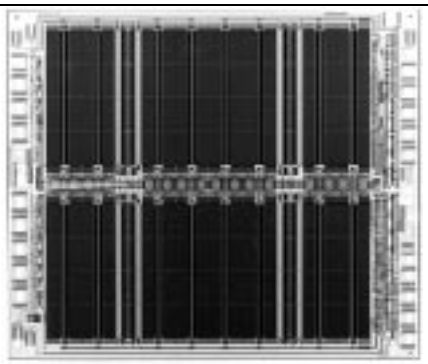
256-Kbit FRAM® Device Combines High Speed of SRAM and DRAM with Nonvolatility of ROM

Chip is a breakthrough for cost-effective, low-power, write-intensive applications that require nonvolatility and fast writes

The 32Kx8bit HM71V832—the world's first high-density, sub-micron Ferroelectric RAM (FRAM) device—combines the high speed of DRAM and SRAM with the nonvolatility of ROM, making it the industry's first ideal memory device. These characteristics have never before been available in any single-chip semiconductor memory device at 256-Kbit density. Other nonvolatile memory (NVM) technologies such as EE-PROM and Flash cannot be reprogrammed at high speeds and require more power to operate. They also wear out after far fewer rewrite cycles than FRAM memories.

The breakthrough 256-Kbit FRAM device has a one trillion (10^{12}) read/write cycle lifetime, a tremendous endurance. As a result, designers of write-intensive applications such as cellular phones can now use only NVM for the total memory solution, thus eliminating the need to use battery-backed-up SRAM to achieve nonvolatility. Pagers, cellular phones, and other battery-powered products also benefit from the 3-V FRAM device's low-power operation (30 mA active, 25 µA standby), as well as its SRAM-type pinout, block protection software sequence, and selectable block write protection. Another design plus is a fast rewrite speed (235 ns); at last, engineers have an NVM solution for systems that require sub-microsecond write times.

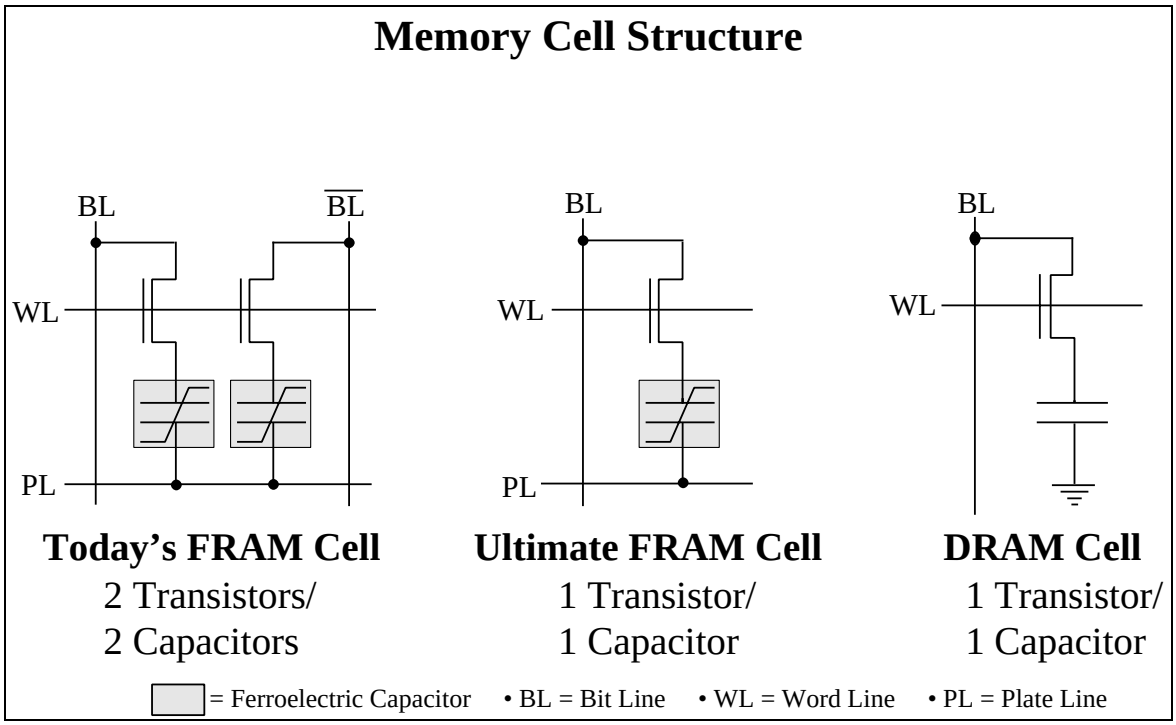


For easy system integration, the 256-Kbit FRAM chip has CMOS-compatible I/O, uses a standard Bytewide SRAM pinout, and needs no special store or recall sequence.

Conforms to standards

The 256-Kbit FRAM device allows designers to produce NVM subsystems using an industry-standard pinout and interface, without resorting to proprietary or nonstandard command sets. No software drivers are needed. Moreover, unlike Flash devices, sectors in FRAM devices don't have to be erased prior to the write operation. By eliminating the need for software drivers and erase/prewrite operations, the FRAM chip greatly eases software development. OEMs will also welcome the anticipated standardization and multiple sourcing of FRAM products.

The FRAM device's block protection software command sequence is the same as the sequence used for EEPROMs, for easy migration of EEPROM designs to FRAM implementations. The selectable block write protection feature of the HM71V832 is divided into eight 4-KByte blocks. The device has a chip write protection mechanism that is identical to the JC42.2 industry standard for EEPROMs, allowing you to protect sensitive code from inadvertent writes.

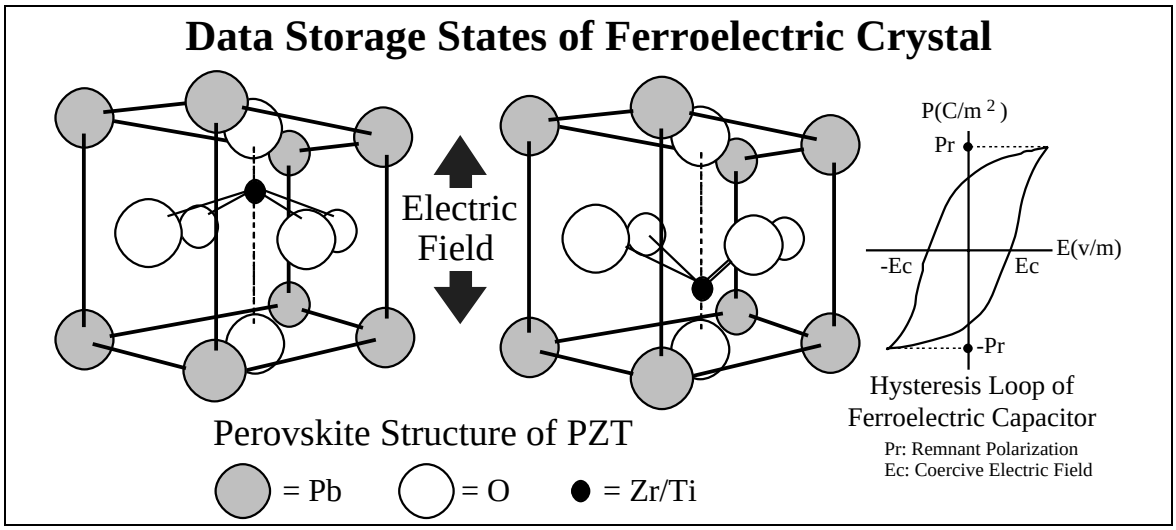


The ferroelectric film (PZT) in the cell of the 256-Kbit FRAM device performs the same data storage function as the stacked capacitor in a DRAM. Ongoing co-development by Hitachi and Ramtron aims at simplifying the FRAM cell design to obtain faster speeds and higher densities.

Uses existing software

Hitachi's 256-Kbit FRAM device has an excellent opportunity to consolidate the NVM market because its architecture requires no software development, unlike Flash memory. The FRAM device aids new designs and upgrades of existing systems by using an industry-standard SRAM/EPROM/EEPROM pinout and an EEPROM interface. Power for the program/erase operations, 57 mW typical, is about the same as for EEPROMs, and up to 75 percent less than for Flash devices, while endurance is about one million times better than Flash, which has an endurance of about one million cycles.

Overall, HM71V832 offers a combination of density, endurance, speed, and low-power operation unmatched by any other nonvolatile memory device. The price of this FRAM device is about equal to that of a 256-Kbit SRAM plus a backup battery, and is nearly the same as a 256-Kbit EEPROM.



During read/write operations, an externally applied electric field moves the atom at the center of the ferroelectric crystal to one of two stable positions, depending on the direction of the field, which is determined by the data being stored. The electron maintains its position after the field is removed, so data storage is nonvolatile.

Technology pact with Ramtron

Hitachi, Ltd., has partnered with Ramtron International Corporation since 1992, when the companies entered into a program to explore the technical feasibility of integrating Ramtron's ferroelectric technology with Hitachi's leading-edge semiconductor processes and manufacturing capability. After successfully completing the feasibility program, the companies began a commercialization program for high-density 256-Kbit to 4-Mbit standard FRAM memory devices. The 256-Kbit device is the first product to result from that program, and it's being offered independently by Hitachi and Ramtron to their respective customers.

Design momentum for FRAM devices is likely to build rapidly as engineers discover the compelling benefits of this revolutionary technology and gain more experience applying it. Usage will be encouraged by increasing densities and decreasing costs per bit (see article, Market and Technology Trends in Non-volatile Memory Devices, page 6). Moreover, Hitachi now sees the FRAM technology as a possible basis for a much wider range of products beyond memory devices, including specialized micro-controllers and logic devices.