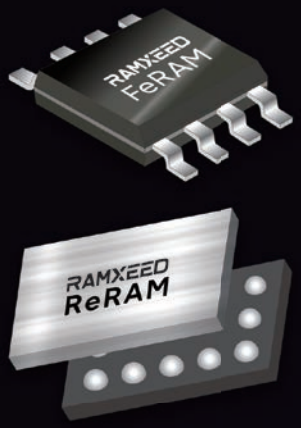
RAMXEED

Our Memory, Your Future.

RAMXEED

RAMXEED represents our company that continues to grow and co-create in the pursuit of infinite possibilities based on Random Access Memory (RAM) technology.

"XEED" denotes SUCCEED and EXCEED, which mean success and going beyond the present respectively, while "X" signifies infinite possibilities and co-creation.
Although our company name has changed, we will continue to focus on the high reliability and unique proposal capabilities that our customers value.



PURPOSE

Realizing a future full of dreams with memory technology.

We changed our company name from Fujitsu Semiconductor Memory Solution Limited to RAMXEED Limited.
Our new company name reflects our desire to continue to be a professional group for non-volatile RAM, including FeRAM, which has provided value to our customers for over 20 years.

High-Performance and High-Reliability Memory

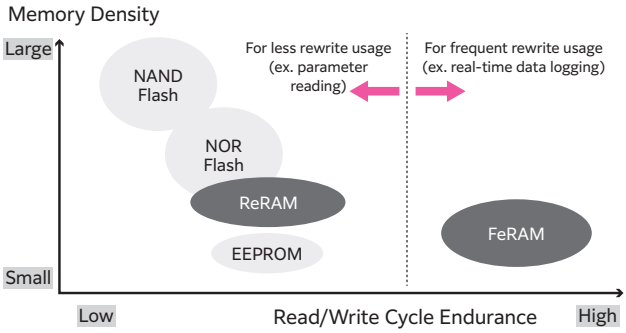
We currently offer product families for FeRAM and ReRAM. Both are non-volatile memories, but each has different features and is suitable for different applications.

The greatest strength of FeRAM is the high number of data read/write cycles that can be guaranteed.

Since it can be rewritten data up to 100 trillion times, our FeRAM is suitable for usages that rewrite data frequently. For example, the FeRAM memory has been adopted as a memory for recording information in meters, measuring instruments, industrial robots, and automobiles.

On the other hand, ReRAM's strengths are an unlimited number of data reading times and an extremely small read current. It is suitable for usages that first record basic information and programs required for operation and frequently read that data during. In addition, it is expected extension of battery life in battery-operated small devices by using ReRAM for memory. For example, it is ideal for small wearable devices such as hearing aids and smartwatches.

Position of Non-volatile Memory



FeRAM Shipment History

Production Supply Period	Shipped Quantity	FeRAM Usages	Countries FeRAM Shipped
>20 years	>4 billion pcs	>200 applications	>60 countries

For the global environment, what we can do

By developing memory products that consume less power, we are cooperating in reducing CO_2 emissions, one of the greenhouse gases.

In this way, we are contributing to the achievement of three of the 17 Sustainable Development Goals (SDGs) adopted by the United Nations by providing environmentally friendly semiconductor devices and solutions.

Goal	Our activities	Efficiency	Our products
Goals4: Quality education	Providing products to universities and public facility by free	Cooperate with science technology learning	Non-volatile memory "FeRAM", "RFID"
Goals7: Affordable and clean energy	Providing low power devices	Reduction of CO_2 emission	Non-volatile memory "FeRAM", "RFID"
Goals12: Responsible consumption, production	Providing Batteryless solutions	Reduction of battery wastes	Batteryless solutions

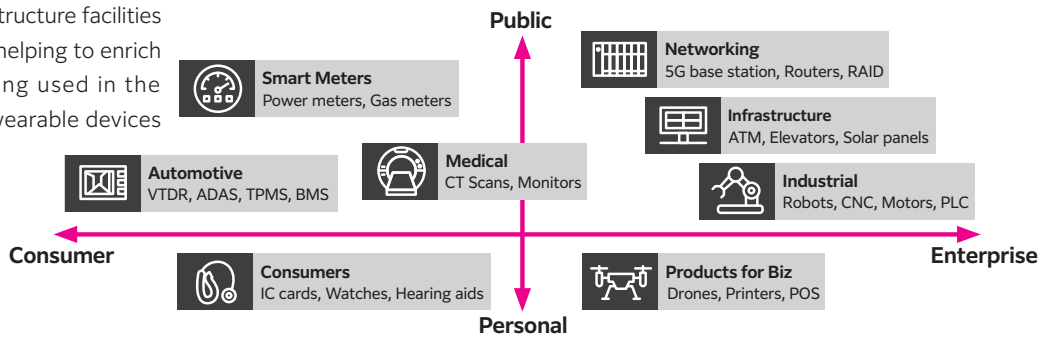
For a healthy life, what we can do

Our memory products help people around the world live healthier lives.

Hearing aids are used for people who are hard of hearing. Also, for people who have trouble sleeping, continuous positive airway pressure (C PAP) devices are working to help them sleep. Our memory products are also used in those products and devices that support such healthy living.

For society, what we can do

By providing compact, high-performance memory products, we are enabling the miniaturization and high performance of social infrastructure facilities and devices. In addition, we are helping to enrich the lives of individuals by being used in the products such as IC cards and wearable devices for general consumers.



FeRAM

FeRAM Product Family

Our FeRAM products are categorized into two product families. One is “FeRAM (Device)” in the form of SOP and TSOP packages for general use, and another is “FeRAM-embedded LSI” which is an applicationspecified LSI such as RFID LSI and authentication LSI.
One type of RFID LSI provides not only high-speed wireless communications, but also features wireless power transfer, making it possible to construct a Battery-less wireless solution that consists of a FeRAM-embedded LSI and Reader/Writer device.

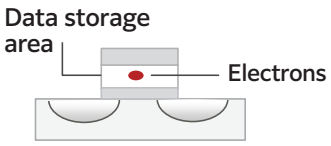
FeRAM Product Family

- FeRAM(Device)
  - Serial Memory
  - Parallel Memory
- FeRAM-embedded LSI
  - RFID LSI
  - Authentication LSI
  - Custom LSI

FeRAM Structure

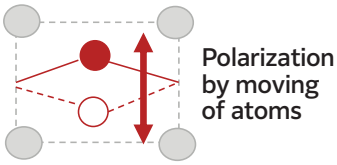
FeRAM is a memory using ferroelectric elements. Its cell structure and method to store data are different from other conventional nonvolatile memory devices such as EEPROM and Flash memory. Of course, the judgment method of stored data “1” and “0” is also different.
EEPROM judges “1” or “0” data by the state of the memory cell being charged or discharged. While FeRAM is judged by the state of electric polarization caused by the movement of atoms in the molecule. Regarding FeRAM structure, we use PZT(lead zirconate titanate) as a ferroelectric element. The crystalline structure of PZT is shown below.
The zirconium or titanium positive ion occupies two stable positions in the lattice and can be moved between the positions by applying an external electric field. Either up or down polarization can be stored even if the electric field is removed. This means the state of “polarization” is memorized. Ferroelectric memory utilizes the characteristics of this non-volatility.

EEPROM

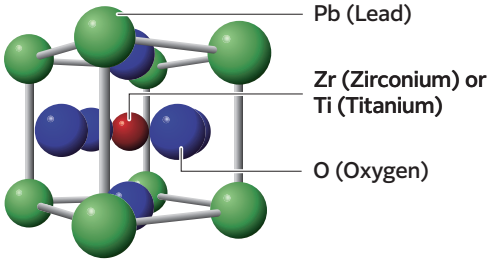


presence or absence of electrons in the data storage area forms “1” or “0”

FeRAM



Position of atoms in center forms data “1” or “0”

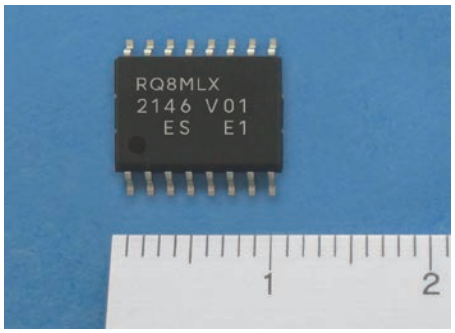


Crystal structure of PZT

FeRAM

FeRAM Overview

The memory density of FeRAM products ranges from 4Kbit to 8Mbit. The interface has a serial interface (SPI, I²C) and a parallel interface.



8Mbit Quad SPI FeRAM

Density	16Kbit to 8Mbit (SPI interface) / 4Kbit to 1Mbit (I²C interface) / 256Kbit to 8Mbit (parallel interface)
Operating voltage	1.65 to 1.95V / 1.7 to 1.95V / 1.7 to 3.6V / 1.8 to 3.6V / 2.7 to 3.6V / 2.7 to 5.5V / 3.0 to 5.5V
Operating temperature range	-40 to +85°C / -40 to +95°C / -40 to +105°C / -40 to +125°C
Read/Write endurance	1 trillion / 10 trillion / 100 trillion

*: Please refer to datasheet of each product in details.

FeRAM Features

FeRAM has four superior features non-volatility, high read/write endurance, fast writing speed, and low power consumption.

4 Great Features

Non-volatility

- Stored data are not disappeared at power off
- No battery is needed for data retention

Fast Writing Speed

- Enable to overwrite data without erasing operation
- No waiting time for erasing/writing operation

High Read/Write Cycle Endurance

- Guarantees 100 trillion(10^{14}) read/write cycles
- 100 million times EEPROM's endurance

Low Power Consumption

- No booster circuit for a write operation
- Lower power consumption at writing by short writing time
- No data retention current to keep the data

Comparison between FeRAM and other memories

Item	FeRAM	EEPROM	FLASH	SRAM
Memory Type	Non-volatile	Non-volatile	Non-volatile	Volatile
Write Method	Overwrite	Erase + Write	Erase + Write	Overwrite
Write Cycle Time	120ns	5ms	10µs	55ns
Read/Write Cycles	100 trillion	1 million	0.1 million	Unlimited
Booster Circuit	No	Yes	Yes	No
Data Backup Battery	No	No	No	Yes

Serial Memory Lineup

SPI Interface *1

Memory density (bit)	Part number	Grade *2	Power supply voltage (V)	Operating frequency (Hz)	Operating temperature (°C)	Read/Write cycles	Data retention *3	Package
8M	MB85RQ8MX	Industrial	2.7 to 3.6	108M	-40 to +105	100 trillion	10years(+105°C)	SOP-16
	MB85RQ8MLX	Industrial	1.7 to 1.95	108M	-40 to +105	100 trillion	10years(+105°C)	SOP-16
4M	MB85RS4MTY	Automotive/Industrial	1.8 to 3.6	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8*4
	MB85RS4MLY	Automotive/Industrial	1.7 to 1.95	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8*4
	MB85RS4MT	Industrial	1.8 to 3.6	40M	-40 to +85	100 trillion	10years(+85°C)	SOP-8
	MB85RQ4ML	Industrial	1.7 to 1.95	108M	-40 to +85	10 trillion	10years(+85°C)	SOP-16
2M	MB85RS2MTY	Automotive/Industrial	1.8 to 3.6	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RS2MLY	Automotive/Industrial	1.7 to 1.95	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RS2MTA	Industrial	1.7 to 3.6	40M	-40 to +85	100 trillion	10years(+85°C)	SOP-8
1M	MS85RS1MTY	Automotive/Industrial	1.8 to 3.6	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MS85RS1MLY	Automotive/Industrial	1.7 to 1.95	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RS1MT	Industrial	1.8 to 3.6	30M	-40 to +85	10 trillion	10years(+85°C)	SOP-8/DFN-8/WL-CSP-8*5
512K	MB85RS512TY	Automotive/Industrial	1.8 to 3.6	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RS512LY	Automotive/Industrial	1.7 to 1.95	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RS512T	Industrial	1.8 to 3.6	30M	-40 to +85	10 trillion	10years(+85°C)	SOP-8
256K	MB85RS256TYA	Automotive/Industrial	1.8 to 3.6	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RS256LYA	Automotive/Industrial	1.7 to 1.95	50M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RS256TY	Automotive/Industrial	1.8 to 3.6	40M	-40 to +125	10 trillion	70.4years(+85°C)	SOP-8
	MB85RS256B	Industrial	2.7 to 3.6	33M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
128K	MB85RS128TY	Automotive/Industrial	1.8 to 3.6	40M	-40 to +125	10 trillion	70.4years(+85°C)	SOP-8
	MB85RS128B	Industrial	2.7 to 3.6	33M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
64K	MB85RS64VY	Automotive/Industrial	2.7 to 5.5	33M	-40 to +125	10 trillion	70.4years(+85°C)	SOP-8
	MB85RS64V	Industrial	3.0 to 5.5	20M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
	MB85RS64T	Industrial	1.8 to 3.6	10M	-40 to +85	10 trillion	40.2years(+85°C)	SOP-8*5/SON-8
	MB85RS64	Industrial	2.7 to 3.6	20M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
16K	MB85RS16N	Industrial	2.7 to 3.6	20M	-40 to +95	1 trillion	10years(+95°C)	SOP-8/SON-8
	MB85RD16LX	Industrial	1.65 to 1.95	15M	-40 to +125	10 trillion	23.7years(+105°C)	SON-8

*1: Please refer to the datasheet of each product for details.
*2: Automotive-grade products comply with AEC-Q100.
*3: Please refer to the datasheet for data retention time at 125°C.
*4: SOP-8 is an industrial grade.
*5: Products that operate at 1.7 V are also available.

Serial Memory Lineup

I²C Interface *1

Memory density (bit)	Part number	Grade *2	Power supply voltage (V)	Operating frequency (Hz)	Operating temperature (°C)	Read/Write cycles	Data retention *3	Package
1M	MS85RC1MTY	Automotive/Industrial	1.8 to 3.6	3.4M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MS85RC1MLY	Automotive/Industrial	1.7 to 1.95	3.4M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RC1MT	Industrial	1.8 to 3.6	3.4M	-40 to +85	10 trillion	10years(+85°C)	SOP-8
512K	MB85RC512TY	Automotive/Industrial	1.8 to 3.6	3.4M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RC512LY	Automotive/Industrial	1.7 to 1.95	3.4M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RC512T	Industrial	1.7 to 3.6	3.4M	-40 to +85	10 trillion	10years(+85°C)	SOP-8
256K	MB85RC256TY	Automotive/Industrial	1.8 to 3.6	3.4M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RC256LY	Automotive/Industrial	1.7 to 1.95	3.4M	-40 to +125	100 trillion	70.4years(+85°C)	DFN-8/SOP-8
	MB85RC256V	Industrial	2.7 to 5.5	1M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
	MB85RC256VN	Industrial	2.7 to 5.5	1M	-40 to +95	1 trillion	10years(+95°C)	SOP-8
128K	MB85RC128A	Industrial	2.7 to 3.6	1M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
64K	MB85RC64TA	Industrial	1.8 to 3.6	3.4M	-40 to +105	10 trillion	19.1years(+105°C)	SOP-8/SON-8
	MB85RC64A	Industrial	2.7 to 3.6	1M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
	MB85RC64V	Industrial	3.0 to 5.5	1M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
16K	MB85RC16	Industrial	2.7 to 3.6	1M	-40 to +85	1 trillion	10years(+85°C)	SOP-8/SON-8
	MB85RC16V	Industrial	3.0 to 5.5	1M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
4K	MB85RC04	Industrial	2.7 to 3.6	1M	-40 to +85	1 trillion	10years(+85°C)	SOP-8
	MB85RC04V	Industrial	3.0 to 5.5	1M	-40 to +85	1 trillion	10years(+85°C)	SOP-8

*1: Please refer to the datasheet of each product for details.
*2: Automotive-grade products comply with AEC-Q100.
*3: Please refer to the datasheet for data retention time at 125°C.

Parallel Interface *1

Memory density (bit)	Part number	Grade	Power supply voltage (V)	Cycle time (ns)	Operating temperature (°C)	Read/Write cycles	Data retention	Package
8M(1M×8)	MB85R8M1TA	Industrial	1.8 to 3.6	120	-40 to +85	100 trillion	10years(+85°C)	TSOP-44/FBGA-48
8M(512K×16)	MB85R8M2TA	Industrial	1.8 to 3.6	120	-40 to +85	100 trillion	10years(+85°C)	TSOP-44/FBGA-48
4M(512K×8)	MS85R4M1TA	Industrial	1.8 to 3.6	120	-40 to +105	100 trillion	10years(+105°C)	TSOP-44/FBGA-48
4M(256K×16)	MS85R4M2TA	Industrial	1.8 to 3.6	120	-40 to +105	100 trillion	10years(+105°C)	TSOP-44/FBGA-48
	MB85R4M2T	Industrial	1.8 to 3.6	150	-40 to +85	10 trillion	10years(+85°C)	TSOP-44
256K(32K×8)	MB85R256F	Industrial	2.7 to 3.6	150	-40 to +85	1 trillion	10years(+85°C)	TSOP-28

*1: Please refer to the datasheet of each product for details.

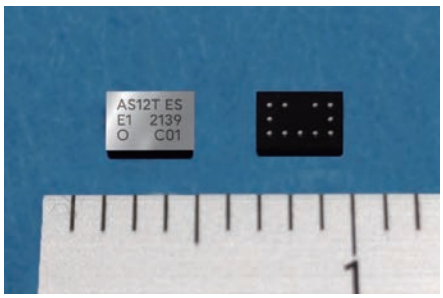
ReRAM

ReRAM Overview

The memory density lineup of ReRAM products is 8Mbit and 12Mbit. Their interface is SPI interface.

Density	8Mbit, 12Mbit (SPI interface)
Operating voltage	1.6 to 3.6V
Operating temperature range	-40 to +85°C
Read endurance	Unlimited
Write endurance	1 million (8Mbit), 0.5 million(12Mbit)
Package	11pin WL-CSP

*: Please refer to datasheet of each product in details.



12Mbit ReRAM

ReRAM Features, Structure

ReRAM which stands for Resistive Random Access Memory has four superior features non-volatility, very small read current, large density, and very small package. Especially, it has an extremely smaller read current level than other non-volatile memory products as the average read current is as small as 0.15mA at an operating frequency of 5MHz. It enables to extend of battery life in battery-operated end-products. Our ReRAM product in a very small package of 2mm x 3mm is ideal for use in wearable devices.

ReRAM which stands for Resistive Random Access Memory is a non-volatile memory storing data by changing resistance in cell material. It records "1" or "0" of data by massive changes in resistance.

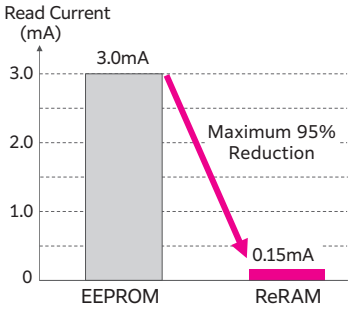
4 Great Features

Non-volatility
- Stored data are not disappeared at power off
- No battery is needed for data retention

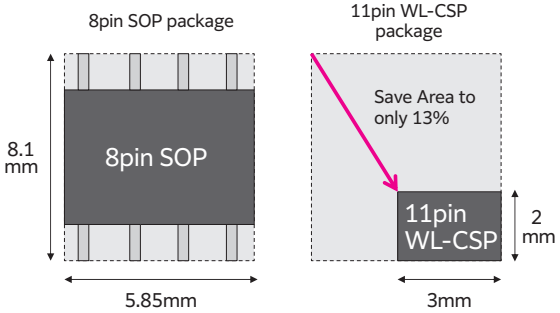
Large Density
- Large density of 12Mbit as non-volatile random access memory

Very Small Read Current
- Average read current is 0.15mA at 5MHz operation
- Maximum read current is 0.7mA at 10MHz operation

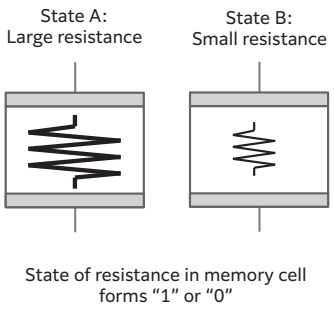
Very Small Package
- 11pin WL-CSP in approximately 2mm x 3mm



Read Current Comparison



Mounting Area Comparison



Cell Structure of ReRAM

ReRAM Lineup

Memory density(bit)	Part number	Power supply voltage(V)	Operating frequency(Hz)	Operating temperature(°C)	Read current	Read cycles	Write cycles	Package
12M	MB85AS12MT	1.6 to 3.6	10M	-40 to +85	Max 0.7mA	Unlimited	0.5 million	WL-CSP-11
8M	MB85AS8MT	1.6 to 3.6	10M	-40 to +85	Max 0.7mA	Unlimited	1 million	WL-CSP-11

Customer's Issues and Solutions

FeRAM and ReRAM of non-volatility memory products have superior features compared with conventional memories such as flash memory, EEPROM, and SRAM.
Our memory products can solve the following issues arising from the use of conventional memory products.

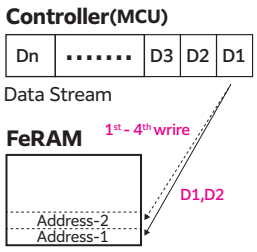
Solutions by FeRAM 01 High read/write endurance eliminates the need for wear leveling

Issues with conventional memories

- Increased software complexity
- As a result, more verification hours
- It also increases the risk of buggy products entering the market

Solutions by FeRAM

- No downside to performing wear leveling because the software is simplified
- Reduced development time
- Fewer buggy products on the market, with the expectation of increased customer satisfaction



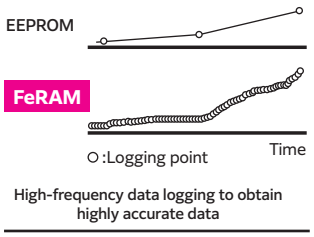
Solutions by FeRAM 02 High read/write endurance and fast writing speed enable high-frequency data logging

Issues with conventional memories

- When writing data over a 10-year period, EEPROMs are limited to 11 writes per hour or 270 writes per day
- It is possible that the necessary data is not collected
- More frequent data writing than that requires wear leveling and other measures that increases software complexity

Solutions by FeRAM

- FeRAM can be rewritten data up to 300,000 times/second (over 20 billion times per day)
- Enables detailed recording of data transitions to obtain real data



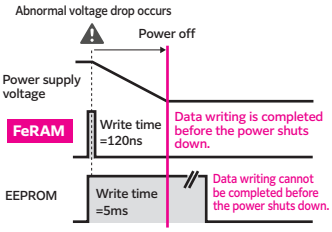
Solutions by FeRAM 03 High-speed writing ensures recording of data even in the event of a power outage or temporary power failure

Issues with conventional memories

- Since the write time is on the order of ms, if the power supply stops during a write or erase operation, there is a high probability that the data that was being written will be lost.

Solutions by FeRAM

- Because data is written at 120ns, data writing is completed before power loss
- Reliable data logging even in the event of a sudden power outage



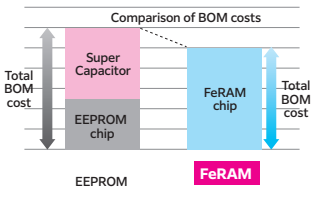
Solutions by FeRAM 04 Low write energy allows power consumption to be reduced

Issues with conventional memories

- High write power consumption affects battery life

Solutions by FeRAM

- Write energy of FeRAM is 1/100th of EEPROM and 1/20,000th of Flash
- Battery life can be greatly extended in write-intensive applications
- Contributes to reducing environmental impact



FeRAM-embedded ASICs/ASSPs

What is an FeRAM-embedded ASIC/ASSP?

We design and develop FeRAM a non-volatile memory integrated application-specific integrated circuits (ASICs: custom LSI products) and application-specific standard products (ASSPs). FeRAM can be integrated into the CMOS process and combined with logic and analog circuits on a single chip. We have developed many highly reliable and high-performance system LSIs, such as LSIs for RFID and IC cards, based on our know-how cultivated through more than 20 years of experience in the design and development of FeRAM integrated LSIs. We offer one-stop IC development services from specification design to manufacturing according to customer needs.

Do you have any of the following issues?

CASE1
You cannot differentiate your products from those of your competitors and can only compete on price.

CASE2
Due to the low number of data read/write cycles, it takes time to develop software to extend the life of the product.

CASE3
Battery life cannot be extended as long as desired.

CASE4
Combining different chips increases size and costs.

CASE5
Your products are susceptible to data loss, power outages, and shocks, resulting in an unstable system.

FeRAM-embedded ASICs/ASSPs can solve your problems!

Performance beyond conventional memory

Highly unique IC with many features beyond conventional memory, such as fast writing speed, low power consumption, and environmental resistance.

High endurance of products

Due to the high number of data read/write cycles, there is no need to develop software to extend the life of the product.

Unparalleled low power consumption

Powerful in wearable devices and other devices where battery life is critical

Chip miniaturization

Area reduction is possible by using ferro capacitance, which has more than 10 times the capacitance per unit area of MIM and MOS capacitance.

Excellent stability

Eliminates data loss associated with EEPROM and FLASH, allowing you to configure highly reliable systems that can withstand power outages and shock.

Authentication IC

Want to protect products from counterfeiters and ensure their safety and reliability

Reason for employing authentication ICs

RAMXEED's unique authentication without encryption provides high security strength with no key information to be stolen, protecting your products from the threat of counterfeit products. We provide ICs that can be used safely and reliably for a long time and reduce the development burden for our customers.

Rotary encoder

Want to count the number of motor revolutions even when there is no power supply, such as during a power failure in a factory.

Reason for employing rotary encoders

By far the lowest write power consumption compared to other memories, enabling module design in conjunction with energy harvesting devices. Modules previously consisting of battery + SRAM can be replaced with a maintenance-free configuration of an energy harvesting device + FeRAM.

Wireless powered sensing

Want to make the sensor part wireless so it can be placed anywhere and also eliminate the need to change batteries.

Reason for employing wireless powered sensing ICs

Wirelessly powered sensing ICs have no batteries but can activate power at high speed by radio waves from a wireless reader/writer or weak power from an energy harvesting device to feed power to the sensor, acquire sensor data, and transmit it wirelessly. They require no batteries or wiring, making them environmentally friendly and economical.

VISION: Future co-creation partner chosen for our unique technologies.

FeRAM-embedded RFID

The advantages of our FeRAM-embedded RFID are the large memory capacity and fast data writing speed. If our RFID LSI is used in a tag to record the process history of products in a factory, the throughput time can be shortened. In addition, a product line with two interfaces, wireless and SPI, can use SPI for high-speed processing to record data and read back the written data wirelessly when the device is turned off. The products can operate fast processing by SPI interface and can read out important data using a wireless interface during power outages.

Lineup of FeRAM-embedded RFID

Part number	Operating frequency	User memory density	Commands	Interface	Read/Write cycles
MB97R8110	UHF band 860 to 960MHz	8Kbyte	ISO/IEC18000-63 EPC C1G2 Ver.1.2.0	SPI(Master/Slave)	10 trillion
MB97R8050		36byte(EPC128bit)		—	10 billion
MB89R112A	HF band 13.56MHz	8Kbyte	ISO/IEC15693	—	1 trillion
MB89R118C		2Kbyte	ISO/IEC15693	—	1 trillion
MB89R119B		256byte	ISO/IEC15693	—	1 trillion

What is ePaper Tag?

ePaper Tag uses UHF RFID technology and is a battery-less RFID tag with a display function. ePaper Tag can update its display content, eliminating the need to replace labels. In addition, battery-free operation eliminates the need to change batteries. Because of these characteristics, ePaper Tag can be used to replace paper labels for logistics containers, process control charts, and identification tags.

UHF ePaper Tag

ePaper Tag

ePaper Tag products from partner companies:
Top: Netronix
Left: Nagano Japan Radio
Right: SK-Electronics

Customer's Issues and Solutions

By using ePaper Tag with our LSI products, you can solve the problems you have been facing in your production plants and logistics management.

■ Challenges at production plants

- Replacing the battery in the terminal is a hassle.
- The wiring to the terminal is a hassle.

■ Proposed solution for production plants and its effect

- The use of ePaper Tag reduces battery costs and replacement work and also eliminates the need to wire power to the terminal.

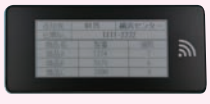
Identification tag

■ Challenges in the logistics field

- Rewriting the logistics label is a hassle.

■ Proposed solution with logistics labels and its effect

- The use of ePaper Tag reduces rewrite time via wireless and also reduces rewrite work and costs because it can be rewritten as many times as needed.



Logistics label

Global contacts

Authorized Distributors

RAMXEED web site
https://ramxeed.com ▶

Americas

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