



## Description

The GM71C4800C/CL is the new generation dynamic RAM organized 524,288 x 8 bit. GM71C4800C/CL has realized higher density, higher performance and various functions by utilizing advanced CMOS process technology. The GM71C4800C/CL offers Fast Page Mode as a high speed access mode. Multiplexed address inputs permit the GM71C4800C/CL to be packaged in standard 400 mil 28pin plastic SOJ. The package size provides high system bit densities and is compatible with widely available automated testing and insertion equipment. System oriented features include single power supply of 5V+/-10% tolerance, direct interfacing capability with high performance logic families such as Schottky TTL.

## Features

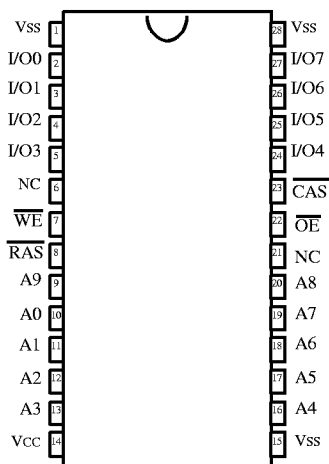
- \* 524,288 Words x 8 Bit Organization
- \* Fast Page Mode Capability
- \* Single Power Supply (5V+/-10%)
- \* Fast Access Time & Cycle Time (Unit: ns)

|                     | t <sub>RAC</sub> | t <sub>CAC</sub> | t <sub>RC</sub> | t <sub>PC</sub> |
|---------------------|------------------|------------------|-----------------|-----------------|
| GM71C(S)4800C/CL-60 | 60               | 18               | 110             | 40              |
| GM71C(S)4800C/CL-70 | 70               | 20               | 130             | 45              |

- \* Low Power  
Active : 715/660 mW(MAX)  
Standby : 5.5mW (CMOS level : MAX)  
1.1mW (L-series)
- \*  $\overline{\text{RAS}}$  Only Refresh,  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  Refresh, Hidden Refresh Capability
- \* All inputs and outputs TTL Compatible
- \* 1024 Refresh Cycles/16S $\bar{\prime}$
- \* 1024 Refresh Cycles/128S $\bar{\prime}$  (L-series)
- \* Battery Back Up Operation (L-series)
- \* Self-Refresh Operation (GM71C4800C/CL)

## Pin Configuration

### 28 SOJ



(Top View)

### **Pin Description**

| <b>Pin</b>              | <b>Function</b>        | <b>Pin</b>             | <b>Function</b>   |
|-------------------------|------------------------|------------------------|-------------------|
| A0-A9                   | Address Inputs         | $\overline{\text{WE}}$ | Read/Write Enable |
| A0-A9                   | Refresh Address Inputs | $\overline{\text{OE}}$ | Output Enable     |
| I/O0-I/O7               | Data-In/Out            | V <sub>cc</sub>        | Power (+5V)       |
| $\overline{\text{RAS}}$ | Row Address Strobe     | V <sub>ss</sub>        | Ground            |
| $\overline{\text{CAS}}$ | Column Address Strobe  | NC                     | No Connection     |

### **Ordering Information**

| <b>Type No.</b>                      | <b>Access Time</b> | <b>Package</b>                   |
|--------------------------------------|--------------------|----------------------------------|
| GM71C4800CJ-60<br>GM71C4800CJ-70     | 60ns<br>70§        | 400 Mil<br>28 Pin<br>Plastic SOJ |
| GM71CS4800CLJ-60<br>GM71CS4800CLJ-70 | 60ns<br>70§        | 400 Mil<br>28Pin<br>Plastic SOJ  |

### 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>                   | Voltage on V <sub>CC</sub> Relative to V <sub>SS</sub> | -1.0 ~ 7.0 | V    |
| I <sub>OUT</sub>                  | Short Circuit Output Current                           | 50         | mA   |
| P <sub>D</sub>                    | Power Dissipation                                      | 1.0        | W    |

\*Note: Operation at or above Absolute Maximum Ratings can adversely affect device reliability.

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

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

\*Note: All voltage referred to V<sub>SS</sub>

### Truth Table

| $\overline{\text{RAS}}$ | $\overline{\text{CAS}}$ | $\overline{\text{WE}}$ | $\overline{\text{OE}}$ | I/O0-I/O7        | I/O8-I/O15       | Operation                         |
|-------------------------|-------------------------|------------------------|------------------------|------------------|------------------|-----------------------------------|
|                         | H                       | H                      | H                      | High-Z           | High-Z           | Standby                           |
| L                       | H                       | H                      | H                      | High-Z           | High-Z           | Refresh                           |
| L                       | L                       | H                      | L                      | D <sub>OUT</sub> | High-Z           | Lower Byte Read                   |
|                         | H                       | H                      | L                      | High-Z           | D <sub>OUT</sub> | Upper Byte Read                   |
| L                       | L                       | H                      | L                      | D <sub>OUT</sub> | D <sub>OUT</sub> | Word Read                         |
| L                       | L                       | L                      | H                      | D <sub>IN</sub>  | Don't Care       | Lower Byte Write                  |
| L                       | H                       | L                      | H                      | Don't Care       | D <sub>IN</sub>  | Upper Byte Write                  |
| L                       | L                       | L                      | H                      | D <sub>IN</sub>  | D <sub>IN</sub>  | Word Write                        |
| L                       | L                       | H                      | H                      | High-Z           | High-Z           |                                   |
| H to L                  | L                       | -                      | -                      | High-Z           | High-Z           | CBR Refresh<br>or<br>Self Refresh |
| H to L                  | H                       | -                      | -                      | High-Z           | High-Z           |                                   |
| H to L                  | L                       | -                      | -                      | High-Z           | High-Z           |                                   |

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

| Symbol            | Parameter                                                                                                                                                                                                                               |              | Min | Max             | Unit | Note |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----|-----------------|------|------|
| V <sub>OH</sub>   | Output Level<br>Output "H" Level Voltage (I <sub>OUT</sub> = -2mA)                                                                                                                                                                      |              | 2.4 | V <sub>CC</sub> | V    |      |
| V <sub>OL</sub>   | Output Level<br>Output "L" Level Voltage (I <sub>OUT</sub> = 2mA)                                                                                                                                                                       |              | 0   | 0.4             | V    |      |
| I <sub>CC1</sub>  | Operating Current<br>Average Power Supply Operating Current<br>( $\overline{RAS}$ , $\overline{CAS}$ Cycling; t <sub>RC</sub> = t <sub>RC min</sub> )                                                                                   | 60 $\mu$ S   | -   | 130             | mA   | 1, 2 |
|                   |                                                                                                                                                                                                                                         | 70 $\mu$ S   | -   | 120             |      |      |
| I <sub>CC2</sub>  | Standby Current (TTL)<br>Power Supply Standby Current<br>( $\overline{RAS}$ , $\overline{CAS}$ = V <sub>IH</sub> , D <sub>OUT</sub> = High-Z)                                                                                           |              | -   | 2               | mA   |      |
| I <sub>CC3</sub>  | $\overline{RAS}$ -Only Refresh Current<br>Average Power Supply Current<br>(t <sub>RC</sub> = t <sub>RC min</sub> )                                                                                                                      | 60 $\mu$ S   | -   | 130             | mA   | 2    |
|                   |                                                                                                                                                                                                                                         | 70 $\mu$ S   | -   | 120             |      |      |
| I <sub>CC4</sub>  | Fast Page mode current<br>Average Power Supply Current<br>(t <sub>PC</sub> = t <sub>PC min</sub> )                                                                                                                                      | 60 $\mu$ S   | -   | 130             | mA   | 1, 3 |
|                   |                                                                                                                                                                                                                                         | 70 $\mu$ S   | -   | 120             |      |      |
| I <sub>CC5</sub>  | Standby Current (CMOS)<br>Power Supply Standby Current<br>( $\overline{RAS}$ , $\overline{CAS}$ , $\overline{WE}$ , $\overline{OE}$ ≥ V <sub>CC</sub> -0.2V, D <sub>OUT</sub> =High-Z)                                                  |              | -   | 1               | mA   | 4    |
|                   |                                                                                                                                                                                                                                         |              | -   | 200             | uA   | 4,5  |
| I <sub>CC6</sub>  | $\overline{CAS}$ -before- $\overline{RAS}$ Refresh Current<br>(t <sub>RC</sub> = t <sub>RC min</sub> )                                                                                                                                  | 60 $\mu$ S   | -   | 130             | mA   |      |
|                   |                                                                                                                                                                                                                                         | 70 $\mu$ S   | -   | 120             |      |      |
| I <sub>CC7</sub>  | Battery Back Up Current<br>(Standby with CBR Refresh)<br>(t <sub>RC</sub> =125 $\mu$ s, t <sub>RAS</sub> ≤1 $\mu$ s, $\overline{WE}$ , $\overline{OE}$ =V <sub>IH</sub> , $\overline{CAS}$ =V <sub>IL</sub> , D <sub>OUT</sub> =High-Z) |              | -   | 300             | uA   | 4, 5 |
| I <sub>CC8</sub>  | Standby Current $\overline{RAS}$ = V <sub>IH</sub><br>CAS = V <sub>IL</sub><br>D <sub>OUT</sub> = Enable                                                                                                                                |              | -   | 5               | mA   | 1    |
| I <sub>CC9</sub>  | Self-Refresh Mode Current<br>( $\overline{RAS}$ , $\overline{CAS}$ ≤0.2V, D <sub>OUT</sub> = High-Z)                                                                                                                                    | GM71C4800C   | -   | 1               | mA   | 6    |
|                   |                                                                                                                                                                                                                                         | GM71CS4800CL | -   | 200             | uA   |      |
| I <sub>I(L)</sub> | Input Leakage Current<br>Any Input (0V ≤ V <sub>IN</sub> ≤ 6.5V)                                                                                                                                                                        |              | -10 | 10              | uA   |      |
| I <sub>O(L)</sub> | Output Leakage Current<br>(D <sub>OUT</sub> is Disabled, 0V ≤ V <sub>OUT</sub> ≤ 6.5V)                                                                                                                                                  |              | -10 | 10              | uA   |      |

- 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  $\overline{LCAS}$  and  $\overline{UCAS} = V_{IH}$ .  
4.  $V_{IH} \geq V_{CC} - 0.2V$ ,  $0 \leq V_{IL} \leq 0.2V$ , Address can be changed once or less while  $\overline{RAS} = V_{IL}$ .  
5. L-Series.  
6. Self-refresh series. (GM71C(S)4800C/CL)

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

| Symbol           | Parameter                        | Min | Max | Unit | Note |
|------------------|----------------------------------|-----|-----|------|------|
| C <sub>I1</sub>  | Input Capacitance (Address)      | -   | 5   | §    | 1    |
| C <sub>I2</sub>  | Input Capacitance (Clocks)       | -   | 7   | §    | 1    |
| C <sub>I/O</sub> | Output Capacitance (Data-In/Out) | -   | 7   | §    | 1, 2 |

Note: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.

2. OE = V<sub>IH</sub> to disable D<sub>OUT</sub>.

**AC Characteristics** ( $V_{CC} = 5V \pm 10\%$ ,  $T_A = 0 \sim 70^\circ C$ , Notes 1, 14, 15, 17, 18)

Test Conditions

Input rise and fall times : 5ns

Input level : V<sub>IL</sub> = 0V, V<sub>IH</sub> = 3.0V

Input timing reference level : 0.8V, 2.4V

Output timing reference level : 0.8V, 2.4V

Output load : 2TTL gate + C<sub>L</sub> (100pF)

(Including scope and jig)

**Read, Write, Read-Modify-Write and Refresh Cycles** (Common Parameters)

| Symbol           | Parameter                                           | GM71C(S)4800<br>C/CL-60 |        | GM71C(S)4800<br>C/CL-70 |        | Unit | Note |
|------------------|-----------------------------------------------------|-------------------------|--------|-------------------------|--------|------|------|
|                  |                                                     | Min                     | Max    | Min                     | Max    |      |      |
| t <sub>RC</sub>  | Random Read or Write Cycle Time                     | 110                     | 130    |                         | -      | §    |      |
| t <sub>RP</sub>  | $\overline{RAS}$ Precharge Time                     | 40                      | -      | 50                      | -      | §    |      |
| t <sub>CP</sub>  | $\overline{CAS}$ Precharge Time                     | 10                      |        | 10                      | -      | §    | 22   |
| t <sub>RAS</sub> | $\overline{RAS}$ Pulse Width                        | 60                      | 10,000 | 70                      | 10,000 | §    |      |
| t <sub>CAS</sub> | $\overline{CAS}$ Pulse Width                        | 15                      |        | 20                      | 10,000 | §    |      |
| t <sub>ASR</sub> | Row Address Set-up Time                             | 0                       | -      | 0                       | -      | §    |      |
| t <sub>RAH</sub> | Row Address Hold Time                               | 10                      | -      | 10                      | -      | §    |      |
| t <sub>ASC</sub> | Column Address Set-up Time                          | 0                       | -      | 0                       | -      | §    | 19   |
| t <sub>CAH</sub> | Column Address Hold Time                            | 15                      |        | 15                      | -      | §    | 19   |
| t <sub>RCD</sub> | $\overline{RAS}$ to $\overline{CAS}$ Delay Time     | 20                      | 45     | 20                      | 50     | §    | 8    |
| t <sub>RAD</sub> | $\overline{RAS}$ to Column Address Delay Time       | 15                      | 30     | 15                      | 35     | §    | 9    |
| t <sub>RSH</sub> | $\overline{RAS}$ Hold Time                          | 15                      | -      | 20                      | -      | §    |      |
| t <sub>CSH</sub> | $\overline{CAS}$ Hold Time                          | 60                      | -      | 70                      | -      | §    |      |
| t <sub>CRP</sub> | $\overline{CAS}$ to $\overline{RAS}$ Precharge Time | 5                       | -      | 5                       | -      | §    | 20   |
| t <sub>OED</sub> | $\overline{OE}$ to D <sub>IN</sub> Delay Time       | 15                      | -      | 20                      | -      | §    | 24   |
| t <sub>DZO</sub> | $\overline{OE}$ Delay Time from D <sub>IN</sub>     | 0                       | -      | 0                       | -      | §    | 25   |
| t <sub>DZC</sub> | $\overline{CAS}$ Setup Time from D <sub>IN</sub>    | 0                       | -      | 0                       | -      | §    | 25   |
| t <sub>t</sub>   | Transition Time<br>(Rise and Fall)                  | 3                       | 50     | 3                       | 50     | §    | 7    |
| t <sub>REF</sub> | Refresh Period                                      | -                       | 16     | -                       | 16     | §'   |      |
|                  | Refresh Period (L-Series)                           | -                       | 128    | -                       | 128    | §'   |      |

### Read Cycle

| Symbol           | Parameter                                               | GM71C(S)4800<br>C/CL-60 |     | GM71C(S)4800<br>C/CL-70 |     | Unit | Note     |
|------------------|---------------------------------------------------------|-------------------------|-----|-------------------------|-----|------|----------|
|                  |                                                         | Min                     | Max | Min                     | Max |      |          |
| t <sub>RAC</sub> | Access Time from $\overline{\text{RAS}}$                | -                       | 60  | -                       | 70  | §    | 2, 3     |
| t <sub>CAC</sub> | Access Time from $\overline{\text{CAS}}$                | -                       | 15  | -                       | 20  | §    | 3, 4, 13 |
| t <sub>AA</sub>  | Access Time from Address                                | -                       | 30  | -                       | 35  | §    | 3, 5, 13 |
| t <sub>OAC</sub> | Access Time from $\overline{\text{OE}}$                 | -                       | 15  | -                       | 20  | §    | 3        |
| t <sub>RCS</sub> | Read Command Setup Time                                 | 0                       | -   | 0                       | -   | §    | 19       |
| t <sub>RCH</sub> | Read Command Hold Time to $\overline{\text{CAS}}$       | 0                       | -   | 0                       | -   | §    | 16, 19   |
| t <sub>RRH</sub> | Read Command Hold Time to $\overline{\text{RAS}}$       | 0                       | -   | 0                       | -   | §    | 16       |
| t <sub>RAL</sub> | Column Address to $\overline{\text{RAS}}$ Lead Time     | 30                      | -   | 35                      | -   | §    |          |
| t <sub>CAL</sub> | Column Address to $\overline{\text{CAS}}$ Lead Time     | 30                      | -   | 35                      | -   | §    |          |
| t <sub>CLZ</sub> | $\overline{\text{CAS}}$ to Output in Low-Z              | 0                       | -   | 0                       | -   | §    |          |
| t <sub>OH</sub>  | Output Data Hold Time                                   | 5                       | -   | 5                       | -   | §    |          |
| t <sub>OHO</sub> | Output Data Hold Time from $\overline{\text{OE}}$       | 5                       | -   | 5                       | -   | §    |          |
| t <sub>OFF</sub> | Output Buffer Turn-off Time                             | 0                       | 15  | 0                       | 20  | §    | 6        |
| t <sub>OEZ</sub> | Output Buffer Turn-off Time from $\overline{\text{OE}}$ | 0                       | 15  | 0                       | 20  | §    | 6        |
| t <sub>CDD</sub> | $\overline{\text{CAS}}$ to D <sub>IN</sub> Delay Time   | 15                      | -   | 20                      | -   | §    | 24       |

### Write Cycle

| Symbol           | Parameter                                          | GM71C(S)4800<br>C/CL-60 |     | GM71C(S)4800<br>C/CL-70 |     | Unit | Note   |
|------------------|----------------------------------------------------|-------------------------|-----|-------------------------|-----|------|--------|
|                  |                                                    | Min                     | Max | Min                     | Max |      |        |
| t <sub>WCS</sub> | Write Command Setup Time                           | 0                       | -   | 0                       | -   | §    | 10, 19 |
| t <sub>WCH</sub> | Write Command Hold Time                            | 15                      | -   | 15                      | -   | §    | 19     |
| t <sub>WP</sub>  | Write Command Pulse Width                          | 10                      | -   | 10                      | -   | §    |        |
| t <sub>RWL</sub> | Write Command to $\overline{\text{RAS}}$ Lead Time | 15                      | -   | 20                      | -   | §    |        |
| t <sub>CWL</sub> | Write Command to $\overline{\text{CAS}}$ Lead Time | 15                      | -   | 20                      | -   | §    | 21     |
| t <sub>DS</sub>  | Data-in Setup Time                                 | 0                       | -   | 0                       | -   | §    | 11, 21 |
| t <sub>DH</sub>  | Data-in Hold Time                                  | 15                      | -   | 15                      | -   | §    | 11, 21 |

### Read- Modify-Write Cycle

| Symbol           | Parameter                                                    | GM71C(S)4800<br>C/CL-60 |     | GM71C(S)4800<br>C/CL-70 |     | Unit | Note |
|------------------|--------------------------------------------------------------|-------------------------|-----|-------------------------|-----|------|------|
|                  |                                                              | Min                     | Max | Min                     | Max |      |      |
| t <sub>RWC</sub> | Read-Modify-Write Cycle Time                                 | 150                     | -   | 180                     | -   | \$   |      |
| t <sub>RWD</sub> | $\overline{\text{RAS}}$ to $\overline{\text{WE}}$ Delay Time | 80                      | -   | 95                      | -   | \$   | 10   |
| t <sub>CWD</sub> | $\overline{\text{CAS}}$ to $\overline{\text{WE}}$ Delay Time | 35                      | -   | 45                      | -   | \$   | 10   |
| t <sub>AWD</sub> | Column Address to $\overline{\text{WE}}$ Delay Time          | 50                      | -   | 60                      | -   | \$   | 10   |
| t <sub>OEh</sub> | $\overline{\text{OE}}$ Hold Time from $\overline{\text{WE}}$ | 15                      | -   | 20                      | -   | \$   |      |

### Refresh Cycle

| Symbol           | Parameter                                                                                                       | GM71C(S)4800<br>C/CL-60 |     | GM71C(S)4800<br>C/CL-70 |     | Unit | Note |
|------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------|-----|-------------------------|-----|------|------|
|                  |                                                                                                                 | 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                      | -   | \$   | 19   |
| t <sub>CHR</sub> | $\overline{\text{CAS}}$ Hold Time<br>( $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle)  | 10                      | -   | 10                      | -   | \$   | 20   |
| t <sub>RPC</sub> | $\overline{\text{RAS}}$ Precharge to $\overline{\text{CAS}}$ Hold Time                                          | 10                      | -   | 10                      | -   | \$   | 19   |
| t <sub>WRP</sub> | WE Setup time( CBR refresh cycle )                                                                              | 10                      | -   | 10                      | -   | \$   |      |

### Fast Page Mode Cycle

| Symbol            | Parameter                                                                                                        | GM71C(S)4800<br>C/CL-60 |         | GM71C(S)4800<br>C/CL-70 |         | Unit | Note      |
|-------------------|------------------------------------------------------------------------------------------------------------------|-------------------------|---------|-------------------------|---------|------|-----------|
|                   |                                                                                                                  | Min                     | Max     | Min                     | Max     |      |           |
| t <sub>PC</sub>   | Fast Page Mode Cycle Time                                                                                        | 40                      | -       | 45                      | -       | \$   |           |
| t <sub>RASC</sub> | Fast Page Mode $\overline{\text{RAS}}$ Pulse Width                                                               | -                       | 100,000 | -                       | 100,000 | \$   | 12        |
| t <sub>ACP</sub>  | Access Time from $\overline{\text{CAS}}$ Precharge                                                               | -                       | 35      | -                       | 40      | \$   | 3, 13, 20 |
| t <sub>RHCP</sub> | $\overline{\text{RAS}}$ Hold Time from $\overline{\text{CAS}}$ Precharge                                         | 35                      | -       | 40                      | -       | \$   |           |
| t <sub>CPW</sub>  | Fast Page Mode Read-Modify-Write<br>Cycle $\overline{\text{CAS}}$ Precharge to $\overline{\text{WE}}$ Delay Time | 55                      | -       | 65                      | -       | \$   | 10,20     |
| t <sub>PCM</sub>  | Fast Page Mode Read-Modify-Write<br>Cycle Time                                                                   | 80                      | -       | 95                      | -       | \$   |           |

### Self-Refresh Mode

| Symbol            | Parameter                                             | GM71C(S)4800<br>C/CL-60 |     | GM71C(S)4800<br>C/CL-70 |     | Unit | Note |
|-------------------|-------------------------------------------------------|-------------------------|-----|-------------------------|-----|------|------|
|                   |                                                       | Min                     | Max | Min                     | Max |      |      |
| t <sub>RASS</sub> | $\overline{\text{RAS}}$ Pulse Width (Self-Refresh)    | 100                     | -   | 100                     | -   | ns   |      |
| t <sub>RPS</sub>  | $\overline{\text{RAS}}$ Precharge Time (Self-Refresh) | 110                     | -   | 130                     | -   | §    |      |
| t <sub>CHS</sub>  | $\overline{\text{CAS}}$ Hold Time (Self-Refresh)      | -50                     | -   | -50                     | -   | §    | 21   |

#### Notes:

1. AC Measurements assume  $t_r = 5\text{§}$  .
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 2 TTL loads and  $100\text{§}$  .
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.  $t_{\text{OFF}}(\text{max})$  define the time at which the output achieves the open circuit condition and are 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.  $t_{\text{WCS}}$ ,  $t_{\text{RWD}}$ ,  $t_{\text{CWD}}$ ,  $t_{\text{AWD}}$  and  $t_{\text{CPW}}$  are not restrictive operating parameters. They are 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; if  $t_{\text{RWD}} \geq t_{\text{RWD}}(\text{min})$ ,  $t_{\text{CWD}} \geq t_{\text{CWD}}(\text{min})$ ,  $t_{\text{AWD}} \geq t_{\text{AWD}}(\text{min})$  and  $t_{\text{CPW}} \geq t_{\text{CPW}}(\text{min})$ , the cycle is a read modify write and the data output will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indeterminate.
11. These parameters are referred to  $\overline{\text{CAS}}$  leading edge in early write cycle and to  $\overline{\text{WE}}$  leading edge in a delayed write or a read modify write cycle.
12.  $t_{\text{RASC}}$  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  $100\text{§}$  s is required after power up followed by a minimum of eight initialization cycles ( $\overline{\text{RAS}}$  only refresh cycle or  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh cycle). If the internal refresh counter is used, a minimum of eight  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh cycles is required.

15. In delayed write or read-modify-write cycles,  $\overline{OE}$  must disable output buffer prior to applying data to the device.
16. Either  $T_{RCH}$  or  $T_{RRH}$  must be satisfied for a read cycle.
17. The supply voltage with all Vcc pins must be on the same level.  
The supply voltage with all Vcc pins must be on the same level.
18. Do not enable  $D_{OUT}$  buffer when using delayed write timing.
19. If you use distributed CBR refresh mode with 15.6 $\mu$ s interval in normal read/write cycle, CBR refresh should be executed within 15.6 $\mu$ s immediately after exiting from and before entering into self refresh mode.
20. If you use  $\overline{RAS}$  only refresh or CBR burst refresh mode in normal read/write cycle, 1024 cycles of distributed CBR refresh with 15.6 $\mu$ s interval should be executed within 16ms immediately after exiting from and before entering into self refresh mode.
21. Repetitive self refresh mode without refreshing all memory is not allowed. once you exit from self refresh mode, all memory cells need to be refreshed before re-entering the self refresh mode again.

Package Dimensions

Unit: Inches (mm)

SOJ

