StorePak XMC

StorePak XMC / CCXMC Data Sheet : High Density Solid State Storage XMC

StorePak XMC and CCXMC

StorePak XMC is an ultra-high-density SSD (solid state drive) storage XMC module designed to be used in two different ways: 1) installed and used in conjunction with Critical I/O's StoreEngine storage manager blade and software, 2) installed as an XMC on most standard SBC, used as Direct Attached Storage. StorePak XMC provides very high performance and high-capacity rugged solid-state storage all within a small size, weight, and power (SWaP) footprint. StorePak XMC supports high bandwidth data recording, file serving, and general-purpose RAID applications where large storage capacity and high performance is essential.

High Density

A StorePak XMC module can provide up to 12 Terabytes (12TB) of solid-state storage in a single XMC. Multiple configurations of StorePak XMC are available which feature various storage capacities, performance capabilities.

High Performance

StorePak XMC combines up to six high performance NVMe PCIe SSDs with a PCIe Gen3 switch and a PCIe Gen3 x8 host port, providing storage performance levels of up to 6 GB/s.**

Stackable Storage

Storage capacity can be scaled by "stacking" two or more StorePak XMCs, aggregating the capacity of these XMCs. The stacked StorePaks can operate independently or as a single storage resource. Note that stacked configurations typically require that an adjacent card slot be left empty.

Critical I/O Storage Building Blocks

StorePak XMC is part of a set of compatible board level building blocks. Included in this set is the **StoreEngine 3U VPX board.** StoreEngine incorporates a Xeon-D Storage Management processor and a rich, high-performance storage/recording software stack. An on-board PCIe Gen3 capable XMC site can be used to host a StorePak XMC or other standard XMC.

Multi-Mode Operation with StoreEngine

When StorePak XMC is used stand-alone on a 3rd party CPU board, it provides a high-performance unmanaged SSD storage. When used in conjunction with a StoreEngine storage manager blade, StorePak XMC also provides high performance data recording/ playback capability, fully managed Direct Attached Storage (RAID), as well as a NAS/NFS file sharing capability.

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

Conduction Cooled StorePak CCXMC

StorePak XMC Features:

- **High Capacity – up to 12 TB in a single XMC**
- **3 or 6 High Performance PCIe NVMe SSDs**
- **Small SWaP footprint (size, weight and power)**
- **PCIe Gen3 x8 host XMC connection**
- **Optional PCIe Gen3 x8 XMC "stack" connector**
- **High Performance: up to 6 GBytes/s ***
- **20 Watts typical (at 2 GB/s rate)**
- **Scalable (by stacking multiple XMCs)**
- **Rugged Air and Conduction Cooled Designs**
- **Compatible with Critical I/O StoreEngine 3U VPX**
- **VITA 61 and VITA 42 XMC versions available****

   ****See page 3 for important compatibility information

Air Cooled StorePak XMC shown installed on Air Cooled 3U Critical I/O StoreEngine board (shown with optional XMC "stack" connector)

StorePak XMC Version Matrix

Base Model Number	Cooling	Number of NVMe SSDs	Includes XMC "Stack" Connector	Peak Storage Performance	Maximum SSD Storage Capacity	Compatible with CPU Board VITA 61 XMC Sites
SX3-XMC-	Air	3 SSDs	No	3 GB/s	6TB	Yes*
SX6-XMC-	Air	6 SSDs	No	6 GB/s	12TB	Yes*
SX6**S**-XMC-	Air	6 SSDs	Yes**	6 GB/s	12TB	Yes**
SX3M-CCXMC-	Conduction	3 SSDs	No	3 GB/s	6TB	Yes*
SX3-CCXMC	Conduction	3 SSDs	No	3 GB/s	6TB	No
SX6-CCXMC-	Conduction	6 SSDs	No	6 GB/s	12TB	No
SX6**S**-CCXMC-	Conduction	6 SSDs	Yes**	6 GB/s	12TB	No

All StorePak XMC models are compatible with the <u>appropriate</u> Critical I/O 3U VPX StoreEngine board.
Model numbers shown are for VITA 61 XMC version. For VITA 42 XMC versions append "**4**" to the part number, e.g. SX3-XMC**4**
*Installation on standard CPU board XMC sites generally precludes the use of an XMC cover. Special spacing considerations apply to conduction cooled StorePak XMC installed on host CPU boards. See the ***StorePak XMC Mechanical Form Factor*** section.
**The optional XMC "stack" connector will violate the VPX/XMC space envelope by protruding into the adjacent card slot.

StorePak Air Cooled SX6-XMC
(without XMC "stack" connector)

StorePak Conduction Cooled SX6-CCXMC
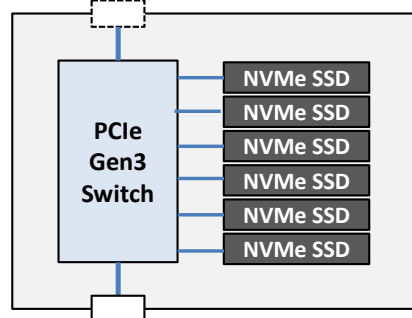*(without XMC "stack" connector)*

StorePak Air Cooled SX6S-XMC
(with XMC "stack" connector)

StorePak Conduction Cooled SX6S-CCXMC
(with XMC "stack" connector)

StorePak XMC Block Diagram (6 SSD version)

StorePak XMC Mechanical Form Factor

XMC Usage on Standard CPU Boards - StorePak XMC is implemented as a <u>non-standard</u> XMC form factor in that the "rear/top" side components are taller than the CMC/XMC specification allows. The **air cooled** StorePak XMC can generally be installed on most **air cooled** 0.8" or 1" pitch host CPU boards, with the resulting combination fitting within the single slot envelope. But the use of an XMC cover is generally precluded as shown in figures 1 and 2 below. The **conduction cooled** StorePak XMC rear/top components are taller still, and as a result the CC StorePak XMC will exceed the allowable VPX slot envelope if: a) the XMC is installed on a conduction cooled CPU board with a 12mm XMC standoff height, <u>or</u> b) the CPU board/XMC combination is installed into a 0.8" pitch VPX slot. See figures 3 and 4 below.

This is a critical issue when evaluating the usability of the conduction cooled StorePak XMC on a standard CPU board. If in doubt about the dimensional suitability of the StorePak XMC in your system, please obtain a StorePak XMC CAD model from Critical I/O for further analysis.

Note that the 6-drive <u>conduction cooled</u> StorePak XMC is designed to work with Critical I/O's StoreEngine, and is mechanically incompatible with most other CPU boards.
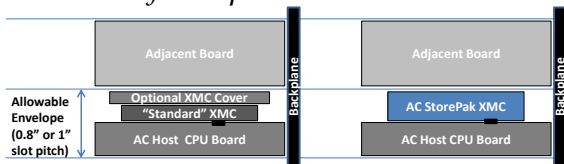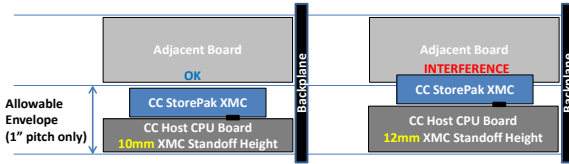
Figure 1

Figure 2

Figure 3

Figure 4

Stacked XMC Usage – StorePak XMC is unique in that it features an *optional* second XMC connector on the "back" of the XMC that allows two or more StorePak XMCs to be "stacked" together for increased storage capacity, as illustrated in figure 3. Stacked XMC configurations need extra space and generally require that the adjacent card slot be left empty. In some very limited situations, it is also possible to stack a StorePak XMC with an interface XMC (with a back/top mounted transceiver) such as Fibre Channel or 10 GbE XMC, as illustrated in figure 6. All stacked XMC configurations must be analyzed and managed with respect to storage access rates and patterns to ensure that the host board XMC power and thermal limits are not exceeded, also note that standard power and environmental specs do not apply.
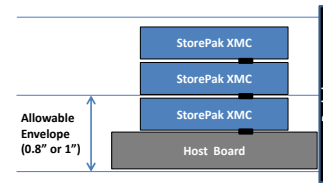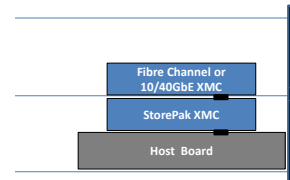
Figure 5

Figure 6

Power, Thermal, and Performance Notes

StorePak XMC is powered by either 12V or 5V, depending on host board XMC voltage level. Actual StorePak XMC power usage is dependent on storage access rates and patterns. The maximum data read/write rates that can be sustained are also highly dependent on temperature, airflow, host SBC, and storage access patterns and duty cycles. Typical maximum sustained rates vs. temperature are shown in the charts below.

The rate limits shown are typical and are the result of thermal protection rate throttling of the SSDs within the StorePak. For air cooled XMCs, the actual rate limit ambient temperatures are highly dependent on airflow and host SBC mechanical/thermal characteristics. Once an SSD has entered a thermal throttling state, the sustainable rate will drop to a lower 'recovery rate'. The XMC temperature must then drop below a 'recovery temperature' before full performance is restored as indicated by the dashed lines in the chart.
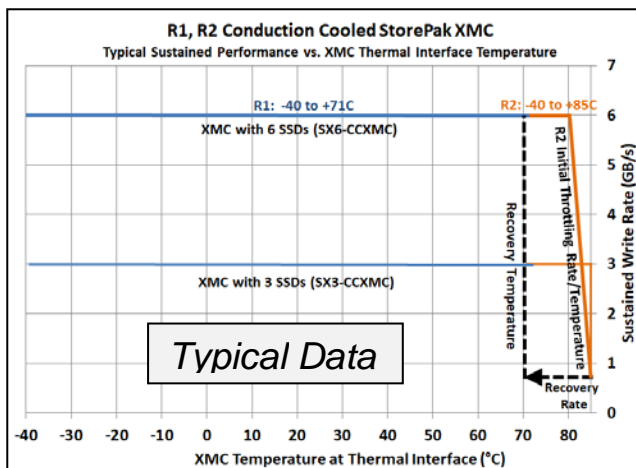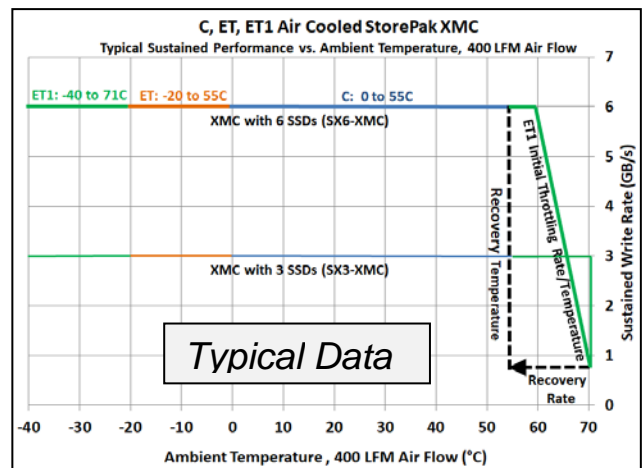
StorePak XMC Usage Models

StorePak XMC can be used stand-alone as an 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 XMC with Customer CPU Board: Unmanaged Direct Attached Storage

When used stand-alone, StorePak XMC 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 drives may be aggregated using host software RAID.
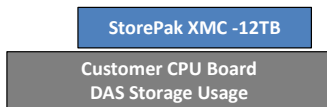
StorePak XMC + StoreEngine: Multi-Channel Data Recorder

A more complex application of a StorePak/StoreEngine combination is shown below. Here StoreEngine's recording software is managing the recording of multiple channels of data to StorePak XMC. This example system provides up to 12 TB of recording capacity, with a recording rate of up to 6 GBytes/s.
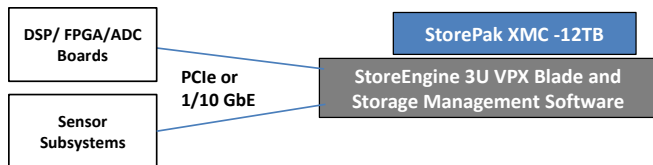

StorePak XMC + StoreEngine: Concurrent Multi-mode Operation

The StorePak XMC / StoreEngine combination can provide concurrently:

- High performance data recording capabilities at rates of up to 6 GB/s per StorePak.
- NAS file sharing capabilities using NFS, CIFS, or FTP using 1/10 Gb Ethernet.
- Fully managed Direct Attached Storage (DAS, aka RAID) capabilities using PCIe.

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.
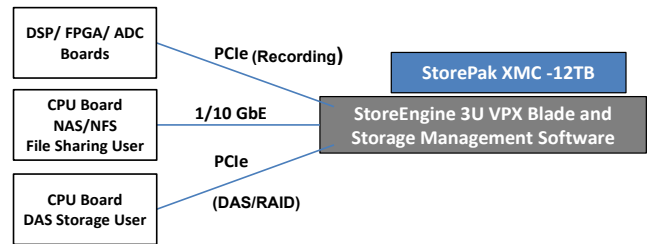
StorePak XMC SSD Security Options

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.

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

Media Characteristics & Storage Capacity of Standard StorePak XMC Configurations

StorePak XMC Base Model#:	Media Type	Relative Capacity	Sequential Performance	Random Performance	Write Endurance	Reliability
SX6-XMC-3Txxxxx	SSD-3DTLC	Highest	Excellent	Very Good	Good	Very High
SX6-XMC-MCxxxxx	SSD-MLC	High	Excellent	Very Good	Good	Very High

Air Cooled StorePak XMC Technical Specifications

Architecture	XMC Storage Module with up to 6 NVMe PCIe SSDs
XMC Interface	PCIe Gen3 x8 (Gen2/1 capable) Gen3 operation only with VITA 61 connector and well-designed baseboard
Storage Performance	up to 3 GB/s read/write (3 SSD XMC, may be thermally limited, see page 3) up to 6 GB/s read/write (6 SSD VITA 61 XMC, Gen3, may be thermally limited, see page 3)
SSD Storage Capacity	Up to 6TB (3 SSD StorePak XMC) Up to 12TB (6 SSD StorePak XMC)
Security	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
Form Factor	Modified VITA 61 or VITA 42 conduction cooled XMC Contact Critical I/O regarding host board compatibility (see page 3)
Power Requirements	+12VDC at 3A maximum (6 SSD), 2A maximum (3 SSD) or +5VDC at 7A maximum (6 SSD, 5A maximum (3 SSD)
Power Consumption (preliminary)	20 Watts typical (6 SSD), 15 Watts typical (3 SSD) power is highly dependent on SSD access rate/pattern)
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)	0.01g2/Hz (100-1000 Hz)
Shock	20g Peak sawtooth (11ms duration)
Weight	7 oz
Supported Host Platforms	Intel, PowerPC
Host Software Support	Linux, Windows
Base Model Numbers	SX3-XMC – 3 SSD StorePak VITA 61 XMC SX6-XMC – 6 SSD StorePak VITA 61 XMC SX6-XMCS – 6 SSD StorePak VITA 61 XMC with optional "stack" connector SX3-XMC4 – 3 SSD StorePak VITA 42 XMC SX6-XMC4 – 6 SSD StorePak VITA 42 XMC SX6S-XMC4 – 6 SSD StorePak VITA 42 XMC with optional "stack" connector
Model Description	StorePak XMC (with 3 or 6 embedded NVMe PCIe SSDs), air-cooled XMC, RoHS LEAD FREE

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

Air Cooled StorePak XMC Model Numbers (not all option combinations are valid)

3 drive XMC	SX3-XMC-YYxxxxxW-ZZZ	(for VITA 61 host)
6 drive XMC	SX6-XMC-YYxxxxxW-ZZZ	(for VITA 61 host, XMC does not have "stack" connector)
6 drive XMC	SX6**S**-XMC-YYxxxxxW-ZZZ	(for VITA 61 host, XMC has "stack" connector)
3 drive XMC	SX3-XMC4-YYxxxxxW-ZZZ	(for VITA 42 host)
6 drive XMC	SX6-XMC4-YYxxxxxW-ZZZ	(for VITA 42 host, XMC does not have "stack" connector)
6 drive XMC	SX6**S**-XMC4-YYxxxxxW-ZZZ	(for VITA 42 host, XMC has "stack" connector)

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

Example: SX6-XMC-3T12000E-ET1
Air Cooled StorePak XMC with 6 SSDs, 12000GB 3DTLC, AES-256, ET1: -40C to +71C

Conduction Cooled StorePak CCXMC Technical Specifications

Architecture	XMC Storage Module with up to 6 NVMe PCIe SSDs
XMC Interface	PCIe Gen3 x8 (Gen2/1 capable) Gen3 operation only with VITA 61 connector and well-designed baseboard
Storage Performance	up to 3 GB/s read/write (3 SSD XMC, may be thermally limited, see page 3) up to 6 GB/s read/write (6 SSD VITA 61 XMC, Gen3, may be thermally limited, see page 3)
SSD Storage Capacity	Up to 6TB (3 SSD StorePak XMC) Up to 12TB (6 SSD StorePak XMC)
Security	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
Form Factor	Modified VITA 61 or VITA 42 conduction cooled XMC Contact Critical I/O regarding host board compatibility (see page 3)
Power Requirements	+12VDC at 3A maximum (6 SSD), 2A maximum (3 SSD) or +5VDC at 7A maximum (6 SSD, 5A maximum (3 SSD)
Power Consumption (preliminary)	20 Watts typical (6 SSD), 15 Watts typical (3 SSD) power is highly dependent on SSD access rate/pattern
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 (100-1000 Hz)
Shock	Class 0S2: 40g Peak sawtooth (11ms duration)
Weight	8 oz
Supported Host Platforms	Intel, PowerPC
Host Software Support	Linux, Windows
Base Model Numbers	SX3M-CCXMC – 3 SSD StorePak VITA 61 CCXMC (to be used with VITA 61 XMC capable host boards) SX3M-CCXMC4 – 3 SSD StorePak VITA 42 CCXMC (to be used with VITA 42 XMC capable host boards) SX3-CCXMC – 3 SSD StorePak CCXMC (to be used with Critical I/O StoreEngine host) SX6-CCXMC – 6 SSD StorePak CCXMC (to be used with Critical I/O StoreEngine host) SX6-CCXMCS – 6 SSD StorePak CCXMC as above, but with optional "stack" connector
Model Description	StorePak XMC (with 3 or 6 embedded NVMe PCIe SSDs), conduction cooled XMC, RoHS LEAD FREE

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

Conduction Cooled StorePak XMC Model Numbers (not all option combinations are valid)

3 drive XMC	SX3M-CCXMC-YYxxxxxW-ZZ	(for use with VITA 61 capable host boards)
3 drive XMC	SX3M-CCXMC4-YYxxxxxW-ZZ	(for use with VITA 42 capable host boards)
3 drive XMC	SX3-CCXMC-YYxxxxxW-ZZ	(for use only with Critical I/O StoreEngine host)
6 drive XMC	SX6-CCXMC-YYxxxxxW-ZZ	(for use only with Critical I/O StoreEngine host, no "stack" connector)
6 drive XMC	SX6**S**-CCXMC-YYxxxxxW-ZZ	(for use with Critical I/O StoreEngine host, with "stack" connector)

where: YY: SSD Class (3T = 3D TLC NAND, MC = MLC NAND)
      xxxxx : Aggregate minimum raw StorePak XMC flash capacity in GBytes. Usable capacity is lower.
      W: SSD security option (blank = password, E = AES-256, T = TCG/Opal, F = FIPS140-2)
      ZZ: Temperature range (R1 = -40C to +71C, R2 = -40C to +85C)

Example: SX6-CCXMC-3T12000E-R1
      Conduction Cooled StorePak XMC with 6 SSDs, 12000 GB 3DTLC, AES-256, R1: -40C to +71C