

32 M-Bit Dual-Operation Flash Memory with Single 1.8V Power Supply: MBM29DS323TE/BE

Dual-operation flash memory performs simultaneous read/program/erase operations and combines low voltage with high performance.

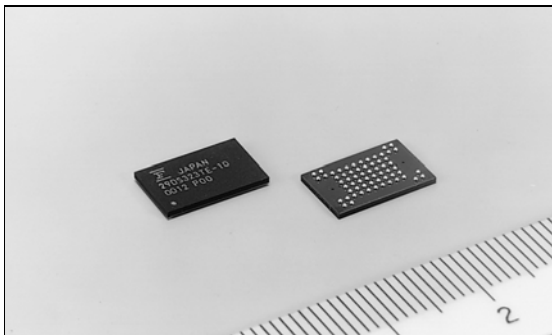
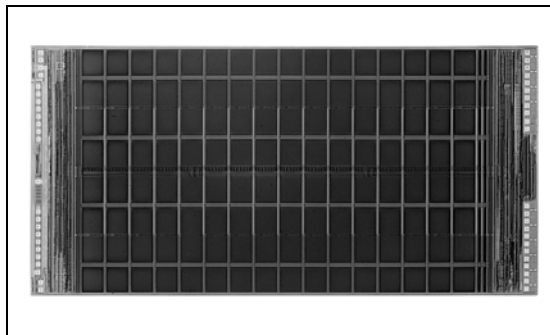
Features

- **Single 1.8V power supply**
- **High-speed access capability**
- **Dual operation**
- **Hi-ROM region**
- **Write protection**
- **Accelerated program operation**
- **Automatic sleep mode**

Product Overview

Recent advances in lower-power battery drives are being pushed by demand for longer usage times in products such as portable telephones and portable information terminals, combined with higher performance levels for web browsing and image loading over Internet connections. Also, because such devices use faster processors, requirements for enhanced system capability are fueling demand for flash memories with ever-larger density, lower voltage, and faster read times.

FUJITSU has responded to this demand by developing the MBM29DS323TE/BE 32 M-bit dual-operation flash memory capable of operating on a single 1.8V power supply and performing simultaneous read/program/erase operations.

Photo 1. MBM29DS323TE/BE External Views**Photo 2. MBM29DS323TE/BE Chip**

The principal advantages of this product, in addition to its 1.8V operation and dual-operation function, include 100 ns high-speed access capability. To conserve power consumption, an automatic sleep mode reduces power consumption levels whenever the device is not accessed within a fixed time. Other features include a Hi-ROM, write-protection, and acceleration functions.

Product Features

Single 1.8V Power Supply

The MBM29DS323TE/BE is capable of data read/program/erase operation from a single 1.8V power supply. Operation of the flash memory from a low voltage requires that the input voltage be stepped up inside the chip, which is accomplished using a two-step boost circuit. This circuit makes it possible to maintain a low supply voltage with a minimal increase in chip size, while assuring sufficient operating margin on the low-voltage side. Also, the circuit assures sufficient word line voltage, making it possible to use the same cell structure as in existing high-reliability 3V flash memories.

Dual-Operation Functions

In dual-operation, one device is divided into two areas (bank 1 and bank 2). This makes it possible to perform an erase or program operation to a sector in bank 1

while reading data from a sector in bank 2 (or vice versa). This is ideal for products, such as cellular telephones, that require frequent reprogram operations.

High-Speed Access Capability

The MBM29DS323TE/BE, even with single 1.8V operation, achieves high performance with a read time of 100 ns (min.), byte program time of 8 μ s (typ.), and word program time of 16 μ s (typ.).

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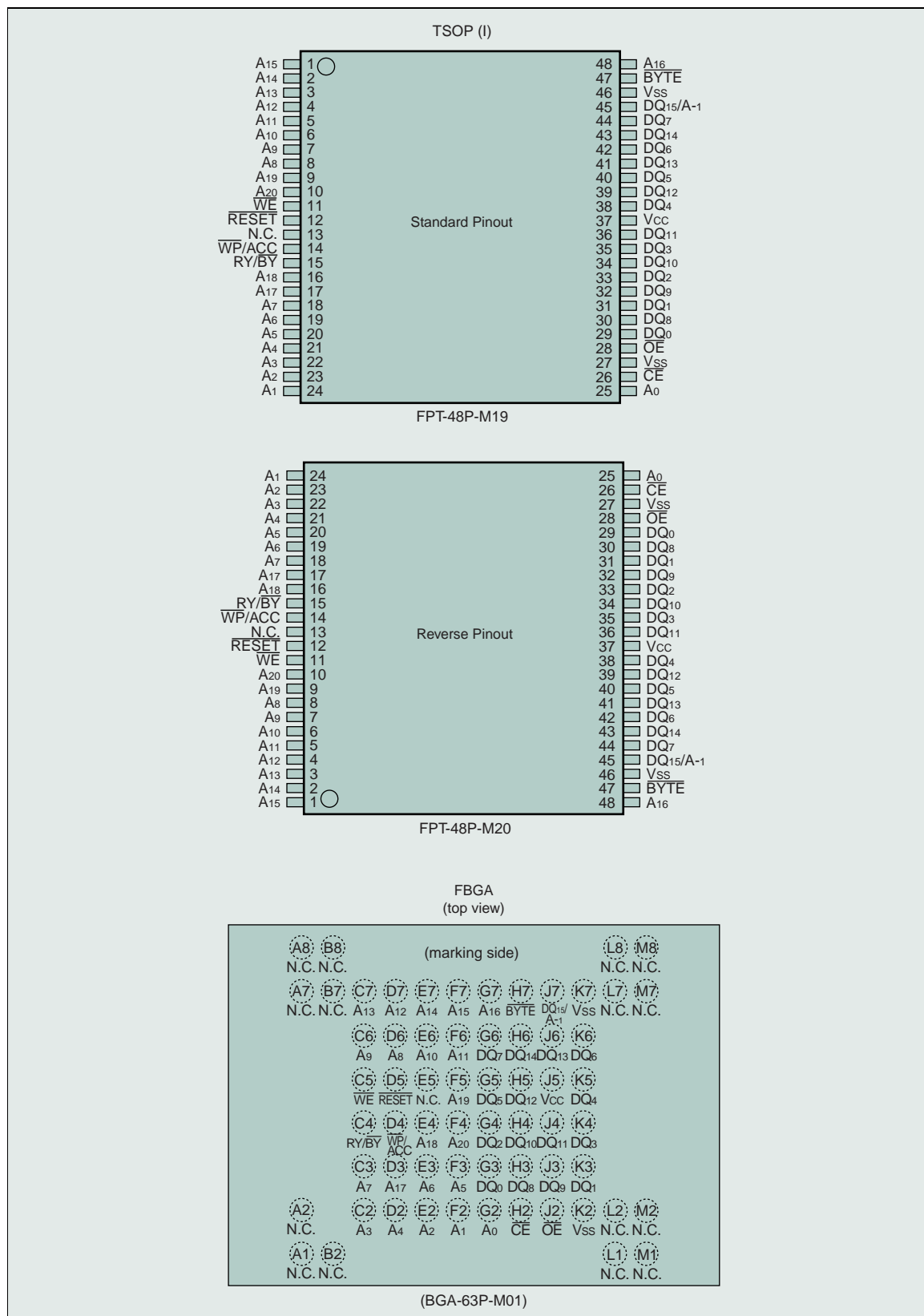
Hi-ROM Functions

In addition to the normal memory area, a special area of 64 K-byte is provided for programming special data, such as unique ID numbers. This can be used in combination with applications to provide a high level of security.

Write-Protection Function

This is a simple, hardware-based write-protect function. When the WP#/ACC pin goes to 'L' level and regardless of whether normal sector protection is applied, write protection is simultaneously applied to the two outermost sectors of the small sectors (8 K-byte x 8) at the lower end (MBM29DS323BE) or upper end (MBM29DS323TE) of the address.

Figure 1. MBM29DS323TE/BE Pin Assignments



In previous flash memories, sector protection was released by temporarily applying high voltage (V_{ID}) to the RESET# pin, leading to the possibility that necessary data could be unintentionally modified. Now, the write-protection function is applied even during such temporary release of sector-protection functions.

Accelerated Program Function

This function is effective for programming to large numbers of flash memories, such as during installation in systems before delivery from the factory. Applying a high voltage (V_{HH}) to the WP#/ACC pin places the chip in acceleration mode, allowing programming at faster-than-normal speeds. This can reduce program times to 60% of normal.

Automatic Sleep Mode

During read operations, whenever the address has not changed for 150 ns or longer, the flash memory device automatically reduces power consumption (from a maximum of 16 mA during read operation to a typical level of 1 μ A). This is effective for portable terminal devices requiring low power consumption. Normal read operation is restored automatically when the address is changed.

Figure 1 (see p. 72) shows the pin assignments, and Figure 2 shows the relation of access time to supply voltage. Table 1 (see p. 74) lists the models in the product line.

Advantages and Effectiveness

Contributes to System Efficiency

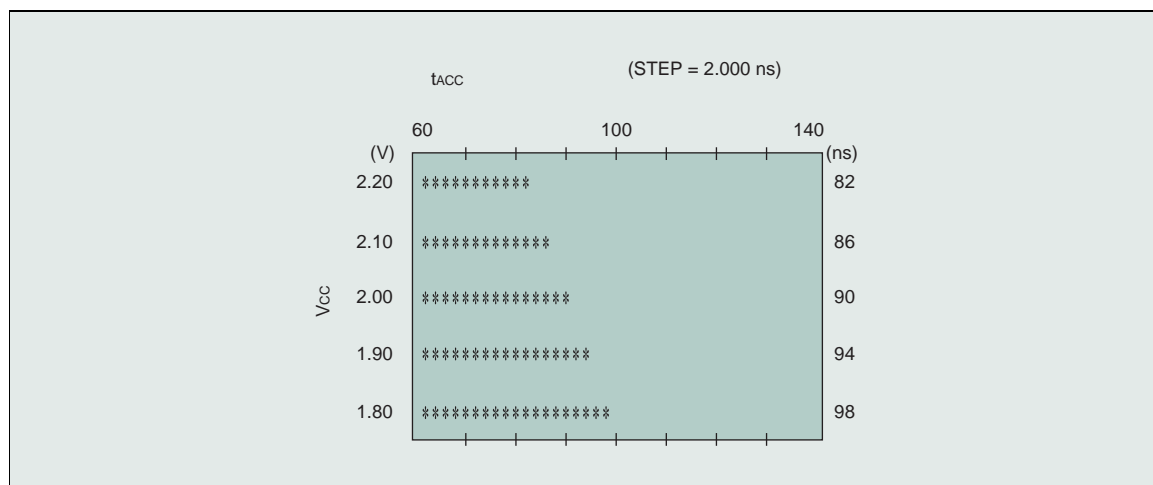
Reducing the operating voltage of the flash memory contributes substantially to extending battery life for the entire system.

Eliminates External ROM/RAM

The dual-operation function allows flash memory reprogramming to be executed directly by performing erase and program operations to the memory itself, without having to load a program from another memory. This greatly reduces system cost, mounting area, and power consumption.

“... greatly reduces system cost, mounting area, and power consumption.”

Figure 2. Access Time vs. Supply Voltage



Enables Effective Use of Program and Erase Times

During erase/program processing to one sector, the address can be switched to another bank to read data from that address without interrupting the erase/program operation. Thus, by switching the address to another bank, the internal data bus of the flash memory can be freed from carrying status information and returned to use for the original purpose of a memory chip, namely the output of stored information.

Software can be devised to reduce the apparent erase/program time until it approaches zero, thereby enhancing the processing speed of products containing dual-operation flash memory.

SoFFS Software

FUJITSU's Sophisticated Flash File System (SoFFS) software provides functions such as control of program unit size reduction and program/erase timing. This software emulates small customer-designated program unit sizes in flash memory as viewed from the operating system or application software and eliminates the need for erasing before reprogramming. Additional functions, such as garbage collection and wear leveling, can shorten sector erase time or extend erase cycle length as viewed from the operating system or application. SoFFS is currently in use in a great number of our clients' systems worldwide, contributing significantly not only to multi-function, space-saving, durable systems, but also to shorter overall system development times.

Table 1. MBM29DS323TE/BE Product Line

Model			MBM29DS323TE/BE 10/12
Bank Division			Bank 1 (8 MB) Bank 2 (24 MB)
Access Time (max.)			100 ns/120 ns
Power Supply Voltage			1.8V to 2.2V
Power Consumption (max.)	Read	Byte	35.2 mW
		Word	35.2 mW
	Erase/Program		55.0 mW
	CMOS Standby		11 μW
Erase Time (typ.)			1s/sector
Program Time (typ.)		Byte	8 μs
		Word	16 μs
Package			TSOP-48 (I), FBGA-63



Applications

The single 1.8V, dual-operation flash memory is suited to applications, such as the following:

- Systems requiring built-in flash memories with low-voltage operation and multiple functions for both reduced power and high performance
- Systems requiring updating of programs and code
- Systems storing ID, parameters, or data on EEPROM devices
- Systems using external RAM or ROM
- Systems requiring frequent reprogramming operations

Future Development

This article has introduced the MBM29DS323TE/BE, a new product designed as a solution primarily for reduced power and high performance in portable information devices. FUJITSU has already provided a wide variety of flash memory devices in response to the requirements of our customers, and we intend to continue to expand our product line.

In the future, FUJITSU is planning to continue to provide a family of products with lower voltage, higher capability, and higher density in response to the requests of our customers. ◆