SMART®
Modular Technologies

DuraMemory
DDR5
RDIMM

DuraMemory
DDR5
ECC SODIMM

SMART®
Modular Technologies
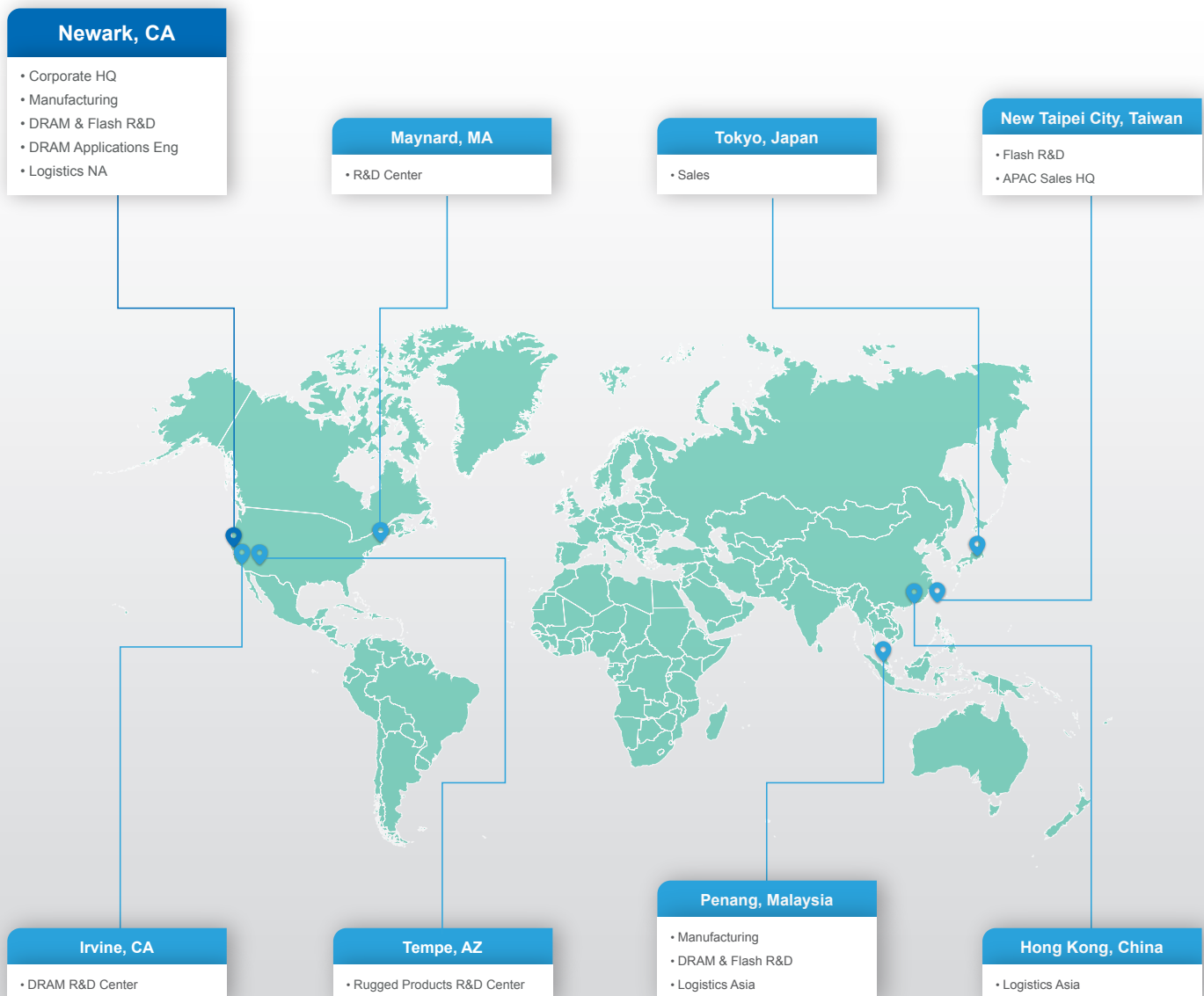
Think Memory.
Think SMART.

DuraMemory™

Memory Module Products

About SGH and SMART Modular Technologies

SGH (SMART Global Holdings, Inc.) is a NASDAQ listed holding company (NASDAQ:SGH). Over the past few years, the SGH business units have evolved and grown into as leading designers and manufacturers of electronics for Intelligent Computing, Specialty Memory, and LED Solutions. SGH's success is based on a customer-focused approach characterized by a commitment to raise the bar, execute with discipline and focus on what's next.

As an SGH company, SMART Modular is a global leader in specialty memory products including memory modules, solid-state storage products, and hybrid solutions. SMART has been serving the industry for over 30 years, providing standard, ruggedized and custom memory and storage solutions that meet the needs of diverse applications in high-growth markets.

SMART Modular delivers solutions to a broad customer base, including OEMs in computing, networking, communications, storage, mobile, military, aerospace and industrial markets. Focused on providing extensive customer-specific design capabilities, technical support and value-added testing services, SMART collaborates closely with their global OEM customers throughout the design process and across multiple projects to create solutions for demanding applications with differentiated requirements. For more information, visit SMART Modular's website at **www.smartm.com**

Newark, CA
- Corporate HQ
- Manufacturing
- DRAM & Flash R&D
- DRAM Applications Eng
- Logistics NA

Maynard, MA
- R&D Center

Tokyo, Japan
- Sales

New Taipei City, Taiwan
- Flash R&D
- APAC Sales HQ

Irvine, CA
- DRAM R&D Center

Tempe, AZ
- Rugged Products R&D Center

Penang, Malaysia
- Manufacturing
- DRAM & Flash R&D
- Logistics Asia

Hong Kong, China
- Logistics Asia

Designed for Intensive Workloads

SMART is known for its advanced technologies and product quality. We focus on providing specialty high-value memory, storage and compute products for various applications. We are widely trusted by our tier 1 OEM partners. The DuraMemory brand conveys SMART's continued commitment to provide the highest quality and reliability in industrial and computing memory products.

Data Centers (ZDIMM) *

Data centers require reliable, high-density memory with low latency and low power consumption. SMART's Zefr ZDIMM Memory products provide flexible options to meet the ever-changing needs of fast growing data demand in server applications. Zefr Memory has been intensely processed to filter out weak memory modules, providing one of the lowest DPPMs in the industry.
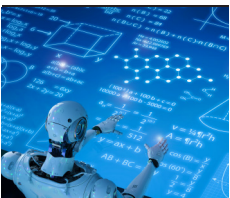
Artificial Intelligence / High-Performance Computing

Data intensive applications like AI and HPC generate and process large amounts of data, while requiring low latency and high performance. SMART Modular's DuraFlash embedded and removable drives are designed for compute intensive, high throughput and high capacity storage applications.

Networking

Requiring small to standard form factors, networking applications have strict footprint and thermal specifications. DuraFlash removable and embedded solutions with low latency provide high performance and signal integrity for networking applications.

Industrial Internet of Things

Industrial applications need replacement storage solutions with extended life cycles. Key requirement features include reliability, security and performance. DuraFlash PCIe NVMe, embedded, and microSD removable solutions are just some of the industrial Flash options customers can choose from with SMART Modular.

Transportation

Memory applications for the transportation industry demand a flexible range of options, whether it's performing in harsh environments or for synchronized computing. SMART Modular's DuraFlash options can accommodate any vehicle telematics application whether it requires a standard or small form factor.

POS / Gaming

Gaming applications typically require memory with compact form factors, reduced voltage demands, high performance and high reliability. DuraFlash embedded and removable memory products provide a wide variety of solutions for POS and gaming applications.

Military / Aerospace

Defense and aerospace applications require the utmost in reliable, robust storage, and they must be able to withstand punishing conditions. Factors including extreme changes in temperature gradient, vibration, altitude and humidity all need to be considered when designing in memory for these types of mission-critical, high-reliability applications.

* For more Zefr ZDIMM information, please visit **https://www.smartm.com/product/list/zefr-zdimm**

DuraMemory™

Durable and Reliable Memory for Industrial Workloads

SMART's DuraMemory portfolio provides a superior level quality, durability and reliability to meet the needs of today's demanding industrial specifications and applications.

All DuraMemory products are backed by SMART's extensive expertise in design, manufacturing, testing and logistical support. The DuraMemory line provides an added level of confidence and security, knowing that these products will perform to the highest standards for durability and reliability, while meeting industrial workload requirements and exceeding performance expectations.

Enterprise Quality for High Reliability	Undergoes Triple Stress Testing and Burn-In	Encryption and Other Features Available

DuraMemory Product Family
DDR5 / DDR4 / DDR3

NVDIMM	LRDIMM	RDIMM	UDIMM

SODIMM	Mini DIMM	MIP™

Servers/Data Centers

- Enterprise Memory for High Reliability
- Supports ECC Memory for Error Detection and Correction
- Register to Support Signal and Address Buffer
- LRDIMM Buffer Memory Reinforces Data Integrity

DIMM Type	RDIMM		LRDIMM
Technology	DDR5	DDR4	DDR4
Density	16GB-128GB	4GB-256GB	128GB-256GB
Height	31.25mm	31.25mm	31.25mm
Configuration	80bit	72bit	72bit
Speed (MT/s)	4800-5600	2666-3200	3200
Voltage	1.1V	1.2V	1.2V
Operating Temperature*	C/I Temp	C/I Temp	C Temp

Blade/Compact Servers

- For 1U and <1U Blade System Form Factors
- For Low-Profile Server Applications
- Supports ECC Memory for Error Detection and Correction

DIMM Type	VLP RDIMM		VLP/ULP Mini RDIMM
Technology	DDR5	DDR4	DDR4
Density	32GB-48GB	4GB-64GB	8GB-32GB
Height	18.75mm	18.75mm	18.75/17.78mm
Configuration	80bit	72bit	72bit
Speed (MT/s)	4800-5600	2666-3200	2666-3200
Voltage	1.1V	1.2V	1.2V
Operating Temperature*	C/I Temp	C/I Temp	C/I Temp

*C Temp (0˚C to +70˚C); I Temp (-40˚C to +85˚C); Ambient Temp (+40˚C to +70˚C)

Networking

- 100% High and Low Temperature Testing
- Conformal Coating for Moisture and Environmental Protection
- Anti-Sulfur Passive Components - Protection Against Environmental Decay

DIMM Type	UDIMM		ECC UDIMM	
Technology	DDR5	DDR4	DDR5	DDR4
Density	8GB-48GB	4GB-32GB	16GB-48GB	4GB-32GB
Height	31.25mm	31.25mm	31.25mm	31.25mm
Configuration	64bit	64bit	72bit	72bit
Speed (MT/s)	4800-5600	2666-3200	4800-5600	2666-3200
Voltage	1.1V	1.2V	1.1V	1.2V
Operating Temperature*	C/I Temp	C/I Temp	C/I Temp	C/I Temp

Telecommunication

- Component Underfill for Vibration Resistance
- Rigorous Testing to Prevent Failure in the Field
- Specific Enhancements for Extra Environmental Protection

DIMM Type	SODIMM		ECC SODIMM	
Technology	DDR5	DDR4	DDR5	DDR4
Density	8GB-48GB	2GB-32GB	16GB-48GB	4GB-32GB
Height	30mm	30mm	30mm	30mm
Configuration	64bit	64bit	72bit	72bit
Speed (MT/s)	4800-5600	2400-3200	4800-5600	2666-3200
Voltage	1.1V	1.2V	1.1V	1.2V
Operating Temperature*	C/I Temp	C/I Temp	C/I Temp	C/I Temp

*C Temp (0˚C to +70˚C); I Temp (-40˚C to +85˚C); Ambient Temp (+40˚C to +70˚C)

Compact Systems

- Ultra Low and Very Low System Architecture Available
- Extra Power and Ground Pins Provide Greater Reliability and Data Integrity
- Supports ECC Memory for Error Detection and Correction

DIMM Type	VLP UDIMM	VLP/ULP ECC UDIMM	
Technology	DDR3	DDR5	DDR4
Density	4GB-8GB	32GB-48GB	16GB-32GB
Height	18.3mm	18.75mm	17.78mm
Configuration	64bit	72bit	72bit
Speed (MT/s)	1600	4800-5600	2666-3200
Voltage	1.35V/1.5V	1.1V	1.2V
Operating Temperature*	C Temp	C/I Temp	C/I Temp

Industrial Internet of Things

- Broad Choice of Products, Form Factors, Technologies, Speeds and Densities
- Multiple Solutions to Protect Against Environmental Threats
- Shorter Lead Times from Order to Delivery

DIMM Type	ECC Mini UDIMM	VLP/ULP ECC Mini UDIMM	
Technology	DDR4	DDR4	DDR3
Density	8GB	4GB-32GB	2GB-4GB
Height	18.75mm	18.75mm	18.75mm
Configuration	72bit	72bit	72bit
Speed (MT/s)	2666	2666-3200	1600-1866
Voltage	1.2V	1.2V	1.35V/1.5V
Operating Temperature*	C Temp	C Temp	C/I Temp

*C Temp (0˚C to +70˚C); I Temp (-40˚C to +85˚C); Ambient Temp (+40˚C to +70˚C)

Aerospace/Military

- Underfill for Excessive Shock and Vibration
- Optional Module Retention Clips for Extra Secure Attachment
- Conformal Coating for Moisture Exposure
- Industrial Temperature and Low Power Options Available

DIMM Type	ECC SODIMM	
Technology	DDR4	DDR3
Density	4GB-32GB	2GB-16GB
Height	30mm	30/25.4mm
Configuration	72bit	72bit
Speed (MT/s)	2666-3200	1600-1866
Voltage	1.2V	1.35V/1.5V
Operating Temperature*	C/I Temp	C/I Temp

SBC/SOM
(Module-In-A-Package™)

- MIP Small Form Factor 22.25 x 22.25 x 3.85 mm
- Simplified System Design to Avoid Back-to-Back Chip Placements
- Better Signal Integrity and Reduced Flight Time
- Build-to-Order Model with Multiple Standard DRAM Sources Available
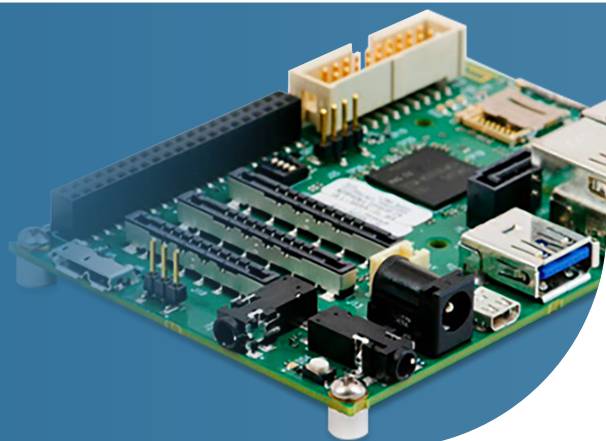
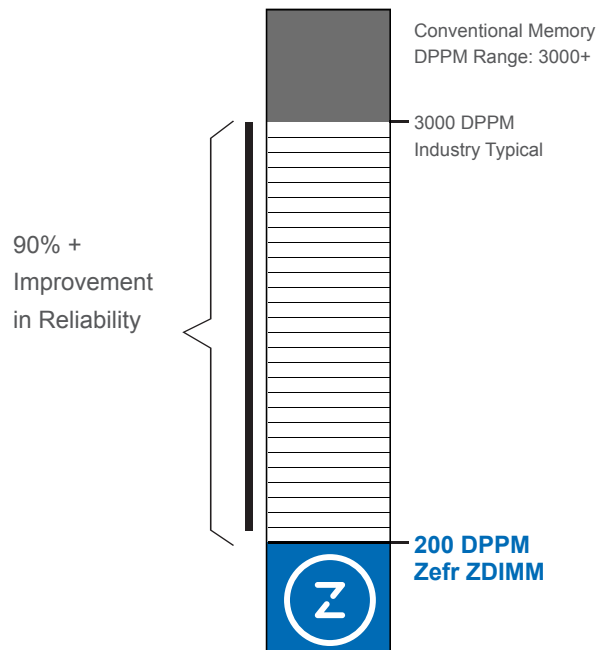| DIMM Type	Module-In-A-Package (MIP)	
Technology	DDR4	DDR3
Density	2GB-16GB	2GB
Height	22.25 x 22.25 x 3.85 mm	22.25 x 22.25 x 3.85 mm
Configuration	64bit	64bit
Speed (MT/s)	2400-3200	1866
Voltage	1.2V	1.35V/1.5V
Operating Temperature*	C/I Temp	C Temp

*C Temp (0˚C to +70˚C); I Temp (-40˚C to +85˚C); Ambient Temp (+40˚C to +70˚C)

# Zefr Eliminating Over 90% of Memory Reliability Failures

Zefr is a screening process performed on OEM original memory modules or SMART Modular built memory modules to deliver ultra-high reliability for demanding workloads.

Industry Standard Memory Reliability isn't Sufficient

Conventional Memory DPPM Range: 3000+

3000 DPPM Industry Typical

90% + Improvement in Reliability

200 DPPM Zefr ZDIMM

Zefr Screens Memory to Real-World Conditions

Zefr Memory has been intensely processed to filter out weak memory modules. The Zefr Process combines five key testing ingredients.

Elevated Temperature

Demanding Test Scripts

Extended Time

High Speed

Server Motherboards
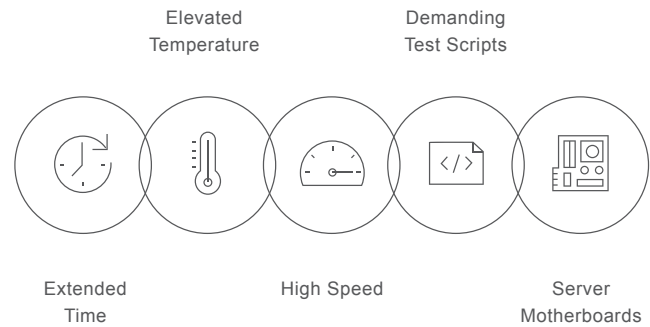
* For more Zefr information, please visit **https://www.smartm.com/product/list/zefr-zdimm**

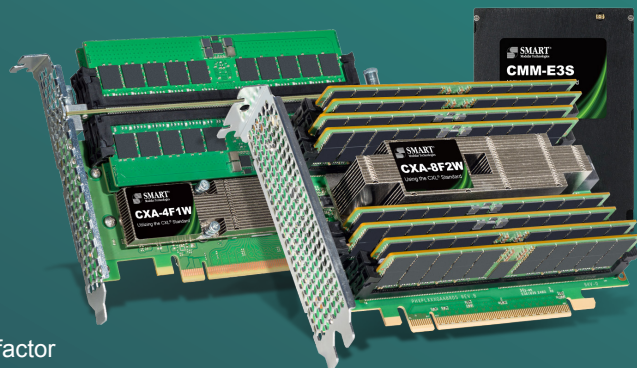| DIMM Type	Registered ZDIMM	
Technology	DDR5	DDR4
Density	32GB-128GB	16GB-128GB
Height	31.25mm	31.25mm
Configuration	80bit	72bit
Speed (MT/s)	5600	3200
Voltage	1.1V	1.2V
Operating Temperature*	C Temp	C Temp

*C Temp (0˚C to +70˚C); I Temp (-40˚C to +85˚C); Ambient Temp (+40˚C to +70˚C)

Key to

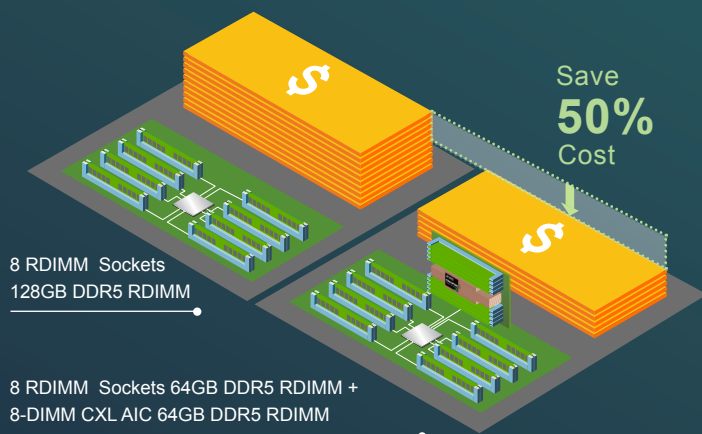## Memory Capacity & Bandwidth Expansion

Advanced Serial Memory Utilizing CXL® Standard

Features

- Available in Add-in Card (AIC) and EDSFF E3.S 2T(2U short) form factor
- ASIC and FPGA-based memory modules supporting multiple interconnect standards
- Customization of features like RAS, memory interleaving, performance tuning, and support for low-power mode
- Debug capabilities for memory and Phy
- Custom packaging, processing, and testing

AIC Form Factor Use Case

Save **50%** Cost

8 RDIMM Sockets
128GB DDR5 RDIMM

8 RDIMM Sockets 64GB DDR5 RDIMM +
8-DIMM CXL AIC 64GB DDR5 RDIMM

1TB (128GB DDR5 RDIMM x 8)	=	**512GB** (64GB DDR5 RDIMM x 8)
		+
		512GB (64GB DDR5 RDIMM x 8)

8 RDIMM Sockets

8 RDIMM Sockets + 8-DIMM CXL AIC

E3.S Form Factor Use Case

CMM-E3S x 4

Bandwidth **1.66x up**

Capacity **1.5x up**

CXL on PCIe

DDR5 RDIMM x 8
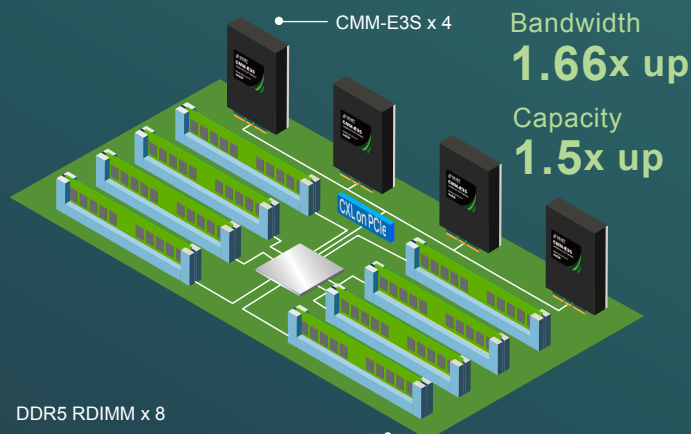
Total Bandwidth **380** GB/s	➡	Total Bandwidth **640** GB/s ⬆
Total Capacity **1** TB	➡	Total Capacity **1.5** TB ⬆

with 8 x DDR5 DIMM

by adding extra 4 x CMM-E3S

For more information, please visit our website: **www.smartm.com**

Advanced Serial Memory Utilizing CXL® Standard

CXL® (Compute Express Link®) is an industry standard, open protocol for high speed and low latency communications between host accelerator, which are increasingly used in emerging applications, such as Artificial Intelligence (AI) and Machine Learning (ML).
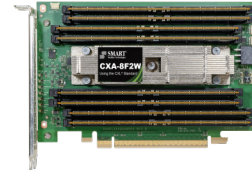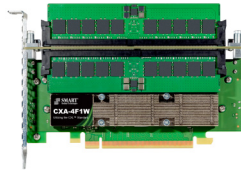
Product	CXA-4F1W	CXA-8F2W
Bus	CXL 2.0 x16	CXL 2.0 x16 (dual x8)
Form Factor	FHHL, 1W	FHHL, 2W
Configuration	4 x DDR5 DIMMs	4 x DDR5-4800 DIMMs
Max Capacity	2TB (TSV) 256GB (SDP)	4TB (TSV) 512GB (SDP)
NV Option	-	-
Performance	64GB/s	64GB/s
Latency	200ns	200ns
Power	64W for 2TB 45W for 256GB	135W for 4TB 90W for 512GB

Product	CMM-E3Sx8	NV-CMM-E3S
Bus	CXL 2.0 x16	CXL 2.0 x16
Form Factor	E3.S 2T	E3.S 2T
Configuration	DDR5-4800	DDR4-3200
Max Capacity	128GB	32GB
NV Option	-	Yes
Performance	32GB/s	32GB/s
Latency	200ns	200ns
Power	30W	30W

*Engineering samples available in Q3 2024. Stay tuned for more updates.

Think Memory.
Think SMART.

For more product details, please contact the SMART sales team or visit our website.

**Product images are for promotional purposes only.
Labels may not be representative of the actual product.*

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