



APPLICATION NOTE 3886

Benefits of the DS32X35 Accurate Real-Time Clock with Ferroelectric Random Access Memory (RTC + FRAM)

Abstract: This application note presents an overview of the DS32X35 family of products. These devices provide an accurate Real-Time Clock with Ferroelectric Random Access Memory (RTC + FRAM) that does not require a battery to maintain its contents.

Overview

With the introduction of the DS32X35 family of products, Maxim provides nonvolatile memory that does not require a battery. These devices utilize Ferroelectric Random Access Memory (FRAM) technology. FRAM is nonvolatile and performs read/write cycles like RAM. It provides reliable data retention for over 10 years while eliminating the complexities, overhead, and system-level reliability problems caused by EEPROM and other nonvolatile memories. This is an established technology with devices available since 1992.

Nonvolatile Memory

The dominant nonvolatile memory technologies consist of battery-backed SRAM, EEPROM, and flash. FRAM provides nonvolatile storage at speeds similar to traditional SRAM. Functional operation is similar to serial EEPROMs with the major difference being its superior performance on writes and endurance. The memory is read or written at the speed of the I²C interface. It is not necessary to poll the device for a ready condition during writes.

Table 1 ranks nonvolatile memory technologies on a scale of 1 (the best) to 4 (the worst).

Table 1. Ranking of Nonvolatile Memory Technologies

Features	Battery-Backed SRAM	EEPROM	Flash	FRAM
Read Speed	1	4	2	1
Write Speed	1	4	4	1
Power Consumption	3	4	4	1
Memory Density	2	4	1	4
Ease of Use	2	3	4	1
Endurance	1	3	4	1

Benefits of FRAM over EEPROM

FRAM has many advantages over similar quantities of EEPROM. The first advantage is that FRAM performs write operations at bus speed with no write delay once data is transferred. Additionally, it uses no write pages, so the user can simply write consecutive data. There are no limits on the size of the data transfer and no delay. If desired, the system can write the entire memory array in one burst.

The second advantage is write endurance, which allows up to ten billion write cycles. Most EEPROMs only allow up to one million write cycles. FRAM's virtually unlimited number of write cycles makes it an ideal type of memory for data collection.

The third advantage is power and energy consumption. FRAM uses a ferroelectric mechanism that performs write operations using the native V_{CC}. EEPROM technology requires a charge pump or voltage boosting. Consequently, FRAM current requirements are substantially lower than a similar configuration of EEPROM.

DS32X35 Accurate RTC with FRAM

The DS32X35 is a temperature-compensated clock/calendar that includes an integrated 32.768kHz crystal and a bank of nonvolatile memory in a single package. The nonvolatile memory is available in two different densities: 2048 x 8 bits or 8192 x 8 bits. The device is available in a 20-pin, 300-mil SO package. The DS32X35 includes a bank of FRAM, which does not require a backup energy source to maintain memory contents. In addition, there are no read- or write-cycle limitations. The memory array can be accessed at maximum cycle rates for the life of the product with no wear-out mechanisms.

Other device features include two time-of-day alarms, a selectable output that provides either an interrupt or programmable square wave, and a calibrated 32.768kHz square-wave output. A reset input/output pin provides a power-on reset. Additionally, the reset pin is monitored as a pushbutton input for generating a reset externally. The RTC and FRAM are accessed through an I²C serial interface.

Address Requirements

The serial FRAM memory is logically organized as either a 2048 x 8-bit or 8192 x 8-bit memory array and is accessed using the I²C interface. Due to the different densities, the I²C addressing technique is different for each version of the DS32X35. **Table 2** details the address requirements for each version of the DS32X35.

Table 2. Memory Slave Address

Part	Memory (kB)	Slave Address	Address Cycle 1	Address Cycle 2
DS32B35	2	1010 A ₁₀ A ₉ A ₈ R	A ₇ A ₆ A ₅ A ₄ A ₃ A ₂ A ₁ A ₀	N/A
DS32C35	8	1010 000R	XXXA ₁₂ A ₁₁ A ₁₀ A ₉ A ₈	A ₇ A ₆ A ₅ A ₄ A ₃ A ₂ A ₁ A ₀

R = read/write select bit, X = don't care, A_N = address bit N

Conclusion

The new DS32X35 family of products provides accurate timekeeping combines four separate components into one. **Figure 1** shows how the DS32X35 provides an RTC, a small bank of nonvolatile memory, a system reset, and a 32.768kHz crystal.

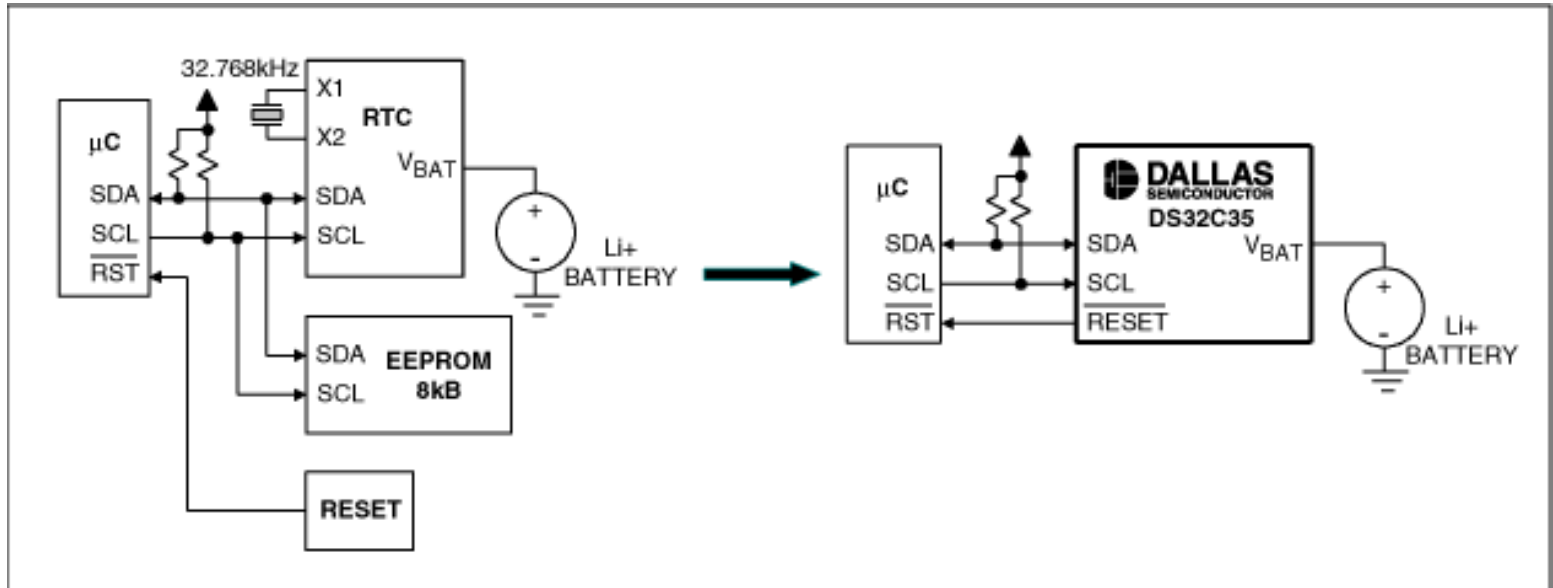


Figure 1. DS32X35 integration benefits.

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