



Fast Non-Volatile RAM Products

Superior price and performance
from a source you can trust

The Future of Non-Volatile Read/Write Memory is Magnetic

Freescale MRAM Features

- 35 ns read/write cycle time
- Unlimited read/write endurance
- 3.3V ± 10 percent power supply
- Always non-volatile with greater than 20-year retention
- Magnetically shielded to greater than 25 oersted (Oe)
- Commercial, Industrial and Extended Temperature Options

Freescale MRAM Benefits

- Small size—up to 4 Mb on one chip
- Fast, simple interface—35 ns cycle, SRAM timing and pin out
- Cost effective—simple one transistor and one magnetic tunnel junction (1T-1MTJ) bit cell structure
- Extremely reliable—soft error rate significantly better than SRAM, BBSRAM and nvSRAM
- Alternate sources—pin-compatible with 4 Mb SRAM, nvSRAM and FRAM products
- RoHS compliant—no battery, no lead (Pb)

Freescale Semiconductor delivers the world's first commercial magnetoresistive random access memory (MRAM) products. Our MRAM products store data using magnetic polarization rather than electric charge. MRAM stores data for decades while reading and writing at SRAM speed without wear-out. MRAM products use small, simple cells to deliver the highest density and best price/performance in the non-volatile RAM marketplace. With our new expanded product line, we serve a growing portion of the non-volatile RAM market.

The MRAM Advantage

Price/Performance Leader

The simple MRAM cell structure makes it the price/performance leader among competing stand-alone non-volatile RAM (nvRAM) products. Better combined price-per-megabit and performance than ferroelectric RAM (FRAM), battery-backed static RAM (BBSRAM), and nvSRAM.

Simple SRAM Interface

The MRAM has the same 35 ns read and write cycle time as SRAM yet data is always

non-volatile for greater than 20 years. SRAM-compatible packaging assures alternate sourcing from other suppliers.

Extended Temperature Range and Superior Reliability

MRAM delivers a 3 volt high-density non-volatile RAM that operates over extended temperature. MRAM does not exhibit the charge storage failure modes that limit the data retention or endurance of other technologies.

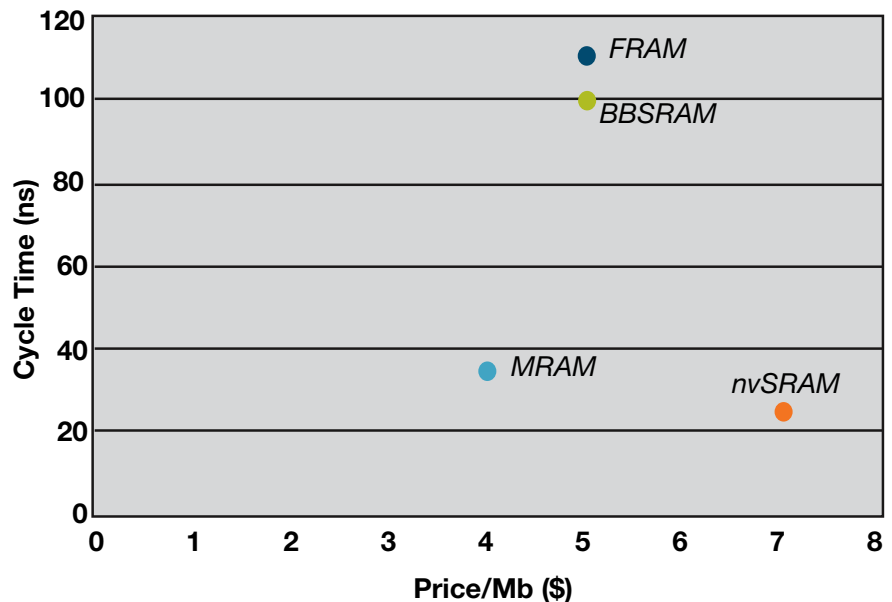
Superior Soft Error Rate

SRAM, BBSRAM and nvSRAM storage technologies are increasingly susceptible to soft errors. MRAM technology and architecture assure soft error rates two orders of magnitude better than competing non-volatile storage.

Universal Memory

MRAM performs the functions of in-system programmable memory (flash), rapid data buffers (SRAM) and non-volatile data storage (EEPROM), to eliminate extra memory devices and flatten the storage hierarchy.

MRAM: nvRAM Price/Performance Leader



Commercial MRAM Products Selector Guide

Part Number	Density	Configuration	Voltage	Speed Grades	Temperature	Package	RoHS Compliant
MR2A16ATS35C	4 Mb	256 Kb x 16	3.3V	35 ns	0 to 70°C	44-TSOP Type II	✓
MR1A16AYS35	2 Mb	128 Kb x 16	3.3V	35 ns	0 to 70°C	44-TSOP Type II	✓
MR0A16AYS35	1 Mb	64 Kb x 16	3.3V	35 ns	0 to 70°C	44-TSOP Type II	✓

Fast, reliable non-volatile memory with the best price/performance in the market. Critical systems data read and write every 35 ns with unlimited endurance. Critical data is always non-volatile for greater than 20 year retention without a backup cycle.

Industrial MRAM Products Selector Guide

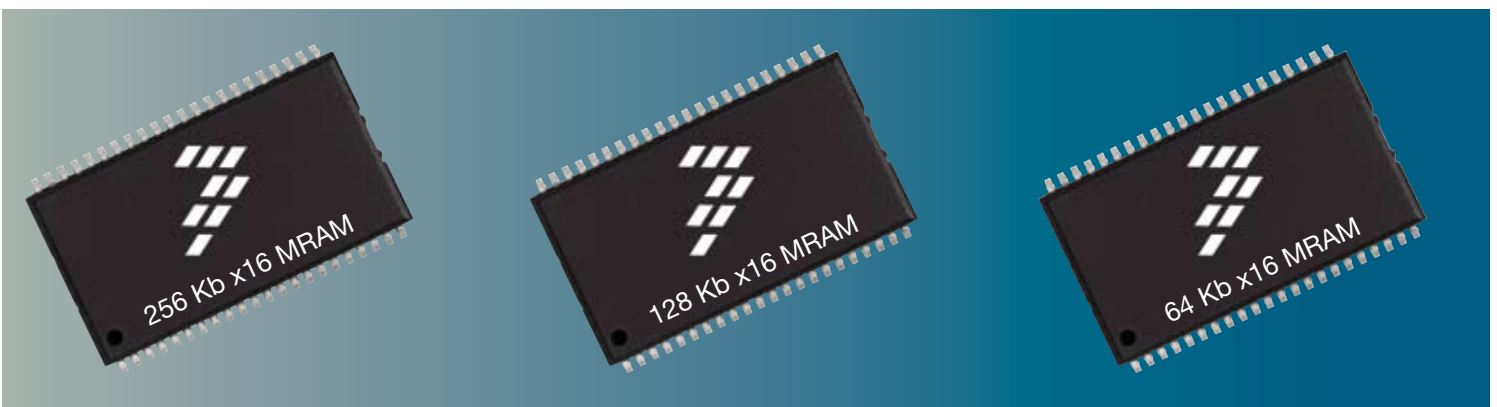
Part Number	Density	Configuration	Voltage	Speed Grades	Temperature	Package	RoHS Compliant
MR2A16ACYS35	4 Mb	256 Kb x 16	3.3V	35 ns	-40°C to +85°C	44-TSOP Type II	✓
MR1A16ACYS35	2 Mb	128 Kb x 16	3.3V	35 ns	-40°C to +85°C	44-TSOP Type II	✓
MR0A16ACYS35	1 Mb	64 Kb x 16	3.3V	35 ns	-40°C to +85°C	44-TSOP Type II	✓

Ruggedized version of our commercial MRAM products operates over the full industrial temperature range. Magnetic storage provides superior data retention under tough environmental conditions.

Extended Temperature MRAM Products Selector Guide

Part Number	Density	Configuration	Voltage	Speed Grades	Temperature	Package	RoHS Compliant
MR2A16AVYS35	4 Mb	256 Kb x 16	3.3V	35 ns	-40°C to +105°C	44-TSOP Type II	✓
MR1A16AVYS35	2 Mb	128 Kb x 16	3.3V	35 ns	-40°C to +105°C	44-TSOP Type II	✓
MR0A16AVYS35	1 Mb	64 Kb x 16	3.3V	35 ns	-40°C to +105°C	44-TSOP Type II	✓

Extended temperature MRAM with extreme temperature rating not available with any other 3.3V, high-density non-volatile RAM. The right solution for tough industrial automation, transportation, military and avionics requirements.



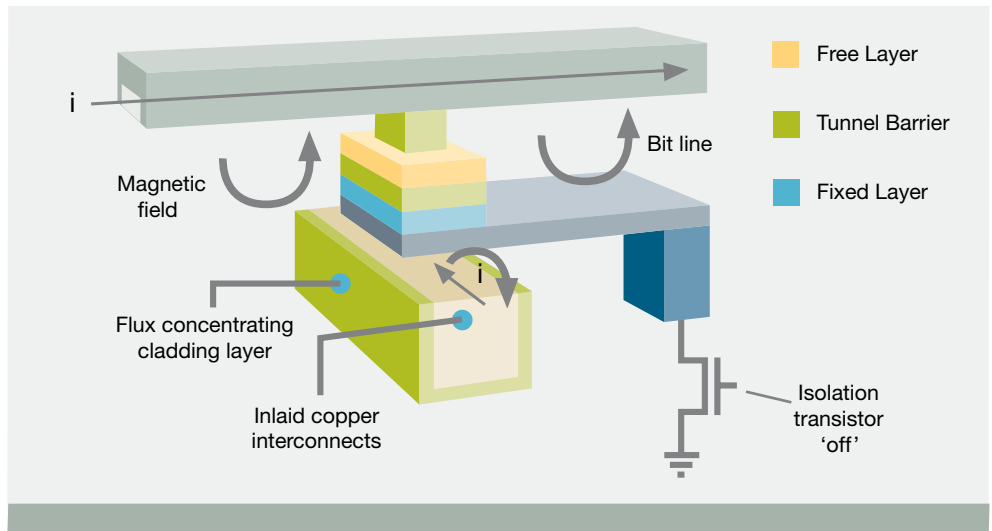
Freescale MRAM Technology

Freescale's patented MRAM technology is based on a magnetic tunnel junction (MTJ) storage element that is deposited on top of a standard logic process. The MTJ contains a fixed layer that is always polarized in one direction, separated from a free layer by a tunnel barrier. When the free layer is polarized in the same direction as the fixed layer, the MTJ exhibits a low resistance across the tunnel barrier. When the free layer is polarized in the reverse direction, the MTJ has a high resistance. This magneto-resistive effect allows MRAM to read data quickly without altering the memory state.

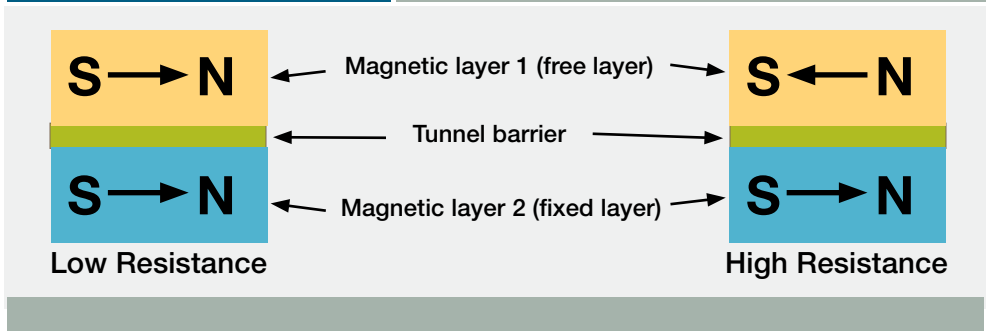
The MTJ at the cross-point of two metal lines is polarized (written) when the magnetic fields from currents flowing through two metal lines become sufficient to switch the MTJ. This is accomplished at SRAM speed.

The one benefit of the MTJ storage element is magnetic polarization does not leak away like an electric charge. Data can be retained for long periods of time at extended temperatures. The second benefit is that switching the magnetic polarization between the two states does not involve actual movement of electrons or atoms, thus no known wear-out mechanism exists.

1-Transistor - 1-MTJ Memory Cell



MTJ Storage Element



Example MRAM Applications

RAID Storage for Servers and Storage Arrays

Critical write journals and write cache information is updated at SRAM speed and always retained during a power failures.

Communications Systems

Critical system parameters and packet information is retained without backup systems.

Transportation, Military and Avionics Systems

Highly reliable system operation over extreme temperature conditions and environments.

Automatic Meters and Printers

Continuously updated customer usage data is never lost during power failure even under extreme temperatures and extended field life.

Industrial Motor Control and Robotics

Multiple axis positional data constantly updated. Safe, rapid restarts following any power loss.

Industrial Power and Energy Management

Reliable operation under transient power conditions.

Health Care Electronics

Easy to use, highly reliable memory for health care instrumentation and systems.

Learn More:

For current information about Freescale products, please visit www.freescale.com/MRAM.