

Non-Volatile Random-Access Memory FRAM (Ferroelectric RAM)



FRAM has what it takes to become the non-volatile memory of the future and to supersede both Flash and E²PROM. With its low power consumption, the technology combines the benefits of conventional non-volatile memories and rapid static RAM.

Features

- Fast writing speed. Overwriting (no need to erase), Write Cycle=Read Cycle (no delay)
- High endurance. Guaranteed up to 1 trillion cycles
- High tamper resistance. Data written in FRAM cannot be stolen by physical analysis
- Low power consumption
- Ecology memory. Operating like SRAMs, with no requirement for battery back-up

Applications

- Factory automation
- Metering
- Data logging
- Parameter storage
- Back-up memory
- Real-time data writing

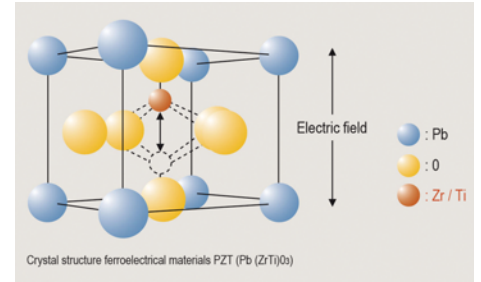
FRAM technology

In contrast to the conventional non-volatile memories, Flash and E²PROM, the content of an FRAM cell is not stored in the form of charge carriers in a 'floating gate'. The information – logically 0 or 1 – is contained in the polarisation of the ferroelectric material lead zirconate titanate, PZT (Pb (ZrTi)O₃). This material is placed between two electrodes in the form of a thin film, in a similar way to the structure of a capacitor.

An FRAM memory cell has the same structure as a DRAM cell and consists of a transistor and a capacitor, but in this case the FRAM cell contains a capacitor with a ferroelectric dielectric.

Since no large charge quantities have to be displaced, charge pumps to generate higher programming voltages are not necessary.

Consequently, the FRAM technology is much more energy-saving than Flash or E²PROM. Write and Read access times are in the 2-3 digit nanosecond range and comparable with those of RAM. FRAM combines the benefits of non-volatile memories with those of static RAM. A by-product, so to speak, is a high resistance to radiation because unlike the case of floating gate memories, alpha, beta and gamma radiation cannot harm the stored data. FRAM is therefore very well suited for medical or space applications or applications in the food industry in which radiation is used for disinfection. The maximum number of write/delete cycles for Flash and E²PROM is between 10,000 and 100,000. If this limit is exceeded, the memory content can no longer be reliably stored. If the content of a memory cell has to be updated once per second, for example, this limit is reached after only one day. By comparison with over 10 thousand million write/delete cycles (10¹⁰), the lifetime of an FRAM memory is almost unlimited.



Writing could theoretically take place on a cell for over 300 years at one-second intervals. However, as read processes involve a re-programming of the FRAM cell, read accesses also have to be included in the total.

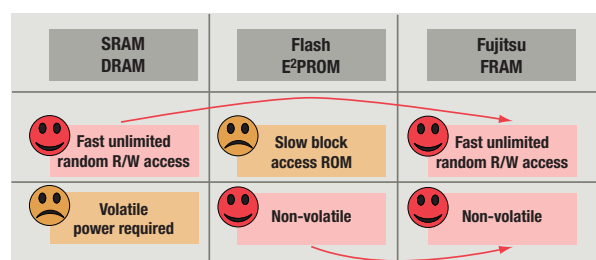
The latest FRAM products are internally operated at 1.8V and specified up to 10¹⁵ read/write cycles. Occasionally, FRAM is incorrectly associated with ferromagnetism. Magnetic fields do not affect the ferroelectric material.

Memory size (kbit)	Serial I ² C		Parallel I/F	Serial SPI		
	3V	5V		1.8V	3V	5V
8Mb			MB85R8xxx Parallel			
4Mb			MB85R4001/2A Parallel			
2Mb				MB85RS2xxx Serial SPI (1.8-3V)		
1Mb			MB85R1001/2A Parallel	MB85RS1xxx Serial SPI (1.8-3V)		
256kbit			MB85R256F Parallel	MB85RS256A Serial SPI		
128kbit	MB85RC256V Serial I ² C (3-5V)			MB85RS256V Serial SPI		
64kbit	MB85RC128 Serial I ² C			MB85RS128A Serial SPI		
	MB85RC64 Serial I ² C			MB85RS64 Serial SPI		
16kbit	MB85RC64V Serial I ² C			MB85RS64V Serial SPI		
	MB85RC16 Serial I ² C			MB85RS16 Serial SPI		
	MB85RC16V Serial I ² C			MB85RS16V Serial SPI		

Line-up of Fujitsu standalone FRAM devices

Comparison of FRAM with other memory devices

	FRAM	E ² PROM	Flash	SRAM
Type	Non-volatile	Non-volatile	Non-volatile	Volatile
Method writing	Overwriting	Erase (byte) + write	Erase (sector) + write	Overwriting
Write cycle time	150ns	3ms	1s	55ns
Endurance	1 trillion	1 million	1 million	Unlimited

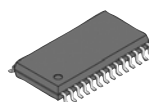


FRAM combines the benefits of Flash/E²PROM and SRAM / DRAM

Product overview

Parallel interface

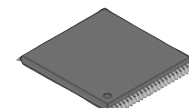
Part Number	Availability	Size	Operating Voltage	Write Cycle Time	Operating Temperature	Data Retention	Package
MB85R4001A	Available	4Mbit	3.0 - 3.6V	150ns	-40 - +85°C	10 years at 55°C	TSOP-48
MB85R4002A	Available						
MB85R1001A	Available	1Mbit	3.0 - 3.6V	150ns	-40 - +85°C	10 years at 55°C	TSOP-48
MB85R1002A							
MB85R256F	Available	256kbit	2.7 - 3.6V	150ns	-40 - +85°C	10 years at 55°C	TSOP-28 SOP-28



28-pin SOP-28 package



28-pin TSOP-28 package



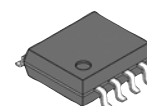
48-pin TSOP-48 package

Serial interface (SPI)

Part Number	Availability	Size	Operating Voltage	Operating Frequency (Max)	Operating Temperature	Data Retention	Package
MB85RS256A	Available	256kbit	3.0 - 3.6V	25MHz	-40 - +85°C	10 years at 55°C	SOP-8
MB85RS128A	Available	128kbit	3.0 - 3.6V	25MHz	-40 - +85°C	10 years at 55°C	SOP-8
MB85RS64	Available	64kbit	2.7 - 3.6V	20MHz	-40 - +85°C	10 years at 85°C	SOP-8
MB85RS16	Mar. 2012	16kbit	2.7 - 3.6V	20MHz	-40 - +85°C	10 years at 85°C	SOP-8

Serial interface (I²C)

Part Number	Availability	Size	Operating Voltage	Operating Frequency (Max)	Operating Temperature	Data Retention	Package
MB85RC128	Available	128kbit	2.7 - 3.6V	400kHz	-40 - +85°C	10 years at 85°C	SOP-8
MB85RC64	Available	64kbit	2.7 - 3.6V	400kHz	-40 - +85°C	10 years at 85°C	SOP-8
MB85RC64V	Available	64kbit	3.0 - 5.5V	400kHz	-40 - +85°C	10 years at 85°C	SOP-8
MB85RC16	Available	16kbit	2.7 - 3.6V	400kHz/1MHz	-40 - +85°C	10 years at 85°C	SOP-8
MB85RC16V	Available	16kbit	3.0 - 5.5V	400kHz	-40 - +85°C	10 years at 85°C	SOP-8



8-pin SOP-8 package

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<http://emea.fujitsu.com/fram>