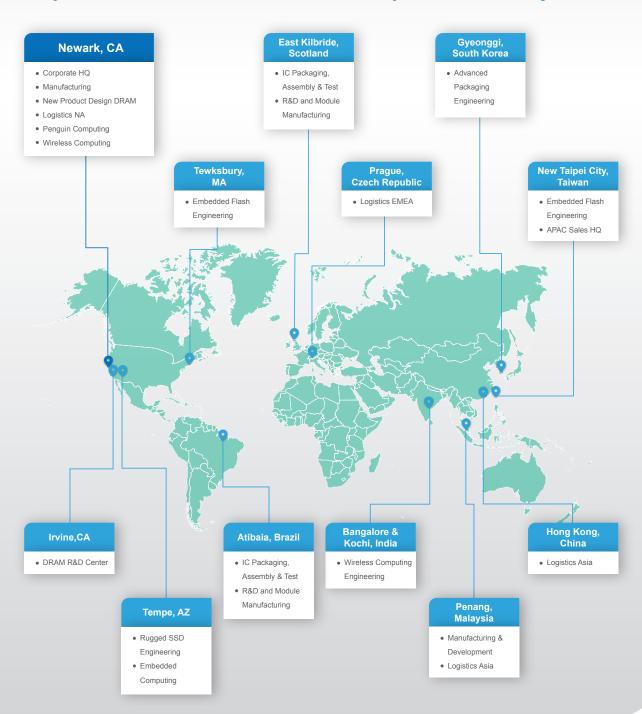


About SMART Global Holdings

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.smartgh.com



Application-Ready Solutions

SMART Modular Technologies has developed a comprehensive product line of DRAM and Flash memory technologies that span a variety of form factors to help customers take their innovative ideas from the design stage through manufacturing and the supply chain. SMART RUGGED offers high-performance, high-capacity solid state drives ("SSDs") for defense, aerospace and industrial automation markets. SMART Modular's presence in the U.S., Europe, Asia and Latin America enables us to provide our customers with proven expertise in supply chain management, international logistics and asset management worldwide.



Data Center

Secure storage memory requires data protection and encryption capabilities that are available in a range of speeds, densities, form factors and technologies. SMART Modular has a host of DuraFlash choices for data center 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.



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.



Military / Aerospace

Key memory needs for defense require rugged and durable designs with proven reliability in extreme conditions, e.g., shock, vibration, dust and humidity. DuraFlash M.2 SATA is an ideal option for demanding defense applications. Applications requiring higher levels of security and sanitization should consider the SMART RUGGED's line of 2.5" SSDs specifically designed for defense and aerospace.

DuraFlash™

Durable and Reliable Flash Solutions

With DuraFlash, SMART Modular is committed in offering a wide range of Flash storage form factors designed and manufactured to meet the heavy demands of accelerating embedded applications in the telecom, networking, storage, industrial control, medical, IIoT, transportation, and video surveillance market segments. SMART Modular's extensive capabilities and attention to detail integrate quality controls and stringent processes into all aspects of its design, procurement and manufacturing cycle. The process begins with the selection of specialized material and component suppliers that meet SMART Modular's strict requirements, to finished products, which are subjected to a rigorous design verification test (DVT) process requiring every unit to pass an extensive checklists of criteria, and final inspection for release.



Value-Added Features:

- Optimized for Enterprise and Industrial Applications
- Available in C Temp (0°C to +70 °C) and I Temp (-40°C to +85 °C)
- Multiple NAND Options: TLC, eTLC, MLC, SLC, and pSLC
- Extensive Burn-In to Ensure Field Reliability
- Customized Options with Advanced Features Available
- SafeDATA™ Technology Safeguards In-Flight Data During Sudden Power Loss (SPL)
- Available in Broad Range of Capacities

DuraFlash Product Family











DuraFlash SSDs

• 2.5"

• M.2

mSATA

- Slim SATA
- SATA DOM

DuraFlash BGA

- BGA NVMe
- eMMC

DuraFlash Cards

- SD Cards
- microSD Cards
- CF Cards
- CFast Cards

DuraFlash USB

- eUSB
- USB Flash Drives

Data Center/ Enterprise SSDs

- EDSFF
- U.2

DuraFlash

High Performance

- Offers high quality, performance and reliability expected in crucial industrial and enterprise applications
- Optimized for consistent performance during continuous duty cycles and heavy workload applications
- Boot drives and data storage for networking, storage server, data communications, transportation, video, and CCTV industries

R800 (2.5" SATA / M.2 2280 SATA)

(M.2 2280 SATA / mSATA)

ME2 (2.5" SATA / M.2 2280 SATA)

S1800 (M.2 2280 PCIe NVMe / U.2 PCIe NVMe)

SP2800 (M.2 PCle NVMe / U.2 PCle NVMe)



Q400



Balanced Power and Performance

- Designed for general computing required reliability and durability in industrial applications
- N200 offers multiple form factors for various embedded applications
- M1400 is compliant with NVMe 1.3 PCIe Gen3
 x2 interface specifications to optimize the access
 performance

N200

(2.5" SATA / M.2 SATA / mSATA / Slim SATA / CFast)

M1400

(M.2 2280 PCIe NVMe)





Data Center/Enterprise

- Lower latency
- Hot swap
- Lower power consumption and higher endurance
- · Built for sustained performance
- Data center/enterprise workloads
- · 24/7 consistent input/output operations
- · Built-in power-loss protection

MDC7000

(EDSFF)





■ 2.5" SATA

DuraFlash 2.5" SATA solid state drives bring the advantages of non-volatile memory to embedded computing applications. The 2.5" SATA product are offered in Triple-Level Cell (TLC) 3D NAND and provide excellent sustained read/write performance in both commercial and industrial temperature ranges.







Speci	fications	ME2	N200v	R800		
Interface			SATA III 6Gb/s			
Form Factor			2.5"			
	Read	560MB/s	550MB/s	550MB/s		
Max. Performance	Write	500MB/s	500MB/s	500MB/s		
Capacity		240GB-1920GB	32GB-1TB	240GB-7680GB		
DRAM		V	-	V		
	SafeDATA	Optional	-	Optional		
Data Integrity	Advanced Error Detection & Correction	V	V	V		
	AES 256 Encryption	V	-	V		
Security	TCG OPAL 2.0	V	-	V		
	Security Erase (ATA)	V	V	V		
	Shock Operating	1500 g half-sine, 0.5 msec, shock along each axis, X, Y, Z in each direction				
Reliability	Vibration Operating	20G 80-2000Hz, 1.52mm 20-80Hz, 3 axis				
	Operating Temperature*	C/I Temp	C/I Temp	C/I Temp		
Durability	DWPD (for 5 Years)	0.3/1** (Enterprise Workload)	0.4 (Client Workload)	0.3 (Enterprise Workload)		
	Pseudo-SLC	Optional	Optional	-		
	Thermal Throttling	V	V	V		
	Wear-Leveling/ Garbage Collection/ TRIM	V	V	V		

- NAS / SAN storage systems
- x86 server-storage appliances

- · Distributed scale-out cloud servers
- Telecom and networking routers and switches

■ M.2 SATA

DuraFlash M.2 SATA embedded SSDs are designed for applications requiring reliable internal storage, yet constrained by small footprints. DuraFlash M.2 drives offer best-in-class sequential and random read/write performance in transaction intensive applications. M.2 SATA can be easily integrated into a host system without any special BIOS modifications or additional device drivers. SafeDATA Technology safeguards data against corruption during power loss.









Specific	cations	ME2	N200v	Q400	R800		
Interface			SATA II	I 6Gb/s			
Form Factor		M.2 2280					
Max.	Read	560MB/s	550MB/s	560MB/s	550MB/s		
Performance	Write	500MB/s	500MB/s	500MB/s	500MB/s		
Capacity		240GB-1920GB	32GB-1TB	120GB-960GB	240GB-1920GB		
DRAM		V	-	V	V		
	SafeDATA	Optional	-	Optional	Optional		
Data Integrity	Advanced Error Detection & Correction	V	V	V	V		
	AES 256 Encryption	V	-	V	V		
Security	TCG OPAL 2.0	V	-	V	V		
	Security Erase (ATA)	V	V	V	V		
	Shock Operating	1500 g half-sine, 0.5 msec, shock along each axis, X, Y, Z in each direction					
Reliability	Vibration Operating	20G 80-2000Hz, 1.52mm 20-80Hz, 3 axis					
	Operating Temperature*	C/I Temp	C/I Temp	C/I Temp	C/I Temp		
	DWPD (for 5 Years)	0.3/1** (Enterprise Workload)	0.4 (Client Workload)	0.3 (Enterprise Workload)	0.3 (Enterprise Workload)		
Durability	Pseudo-SLC	Optional	Optional	-	-		
	Thermal Thorttling	V	V	V	V		
	Wear-Leveling/ Garbage Collection/ TRIM	V	V	V	V		

- Personal PC
 Communications
 - ommunications Embedded computing
- POS
- Industrial

■ mSATA / Slim SATA

DuraFlash mSATA and Slim SATA drivers are ideally suited for use in a wide variety of OEM storage applications requiring multiple supply chains, design, interoperability, rapid time to market and long product life cycles. The mSATA embedded drives are fully MO-300 compliant and Slim SATA drives are MO-297 compliant.







Speci	fications	N200v	Q400	N200v		
Interface			SATA III 6Gb/s			
Form Factor		mSATA	mSATA	Slim SATA		
	Read	550MB/s	560MB/s	550MB/s		
Max. Performance	Write	500MB/s	500MB/s	490MB/s		
Capacity		32GB-1TB	120GB-960GB	32GB-1TB		
DRAM		-	V	V		
	SafeDATA	-	Optional	Optional		
Data Integrity	Advanced Error Detection & Correction	V	V	V		
	AES 256 Encryption	-	V	V		
Security	TCG OPAL 2.0	-	V	V		
	Security Erase (ATA)	V	V	V		
	Shock Operating	1500 g half-sine, 0.5 msec, shock along each axis, X, Y, Z in each direction				
Reliability	Vibration Operating	20G 80-2000Hz, 1.52mm 20-80Hz, 3 axis				
•	Operating Temperature*	C/I Temp	C/I Temp	C/I Temp		
	DWPD (for 5 Years)	0.4 (Client Workload)	0.3 (Enterprise Workload)	0.4 (Client Workload)		
Durability	Pseudo-SLC	Optional	-	Optional		
	Thermal Throttling	V	V	V		
	Wear-Leveling/ Garbage Collection/ TRIM	V	V	V		

Recommended/Suggested Applications

• NAS / SAN storage systems

• Distributed scale-out cloud servers

• x86 server-storage appliances

■ M.2 / U.2 PCIe

DuraFlash M.2 and PCIe U.2 module are specifically applicable for server, storage cache/accelerators, and data communications applications requiring reliable internal storage with a small footprint. Utilizing a PCIe Base 3.1 interface, M.2 PCIe modules are easily integrated into a host system without any special BIOS modifications or additional device drivers.







Speci	fications	M1400	S1800	SP2800		
Interface		PCIe Gen3 x2	PCIe Gen3 x4	PCIe Gen3 x4		
Form Factor		M.2 2280	M.2 2280 U.2	M.2 22110 M.2 2280 U.2		
M	Read	1600MB/s	3200MB/s	3300MB/s		
Max. Performance	Write	1000MB/s	1000MB/s	2600MB/s		
Capacity		120GB-960GB	240GB-1920GB (M.2) 240GB-3840GB (U.2)	240GB-1920GB		
DRAM		V	V	V		
	SafeDATA	-	Optional	Optional		
Data Integrity	Advanced Error Detection & Correction	V	V	V		
	AES 256 Encryption	-	V	V		
Security	TCG OPAL 2.0	-	V	V		
	Security Erase (ATA)	V	V	V		
Reliability	Shock Operating	1500 g half-sine, 0.5 msec, shock along each axis, X, Y, Z in each direction				
	Vibration Operating	20G 80-2000Hz, 1.52mm 20-80Hz, 3 axis				
	Operating Temperature*		C/I Temp			
	DWPD (for 5 Years)	0.5 (Client Workload)	0.3 (Enterprise Workload)	0.3/1** (Enterprise Workload)		
Durability	Pseudo-SLC	-	-	-		
	Thermal Throttling	V	V	V		
	Wear-Leveling/ Garbage Collection/ TRIM	V	V	V		

Recommended/Suggested Applications

• Industrial • Networking • Data communications

■ BGA NVMe

DuraFlash BGA NVMe SSDs are optimally designed for a wide range of embedded applications requiring a small flexible form factor, fast access speed, and reliable PCIe NVMe storage. Additionally, BGA NVMe SSDs support PCIe Gen3 x4 NVMe, crafted for high-performance, light weight, and mission-critical industrial applications.

Specifications		BGAP520		
Interface	·	PCle Gen3 x4		
Form Factor		M.2 1620 (BGA)	M.2 2230	
Max.	Read	1600MB/s	1600MB/s	
Performance	Write	600MB/s	600MB/s	
Capacity		32GB-256GB	32GB-256GB	
Ball Counts		291	-	
Operating Temperature*		C/I Temp	C/I Temp	







Recommended/Suggested Applications

- · Industrial, embedded applications
- · Single-board computers

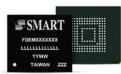
- Networking
- Data communications

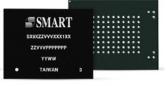
■ BGA eMMC 5.1

DuraFlash BGA eMMC 5.1 is designed to meet the rigid requirements of the industrial, medical and networking markets where technical support, extended life, and stable road maps are critical. eMMC is a soldered down Flash storage solution that combines NAND Flash memory, an embedded MMC (MultiMediaCard) controller, and advanced firmware in a small BGA (Ball Grid Array) package that provides stable, yet cost-effective high-density embedded storage.

Specifications		BGAE440
Max.	Read	330MB/s
Performance	Write	200MB/s
Capacity		32GB-256GB
Ball Counts		100/153
Operating Temperature*		E/I Temp







- Factory automation
- Medical devices
- RFID scanners
- Telecom infrastructure

- Networking appliances
- POS terminals
- Single-board computers
- IIoT

■ Memory Cards

DuraFlash SD and microSD memory cards are robust and reliable solutions for solid state storage needs. By incorporating on-board error detection and correction algorithms, and static and dynamic wear-leveling techniques, DuraFlash memory card products ensure years of reliable operation over its product lifespan. SD cards are offered in commercial and industrial temperature versions, and specifically designed to meet strict industrial operating and environmental requirements.



SD Cards



Specifications	XL+ SLC	XL+ MLC	RD2	230
NAND Type	SLC	MLC	TLC	pSLC (TLC)
Capacity	512MB-2GB 4GB-32GB	8GB-128GB	16GB-256GB	4GB-64GB
Operating Temperature* C/I Temp		C/I Temp	C/I Temp	C/I Temp

Recommended/Suggested Applications

- · Automotive telematics, navigation, and infotainment
- Digital commercial camcorders

- Telecom and communications
- Medical equipment
- Embedded computing

microSD Cards



Specifications RD130m		RD2	30m
NAND Type	SLC	TLC	pSLC (TLC)
Capacity 1GB-4GB		16GB-256GB	4GB-64GB
Operating Temperature*	E/I Temp	C/I Temp	C/I Temp

- Automotive telematics, navigation, and infotainment
- Telecom and communications
- Embedded computing

- · Digital commercial camcorders
- Gaming
- · Industrial meters and industrial control
- · Medical equipment

■ CF Cards

DuraFlash industrial and commercial temperature CF cards are designed for networking, telecommunications and data communications applications. DuraFlas CF products are also a natural fit for mobile and embedded computing, medica automotive and industrial applications.

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Specifications		H9 CF Card
Interface		CF 6.1
NAND Type		SLC
Max.	Read	100MB/s
Performance	Write	70MB/s
Capacity		64MB-64GB
Operating Temperature*		C/I Temp



Recommended/Suggested Applications

Gaming

Communications

- Defense
- · Industrial control equipment

- Networking
- Printers

■ CFast Cards

DuraFlash N200v CFast Cards are a solid state drive product with 3D NAND Flash memory. Designed for server, storage cache/accelerators, networking, and data communications applications, CFast Cards are ideal for applications requiring reliable

internal storage with a small footprint.

Specifications		N200v		
Interface		SATA III 6Gb/s		
NAND Type		TLC		
Max.	Read	550MB/s		
Performance	Write	490MB/s		
Capacity		32GB-256GB		
Operating Tem	perature*	C/I Temp		





Recommended/Suggested Applications

Industrial

· Server/Storage cache accelerators

Networking

Data communications

■ eUSB Flash Drives

DuraFlash industrial-grade embedded USB (eUSB) Flash Drives feature a small form factor, low power consumption, and fast access times. Applications include singleboard computing for defense, telecom, networking, ATCA compute blades, general networking, and standard server applications.

Specifications		RU150e	HU250e	
Interface		USB 2.0	USB 3.0	
NAND Type		SLC	SLC	
Max.	Read	45MB/s	150MB/s	
Performance	Write	35MB/s	90MB/s	
Capacity		1GB-32GB	8GB-32GB	
Operating Tem	perature*	C/I Temp	C/I Temp	
		Pin pitch 2.54mm, H: 7.50mm		
Connector		Pin pitch 2.54mm, H: 9.78mm	Pin pitch 2.00mm, H: 3.68mm	
		Pin pitch 2.00mm, H: 3.68mm		



Recommended/Suggested Applications

- Single-board computers for defense, gaming and industrial control applications
- ATCA compute blades

· Industry standard servers

USB Flash Drives

USB Flash Drives address the need for enhanced reliability with the industry's bestin-class read and write speeds, providing reliable operation over the product life cycle. DuraFlash USB Flash Drives offer both USB 2.0 and USB 3.0 high speed bus protocols, and are designed as the main boot and storage devices in embedded systems.

Specifications		RU150	RU350	
Interface		USB 2.0	USB 3.1 Gen 1	
NAND Type		SLC	TLC	
Max.	Read	34MB/s	240MB/s	
Performance	Write	29MB/s	90MB/s	
Capacity		1GB-16GB	16GB-256GB	
Operating Temperature*		C Temp	C/I Temp	
Connector		Туре А	Type A	



- Single-board computers for defense, gaming and industrial control applications ATCA compute blades
- · Telecom and networking routers and switches

- Networking
- · Industry standard servers

SMARTRUGGED[™]

WHEN FAILURE IS NOT AN OPTION

SMART RUGGED pioneered secure, ruggedized solid-state drives and continues to be a technology leader, employing current and next-generation defense-focused designs with physical ruggedization, conformal coating, HW-based erase triggers on each end of the drives, and more. Utilizing Flash technology backed with proven world-class support, SMART RUGGED designs and manufactures high performance military and industrial SSDs with military standard encryption, secure data elimination and write-protect features.



Standard



Shock & Vibration



Security



Specific Shock & Vibration



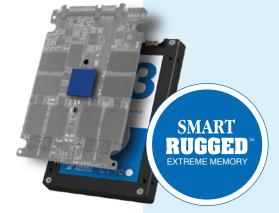
Underfill & Staking



Conformal Coat



Humidity Condensation





Optional

Leaded Process



Custom FW



Altitude



Industiral Temperature



Extreme
Temperature
Screening



Custom HW

■ SMART RUGGED SSD LINE-UP









		T5E	S5E	M4	M4P	M1HC	
NAND Flash Ty	rpe	3D TLC pSLC	SLC	MLC	MLC	MLC	
Max.	Read	550MB/s	530MB/s	500MB/s	525MB/s	520MB/s	
Performance	Write	535MB/s	530MB/s	260MB/s	500MB/s	500MB/s	
Capacity		120GB-4TB (3D TLC) 40GB-1280GB (pSLC)	60GB-480GB	240GB-960GB	240GB-2TB	1TB-8TB	
Applications							
Industrial		V	V	V	V	V	
Defense		V	V	V	V	V	
Data Recording	J	V	V	V	V	V	
Mission Critical		V	V	V	V	V	
Surveillance		V	V	V	V	V	
Telemetry		V	V	V	V	V	
Reliability							
MTBF		2M hours, Telcordia 25°C	2M hours, Telcordia 25°C	>3M Hours	>2M Hours	1.5M Hours	
Data Reliability		1 in 10 ¹⁷ bits read	1 in 10 ¹⁷ bits read	1 in 10 ¹⁵ bits read	1 in 10 ¹⁷ bits read	1 in 10 ¹⁷ bits read	
Data Retention		10 years @ 25°C	10 years @ 25°C	1 year @ 55°C	10 years @ 40°C	1 year @ 30°C	
Endurance		1,000 Total Drive Writes	40,000 Total Drive Writes	1,200 Total Drive Writes	2,100 Total Drive Writes	2,000 Total Drive Writes	
Power Loss Pro	otection	SafeDATA	SafeDATA	SafeDATA	SafeDATA	Fast Flush of Cached Data	
Warranty		1 Year	1 Year	1 Year	1 Year	1 Year	
Environmenta	ı						
Operating Temp	erature		Industrial (-40° C to 85° C) Commercial (0° C to 70° C)	-40°C to 85°C	-40°C to 85°C	-40°C to 85°C	
Storage Temper	rature	-55°C to 95°C	-55°C to 95°C	-55°C to 95°C	-55°C to 95°C	-55°C to 95°C	
Operating Shoc	ing Shock 50 g half-sine, 11 ms, 3 shocks along each axis						
Operating Vibra	tion	16.4 g rms, 15-2,000 Hz	16.4 g rms, 15-2,000 Hz	16.4 g rms, 15-2,000 Hz	16.4 g rms, 10-2,000 Hz	16.3 g rms, 10-2,000Hz	
Relative Humidi	ty	5%-95% non-condensing	5%-95% non-condensing	5%-95% non-condensing	5%-95% non-condensing	5%-95% non-condensing	
Altitude		24,384m (80,000 ft)	24,384m (80,000 ft)	24,384m (80,000 ft)	24,384m (80,000 ft)	30,480m (100,000 ft)	
Conformal Coat	ing	Optional	Optional	Optional	Optional	Optional	
Security (Prote	ection & Data	a Elimination)					
ATA Password		V	V	V	V	V	
AES 256b		V	V	V	V	V	
Write Protect		V	V	V	V	V	
External HW Tr	igger	V	V	V	V	V	
Erase Key and	Flash	V	V	V	V	V	
Mil Erase Sequ	uences						
NSA/CSS Manu	al 9-12	V	V	V	V	V	
DoD NISPOM 5	220.22-M	V	V	V	V	V	
DoD NISPOM 52	220.22-M-Sup	1 V	V	-	-	V	
NSA/CSS Manu	al 130-2	V	V	V	V	V	
Army AR 380-1	9	V	V	V	V	-	
Navy NAVSO F	9-5239-26	V	V	V	V	V	
Air Force AFSS	SI-5020	V	V	-	-	V	
Custom Seque	nce	V	V	-	-	V	



A Global Leader in Specialty Memory, Storage and Hybrid Solutions

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

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