10/09/2009

# Enhancing RF-Enabled ICs with F-RAM

***Ferroelectric materials in semiconductor products have been commercially available for over two decades. Today F-RAM, the non-volatile RAM, exhibits endurance, fast write speeds, and low-power operation, particularly in recent applications for wireless memories for RF. This article explains the memory technology's advantages for this growing market—primarily amongst these is its ability to meet the various international wireless standards as they are introduced.*** ONLINE SOURCE: http://www.epn-online.com/page/new122935/enhancing-rf-enabled-ics-with-f-ram.html

By Duncan Bennett, Ramtron Europe

Recent customer-driven, RF-based projects that Ramtron has contributed to have shown that a ferroelectric memory can be used successfully in wireless memory (memory that can be read and written using an RF field). Recently, the company began the design and manufacture of a family of standard wireless memories that use the technical advantages of F-RAM to produce a range of RF solutions for a number of applications for this growing market sector. Compared to EEPROM-based RF products, F-RAM-based wireless memories have greater RF sensitivity, improved range with symmetrical read and write, superior write speed, full block-write capability, and magnetic-resistant and gamma-tolerant operation.

### *The wireless market*

The market for wireless solutions has grown appreciably in recent years and continues to grow even during recessionary times. Over the last couple of years, the wireless-memory market has matured with a number of globally recognised standards. One of the more promising of these is the EPC global class-1, generation-2 standard. It offers customers the ability to use transponders, readers, and system solutions from a number of different suppliers. The company opted to manufacture wireless memories to the generation-2 standard in order to take advantage of the infrastructure already in place.

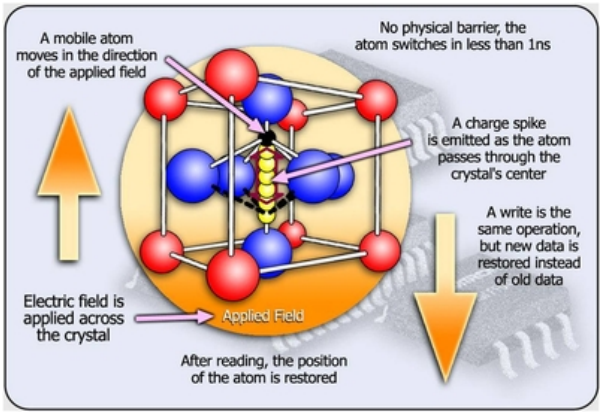


Figure 1: F-RAM properties in the presence of an electrical field.

The underlying molecular structure of an F-RAM memory cell is shown in Figure 1. When an electric field is applied across the ferroelectric crystal, the central atom moves in the direction of the applied field and then remains in that position when power is removed.

The two positions of the central atom are used to represent a 1 and 0. F-RAM has three principle benefits : virtually unlimited endurance, low power, and a NoDelay™ Write feature: the F-RAM writes so quickly that there is no need to wait for the write to complete. Typical write speed is around 55ns, compared to the 5ms write speed of EEPROM.

The memory can withstand 100 trillion read/write cycles, making it virtually impossible to wear out. It also requires less power to perform writes. For example, erasing and writing 64kbit of data in an F-RAM consumes 1/60th of the power used by a low-power EEPROM and 1/400th of that used by a serial flash.

***Applying to wireless memory***

For a passive wireless memory, all of the energy necessary to operate the memory comes from the RF field. Using the low-power operation, the energy required is lower, which means that less RF energy is needed for the tag to operate. This translates into F-RAM-based wireless memories working in lower-powered RF fields or in the same power RF field at a greater distance.

If the system requires that a memory be written—for example, to reduce the amount of credit available for train trips that are left on the user's transport RF tag—then the time to write is the time that the user has to hold the tag in the RF field. F-RAM can be written with much less power and much faster than EEPROM. This means that writing to the wireless memory can begin at a much greater distance from the reader—where there is less RF power—and will complete the task much quicker. This may just mean that the users don't have to remove the tag from their wallet or purse, and that they do not have to slow down as they pass the reader.

The F-RAM had to be re-designed with low-power operation as a key design goal. A different interface to the memory core was designed that reduces the power consumption of the interface by about 25% compared to a standard SPI. The memory core was re-worked to optimise for low-power consumption, and the access speed of the memory was closely matched to the speed of the RF interface. The result is a memory that consumes about 1/200th of the power of a standard SPI F-RAM, which is already about 60 times better than the EEPROMs that have been optimised for low-power consumption. Compared to low-power EEPROMs, the new low-power F-RAM technology uses about 10,000 times less power when writing.

***A robust technology***

There are some less well-known benefits of F-RAM memory technology that enable wireless-memory applications that would be impossible if based on other memory technologies. For example, F-RAM is immune to magnetic fields, and the resistance to electrical fields is so high that electric fields can be ignored. This means that wireless memories based on F-RAM can be placed in your pocket next to mobile devices and will not suffer any ill effects.

F-RAM is highly tolerant to gamma radiation. Gamma radiation is being increasingly used in medical applications for sterilising medical equipment. With the introduction of F-RAM-based wireless memories, manufacturers can now attach wireless memories to medical equipment that is subsequently sterilised with gamma radiation. Previous wireless memories based on other non-volatile memory technology would have their data corrupted by gamma radiation.

***Suitability for RFID***

As most of the existing RF-enabled products have a very small amount of writable memory, the company determined that there is a demand for wireless memories that could hold more information to expand the applications in which it can be used.

The wireless-memory market has started as a simple identifier technology—wireless memory that simply provides the reader with a fixed number. The system is responsible for attaching all information to this number that is required to make the application work in the same way that the police computer attaches a name and address to the car owner's registration plate.

At present, the wireless memory market is maturing, and with that maturity it is becoming apparent that applications are requiring more memory. For example, large memory tags based on EEPROM would require a significant amount of time in the RF field to permit the writing of significant amounts of data. However, large F-RAM-based wireless memories have a write speed that is typically limited by the RF protocol rather than the memory technology. The F-RAM-based solutions offer speeds that are up to six times faster than EEPROM-based RF solutions. In addition, F-RAM-based wireless memory enables full 512byte block-write operations. This is a function that may not be practical with EEPROM due to the memory's required soak time in an RF field.

By applying the advantages that F-RAM has over other non-volatile memories to wireless-memory products, the company believes that it is giving customers RF solutions that are not available with any other memory technology. With an increasing demand for wireless memories in general and larger density wireless-memory solutions in particular, F-RAM-based wireless memories are poised to take advantage of a growing market.

Ramtron UK
11 Medway Close
RG41 3TP Wokingham - United Kingdom -Berkshire
tel: +44-(1189)770939
fax: +44-11 89 770 953