more external StorePak storage blades, providing high performance storage with a small size, weight, and power (SWaP) footprint.

## Removable SSD Storage

Up to 8 TB of high speed NVMe SSD storage, supporting sustained rates of up to 3GB/s, is provided by the easily removable StorePak SSD storage module.

## Expand Storage with StorePak NVMe

StoreEngine-R may also be used in conjunction with one or more optional non-removable external StorePak NVMe 3U VPX modules.  Each external 3U StorePak NVMe module provides up to 24 TB of hot-swappable SSD storage.  Multiple StorePaks can be aggregated for increased capacity.  A backplane PCIe link connects StoreEngine and StorePak(s).  See the StorePak NVMe 3U VPX data sheet for more information.

## Scalable Data Recording/Playback

StoreEngine-R 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 or  1/10GbE data sources, at rates of up to 3 GB/s* using only the onboard storage, or at higher rates in conjunction with StorePaks.

## 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-R NAS supports data rates of over 1 GB/s.

## Embedded DAS/RAID

StoreEngine's embedded RAID option provides block-level access to its onboard storage via PCIe interfaces at rates of over 2GB/s.  Access to storage is provided via multiple VPX backplane PCIe Gen 2/3 interfaces.



*StoreEngine-R SER302-CCVPX Conduction Cooled*

## 3U StoreEngine-R VPX Features:

- **Intel Xeon based Storage Management Blade**
- **Removable SSD Storage Module - up to 8 TB**
- **Linux based storage management software stack**
- **High Performance:  up to 3 GB/s\***
- **Turnkey Scalable High-Speed Recording**
- **NAS Network File Server (NFS/CIFS) functionality**
- **Concurrent recording, RAID/DAS & NAS operation**
- **Software based RAID 0/1/5/10**
- **Xeon D processor, 16 GB DDR4-2133 (34 GB/s)**
- **Built-in PCIe Gen 2/3/4 and 1/10 GbE backplane I/O**
- **Scalable & expandable storage (add StorePaks)**
- **45 Watts typical power consumption**
- **Air or conduction cooled rugged versions**
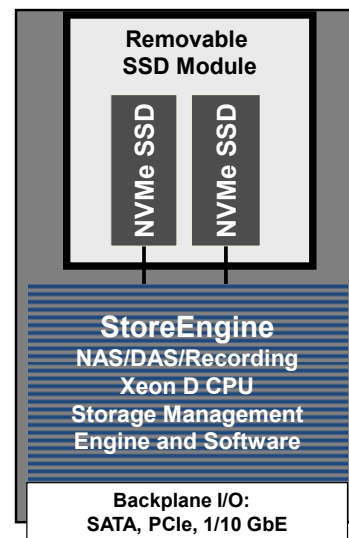


*Critical I/O's StoreEngine-R provides secure, reliable, high-performance Recording, NAS, and DAS capabilities, with high performance on-board removable SSD storage.*
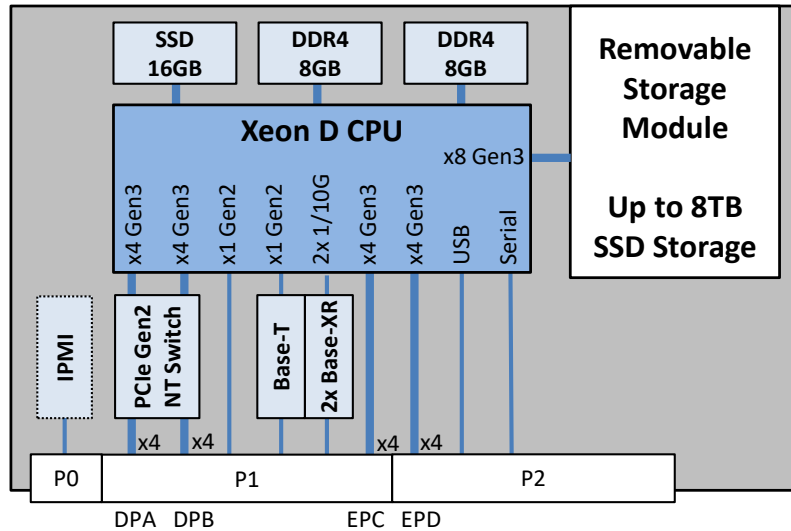
*\*Sustained SSD data rates may be thermally limited.*

*StoreEngine-R 3U Conduction Cooled VPX*
*with Removable SSD Module*



*StoreEngine-R 3U Air Cooled VPX with*
*Removable SSD Module*



*StoreEngine-R Architecture and Backplane Interfaces*

## Flexible Storage Interfaces

StoreEngine-R VPX supports a wide variety of standard I/O

- Backplane I/O – P1, P2
  - 2x 1/10 GbE KX/KR (supports NAS, recording)
  - 1x 1GbE Base-T (supports NAS)
  - 4x PCIe G2/3/4 x4 (supports DAS, recording)
  - 2x PCIe G2 x1 (for RTM and control connections)

## Flexible StoreEngine-R Usage Models

StoreEngine-R 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 and 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 3 GB/s to onboad storage, or up to 6 GB/s with additional external StorePak storage. It also provides unified playback of recorded data, allowing multiple StoreEngines and StorePaks to appear as a single data source.

Record/playback data sources may be streams from PCIe connected devices such as 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.
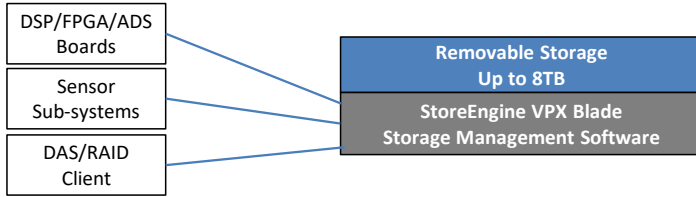
*PCIe DAS*: In these modes, the client utilizes StoreEngine-R storage in a low-level block mode. The client processor hosts a file system that is provided by the client's own local operating system. The allocation and use of these low-level SSD storage blocks is controlled completely by the client file 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-R 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-R Connectivity

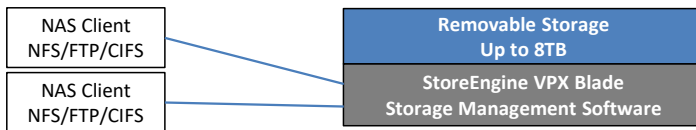Several StoreEngine-R connective examples are shown in the figures below.

**PCIe and/or 1/10 GbE:**
**High Speed Recording and/or DAS**

DSP/FPGA/ADS Boards
Sensor Sub-systems
DAS/RAID Client

Removable Storage
Up to 8TB
StoreEngine VPX Blade
Storage Management Software

For PCIe data recording, the StoreEngine-R recorder blades, along with the data source(s), are typically hosted in a VPX rack, and are interconnected using a VPX PCIe point to point or switched backplane.

For 1/10 GbE data recording, the StoreEngine-R recorder blade(s) may be connected via backplane 1/10 Gb.

**1/10 Gb Ethernet:  NAS**

NAS Client NFS/FTP/CIFS
NAS Client NFS/FTP/CIFS

Removable Storage
Up to 8TB
StoreEngine VPX Blade
Storage Management Software

NAS clients are connected to StoreEngine-R SE303/SE306 via an 1/10 Gb Ethernet network, with connections made via backplane Ethernet.

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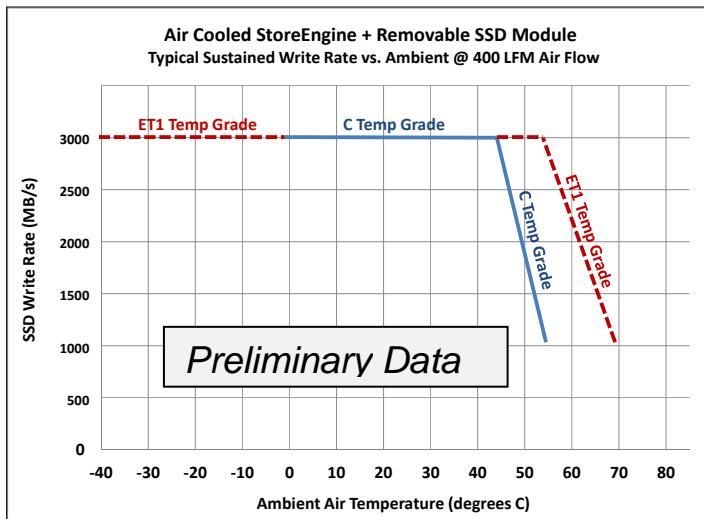
## Thermal Performance Considerations

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-R and its SSD storage will function over their full specified temperature range, SSD data rates and/or StoreEngine-R 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 on-board SSDs and the internal PCIe switch) dissipate higher power levels at elevated temperatures.
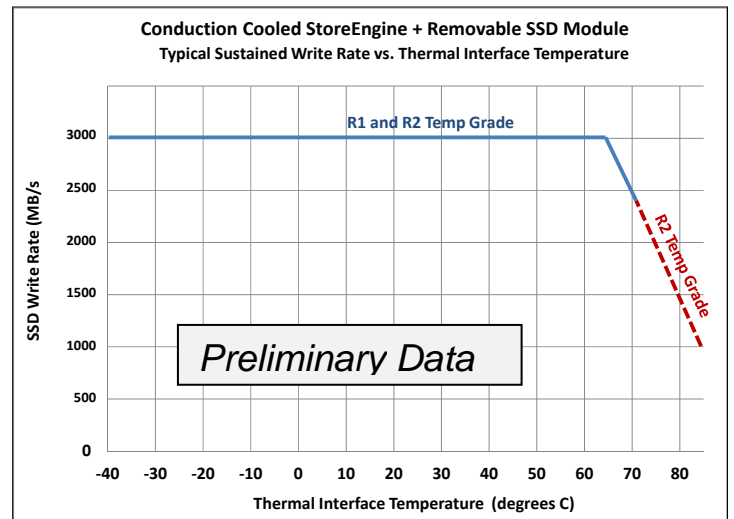
Several specific thermal factors should be evaluated:
1) Air or thermal interface temperature
2) SSD read/write rates and duty cycle
3) StoreEngine-R CPU loading/power
4) Adjacent heat sources (other boards)

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

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

The charts below show typical maximum sustained write performance vs. temperature for air and conduction StoreEngine-R versions.

**Air Cooled StoreEngine + Removable SSD Module**
**Typical Sustained Write Rate vs. Ambient @ 400 LFM Air Flow**

ET1 Temp Grade    C Temp Grade

C Temp Grade
ET1 Temp Grade

*Preliminary Data*

SSD Write Rate (MB/s) vs. Ambient Air Temperature (degrees C)

**Conduction Cooled StoreEngine + Removable SSD Module**
**Typical Sustained Write Rate vs. Thermal Interface Temperature**

R1 and R2 Temp Grade

R2 Temp Grade

*Preliminary Data*

SSD Write Rate (MB/s) vs. Thermal Interface Temperature (degrees C)

## StoreEngine SSD Options

StoreEngine-R 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.

## RAID Options

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

## SSD Security Options

The following data protection options are available:

- **Password Protection** - All StorePak SSD options implement a user definable drive password which if set is subsequently used to unlock the SSD.
- **AES-256 Full Drive Encryption** - SSDs implement password protection and full drive encryption of all data, 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.
- **FIPS 140-2 Level 1** -. FIPS-140-2 defines a certification process to which SSD implementations must complete prior to claiming FIPS compliance. FIPS-140 compliant SSDs always implement full drive AES encryption and password protection.

## Unified Web Based Management

StoreEngine-R 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-R 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 if drive performance or life expectancy begins to degrade.

# Air Cooled StoreEngine-R <span style="color:red">Preliminary</span> Technical Specifications

| | |
|---|---|
| Controller Architecture | Storage Controller with removable SSD storage module |
| Form Factor | 3U VPX (1.0" pitch VITA 48) air cooled |
| Removable SSD Storage | Up to 8TB NVMe SSD storage |
| Storage Software | StoreEngine Storage Management/Recording software (Linux based) |
| DRAM | 16GB Dual Channel DDR4-2133 (34GB/s raw aggregate bandwidth) |
| Backplane Interfaces | 2x PCIe x4 G2<br>2x PCIe x4 G2/3<br>2x PCIe G2 x1 (for RTM and control connections)<br>1x 1000Base-T GbE<br>2x 1/10G Base-KX/KR |
| Typical Performance | Recorder mode: up to 3 GB/s<br>Direct Attached Storage (DAS) mode: up to 2 GB/s<br>File Server (NAS) mode: up to 1GB/s |
| Recording Protocol Support | PCIe: CPU Host, FPGA, ADC<br>1/10GbE: RDMA, TCP, UDP, UDP Direct |
| DAS Protocol Support | PCIe DAS |
| NAS Protocol Support | NFS, FTP, CIFS/SMB, UDP Direct |
| Storage Security | Std: ATA security (password), no encryption<br>E: AES-256 full drive encryption<br>T: TCG/Opal AES-256 full drive encryption<br>F: FIPS-140-2 Level 1 full drive encryption |
| Management | Web GUI, Network Management Protocol |
| Power Requirements | +12VDC at 6A<br>+3.3VDC at 0.5A |
| Power Consumption | 45 Watts (typical) |
| Temperature | Std: Operating: 0C to +55C; Storage: 0C to +70C<br>ET: Operating: -20C to +55C; Storage: -40C to +85C*<br>ET1: Operating: -40C to +71C; Storage: -40C to +85C* |
| Humidity | Std: Operating: 10-90%, non-condensing, Storage: 5-95%, non-condensing<br>ET: Operating: 0-95%, non-condensing, Storage: 0-100%, condensing<br>ET1: Operating: 0-95%, non-condensing, Storage: 0-100%, condensing |
| Vibration (random) | VITA 47 Class V2: 0.04g2/Hz (100-1000 Hz) |
| Shock | 20g Peak sawtooth (11ms duration) |
| Weight | TBD |
| 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 | SER302-VPX |
| Model Description | 3U VPX StoreEngine, embedded storage controller with removable SSD storage module, 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-R Model Numbers (Not all option combinations are valid)

StoreEngine-R Model Number:     SER302-VPX-YYxxxxxW-ZZZ

     where:   YY:     SSD Class (MC = MLC, 3T = 3D TLC NAND)
                 xxxxx:  aggregate raw StorePak 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:   SER302-VPX-3T08000E-ET1
            3U VPX Air Cooled StoreEngine-R with 8000GB 3D TLC removable storage, AES-256, -40C to +71C

# Conduction Cooled StoreEngine-R <span style="color:red">Preliminary</span> Technical Specifications

| | |
|---|---|
| Controller Architecture | Storage Controller with removable SSD storage module |
| Form Factor | 3U VPX (1.0" pitch VITA 48) conduction cooled |
| Removable SSD Storage | Up to 8TB NVMe SSD storage |
| Storage Software | StoreEngine Storage Management/Recording software (Linux based) |
| DRAM | 16GB Dual Channel DDR4-2133 (34GB/s raw aggregate bandwidth) |
| Backplane Interfaces | 2x PCIe x4 G2<br>2x PCIe x4 G2/3<br>2x PCIe G2 x1 (for RTM and control connections)<br>1x 1000Base-T GbE<br>2x 1/10G Base-KX/KR |
| Performance | Recorder mode: up to 3 GB/s<br>Direct Attached Storage (DAS) mode: up to 2 GB/s<br>File Server (NAS) mode: up to 1 GB/s |
| Recording Protocol Support | PCIe: CPU Host, FPGA, ADC<br>1/10GbE: RDMA, TCP, UDP, UDP Direct |
| DAS Protocol Support | PCIe DAS |
| NAS Protocol Support | NFS, FTP, CIFS/SMB, UDP Direct |
| Storage Security | Std: ATA security (password), no encryption<br>E: AES-256 full drive encryption<br>T: TCG/Opal AES-256 full drive encryption<br>F: FIPS-140-2 Level 1 full drive encryption |
| Management | Web GUI, Network Management Protocol |
| Power Requirements<br>All voltages +/- 5% | +12VDC at 6A<br>+3.3VDC at 0.5A |
| Power Consumption | 45 Watts (typica) |
| Temperature | R1 Operating: -40C to +71C; Storage: -40C to +100C*<br>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 | TBD |
| 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 | SER302-CCVPX |
| Model Description | 3U VPX StoreEngine-R, embedded storage controller with removable SSD storage module, 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-R Model Numbers (Not all option combinations are valid)

StoreEngine-R Model Number:     SER302-CCVPX-YYxxxxxW-ZZZ

      where:   YY:      SSD Class (MC = MLC, 3T = 3D TLC NAND)
                  xxxxx:  aggregate raw StorePak 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:   SER302-CCVPX-3T08000E-R1
          3U VPX Conduction Cooled StoreEngine-R with 8000 GB 3D TLC removable storage, AES-256, -40C to +71C