Replacing Serial EEPROMs with User Flash Memory in Altera CPLDs

MAX® II and MAX V devices have a user flash memory (UFM) block to store up to 8 Kbits of user data. You can use the UFM block to replace on-board flash and EEPROM memory devices to store ASSP or processor configuration bits, or electronic identification (ID) information for a board during manufacturing. MAX II and MAX V devices logic capacity allows integration of system power-on reset (POR), interface bridging, and I/O expansion designs in addition to these serial flash capabilities.

Table 1 lists the capacity for the UFM block for all MAX II and MAX V devices.

Table 1. UFM Array Size

Device Family	Device	Total Bits	Sectors	Address Bits	Data Width
MAX II Devices	EPM240	8,192	2 (4,096 bits per sector)	9	16
	EPM570	8,192	2 (4,096 bits per sector)	9	16
	EPM1270	8,192	2 (4,096 bits per sector)	9	16
	EPM2210	8,192	2 (4,096 bits per sector)	9	16
MAX V Devices	5M40Z	8,192	2 (4,096 bits per sector)	9	16
	5M80Z	8,192	2 (4,096 bits per sector)	9	16
	5M160Z	8,192	2 (4,096 bits per sector)	9	16
	5M240Z	8,192	2 (4,096 bits per sector)	9	16
	5M570Z	8,192	2 (4,096 bits per sector)	9	16
	5M1270Z	8,192	2 (4,096 bits per sector)	9	16
	5M2210Z	8,192	2 (4,096 bits per sector)	9	16

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Design Considerations

To successfully replace the serial EEPROMs with the MAX II and MAX V UFM blocks, you must consider the following:

- logic array interface
- erase and reprogram sequence
- size and operating conditions

Logic Array Interface

The MAX II and MAX V UFM can be programmed, erased, and verified through the JTAG port or through connections to and from the logic array in accordance with IEEE Std. 1532-2002. There are 13 interface signals to and from the UFM block and the logic array that allow the logic array to read from or write to the UFM during device user mode. A reference design or user logic can be used to interface the UFM to many standard interface protocols such as SCI, SPI, I²C, Microwire, or other proprietary protocols. The Quartus® II ALTUFM megafunction provides interface logic for a subset of these interfaces (parallel and SPI). For interfaces not provided by the megafunction or design examples, you must create user logic to bridge the UFM block to your desired interface protocol.

For more information about programming and erasing the UFM block and the ALTUFM megafunction, refer to the *Using User Flash Memory in MAX II Devices* chapter in the *MAX II Device Handbook* or the *User Flash Memory in MAX V Devices* chapter in the *MAX V Device Handbook*.

Erase and Reprogram Sequence

The differences between the UFM block and serial EEPROMs that you should consider in your integration of serial EEPROM applications are the sector-based erase and erase/reprogram cycles. Serial EEPROMs support byte-wide erase, which is automatically implemented during a byte write sequence. The UFM block supports byte writes, but does not support byte erase, requiring a sector-based erase sequence prior to any programming or writing. If the data content of a specific byte location needs to be overwritten in the UFM, the entire sector that the byte resides in must be erased unless the byte location was already erased (all 1s). For programming endurance, the UFM erase/reprogram cycles do not meet the 10^7 and greater cycles seen in serial EEPROMs.

For the MAX II or MAX V UFM block erase/programming endurance specifications, refer to the *DC and Switching Characteristics* chapter in the *MAX II Device Handbook* or the *DC and Switching Characteristics* chapter in the *MAX V Device Handbook*.

Size and Operating Conditions

The memory size that can be replaced using the UFM must not exceed the CPLDs UFM size listed in Table 1. The operating conditions for the on-board flash and EEPROM memory devices you intend to replace must be within the range of the Altera CPLDs.

For more information about the operating conditions of the specific Altera CPLD, refor to the *DC and Switching Characteristics* chapter in the *MAX II Device Handbook* or the *DC and Switching Characteristics* chapter in the *MAX V Device Handbook*.

Table 2 provides a non-exhaustive list of vendors for 2-Kbit, 4-Kbit, and 8-Kbit non-volatile memory devices that could be potentially replaced by MAX II or MAX V UFM blocks.

Table 2. Memory Device Vendors

Vendor	Product Information
Asahi Kasei Microsystems Corp.	*Asahi Kasei Microsystems Serial EEPROM Device Characteristic*
NXP Semiconductors N. V. (Philips Semiconductor)	*NXP Semiconductors Serial EEPROM/RAM Selection Guide*
Atmel Corp.	*Atmel Serial EEPROMS Devices*
ON Semiconductor (Catalyst Semiconductor)	*ON Semiconductor Memory Products*
Maxim Integrated Products (Dallas Semiconductor)	*Maxim EEPROM List*
Holtek Semiconductor Inc.	*Holtek EEPROM List*
Microchip Technology Inc.	*Microchip Serial EEPROM List*
Rohm Co., Ltd.	*Rohm Semiconductor Serial EEPROM List*
Seiko Instruments Inc.	*Seiko Instruments General use Serial EEPROM* *Seiko Instruments Automotive use Serial EEPROM*
STMicroelectronics	*STMicroelectronics Serial EEPROM Portfolio*
Toshiba Corporation	*Toshiba Serial EEPROM Series*

Document Revision History

Table 3 lists the revision history for this document.

Table 3. Document Revision History

Date	Version	Changes
December 2010	1.0	Initial Release.