Infotainment Applications
Need for dynamic data integrity

F-RAM memory protects data / system integrity against glitches such as sudden power loss, and records and stores dynamic data continuously, as required by today's advanced car infotainment systems such as navigation and radio systems.

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The quantity of dynamic data in today's infotainment applications is increasing. This data is often essential to the correct operation of a system and / or is user-centric, changing as the user's environment changes (e.g. local traffic information). Advanced infotainment systems therefore require a non-volatile storage memory that guarantees high data availability and maintains data integrity.

Sudden power loss

A common problem that many automotive infotainment systems designers face is the sudden loss of power. This typically occurs any time the engine is restarted after a stall. Power loss can cause data corruption and therefore can disrupt proper system operation, unless provisions are designed-in to maintain data integrity.

The following standard circuit techniques make the most of F-RAM (Ferroelectric Random Access Memory) non-volatile memory to prevent the pitfalls of sudden power loss in automotive applications. The first is to replace an EEPPROM (Electrically Erasable Programmable Read-Only Memory) and capacitor combination with F-RAM memory. F-RAM uses much less power than EEPROM and writes much more quickly, eliminating the need for a capacitor to maintain power supply while writing is completed in a power-loss scenario. In addition, the F-RAM-based solution requires less physical board space than the EEPROM + capacitor combination, while the cost of eliminating the capacitor can prove a significant difference in applications that demand a large amount of capacitance.

The two circuits shown in Figure 1 are essentially equivalent:

F-RAM is commonly used when the system demands that data be stored upon power loss. The graph below shows a typical RC decay curve. The microcontroller (MCU) sees the power starting to fail at 3.1V and has until Vdd reaches 2.8V before the brown-out detector fires the reset of the MCU and prevents further writing. In the example in Figure 2, the MCU only has 10 milliseconds between these two points – just enough time to write 1 byte or one page of data to an EEPROM. In the same time, it is possible to complete 50,000 writes to a serial peripheral interface (SPI) F-RAM device.

Power Loss–Comparing F-RAM and EEPROM writing speeds (Figure 2)

F-RAM has already been adopted in advanced navigation systems to maintain system integrity in case of a sudden power failure. In systems that rely on a DVD for mapping information, F-RAM is used to record the position of the DVD reading head, so if power is unexpectedly lost (i.e. the vehicle engine stalls) the DVD player can quickly resume from its last position. The solution is to continuously write the position of the head to the F-RAM, making use of F-RAM's virtually unlimited endurance.

The same technique is commonly used in automotive DVD players to prevent data loss if the power fails. Movies recommence exactly where they ▶

F-RAM and EEPROM circuits

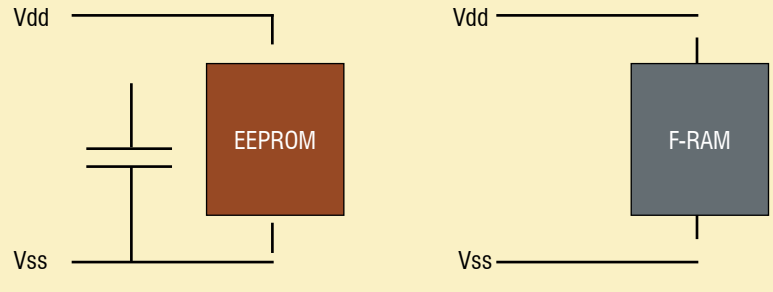


Figure 1

Power loss – Comparing F-RAM and EEPROM writing speeds

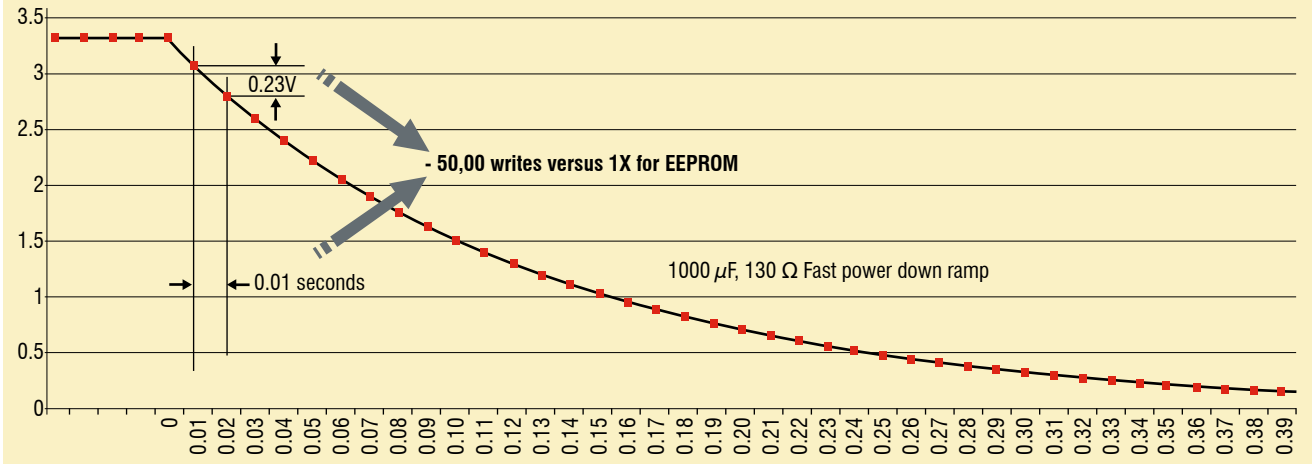


Figure 2

stopped since the F-RAM knows the DVD reading head position. This is an essential feature to avoid the wrath of a child complaining that poor driving has caused the movie to restart.

F-RAM also solves the problem of navigation systems losing contact with enough satellites to make a firm position fix. This typically occurs when the vehicle enters a tunnel or an underground garage. If the position of the vehicle is being constantly stored in the F-RAM, the navigation system can use the F-RAM-stored position until a new satellite position fix is acquired. This also means that the position is available if power is suddenly lost. This type of continuous writing is a common technique when using high-endurance F-RAM.

An exciting prospect for future navigation systems is their ability to access localised points-of-interest via a server connection.

High endurance / low power

Many of today's new automotive radio formats handle large quantities of data in addition to the regular audio channels. This data ranges from traffic or weather information to road conditions, and should be available as soon as the driver starts the car. This means that the radio must download the data while the car engine is turned off. Since the system cannot know when the driver will return to the vehicle, it must download and store the data continuously.

While automobile manufacturers are demanding more sophisticated car radio systems, they are increasingly limiting the amount of power that can be drawn from the vehicle's electrical supply, particularly when the engine is off. This presents car infotainment designers with a very difficult challenge. F-RAM solves this because it can be written to as often as required, with no practical limitation on the memory's endurance. This means that data is written to the F-RAM whenever data is available. And after writing, the radio enters a low power state to await the next wake up.

In addition, the power required to write to F-RAM is considerably lower than writing to EEPROM (approximately 1/60th for 64 kilobits), further reducing the overall power budget. EEPROM in this application would not suffice as it does not have enough endurance and consumes too much power when writing.

Dynamic data storage

USB connectivity is being designed into new vehicles as a standard user interface. A USB connector allows the vehicle to access music collections stored on portable music players / flash drives via the vehicle's audio system. The USB interface must recognise a variety of available music storage devices and a variety of music (or video) file formats. It must be able to store playlists for different devices (e.g. MP3 players or USB flash drives). It must recall the last play points for each playlist on each device. This data is stored in the F-RAM so that the music resumes exactly where it stopped before the vehicle was turned off. F-RAM's non-volatility and high endurance enable these features.

Extensive data storage is also crucial in next-generation navigation systems. An exciting prospect for future navigation systems is their ability to access localised points-of-interest via a server connection. This dynamic data includes information on the car's immediate surroundings such as local restaurants, attractions, and activities. This constantly changing data is written to the F-RAM as quickly as the data becomes available, ensuring that the most recently-acquired data is immediately available after a power interruption.

Another future development in navigation systems is the distribution of localised data. With the growth of electronic stability control, a vehicle can detect an icy patch in the road, send this information to the navigation system, which, in turn notifies the server. Other navigation systems interrogating the server are then warned of the road conditions.

Storage of dynamic data is also integral to many new car radio features. This data may be:

- *Favorite artist / song:* The radio remembers favorite songs/artists and changes stations if the artist / song is playing on another station.
- *Favorite station:* The radio records favorite radio stations as the car travels from area to area and tunes into those stations if the car travels on the same route again.
- *Last station recall:* The radio remembers the previous station and can switch back to it when prompted.

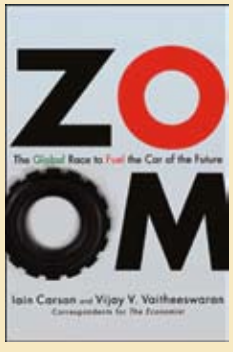
All of this dynamic data must be retained between journeys, requiring a storage memory that is non-volatile, enables frequent writes, and often operates at low-power.

Dynamic data is a fundamental component of many automotive infotainment systems and protecting this data is essential. The unique advantages of F-RAM—fast writes, virtually unlimited endurance, and low power consumption—allow designers to guarantee that this dynamic data has higher availability and greater integrity. ■

AUTHOR

Duncan Bennett is a strategic marketing manager at Ramtron International of Colorado Springs, CO. He has over 20 years experience in the semiconductor industry. He started as a Design Engineer in the industrial control/graphical instrumentation systems field, then shifted from applications to sales and, finally, into marketing. At Ramtron, Duncan is responsible for enabling new F-RAM applications in the automotive industry and for the definition of new memory products.

BOOK SHELF



ZOOM: The Global Race To Fuel the Car of the Future

Editor: Vijay Vaitheeswaran and Iain Carson

Year of Publication: 2008

Pages: 1199

Description

Oil is the problem. Cars are the solution. Zoom identifies and gives voice to a Great Awakening sweeping the industrialized world - a growing realization that in order to protect the environment and lessen our dependence on oil from volatile Middle East countries, we must rethink and recreate the automobile. This is happening, now, all over the world, in Japan, Silicon Valley, India, and China, as entrepreneurs, environmentalists, and inventors collaborate on a new generation of cars powered by hydrogen, electricity, bio-fuels, and digital technology.

You may think the solutions are decades away, but Economist correspondents Iain Carson and Vijay Vaitheeswaran prove that the revolution is underway now by introducing readers to an inspiring group of visionaries who are trying to remake the automobile and energy industries. We also meet the petroleum and automobile executives in Michigan and Texas who are fighting for survival, and the savvy leaders at Toyota who have transformed their company into the world's top automobile manufacturer.

Every political candidate running for national office advocates energy reform. Zoom offers a lucid and compelling way forward.