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PUTTING NEW TECHNOLOGY IN PERSPECTIVE

Microcontrollers Commit To FRAM

Ramtron's split memory is the first step toward a full-fledged FRAM platform.

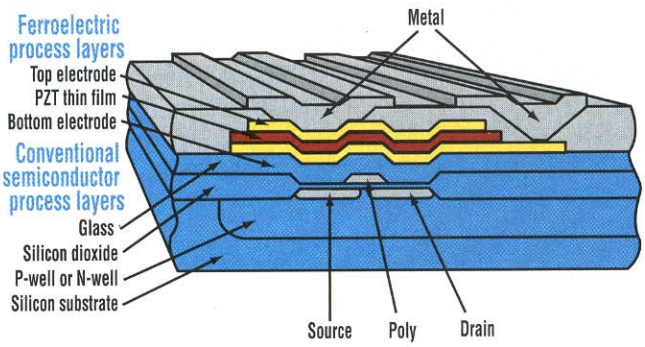
Memory options have their good and not-so-good qualities. Flash is nonvolatile, but updates are very slow. On the other hand, SRAM is fast but volatile. Now those tradeoffs may be a thing of the past with ferroelectric random-access memory, otherwise known as FRAM. It offers the best of both worlds.

According to Ramtron, its 40-MHz VRS51L3074 is the first 8-bit microcontroller to incorporate FRAM into its memory complement *(Fig. 1)*. To keep costs down, the company included 8 kbytes of FRAM, along with flash and SRAM. In the future, FRAM microcontrollers may carry just FRAM, since it possesses the nonvolatility of flash and the access speed of SRAM.

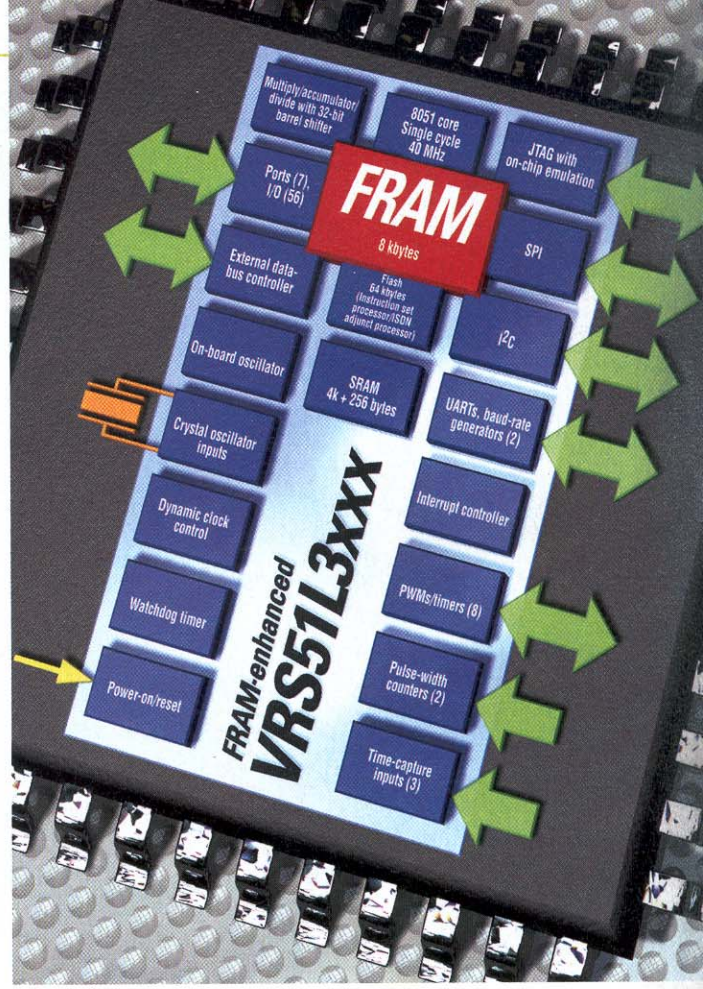
The company put together an interesting mix of memory. The 64 kbytes of flash and SRAM is comparable to other 8051 MCUs. The first 256 bytes of SRAM map to 8051 registers. The other 4 kbytes are extended memory. The FRAM block of extended memory, which is 8 kbytes, can run using the faster burst mode. Write-protect support is available along 2-kbyte boundaries.

Other microcontrollers tend to put nonvolatile information into EEPROM or flash. Both are slow when writing, and they have other disadvantages, too: EEPROM is expensive, and flash can wear out.

Flash improvements have extended its write life, and there's no problem with reading. But flash can't match FRAM's lifetime performance—FRAM should be stable in excess of 45 years. Moreover, it can be modified at the byte level, while flash updates are block-oriented.



2. Ramtron adds a set of ferroelectric process layers atop conventional semiconductor layering to incorporate FRAM into its architecture.



1. Ramtron's VRS51L3074 is the first microcontroller to incorporate FRAM into its memory complement.

Different approaches have been used on larger flash arrays to extend write life through remapping. This hasn't been done on microcontrollers, though, due to the overhead. So once again, FRAM offers the best alternative when high-speed, long-term updates are required.

Ramtron implemented FRAM on top of its conventional silicon architecture *(Fig. 2)*. The zirconium-titanium (PZT) layer is used to form a capacitor that stores the magnetic polarization for each bit. Each state remains stable after power is removed. This structure requires only two additional process steps. This includes the PZT and top electrode.

The VRS51L3074 is a relatively conventional 8-bit MCU with no analog peripherals, although there's nothing to prevent FRAM from being used with this type of peripheral. Its complement of digital interfaces includes a pair of UARTs, an I^2C serial interface, an eight-channel pulse-width modulation (PWM) controller, and plenty of general-purpose I/O and interrupts. It also supports JTAG debugging.

The chip really performs when it comes to data manipulation. Its arithmetic engine has a 32-bit accumulator, and there's support for 16-bit hardware multiply and divide. A 32-bit barrel shifter is also in the mix.

The VRS51L3074 comes in a QFP-64 (quad flat no-lead) package for less than $5. Another version, the pin-compatible VRS51L3070, lacks the 8 kbytes of FRAM. Development kits are available.

Ramtron
www.ramtron.com

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