

Advantages of the FM24C16

Serial 16Kb FRAM Memory



Overview

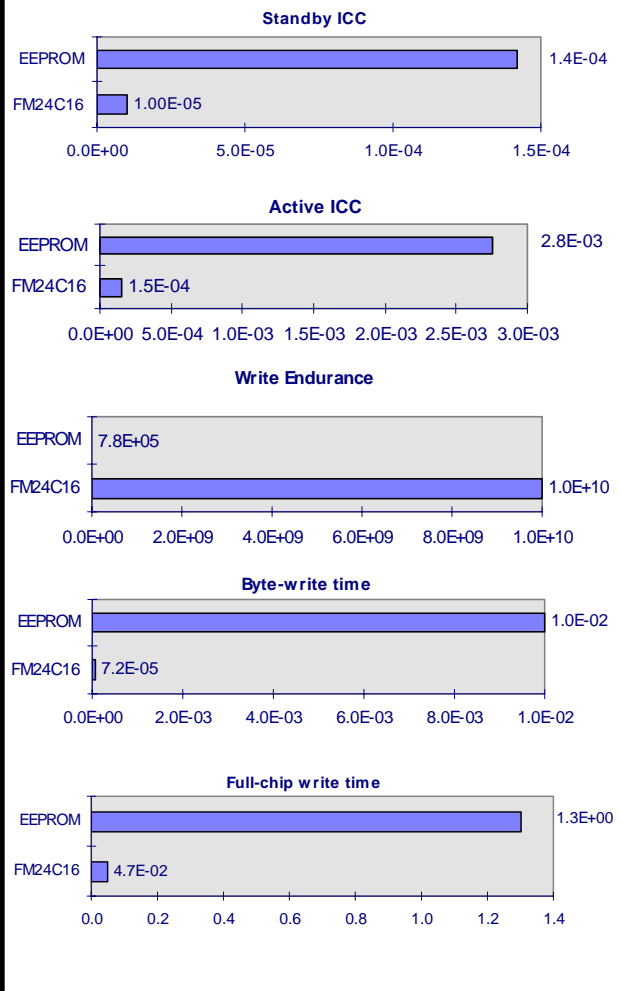
The FM24C16 is a drop-in replacement for industry standard 24C16-type EEPROMs. The 24C16 configuration is a 2-wire interface, 2,048x8 serial memory. Instead of using EEPROM as a storage mechanism, the FM24C16 uses FRAM technology. This technology enables unique feature advantages.

The table below shows a comparison of the FM24C16 with four EEPROM-devices of the same type. The chart on the right visually highlights a comparison of the FM24C16 with the average EEPROM. Averages calculated for the EEPROMs in the table.

The first and most obvious advantage is that the FM24C16 performs write operations at the bus speed. There is 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. The system can write the entire chip in one burst if desired.

The second advantage of the FM24C16 is write endurance. It allows up to 1E+10 (10,000,000,000) write cycles. Most EEPROMs allow either 1E+05 (100,000) or 1E+06 (1,000,000) write cycles. While this small number of write cycles might be adequate for read-mostly types of applications, it is too restrictive for data collection. The FM24C16 allows virtually an unlimited number of write cycles and is an ideal memory for data collection.

Figure 1. FRAM Compared to EEPROM



Comparison Table

Supplier	Part number	Standby current	Write ICC @ 100 kHz	Write endurance	Byte write time	Full-chip write time
Ramtron	FM24C16	10 μ A	150 μ A	1E+10	72 μ S	47 mS
Atmel	AT24C16	18 μ A	3 mA	1E+06	10 mS	1.3 seconds
ST	ST24C16	300 μ A	2 mA	1E+06	10 mS	1.3 seconds
Microchip	24AA16	100 μ A	3 mA	1E+06	10 mS	1.3 seconds
Xicor	X24C16	150 μ A	3 mA	1E+05	10 mS	1.3 seconds

* Write times assume 400 kHz bus speed.

The third obvious advantage is power and energy consumption. The FM24C16 uses a ferroelectric mechanism that performs write operations using the native V_{CC} . Unlike an EEPROM technology, it requires no charge pump or voltage boosting. Consequently, the FM24C16 current requirement is substantially lower than a similar configuration EEPROM. As shown in the table above, both the active and standby currents are much lower for FRAM than for EEPROM.

An additional consideration is that the FM24C16 writes very fast. Total energy usage relates not only to current but to the current profile over time. The fast write of FRAM technology plays an important but less obvious role in energy management. The graph below shows the energy usage profile. This is the maximum current spread over the duration of an entire write cycle. Due to both higher-current used, and much longer time required, the EEPROM write operation uses over 2500 times as much energy as the FRAM. As shown, the EEPROM write cycle uses $27.5e-6$ amp-seconds compared with $10.8e-9$ amp-seconds for the FRAM write cycle.

Drop-in Replacement

The benefits of the FM24C16 are available immediately on dropping it into an existing design in most cases. The write speed will result in an immediate improvement in system throughput, depending on the method used by software to compensate for EEPROM delays. EEPROMs use acknowledge-polling to indicate the status of a write operation. If the FRAM is polled, it always will be ready. This allows an FM24C16 to drop-in and immediately speed-up the system. For new designs with the FM24C16, acknowledge polling is really unnecessary. If software delays are implemented in as fixed time periods, users should remove them to take advantage of the speed of FRAM.

The write endurance benefit also is transparent. There simply is no need to limit write operations as with EEPROM. Some software modification may be desirable to add features as this capability is new. Lastly, the power and energy consumption will drop automatically. Even if software does not capture the speed improvement, the write cycle will still complete quickly with much lower I_{CC} . The FM24C16 drops in and provides immediate benefits.

Figure 2. Energy Usage Comparison

