SGS-THOMSON MICROELECTRONICS

AN625 APPLICATION NOTE

COMPATIBILITY FOR 4-Megabit SINGLE VOLTAGE FLASH MEMORY FROM ST AND AMD

by Ian BLYTHE

The users of flash memory have always found that the additional programming voltage needed for the "dual-voltage" flash memories can be a significant inconvenience in certain applications. The target then was to develop a "single voltage" flash memory, using the same low voltage for reading and for programming. With this in mind, and to be sure to bring this part to the market with several sources giving longer-term committment, SGS-THOMSON and AMD jointly agreed in a specification. The memory capacity chosen for the technology verification vehicle was the 4-Megabit, organized as 512Kx8-bits.

Despite the agreement on the specification for this device, it now appears that there are differences between the SGS-THOMSON and AMD products. This Application Note seeks to identify any apparent differences in programming and compatibility and to show the cause of any that are found.

THE 4MEG SINGLE VOLTAGE FLASH MEMORY

Following the agreement made over the specification with AMD in 1995, both parties designed products to this specification independently. The 4Meg single voltage FLASH Memory from SGS-THOMSON was developed from the specification using proprietary technologies and circuitries, in fact, the SGS-THOMSON design contains many innovative patents. It was also our aim to use the technology we already use for the dual voltage flash memories, which is robust and has been proven in high volume production.

It is understood that AMD also developed a part and started production in the USA. However, AMD later continued production using the joint venture Fujitsu-AMD (FASL) facility in Japan. At the same time AMD have introduced a shrink from a 0.85µm technology to a 0.5µm technology (common to other members of AMD's flash memories) and a revision of the device. The move in production site to Japan also produced a change in the silicon processing (few Fabs have common technology, except for the deliberate cross technology used internally by SGS-THOMSON. This is to provide internal second sourcing in case of any potential production difficulty).

As a result of these changes, the AMD product specification has changed in comparison with the original specification, and additional identification on the product has been added in order to show the Fab location of the AMD parts.

The ST M29F040 is fully compatible with the original and agreed specification of the 4Meg single voltage flash memory from AMD and is compatible with the FASL device.

THE DIFFERENCES?

Multiple Sector erase

AMD has changed their specification for the FASL product by making the erase of several sectors serially rather than in parallel as in the original specification. With this serial action, the total erase time for multiple sectors with the AMD product becomes equal to (the number of sectors to be erased) x 30 seconds (the maximum sector erase time) and the chip erase command takes a maximum of 120 seconds.

The SGS-THOMSON product remains compatible with the original specification with the sector erasure in parallel and thus has a faster erase time of 30 seconds maximum for single or multiple sectors, or for the chip erase command.

Table 1. Erase Time Comparison

Device		Erase Time	Typical	Maximum	Unit
M29F040	ST	Sector	1.5	30	sec
		Chip	2.5	30	sec
Am29F040	USA	Sector	1.5	30	sec
		Chip	1.5	30	sec
Am29F040	FASL	Sector	1.5	15	sec
		Chip	1.4	120	sec

Note: 1. Multiply by number of sectors for multiple sector erase.

Sector Protection/Unprotection

The hardware Sector protect feature of the 4Meg flash specification offers the capability to disable (protect) both program and erase operations in one or a combination of the eight sectors. Previously protected sectors can be tested for, and unprotected using the correct sequence of commands.

While this function remains in both the ST part and the AMD part, AMD have chosen to withdraw the sector protection from general use. AMD are continuing the use of this only through PROM programmers.

The ST part allows use of this mode by the user or through the PROM programmers.

Programming

The changes in the new AMD FASL parts have also generated changes in the programming algorithm. These changes are documented in the AMD datasheets. This has meant that there have been several versions of the programming routines required by PROM programmers; the original AMD style and the new FASL style. The FASL style is being implemented with PROM programmer manufacturers.

The differentiation between the AMD and FASL parts is determined electronically by looking at the Device Code for Sector Unprotect through the software Autoselect capability. This function is not required and does not exist in the ST part, as it was not in the original specification.

The ST M29F040 is capable of being programmed as the original AMD Am29F040, with the AMD part selected but with Manufacturer Identification disabled. Please refer to your PROM programmer documentation for how to do this with your programmers. However the recommended solution is to use the correct SGS-THOMSON algorithm which is available by updates from PROM manufacturers.

Table 2. Electronic Signature

29F040		Manufacture code	Device code(s) (1)	
ST		20h	E2h	–
AMD	(USA)	01h	A4h	00h
AMD	(FASL)	01h	A4h	01h

Note: 1. AMD/FASL require additional command cycles for die identification.

Autoselect Command

According to the common specification, the AUTOSELECT command is terminated by a Read-RESET command sequence before a subsequent ERASE command. However it is found that with the AMD Am29F040, the sequence AUTOSELECT/ERASE commands with no intermediate command will function. In order to maintain compatibility between the two devices, it was originally recommended to use the sequence AUTOSELECT/RESET/ERASE. The typical delay of one second of the Read-RESET command before an ERASE operation should not be seen as significant for most applications. The SGS-THOMSON part now operates as the AMD part.

SUMMARY

The strategy of having a common device from two or more independent suppliers in the multiple supplier/specification market for flash is a stabilizing influence. This allows the design-in of a flash memory with the confidence of supply.

With respect to the ”differences” shown in this Application Note, it can be seen that within most constraints the M29F040 from SGS-THOMSON and the Am29F040 from AMD are compatible. If the points shown are integrated into a design, no problems will arise in using the 4Meg flash memories.

SGS-THOMSON is active in future developments in flash memories which will bring low voltage versions and higher density devices. Also part of the strategy of SGS-THOMSON is to provide a range of OTP EPROM memories, pin compatible to flash. These OTP EPROMs are for those applications with stable code in volume production requiring when competition pricing demand cost saving. The pin compatible OTP equivalent to the M29F040 FLASH Memory is the M27C405.