



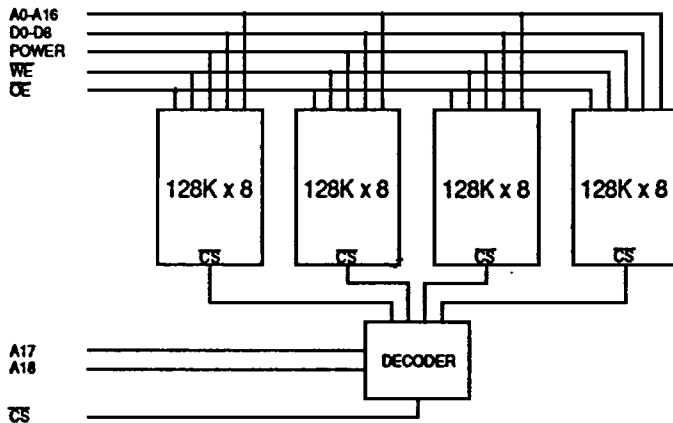
Mosaic  
Semiconductor  
Inc.

## 524,288x 8 CMOS EEPROM

### Features

Very Fast Access Times of 150/200 ns  
JEDEC 4M EEPROM Standard 32 pin DIL footprint  
Operating Power 350 mW (max)  
Standby Power 11 mW (max)  
Hardware and Software Data Protection  
Byte and Page Write Cycle: 10ms  
DATA Polling for End of Write Detection  
10<sup>4</sup> Erase/Write cycles & 10 year Data Retention  
Completely Static Operation  
May be Processed to MIL-STD-883, Method 5004

### Block Diagram



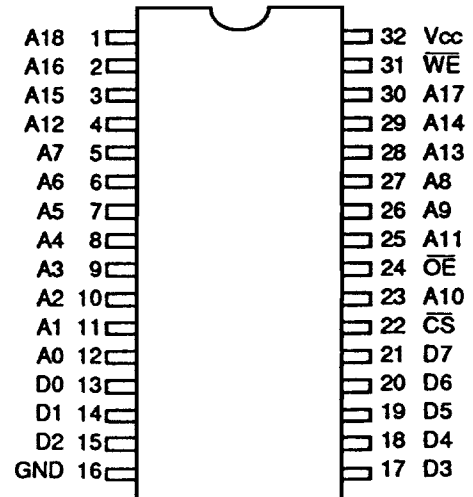
## 512K X 8 EEPROM

ME8512SC-15/20

Issue 1.3 : April 1993

### ADVANCE PRODUCT INFORMATION

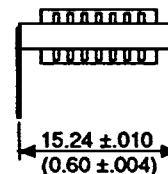
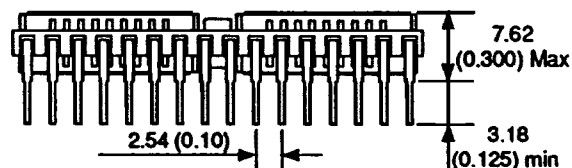
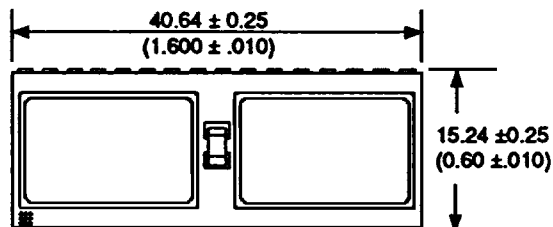
#### Pin Definition



#### Pin Functions

|                 |                   |
|-----------------|-------------------|
| A0-A18          | Address Inputs    |
| D0-D7           | Data Input/Output |
| $\overline{CS}$ | Chip Select       |
| $\overline{OE}$ | Output Enable     |
| $\overline{WE}$ | Write Enable      |
| NC              | No Connect        |
| V <sub>cc</sub> | Power (+5V)       |
| GND             | Ground            |

### Package Details Dimensions in mm (inches).



## Absolute Maximum Ratings

|                                    |           |              |    |
|------------------------------------|-----------|--------------|----|
| Voltage on any pin relative to GND | $V_T$     | -1.0 to +7.0 | V  |
| Power Dissipation                  | $P_T$     | 1            | W  |
| Storage Temperature                | $T_{STG}$ | -65 to +150  | °C |
| Temperature Under Bias             | $T_{BAS}$ | -55 to +125  | °C |

Notes : (1) Stresses above those listed may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Recommended Operating Conditions

|                       |          | <i>min</i> | <i>typ</i> | <i>max</i> |                   |
|-----------------------|----------|------------|------------|------------|-------------------|
| Supply Voltage        | $V_{CC}$ | 4.5        | 5.0        | 5.5        | V                 |
| Input High Voltage    | $V_{IH}$ | 2.0        | -          | $V_{CC}+1$ | V                 |
| Input Low Voltage     | $V_{IL}$ | -0.1       | -          | 0.8        | V                 |
| Operating Temperature | $T_A$    | 0          | -          | 70         | °C                |
|                       | $T_{AL}$ | -40        | -          | 85         | °C (ME8512SCI)    |
|                       | $T_{AM}$ | -55        | -          | 125        | °C (ME8512SCM,MB) |

## DC Electrical Characteristics

| Parameter              | Symbol    | Test Condition                                            | <i>min</i> | <i>max</i> | Unit    |
|------------------------|-----------|-----------------------------------------------------------|------------|------------|---------|
| Input Leakage Current  | $I_{LH}$  | $0V \leq V_{IN} \leq V_{CC}$                              | -          | 40         | $\mu A$ |
| Output Leakage Current | $I_{LO}$  | $\overline{CS} = V_{IH}, V_{IO} = GND \text{ to } V_{CC}$ | -          | 40         | $\mu A$ |
| Average Current        | $I_{CC1}$ | $f = 5 \text{ MHz}, I_{IO} = 0 \text{ mA}$                | -          | 64         | mA      |
| Standby Current        | $I_{SB}$  | TTL Levels                                                | -          | 14         | mA      |
| Standby Current        | $I_{SB1}$ | CMOS Levels                                               | -          | 2          | mA      |
| Output Voltage         | $V_{OL}$  | $I_{OL} = 2.1 \text{ mA}$                                 | -          | 0.4        | V       |
|                        | $V_{OH}$  | $I_{OH} = -400 \mu A$                                     | 2.4        | -          | V       |

## Capacitance ( $V_{CC} = 5V \pm 10\%$ , $T_A = 25^\circ C$ , $f = 1 \text{ MHz}$ )

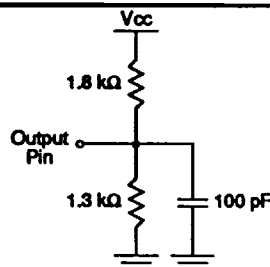
| Parameter                                       | Symbol    | Test Condition | <i>typ</i> | <i>max</i> | Unit |
|-------------------------------------------------|-----------|----------------|------------|------------|------|
| Input Capacitance ( $\overline{CS}$ , A15, A16) | $C_{IN1}$ | $V_{IN} = 0V$  | -          | 10         | pF   |
| ( $\overline{WE}$ , $\overline{OE}$ , A0-14)    | $C_{IN2}$ | $V_{IN} = 0V$  | -          | 40         | pF   |
| I/O Capacitance                                 | $C_{IO}$  | $V_{IO} = 0V$  | -          | 40         | pF   |

Note: Capacitance calculated, not measured.

## AC Test Conditions

- \* Input pulse levels: 0V to 3.0V
- \* Input rise and fall times: 10ns
- \* Input and Output timing reference levels: 1.5V
- \* Output load: 1 TTL gate + 100pF
- \*  $V_{CC} = 5V \pm 10\%$

## Output Test Load



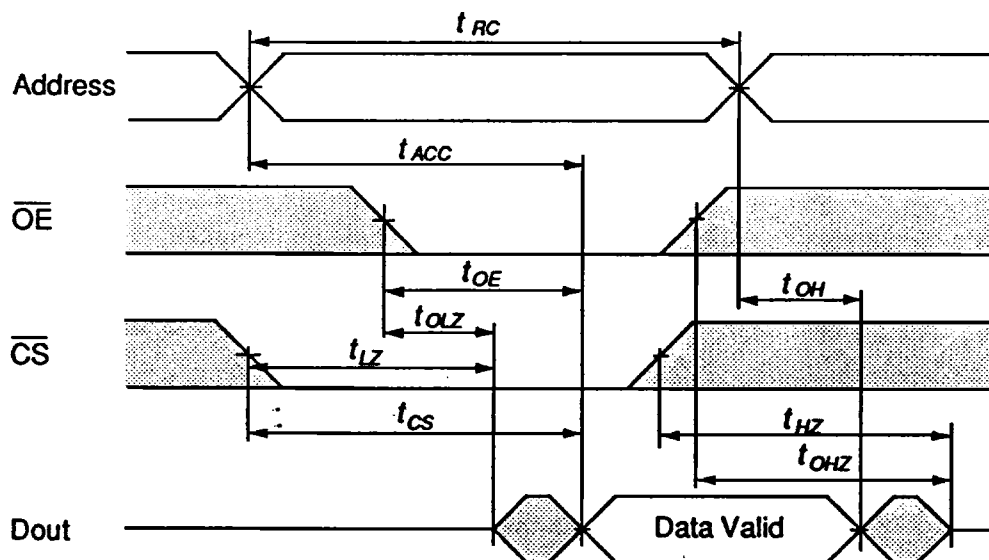
## AC READ CHARACTERISTICS

### Read Cycle

| Parameter                                            | Symbol            | -15 |     | -20 |     | Unit | Notes |
|------------------------------------------------------|-------------------|-----|-----|-----|-----|------|-------|
|                                                      |                   | min | max | min | max |      |       |
| Read Cycle Time                                      | $t_{RC}$          | 150 | -   | 200 | -   | ns   |       |
| Address to Output Delay                              | $t_{ACC}$         | -   | 150 | -   | 200 | ns   |       |
| $\overline{CS}$ to Output Delay                      | $t_{CS}$          | -   | 150 | -   | 200 | ns   |       |
| $\overline{OE}$ to Output Delay                      | $t_{OE}$          | -   | 50  | -   | 50  | ns   |       |
| $\overline{CS}, \overline{OE}$ High to High Z Output | $t_{HZ}, t_{OHZ}$ | -   | 50  | -   | 50  | ns   | 2     |
| $\overline{CS}, \overline{OE}$ Low to Active Output  | $t_{LZ}, t_{OLZ}$ | 0   | -   | 0   | -   | ns   | 2     |

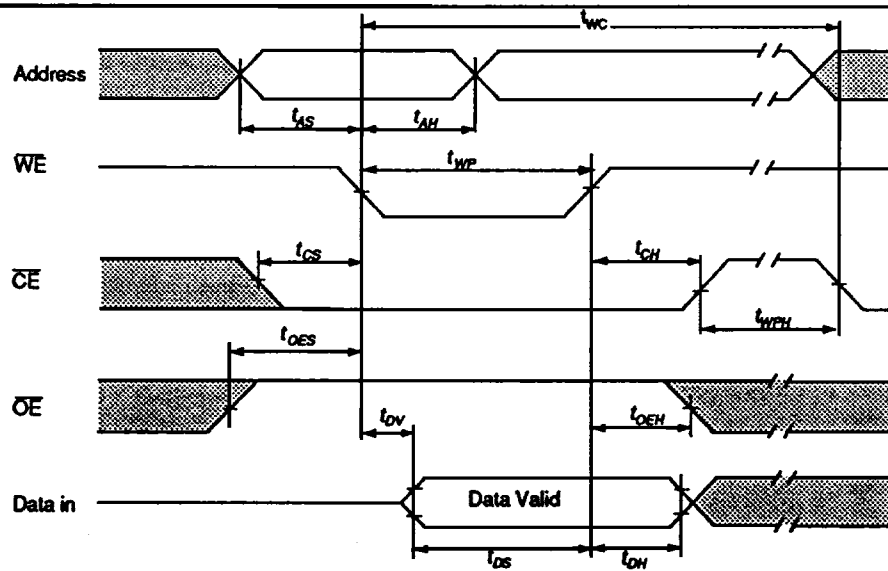
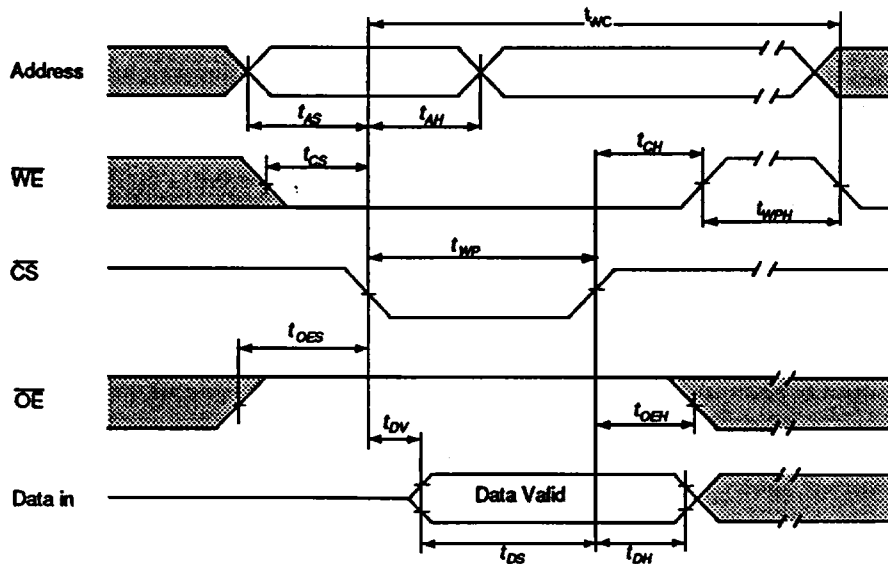
Notes: (1)  $t_{LZ}$  and  $t_{OLZ}$  are specified from  $\overline{OE}$  or  $\overline{CS}$  whichever occurs first ( $C_L = 5pF$ ).  
 (2) This parameter is only sampled and is not 100% tested.

### Read Cycle Timing Waveform



**AC WRITE CHARACTERISTICS****Write Cycle**

| Parameter                                                | Symbol    | min | typ | max | Unit    |
|----------------------------------------------------------|-----------|-----|-----|-----|---------|
| Address Set-up Time                                      | $t_{AS}$  | 0   | -   | -   | ns      |
| Address Hold Time                                        | $t_{AH}$  | 50  | -   | -   | ns      |
| Chip Select Set-up Time                                  | $t_{CS}$  | 0   | -   | -   | ns      |
| Chip Select Hold Time                                    | $t_{CH}$  | 0   | -   | -   | ns      |
| Write Pulse Width ( $\overline{WE}$ or $\overline{CS}$ ) | $t_{WP}$  | 100 | -   | -   | ns      |
| Data Set-up Time                                         | $t_{DS}$  | 50  | -   | -   | ns      |
| Data Hold Time                                           | $t_{DH}$  | 10  | -   | -   | ns      |
| Time to Data Valid                                       | $t_{DV}$  | -   | -   | 1   | $\mu$ s |
| Write Cycle Time                                         | $t_{WC}$  | -   | -   | 10  | ms      |
| Write Pulse Width High                                   | $t_{WPH}$ | 100 | -   | -   | ns      |
| $\overline{OE}$ Set-up Time                              | $t_{OES}$ | 10  | -   | -   | ns      |
| $\overline{OE}$ Hold Time                                | $t_{OEH}$ | 10  | -   | -   | ns      |

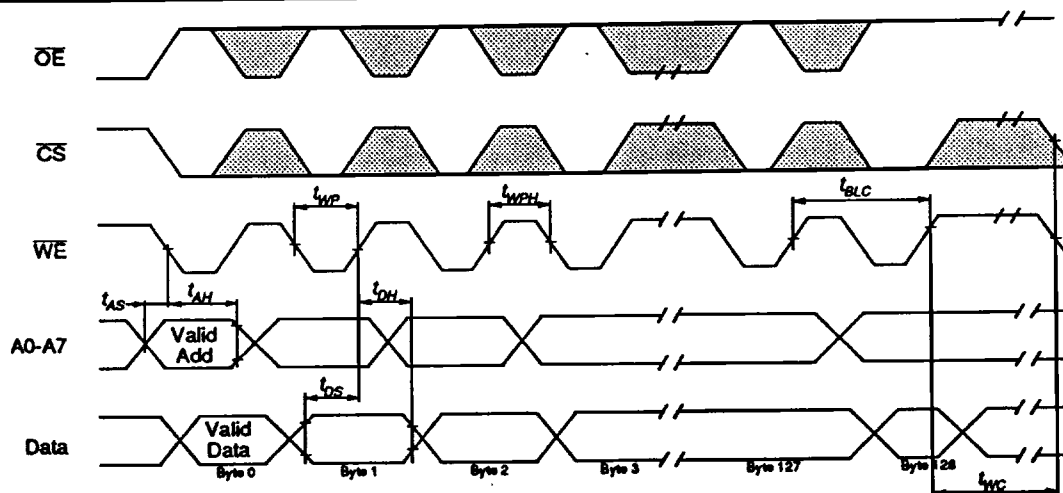
**AC Write Waveform -  $\overline{WE}$  Controlled****AC Write Waveform -  $\overline{CS}$  Controlled**

## PAGE MODE WRITE CHARACTERISTICS

### Write Cycle

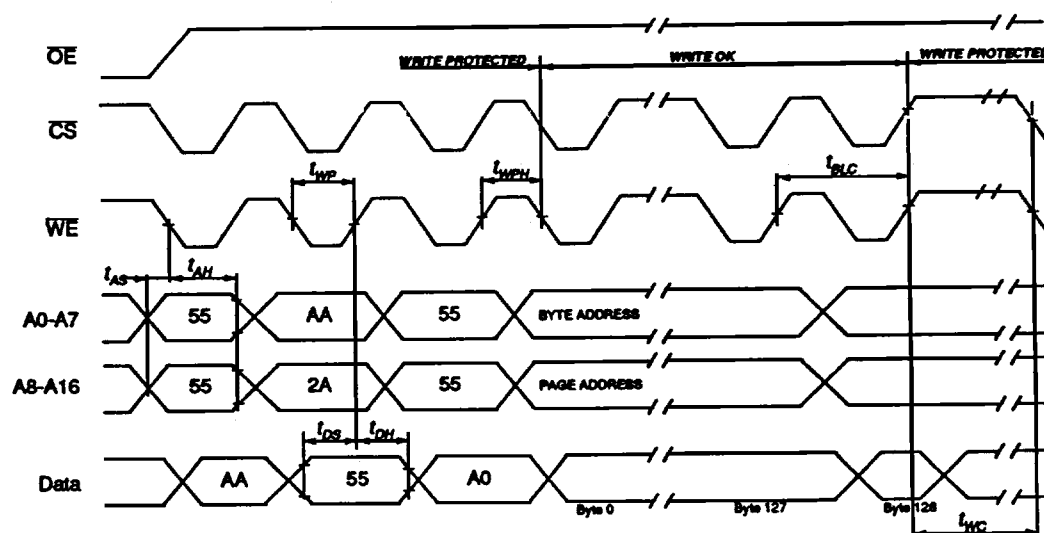
| Parameter              | Symbol    | min | typ | max | Unit    |
|------------------------|-----------|-----|-----|-----|---------|
| Write Cycle Time       | $t_{WC}$  | -   | -   | 10  | ms      |
| Address Set-up Time    | $t_{AS}$  | 0   | -   | -   | ns      |
| Address Hold Time      | $t_{AH}$  | 50  | -   | -   | ns      |
| Data Set-up Time       | $t_{DS}$  | 50  | -   | -   | ns      |
| Data Hold Time         | $t_{DH}$  | 10  | -   | -   | ns      |
| Write Pulse Width      | $t_{WP}$  | 100 | -   | -   | ns      |
| Byte Load Cycle Time   | $t_{BLC}$ | 0.2 | -   | 100 | $\mu$ s |
| Write Pulse Width High | $t_{WPH}$ | 100 | -   | -   | ns      |

### Page Mode Write Waveform



Note: A8 through A16 must specify the page address during each high to low transition of  $\overline{WE}$  (or  $\overline{CS}$ ).  
 $\overline{OE}$  must be high only when  $\overline{WE}$  and  $\overline{CS}$  are both low.

### Software Protected Write Waveform

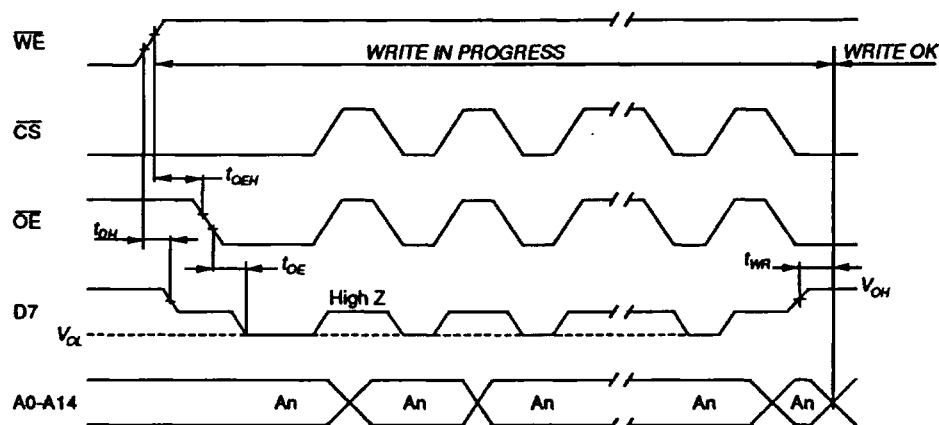


Note: A8 through A16 must specify the page address during each high to low transition of  $\overline{WE}$  (or  $\overline{CS}$ ).  
 The example addresses above are for EEPROM 1 on the module - see page 8 for full details.  
 $\overline{OE}$  must be high only when  $\overline{WE}$  and  $\overline{CS}$  are both low.

**DATA Polling Characteristics <sup>(1)</sup>**

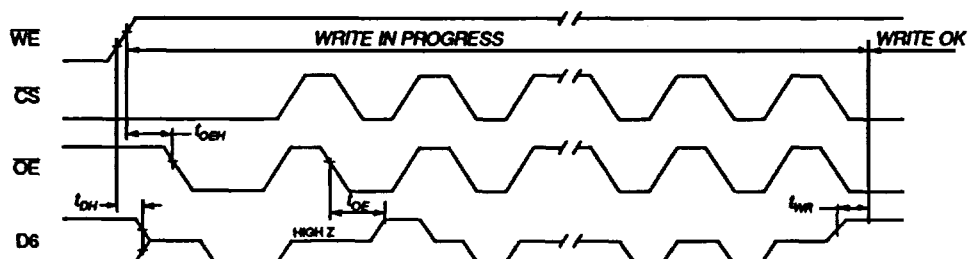
| Parameter                       | Symbol     | min | typ | max | Unit |
|---------------------------------|------------|-----|-----|-----|------|
| Data Hold Time                  | $t_{DH}$   | 10  | -   | -   | ns   |
| $\overline{OE}$ Hold Time       | $t_{OE H}$ | 0   | -   | -   | ns   |
| $\overline{OE}$ to Output Delay | $t_{OE}$   | -   | -   | 100 | ns   |
| Write Recovery Time             | $t_{WR}$   | 0   | -   | -   | ns   |

Note : (1) These parameters are sampled and not 100% tested.

**DATA Polling Waveform****Toggle Bit Characteristics <sup>(1)</sup>**

| Parameter                       | Symbol     | min | typ | max | Unit |
|---------------------------------|------------|-----|-----|-----|------|
| Data Hold Time                  | $t_{DH}$   | 10  | -   | -   | ns   |
| $\overline{OE}$ Hold Time       | $t_{OE H}$ | 10  | -   | -   | ns   |
| $\overline{OE}$ to Output Delay | $t_{OE}$   | -   | -   | 100 | ns   |
| Write Recovery Time             | $t_{WR}$   | 0   | -   | -   | ns   |

Note : (1) These parameters are sampled and not 100% tested.

**Toggle Bit Waveform**

- Notes : (1) Toggling either  $\overline{OE}$  or  $\overline{CS}$  or both  $\overline{OE}$  and  $\overline{CS}$  will operate toggle bit.  
 (2) Beginning and ending state of D6 may vary.  
 (3) Any address location may be used but the address should not vary.

## DEVICE OPERATION

### Read

The ME8512SC is accessed in the same way as a static RAM, with the data stored at the memory location determined by the address being placed on the output pins when  $\overline{CS}$  and  $\overline{OE}$  are low, and  $\overline{WE}$  is high. Whenever  $\overline{CS}$  or  $\overline{OE}$  are high, the outputs are in the OFF or high impedance state.

### Write

A low pulse on  $\overline{WE}$  with  $\overline{CS}$  low or a low pulse on  $\overline{CS}$  with  $\overline{WE}$  low indicates a Write Cycle. The address is latched on the falling edge of  $\overline{CS}$  or  $\overline{WE}$ , and the data is latched on the first rising edge of  $\overline{CS}$  or  $\overline{WE}$ . Once a Byte Write has begun it will automatically time itself to completion.

### Page Mode Write

This mode allows 2 to 256 bytes of data to be loaded into an EEPROM, which are then simultaneously written. Once the first byte has been written, each subsequent byte must have the high to low transition of  $\overline{WE}$  (or  $\overline{CS}$ ) within 100 $\mu$ s of the same transition of the previous byte. If this 100 $\mu$ s time is exceeded, the load period ends and internal programming starts. A8 to A16 specify the page address (which must be valid during the above transitions) and A0 to A7 specify which bytes within the page are to be written. Note that the bytes may be loaded in any order and may be changed within the same load period.

### Operating Modes

| MODE                 | $\overline{CS}$ | $\overline{OE}$ | $\overline{WE}$ | OUTPUTS  |
|----------------------|-----------------|-----------------|-----------------|----------|
| Read                 | 0               | 0               | 1               | Data Out |
| Write <sup>(1)</sup> | 0               | 1               | 0               | Data In  |
| Standby              | 1               | X               | X               | Floating |
| Write Inhibit        | X               | X               | 1               |          |
|                      | X               | 0               | X               |          |
| Output Disable       | X               | 1               | X               | Floating |
| Chip Erase           | 0               | V <sub>H</sub>  | 0               | Floating |

1 = V<sub>H</sub> 0 = V<sub>L</sub> X = Don't care V<sub>H</sub> = 12.0V $\pm$ 0.5V

### DATA Polling

In order to detect the end of a Write Cycle, two methods are provided. During a Write operation (Byte or Page) an attempt to Read the device will result in the complement of the written data appearing on D7. Once the Write Cycle is complete true data appears on the outputs and the next Write Cycle may begin.

## TOGGLE bit

In addition to DATA polling, another method is provided to determine the end of a Write Cycle. During a write operation successive attempts to read data will result in D6 toggling between 1 and 0. Once a write is complete, this toggling will stop and valid data will be read.

### Hardware Data Protection

Four types of hardware protection give high security against accidental writes:

- (a) If V<sub>cc</sub> < 3.8V write is inhibited
- (b) At power on, the device times out 5ms before allowing a Write.
- (c)  $\overline{OE}$  low,  $\overline{CS}$  or  $\overline{WE}$  high inhibits writes.
- (d) Pulses of less than 15ns on  $\overline{WE}$  or  $\overline{CS}$  do not initiate a write cycle.

### Software Data Protection

Software controlled data protection, once enabled by the user, necessitates the use of a software algorithm before any Write can be performed. To enable this feature a special sequence of Writes must be performed, and must be reused for each subsequent Write cycle. Once set the data protection remains operational until it is disabled by using a second algorithm; power transitions will not reset this feature.

Note that the ME8512SC is supplied with the Software Data Protection feature disabled.

The ME8512SC consists of four 128K x 8 EEPROMs; which device is active at a particular time and  $\overline{CS}$  inputs are controlled by address lines A17 and A18. The Memory Map of this module is arranged as follows:

| EEPROM<br>NUMBER | ADDRESSING RANGE |       |
|------------------|------------------|-------|
|                  | START            | END   |
| 1                | 00000            | 1FFFF |
| 2                | 20000            | 3FFFF |
| 3                | 40000            | 5FFFF |
| 4                | 60000            | 7FFFF |

The Software Data Protection operation mode is available on a single device independent from the mode of the others e.g. one EEPROM could be protected while the others were not. However this situation is undesirable because the current mode of each EEPROM would have to be recorded during operation in order to avoid trying to Write to a device without first issuing the correct command codes. Because of this it is advisable that if this feature is to be used then all four devices on each module are either disabled or enabled at the same time. Software Data Protection Enable for any device can be achieved by using the following table:

| ACTION<br>PERFORMED           | EEPROM NUMBER            |       |       |       |
|-------------------------------|--------------------------|-------|-------|-------|
|                               | 1                        | 2     | 3     | 4     |
| LOAD DATA <sup>(1)</sup>      | AA                       | AA    | AA    | AA    |
| TO ADDRESS <sup>(1)</sup>     | 05555                    | 25555 | 45555 | 65555 |
| LOAD DATA                     | 55                       | 55    | 55    | 55    |
| TO ADDRESS                    | 02AAA                    | 22AAA | 42AAA | 62AAA |
| LOAD DATA                     | A0                       | A0    | A0    | A0    |
| TO ADDRESS                    | 05555                    | 25555 | 45555 | 65555 |
| WRITES ENABLED <sup>(2)</sup> |                          |       |       |       |
| LOAD DATA <sup>(3)</sup>      | ANY                      | ANY   | ANY   | ANY   |
| TO ADDRESS                    | ANY VALID FOR PAGE WRITE |       |       |       |
| LOAD LAST DATA                | ANY                      | ANY   | ANY   | ANY   |
| TO LAST ADDRESS               | ANY VALID FOR PAGE WRITE |       |       |       |
| ENTER DATA PROTECTED STATE    |                          |       |       |       |

- Notes : (1) Data D7 - D0 (hex); Address A16 - A0 (hex).  
 (2) Write Protect Mode will be activated at end of Write even if no other data is loaded.  
 (3) 1 to 64 bytes of data may be loaded.

In order to enable Data Protection for the entire ME8512SC module, the sequence of three loads shown above must be performed for each EEPROM in turn, totalling 12 loads in all. Once activated, the same three bytes must be loaded to the same addresses before any Writes will occur to a particular device. All software write commands must obey the Page Write timing specifications.

The process of disabling the Data Protection mode is very similar to that described for enable, except 6 bytes must be loaded to specific locations for each EEPROM as shown in the table below:

| ACTION PERFORMED                         | EEPROM NUMBER            |       |       |       |
|------------------------------------------|--------------------------|-------|-------|-------|
|                                          | 1                        | 2     | 3     | 4     |
| LOAD DATA <sup>(1)</sup>                 | AA                       | AA    | AA    | AA    |
| TO ADDRESS <sup>(1)</sup>                | 05555                    | 25555 | 45555 | 65555 |
| LOAD DATA                                | 55                       | 55    | 55    | 55    |
| TO ADDRESS                               | 02AAA                    | 22AAA | 42AAA | 62AAA |
| LOAD DATA                                | 80                       | 80    | 80    | 80    |
| TO ADDRESS                               | 05555                    | 25555 | 45555 | 65555 |
| LOAD DATA                                | AA                       | AA    | AA    | AA    |
| TO ADDRESS                               | 05555                    | 25555 | 45555 | 65555 |
| LOAD DATA                                | 55                       | 55    | 55    | 55    |
| TO ADDRESS                               | 02AAA                    | 22AAA | 42AAA | 62AAA |
| LOAD DATA                                | 20                       | 20    | 20    | 20    |
| TO ADDRESS                               | 05555                    | 25555 | 45555 | 65555 |
| EXIT DATA PROTECTED STATE <sup>(2)</sup> |                          |       |       |       |
| LOAD DATA <sup>(3)</sup>                 | ANY                      | ANY   | ANY   | ANY   |
| TO ADDRESS                               | ANY VALID FOR PAGE WRITE |       |       |       |
| LOAD LAST DATA                           | ANY                      | ANY   | ANY   | ANY   |
| TO LAST ADDRESS                          | ANY VALID FOR PAGE WRITE |       |       |       |

- Notes : (1) Data D7 - D0 (hex); Address A16 - A0 (hex).  
 (2) Write Protect Mode will be activated at end of Write even if no other data is loaded.  
 (3) 1 to 64 bytes of data may be loaded.

Thus, to disable the Software Data Protection mode for the module 24 bytes have to be loaded.

Note here the use of the word 'load' to describe enabling and disabling the protection modes is in preference to 'write'. Although it may seem that if the Write command sequence is performed to enable protection then the three bytes at those addresses will be overwritten with AA,55,A0, this is not the case. This is because these Writes obey Page Write parameters, where A8 - A16 must remain valid to specify the page address, but during this enable sequence they change. Actual Writes therefore never occur, and data is not corrupted during an enable sequence.

For the same reasons no Writes are performed during the disable routine, in addition to the fact that since Data Protection is enabled no Writes can occur without the correct bytes being loaded in sequence.

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**Ordering Information**

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**ME8512SCMB-15**

Speed

15 = 150 ns

20 = 200 ns

Temp. range/screening

Blank = Commercial Temp.

I = Industrial Temp.

M = Military Temp.

MB = Processed to MIL-STD-883  
Method 5004, non-compliant

Package

SC = 32 Pin 600 mil Ceramic DIP

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The policy of the company is one of continuous development and while the information presented in this data sheet is believed to be accurate, no liability is assumed for any data contained within. The company reserves the right to make changes without notice at any time.

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***mosaic***

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