Driving the MRAM Revolution

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MRAM In Datacenter Core Enables Data Persistence At Speed
MRAM Enables Critical Data Persistence At Speed In Edge Applications

By 2025, 75% of enterprise data will be created and processed outside the Data Center.¹

¹Gartner: How Edge Computing Redefines Infrastructure, 23 August 2018.
MRAM is Deployed in Various Mission-Critical End Points

27B Networked Devices by 2021

1Cisco Visual Networking Index, June 2017
MRAM: Persistence, Performance, Endurance & Reliability

**PERSISTENCE**
Maintains memory contents without requiring power

**PERFORMANCE**
SRAM & DRAM-like performance with low latency

**ENDURANCE**
Superior durability supports memory workloads without sophisticated management

**RELIABILITY**
Best-in-class robustness designed and tested for extreme conditions
A Variety of Persistent MRAM Technologies

**Toggle MRAM as Persistent SRAM**

- Standard SPI and Parallel I/F
- Replacement for nvSRAM, FRAM, BBSRAM and NOR Flash
- Robust operating reliability across extended temperature
- Steadily growing long-term market value

**STT-MRAM As Persistent DRAM**

- DDR3 & DDR4 compatible
- Complementary to DRAM & Flash
- High performance NVM with high chip capacity
- Disruptive value as non-volatile write buffer
- New market growth driver
Legacy Discrete Memory Backdrop

**DRAM** is fast, but volatile and requires refresh cycle.

**SRAM** has lower density than DRAM and is also volatile. Both require external batteries or capacitors to provide operating power.

**SCM** (Storage-Class Memory) is faster than NAND, but lower endurance than DRAM.

**NAND** Flash is non-volatile, but has high latency and low endurance.
MRAM Brings Native Persistence to Memory Workloads

- Non-Volatile: Maintains memory without power
- Fast Read/Write Speeds: Similar to DRAM
- Superior Endurance: Survives memory workloads
- High Data Retention

MRAM combines performance of memory with persistence of storage

Target area for true persistent memory
World’s First Pre-Production 1Gb STT-MRAM

Everspin ships the World’s First Pre-Production 28nm 1Gb STT-MRAM Customer Samples

January 29, 2019, Irvine, Calif – Everspin Technologies, Inc., the world leader in innovative MRAM solutions, announced today the shipment of its pre-production samples of the 28nm 1Gb STT-MRAM. Everspin has been working with its customers and key technology partners to bring this product to market. These are the world’s first 1Gb STT-MRAM parts that have customer samples for design-in, performance and reliability testing in production write buffer applications.

“Everspin’s STT-MRAM devices add a new infrastructural capability to increase the reliability and performance of systems where high performance data persistence is critical by delivering protection against power loss without the use of supercapacitors or batteries,” said Kevin Conley, Everspin’s President and CEO. “We are looking forward to working with our customers to bring the next generation of STT-MRAM enabled products to market.”

Everspin’s 1Gb product family includes both 8-bit and 16-bit DDR4 compatible 3200MHz interface versions of the device, and are available in a single TSSOP package. Everspin is expecting volume of 350M points, providing a critical increase in density in the same physical space. Production ramp for the 1Gb product is scheduled to begin in the second half of 2019.

About Everspin Technologies

Everspin Technologies is a leading developer of magnetic random access memory (MRAM) solutions that provide a new level of data security, performance, and endurance for applications requiring persistent data. Everspin’s products are used in a wide range of applications in the datacenter, Internet of Things, and networking markets. Everspin is headquartered in Chandler, Arizona. Everspin Technologies is a wholly owned subsidiary of Western Digital Corporation.

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- 28nm technology from GLOBALFOUNDRIES JDA
- Shipped in December 2018
- Full performance & reliability specs
- Production ramp 2H 2019
STT-MRAM in Enterprise Storage

In Partnership With:

IBM

- Larger Buffer To Absorb NAND Latency
- Optimized Interleave For Sequential Performance
- Maximized Stream Management
- More Physical Space For Storage Capacity
- No Capacitor Liability
- Simplified Architecture Eliminates Power Fail Hardening
In Partnership With:

**STT-MRAM in Server Storage Accelerator**

Optimized Log Management

9x Improvement In Overall Storage Performance*

No Special Drivers
Standard NVMe

No Stored Charge Liability

Provide bigger working persistent memory region

Higher Performance With Bypass Assist

- Acts as a power loss protected write burst data buffer on the fabric/network controller card for offload engines
- Providing at point persistent write data completion
- Eliminates the multi-microseconds latency path before data can be committed to a persistent device

Enables product differentiation
Toggle MRAM in RAID Controller Journal Memory

- No Stored Charge Liability
- Simplified Architecture Eliminates Power Fail Hardening
- Solid Reliability
Toggle MRAM in Gaming Machine Data Log

MRAM Ensures Data Retention

- Persistent Memory ensures data retention
- Ensures accuracy of data logging applications

No Stored Charge Liability

Extended Temperature Operation

Solid Reliability
What Is Next for MRAM?

- Expanding discrete MRAM adoption in data center storage and networking applications
- Growth of discrete MRAM in mission critical applications in gaming, industrial, transportation and medical endpoints
- Embedded MRAM penetration in SOCs for consumer, industrial, and transportation endpoints
In Conclusion

- MRAM meets persistent data needs from the data center to the edge
- MRAM is the key technology for tomorrow’s need for a universal memory that delivers persistence at speed with high endurance and reliability
- Everspin Technologies is the memory pioneer driving the MRAM revolution
Thank You