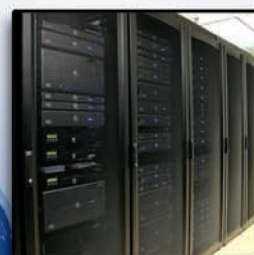# RAMTRON
## International Corporation

# Ramtron Short Form Catalog
## Second Half 2008

# F-RAM
## by RAMTRON

### Nonvolatile F-RAM ICs
### for a world of applications

# Design to a higher standard

Ramtron's broad line of specialized semiconductor memory, microcontroller and integrated semiconductor solutions are found in a wide range of industries and applications including metering, computing, automotive, and consumer.

Ramtron products are also found in industrial, scientific, and medical applications that thrive on the high-speed, high-endurance, and low power consumption of ferroelectric random access memory, or F-RAM.

## Benefits of F-RAM

F-RAM products combine the nonvolatile data storage capability of ROM with the benefits of RAM.

### Fast Write Speed
F-RAM performs read and write operations at the same speed. Because F-RAM writes data at bus speed, there are no delays before the written data becomes nonvolatile. Floating gate memories have a long write delay of five milliseconds. F-RAM writes in nanoseconds, essential in applications like auto safety systems.

### High Endurance
F-RAM offers virtually unlimited write endurance, which means it doesn't wear out like other nonvolatile memory devices. Floating gate devices experience a hard failure and stop writing in as little as $10^5$ cycles, making them unsuitable for write intensive applications.

### Low Power Consumption
F-RAM operates without a charge pump, enabling low power consumption. Floating gate devices demand high voltage during write operations. F-RAM writes at the native voltage of the manufacturing process: 5V, 3V, or even less on more advanced processes.

## A primer on F-RAM memory

F-RAM offers a unique set of features relative to other semiconductor technologies. Established semiconductor memories can be divided into two categories: volatile and nonvolatile. Volatile memory includes SRAM (static random access memory) and DRAM (dynamic random access memory), among others. RAM type devices are easy to use, offer high performance, but they share a common vulnerability: stored memory is lost when the power supply is removed.

Figure 1.
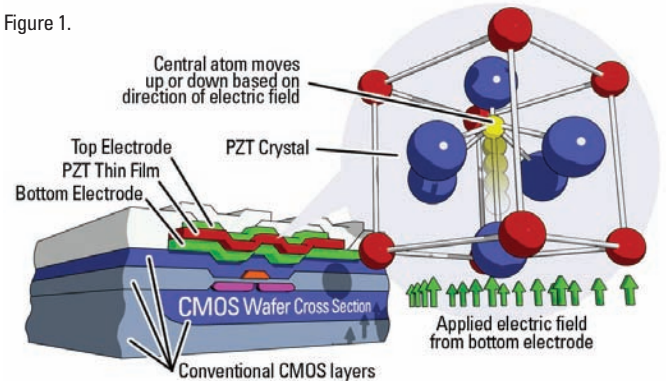


The F-RAM chip contains a thin ferroelectric film of lead zirconate titanate [$Pb(Zr,Ti)O_3$], commonly referred to as PZT (Figure 1). The Zr/Ti atoms in the PZT change polarity in an electric field, thereby producing a binary switch. Unlike RAM devices, F-RAM retains its data memory when power is shut off or interrupted, due to the PZT crystal maintaining polarity. This unique property makes F-RAM a low power, nonvolatile memory.

Like F-RAM, ROM (read only memory) is a nonvolatile memory that does not lose its data content when power is removed. Newer generation ROM, like EEPROM (electrically erasable programmable read only memory) and flash memory, can be erased and re-programmed multiple times, but they require high voltage and write very slowly. ROM-based technologies eventually wear out (in as little as $10^5$ cycles), making them unsuitable for high-endurance industrial applications.
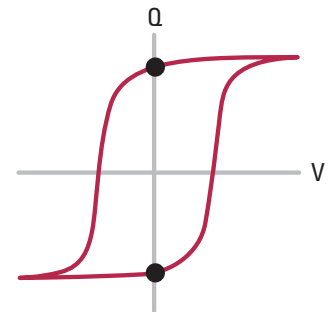


*This hysteresis loop shows the switching charge/voltage fundamental of an F-RAM memory cell.*

F-RAM has 10,000 times greater endurance and uses 3,000 times less energy than a typical serial EEPROM device, and nearly 500 times the write speed.

F-RAM combines the best of RAM and ROM into a single package that outperforms other nonvolatile memories with remarkably fast writes, high endurance, and ultra-low power consumption.

## ▶ Serial F-RAM Memory

F-RAM serial memories provide reliable data collection, perform reads and writes like a RAM, and eliminate the complexities, overhead, and system reliability problems of EEPROM. The I2C serial interface is common and many MCUs implement a dedicated I2C port. The serial peripheral interface (SPI) is capable of clock rates up to 40MHz.

### I2C Serial F-RAM Memory

| Part | Density | Package | Max. Bus Speed | Vdd | IDD@fMax | Device ID† | Reset Option (R) | Unique S/N (N)‡ |
|------|---------|---------|----------------|-----|----------|-----------|------------------|-----------------|
| FM24V(R)(N)10 | 1Mb | SOIC8 | 3.4MHz | 2.0V-3.6V | 1.0mA | Yes | Upon Request | Upon Request |
| FM24V(R)(N)05 | 512Kb | SOIC8 | 3.4MHz | 2.0V-3.6V | 1.0mA | Yes | Upon Request | Upon Request |
| FM24C512 | 512Kb | EIAJ SOIC8 | 1MHz | 4.5V-5.5V | 1.5mA | | | |
| FM24C256 | 256Kb | EIAJ SOIC8 | 1MHz | 4.5V-5.5V | 1.2mA | | | |
| FM24L256 | 256Kb | SOIC8 | 1MHz | 2.7V-3.6V | 600mA | | | |
| FM24CL64* | 64Kb | SOIC8 or TDFN8 | 1MHz | 2.7V-3.6V | 400µA | | | |
| FM24C64* | 64Kb | SOIC8 | 1MHz | 4.5V-5.5V | 1.2mA | | | |
| FM24CL16* | 16Kb | SOIC8 or TDFN8 | 1MHz | 2.7V-3.6V | 450µA | | | |
| FM24C16A | 16Kb | SOIC8 | 1MHz | 4.5V-5.5V | 1.0mA | | | |
| FM24CL04 | 4Kb | SOIC8 | 1MHz | 2.7V-3.6V | 300µA | | | |
| FM24C04A | 4Kb | SOIC8 | 1MHz | 4.5V-5.5V | 1.0mA | | | |

†Manufacturer ID and Part Number read out. ‡ Read-only 64-bit Customer Identifier and Unique Serial Number.

### SPI Serial F-RAM Memory

| Part | Density | Package | Max. Bus Speed | Vdd | IDD@fMax | Device ID† | Reset Option (R) | Unique S/N (N)‡ |
|------|---------|---------|----------------|-----|----------|-----------|------------------|-----------------|
| FM25H20 | 2Mb | TDFN8 | 40MHz | 2.7V-3.6V | 10mA | | | |
| FM25V(R)(N)10 | 1Mb | SOIC8 | 40MHz | 2.0V-3.6V | 3.0mA | Yes | Upon Request | Upon Request |
| FM25V(R)(N)05 | 512Kb | SOIC8 | 40MHz | 2.0V-3.6V | 3.0mA | Yes | Upon Request | Upon Request |
| FM25L512 | 512Kb | TDFN8 | 20MHz | 3.0-3.6V | 12mA | | | |
| FM25L256B | 256Kb | SOIC8 or TDFN8 | 20MHz | 2.7V-3.6V | 10mA | | | |
| FM25256B | 256Kb | SOIC8 | 20MHz | 4.0V-5.5V | 15mA | | | |
| FM25CL64-GA** | 64Kb | SOIC8 | 16MHz | 3.0V-3.6V | 7.0mA | | | |
| FM25CL64 | 64Kb | SOIC8 or TDFN8 | 20MHz | 2.7V-3.6V | 10mA | | | |
| FM25640-GA** | 64Kb | SOIC8 | 4MHz | 4.5V-5.5V | 2.7mA | | | |
| FM25640* | 64Kb | SOIC8 | 5MHz | 4.5V-5.5V | 3.0mA | | | |
| FM25L16* | 16Kb | SOIC8 or TDFN8 | 18MHz | 2.7V-3.6V | 5.5mA | | | |
| FM25C160-GA** | 16Kb | SOIC8 | 15MHz | 4.5V-5.5V | 6.5mA | | | |
| FM25C160* | 16Kb | SOIC8 | 20MHz | 4.5V-5.5V | 8.0mA | | | |
| FM25L04-GA** | 4Kb | SOIC8 | 10MHz | 3.0V-3.6V | 2.2mA | | | |
| FM25L04 | 4Kb | SOIC8 or TDFN8 | 14MHz | 2.7V-3.6V | 3.0mA | | | |
| FM25040A-GA** | 4Kb | SOIC8 | 14MHz | 4.5V-5.5V | 6.0mA | | | |
| FM25040A | 4Kb | SOIC8 | 20MHz | 4.5V-5.5V | 8.0mA | | | |

*AEC-Q100 Grade-3 Qualified (-40°C to +85°C)   **AEC-Q100 Grade-1 Qualified (-40°C to +125°C)

## ▶ Parallel F-RAM Memory

Ramtron parallel memory offers high-performance reads and writes with true nonvolatility without a battery. F-RAM bytewide devices have standard SRAM pinouts and store data without battery backup.

| Part | Organization | Package | Access Time | Vdd | IDD@fMax Cycle | Software WP |
|------|--------------|---------|-------------|-----|----------------|-------------|
| FM22L16 | 256K x 16 | TSOP-II-44 | 55ns | 2.7V-3.6V | 18mA | 8 blocks |
| FM21L16 | 128K x 16 | TSOP-II-44 | 60ns | 2.7V-3.6V | 18mA | 8 blocks |
| FM28V100 | 128K x 8 | TSOP-I-32 or SOIC32 | 60ns | 2.0V-3.6V | 15mA | 8 blocks |
| FM20L08 | 128K x 8 | TSOP-I-32 | 60ns | 3.13V-3.6V | 22mA | |
| FM18L08 | 32K x 8 | SOIC28, PDIP28, TSOP-I-32 | 70ns | 3.0V-3.6V | 15mA | |
| FM1808 | 32K x 8 | SOIC28 or PDIP28 | 70ns | 4.5V-5.5V | 25mA | |
| FM1608 | 8K x 8 | SOIC28 or PDIP28 | 120ns | 4.5V-5.5V | 15mA | |

# F-RAM Processor Companion

Ramtron Processor Companions are complete support and peripheral solutions with highly integrated mixed signal (analog and digital) functions for processor-based systems. Never before has a solution combined the fast read/write performance and unlimited endurance of nonvolatile F-RAM with a real-time clock (RTC), processor supervisor, and other common peripherals.
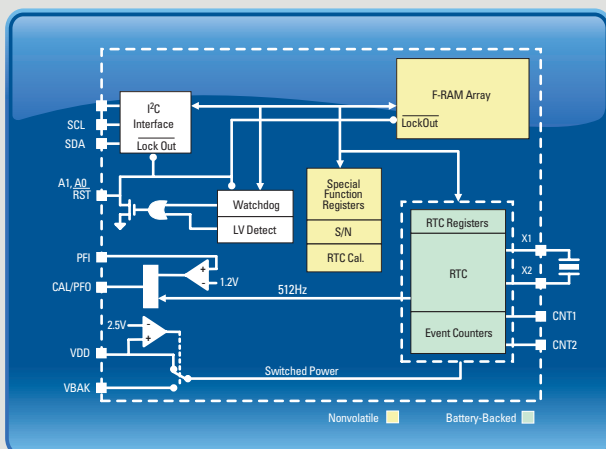
## SPI F-RAM Processor Companion

| Part | Vdd | Memory | RTC | RTC Alarm | Power Monitor | Watch Dog | Early Power Fail | Serial Number | Battery Switch Over | Event Detect | Package |
|------|-----|--------|-----|-----------|---------------|-----------|------------------|---------------|---------------------|--------------|---------|
| FM33256 | 3V | 256Kb | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM3316 | 3V | 16Kb | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |

## I²C F-RAM Processor Companion

| Part | Vdd | Memory | RTC | RTC Alarm | Power Monitor | Watch Dog | Early Power Fail | Serial Number | Battery Switch Over | Event Detect | Package |
|------|-----|--------|-----|-----------|---------------|-----------|------------------|---------------|---------------------|--------------|---------|
| FM31L278 | 3V | 256Kb | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM31L276 | 3V | 64Kb | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM31L274 | 3V | 16Kb | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM31L272 | 3V | 4Kb | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM31278 | 5V | 256Kb | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM31276 | 5V | 64Kb | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM31274 | 5V | 16Kb | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM31272 | 5V | 4Kb | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM3130 | 3V | 64Kb | Yes | Yes | No | No | No | No | Yes | -- | SOIC 8 or TDFN |
| FM3135 w/Xtal | 3V | 64Kb | Yes | Yes | No | No | No | No | Yes | -- | SOIC 20 |
| FM32L278 | 3V | 256Kb | No | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM32L276 | 3V | 64Kb | No | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM32L274 | 3V | 16Kb | No | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM32L272 | 3V | 4Kb | No | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM32278 | 5V | 256Kb | No | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM32276 | 5V | 64Kb | No | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM32274 | 5V | 16Kb | No | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM32272 | 5V | 4Kb | No | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |
| FM4005 | 5V | -- | Yes | No | Yes | Yes | Yes | Yes | Yes | Count | SOIC14 |

### 31x Processor Companion Block Diagram

### 32x Processor Companion Block Diagram
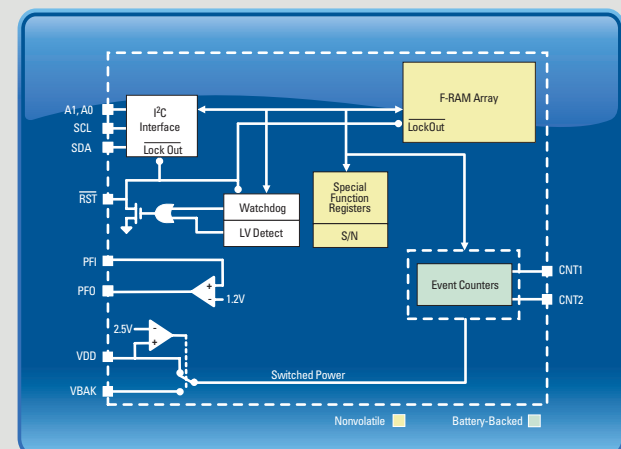
## ▶ Dual and Quad Nonvolatile State Saver

The Ramtron low-power nonvolatile state saver is a logic building block that provides continuous access to nonvolatile system settings without reading a memory. It enables storage of signals that may change frequently and without notice, and it allows the nonvolatile storage of system settings without the system overhead of a serial memory.
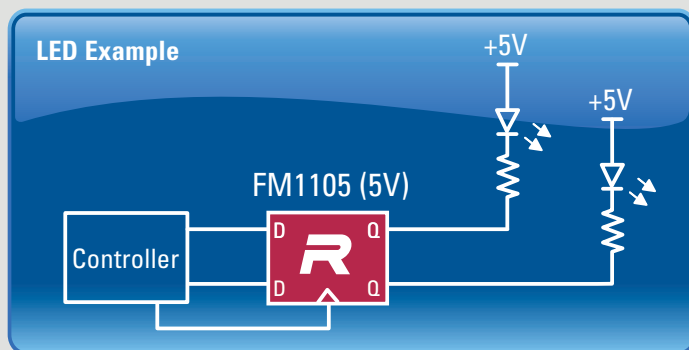
These Ramtron F-RAM-based devices save the state of signals on demand and automatically restore signals to their correct state upon power up. Ramtron nonvolatile state savers:

- Provide continuous access to nonvolatile system settings without performing a memory read operation
- Enable storage of signals that may change frequently and without notice
- Allow the nonvolatile storage of a system setting without the system overhead of a serial memory

| Part | Operating Current | Savers | Output Current | Standby Current | Package |
|------|-------------------|--------|----------------|-----------------|---------|
| FM1105 | 5V | 2 | 10mA | 15µA | SOT23-8 |
| FM1106 | 3V | 2 | 10mA | 5µA | SOT23-8 |
| FM1107 | 3V | 2 | 10mA | 0.5µA | SOT23-8 |
| FM1110 | 5V | 4 | 10mA | 30µA | QFN16 |
| FM1112 | 3V | 4 | 10mA | 10µA | QFN16 |
| FM1114 | 3V | 4 | 10mA | 0.5µA | QFN16 |

## F-RAM State Saver Application Examples

**Relay Example**

+12V
+12V

FM1106 (3V)

Controller

D  Q
D  Q
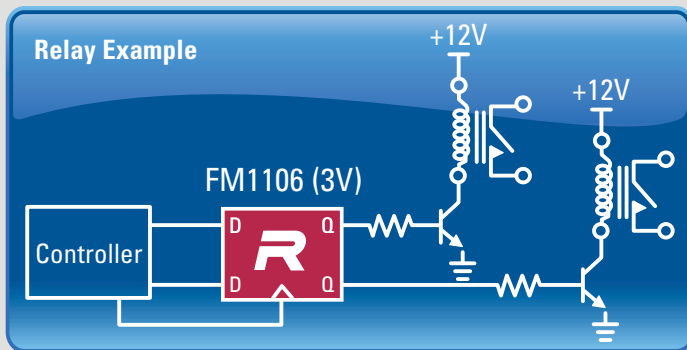
**Restores switches and relays**
Ramtron nonvolatile state savers restore the state of switches and relays on power up.

**Need help?**
Contact a technical applications engineer at framinfo@ramtron.com or download a datasheet at www.ramtron.com

**LED Example**

+5V
+5V

FM1105 (5V)

Controller

D  Q
D  Q

**Restore the state of LEDs**
Ramtron nonvolatile state savers restore the state of LEDs on power up.

## ▶ 8051 Microcontrollers

Ramtron microcontrollers (MCUs) are fully integrated, high-performance, 8-bit MCUs based on an advanced 40 MIPs platform with JTAG interface for Flash programming/debugging. Our MCUs are the ideal system-on-chip solution for the embedded data acquisition markets, including instrumentation, industrial control applications, imaging, security, automotive, medical devices, and more.

**RoHS compliant**

### 8051 Microcontrollers

| Part | Speed | Power Supply | Flash & F-RAM Memory | SRAM | I/O | Package |
|------|-------|--------------|----------------------|------|-----|---------|
| VRS51L3074 | 40MHz | 3.3V | 64KB & 8KB F-RAM | 4352B | 56 | QFP-64 |
| VRS51L3174 | 40MHz | 3.3V | 64KB & 8KB F-RAM | 4352B | 40 | QFP-44 |
| VRS51L3072 | 40MHz | 3.3V | 64KB & 2KB F-RAM | 4352B | 56 | QFP-64 |
| VRS51L2070 | 40MHz | 3.3V | 64KB & 0KB F-RAM | 4352B | 56 | QFP-64 |

### VRS51Lxxxx Functional Diagram



**RAMTRON VRS51Lxxxx**
- Mult/Accu/Div w/ 32-Bit Barrel Shifter
- 8051 Core Single Cycle 40MHz
- JTAG w/On-Chip Emulation
- Ports (5-7) I/O (40-56)
- Flash 65K Bytes
- SPI
- External Data Bus Controller
- SRAM 4352 Bytes
- I2C
- On-Board Oscillator
- F-RAM 0KB - 8KB
- UARTs Baud Rate Generators (2)
- Crystal Oscillator Inputs
- Interrupt Controller
- Dynamic Clock Control
- PWMs/ Timers (8)
- Watch Dog Timer
- Pulse Width Counters (2)
- Power-On/ Reset
- Timer Capture Inputs (3)

### High-Performance MCU with embedded F-RAM for data acquisition

- 8KB F-RAM (VRS51L3174, VRS51L3074)
- 2KB F-RAM (VRS51L3072)
- 64KB ISP/IAP Flash, 4KB SRAM
- 40MHz, Single-Cycle 8051 Processor
- Enhanced MULT/ACCU/DIV Unit with 32-bit Barrel Shifter
- 40MHz Internal Oscillator
- JTAG Interface for In-Circuit Programming & Debugging
- Dual UARTs with Baud Rate Generator
- Enhanced SPI, 2-Wire Serial Interface
- 2 Pulse Width Counters with 4 inputs
- 8 Pulse Width Modulators with adjustable resolution
- QFP-64 package (VRS51L3074, VRS51L3072, VRS51L2070)
- QFP-44 package (VRS51L3174)
- Operates at 3.3 volts over the entire industrial temperature range (-40°C to +85°C)

**VRS51L2070** (40MHz; 7 Ports, 56 I/O)
**VRS51L3072** (40MHz; 7 Ports, 56 I/O; 2KB F-RAM)
**VRS51L3074** (40MHz; 7 Ports, 56 I/O; 8KB F-RAM)
**VRS51L3174** (40MHz; 5 Ports, 40 I/O; 8KB F-RAM)

## ▶ F-RAM Event Data Recorder

| Part | Power Supply | Event Memory | User F-RAM | RTC | PFI | Count | Com. Interface | Package |
|------|--------------|--------------|------------|-----|-----|-------|----------------|---------|
| FM6124-QG | 3.0V-3.6V | 1000 to 4000 events | 0 to 24KB | Yes | Yes | Yes | I2C | QFP-44 |

### FM6124 Event Data Recorder Highlights

**Automatic Event Monitor**
- Monitors 12 digital inputs
- Continuous monitoring for state changes
- Capable of edge detection
- Records up to 4000 separate events

**Interrupt Output on Events**
- Buffer half full/full
- Pin change state
- Programmable high/low trip points for event and data alarms

**RTC Alarm Timestamp & Nonvolatile Storage**
- Built-in real-time clock with time base
- Schedule retained without a battery
- 24KB nonvolatile store for user data

**Micro Peripheral**
- I2C interface to host MCU
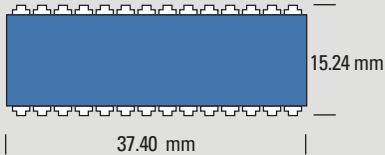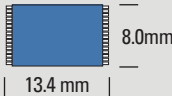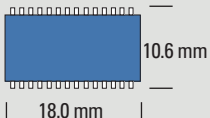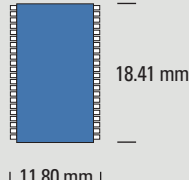- Reads external pins via serial interface
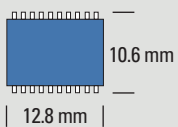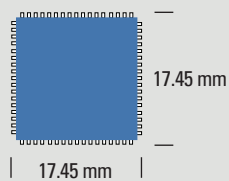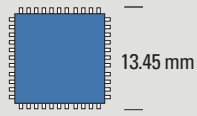
Contact your local representative for a **free sample**.

# ▶ Package Dimensions

Package dimensions are shown as nominal measurements and are intended for quick reference only. Please refer to detailed product datasheets for precise package dimensions and complete specifications. Datasheets are available at www.ramtron.com/support/datasheets.aspx.

**RoHS compliant**

All Ramtron products are now available in environmentally friendly "green" packaging. Responding to the industry's drive toward the lead-free packaging of electronic products, Ramtron has removed lead (Pb) from finished packaging as well as brominated, flame-retarding compounds from encapsulants and substrates.

**28-pin PDIP**

15.24 mm

37.40 mm

**8-pin EIAJ**

5.23 mm x 8.25 mm

**32-pin TSOP-I**

8.0mm

13.4 mm

**28-pin SOIC**

10.6 mm

18.0 mm

**8-pin SOT23**

2.8 mm x 2.9 mm

**16-pin QFN**

4.01 mm x 4.01 mm

**20-pin SOIC**

10.6 mm

12.8 mm

**64-pin QFN**

17.45 mm

17.45 mm

**8-pin TDFN**

3.0 mm x 6.4 mm

**14-pin SOIC**

8.64 mm x 6.00 mm

**44-pin QFP**

13.45 mm

13.45 mm

**8-pin TDFN**

5.0 mm x 6.0 mm

**8-pin SOIC**

4.9 mm x 6.0 mm

**44-pin TSOP-II**

18.41 mm

11.80 mm

**8-pin TDFN**

4.0 mm x 4.5 mm

## About Ramtron International Corporation

Ramtron International Corporation is a fabless semiconductor company that designs, develops, and markets specialized semiconductor memory and integrated semiconductor solutions for a broad range of applications across targeted vertical markets. Founded in 1984, Ramtron pioneered the integration of ferroelectric materials into semiconductor products, which enabled the development of a new class of nonvolatile memory products called ferroelectric random access memory (F-RAM) products.

Since its inception, Ramtron has supplied over 175-million F-RAM products worldwide, fueling the company's product revenue growth from US$2.4 million in 2001 to more than $49 million in 2007.

Ramtron is traded on The Nasdaq Global Stock Market under the symbol RMTR.

For Ramtron corporate and financial information contact the company at 719-481-7000 and ask for Ramtron Investor Relations.

### General Information

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**RAMTRON**
International Corporation