

## MSM2716AS

16384-BIT UV ERASABLE ELECTRICALLY PROGRAMMABLE  
READ-ONLY MEMORY

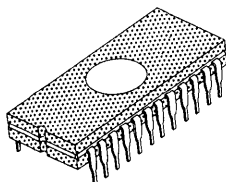
### GENERAL DESCRIPTION

The MSM2716AS is a read only memory with the capacity of 2048 words x 8 bits whose contents can be erased by ultraviolet ray irradiation. Since the memory contents can be programmed as desired by the user and the alteration is easy, it is ideal for a processor program.

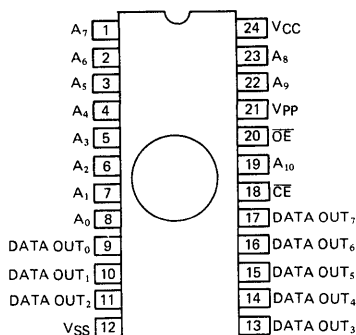
The MSM2716AS is processed as the N-channel silicon gate MOS with floating gates, and is encased in a standard 24-pin ceramic package.

### FEATURES

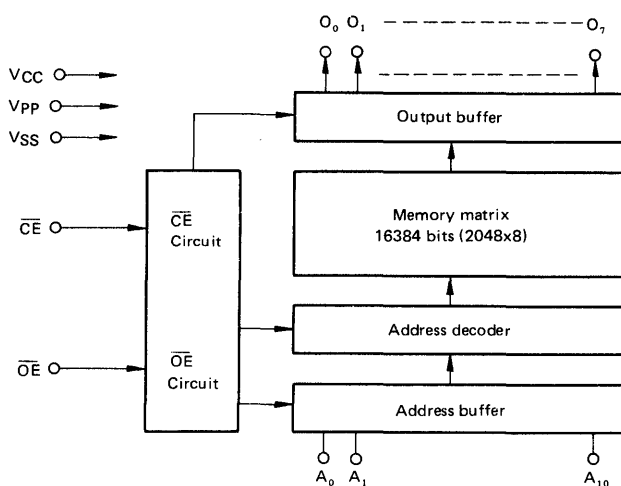
- Single power supply . . . . . +5V
- Low power Dissipation . . . . . 525 mW in operation and 132 mW in standby state
- UV erasable and electrically programmable.
- Minimum programming time . . . . . 100 seconds for all 16,384 bits.
- Full decoding . . . . . 2048 words x 8 bits
- Static operation . . . . . No clock requirement
- TTL connection for inputs/outputs (tristate output)
- Easy expansion of memory capacity (wired-OR connection)
- Access time . . . . . 450 ns
- Pin compatible with INTEL's 2716



### PIN CONFIGURATION



### FUNCTIONAL BLOCK DIAGRAM



The specifications  
are subject to  
change without notice.

## FUNCTION TABLE

| Mode \ Pins     | $\overline{CE}$<br>(18)        | $\overline{OE}$<br>(20) | $V_{pp}$<br>(21) | $V_{cc}$<br>(24) | OUTPUTS<br>(9~11, 13~17) |
|-----------------|--------------------------------|-------------------------|------------------|------------------|--------------------------|
| Read            | $V_{IL}$                       | $V_{IL}$                | +5V              | +5V              | D out                    |
| Stand by        | $V_{IH}$                       | Don't care              | +5V              | +5V              | High Z                   |
| Program         | Pulsed $V_{IL}$<br>to $V_{IH}$ | $V_{IH}$                | +25V             | +5V              | D in                     |
| Program Verify  | $V_{IL}$                       | $V_{IL}$                | +25V             | +5V              | D out                    |
| Program Inhibit | $V_{IL}$                       | $V_{IH}$                | +25V             | +5V              | High Z                   |

High Z = High Impedance

## ELECTRICAL CHARACTERISTICS

### ABSOLUTE MAXIMUM RATING

| Item                         | Symbol    | Conditions | Rated Value    | Unit |
|------------------------------|-----------|------------|----------------|------|
| Storage Temperature          | $T_{stg}$ | —          | −55 to +125    | °C   |
| Terminal Voltage             |           |            | (to $V_{ss}$ ) |      |
| Address Input and Data Input |           |            | −0.3 to +6     | V    |
| Program Input $V_{pp}$       |           |            | −0.3 to +28    |      |
| $V_{cc}$                     |           |            | −0.3 to +6     |      |
| Power Dissipation            | $P_D$     |            | 525            | mW   |

## READ OPERATION

Operating range (for  $V_{ss} = 0V$ )

| Item                  | Symbol    | Conditions    | Guaranteed Range | Unit |
|-----------------------|-----------|---------------|------------------|------|
| Source Supply Voltage | $V_{cc}$  |               | +5 to $\pm 0.25$ | V    |
|                       | $V_{pp}$  |               | $V_{cc} \pm 0.6$ | V    |
| Operating Temperature | $T_{opr}$ |               | 0 to +70         | °C   |
| Number of Leads       | N         | TTL gate load | 1                | —    |

DC OPERATING CHARACTERISTICS

(Vcc = 5V ± 5%, Vpp = Vcc ± 0.6V, Ta = 0° C to +70° C unless specified otherwise)

| Item                               | Symbol           | Conditions                                       | Guaranteed Range |      |                    | Unit |
|------------------------------------|------------------|--|------------------|------|--------------------|------|
|                                    |                  |  | Min.             | Typ. | Max.               |      |
| Input Leak Current                 | I <sub>LI</sub>  | V <sub>IN</sub> = 5.25V                          |                  |      | 10                 | μA   |
| Output Leak Current                | I <sub>LO</sub>  | V <sub>OUT</sub> = 5.25V                         |                  |      | 10                 | μA   |
| Program Pin Current                | I <sub>pp</sub>  | V <sub>pp</sub> = 5.85V                          |                  |      | 5                  | mA   |
| Collector Supply Current (Standby) | I <sub>CC1</sub> | $\overline{CE} = V_{IH}, \overline{OE} = V_{IL}$ |                  | 10   | 25                 | mA   |
| Collector Supply Current (Active)  | I <sub>CC2</sub> | $\overline{OE} = \overline{CE} = V_{IL}$         |                  | 60   | 100                | mA   |
| "H" Input Voltage                  | V <sub>IH</sub>  |  | 2.2              |      | V <sub>CC</sub> +1 | V    |
| "L" Input Voltage                  | V <sub>IL</sub>  |  | -0.1             |      | 0.8                | V    |
| "H" Output Voltage                 | V <sub>OH</sub>  | I <sub>OH</sub> = -400 μA                        | 2.4              |      |                    | V    |
| "L" Output Voltage                 | V <sub>OL</sub>  | I <sub>OL</sub> = 2.1 mA                         |                  |      | 0.45               | V    |

**Note:** V<sub>CC</sub> must be supplied before or when V<sub>pp</sub> is supplied, and must be cut off when or after V<sub>pp</sub> is cut off.

AC OPERATING CHARACTERISTICS

(Vcc = 5V ± 5%, Vpp = Vcc ± 0.6V, Ta = 0° C to +70° C unless specified otherwise)

| Item                              | Symbol           | Conditions                    | Guaranteed range |      |      | Unit |
|-----------------------------------|------------------|-------------------------------|------------------|------|------|------|
|                                   |                  |                               | Min.             | Typ. | Max. |      |
| Address Output Delay Time         | t <sub>ACC</sub> | $\overline{OE} = CE = V_{IL}$ |                  | 250  | 450  | ns   |
| $\overline{CE}$ Output Delay Time | t <sub>CE</sub>  | $\overline{OE} = V_{IL}$      |                  | 280  | 450  | ns   |
| $\overline{OE}$ Output Delay Time | t <sub>OE</sub>  | $\overline{CE} = V_{IL}$      |                  |      | 120  | ns   |
| Output Disable Delay Time         | t <sub>DF</sub>  | $\overline{CE} = V_{IL}$      | 0                |      | 100  | ns   |

\*AC characteristics measuring conditions

Input pulse level . . . . . 0.8 ~ 2.2V

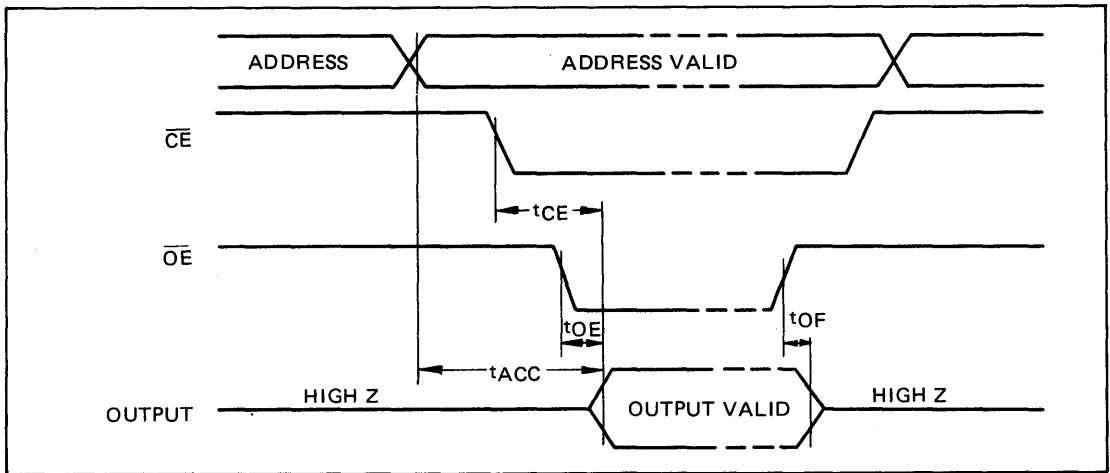
Input rise/fall time . . . . . Within 20 ns

Output load . . . . . 1TTL Gate + 100 pF

Timing measurement reference levels . . . . Input 1V and 2V, Output 0.8V and 2.4V

TIME CHART

Read Mode



PROGRAMMING OPERATION

(Vcc = 5V ± 5%, Vpp = 25V ± 1V, Ta = 25°C ± 5°C unless specified otherwise)

| Item                     | Symbol           | Conditions                    | Guaranteed Range |      |                    | Unit |
|--------------------------|------------------|-------------------------------|------------------|------|--------------------|------|
|                          |                  |                               | Min.             | Typ. | Max.               |      |
| Input Leak Current       | I <sub>LI</sub>  | V <sub>IN</sub> = 5.25V/0.45V |                  |      | 10                 | μA   |
| Program Pin Current      | I <sub>PP1</sub> | $\overline{CE} = V_{IL}$      |                  |      | 6                  | mA   |
| Programming Current      | I <sub>PP2</sub> | $\overline{CE} = V_{IH}$      |                  |      | 30                 | mA   |
| Collector Supply Current | I <sub>CC</sub>  |                               |                  |      | 100                | mA   |
| "H" Input Voltage        | V <sub>IH</sub>  |                               | 2.2              |      | V <sub>CC</sub> +1 | V    |
| "L" Input Voltage        | V <sub>IL</sub>  |                               | -0.1             |      | 0.8                | V    |

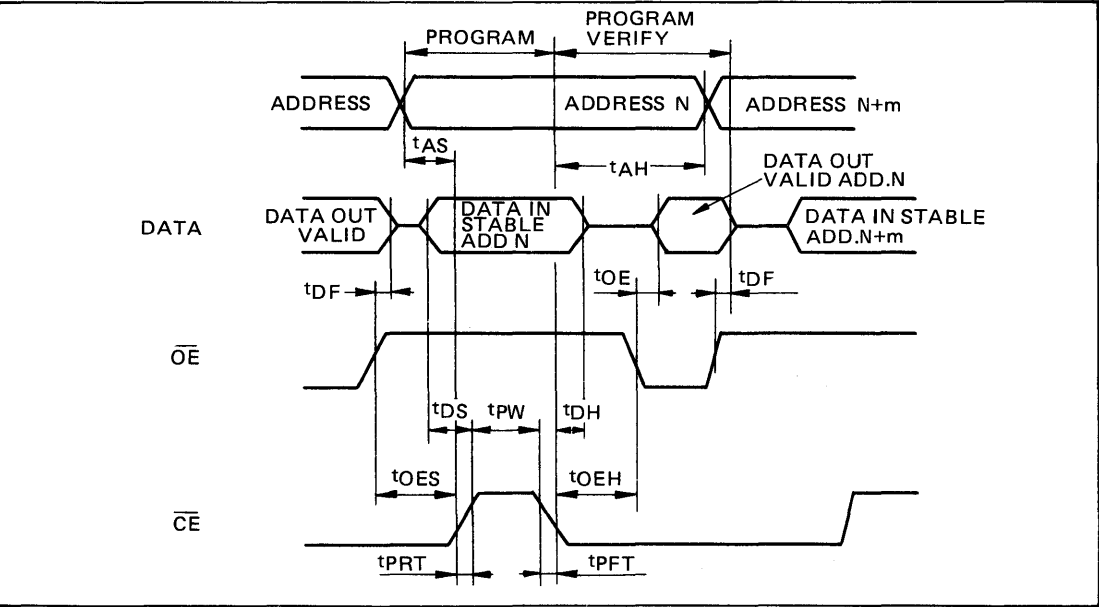
AC CHARACTERISTICS

(Vcc = 5V ± 5%, Vpp = 25V ± 1V, Ta = 25°C ± 5°C unless specified otherwise)

| Item                      | Symbol           | Guaranteed Range |      |      | Unit |
|---------------------------|------------------|------------------|------|------|------|
|                           |                  | Min.             | Typ. | Max. |      |
| Address Setup Time        | t <sub>AS</sub>  | 2                |      |      | μS   |
| OE Setup Time             | t <sub>OES</sub> | 2                |      |      | μS   |
| Data Setup Time           | t <sub>DS</sub>  | 2                |      |      | μS   |
| Address Hold Time         | t <sub>AH</sub>  | 2                |      |      | μS   |
| OE Hold Time              | t <sub>OEH</sub> | 2                |      |      | μS   |
| Data Hold Time            | t <sub>DH</sub>  | 2                |      |      | μS   |
| Output Disable Delay Time | t <sub>DF</sub>  | 0                |      | 120  | ns   |
| Output Enable Delay Time  | t <sub>OE</sub>  |                  |      | 120  | ns   |
| Program Pulse Width       | t <sub>PW</sub>  | 45               | 50   | 55   | ms   |
| Program Pulse Fall Time   | t <sub>PRT</sub> | 5                |      |      | ns   |
| Program Pulse Rise Time   | t <sub>PFT</sub> | 5                |      |      | ns   |

\* AC characteristics measurement conditions are the same as those for read operation.

TIME CHART (PROGRAM MODE)



## OPERATION

### • Read mode

When  $\overline{OE}$  is set to "L" level, reading of the memory contents starts 450 ns ( $T_{ACC}$ ) after the address or 120 ns ( $t_{OE}$ ) after  $\overline{OE}$  if the address is already fixed.

### • Output deselection

Multiple MSM2716AS chips may be combined by wired-OR connection. The data in one MSM2716AS is read when  $\overline{OE}$  is at "L" level. Other MSM2716AS chips are set to the output deselection state by setting the  $\overline{OE}$  to the "H" level.

### • Standby mode

Setting  $\overline{CE}$  to "H" level causes the power to be decreased to 1/4 of that in the read mode (525 mW → 132 mW).

### • Programming

All bits of the MSM2716AS are set to "H" level at the time of delivery or after erasure. When 0 is written, the corresponding bit goes to "L" level. In the programming mode,  $\overline{OE}$  input at  $V_{pp}=25V$  is used as "H" level.

The programming data must be supplied in parallel to output pins ( $O_0 \sim O_7$ ). The address and input are both TTL level. Supplying  $\overline{CE}$  input (TTL "H" level) at 50 ms intervals after setting up the address and data enables programming. Avoid programming by supplying a DC signal to  $\overline{CE}$  pin.

### • Program verify

The MSM2716AS can be verified in the programming mode.  $V_{pp}$  for this operation is 25V.

### • Program inhibit

Multiple MSM2716AS chips can be programmed in parallel and with different data in this mode. All pins other than  $\overline{CE}$  can be used in common for all chips.

Supply TTL "H" level to  $\overline{CE}$  pins of the chips to be programmed and TTL "L" level to  $\overline{CE}$  pins of the chips not to be programmed.

## HANDLING OF MSM2716AS

Since the MSM2716AS is an EPROM of N-channel silicon gate FAMOS type, pay special attention as follows in addition to general handling caution of MOS ICs so as to maintain high reliability.

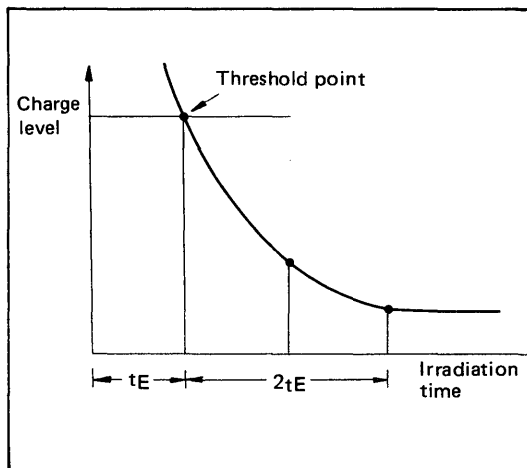
### • Attention during writing

Since all bits of the MSM2716AS are erased before delivery, writing can be started as it is. Sufficient erasure is necessary before reprogramming.

For writing operation, avoid a location with strong light intensity. 100–200 lux is allowable.

### • Attention during erasure

The contents of the MSM2716AS can be erased by irradiation of ultraviolet rays. The charge (electrons) in the floating gates decreases with the time lapse, but erasing time  $t_E$  till the threshold point (where all bits are judged as 1 by a writer) is insufficient. Irradiate for another 2  $t_E$  for sufficient discharge of electrons.



The irradiation energy for erasure of the MSM2716AS contents is 15W-sec/cm<sup>2</sup>.

### • Caution for handling

- (1) Keep away from carpet or cloth that generates static electricity.
- (2) Perfectly ground the using writer and the system in which the MSM2716AS is used.
- (3) If a soldering iron is used, be sure to ground it.
- (4) Always carry in electrically conductive plastic mat.
- (5) The programmed ROM must be encased in electrically conductive plastic mat.
- (6) Do not touch the glass seal portion with a hand to prevent insufficient erasure caused by decreased UV ray transmission.

### • Caution for system debugging

Check the functioning status by fluctuating the voltage by  $\pm 5\%$ .