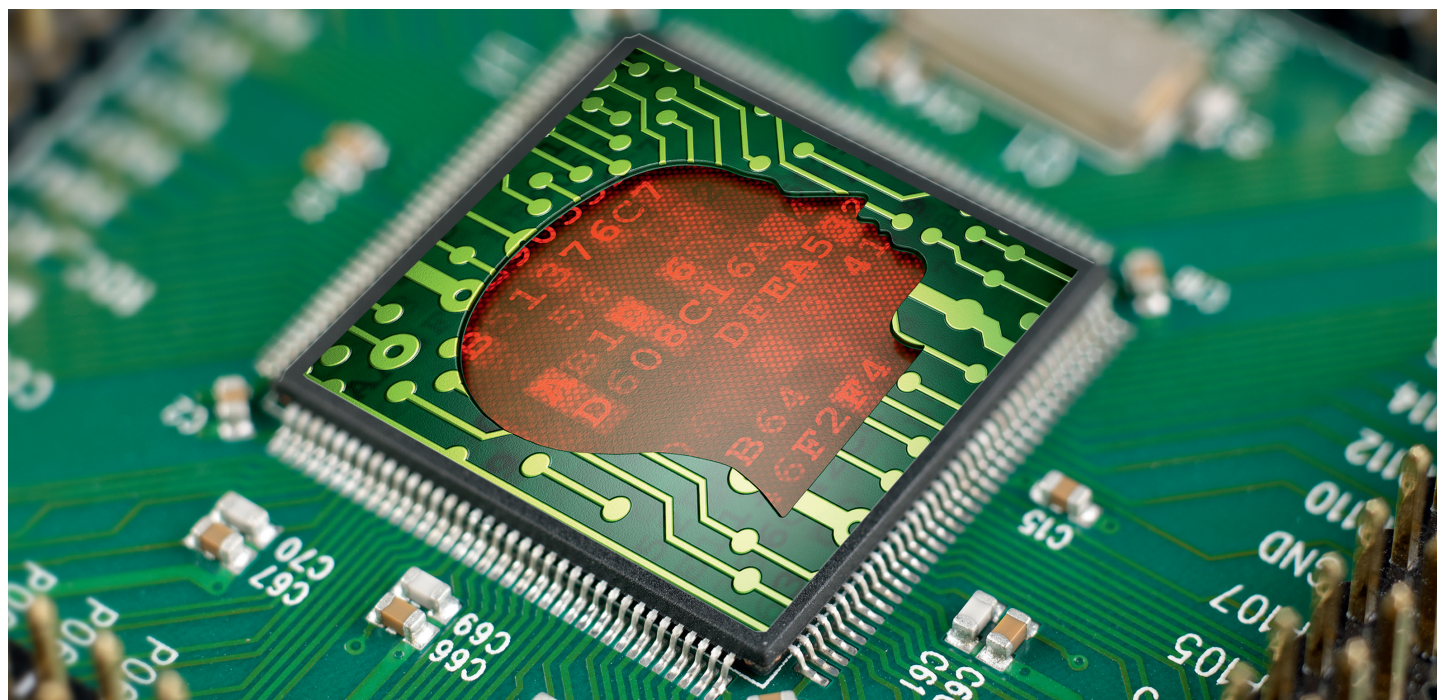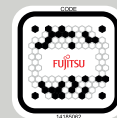# FUJITSU

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

FRAM (Ferroelectric Random Access Memory) is a low power non-volatile memory with fast random access. It combines the benefits of conventional non-volatile memories (like Flash and EEPROM) and rapid static RAM (SRAM and DRAM).

This universal memory outperforms conventional non-volatile memories by consuming much less power, writing much faster and having much greater endurance to multiple read-and-write operations.

Features

- Fast Overwrite: write cycle time: 150ns; up to 30k times faster than EEPROM
- High endurance. Up to 10 trillion cycles (10^{13}). 10 million times more than EEPROM.
- Low power consumption in write operation
- Green memory. Operating like SRAMs, with no requirement for battery back-up
- Robust against radiation and magnetic fields
- Tamper resistance: data in FRAM cannot be detected by physical analysis

Applications

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

Market segments

- Metering / Measurement
- Factory automation
- Motion control
- Sensors
- Office equipment
- Medical
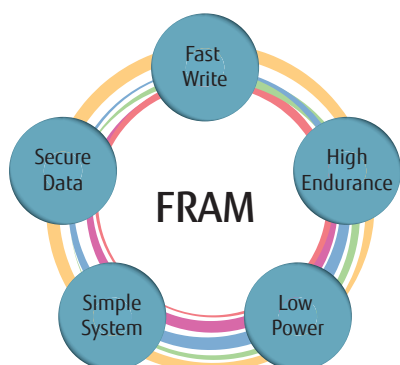
Data Integrity

Realtime Logging

Energy Efficiency

Best Total Cost

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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 $(ZrTi)O_3$). 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, used to generate higher programming voltages, are not neces-

sary. As a result, FRAM technology is much more energy efficient than Flash or E2PROM.

Since FRAM operates based on random access, write process can be completed without any delay. Write and Read access times are in the 2–3 digit nanosecond range and comparable with those of RAM. As a result, FRAM is able to complete the writing process even at sudden power outage, thus ensures data integrity.
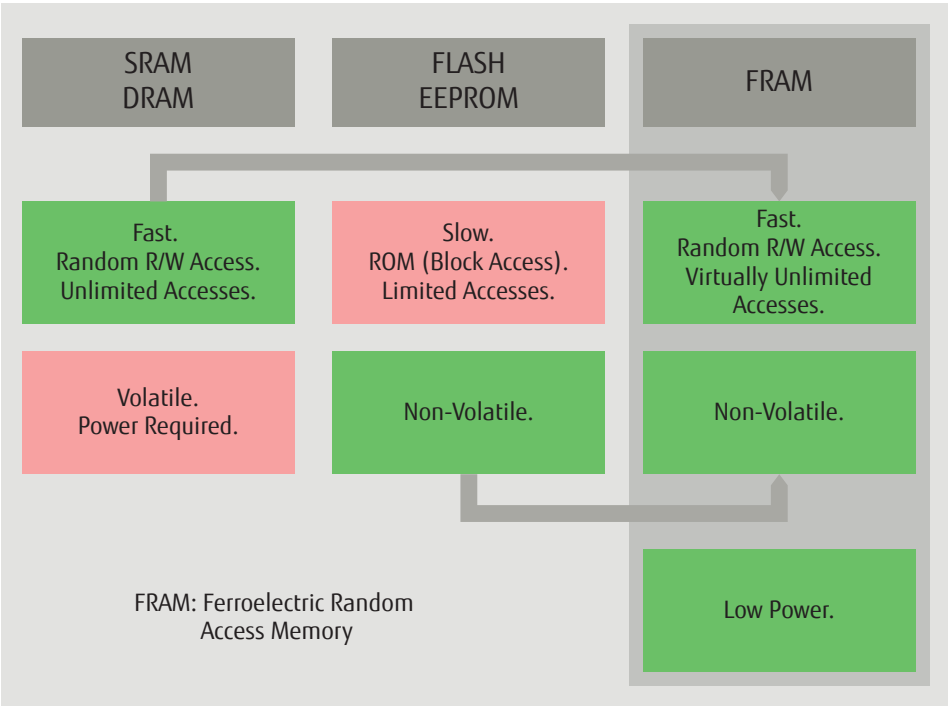
The maximum number of write/delete cycles for Flash and E^2PROM is between 100,000 and 1 Million. By comparison with over 10 trillion write/read cycles (10^{13}), the lifetime of FRAM memory is almost unlimited. Writing/reading access could theoretically take place on a cell for over 300,000 years at one-second intervals.

Crystal structure ferroelectrical materials PZT (Pb (ZrTi)0₃)

Electric field

: Pb
: 0
: Zr / Ti
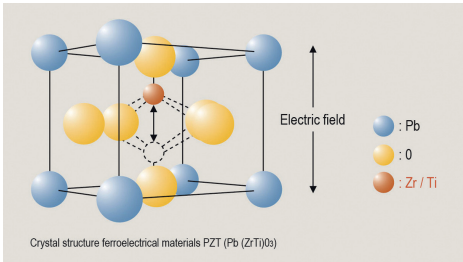
A by-product of this technology is a high resistance to radiation because, unlike with floating gate memories, alpha, beta and gamma radiation cannot harm the stored data. FRAM is therefore very well suited for medical or space-science applications, or applications in the food industry in which radiation can be used for disinfection.

Comparison of FRAM with other memory devices

	FRAM	E2PROM	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	10 trillion (10^{13})	1 million (10^6)	1 million (10^6)	Unlimited

SRAM DRAM

FLASH EEPROM

FRAM

Fast.
Random R/W Access.
Unlimited Accesses.

Slow.
ROM (Block Access).
Limited Accesses.

Fast.
Random R/W Access.
Virtually Unlimited Accesses.

Volatile.
Power Required.

Non-Volatile.

Non-Volatile.

Low Power.

FRAM: Ferroelectric Random
Access Memory

FRAM combines the benefits of Flash/E^2PROM and SRAM / DRAM

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Product Line-up – FRAM Standalone

Under Development

| Density (bit)	Serial I²C			Parallel I/F		Serial SPI		
	1.8V	3V	5V	1.8V	3V	1.8V	3V	5V
4Mb				MB85R4M2T		Quad SPI 4Mbit 1.65-1.95V (MP July 2016) **ES now!**		
					MB85R400xA			
2Mb						MB85RS2MT (1.8-3.6V)		
1Mb	MB85RC1MT (1.8 – 3.6V)					MB85RS1MT WLP		
					MB85R100xA	MB85RS1MT SOP-8		
512Kb	MB85RC512T (1.8 – 3.6V)					MB85RS512T (1.8 – 3.6V)		
256Kb		MB85RC256V (2.7 – 5.5V)			MB85R256F		MB85RS256B	
128Kb		MB85RC128A					MB85RS128B	
64Kb		MB85RC64A					MB85RS64	
		MB85RC64V (3.0 – 5.5V)					MB85RS64V (3.0 – 5.5V)	
16Kb		MB85RC16				MB85RDP16LX* (1.65–1.95V) 105C		
		MB85RC16V (3.0 – 5.5V)					MB85RS16N 95C	
4Kb		MB85RC04V (3.0 – 5.5V)						

Product overview
Parallel interface

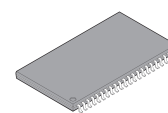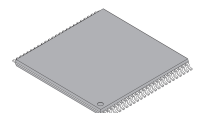| Part number	Availability	Density (Word length)	Operating voltage	Write cycle time	Operating temperature	Write/read endurance	Data retention	Package
MB85R4M2T	Available now	4Mbit	1.8 - 3.6V	150ns	-40° to +85℃	10^13	10 years at 85℃	TSOP-44 (M34)
MB85R4001A	Available now	4Mbit (8bit)	3.0 - 3.6V	150ns	-40° to +85℃	10^10	10 years at 55℃	TSOP-48 (M48)
MB85R4002A	Available now	4Mbit (16bit)	3.0 - 3.6V	150ns	-40° to +85℃	10^10	10 years at 55℃	TSOP-48 (M48)
MB85R1001A	Available now	1Mbit (8bit)	3.0 - 3.6V	150ns	-40° to +85℃	10^10	10 years at 55℃	TSOP-48 (M48)
MB85R1002A	Available now	1Mbit (16bit)	3.0 - 3.6V	150ns	-40° to +85℃	10^10	10 years at 55℃	TSOP-48 (M48)
MB85R256F	Available now	256kbit	2.7 - 3.6V	150ns	-40° to +85℃	10^12	10 years at 85℃	SOP-28 (M01/M17), TSOP-28 (M19)
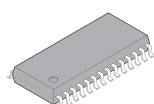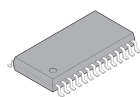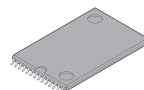
SOP-28 (M01)   SOP-28 (M17)   TSOP-28 (M19)   TSOP-44 (M34)   TSOP-48 (M48)

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Serial interface (SPI)

| Part number	Availability	Density	Operating voltage	Operating frequency (max)	Operating temperature	Write/read endurance	Data retention	Package
MB85RQ4ML	Available now	4Mbit	1.7 - 1.9V	Quad SPI - 108MHz	-40° to +85℃	10^13	10 years at 85℃	SOP-16 (M24)
MB85RS2MT	Available now	2Mbit	1.8 - 3.6V	25 / 40MHz	-40° to +85℃	10^13	10 years at 85℃	SOP-8 (M08), DIP-8 (M03)
MB85RS1MT	Available now	1Mbit	1.8 - 3.6V	25 / 30 / 40MHz	-40° to +85℃	10^13	10 years at 85℃	SOP-8 (M02), WLP-8 (M01)
MB85RS512T	Available now	512kbit	1.8 - 3.6V	25 / 30 / 40MHz	-40° to +85℃	10^13	10 years at 85℃	SOP-8 (M02)
MB85RS256B	Available now	256kbit	2.7 - 3.6V	25 / 33MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
MB85RS128B	Available now	128kbit	2.7 - 3.6V	25 / 33MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
MB85RS64	Available now	64kbit	2.7 - 3.6V	20MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
MB85RS64V	Available now	64kbit	3.0 - 5.5V	20MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
MB85RS16N	Available now	16kbit	2.7 - 3.6V	20MHz	-40° to +95℃	10^12 / 10^10	10 years at 95℃	SOP-8 (M02), SON-8 (M04)
MB85RDP16LX	Available now	16kbit with counter	1.65 - 1.95V	7.5 / 15MHz	-40° to +105℃	10^13	10 years at 105℃	SON-8 (M04)

Serial interface (I²C)

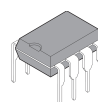| Part number	Availability	Density	Operating voltage	Operating frequency (max)	Operating temperature	Write/read endurance	Data retention	Package
MB85RC1MT	Available now	1Mbit	1.8 - 3.6V	1MHz / 3.4MHz	-40° to +85℃	10^13	10 years at 85℃	SOP-8 (M02)
MB85RC512T	Available now	512kbit	1.8 - 3.6V	1MHz / 3.4MHz	-40° to +85℃	10^13	10 years at 85℃	SOP-8 (M02)
MB85RC256V	Available now	256kbit	2.7 - 5.5V	1MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M08/M02)
MB85RC128A	Available now	128kbit	2.7 - 3.6V	1MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
MB85RC64A	Available now	64kbit	2.7 - 3.6V	1MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
MB85RC64V	Available now	64kbit	3.0 - 5.5V	1MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
MB85RC16	Available now	16kbit	2.7 - 3.6V	1MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02), SON-8 (M04)
MB85RC16V	Available now	16kbit	3.0 - 5.5V	1MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
MB85RC04V	Available now	4kbit	3.0 - 5.5V	1MHz	-40° to +85℃	10^12	10 years at 85℃	SOP-8 (M02)
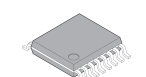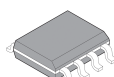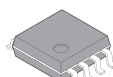
SOP-16 (M24)   SOP-8 (M02)   SOP-8 (M08)   DIP-8 (M03)   SON-8 (M04)   WLP-8 (M01)

You can download the datasheets under the link below:
http://www.fujitsu.com/uk/products/devices/semiconductor/memory/fram/standalone/

fram.feeu@de.fujitsu.com
http://emea.fujitsu.com/fram

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