

DRAM MODULE

M372F320(8)0ET1-C

M372F320(8)0ET1-C EDO Mode

32M x 72 DRAM DIMM with ECC Using 16Mx4, 4K & 8K Refresh, 3.3V

GENERAL DESCRIPTION

The Samsung M372F320(8)0ET1-C is a 32Mx72bits Dynamic RAM high density memory module. The Samsung M372F320(8)0ET1-C consists of thirty-six CMOS 16Mx4bits DRAMs in TSOP 400mil packages and two 16 bits driver IC in TSSOP package mounted on a 168-pin glass-epoxy substrate. A 0.1 or 0.22uF decoupling capacitor is mounted on the printed circuit board for each DRAM. The M372F320(8)0ET1-C is a Dual In-line Memory Module and is intended for mounting into 168 pin edge connector sockets.

PERFORMANCE RANGE

| Speed | t _{rac} | t _{cac} | t _{rc} | t _{hpc} |
|-------|------------------|------------------|-----------------|------------------|
| -C50 | 50ns | 18ns | 84ns | 20ns |
| -C60 | 60ns | 20ns | 104ns | 25ns |

FEATURES

- Part Identification

| Part number | PKG | Ref. | CBR Ref. | ROR Ref. |
|----------------|------|------|----------|----------|
| M372F3200ET1-C | TSOP | 4K | 4K/64ms | |
| M372F3280ET1-C | TSOP | 8K | 4K/64ms | 8K/64ms |

- Extended Data Out Mode Operation
- CAS-before-RAS Refresh capability
- RAS-only and Hidden refresh capability
- LVTTTL compatible inputs and outputs
- Single 3.3V±0.3V power supply
- JEDEC standard pinout & Buffered PDpin
- Buffered input except RAS and DQ
- PCB : Height(2100mil), double sided component

PIN CONFIGURATIONS

| Pin | Front | Pin | Front | Pin | Front | Pin | Back | Pin | Back | Pin | Back |
|-----|------------------|-----|-------------------|-----|-----------------|-----|------------------|-----|-------------------|-----|-----------------|
| 1 | V _{ss} | 29 | *CAS ₂ | 57 | DQ22 | 85 | V _{ss} | 113 | *CAS ₃ | 141 | DQ58 |
| 2 | DQ0 | 30 | RAS ₀ | 58 | DQ23 | 86 | DQ36 | 114 | RAS ₁ | 142 | DQ59 |
| 3 | DQ1 | 31 | OE ₀ | 59 | V _{cc} | 87 | DQ37 | 115 | RFU | 143 | V _{cc} |
| 4 | DQ2 | 32 | V _{ss} | 60 | DQ24 | 88 | DQ38 | 116 | V _{ss} | 144 | DQ60 |
| 5 | DQ3 | 33 | A0 | 61 | RFU | 89 | DQ39 | 117 | A1 | 145 | RFU |
| 6 | V _{cc} | 34 | A2 | 62 | RFU | 90 | V _{cc} | 118 | A3 | 146 | RFU |
| 7 | DQ4 | 35 | A4 | 63 | RFU | 91 | DQ40 | 119 | A5 | 147 | RFU |
| 8 | DQ5 | 36 | A6 | 64 | RFU | 92 | DQ41 | 120 | A7 | 148 | RFU |
| 9 | DQ6 | 37 | A8 | 65 | DQ25 | 93 | DQ42 | 121 | A9 | 149 | DQ61 |
| 10 | DQ7 | 38 | A10 | 66 | DQ26 | 94 | DQ43 | 122 | A11 | 150 | DQ62 |
| 11 | DQ8 | 39 | A12 | 67 | DQ27 | 95 | DQ44 | 123 | *A13 | 151 | DQ63 |
| 12 | V _{ss} | 40 | V _{cc} | 68 | V _{ss} | 96 | V _{ss} | 124 | V _{cc} | 152 | V _{ss} |
| 13 | DQ9 | 41 | RFU | 69 | DQ28 | 97 | DQ45 | 125 | RFU | 153 | DQ64 |
| 14 | DQ10 | 42 | RFU | 70 | DQ29 | 98 | DQ46 | 126 | B0 | 154 | DQ65 |
| 15 | DQ11 | 43 | V _{ss} | 71 | DQ30 | 99 | DQ47 | 127 | V _{ss} | 155 | DQ66 |
| 16 | DQ12 | 44 | OE ₂ | 72 | DQ31 | 100 | DQ48 | 128 | RFU | 156 | DQ67 |
| 17 | DQ13 | 45 | RAS ₂ | 73 | V _{cc} | 101 | DQ49 | 129 | RAS ₃ | 157 | V _{cc} |
| 18 | V _{cc} | 46 | CAS ₄ | 74 | DQ32 | 102 | V _{cc} | 130 | CAS ₅ | 158 | DQ68 |
| 19 | DQ14 | 47 | *CAS ₆ | 75 | DQ33 | 103 | DQ50 | 131 | *CAS ₇ | 159 | DQ69 |
| 20 | DQ15 | 48 | W ₂ | 76 | DQ34 | 104 | DQ51 | 132 | PDE | 160 | DQ70 |
| 21 | DQ16 | 49 | V _{cc} | 77 | DQ35 | 105 | DQ52 | 133 | V _{cc} | 161 | DQ71 |
| 22 | DQ17 | 50 | RSVD | 78 | V _{ss} | 106 | DQ53 | 134 | RSVD | 162 | V _{ss} |
| 23 | V _{ss} | 51 | RSVD | 79 | PD1 | 107 | V _{ss} | 135 | RSVD | 163 | PD2 |
| 24 | RSVD | 52 | DQ18 | 80 | PD3 | 108 | RSVD | 136 | DQ54 | 164 | PD4 |
| 25 | RSVD | 53 | DQ19 | 81 | PD5 | 109 | RSVD | 137 | DQ55 | 165 | PD6 |
| 26 | V _{cc} | 54 | V _{ss} | 82 | PD7 | 110 | V _{cc} | 138 | V _{ss} | 166 | PD8 |
| 27 | W ₀ | 55 | DQ20 | 83 | ID0 | 111 | RFU | 139 | DQ56 | 167 | ID1 |
| 28 | CAS ₀ | 56 | DQ21 | 84 | V _{cc} | 112 | CAS ₁ | 140 | DQ57 | 168 | V _{cc} |

NOTE : A12 is used for only M372F3280ET1-C (8K Ref.)

PIN NAMES

| Pin Names | Function |
|-------------------------------------|-------------------------|
| A0, B0, A1 - A11 | Address Input(4K ref) |
| A0, B0, A1 - A12 | Address Input(8K ref) |
| DQ0 - DQ71 | Data In/Out |
| W ₀ , W ₂ | Read/Write Enable |
| OE ₀ , OE ₂ | Output Enable |
| RAS ₀ - RAS ₃ | Row Address Strobe |
| CAS ₀ , 1,4,5 | Column Address Strobe |
| V _{cc} | Power(+3.3V) |
| V _{ss} | Ground |
| NC | No Connection |
| PDE | Presence Detect Enable |
| PD1 - 8 | Presence Detect |
| ID0 - 1 | ID bit |
| RSVD | Reserved Use |
| RFU | Reserved for Future Use |

Pins marked '*' are not used in this module.

PD & ID Table

| Pin | 50NS | 60NS |
|-----|------|------|
| PD1 | 1 | 1 |
| PD2 | 0 | 0 |
| PD3 | 0 | 0 |
| PD4 | 0 | 0 |
| PD5 | 1 | 1 |
| PD6 | 0 | 1 |
| PD7 | 0 | 1 |
| PD8 | 0 | 0 |
| ID0 | 0 | 0 |
| ID1 | 0 | 0 |

PD Note :PD & ID Terminals must each be pulled up through a register to V_{cc} at the next higher level assembly. PDs will be either open (NC) or driven to V_{ss} via on-board buffer circuits.

ID Note : IDs will be either open (NC) or connected directly to V_{ss} without a buffer.

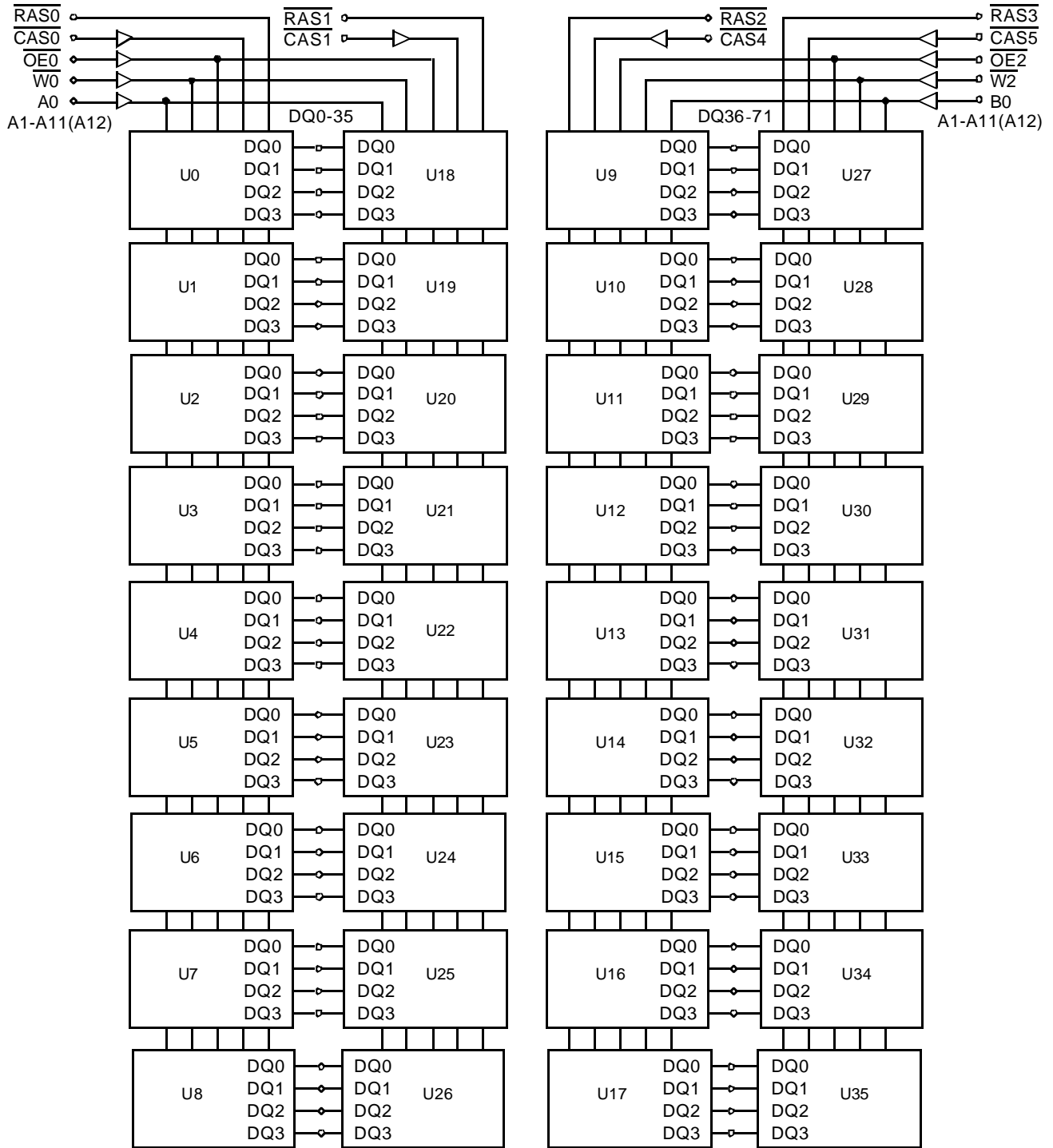
PD : 0 for Vol of Drive IC & 1 for N.C

ID : 0 for V_{ss} & 1 for N.C

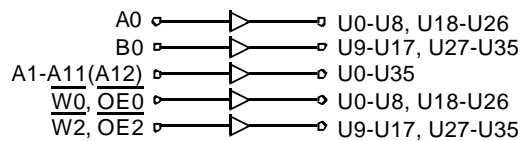
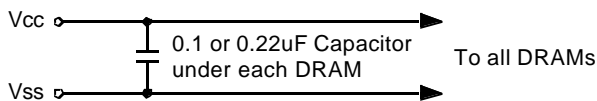
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FUNCTIONAL BLOCK DIAGRAM



NOTE : A12 is used for only M372F3280ET1 (8K Ref.)



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ABSOLUTE MAXIMUM RATINGS *

| Item | Symbol | Rating | Unit |
|---|------------------------------------|--------------|------|
| Voltage on any pin relative V _{ss} | V _{IN} , V _{OUT} | -0.5 to +4.6 | V |
| Voltage on V _{cc} supply relative to V _{ss} | V _{CC} | -0.5 to +4.6 | V |
| Storage Temperature | T _{stg} | -55 to +125 | °C |
| Power Dissipation | P _D | 36 | W |
| Short Circuit Output Current | I _{OS} | 50 | mA |

* Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for intended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS (Voltage referenced to V_{SS}, T_A = 0 to 70°C)

| Item | Symbol | Min | Typ | Max | Unit |
|--------------------|-----------------|--------------------|-----|------------------------------------|------|
| Supply Voltage | V _{CC} | 3.0 | 3.3 | 3.6 | V |
| Ground | V _{SS} | 0 | 0 | 0 | V |
| Input High Voltage | V _{IH} | 2.0 | - | V _{CC} +0.3 ^{*1} | V |
| Input Low Voltage | V _{IL} | -0.3 ^{*2} | - | 0.8 | V |

*1 : V_{CC}+1.3V at pulse width ≤ 15ns, which is measured at V_{CC}.

*2 : -1.3V at pulse width ≤ 15ns, which is measured at V_{SS}.

DC AND OPERATING CHARACTERISTICS (Recommended operating conditions unless otherwise noted)

| Symbol | Speed | M372F3200ET1 | | M372F3280ET1 | | Unit |
|-------------------|------------|--------------|------|--------------|------|------|
| | | Min | Max | Min | Max | |
| I _{CC1} | -50 | - | 1998 | - | 1458 | mA |
| | -60 | - | 1818 | - | 1278 | mA |
| I _{CC2} | Don't care | - | 100 | - | 100 | mA |
| I _{CC3} | -50 | - | 1998 | - | 1458 | mA |
| | -60 | - | 1818 | - | 1278 | mA |
| I _{CC4} | -50 | - | 1638 | - | 1638 | mA |
| | -60 | - | 1458 | - | 1458 | mA |
| I _{CC5} | Don't care | - | 30 | - | 30 | mA |
| I _{CC6} | -50 | - | 1998 | - | 1998 | mA |
| | -60 | - | 1818 | - | 1818 | mA |
| I _{I(L)} | Don't care | -10 | 10 | -10 | 10 | uA |
| I _{O(L)} | | -10 | 10 | -10 | 10 | uA |
| V _{OH} | Don't care | 2.4 | - | 2.4 | - | V |
| V _{OL} | | - | 0.4 | - | 0.4 | V |

I_{CC1}*: Operating Current * (\overline{RAS} , \overline{CAS} , Address cycling @t_{RC}=min)

I_{CC2} : Standby Current ($\overline{RAS}=\overline{CAS}=\overline{W}=V_{IH}$)

I_{CC3}*: \overline{RAS} Only Refresh Current * ($\overline{CAS}=V_{IH}$, \overline{RAS} cycling @t_{RC}=min)

I_{CC4}*: Extended Data Out Mode Current * ($\overline{RAS}=V_{IL}$, \overline{CAS} cycling : t_{HPC}=min)

I_{CC5} : Standby Current ($\overline{RAS}=\overline{CAS}=\overline{W}=V_{CC}-0.2V$)

I_{CC6}*: \overline{CAS} -Before- \overline{RAS} Refresh Current * (\overline{RAS} and \overline{CAS} cycling @t_{RC}=min)

I_{I(L)} : Input Leakage Current (Any input 0 ≤ V_{IN} ≤ V_{CC}+0.3V, all other pins not under test=0 V)

I_{O(L)} : Output Leakage Current(Data Out is disabled, 0V ≤ V_{OUT} ≤ V_{CC})

V_{OH} : Output High Voltage Level (I_{OH} = -2mA)

V_{OL} : Output Low Voltage Level (I_{OL} = 2mA)

* **NOTE** : I_{CC1}, I_{CC3}, I_{CC4} and I_{CC6} are dependent on output loading and cycle rates. Specified values are obtained with the output open. I_{CC} is specified as an average current. In I_{CC1} and I_{CC3}, address can be changed maximum once while $\overline{RAS}=V_{IL}$. In I_{CC4}, address can be changed maximum once within one EDO mode cycle time, t_{HPC}.

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CAPACITANCE (TA = 25°C, f = 1MHz)

| Item | Symbol | Min | Max | Unit |
|-------------------------------------|--------|-----|-----|------|
| Input capacitance[A0, B0, A1 - A12] | CIN1 | - | 20 | pF |
| Input capacitance[W0, W2, OE0, OE2] | CIN2 | - | 20 | pF |
| Input capacitance[RAS0 - RAS3] | CIN3 | - | 73 | pF |
| Input capacitance[CAS0, 1,4,5] | CIN4 | - | 20 | pF |
| Input/Output capacitance[DQ0 - 71] | CDQ | - | 24 | pF |

AC CHARACTERISTICS (0°C ≤ TA ≤ 70°C, VCC=3.3V±0.3V. See notes 1,2.)

Test condition : Vih/Vil=2.2/0.7V, Voh/Vol=2.0/0.8V, output loading CL=100pF

| Parameter | Symbol | -50 | | -60 | | Unit | Note |
|---------------------------------------|--------|-----|-----|-----|-----|------|----------|
| | | Min | Max | Min | Max | | |
| Random read or write cycle time | tRC | 84 | | 104 | | ns | |
| Read-modify-write cycle time | tRWC | 128 | | 153 | | ns | |
| Access time from RAS | tRAC | | 50 | | 60 | ns | 3,4,10 |
| Access time from CAS | tCAC | | 18 | | 20 | ns | 3,4,5,13 |
| Access time from column address | tAA | | 30 | | 35 | ns | 3,10,13 |
| CAS to output in Low-Z | tCLZ | 8 | | 8 | | ns | 3,13 |
| OE to output in Low-Z | tOLZ | 8 | | 8 | | ns | 3,13 |
| Output buffer turn-off delay from CAS | tCEZ | 8 | 18 | 8 | 18 | ns | 6,11,13 |
| Transition time(rise and fall) | tT | 1 | 50 | 1 | 50 | ns | 2 |
| RAS precharge time | tRP | 30 | | 40 | | ns | |
| RAS pulse width | tRAS | 50 | 10K | 60 | 10K | ns | |
| RAS hold time | tRSH | 13 | | 15 | | ns | 13 |
| CAS hold time | tCSH | 36 | | 38 | | ns | 13 |
| CAS pulse width | tCAS | 8 | 10K | 10 | 10K | ns | |
| RAS to CAS delay time | tRCD | 15 | 32 | 18 | 40 | ns | 4,13 |
| RAS to column address delay time | tRAD | 10 | 20 | 13 | 25 | ns | 10,13 |
| CAS to RAS precharge time | tCRP | 10 | | 10 | | ns | 13 |
| Row address set-up time | tASR | 5 | | 5 | | ns | 13 |
| Row address hold time | tRAH | 5 | | 8 | | ns | 13 |
| Column address set-up time | tASC | 0 | | 0 | | ns | |
| Column address hold time | tCAH | 7 | | 10 | | ns | |
| Column address to RAS lead time | tRAL | 30 | | 35 | | ns | 13 |
| Read command set-up time | tRCS | 0 | | 0 | | ns | |
| Read command hold referenced to CAS | tRCH | 0 | | 0 | | ns | 8 |
| Read command hold referenced to RAS | tRRH | -2 | | -2 | | ns | 8,13 |
| Write command set-up time | twCS | 0 | | 0 | | ns | 7 |
| Write command hold time | twCH | 7 | | 10 | | ns | |
| Write command pulse width | tWP | 7 | | 10 | | ns | |
| Write command to RAS lead time | trWL | 13 | | 15 | | ns | 13 |
| Write command to CAS lead time | tcWL | 7 | | 10 | | ns | |
| Data set-up time | tDS | -2 | | -2 | | ns | 9,13 |
| Data hold time | tDH | 13 | | 15 | | ns | 9,13 |
| Refresh period(4K & 8K) | tREF | | 64 | | 64 | ms | |
| CAS to W delay time | tcWD | 33 | | 38 | | ns | 7 |
| RAS to W delay time | trWD | 68 | | 82 | | ns | 7,13 |

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AC CHARACTERISTICS (0°C ≤ T_A ≤ 70°C, V_{CC} = 3.3V ± 0.3V. See notes 1,2.)

| Parameter | Symbol | -50 | | -60 | | Unit | Note |
|--|---------------------|-----|------|-----|------|------|------|
| | | Min | Max | Min | Max | | |
| Column address to \overline{W} delay time | t _{AWD} | 45 | | 53 | | ns | 7 |
| \overline{CAS} precharge time to \overline{W} delay time | t _{CPWD} | 47 | | 58 | | ns | |
| \overline{CAS} setup time(\overline{CAS} -before- \overline{RAS} refresh) | t _{CSR} | 10 | | 10 | | ns | 13 |
| \overline{CAS} hold time(\overline{CAS} -before- \overline{RAS} refresh) | t _{CHR} | 8 | | 8 | | ns | 13 |
| \overline{RAS} to \overline{CAS} precharge time | t _{RPC} | 3 | | 3 | | ns | 13 |
| Access time from \overline{CAS} precharge | t _{CPA} | | 33 | | 40 | ns | 3,13 |
| Hyper page cycle time | t _{HPC} | 20 | | 25 | | ns | 12 |
| Hyper page read-modify-write cycle time | t _{HPRWC} | 70 | | 77 | | ns | 12 |
| \overline{CAS} precharge time(Hyper page cycle) | t _{CP} | 7 | | 10 | | ns | |
| \overline{RAS} pulse width (Hyper page cycle) | t _{RASP} | 50 | 200K | 60 | 200K | ns | |
| \overline{RAS} hold time from \overline{CAS} precharge | t _{RHCP} | 35 | | 40 | | ns | 13 |
| \overline{W} to \overline{RAS} precharge time(C-B-R refresh) | t _{WRP} | 15 | | 15 | | ns | 13 |
| \overline{W} to \overline{RAS} hold time(C-B-R refresh) | t _{WRH} | 8 | | 8 | | ns | 13 |
| \overline{OE} access time | t _{OEA} | | 18 | | 20 | ns | 13 |
| \overline{OE} to data delay | t _{OED} | 15 | | 18 | | ns | 13 |
| Output buffer turn off delay time from \overline{OE} | t _{OEZ} | 8 | 18 | 8 | 18 | ns | 13 |
| \overline{OE} command hold time | t _{OEH} | 5 | | 5 | | ns | |
| Output data hold time(\overline{C} - \overline{B} - \overline{R} refresh) | t _{DOH} | 10 | | 10 | | ns | 13 |
| Output buffer turn off delay time from \overline{RAS} | t _{REZ} | 3 | 13 | 3 | 13 | ns | 6,11 |
| Output buffer turn off delay time from \overline{W} | t _{WEZ} | 8 | 18 | 8 | 18 | ns | 6,13 |
| \overline{W} to data delay | t _{WED} | 20 | | 20 | | ns | 13 |
| \overline{OE} to \overline{CAS} hold time | t _{OCH} | 5 | | 5 | | ns | |
| \overline{CAS} hold time to \overline{OE} | t _{CHO} | 5 | | 5 | | ns | |
| \overline{OE} precharge time | t _{OEP} | 5 | | 5 | | ns | |
| \overline{W} pulse width (Hyper page cycle) | t _{WPPE} | 5 | | 5 | | ns | |
| Present Detect Read Cycle | | | | | | | |
| \overline{PDE} to Valid PD bit | t _{PD} | | 10 | | 10 | ns | |
| \overline{PDE} to PD bit Inactive | t _{PD OFF} | 2 | 7 | 2 | 7 | ns | |

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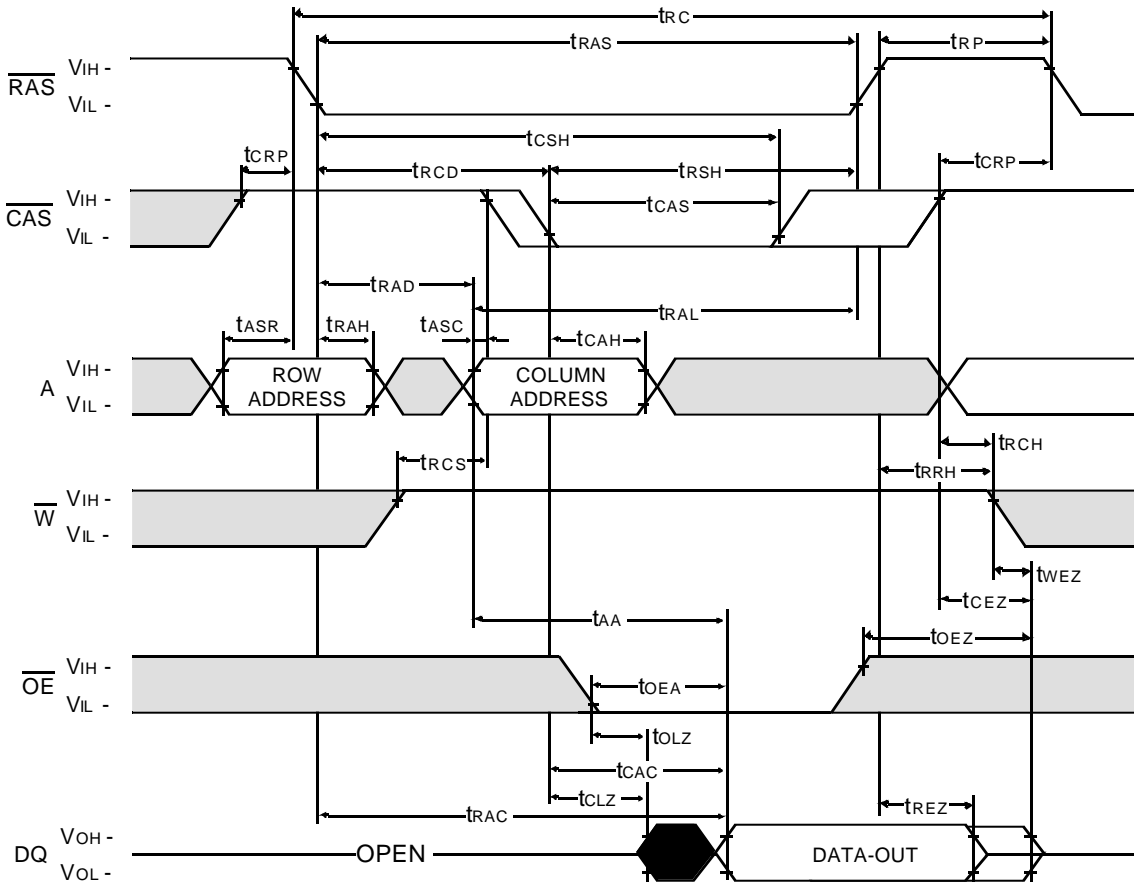
NOTES

1. An initial pause of 200us is required after power-up followed by any 8 $\overline{\text{RAS}}$ -only or $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh cycles before proper device operation is achieved.
2. Input voltage levels are V_{ih}/V_{il} . $V_{IH}(\text{min})$ and $V_{IL}(\text{max})$ are reference levels for measuring timing of input signals. Transition times are measured between $V_{IH}(\text{min})$ and $V_{IL}(\text{max})$ and are assumed to be 5ns for all inputs.
3. Measured with a load equivalent to 1 TTL loads and 100pF.
4. Operation within 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_{RCD} is greater than the specified $t_{\text{RCD}}(\text{max})$ limit, then access time is controlled exclusively by t_{CAC} .
5. Assumes that $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{max})$.
6. This parameter defines the time at which the output achieves the open circuit condition and is not referenced to V_{OH} or V_{OL} .
7. t_{WCS} , t_{RWD} , t_{CWD} , t_{AWD} and t_{CPWD} are not restrictive operating parameter. 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 high impedance for the duration of the 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 $t_{\text{CPWD}} \geq t_{\text{CPWD}}(\text{min})$. The cycle is a read-modify-write cycle and the data out will contain data read from the selected cell. If neither of the above sets of conditions is satisfied, the condition of data out(at access time) is indeterminate.
8. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
9. These parameters are referenced to the $\overline{\text{CAS}}$ leading edge in early write cycles.
10. Operation within 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 reference point only. If t_{RAD} is greater than the specified $t_{\text{RAD}}(\text{max})$ limit, then access time is controlled by t_{AA} .
11. If $\overline{\text{RAS}}$ goes high before $\overline{\text{CAS}}$ high going, the open circuit condition of the output is achieved by $\overline{\text{CAS}}$ high going. If $\overline{\text{CAS}}$ goes high before $\overline{\text{RAS}}$ high going, the open circuit condition of the output is achieved by $\overline{\text{RAS}}$ going.
12. $t_{\text{ASC}} \geq 6\text{ns}$.
13. The timing skew from the DRAM to the DIMM resulted from the addition of buffers.

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READ CYCLE

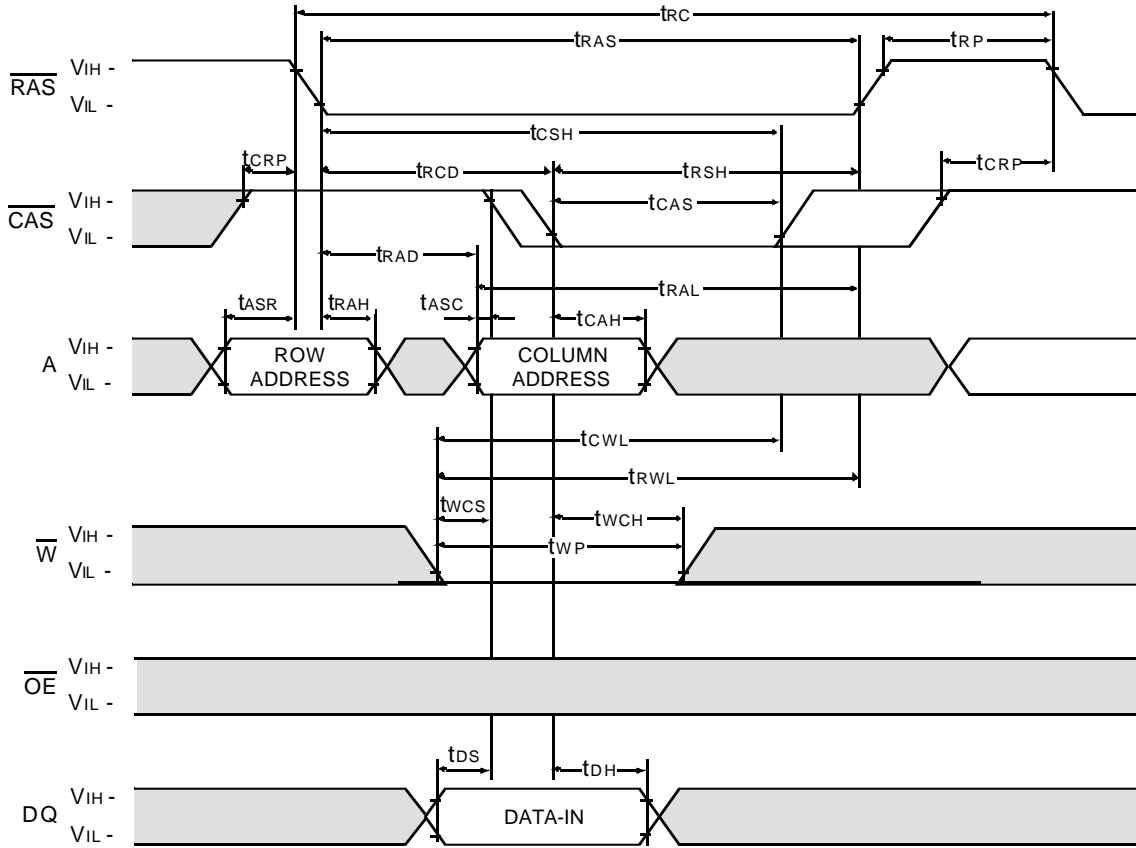


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WRITE CYCLE (EARLY WRITE)

NOTE : DOUT = OPEN



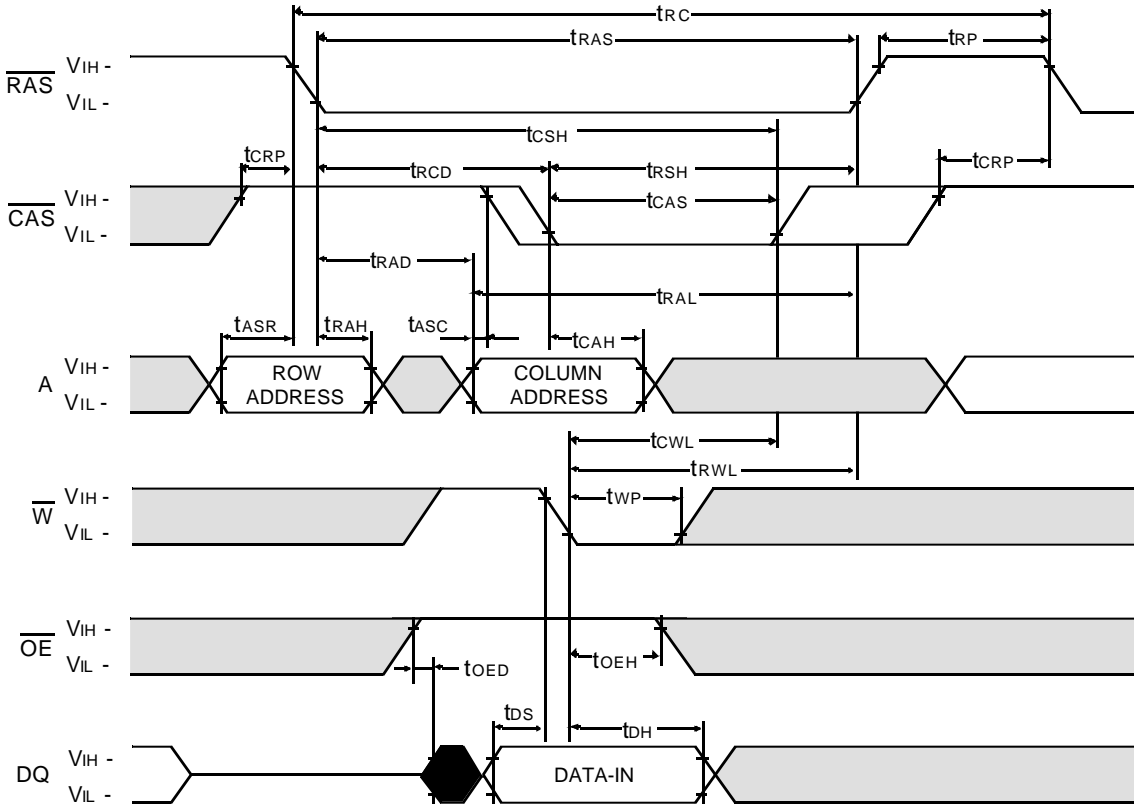
□ Don't care
■ Undefined

DRAM MODULE

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WRITE CYCLE (\overline{OE} CONTROLLED WRITE)

NOTE : DOUT = OPEN

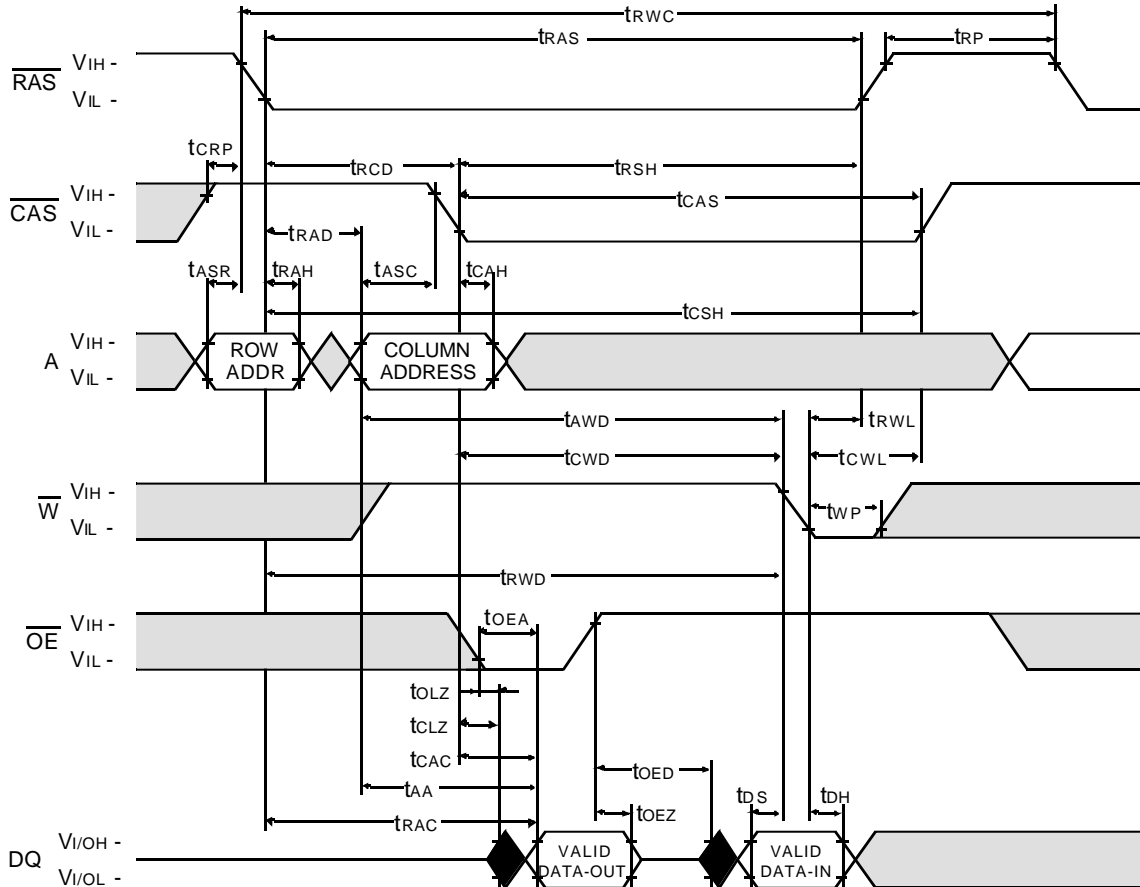


□ Don't care
■ Undefined

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READ - MODIFY - WRITE CYCLE

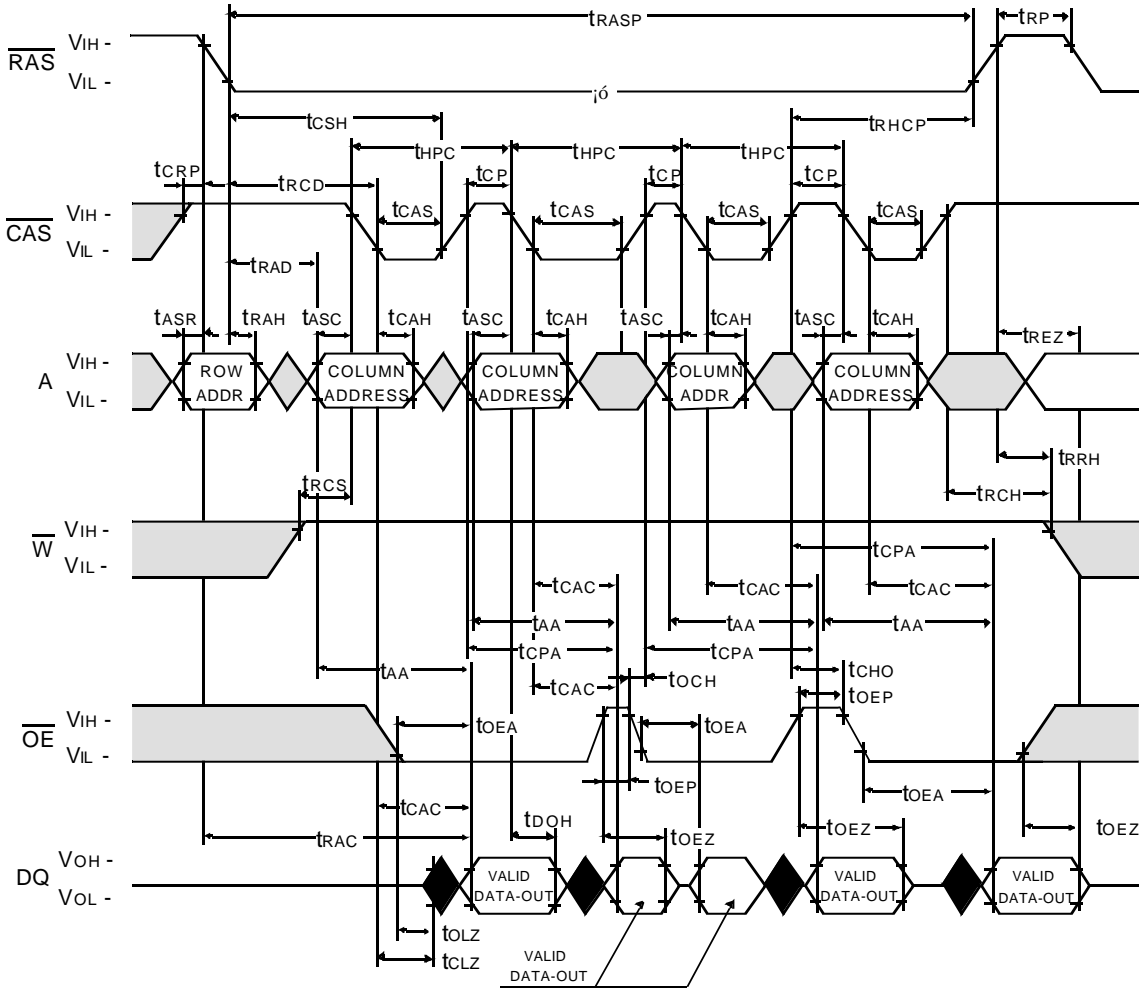


□ Don't care
■ Undefined

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HYPER PAGE READ CYCLE

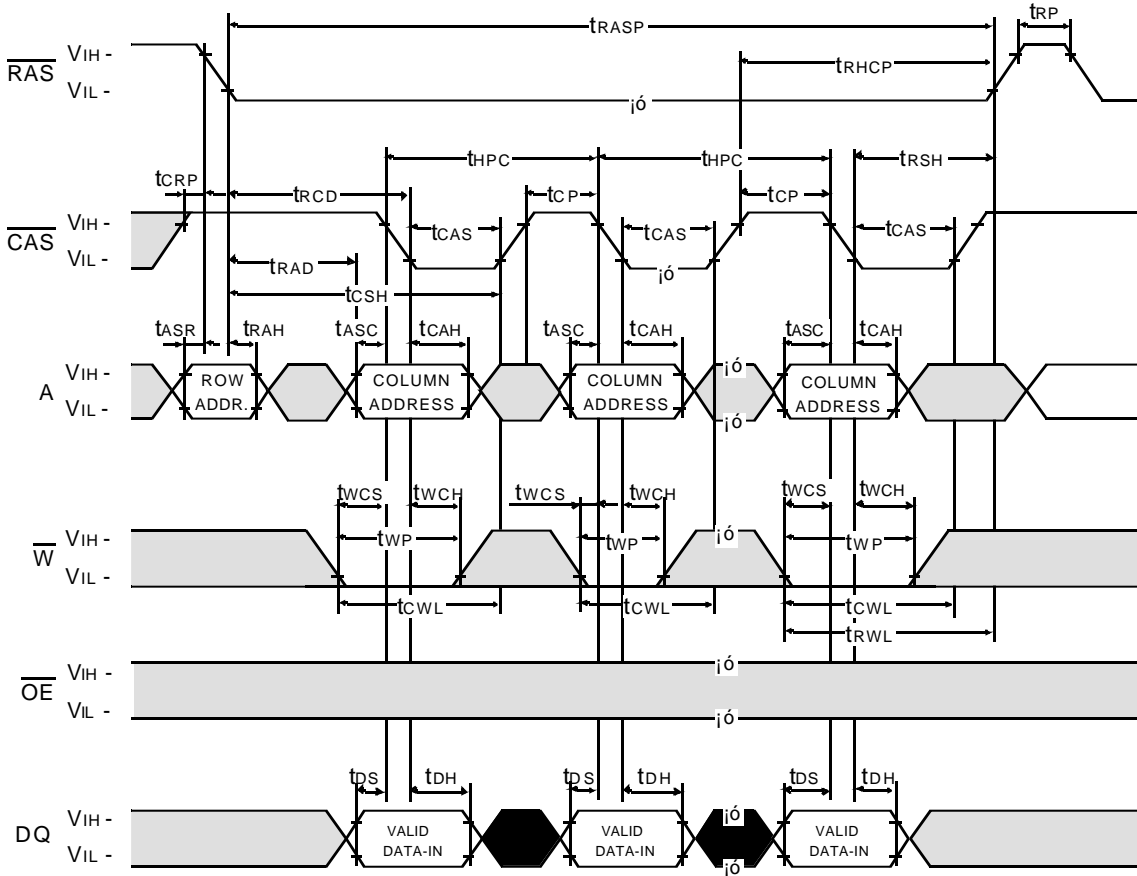


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HYPER PAGE WRITE CYCLE (EARLY WRITE)

NOTE : DOUT = OPEN

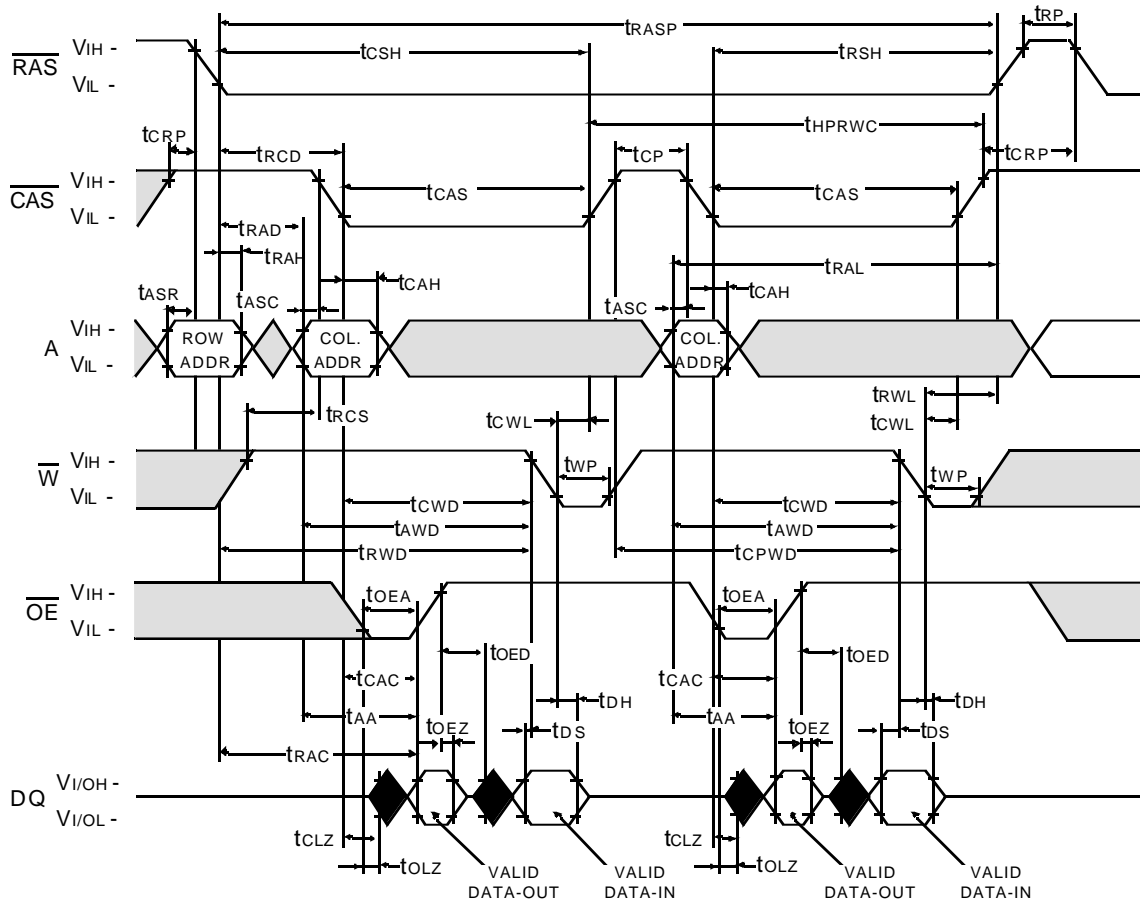


Don't care
 Undefined

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HYPER PAGE READ-MODIFY-WRITE CYCLE

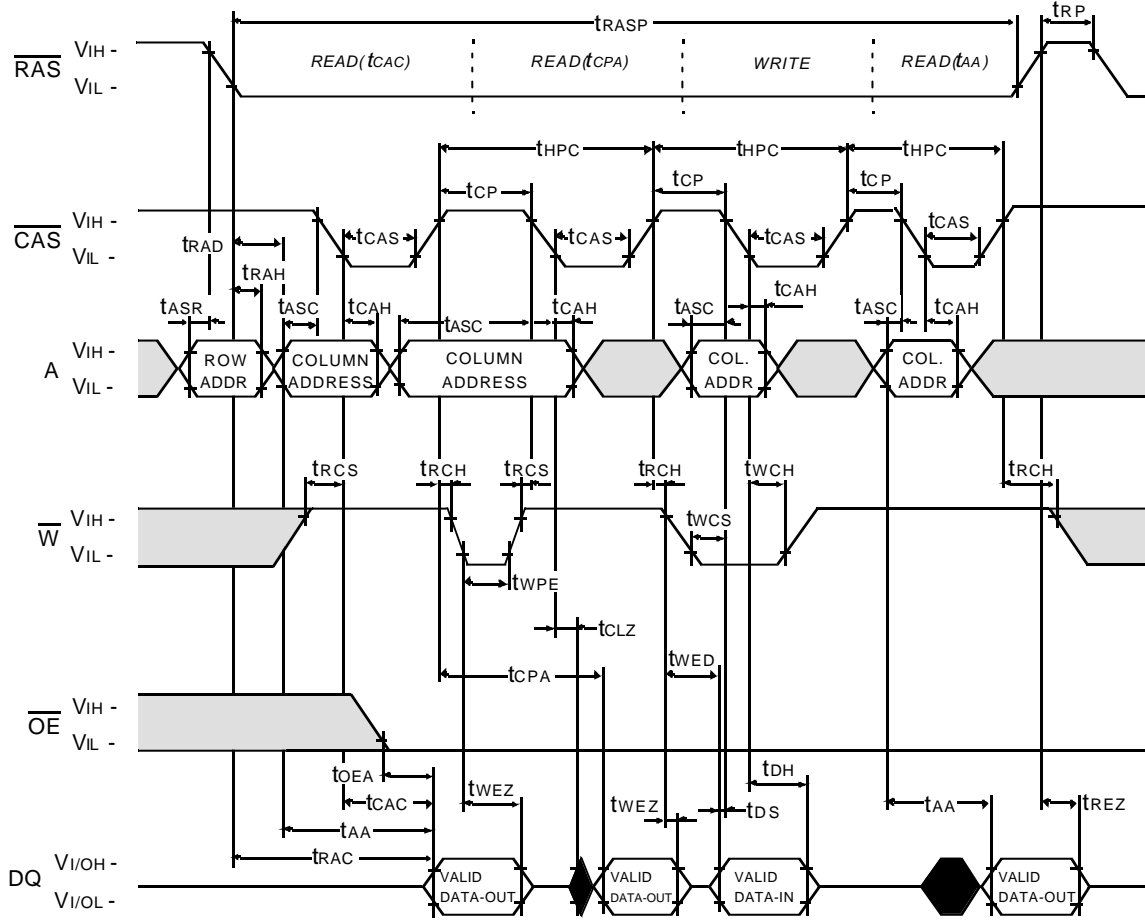


□ Don't care
■ Undefined

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HYPER PAGE READ AND WRITE MIXED CYCLE



Don't care
 Undefined

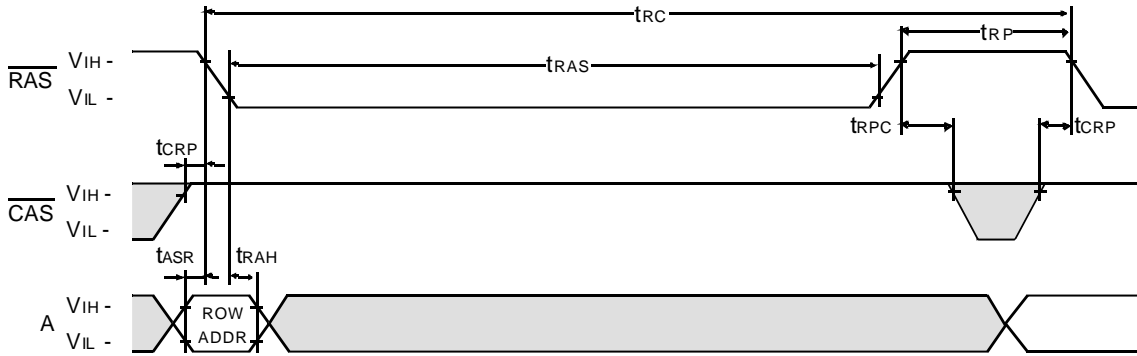
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RAS - ONLY REFRESH CYCLE*

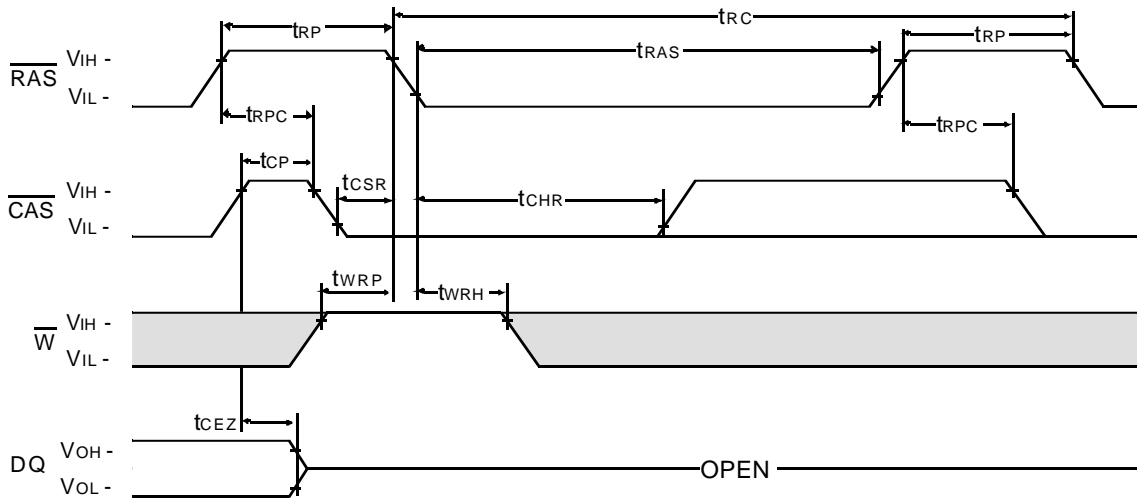
NOTE : \overline{W} , \overline{OE} , DIN = Don't care

DOUT = OPEN



CAS - BEFORE - RAS REFRESH CYCLE

NOTE : \overline{OE} , A = Don't care



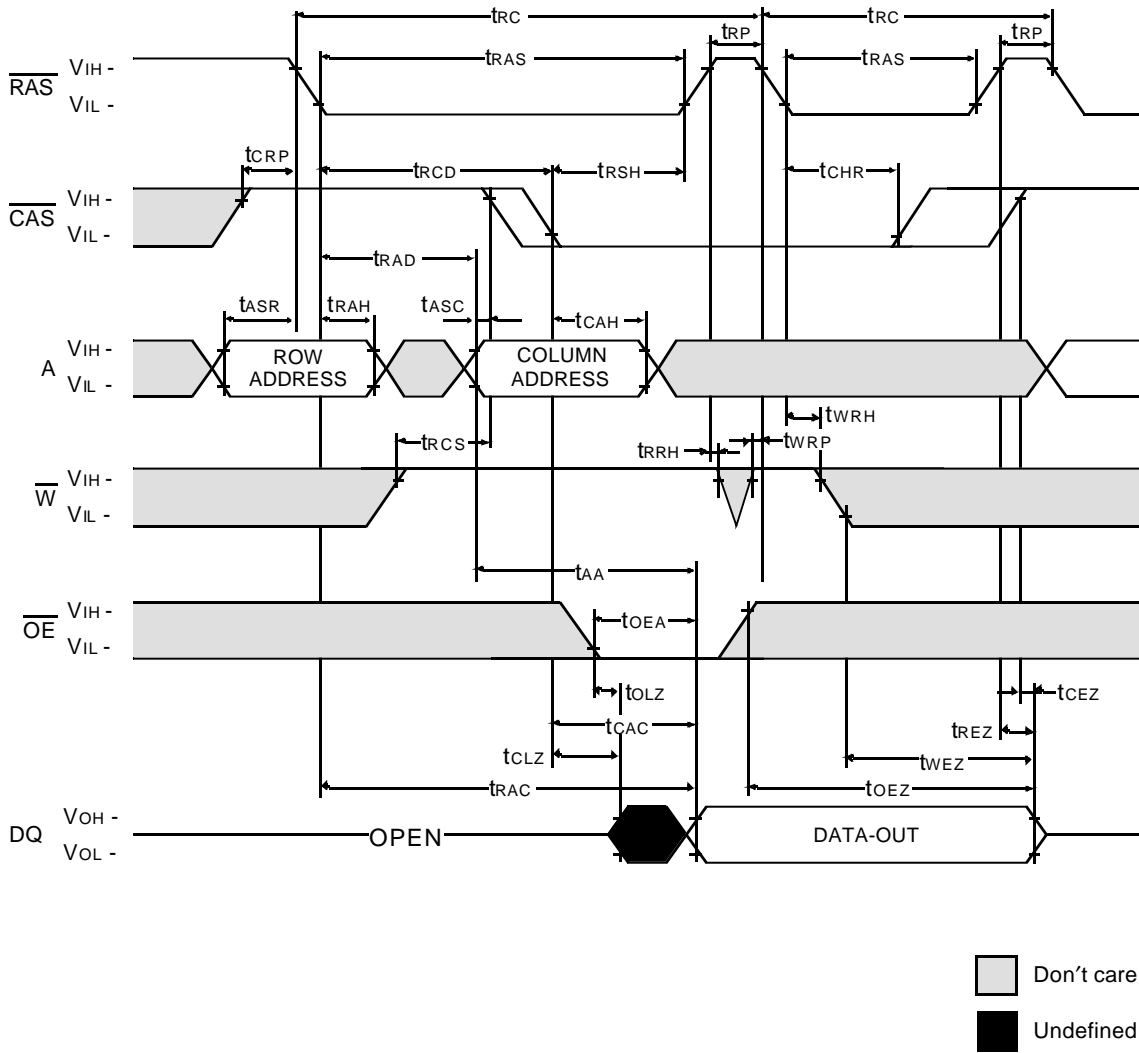
□ Don't care

■ Undefined

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M372F320(8)0ET1-C

HIDDEN REFRESH CYCLE (READ)

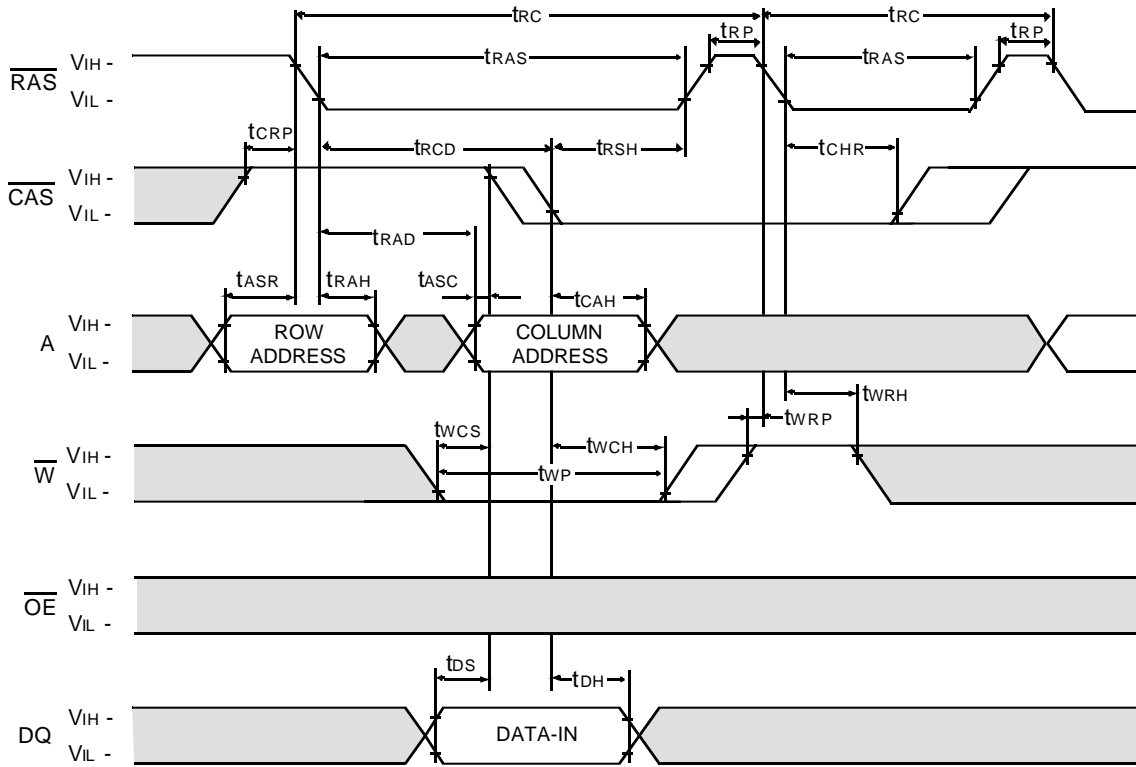


DRAM MODULE

M372F320(8)0ET1-C

HIDDEN REFRESH CYCLE (WRITE)

NOTE : DOUT = OPEN

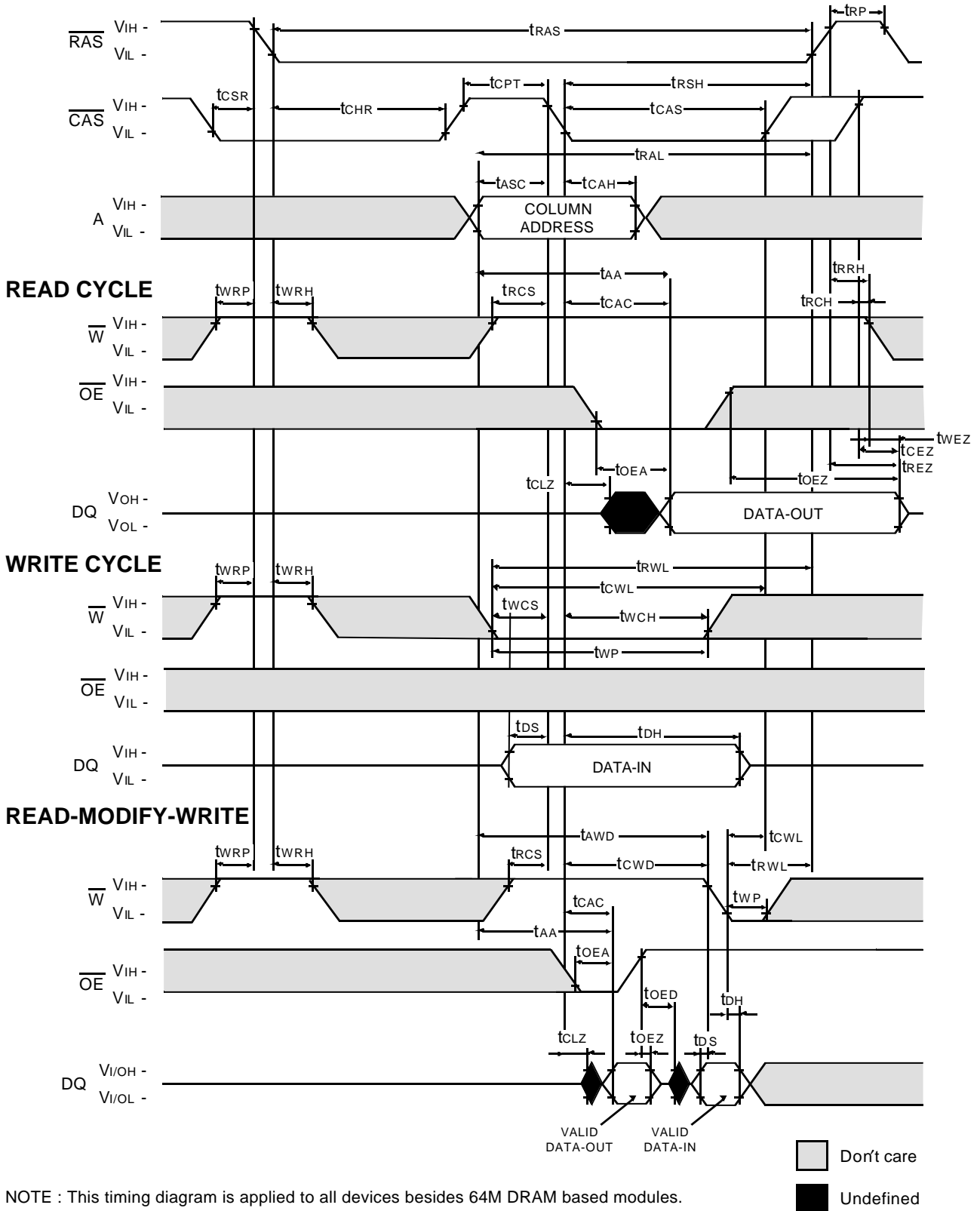


□ Don't care
■ Undefined

DRAM MODULE

M372F320(8)0ET1-C

CAS-BEFORE-RAS REFRESH COUNTER TEST CYCLE

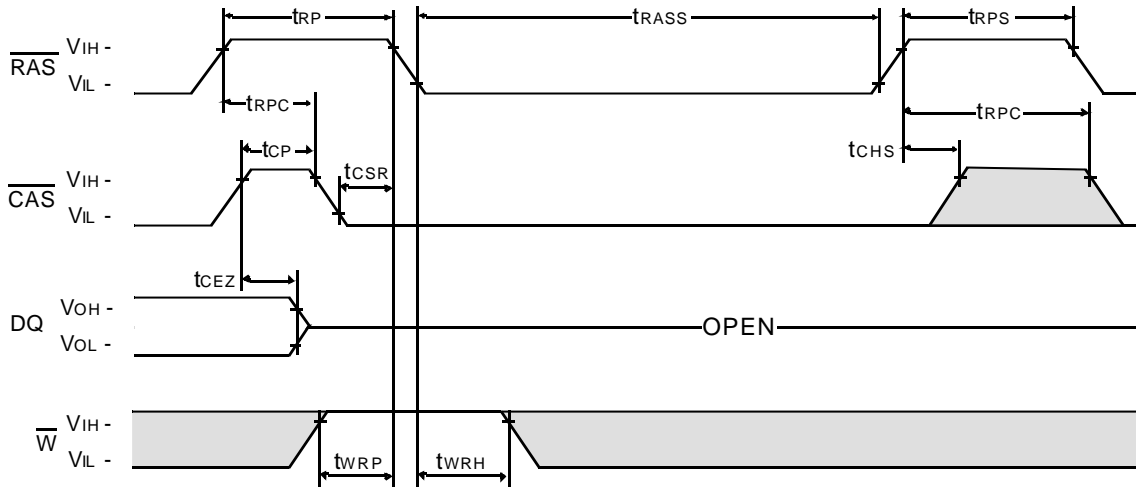


DRAM MODULE

M372F320(8)0ET1-C

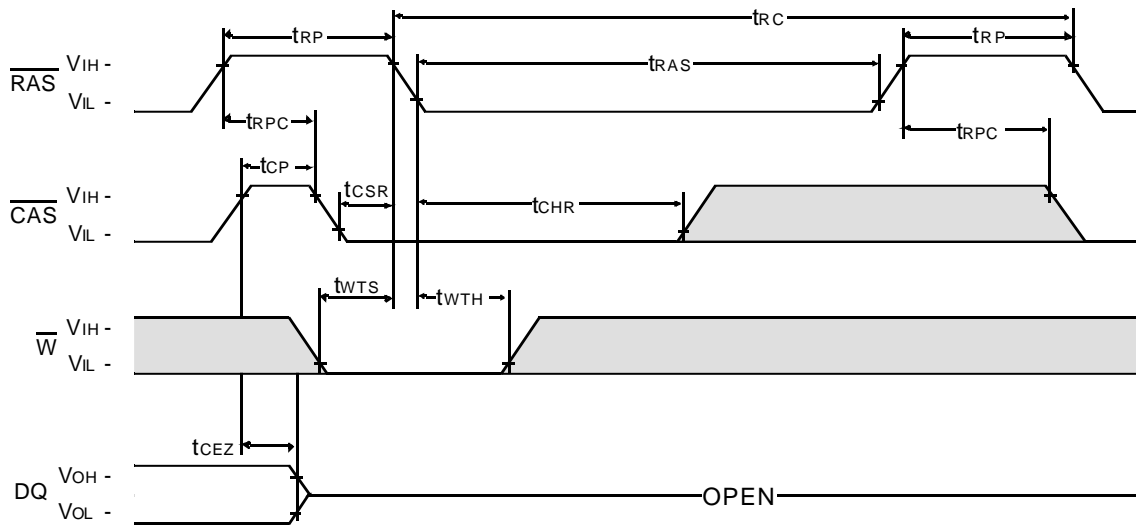
CAS - BEFORE - RAS SELF REFRESH CYCLE

NOTE : \overline{OE} , A = Don't care



TEST MODE IN CYCLE

NOTE : \overline{OE} , A = Don't care



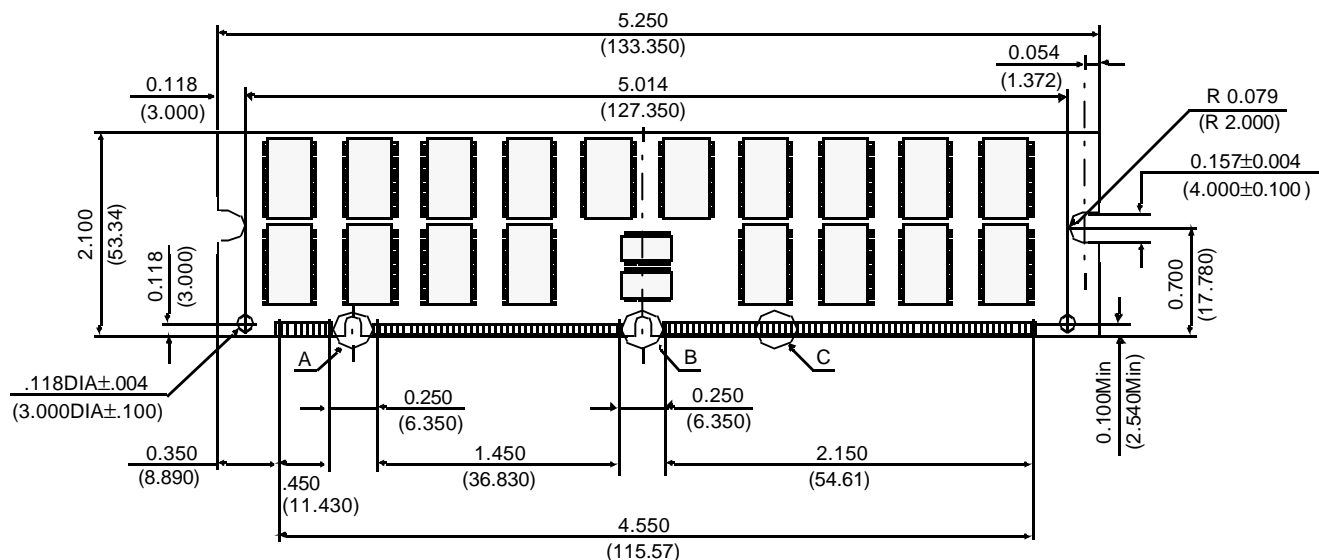
Don't care
 Undefined

DRAM MODULE

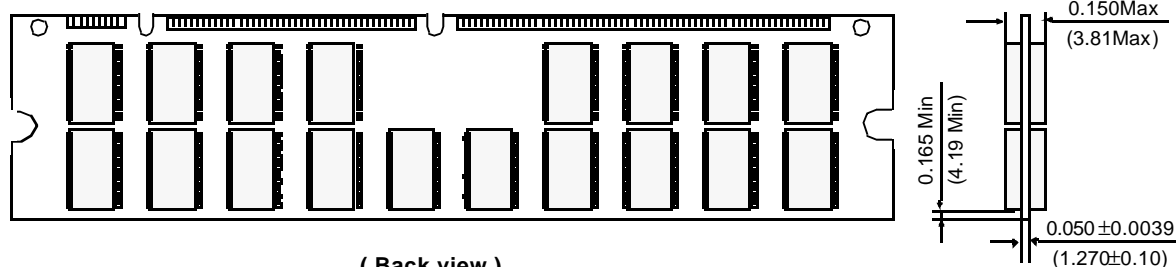
M372F320(8)0ET1-C

PACKAGE DIMENSIONS

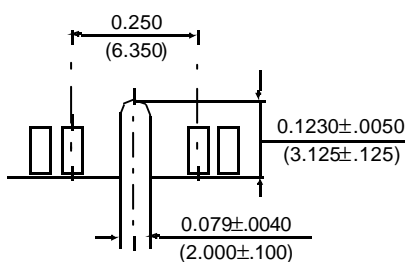
Units : Inches (millimeters)



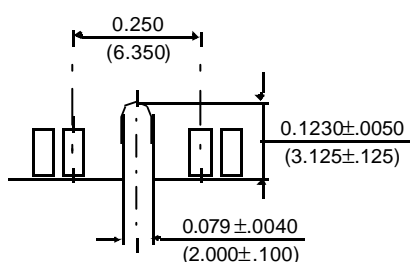
(Front view)



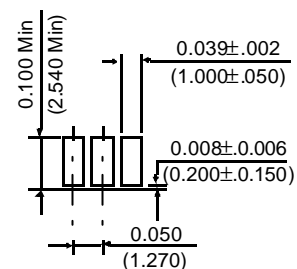
(Back view)



Detail A



Detail B



Detail C

Tolerances : ±.005(.13) unless otherwise specified

The used device is 16Mx4 DRAM with EDO mode, TSOP II.

DRAM Part No. : M372F3200ET1 - K4E640412E-T.

M372F3280ET1 - K4E660412E-T.