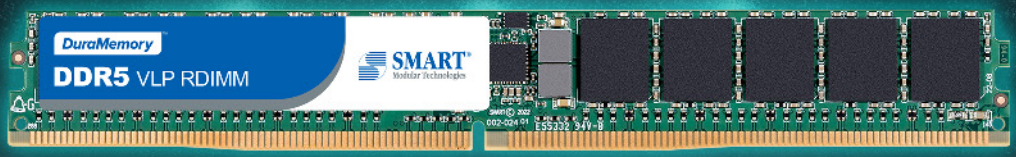
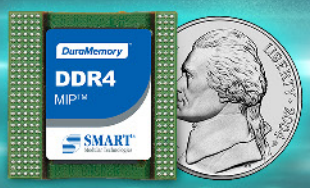
SMART®
Modular Technologies





DuraMemory™

Special DIMM Type
Product Line

Introduction

SMART Modular has a long history of successfully partnering with customers to satisfy their specific design needs. With extensive industry and design expertise and global manufacturing capabilities, SMART Modular offers a unique combination of advantages that can support customers' designs from conception to manufacturing through final testing and logistics. This blend of abilities allows SMART Modular to efficiently and reliably customize products to meet particular customer needs.

SMART Modular delivers solutions to a broad customer base, including OEMs in computing, networking, communications, storage, mobile and industrial markets. Available in registered, unbuffered, and ECC configurations, SMART Modular's DRAM memory modules are available in various form factors that include standard height and special DIMM types, including Very Low Profile (VLP), Ultra Low Profile (ULP), mini-DIMM, Module-in-a-Package (MIP), LRDIMM, XRDIMM and NVDIMM.

Among these special DIMM types,

- Small form factor DIMMs are particularly designed and manufactured for space-constrained applications, such as 1U blade servers and blade enclosure systems, to improves airflow inside the system and reduces thermal impact.
- LRDIMMs, with specific configurations intended for servers, workstations and data center applications, allow adding more DIMMs per channel to maximize capacity and performance.
- NVDIMMs are used for logging and caching functions to accelerate system performance in server and storage applications.

DuraMemory™ Special DIMM Type Memory Products

VLP + VLP Mini

ULP + ULP Mini

MIP

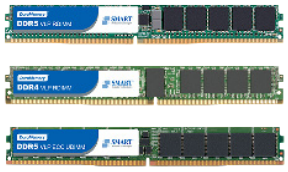
Mini DIMM

LRDIMM

XRDIMM

NVDIMM

VLP DIMM



Features & Benefits

- DIMM Height of 18.75mm for Vertical Placement in 1U Blades
- Maximize System Density and Performance - up to 384GB in 1U Blade Systems with 12 DIMM Sockets
- Maximize Air Flow in Dense Systems
- Zefr™ High Reliability

Applications

- Blade Servers – Compute & Storage
- Telecom and Networking ATCA Blades
- Embedded & Edge Computing

Use Case

DIMM Type	VLP RDIMM		VLP ECC UDIMM
Module Type	DDR5	DDR4	DDR5
Density	32GB	4GB - 64GB	16GB - 32GB
Height	18.75 mm	18.75 mm	18.75 mm
Configuration	80bit	72bit	72bit
Speed (MT/s)	4800	2666-3200	4800
Voltage	1.1V	1.2V	1.1V
Operating Temperature*	C Temp	C/I Temp	C Temp

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

VLP Mini DIMM

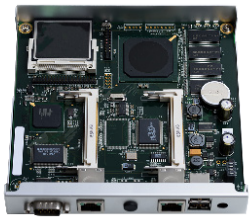
Features & Benefits

- DIMM Height of 18.75mm for Vertical Placement in 1U Blades
- Maximize System Density and Performance - up to 384GB in 1U Blade Systems with 12 DIMM Sockets
- Maximize Air Flow in Dense Systems
- Zefr™ High Reliability

Applications

- Blade Servers – Compute & Storage
- Telecom and Networking ATCA Blades
- Embedded & Edge Computing

Use Case



DIMM Type	VLP Mini UDIMM	VLP Mini RDIMM
Module Type	DDR4	DDR4
Density	4GB – 32GB	4GB - 8GB
Height	18.75 mm	18.75 mm
Configuration	72bit	72bit
Speed (MT/s)	2400-3200	2666-3200
Voltage	1.2V	1.2V
Operating Temperature*	C/I Temp	C Temp

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

ULP DIMM

Features & Benefits

- Suitable for Space-constrained Blade Applications
- For Vertical Placement in 1U Blades
- Maximize System Density and Performance
- Built-in ECC to Detect and Correct Memory Errors

Applications

- Blade Servers – Compute & Storage
- Telecom and Networking ATCA Blades
- Embedded & Edge Computing

Use Case

DIMM Type	ULP ECC UDIMM
Module Type	DDR4
Density	16GB – 32GB
Height	17.78 mm
Configuration	72bit
Speed (MT/s)	2666-3200
Voltage	1.2V
Operating Temperature*	C Temp

*C Temp (0 °C to +70 °C)

ULP Mini DIMM

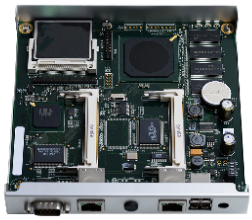
Features & Benefits

- Suitable for Space-constrained Blade Applications
- For Vertical Placement in 1U Blades
- Maximize System Density and Performance
- Built-in ECC to Detect and Correct Memory Errors

Applications

- Blade Servers – Compute & Storage
- Telecom and Networking ATCA Blades
- Embedded & Edge Computing

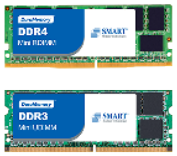
Use Case



DIMM Type	ULP Mini UDIMM	ULP Mini RDIMM
Module Type	DDR4	DDR4
Density	8GB	8GB
Height	17.78 mm	17.78 mm
Configuration	72bit	72bit
Speed (MT/s)	2666	2666
Voltage	1.2V	1.2V
Operating Temperature*	C Temp	C Temp

*C Temp (0 °C to +70 °C)

Mini DIMM



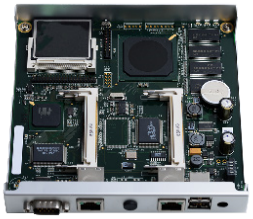
Features & Benefits

- Command/Address and Control bus is Double Data Rate
- Generates CRC Checksum in READ Data Frames
- Default Burst Length Increased to BL16 – Single Burst = 64B of Data
- Integrated Temperature Sensor (MR4)
- DDR5 DRAM Contains 256 Mode Registers

Applications

- Networking
- Telecom
- Industrial SBC Blades

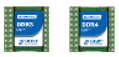
Use Case



DIMM Type	Mini RDIMM	Mini UDIMM
Module Type	DDR4	DDR3
Density	8GB - 16GB	4GB - 8GB
Height	30.00 mm	30.00 mm
Configuration	72bit	72bit
Speed (MT/s)	2666	1600
Voltage	1.2V	1.35V
Operating Temperature*	C Temp	C Temp

*C Temp (0 °C to +70 °C)

Module-In-A-Package™ (MIP™)



Features & Benefits

- Occupies Only 1/5th the Space of an SODIMM
- Up to 42% Power Savings Comparing to SODIMMs
- Superior Ruggedness – Soldered Down; No Sockets or Clips
- Leverages SMART's Proven Stacking Technology

Applications

- Video Broadcast
- Video/Graphics Cards
- Embedded Computing
- Telecom
- Defense/Aerospace
- Automotive

Use Case

DIMM Type	Module-In-A-Package (MIP)	
Module Type	DDR4	DDR3
Density	4GB - 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
Operating Temperature*	C/I Temp	C/I Temp

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

LRDIMM

Features & Benefits

- Load-Reduced Dual In-Line Memory Modular (LRDIMM)
- JEDEC Standard
- Three DIMM per Channel Server Configurations
- High Speed Data Rates
- Minimize Supply Chain Disruptions by Self-Qualifying New Die Revs and Providing Multi-sourced DRAM Options

Applications

- Data Centers Requiring Large Amounts of Server Memory
- Enterprise Grade LRDIMMs Available for Mission Critical Applications

Use Case

DIMM Type	LRDIMM
Module Type	DDR4
Density	64GB – 256GB
Height	31.25 mm
Configuration	72bit
Speed (MT/s)	2400-3200
Voltage	1.2V
Operating Temperature*	C Temp

*C Temp (0 °C to +70 °C)

XRDIMM

Features & Benefits

- Superior Ruggedness and More Compact Than SODIMMs. No Sockets or Clips
- 240-Pin Connector and Screw Attach Interface for Shock and Vibration Resistance
- Industrial Temperature and Low Power Options Available
- Conforms to XR-DIMM Rugged Memory Spec Rev 2.0

Applications

- Single-Board Computing
- Transportation
- Military

DIMM Type	XRDIMM
Module Type	DDR3
Density	2GB – 8GB
Height	38 mm
Configuration	72bit
Speed (MT/s)	1333 - 1600
Voltage	1.35V/1.5V
Operating Temperature*	C/I Temp

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

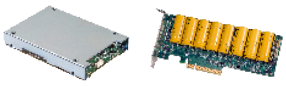
Persistent Memory

DDR4 NVDIMM

Features & Benefits

- Fits Standard 288-pin DIMM Socket
- Function as a Standard RDIMM Module During Normal Operation
- Data is Automatically Backed up to Flash During a Power Loss
- NVDIMM with Encryption is Also Offered as an Option

Backup Power Module options



Applications

High Performance Servers

- Database and analytics servers
- High performance replacement for existing NVRAM PCIe cards
- Journaling & check-pointing for
- In-memory databases
- Real-time response in financial trading & social media

High Performance Storage Servers

- SAN appliances and arrays
- NAS filers
- Distributed storage systems
- High performance replacement for existing NVRAM PCIe cards
- Tiering and caching
- Meta data storage
- SSD address mapping table

Use Case

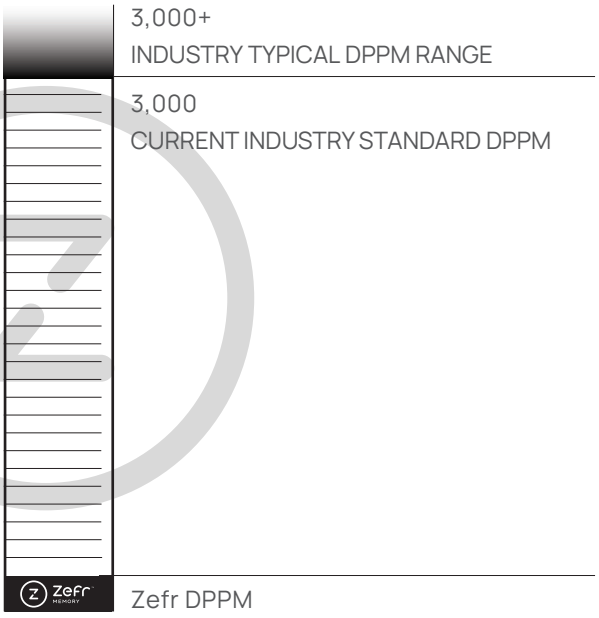
DIMM Type	DDR4
Module Type	NVDIMM
Density	8GB - 32GB
Height	31.25 mm
Configuration	72bit
Speed (MT/s)	2666-3200
Voltage	1.2V
Operating Temperature*	C Temp

*C Temp (0 °C to +70 °C)

Zefr (Zero Failure Rate) Eliminates Over 90% of Memory Reliability Failures

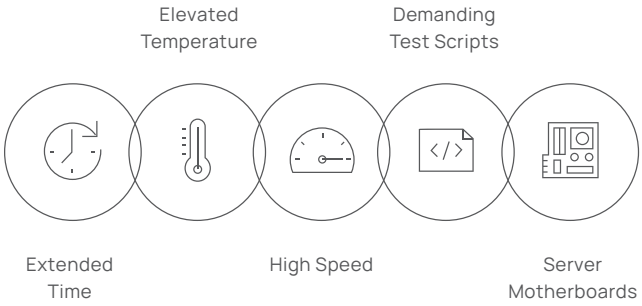
Zefr is a screening process performed on OEM original memory modules or SMART Modular built memory modules to deliver ultra-high reliability for demanding workloads.

Lower DPPM Than Industry Standard Memory



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.



For more information, please visit **https://www.smartm.com/technology/Zefr**

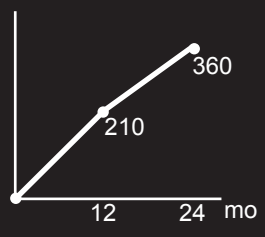
Zefr Benefits

Increase ROI	Maximize System Yield Rate	Accelerate the "Time-to-Insight"

Case Study

An HPC System Integrator built identical systems with standard and Zefr memory.

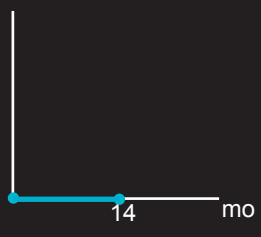
Standard Memory



Purchase 18,384 Standard RDIMMs
Build Cluster A:
- 1,532 Nodes
- Twelve 16GB RDIMMs per Node

Field Failures since Platform Bring up:
360 Failures

Zefr Memory



Purchase 18,384 Standard RDIMMs
Build Cluster B:
- 1,532 Nodes
- Twelve 16GB RDIMMs per Node

Field Failures since Platform Bring up:
0 Failures

SMART®
Modular Technologies

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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