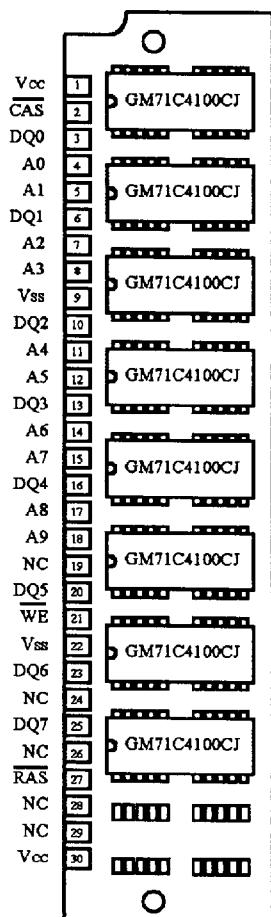


## Description

The GMM784000CS is a 4M x 8 bits Dynamic RAM Module which is assembled 8 pieces of 4M bit DRAM (GM71C4100CJ, 4Mx1) in 20/26 pin small out-line J-form on a 30 pin single in-line package. The GMM784000CS is a socket type memory module, suitable for easy change or addition of module, and provide common data inputs and outputs. It's module board has decoupling capacitors mounted under each DRAM.

### • GMM784000CS (Single Side)



## Features

- High Density JEDEC standard 30 pin mounting  
8 pcs of 4M DRAM
- Fast Page Mode Capability
- Single Power Supply
- Fast Access Time & Cycle Time

(Unit: ns)

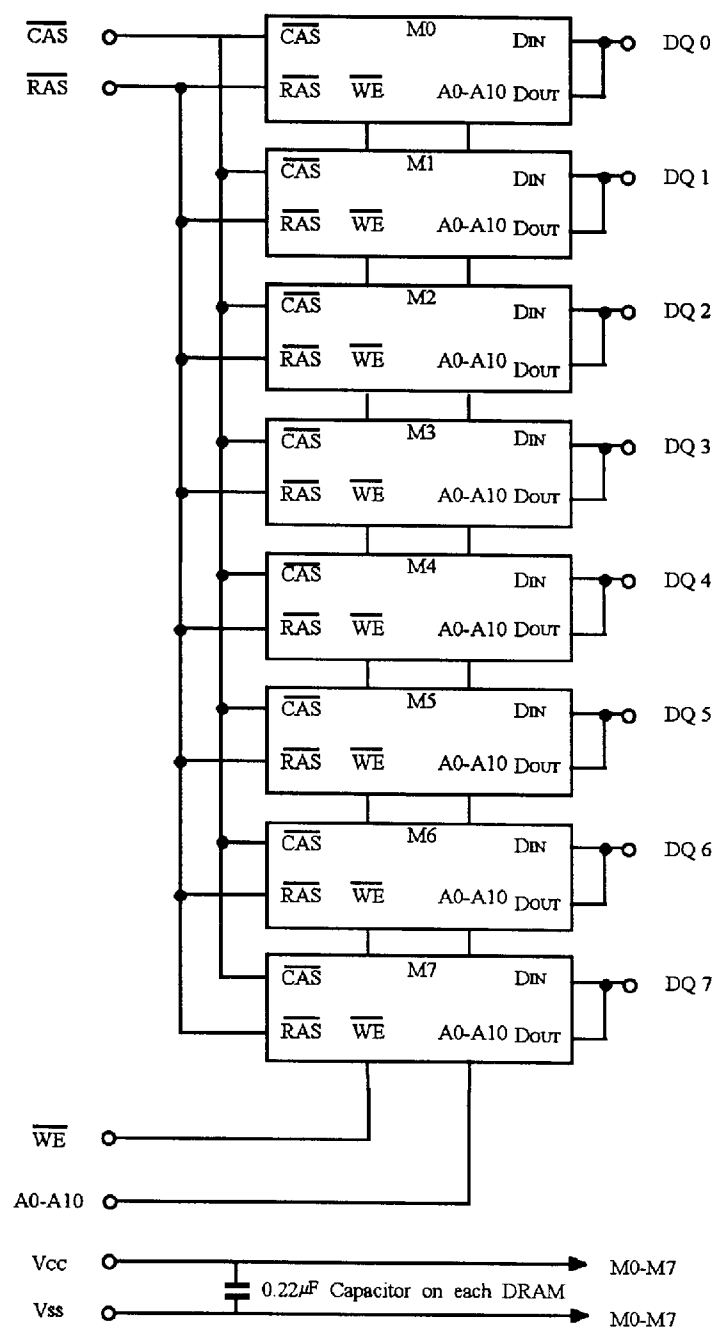
|                | t <sub>TRAC</sub> | t <sub>CAC</sub> | t <sub>RC</sub> | t <sub>PC</sub> |
|----------------|-------------------|------------------|-----------------|-----------------|
| GMM784000CS-60 | 60                | 15               | 110             | 40              |
| GMM784000CS-70 | 70                | 20               | 130             | 45              |
| GMM784000CS-80 | 80                | 20               | 150             | 50              |

- Low Power  
Active : 4,840/4,400/3,960mW (MAX)  
Standby : 44.0mW (CMOS level : MAX)
- RAS Only Refresh, CAS before RAS Refresh, Hidden Refresh Capability
- All inputs and outputs TTL Compatible
- 1024 Refresh Cycles/16ms

## Pin Configuration (Top View)

| Pin | Symbol           | Pin | Symbol | Pin | Symbol           |
|-----|------------------|-----|--------|-----|------------------|
| 1   | V <sub>CC</sub>  | 11  | A4     | 21  | $\overline{WE}$  |
| 2   | $\overline{CAS}$ | 12  | A5     | 22  | V <sub>SS</sub>  |
| 3   | DQ0              | 13  | DQ3    | 23  | DQ6              |
| 4   | A0               | 14  | A6     | 24  | NC               |
| 5   | A1               | 15  | A7     | 25  | DQ7              |
| 6   | DQ1              | 16  | DQ4    | 26  | NC               |
| 7   | A2               | 17  | A8     | 27  | $\overline{RAS}$ |
| 8   | A3               | 18  | A9     | 28  | NC               |
| 9   | V <sub>SS</sub>  | 19  | A10    | 29  | NC               |
| 10  | DQ2              | 20  | DQ5    | 30  | V <sub>CC</sub>  |

# Block Diagram



### Pin Description

| Pin              | Function              | Pin             | Function          |
|------------------|-----------------------|-----------------|-------------------|
| A0-A9            | Address Inputs        | $\overline{WE}$ | Read/Write Enable |
| DQ0-DQ7          | Data Input/Output     | V <sub>CC</sub> | Power (+5V)       |
| $\overline{RAS}$ | Row Address Strobe    | V <sub>SS</sub> | Ground            |
| $\overline{CAS}$ | Column Address Strobe | NC              | No Connection     |

- \*Note: 1. Common  $\overline{CAS}$  controls for eight common data-in and data-out lines.  
 2. The common  $\overline{RAS}$  controls for one separate pair of data-in and data-out lines.  
 3. The common I/O feature dictates the use of only early write operations to prevent contention on data-in and data-out.

### Absolute Maximum Ratings\*

| Symbol                            | Parameter                                      | Rating     | Unit |
|-----------------------------------|------------------------------------------------|------------|------|
| T <sub>A</sub>                    | Ambient Temperature under Bias                 | 0 ~ 70     | °C   |
| T <sub>STG</sub>                  | Storage Temperature (Plastic)                  | -55 ~ 125  | °C   |
| V <sub>IN</sub> /V <sub>OUT</sub> | Voltage on any Pin Relative to V <sub>SS</sub> | -1.0 ~ 7.0 | V    |
| V <sub>CC</sub>                   | Power Supply Voltage                           | -1.0 ~ 7.0 | V    |
| I <sub>OUT</sub>                  | Short Circuit Output Current                   | 50         | mA   |
| P <sub>D</sub>                    | Power Dissipation                              | 8          | W    |

- \*Note: 1. Stress greater than above "Absolute Maximum Ratings" may cause permanent damage to the device.

### Recommended DC Operating Conditions (T<sub>A</sub> = 0 ~ 70°C)

| Symbol          | Parameter          | Min  | Typ | Max | Unit | Note |
|-----------------|--------------------|------|-----|-----|------|------|
| V <sub>CC</sub> | Supply Voltage     | 4.5  | 5.0 | 5.5 | V    | 1    |
| V <sub>IH</sub> | Input High Voltage | 2.4  | -   | 6.5 | V    | 1    |
| V <sub>IL</sub> | Input Low Voltage  | -1.0 | -   | 0.8 | V    | 1    |

- \*Note: 1. All voltages referenced to V<sub>SS</sub>.

**DC Electrical Characteristics** ( $V_{CC} = 5V \pm 10\%$ ,  $T_A = 0 \sim 70^\circ C$ )

| Symbol    | Parameter                                                                                                                                                                               |                                                             | Min | Max      | Unit    | Note |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----|----------|---------|------|
| $V_{OH}$  | Output Level<br>Output "H" Level Voltage ( $I_{OUT} = -5mA$ )                                                                                                                           |                                                             | 2.4 | $V_{CC}$ | V       |      |
| $V_{OL}$  | Output Level<br>Output "L" Level Voltage ( $I_{OUT} = 4.2mA$ )                                                                                                                          |                                                             | 0   | 0.4      | V       |      |
| $I_{CC1}$ | Operating Current<br>Average Power Supply Operating Current<br>( $\overline{RAS}$ , $\overline{CAS}$ , Address Cycling: $t_{RC} = t_{RC \min}$ )                                        | 60 ns                                                       | -   | 880      | mA      | 1, 2 |
|           |                                                                                                                                                                                         | 70 ns                                                       | -   | 800      |         |      |
|           |                                                                                                                                                                                         | 80 ns                                                       | -   | 720      |         |      |
| $I_{CC2}$ | Standby Current (TTL)<br>Power Supply Standby Current<br>( $\overline{RAS}$ , $\overline{CAS} = V_{IH}$ )                                                                               |                                                             | -   | 16       | mA      |      |
| $I_{CC3}$ | $\overline{RAS}$ Only Refresh Current<br>Average Power Supply Current<br>$\overline{RAS}$ Only Mode<br>( $\overline{RAS}$ Cycling, $\overline{CAS} = V_{IH}$ , $t_{RC} = t_{RC \min}$ ) | 60 ns                                                       | -   | 880      | mA      | 2    |
|           |                                                                                                                                                                                         | 70 ns                                                       | -   | 800      |         |      |
|           |                                                                                                                                                                                         | 80 ns                                                       | -   | 720      |         |      |
| $I_{CC4}$ | Fast Page Mode Current<br>Average Power Supply Current<br>Fast Page Mode<br>( $\overline{RAS} = V_{IL}$ , $\overline{CAS}$ , Address Cycling : $t_{RC} = t_{RC \min}$ )                 | 60 ns                                                       | -   | 880      | mA      | 1, 3 |
|           |                                                                                                                                                                                         | 70 ns                                                       | -   | 800      |         |      |
|           |                                                                                                                                                                                         | 80 ns                                                       | -   | 720      |         |      |
| $I_{CC5}$ | Standby Current (CMOS)<br>Power Supply Standby Current<br>( $\overline{RAS}$ , $\overline{CAS} \geq V_{CC} - 0.2V$ )                                                                    |                                                             | -   | 8        | mA      |      |
| $I_{CC6}$ | $\overline{CAS}$ before $\overline{RAS}$ Refresh Current<br>( $t_{RC} = t_{RC \min}$ )                                                                                                  | 60 ns                                                       | -   | 880      | mA      |      |
|           |                                                                                                                                                                                         | 70 ns                                                       | -   | 800      |         |      |
|           |                                                                                                                                                                                         | 80 ns                                                       | -   | 720      |         |      |
| $I_{CC7}$ | Standby Current $\overline{RAS} = V_{IH}$<br>$\overline{CAS} = V_{IL}$<br>$D_{OUT} = \text{Enable}$                                                                                     |                                                             | -   | 40       | mA      | 1    |
| $I_{IL}$  | Input Leakage Current<br>Any Input ( $0V \leq V_{IN} \leq 7V$ )<br>All Other Pins Not Under Test = 0V                                                                                   | ADDR, $\overline{RAS}$ , $\overline{CAS}$ , $\overline{WE}$ | -80 | 80       | $\mu A$ |      |
| $I_{OL}$  | Output Leakage Current<br>( $D_{OUT}$ is Disabled, $0V \leq V_{OUT} \leq 7V$ )                                                                                                          | DQ                                                          | -20 | 20       | $\mu A$ |      |

Note: 1.  $I_{CC}$  depends on output load condition when the device is selected.  $I_{CC}(\max)$  is specified at the output open condition.

2. Address can be changed once or less while  $\overline{RAS} = V_{IL}$ .

3. Address can be changed once or less while  $\overline{CAS} = V_{IH}$ .

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

| Symbol   | Parameter                   | Min | Max | Unit | Note |
|----------|-----------------------------|-----|-----|------|------|
| $C_{II}$ | Input Capacitance (Address) | -   | 60  | pF   | 1    |
| $C_{I2}$ | Input Capacitance (Clocks)  | -   | 75  | pF   | 1, 2 |
| $C_{IO}$ | Input Capacitance (DQ0~DQ7) | -   | 17  | pF   | 1, 2 |

Note: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.  
 2. CAS =  $V_{IH}$  to disable Dout.

**AC Electrical Characteristics** ( $V_{CC} = 5V \pm 10\%$ ,  $T_A = 0 \sim 70^\circ C$ , Notes 1, 14)

The GMM784000CS writes data only in early write cycle ( $twcs \geq twcs(min)$ ).  
 Delayed write cycle is not available because of I/O common.

**Read, Write and Refresh Cycle (Common Parameters)**

| Symbol    | Parameter                                           | GMM784000<br>CS-60 |        | GMM784000<br>CS-70 |        | GMM784000<br>CS-80 |        | Unit | Note |
|-----------|-----------------------------------------------------|--------------------|--------|--------------------|--------|--------------------|--------|------|------|
|           |                                                     | Min                | Max    | Min                | Max    | Min                | Max    |      |      |
| $t_{RC}$  | Random Read or Write Cycle Time                     | 110                | -      | 130                | -      | 150                | -      | ns   |      |
| $t_{RP}$  | $\overline{RAS}$ Precharge Time                     | 40                 | -      | 50                 | -      | 60                 | -      | ns   |      |
| $t_{RAS}$ | $\overline{RAS}$ Pulse Width                        | 60                 | 10,000 | 70                 | 10,000 | 80                 | 10,000 | ns   |      |
| $t_{CAS}$ | $\overline{CAS}$ Pulse Width                        | 15                 | 10,000 | 20                 | 10,000 | 20                 | 10,000 | ns   |      |
| $t_{ASR}$ | Row Address Setup Time                              | 0                  | -      | 0                  | -      | 0                  | -      | ns   |      |
| $t_{RAH}$ | Row Address Hold Time                               | 10                 | -      | 10                 | -      | 10                 | -      | ns   |      |
| $t_{ASC}$ | Column Address Setup Time                           | 0                  | -      | 0                  | -      | 0                  | -      | ns   |      |
| $t_{CAH}$ | Column Address Hold Time                            | 15                 | -      | 15                 | -      | 15                 | -      | ns   |      |
| $t_{RCD}$ | $\overline{RAS}$ to $\overline{CAS}$ Delay Time     | 20                 | 45     | 20                 | 50     | 20                 | 60     | ns   | 8    |
| $t_{RAD}$ | $\overline{RAS}$ to Column Address Delay Time       | 15                 | 30     | 15                 | 35     | 15                 | 40     | ns   | 9    |
| $t_{RSH}$ | $\overline{RAS}$ Hold Time                          | 15                 | -      | 20                 | -      | 20                 | -      | ns   |      |
| $t_{CSH}$ | $\overline{CAS}$ Hold Time                          | 60                 | -      | 70                 | -      | 80                 | -      | ns   |      |
| $t_{CRP}$ | $\overline{CAS}$ to $\overline{RAS}$ Precharge Time | 10                 | -      | 10                 | -      | 10                 | -      | ns   |      |
| $t_T$     | Transition Time<br>(Rise and Fall)                  | 3                  | 50     | 3                  | 50     | 3                  | 50     | ns   | 7    |
| $t_{REF}$ | Refresh Period (1024 Cycles)                        | -                  | 16     | -                  | 16     | -                  | 16     | ms   |      |

## Read Cycle

| Symbol           | Parameter                                           | GMM784000<br>CS-60 |     | GMM784000<br>CS-70 |     | GMM784000<br>CS-80 |     | Unit | Note |
|------------------|-----------------------------------------------------|--------------------|-----|--------------------|-----|--------------------|-----|------|------|
|                  |                                                     | Min                | Max | Min                | Max | Min                | Max |      |      |
| t <sub>RAC</sub> | Access Time from $\overline{\text{RAS}}$            | -                  | 60  | -                  | 70  | -                  | 80  | ns   | 2, 3 |
| t <sub>CAC</sub> | Access Time from $\overline{\text{CAS}}$            | -                  | 15  | -                  | 20  | -                  | 20  | ns   | 3, 4 |
| t <sub>AA</sub>  | Access Time from Column Address                     | -                  | 30  | -                  | 35  | -                  | 40  | ns   | 3, 5 |
| t <sub>RCS</sub> | Read Command Setup Time                             | 0                  | -   | 0                  | -   | 0                  | -   | ns   |      |
| t <sub>RCH</sub> | Read Command Hold Time to $\overline{\text{CAS}}$   | 0                  | -   | 0                  | -   | 0                  | -   | ns   |      |
| t <sub>RRH</sub> | Read Command Hold Time to $\overline{\text{RAS}}$   | 0                  | -   | 0                  | -   | 0                  | -   | ns   |      |
| t <sub>RAL</sub> | Column Address to $\overline{\text{RAS}}$ Lead Time | 30                 | -   | 35                 | -   | 40                 | -   | ns   |      |
| t <sub>OFF</sub> | Output Buffer Turn-off Time                         | 0                  | 20  | 0                  | 20  | 0                  | 20  | ns   | 6    |

## Write Cycle

| Symbol           | Parameter                                          | GMM784000<br>CS-60 |     | GMM784000<br>CS-70 |     | GMM784000<br>CS-80 |     | Unit | Note |
|------------------|----------------------------------------------------|--------------------|-----|--------------------|-----|--------------------|-----|------|------|
|                  |                                                    | Min                | Max | Min                | Max | Min                | Max |      |      |
| t <sub>WCS</sub> | Write Command Setup Time                           | 0                  | -   | 0                  | -   | 0                  | -   | ns   | 10   |
| t <sub>WCH</sub> | Write Command Hold Time                            | 15                 | -   | 15                 | -   | 15                 | -   | ns   |      |
| t <sub>WP</sub>  | Write Command Pulse Width                          | 10                 | -   | 10                 | -   | 10                 | -   | ns   |      |
| t <sub>RWL</sub> | Write Command to $\overline{\text{RAS}}$ Lead Time | 15                 | -   | 20                 | -   | 20                 | -   | ns   |      |
| t <sub>CWL</sub> | Write Command to $\overline{\text{CAS}}$ Lead Time | 15                 | -   | 20                 | -   | 20                 | -   | ns   |      |
| t <sub>DS</sub>  | Data-in Setup Time                                 | 0                  | -   | 0                  | -   | 0                  | -   | ns   | 11   |
| t <sub>DH</sub>  | Data-in Hold Time                                  | 15                 | -   | 15                 | -   | 15                 | -   | ns   | 11   |

## Refresh Cycle

| Symbol           | Parameter                                                                                                       | GMM784000<br>CS-60 |     | GMM784000<br>CS-70 |     | GMM784000<br>CS-80 |     | Unit | Note |
|------------------|-----------------------------------------------------------------------------------------------------------------|--------------------|-----|--------------------|-----|--------------------|-----|------|------|
|                  |                                                                                                                 | Min                | Max | Min                | Max | Min                | Max |      |      |
| t <sub>CSR</sub> | $\overline{\text{CAS}}$ Setup Time<br>( $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle) | 10                 | -   | 10                 | -   | 10                 | -   | ns   |      |
| t <sub>CHR</sub> | $\overline{\text{CAS}}$ Hold Time<br>( $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle)  | 10                 | -   | 10                 | -   | 10                 | -   | ns   |      |
| t <sub>RPC</sub> | $\overline{\text{RAS}}$ Precharge to $\overline{\text{CAS}}$ Hold Time                                          | 10                 | -   | 10                 | -   | 10                 | -   | ns   |      |
| t <sub>CPN</sub> | $\overline{\text{CAS}}$ Precharge Time in Normal Mode                                                           | 10                 | -   | 10                 | -   | 10                 | -   | ns   |      |

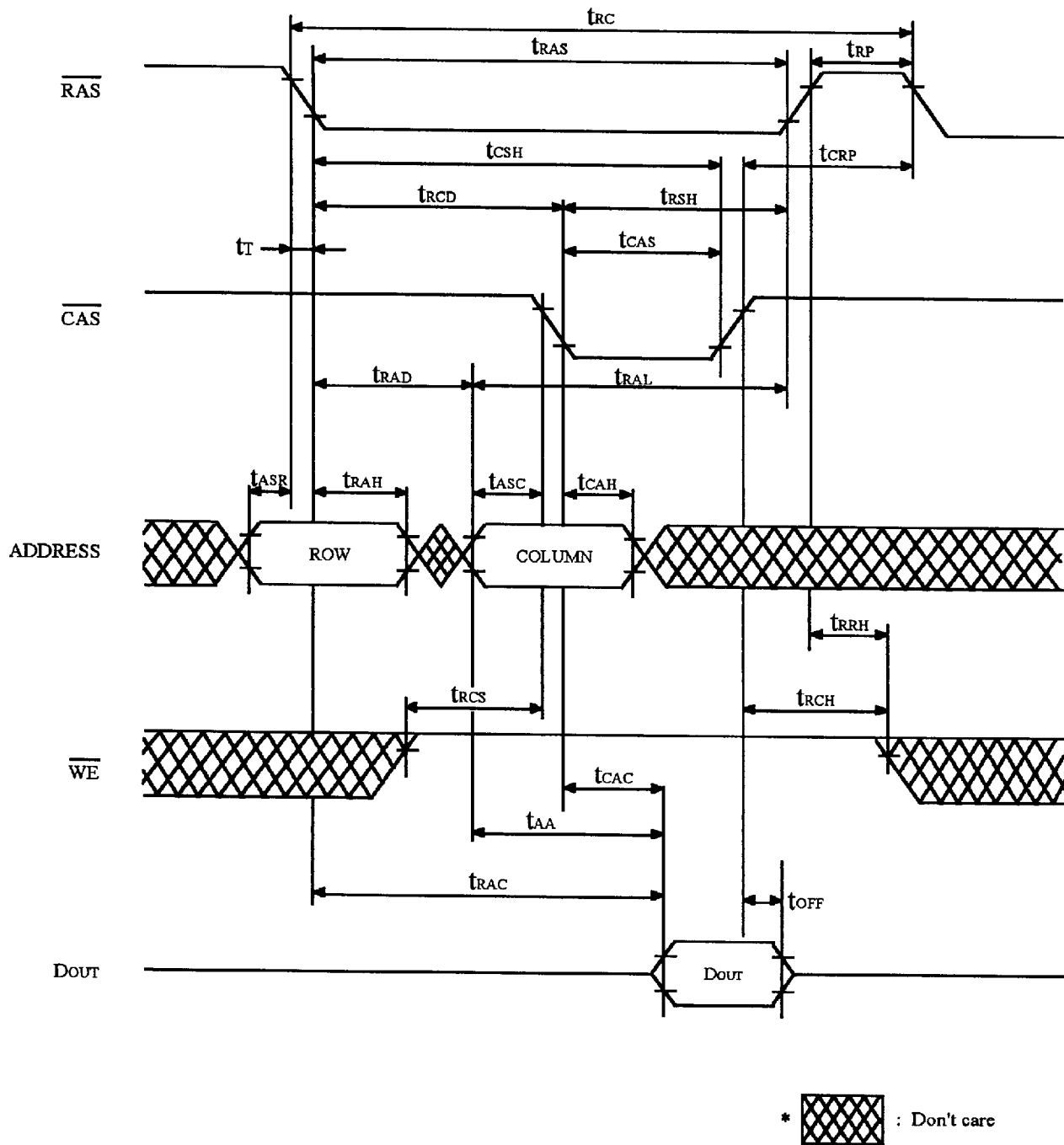
## Fast Page Mode Cycle

| Symbol            | Parameter                                                                | GMM784000<br>CS-60 |         | GMM784000<br>CS-70 |         | GMM784000<br>CS-80 |         | Unit | Note |
|-------------------|--------------------------------------------------------------------------|--------------------|---------|--------------------|---------|--------------------|---------|------|------|
|                   |                                                                          | Min                | Max     | Min                | Max     | Min                | Max     |      |      |
| t <sub>PC</sub>   | Fast Page Mode Cycle Time                                                | 40                 | -       | 45                 | -       | 50                 | -       | ns   |      |
| t <sub>CP</sub>   | Fast Page Mode $\overline{\text{CAS}}$ Precharge Time                    | 10                 | -       | 10                 | -       | 10                 | -       | ns   |      |
| t <sub>RASP</sub> | Fast Page Mode $\overline{\text{RAS}}$ Pulse Width                       | -                  | 100,000 | -                  | 100,000 | -                  | 100,000 | ns   | 12   |
| t <sub>ACP</sub>  | Access Time from $\overline{\text{CAS}}$ Precharge                       | -                  | 35      | -                  | 40      | -                  | 45      | ns   | 13   |
| t <sub>RHCP</sub> | $\overline{\text{RAS}}$ Hold Time from $\overline{\text{CAS}}$ Precharge | 35                 | -       | 40                 | -       | 45                 | -       | ns   |      |

### Notes:

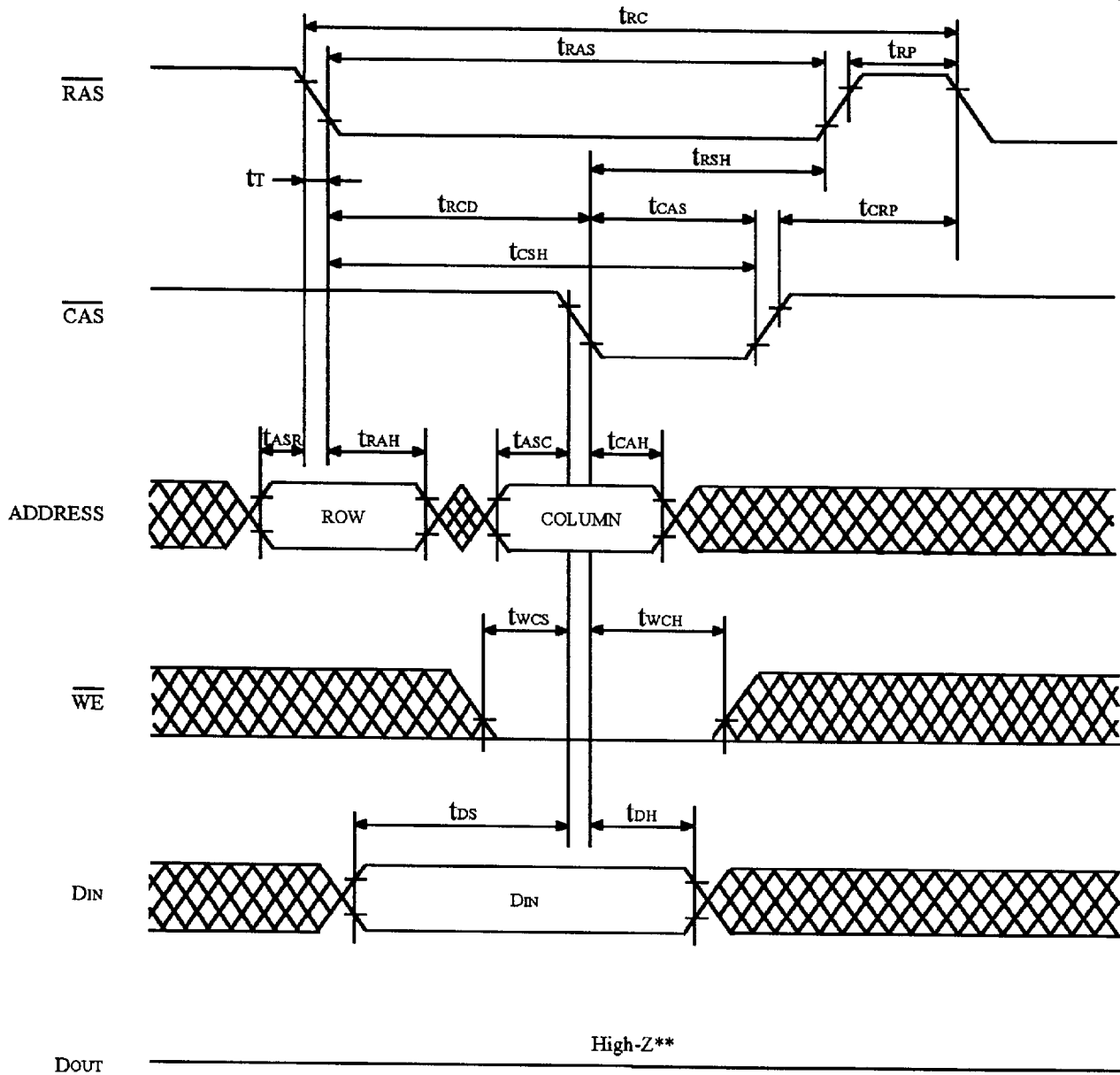
1. AC measurements assume  $t_r = 5 \text{ ns}$ .
2. Assumes that  $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$ . If  $t_{\text{RCD}}$  or  $t_{\text{RAD}}$  is greater than the maximum recommended value shown in this table,  $t_{\text{RAC}}$  exceeds the value shown.
3. Measured with a load circuit equivalent to 2TTL loads and 100pF.
4. Assumes that  $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$ .
5. Assumes that  $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \geq t_{\text{RAD}}(\text{max})$ .
6.  $t_{\text{OFF}}(\text{max})$  defines the time at which the outputs achieve the open circuit condition and is not referenced to output voltage levels.
7.  $V_{\text{IH}}(\text{min})$  and  $V_{\text{IL}}(\text{max})$  are reference levels for measuring timing of input signals. Also, transition times are measured between  $V_{\text{IH}}$  and  $V_{\text{IL}}$ .
8. Operation with the  $t_{\text{RCD}}(\text{max})$  limit insures that  $t_{\text{RAC}}(\text{max})$  can be met,  $t_{\text{RCD}}(\text{max})$  is specified as a reference point only, if  $t_{\text{RCD}}$  is greater than the specified  $t_{\text{RCD}}(\text{max})$  limit, then access time is controlled exclusively by  $t_{\text{CAC}}$ .
9. Operation with the  $t_{\text{RAD}}(\text{max})$  limit insures that  $t_{\text{RAC}}(\text{max})$  can be met,  $t_{\text{RAD}}(\text{max})$  is specified as a reference point only, if  $t_{\text{RAD}}$  is greater than the specified  $t_{\text{RAD}}(\text{max})$  limit, then access time is controlled exclusively by  $t_{\text{AA}}$ .
10.  $t_{\text{WCS}}$  is not restrictive operating parameter. It is included in the data sheet as electrical characteristics only. If  $t_{\text{WCS}} \geq t_{\text{WCS}}(\text{min})$ , the cycle is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle.
11. These parameters are referenced to  $\overline{\text{CAS}}$  leading edge in early write cycles.
12.  $t_{\text{RASP}}$  is defines  $\overline{\text{RAS}}$  pulse width in Fast Page Mode cycles.
13. Access time is determined by the longer of  $t_{\text{AA}}$  or  $t_{\text{CAC}}$  or  $t_{\text{ACP}}$ .
14. An initial pause of 100 $\mu\text{s}$  is required after power up followed by a minimum of eight initialization cycles (any combination of cycles containing  $\overline{\text{RAS}}$  clock such as  $\overline{\text{RAS}}$  only refresh). If the internal refresh counter is used, a minimum of eight  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh cycles are required.

**Timing Waveforms**



**FIGURE 1. READ CYCLE**

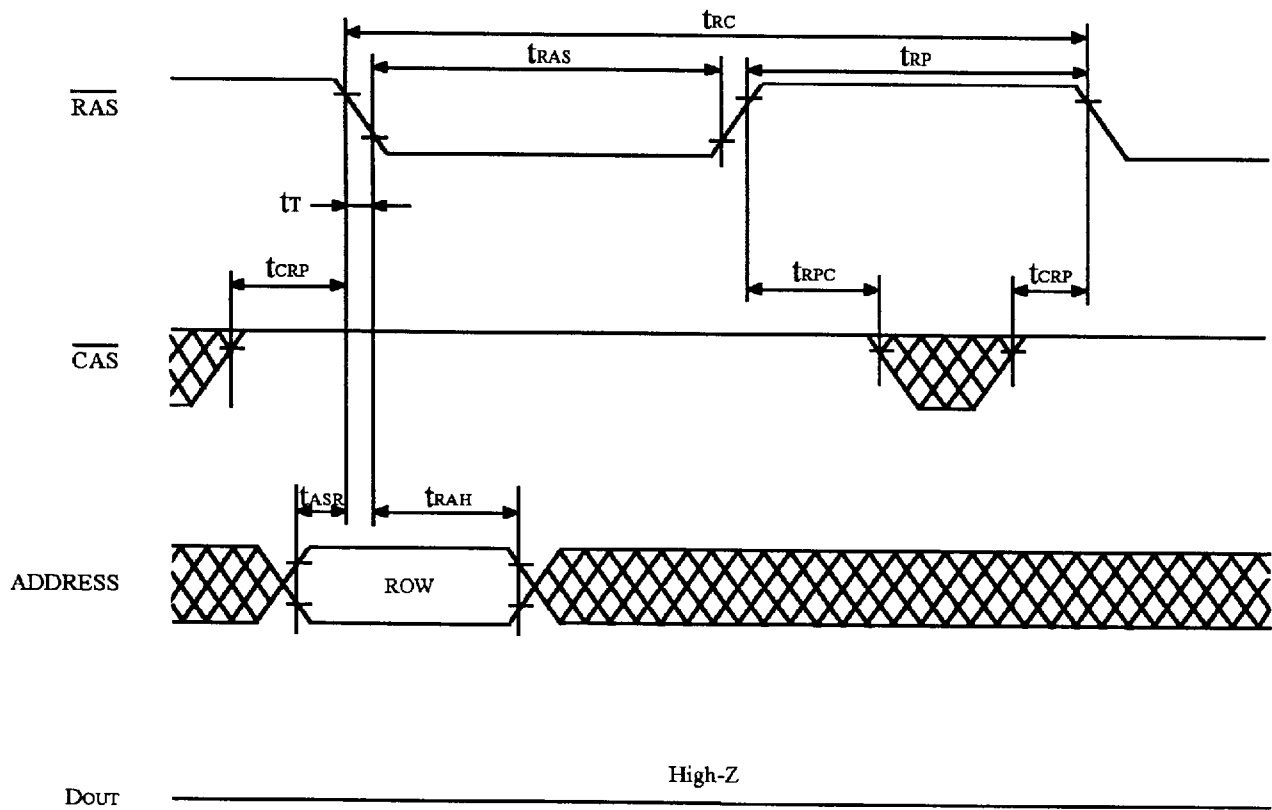




\*  : Don't care

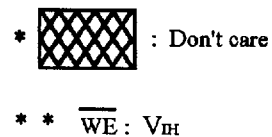
\*\*  $t_{WCS} \geq t_{WCS}(\text{min})$

FIGURE 2. EARLY WRITE CYCLE

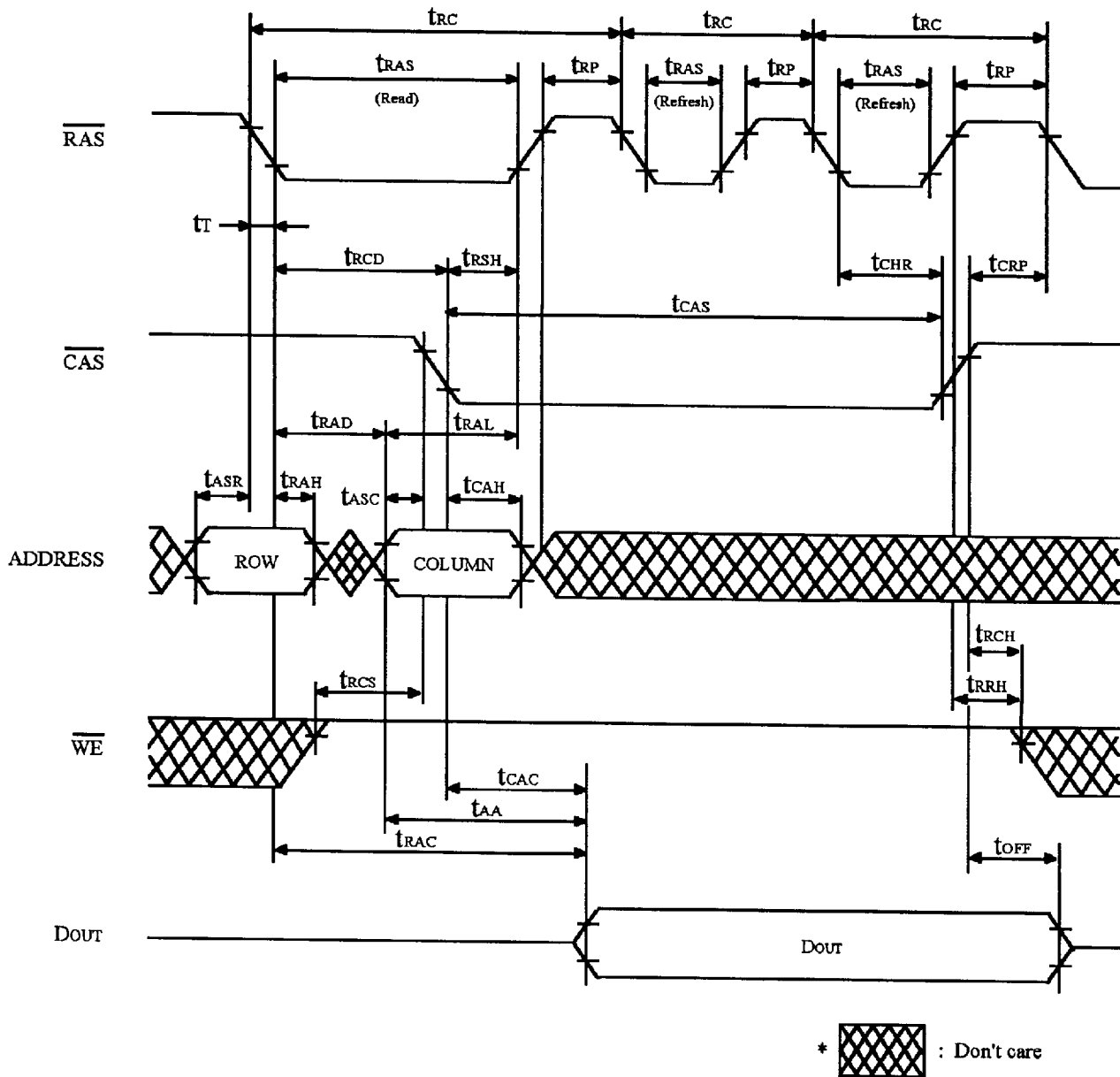


\*  : Don't care  
 \*\*  $\overline{\text{WE}}$  : Don't care

FIGURE 3.  $\overline{\text{RAS}}$  ONLY REFRESH CYCLE



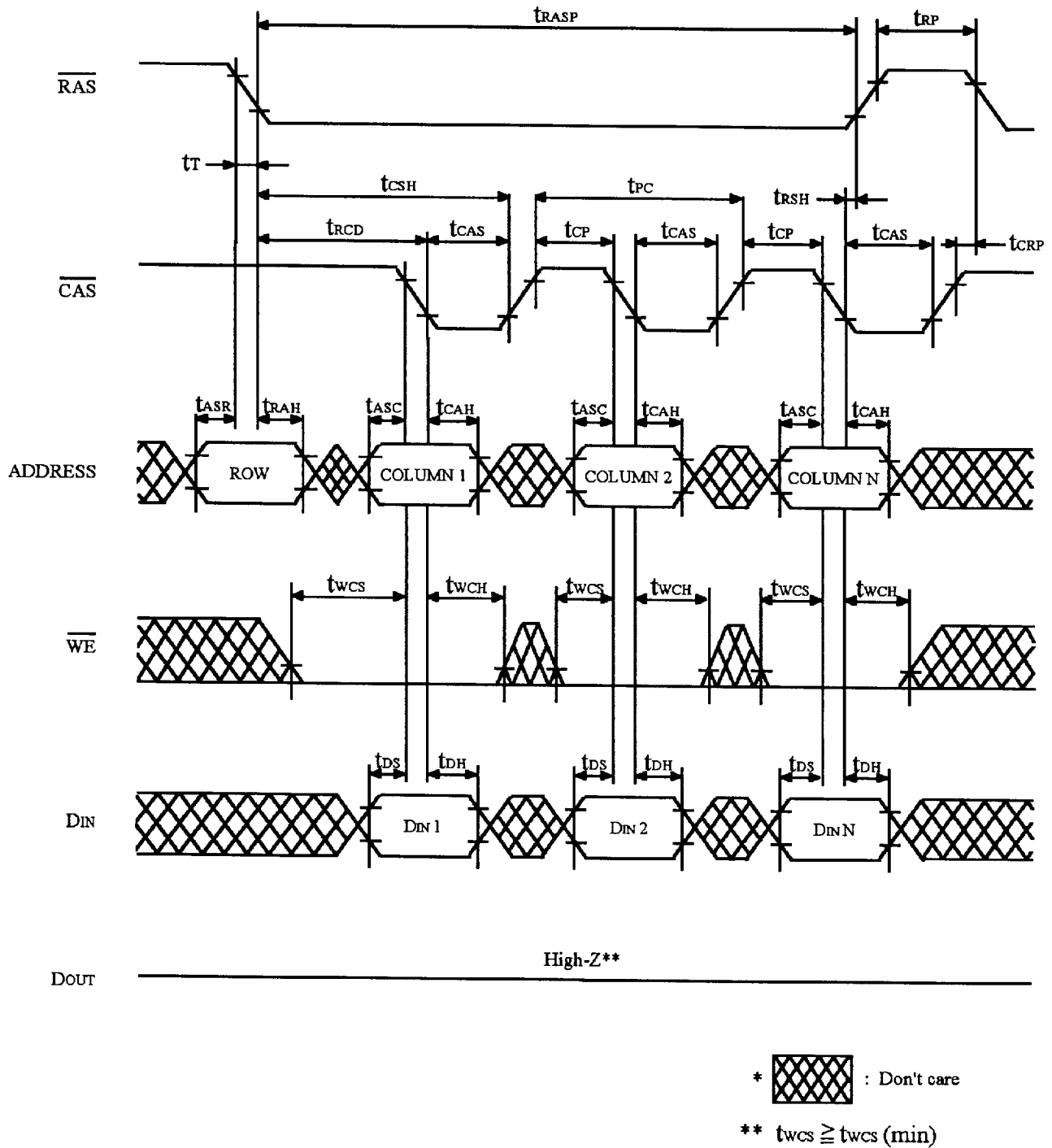
4028757 0007503 767



**FIGURE 5. HIDDEN REFRESH CYCLE**



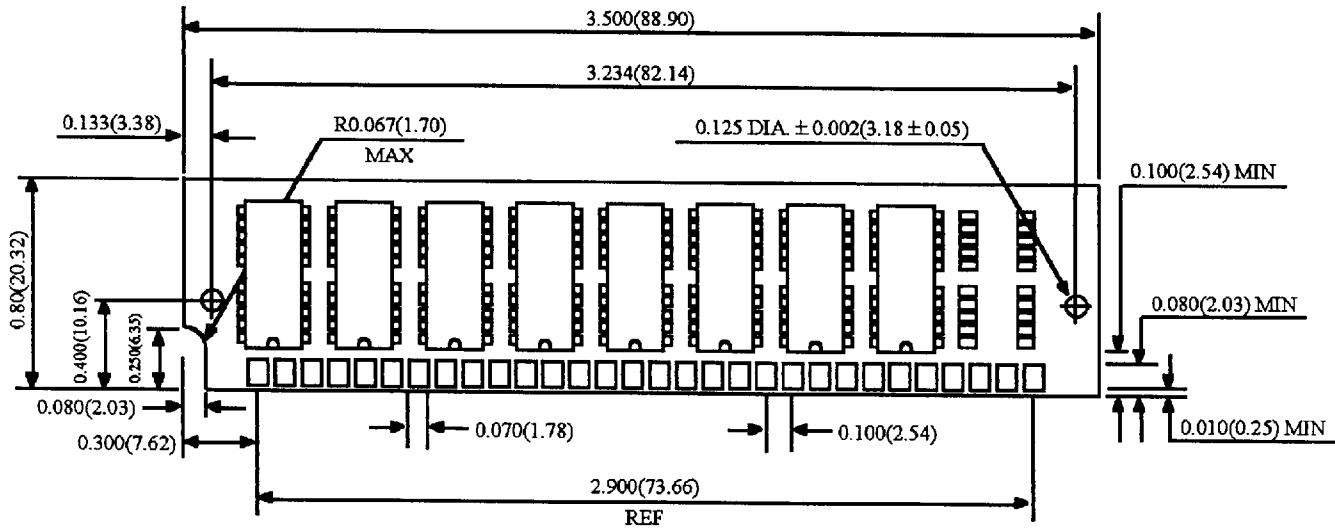
**FIGURE 6. FAST PAGE MODE READ CYCLE**



**FIGURE 7. FAST PAGE MODE EARLY WRITE CYCLE**

**Package Dimension**

Unit: inch (mm)



Tolerances :  $\pm 0.005(0.13)$  unless otherwise specified.

