



**SMART<sup>®</sup>**  
Modular Technologies



**Designed Solutions  
Driven by Innovation**

***DuraMemory***<sup>™</sup>

Memory Module Products

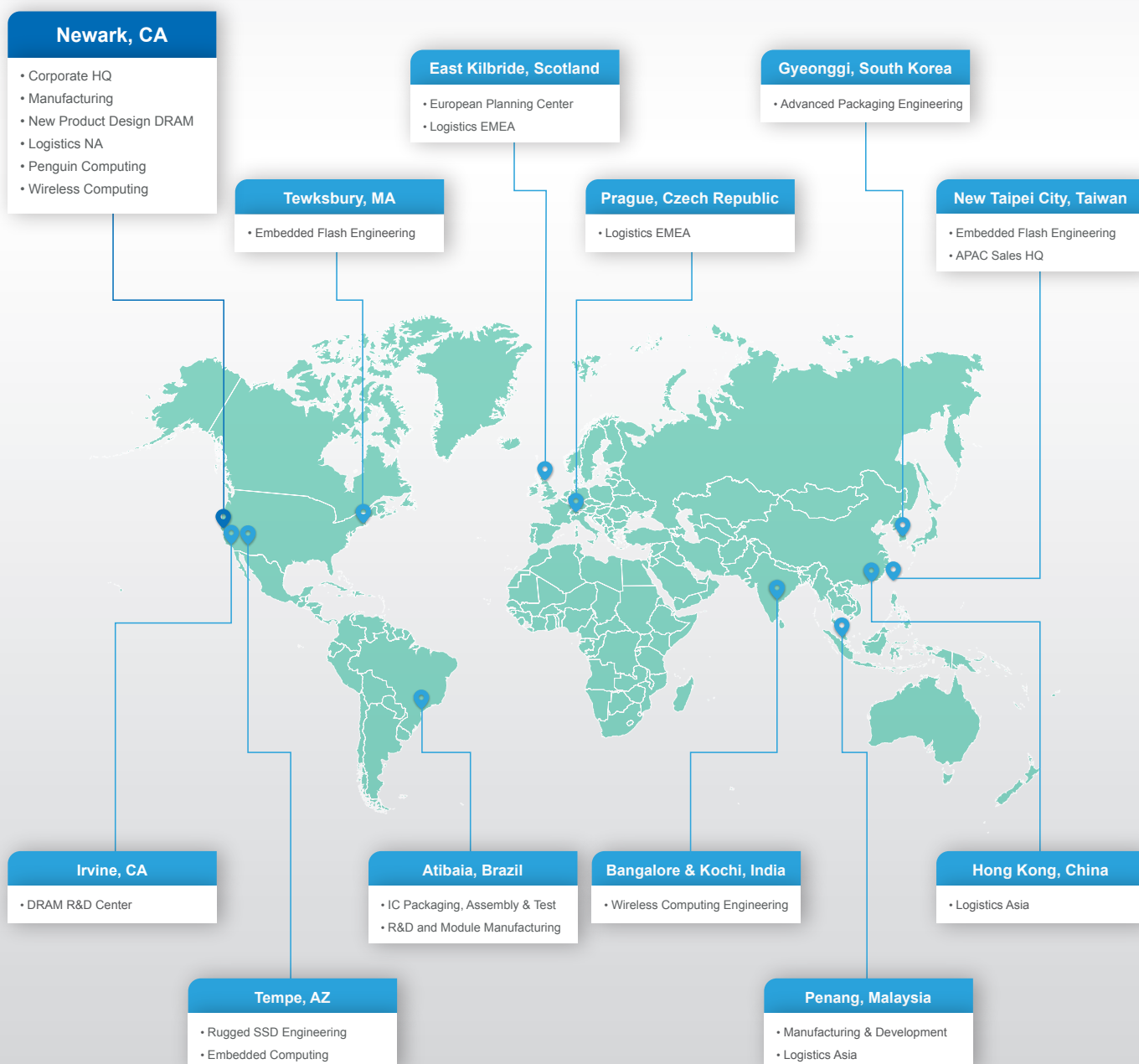


# About SMART Global Holdings

The SMART family of companies are global leaders in technology solutions serving the electronics industry for more than 25 years. Focused on providing extensive customer-specific design capabilities, technical support and value-added testing services, the SMART companies collaborate closely with global OEM customers throughout the design process and across projects to create solutions with differentiated requirements for demanding applications. The SMART companies lead the way in providing standard and custom products to today's leading global OEMs crossing all major electronic industries.

The genesis of SMART Global Holdings began with SMART Modular Technologies, a global leader in specialty memory solutions. For almost three decades, SMART Modular has delivered solutions to a broad and diverse customer base comprised of OEMs that compete in the computing, networking, communications, storage, mobile and industrial markets.

With Penguin Computing, SMART Embedded, SMART Wireless, and SMART Supply Chain Services, SMART Global Holdings also serves the HPC, ruggedized embedded, telecom and global supply chain logistics and freight forwarding markets. For more information, visit SMART Global Holdings' website at [www.smartm.com](http://www.smartm.com)



# ■ 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.



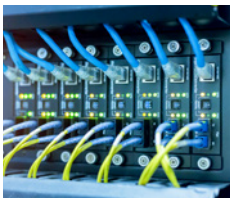
## Data Center

Data centers require reliable, high-density memory with low latency and low power consumption. SMART's Enterprise Memory and Error-Correcting Code (ECC) products provide flexible options to meet the ever-changing needs of fast growing data demand in server applications. SMART's Enterprise Memory solutions undergo rigorous testing, providing one of the lowest DPPMs in the industry.



## Storage

Storage servers and All Flash Arrays (AFA) use Persistent Memory (NVDIMM) with encryption for data logging, which dramatically improves overall system performance. When used in conjunction with standard RDIMMs, they combine to accelerate system speed, recoverability and security — all essential for top performance in storage applications.



## Networking

Networking equipment, including switches and routers, uses a variety of form factors, such as UDIMM, SODIMM and VLP RDIMM, depending on the configuration of the system. Performance, density, and reliability are common requirements for today's complex networking needs and SMART's variable temperature testing ensures that its modules will function in any environment, saving maintenance and replacement costs.



## Telecommunications

Base stations and headend optics platforms have lengthy qualification cycles due to regulatory compliance testing standards – NEBS (Network Equipment-Building System). Telecom equipment requires reliable and scalable memory and storage to transmit and process voice and video data. Mini DIMMs are an example of specialty memory designed specifically for telecom applications. They are highly reliable and offer extra power and ground signal strength which is necessary for rugged operating environments.



## Internet of Things / Video Monitoring

Because of the exponential growth in data transmission and storage, demand for robust memory has intensified for all types of devices that are now connected via the Internet of Things (IoT). This is especially true for industrial IoT (IIoT) and surveillance solutions that must withstand a wide variety of operating conditions, including extreme temperature changes and exposure to harsh environmental elements while functioning as an integrated system.



## Artificial Intelligence / High-Performance Computing

Artificial Intelligence (AI) and High-Performance Computing (HPC) are data-intensive applications that generate and process large amounts of data. Low latency and high performance are critical for transforming raw data into usable information. Persistent Memory and Enterprise Memory are ideal solutions for low latency requirements, ensuring power loss protection and data integrity.



## 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.



## Durable and Reliable Memory for Industrial Workloads

SMART's new 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**

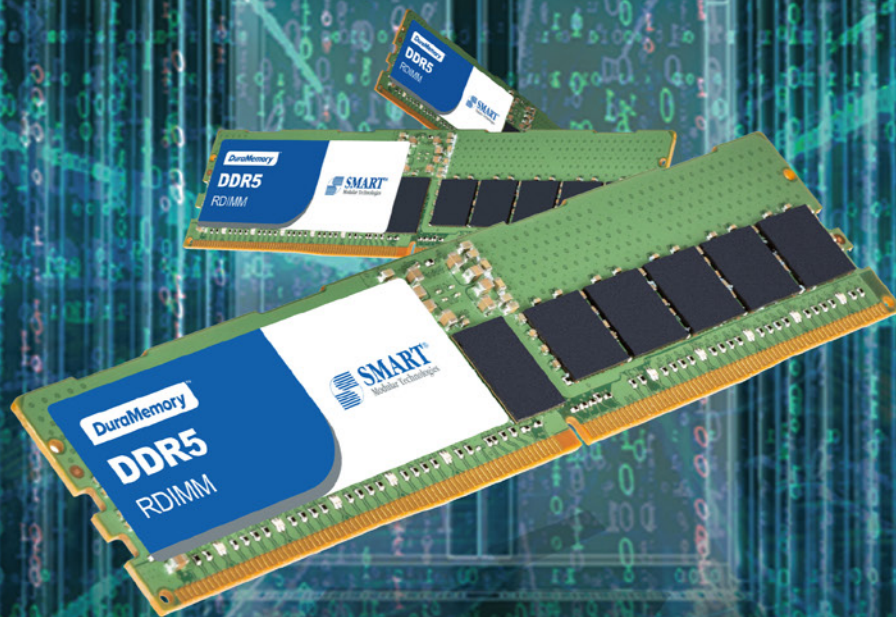


**XRDIMM**



**MIP™**





NEW

# Generation DDR5

## Advancing High Performance Computing

RDIMM

UDIMM

SODIMM

Command/Address and Control Bus is  
double data rate

Default burst length increased to BL16 –  
Single burst = 64B of data

Generates CRC checksum in  
READ data frames

Integrated Temperature Sensor (MR4)

DDR5 DRAM contain  
256 mode registers



## Server/Data Center

- 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		Mini RDIMM
Technology	DDR5	DDR4	DDR3	DDR4	DDR3	DDR4
Density	32GB	4GB-64GB	2GB-32GB	32GB	32GB	8GB-16GB
Height	31.25mm	31.25/24.4mm	30mm	31.25mm	30.35mm	30mm
Configuration	80bit	72bit	72bit	72bit	72bit	72bit
Speed (MT/s)	4800	2666-3200	1333-1866	2666	1600	2666
Voltage	1.1V	1.2V	1.35V/1.5V	1.2V	1.35V/1.5V	1.2V
Operating Temperature*	C Temp	C/I Temp	C/I Temp	C Temp	C 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	DDR4	DDR3	DDR4	DDR3
Density	4GB-64GB	4GB-16GB	8GB-32GB	2GB-8GB
Height	31.25/18.75mm	18.75mm	18.75/17.78mm	18.75/18.3/17.78mm
Configuration	72bit	72bit	72bit	72bit
Speed (MT/s)	2666-3200	1600-1866	2666-3200	1333-1600
Voltage	1.2V	1.35V/1.5V	1.2V	1.35V/1.5V
Operating Temperature*	C/I Temp	C/I Temp	C Temp	C/I Temp

\*C Temp (0°C to +70°C); I Temp (-40°C to +85°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		UDIMM ECC	
Technology	DDR4	DDR3	DDR4	DDR3
Density	4GB-16GB	2GB-8GB	4GB-32GB	4GB-16GB
Height	31.25mm	30mm	31.25mm	30mm
Configuration	64bit	64bit	72bit	72bit
Speed (MT/s)	2666-3200	1600-1866	2666-3200	1600-1866
Voltage	1.2V	1.35V/1.5V	1.2V	1.35V/1.5V
Operating Temperature*	C/I Temp	C/I Temp	C/I Temp	C Temp

## Telecommunication

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



DIMM Type	SODIMM		SODIMM ECC		SORDIMM ECC
Technology	DDR4	DDR3	DDR4	DDR3	DDR3
Density	2GB-32GB	128MB-16GB	4GB-32GB	2GB-16GB	2GB-8GB
Height	30mm	30mm	30mm	30/25.4mm	30mm
Configuration	64bit	64bit	72bit	72bit	72bit
Speed (MT/s)	2400-3200	1600-1866	2666-3200	1600-1866	1600
Voltage	1.2V	1.35V/1.5V	1.2V	1.35V/1.5V	1.35V/1.5V
Operating Temperature*	C/I Temp	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)

## ■ 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 UDIMM ECC	
Technology	DDR3	DDR4	DDR3
Density	4GB-8GB	16GB-32GB	4GB-8GB
Height	18.3mm	17.78mm	18.75/18.3mm
Configuration	64bit	72bit	72bit
Speed (MT/s)	1600	2666-3200	1600
Voltage	1.35V/1.5V	1.2V	1.35V/1.5V
Operating Temperature*	C Temp	C/I Temp	C 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	Mini UDIMM ECC	VLP/ULP Mini UDIMM ECC	
Technology	DDR3	DDR4	DDR3
Density	4GB-8GB	4GB-32GB	2GB-8GB
Height	30mm	18.75/17.78mm	18.75/17.78mm
Configuration	72bit	72/64bit	72bit
Speed (MT/s)	1600	2400-3200	1333-1600
Voltage	1.35V/1.5V	1.2V	1.35V/1.5V
Operating Temperature*	C Temp	C/I Temp	C/I Temp

\*C Temp (0°C to +70°C); I Temp (-40°C to +85°C)



## Aerospace/Military

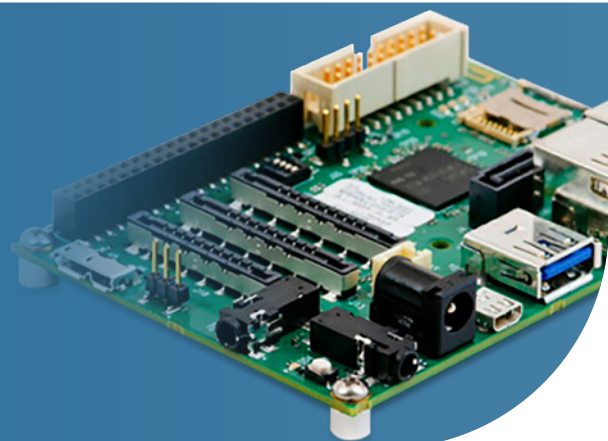
- Underfill for Excessive Shock and Vibration
- Optional Module Retention Clips for Extra Secure Attachment
- Conformal Coating for Moisture Exposure
- Industrial Temperature and Low Power Options Available



DIMM Type	XRDIMM ECC	SODIMM ECC	
Technology	DDR3	DDR4	DDR3
Density	4GB-8GB	4GB-32GB	2GB-16GB
Height	38mm	30mm	30/25.4mm
Configuration	72bit	72bit	72bit
Speed (MT/s)	1600	2666-3200	1600-1866
Voltage	1.35V/1.5V	1.2V	1.35V/1.5V
Operating Temperature*	C/I Temp	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/I Temp

\*C Temp (0°C to +70°C); I Temp (-40°C to +85°C)

# Industrial Temperature (-40°C to +85°C)

## I Temp Server DIMM



DIMM Type	RDIMM		VLP RDIMM		VLP/ULP Mini RDIMM
Technology	DDR4	DDR3	DDR4	DDR3	DDR3
Density	8GB-64GB	16GB	16GB	8GB	8GB
Height	31.25mm	30mm	31.25mm	18.75mm	18.3mm
Configuration	72bit	72bit	72bit	72bit	72bit
Speed (MT/s)	2666-3200	1866	2666	1600	1600
Voltage	1.2V	1.35V/1.5V	1.2V	1.35V/1.5V	1.35V/1.5V
Operating Temperature	I Temp	I Temp	I Temp	I Temp	I Temp

## I Temp UDIMM



DIMM Type	UDIMM		UDIMM ECC
Technology	DDR4	DDR3	DDR4
Density	4GB	2GB-8GB	8GB-32GB
Height	31.25mm	30mm	31.25mm
Configuration	64bit	64bit	72bit
Speed (MT/s)	2666	1600-1866	2666-3200
Voltage	1.2V	1.35V/1.5V	1.2V
Operating Temperature	I Temp	I Temp	I Temp

## I Temp SODIMM



DIMM Type	SODIMM		SODIMM ECC		SORDIMM ECC
Technology	DDR4	DDR3	DDR4	DDR3	DDR3
Density	4GB-16GB	2GB-16GB	4GB-32GB	2GB-16GB	4GB-8GB
Height	30mm	30mm	30mm	30/25.4mm	30mm
Configuration	64bit	64bit	72bit	72bit	72bit
Speed (MT/s)	2666-3200	1600-1866	2666-3200	1600-1866	1600
Voltage	1.2V	1.35V/1.5V	1.2V	1.35V/1.5V	1.35V/1.5V
Operating Temperature	I Temp	I Temp	I Temp	I Temp	I Temp

## I Temp VLP/ULP UDIMM



DIMM Type	ULP UDIMM ECC	VLP/ULP Mini UDIMM ECC	
Technology	DDR4	DDR4	DDR3
Density	32GB	8GB-16GB	2GB-8GB
Height	17.78mm	18.75mm	18.75/17.78mm
Configuration	72bit	72bit	72bit
Speed (MT/s)	2666	2400	1600
Voltage	1.2V	1.2V	1.35V/1.5V
Operating Temperature	I Temp	I Temp	I Temp



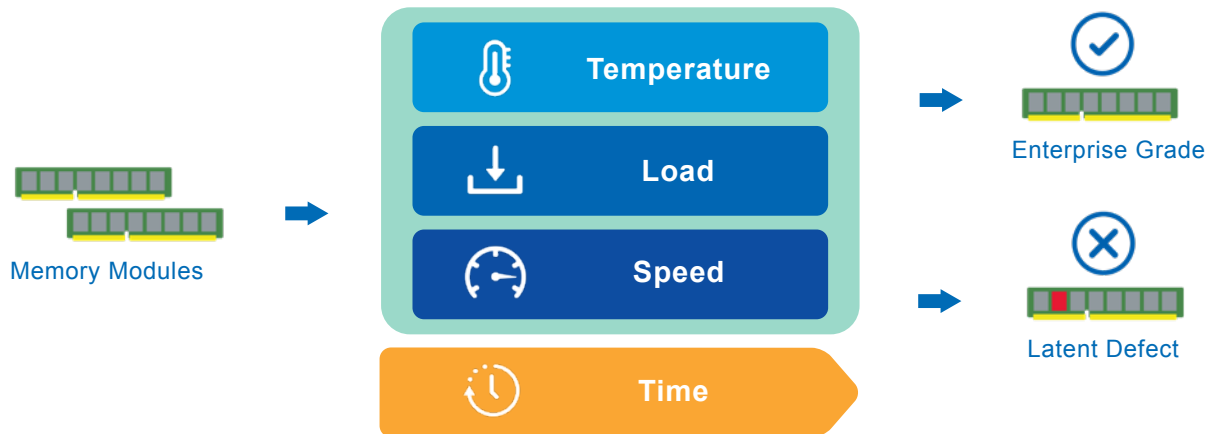


## Enterprise Memory

Proven Exceptional Reliability

SMART Enterprise Memory modules undergo a specialized and comprehensive screening process on custom server boards which ensures the highest reliability before modules are put into field services. Enterprise Memory modules are tested for temperature, speed, load, and environmental and electrical stresses to duplicate strenuous usage in an enterprise environment.

### Comprehensive Triple Stress Testing



### Screening Conditions:

- Continuous DRAM operations at +70°C to +85°C
- Continuous I/O stresses
- High power consumption
- 7-10+ hours of continuous operation
- Module rated speed



## Rugged Memory

Taking Memory to the Extreme

SMART Rugged is a portfolio of value added services to enhance the reliability of your memory products. SMART Rugged Memory is dedicated to developing the industry's most rugged, robust, and reliable memory that meets the needs of a wide variety of demanding applications found in the defense, aerospace, IIoT, telecommunications, transportation, energy, and other industries where devices are exposed to extreme temperatures and susceptible to corrosion.



Anti-Sulfur Resistor



Conformal Coating



30µm Gold Finger



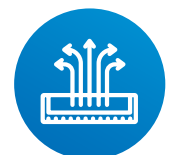
Industrial Temperature\*



Underfill



Retention Clips



Heat Spreaders

\*Industrial Temperature (-40°C to +85°C); Wide Temperature (-40°C to +105°C)



# A Global Leader in Specialty Memory, Storage and Hybrid Solutions

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