

**OKI Semiconductor****MSC2383657D-xxBS20/DS20****8,388,608-word x 36-bit DYNAMIC RAM MODULE : FAST PAGE MODE TYPE WITH EDO****DESCRIPTION**

The MSC2383657D-xxBS20/DS20 is a fully decoded, 8,388,608-word x 36-bit CMOS dynamic random access memory module composed of sixteen 16Mb DRAMs (4Mx4) in SOJ packages and four 8Mb DRAMs (4Mx2) in SOJ packages mounted with twenty decoupling capacitors on a 72-pin glass epoxy single in-line package. This module supports any application where high density and large capacity of storage memory are required.

**FEATURES**

- 8,388,608-word x 36-bit organization
- 72-pin Single In-Line Memory Module
  - MSC2383657D-xxBS20 : Gold tab
  - MSC2383657D-xxDS20 : Solder tab
- Single +5V supply  $\pm 10\%$  tolerance
- Input : TTL compatible
- Output : TTL compatible, 3-state
- Refresh : 2048cycles/32ms
- /CAS before /RAS refresh, hidden refresh, /RAS only refresh capability
- Fast page mode with EDO capability
- Multi-bit test mode capability

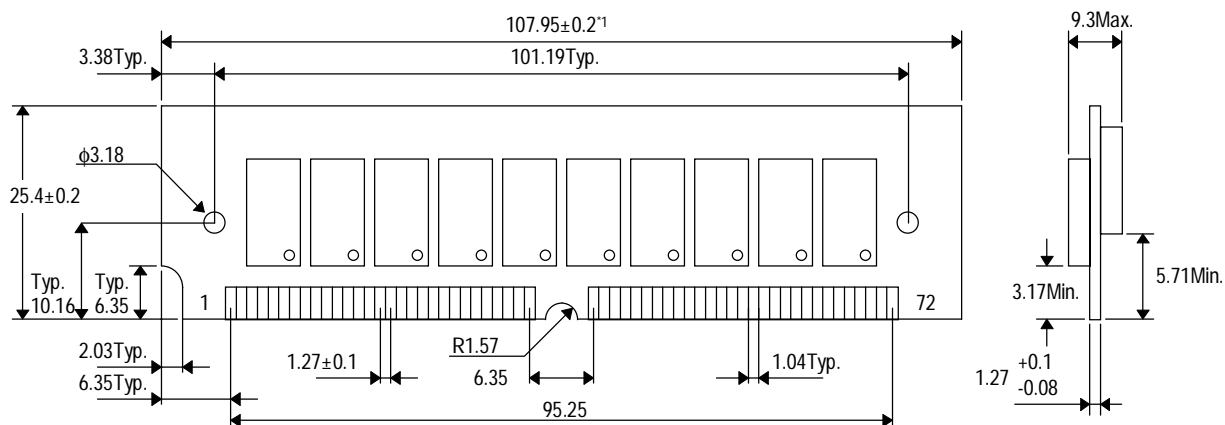
**PRODUCT FAMILY**

| Family                  | Access Time (Max.) |                 |                  | Cycle Time (Min.) | Power Dissipation |                |
|-------------------------|--------------------|-----------------|------------------|-------------------|-------------------|----------------|
|                         | t <sub>RAC</sub>   | t <sub>AA</sub> | t <sub>CAC</sub> |                   | Operating (Max.)  | Standby (Max.) |
| MSC2383657D-60BS20/DS20 | 60ns               | 30ns            | 15ns             | 110ns             | 5995mW            | 110mW          |
| MSC2383657D-70BS20/DS20 | 70ns               | 35ns            | 20ns             | 130ns             | 5500mW            |                |

MODULE OUTLINE

MSC2383657D-xxBS20/DS20

(Unit : mm)



\*1 The common size difference of the board width 12.5mm of its height is specified as  $\pm 0.2$ .  
The value above 12.5mm is specified as  $\pm 0.5$ .

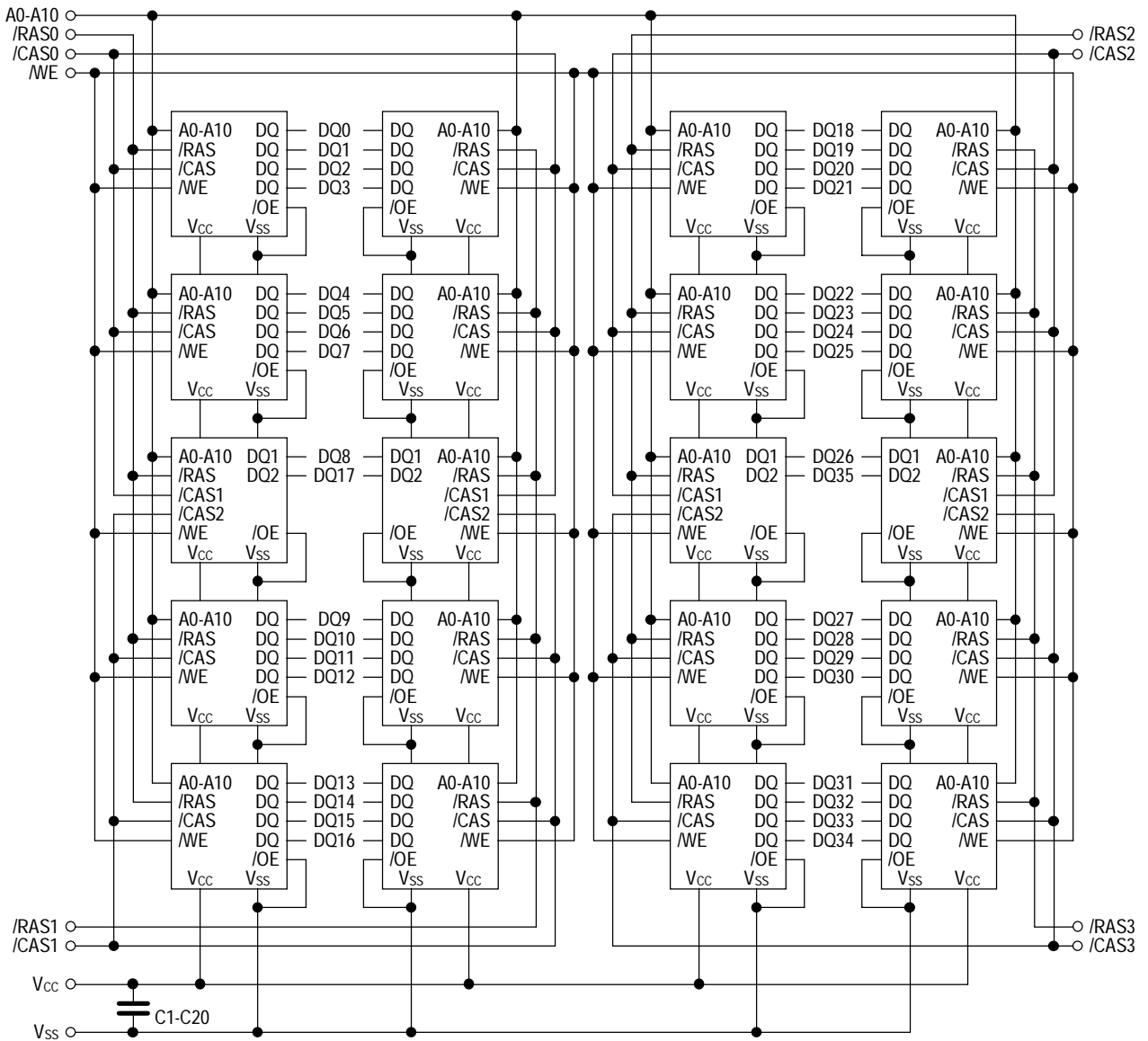
## PIN CONFIGURATION

| Pin No. | Pin Name        | Pin No. | Pin Name        | Pin No. | Pin Name        | Pin No. | Pin Name        |
|---------|-----------------|---------|-----------------|---------|-----------------|---------|-----------------|
| 1       | V <sub>SS</sub> | 19      | A10             | 37      | DQ17            | 55      | DQ12            |
| 2       | DQ0             | 20      | DQ4             | 38      | DQ35            | 56      | DQ30            |
| 3       | DQ18            | 21      | DQ22            | 39      | V <sub>SS</sub> | 57      | DQ13            |
| 4       | DQ1             | 22      | DQ5             | 40      | /CAS0           | 58      | DQ31            |
| 5       | DQ19            | 23      | DQ23            | 41      | /CAS2           | 59      | V <sub>CC</sub> |
| 6       | DQ2             | 24      | DQ6             | 42      | /CAS3           | 60      | DQ32            |
| 7       | DQ20            | 25      | DQ24            | 43      | /CAS1           | 61      | DQ14            |
| 8       | DQ3             | 26      | DQ7             | 44      | /RAS0           | 62      | DQ33            |
| 9       | DQ21            | 27      | DQ25            | 45      | /RAS1           | 63      | DQ15            |
| 10      | V <sub>CC</sub> | 28      | A7              | 46      | NC              | 64      | DQ34            |
| 11      | NC              | 29      | NC              | 47      | /WE             | 65      | DQ16            |
| 12      | A0              | 30      | V <sub>CC</sub> | 48      | NC              | 66      | NC              |
| 13      | A1              | 31      | A8              | 49      | DQ9             | 67      | PD1             |
| 14      | A2              | 32      | A9              | 50      | DQ27            | 68      | PD2             |
| 15      | A3              | 33      | /RAS3           | 51      | DQ10            | 69      | PD3             |
| 16      | A4              | 34      | /RAS2           | 52      | DQ28            | 70      | PD4             |
| 17      | A5              | 35      | DQ26            | 53      | DQ11            | 71      | NC              |
| 18      | A6              | 36      | DQ8             | 54      | DQ29            | 72      | V <sub>SS</sub> |

## Presence Detect Pins

| Pin No. | Pin Name | MSC2383657D<br>-60BS20/DS20 | MSC2383657D<br>-70BS20/DS20 |
|---------|----------|-----------------------------|-----------------------------|
| 67      | PD1      | NC                          | NC                          |
| 68      | PD2      | V <sub>SS</sub>             | V <sub>SS</sub>             |
| 69      | PD3      | NC                          | V <sub>SS</sub>             |
| 70      | PD4      | NC                          | NC                          |

BLOCK DIAGRAM



## ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings

| Parameter                                       | Symbol            | Rating       | Unit |
|---|-------------------|--------------|------|
| Voltage on Any Pin Relative to $V_{SS}$         | $V_{IN}, V_{OUT}$ | -0.5 to +7.0 | V    |
| Voltage on $V_{CC}$ Supply Relative to $V_{SS}$ | $V_{CC}$          | -0.5 to +7.0 | V    |
| Short Circuit Output Current                    | $I_{OS}$          | 50           | mA   |
| Power Dissipation                               | $P_D$ *           | 20           | W    |
| Operating Temperature                           | $T_{OPR}$         | 0 to +70     | °C   |
| Storage Temperature                             | $T_{STG}$         | -40 to +125  | °C   |

\*  $T_a = 25^\circ\text{C}$

### Recommended Operating Conditions

(  $T_a = 0^\circ\text{C}$  to  $+70^\circ\text{C}$  )

| Parameter            | Symbol   | Min. | Typ. | Max.           | Unit |
|----------------------|----------|------|------|----------------|------|
| Power Supply Voltage | $V_{CC}$ | 4.5  | 5.0  | 5.5            | V    |
|                      | $V_{SS}$ | 0    | 0    | 0              | V    |
| Input High Voltage   | $V_{IH}$ | 2.4  | -    | $V_{CC} + 0.5$ | V    |
| Input Low Voltage    | $V_{IL}$ | -0.5 | -    | 0.8            | V    |

### Capacitance

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

| Parameter                        | Symbol    | Typ. | Max. | Unit |
|----------------------------------|-----------|------|------|------|
| Input Capacitance (A0 - A10)     | $C_{IN1}$ | -    | 135  | pF   |
| Input Capacitance (/WE)          | $C_{IN2}$ | -    | 155  | pF   |
| Input Capacitance (/RAS0- /RAS3) | $C_{IN3}$ | -    | 43   | pF   |
| Input Capacitance (/CAS0- /CAS3) | $C_{IN4}$ | -    | 50   | pF   |
| I/O Capacitance (DQ0 - DQ35)     | $C_{DQ}$  | -    | 26   | pF   |

## DC CHARACTERISTICS

(V<sub>CC</sub> = 5V ± 10%, Ta = 0°C to +70°C)

| Parameter   | Symbol           | Condition   | MSC2383657D<br>-60BS20/DS20 |                 | MSC2383657D<br>-70BS20/DS20 |                 | Unit | Note |
|---|------------------|---|-----------------------------|-----------------|-----------------------------|-----------------|------|------|
|   |                  |   | Min.                        | Max.            | Min.                        | Max.            |      |      |
| Input Leakage Current   | I <sub>LI</sub>  | 0V ≤ V <sub>IN</sub> ≤ 6.5V;<br>All other pins not<br>under test = 0V | -200                        | 200             | -200                        | 200             | μA   |      |
| Output Leakage Current  | I <sub>LO</sub>  | DQ disable<br>0V ≤ V <sub>OUT</sub> ≤ 5.5V                            | -20                         | 20              | -20                         | 20              | μA   |      |
| Output High Voltage   | V <sub>OH</sub>  | I <sub>OH</sub> = -5.0mA  | 2.4                         | V <sub>CC</sub> | 2.4                         | V <sub>CC</sub> | V    |      |
| Output Low Voltage  | V <sub>OL</sub>  | I <sub>OL</sub> = 4.2mA   | 0                           | 0.4             | 0                           | 0.4             | V    |      |
| Average Power<br>Supply Current<br>(Operating)                | I <sub>CC1</sub> | /RAS, /CAS cycling,<br>t <sub>RC</sub> = Min.                         | -                           | 1090            | -                           | 1000            | mA   | 1, 2 |
| Power supply current<br>(Standby)                             | I <sub>CC2</sub> | /RAS, /CAS = V <sub>IH</sub>  | -                           | 40              | -                           | 40              | mA   | 1    |
|   |                  | /RAS, /CAS<br>≥ V <sub>CC</sub> - 0.2V                                | -                           | 20              | -                           | 20              | mA   | 1    |
| Average Power<br>Supply Current<br>(/RAS only refresh)        | I <sub>CC3</sub> | /RAS cycling,<br>/CAS = V <sub>IH</sub> ,<br>t <sub>RC</sub> = Min.   | -                           | 1090            | -                           | 1000            | mA   | 1, 2 |
| Average Power<br>Supply Current<br>(/CAS before /RAS refresh) | I <sub>CC6</sub> | /RAS cycling,<br>/CAS before /RAS                                     | -                           | 1090            | -                           | 1000            | mA   | 1, 2 |
| Average Power<br>Supply Current<br>(Fast Page Mode)           | I <sub>CC7</sub> | /RAS = V <sub>IL</sub> ,<br>/CAS cycling,<br>t <sub>HPC</sub> = Min.  | -                           | 970             | -                           | 880             | mA   | 1, 3 |

- Notes: 1. I<sub>CC</sub> Max. is specified as I<sub>CC</sub> for output open condition.  
2. Address can be changed once or less while /RAS = V<sub>IL</sub>.  
3. Address can be changed once or less while /CAS = V<sub>IH</sub>.

## AC CHARACTERISTICS (1/2)

(V<sub>CC</sub> = 5V ± 10%, Ta = 0°C to +70°C) Note: 1, 2, 3, 10, 11

| Parameter                                      | Symbol            | MSC2383657D<br>-60BS20/DS20 |      | MSC2383657D<br>-70BS20/DS20 |      | Unit | Note    |
|--|-------------------|-----------------------------|------|-----------------------------|------|------|---------|
|  |                   | Min.                        | Max. | Min.                        | Max. |      |         |
| Random Read or Write Cycle Time                | t <sub>RC</sub>   | 110                         | -    | 130                         | -    | ns   |         |
| Fast Page Mode Cycle Time                      | t <sub>HPC</sub>  | 25                          | -    | 30                          | -    | ns   |         |
| Access Time from /RAS                          | t <sub>RAC</sub>  | -                           | 60   | -                           | 70   | ns   | 4, 5, 6 |
| Access Time from /CAS                          | t <sub>CAC</sub>  | -                           | 15   | -                           | 20   | ns   | 4, 5    |
| Access Time from Column Address                | t <sub>AA</sub>   | -                           | 30   | -                           | 35   | ns   | 4, 6    |
| Access Time from /CAS Precharge                | t <sub>CPA</sub>  | -                           | 35   | -                           | 40   | ns   | 4       |
| Output Low Impedance Time from /CAS            | t <sub>CLZ</sub>  | 0                           | -    | 0                           | -    | ns   | 4       |
| Data Output Hold After /CAS Low                | t <sub>DOH</sub>  | 5                           | -    | 5                           | -    | ns   |         |
| /CAS to Data Output Buffer Turn-off Delay Time | t <sub>CEZ</sub>  | 0                           | 15   | 0                           | 15   | ns   | 7, 8    |
| /RAS to Data Output Buffer Turn-off Delay Time | t <sub>REZ</sub>  | 0                           | 15   | 0                           | 15   | ns   | 7, 8    |
| /WE to Data Output Buffer Turn-off Delay Time  | t <sub>WEZ</sub>  | 0                           | 15   | 0                           | 15   | ns   | 7       |
| Transition Time                                | t <sub>t</sub>    | 2                           | 50   | 2                           | 50   | ns   | 3       |
| Refresh Period                                 | t <sub>REF</sub>  | -                           | 32   | -                           | 32   | ms   |         |
| /RAS Precharge Time                            | t <sub>RP</sub>   | 40                          | -    | 50                          | -    | ns   |         |
| /RAS Pulse Width                               | t <sub>RAS</sub>  | 60                          | 10K  | 70                          | 10K  | ns   |         |
| /RAS Pulse Width (Fast Page Mode with EDO)     | t <sub>RASP</sub> | 60                          | 100K | 70                          | 100K | ns   |         |
| /RAS Hold Time                                 | t <sub>RSH</sub>  | 15                          | -    | 20                          | -    | ns   |         |
| /CAS Precharge Time (Fast Page Mode with EDO)  | t <sub>CP</sub>   | 10                          | -    | 10                          | -    | ns   |         |
| /CAS Pulse Width                               | t <sub>CAS</sub>  | 10                          | 10K  | 13                          | 10K  | ns   |         |
| /CAS Hold Time                                 | t <sub>CSH</sub>  | 40                          | -    | 45                          | -    | ns   |         |
| /CAS to /RAS Precharge Time                    | t <sub>CRP</sub>  | 10                          | -    | 10                          | -    | ns   |         |
| /RAS Hold Time from /CAS Precharge             | t <sub>RHCP</sub> | 35                          | -    | 40                          | -    | ns   |         |
| /RAS to /CAS Delay Time                        | t <sub>RCD</sub>  | 20                          | 45   | 20                          | 50   | ns   | 5       |
| /RAS to Column Address Delay Time              | t <sub>RAD</sub>  | 15                          | 30   | 15                          | 35   | ns   | 6       |
| Row Address Set-up Time                        | t <sub>ASR</sub>  | 0                           | -    | 0                           | -    | ns   |         |
| Row Address Hold Time                          | t <sub>RAH</sub>  | 10                          | -    | 13                          | -    | ns   |         |
| Column Address Set-up Time                     | t <sub>ASC</sub>  | 0                           | -    | 0                           | -    | ns   |         |
| Column Address Hold Time                       | t <sub>CAH</sub>  | 10                          | -    | 15                          | -    | ns   |         |
| Column Address to /RAS Lead Time               | t <sub>RAL</sub>  | 30                          | -    | 35                          | -    | ns   |         |
| Read Command Set-up Time                       | t <sub>RCS</sub>  | 0                           | -    | 0                           | -    | ns   |         |
| Read Command Hold Time                         | t <sub>RCH</sub>  | 0                           | -    | 0                           | -    | ns   | 9       |
| Read Command Hold Time referenced to /RAS      | t <sub>RRH</sub>  | 0                           | -    | 0                           | -    | ns   | 9       |

**AC Characteristics (2/2)**

(V<sub>CC</sub> = 5V ± 10%, T<sub>a</sub> = 0°C to +70°C ) Note: 1, 2, 3, 10, 11

| Parameter  | Symbol           | MSC2383657D<br>-60BS20/DS20 |      | MSC2383657D<br>-70BS20/DS20 |      | Unit | Note |
|--|------------------|-----------------------------|------|-----------------------------|------|------|------|
|  |                  | Min.                        | Max. | Min.                        | Max. |      |      |
| Write Command Set-up Time                        | t <sub>WCS</sub> | 0                           | -    | 0                           | -    | ns   |      |
| Write Command Hold Time                          | t <sub>WCH</sub> | 10                          | -    | 15                          | -    | ns   |      |
| Write Command Pulse Width                        | t <sub>WCP</sub> | 10                          | -    | 10                          | -    | ns   |      |
| /WE Pulse Width (DQ Disable)                     | t <sub>WPE</sub> | 10                          | -    | 10                          | -    | ns   |      |
| Write Command to /RAS Lead Time                  | t <sub>RWL</sub> | 15                          | -    | 20                          | -    | ns   |      |
| Write Command to /CAS Lead Time                  | t <sub>CWL</sub> | 15                          | -    | 20                          | -    | ns   |      |
| Data-in Set-up Time                              | t <sub>DS</sub>  | 0                           | -    | 0                           | -    | ns   |      |
| Data-in Hold Time                                | t <sub>DH</sub>  | 15                          | -    | 15                          | -    | ns   |      |
| /CAS Active Delay Time from /RAS Precharge       | t <sub>RPC</sub> | 10                          | -    | 10                          | -    | ns   |      |
| /RAS to /CAS Set-up Time<br>(/CAS before /RAS)   | t <sub>CSR</sub> | 10                          | -    | 10                          | -    | ns   |      |
| /RAS to /CAS Hold Time<br>(/CAS before /RAS)     | t <sub>CHR</sub> | 20                          | -    | 20                          | -    | ns   |      |
| /WE to /RAS Precharge Time<br>(/CAS before /RAS) | t <sub>WRP</sub> | 10                          | -    | 10                          | -    | ns   |      |
| /WE Hold Time from /RAS<br>(/CAS before /RAS)    | t <sub>WRH</sub> | 10                          | -    | 10                          | -    | ns   |      |
| /RAS to /WE Set-up Time<br>(Test Mode)           | t <sub>WTS</sub> | 10                          | -    | 10                          | -    | ns   |      |
| /RAS to /WE Hold Time<br>(Test Mode)             | t <sub>WTH</sub> | 20                          | -    | 20                          | -    | ns   |      |



- Notes:
1. A start-up delay of 200 $\mu$ s is required after power-up, followed by a minimum of eight initialization cycles (/RAS only refresh or /CAS before /RAS refresh) before proper device operation is achieved.
  2. The AC characteristics assumes  $t_T = 5$ ns.
  3.  $V_{IH}(\text{Min.})$  and  $V_{IL}(\text{Max.})$  are reference levels for measuring input timing signals. Transition time ( $t_T$ ) are measured between  $V_{IH}$  and  $V_{IL}$ .
  4. This parameter is measured with a load circuit equivalent to 2TTL loads and 100pF.
  5. Operation within the  $t_{RCD}(\text{Max.})$  limit ensures that  $t_{RAC}(\text{Max.})$  can be met.  $t_{RCD}(\text{Max.})$  is specified as a reference point only. If  $t_{RCD}$  is greater than the specified  $t_{RCD}(\text{Max.})$  limit, then the access time is controlled by  $t_{CAC}$ .
  6. Operation within the  $t_{RAD}(\text{Max.})$  limit ensures that  $t_{RAC}(\text{Max.})$  can be met.  $t_{RAD}(\text{Max.})$  is specified as a reference point only. If  $t_{RAD}$  is greater than the specified  $t_{RAD}(\text{Max.})$  limit, then the access time is controlled by  $t_{AA}$ .
  7.  $t_{CEZ}(\text{Max.})$ ,  $t_{REZ}(\text{Max.})$  and  $t_{WEZ}(\text{Max.})$  define the time at which the output achieves the open circuit condition and are not referenced to output voltage levels.
  8.  $t_{CEZ}$  and  $t_{REZ}$  must be satisfied for open circuit condition.
  9.  $t_{RCH}$  or  $t_{RRH}$  must be satisfied for a read cycle.
  10. The test mode is initiated by performing a /WE and /CAS before /RAS refresh cycle. This mode is latched and remains in effect until the exit cycle is generated. The test mode specified in this data sheet is an 8-bit parallel test function. CA0, CA1 and CA10 are not used. In a read cycle, if all internal bits are equal, the DQ pin will indicate a high level. If any internal bits are not equal, the DQ pin will indicate a low level. The test mode is cleared and the memory device returned to its normal operating state by a /RAS only refresh or /CAS before /RAS refresh cycle.
  11. In a test mode read cycle, the value of access time parameters is delayed for 5ns for the specified value. These parameters should be specified in test mode cycle by adding the above value to the specified value in this data sheet.