Designing In SST's Multi-Purpose Flash (39 Series) Word-wide Products

Application Note
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INTRODUCTION

This application note describes the SST39VF160 - SST's 16 Mbit (x16) MPF product and compares it to other 16 Mbit product offerings from AMD, ST Microelectronics, Fujitsu, Intel and Atmel. It describes hardware and software differences between SST and other products and discusses how to design the SST39VF160 MPF product into existing designs based on products from other vendors.

The analysis of each company's device is written the same way, so readers can skip ahead to the appropriate manufacturer without missing anything.

SST39VF160 is organized as 1 Mbit x16, and reads, programs, and erases with a single 2.7-3.6V power supply. The device is offered in 48-pin TSOP and 48-ball TFBGA packages. In this application note, the discussion is focused on TSOP package type.

SST also offers 8 Mbit, 4 Mbit, and 2 Mbit products in its x16 MPF product family: SST39VF800A, SST39VF400A, and SST39VF200A. These products read, program, and erase with a single 2.7-3.6V power supply voltage and are offered in 48-pin TSOP and 48-ball TFBGA packages. Since all four products in the family have same pinouts and the only difference between them is the most significant address, the analogy developed in comparison of 16 Mbit products in this application note can be applied to lower density products when one compares SST products with equivalent products from other vendors.

SST recommends the following power-down and power-up waveform for the MPF family of devices.

TABLE 1: RECOMMENDED POWER-UP/DOWN LIMITS

Symbol	Parameter	Limits			Conditions
		Min	Max	Units	
T_{PF}	V_{DD} Falling Time	3	300	ms	90% to 10% of V_{DD}
T_{PR}	V_{DD} Rising Time	0.1	300	ms	10% to 90% of V_{DD}
T_{OFF}	V_{DD} Off Time	100		ms	
V_{OFF}	V_{DD} Off Level		0.3	V	0V (recommended)

T1.0 2006

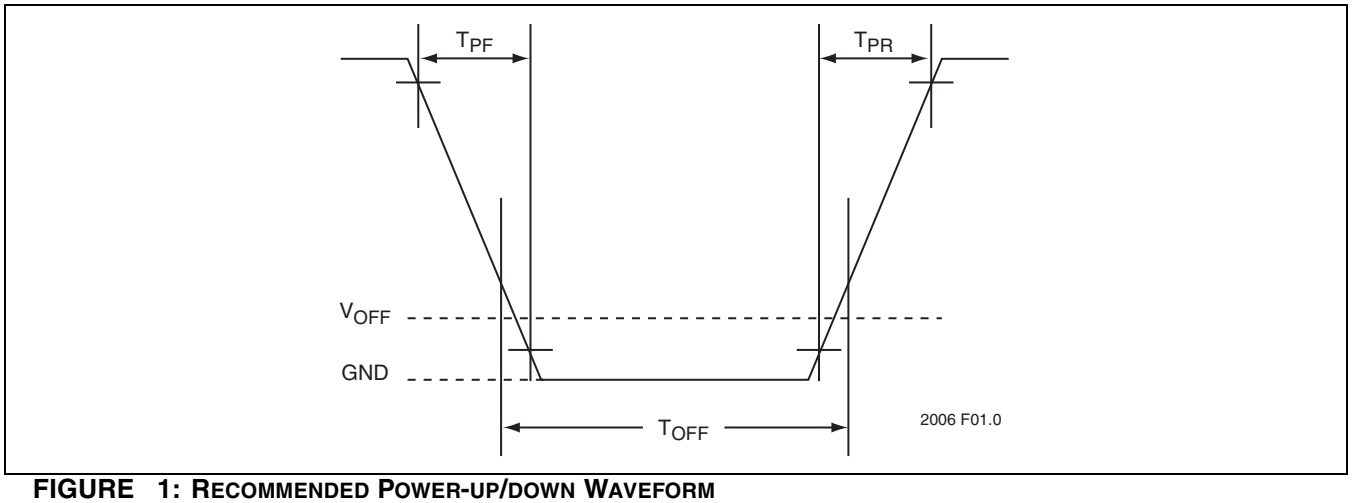

FIGURE 1: RECOMMENDED POWER-UP/DOWN WAVEFORM

Application Note

SST AND AMD

AMD offers the Am29LV160B. This device reads, programs, and erases with a single 2.7-3.6V power supply voltage.

Hardware Consideration

SST39VF160 and Am29LV160B are offered in JEDEC standard 12mm x 20mm 48-pin TSOP packages and have same pinouts for basic functions. The only differences in pinouts between these two products are on pin 12, pin 15, and pin 47, as described in the table below.

TABLE 2: PIN DIFFERENCES

	SST39VF160	Am29LV160B
Pin 12	NC[1]	RESET#
Pin 15	NC	RY/BY#
Pin 47	NC	BYTE#

T2.0 2006

1. No connect

The Am29LV160B has a hardware reset function (RESET#) on pin 12 whereas the SST39VF160 has a no-connect on this pin. The purpose of RESET# is to terminate any operation in progress and reset the internal state machine to read array data. The only difference is that in SST's case, an Erase or Program operation is allowed to complete, whereas in the case of the competitor, such an operation is interrupted by the Reset# command. The system would have to wait for SST's operation to complete before it can read. Since SST has faster Erase and Program times, that is not an issue.

The Ready/Busy pin (RY/BY#) on AMD device provides an additional hardware method of detecting completion of Program or Erase cycles. In the case of AMD, the RY/BY# pin is necessary because AMD has an internal state machine that varies the length of the Write pulse width. SST, on the other hand, uses a fixed pulse width to program and erase its devices. As a result, SST does not require a RY/BY# pin and does not offer it.

The BYTE# signal on pin 47 of Am29LV160B is used to control whether the device operates in the x8 or x16 mode. When the BYTE# pin is set at logic '1', the device is in x16 mode. The BYTE# pin is typically set to high or low in the system and is not dynamically switched. SST39VF160 operates in x16 mode and has pin 47 as no-connect. This device does not support x8, but SST offers 40-pin x8 devices for 16M and 8M densities.

In summary, SST39VF160 can be used on existing Am29LV160B based design without any board layout change when used in x16 mode.

Software Consideration

The SST39VF160 uses JEDEC standard command set for x16 single power supply Flash memory while Am29LV160B uses JEDEC compatible command sequences. The command sets for basic device operations between the two products are almost identical except for the number of addresses in the command sets. For more details, please refer to the datasheet of each product.

TABLE 3: COMMAND SET COMPARISON

	SST39VF160	Am29LV160B
Word-Program	4 Cycle with A0H	Same
Sector-Erase	6 Cycle with 30H	Same
Block-Erase	6 Cycle with 50H	N/A[1]
Chip-Erase	6 Cycle with 10H	Same
ID Entry	3 Cycle with 90H	Same
ID Exit	1 or 3 Cycle with F0H	Same

T3.0 2006

1. Not available

The Sector-Erase operations of SST and AMD devices use the same six-byte command sequence with the same command data of 30H, but different sector addresses during their sixth byte sequence. This is due to the difference in sector architectures between SST and AMD products. Am29LV160B consists of one 8 KWord, two 4 KWord, one 16 KWord, and thirty-one 32 KWord sectors. On the other hand, SST39VF160 consists of 512 uniform 2 KWord sectors. This difference in sector architectures results in the SST device having more sectors than AMD devices. Therefore, when a Sector-Erase operation is performed, the SST device will use address lines A19-A11 to decode sector addresses as opposed to the AMD devices using A19-A12. These differences in sector address decoding should be accounted for by the software driver.

In addition to Sector-Erase command which erases uniform small sectors, SST39VF160 offers Block-Erase command. While Sector-Erase operation erases 2 KWord sectors on SST device, Block-Erase operation erases 32 KWord blocks. Each block consists of sixteen 2 KWord sectors. This flexible sector/block erasability allows a system designer to use Sector-Erase capability for finer software granularity and Block-Erase capability for faster Erase operation. Note that the AMD device erases 32 KWord sector using Sector-Erase command (30H), while the SST device erases 32 KWord block using Block-Erase command (50H).

In summary, when SST39VF160 is used on existing Am29LV160B based design minor modification of the software driver is required.

SST AND ST MICROELECTRONICS

ST Microelectronics offers the M29W160B. This device reads, programs, and erases with a single 2.7-3.6V power supply voltage.

Hardware Consideration

SST39VF160 and ST's M29W160 are offered in JEDEC standard 12mm x 20mm 48-pin TSOP packages and have same pinouts for basic functions. The only differences in pinouts between these two products are on pin 12, pin 15, and pin 47, as described in the table below.

TABLE 4: PIN DIFFERENCES

	SST39VF160	M29W160B
Pin 12	NC[1]	RESET#
Pin 15	NC	RY/BY#
Pin 47	NC	BYTE#

T4.0 2006

1. No connect

The M29W160B has a hardware reset function (RESET#) on pin 12 whereas the SST39VF160 has a no-connect on this pin. The purpose of RESET# is to terminate any operation in progress and reset the internal state machine to read array data. The only difference is that in SST's case, an Erase or Program operation is allowed to complete, whereas in the case of the competitor, such an operation is interrupted by the Reset# command. The system would have to wait for SST's operation to complete before it can read. Since SST has faster Erase and Program times, that is not an issue.

The Ready/Busy pin (RY/BY#) on ST Microelectronics device provides an additional hardware method of detecting completion of Program or Erase cycle. In the case of ST Microelectronics, the RY/BY# pin is necessary because ST Microelectronics has an internal state machine that varies the length of the Write pulse width. SST, on the other hand, uses a fixed pulse width to program and erase its devices. As a result, SST does not require a RY/BY# pin and does not offer it.

The BYTE# signal on pin 47 of M29W160B is used to control whether the device operates in the x8 or x16 mode. When the BYTE# pin is set at logic '1', the device is in x16 mode. The BYTE# pin is typically set to high or low in the system and is not dynamically switched. SST39VF160 operates in x16 mode and has pin 47 as no-connect. This device does not support x8, but SST offers 40-pin x8 devices for 16M and 8M densities.

In summary, SST39VF160 can be used on existing M29W160B based design without any board layout change when used in x16 mode.

Software Consideration

The SST39VF160 uses JEDEC standard command sets for x16 single power supply Flash memory while M29W160B uses JEDEC compatible command sets. The command sequences for basic device operations between the two products are almost identical except for the number of addresses in command sequences. For more details, please refer to the datasheet of each product.

TABLE 5: COMMAND SET COMPARISON

	SST39VF160	M29W160B
Word-Program	4 Cycle with A0H	Same
Sector-Erase	6 Cycle with 30H	Same
Block-Erase	6 Cycle with 50H	N/A[1]
Chip-Erase	6 Cycle with 10H	Same
ID Entry	3 Cycle with 90H	Same
ID Exit	1 or 3 Cycle with F0H	Same

T5.0 2006

1. Not available

The Sector-Erase operations of SST and ST Microelectronics devices use the same six-byte command sequence with the same command data of 30H, but different sector addresses during their sixth byte sequence. This is due to the difference in sector architectures between SST and ST Microelectronics products. M29W160B consists of one 8 KWord, two 4 KWord, one 16 KWord, and thirty-one 32 KWord sectors. On the other hand, SST39VF160 consists of 512 uniform 2 KWord sectors. This difference in sector architectures results in the SST device having more sectors than ST Microelectronics devices. Therefore, when a Sector-Erase operation is performed, the SST device will use address lines A19-A11 to decode sector addresses as opposed to the ST Microelectronics devices using A19-A12. These differences in sector address decoding should be accounted for by the software driver.

In addition to Sector-Erase command which erases uniform small sectors, SST39VF160 offers Block-Erase command. While Sector-Erase operation erases 2 KWord sectors on SST device, Block-Erase operation erases 32 KWord blocks. Each block consists of sixteen 2 KWord sectors. This flexible sector/block erasability allows a system designer to use Sector-Erase capability for finer software granularity and Block-Erase capability for faster Erase operation. Note that the ST Microelectronics device erases

32 KWord sector using Sector-Erase command (30H), while the SST device erases 32 KWord block using Block-Erase command (50H).

In summary, when SST39VF160 is used on existing M29W160B based design minor modification of the software driver is required.

SST AND FUJITSU

Fujitsu offers the MBM29LV160. This device reads, programs, and erases with a single 2.7-3.6V power supply voltage.

Hardware Consideration

SST39VF160 and MBM29LV160 are offered in JEDEC standard 12mm x 20mm 48-pin TSOP packages and have same pinouts for basic functions. The only differences in pinouts between these two products are on pin 12, pin 15, and pin 47, as described in the table below.

TABLE 6: PIN DIFFERENCES

	SST39VF160	MBM29LV160
Pin 12	NC[1]	RESET#
Pin 15	NC	RY/BY#
Pin 47	NC	BYTE#

T6.0 2006

1. No connect

The MBM29LV160 has a hardware reset function (RESET#) on pin 12 whereas the SST39VF160 has a no-connect on this pin. The purpose of RESET# is to terminate any operation in progress and reset the internal state machine to reading array data. The only difference is that in SST's case, an Erase or Program operation is allowed to complete, whereas in the case of the competitor, such an operation is interrupted by the Reset# command. The system would have to wait for SST's operation to complete before it can read. Since SST has faster Erase and Program times, that is not an issue.

The Ready/Busy pin (RY/BY#) on Fujitsu device provides an additional hardware method of detecting completion of Program or Erase cycle. In the case of Fujitsu, the RY/BY# pin is necessary because Fujitsu has an internal state machine that varies the length of the Write pulse width. SST, on the other hand, uses a fixed pulse width to program and erase its devices. As a result, SST does not require a RY/BY# pin and does not offer it.

The BYTE# signal on pin 47 of MBM29LV160 is used to control whether the device operates in the x8 or x16 mode. When the BYTE# pin is set at logic '1', the device is in x16 mode. The BYTE# pin is typically set to high or low in the system and is not dynamically switched. SST39VF160 operates in x16 mode and has pin 47 as no-connect. This device does not support x8, but SST offers 40-pin x8 devices for 16M and 8M densities.

In summary, SST39VF160 can be used on existing MBM29LV160 based design without any board layout change when used in x16 mode.

Software Consideration

The SST39VF160 uses JEDEC standard command sets for x16 single power supply Flash memory while MBM29LV160 uses JEDEC compatible command sets. The command sets for basic device operations between two products are almost identical except for the number of addresses in command sets. For more details, please refer to the datasheet of each product.

TABLE 7: COMMAND SET COMPARISON

	SST39VF160	MBM29LV160
Word-Program	4 Cycle with A0H	Same
Sector-Erase	6 Cycle with 30H	Same
Block-Erase	6 Cycle with 50H	N/A[1]
Chip-Erase	6 Cycle with 10H	Same
ID Entry	3 Cycle with 90H	Same
ID Exit	1 or 3 Cycle with F0H	Same

T7.0 2006

1. Not available

The Sector-Erase operations of SST and Fujitsu devices use the same six-byte command sequence with the same command data of 30H, but different sector addresses during their sixth byte sequence. This is due to the difference in sector architectures between SST and Fujitsu products. MBM29LV160 consists of one 8 KWord, two 4 KWord, one 16 KWord, and thirty-one 32 KWord sectors. On the other hand, SST39VF160 consists of 512 uniform 2 KWord sectors. This difference in sector architectures results in the SST device having more sectors than Fujitsu devices. Therefore, when a Sector-Erase operation is performed, the SST device will use address lines A19-A11 to decode sector addresses as opposed to the Fujitsu devices using A19-A12. These differences in sector address decoding should be accounted for by the software driver.

In addition to Sector-Erase command which erases uniform small sectors, SST39VF160 offers Block-Erase command. While Sector-Erase operation erases 2 KWord sectors on SST device, Block-Erase operation erases 32 KWord blocks. Each block consists of sixteen 2 KWord sectors. This flexible sector/block erasability allows a system designer to use Sector-Erase capability for finer software granularity and Block-Erase capability for faster erase operation. Note that the Fujitsu device erases 32 KWord sector using Sector-Erase command (30H), while the SST device erases 32 KWord block using Block-Erase command (50H).

In summary, when SST39VF160 is used on existing MBM29LV160 based design minor modification of the software driver is required.

SST AND INTEL

Intel offers three x16 16 Mbit (2.7-3.6V) products: 28F160B3, 28F160C3 and 28F160S3. In the section below, we shall describe the 28F160B3 and 28F160C3. The 28F160S3 is not compatible with the SST39VF160, and will not be discussed here.

Hardware Consideration

SST39VF160, 28F160B3 and 28F160C3 are offered in JEDEC standard 12mm x 20mm 48-pin TSOP packages with minor differences in pinouts as described in the table below.

TABLE 8: PIN DIFFERENCES

	SST39VF160	28F160B3/C3
Pin 9	A19	NC
Pin 12	NC[1]	RP#
Pin 13	NC	V_{PP}
Pin 14	NC	WP#
Pin 15	NC	A19
Pin 47	NC	V_{CCQ}

T8.0 2006

1. No connect

The main difference in pinouts comes from pin locations of address A19 on SST and Intel devices. SST device has A19 on pin 9 and no-connect on pin 15 whereas Intel devices have no-connect on pin 9 and A19 on pin 15. When replacing 28F160B3 or 28CF160C3 with SST39VF160 on the board a designer should modify board layout to incorporate the difference in locations of A19. Either device can be supported in system design by having a jumper switch for A19 pin.

Pin 12 on 28F160B3/C3 is hardware reset pin which is used to terminate any operation in progress and reset the internal state machine to reading array data. The only difference is that in SST's case, an Erase or Program operation is allowed to complete, whereas in the case of the competitor, such an operation is interrupted by the Reset# command. The system would have to wait for SST's operation to complete before it can read. Since SST has faster Erase and Program times, that is not an issue.

Intel devices have separate power supply (V_{PP}) pin on pin 13 for Program and Erase operations. Since SST39VF160 has single power supply for read, program, and erase, it does not need additional V_{PP} pin and has pin 13 as no-connect.

Intel devices have write protect input, WP#, on pin 14. WP# is used to protect and unprotect some blocks. SST39VF160 has no-connect on this pin.

The V_{CCQ} pin on 28F160B3 and 28F160C3 allows the devices to interface with 2V chips. When used in 3V design, the V_{CCQ} pin is tied to 2.7-3.6V power supply and, hence, the SST39VF160 can be used in place of Intel device.

In summary, SST39VF160 can be used on existing 28F160B3 or SST28F160C3 based design with minor board layout change.

Software Considerations

Intel 28F160B3 and 28F160C3 and SST39VF160 use different command sets and, therefore, a designer will have to rewrite software driver to support SST device. Refer to SST39VF160 and 28F160B3 and 28F160C3 datasheets for more details.

SST AND ATMEL

Atmel offers two versions of 16 Mbit (x16) products: AT49BV1614 and AT49BV1604. Both devices use the same command set but their pinouts are different from each other. SST39VF160 can be used on board design based on either Atmel products with no or minimal board layout modification.

Hardware Consideration

SST39VF160 and AT49BV1614 are offered in JEDEC standard 12mm x 20mm 48-pin TSOP packages and have same pinouts for basic functions. The only differences in pinouts between these two products are on pin 12, pin 15, and pin 47, as described in the table below.

TABLE 9: PIN DIFFERENCES

	SST39VF160	AT49BV1614
Pin 12	NC[1]	RESET#
Pin 15	NC	RY/BY#
Pin 47	NC	BYTE#

T9.0 2006

1. No connect

The Atmel 49BV1614 has a hardware reset function (RESET#) on pin 12 whereas the SST39VF160 has a no-connect on this pin. The purpose of RESET# is to terminate any operation in progress and reset the internal state machine to read array data. The only difference is that in SST's case, an Erase or Program operation is allowed to complete, whereas in the case of the competitor, such an operation is interrupted by the Reset# command. The system would have to wait for SST's operation to complete before it can read. Since SST has faster Erase and Program times, that is not an issue.

The Ready/Busy pin (RY/BY#) on ATMEL device provides an additional hardware method of detecting completion of Program or Erase cycle. In the case of ATMEL, the RY/BY# pin is necessary because ATMEL has an internal state machine that varies the length of the Write pulse width. SST, on the other hand, uses a fixed pulse width to program and erase its devices. As a result, SST does not require a RY/BY# pin and does not offer it.

The BYTE# signal on pin 47 of AT49BV1614 is used to control whether the device operates in the x8 or x16 mode. When the BYTE# pin is set at logic '1', the device is in x16 mode. The BYTE# pin is typically set to high or low in the system and is not dynamically switched. SST39VF160 operates in x16 mode and has pin 47 as no-connect. This device does not support x8, but SST offers 40-pin x8 devices for 16M and 8M densities.

In summary, SST39VF160 can be used on existing AT49BV1614 based design without any board layout change when used in x16 mode.

Hardware Consideration

SST39VF160 and AT49BV1604 are offered in JEDEC standard 12mm x 20mm 48-pin TSOP packages with minor differences in pinouts as described in the table below.

TABLE 10: PIN DIFFERENCES

	SST39VF160	AT49BV1604
Pin 9	A19	NC
Pin 12	NC[1]	RESET#
Pin 15	NC	A19
Pin 47	NC	V_{CCQ}

T10.0 2006

1. No connect

The main difference in pinouts comes from pin locations of address A19 on both devices. SST device has A19 on pin 9 and no-connect on pin 15 whereas Atmel device has no-connect on pin 9 and A19 on pin 15. When replacing AT49BV1604 with SST39VF160 on the board a designer should modify board layout to incorporate the difference in locations of A19. Either device can be supported in system design by having a jumper switch for A19 pin.

The AT49BV1614 has a hardware reset function (RESET#) on pin 12 whereas SST39VF160 has a no-connect on it. The purpose of RESET# is to terminate any operation in progress and reset the internal state machine to reading array data. The only difference an Erase or Program operation is allowed to complete, whereas in the case of the competitor, such an operation is interrupted by the Reset# command. The system would have to wait for SST's operation to complete before it can read. Since SST has faster Erase and Program times, that is not an issue.

The V_{CCQ} pin allows the AT49BV1604 device to interface with 2V chips. When used in 3V design, the V_{CCQ} pin is tied to 2.7-3.6V power supply and, therefore, the SST39VF160 can be used in place of Atmel device.

In summary, SST39VF160 can be used on existing AT49BV1604 based design with minor board layout change.

Software Consideration

The SST39VF160 uses the same JEDEC standard command sets for x16 single voltage Flash memory as AT49BV1614 and AT49BV1604 for basic device operations.

TABLE 11: COMMAND SET COMPARISON

	SST39VF160	AT49BV1614 AT49BV1604
Word-Program	4 Cycle with A0H	Same
Sector-Erase	6 Cycle with 30H	Same
Block-Erase	6 Cycle with 50H	N/A[1]
Chip-Erase	6 Cycle with 10H	Same
ID Entry	3 Cycle with 90H	Same
ID Exit	1 or 3 Cycle with F0H	Same

T11.0 2006

1. Not available

The Sector-Erase operations of SST and Atmel devices use the same six-byte command sequence with the same command data of 30H, but different sector addresses during their sixth byte sequence. This is due to the difference in sector architectures between SST and Atmel products. Both AT49BV1614 and AT49BV1604 consists of one 8 KWord, two 4 KWord, one 16 KWord, and thirty-one 32 KWord sectors. On the other hand, SST39VF160 consists of 512 uniform 2 KWord sectors. This difference in sector architectures results in the SST device having more sectors than Atmel devices. Therefore, when a Sector-Erase operation is performed, the SST device will use address lines A19-A11 to decode sector addresses as opposed to the Atmel devices using A19-A12. These differences in sector address decoding should be accounted for by the software driver.

In addition to Sector-Erase command which erases uniform small sectors, SST39VF160 offers Block-Erase command. While Sector-Erase operation erases 2 KWord sectors on SST device, Block-Erase operation erases 32 KWord blocks. Each block consists of sixteen 2 KWord sectors. This flexible sector/block erasability allows a system designer to use Sector-Erase capability for finer software granularity and Block-Erase capability for faster erase operation. Note that the Atmel devices erase 32 KWord sector using Sector-Erase command (30H), while the SST devices erase 32 KWord block using Block-Erase command (50H).

In summary, when SST39VF160 is used on existing AT49BV1614 or AT49BV1604 based design minor modification of the software driver is required.

CONCLUSION

The SST39VF160 can be used on existing design based on following products with no board layout change and minor software driver modification:

- AMD Am29LV160B
- ST Microelectronics M29F160B
- Fujitsu MBM29LV160B
- Atmel AT49BV1614

When SST39VF160 is used on existing design based on following products, minor board layout and software modification or rewriting is required:

- Intel 28F160B3/C3
- Atmel AT49BV1604

SST's lower density x16 MPF SST39VF800A, SST39VF400A, and SST39VF200A can be used on designs based on equivalent density products from above vendors. The same analogy developed above in comparing 16 Mbit products can be applied to these lower densities.