

OKI Semiconductor

Technical Information

MSM5416258B

262,144-Word x 16-Bit DYNAMIC RAM : FAST PAGE MODE TYPE WITH EDO

DESCRIPTION

The MSM5416258B is a 262,144-word x 16-bit dynamic RAM fabricated in OKI's CMOS silicon gate technology. The MSM5416258B achieves high integration, high-speed operation, and low-power consumption due to quadruple polysilicon double metal CMOS. The MSM5416258B is available in a 40-pin plastic SOJ.

FEATURES

- 262,144-word by 16-bit configuration
- Single 5V power supply, $\pm 10\%$ tolerance
- Input :TTL compatible
- Output :TTL compatible, 3-state
- Refresh : 512 cycles/8ms
- Fast page mode with EDO, read modify write capability
- Byte wide control: 2 $\overline{\text{CAS}}$ control
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, Hidden refresh, $\overline{\text{RAS}}$ only refresh capability
- Package : 40-Pin 400 mil plastic SOJ (SOJ40-P-400)
(Product : MSM5416258B-xxJS) xx : indicates speed rank.

PRODUCT FAMILY

| Family | Access Time (Max.) | | | | Cycle Time (Min.) | | Power Dissipation |
|----------------|--------------------|------|------|------|-------------------|------|-------------------|
| | tRAC | tAA | tCAC | tOEA | tRC | tHPC | |
| MSM5416258B-28 | 28ns | 15ns | 9ns | 9ns | 48ns | 12ns | 1485mW |
| MSM5416258B-30 | 30ns | 16ns | 9ns | 9ns | 55ns | 13ns | 1458mW |
| MSM5416258B-35 | 35ns | 19ns | 10ns | 10ns | 60ns | 13ns | 1430mW |

PIN CONFIGURATION (TOP VIEW)

| | | | |
|-------------------------|----|----|--------------------------|
| Vcc | 1 | 40 | Vss |
| DQ0 | 2 | 39 | DQ15 |
| DQ1 | 3 | 38 | DQ14 |
| DQ2 | 4 | 37 | DQ13 |
| DQ3 | 5 | 36 | DQ12 |
| Vcc | 6 | 35 | Vss |
| DQ4 | 7 | 34 | DQ11 |
| DQ5 | 8 | 33 | DQ10 |
| DQ6 | 9 | 32 | DQ9 |
| DQ7 | 10 | 31 | DQ8 |
| NC | 11 | 30 | NC |
| NC | 12 | 29 | $\overline{\text{LCAS}}$ |
| $\overline{\text{WE}}$ | 13 | 28 | $\overline{\text{UCAS}}$ |
| $\overline{\text{RAS}}$ | 14 | 27 | $\overline{\text{OE}}$ |
| NC | 15 | 26 | A8 |
| A0 | 16 | 25 | A7 |
| A1 | 17 | 24 | A6 |
| A2 | 18 | 23 | A5 |
| A3 | 19 | 22 | A4 |
| Vcc | 20 | 21 | Vss |

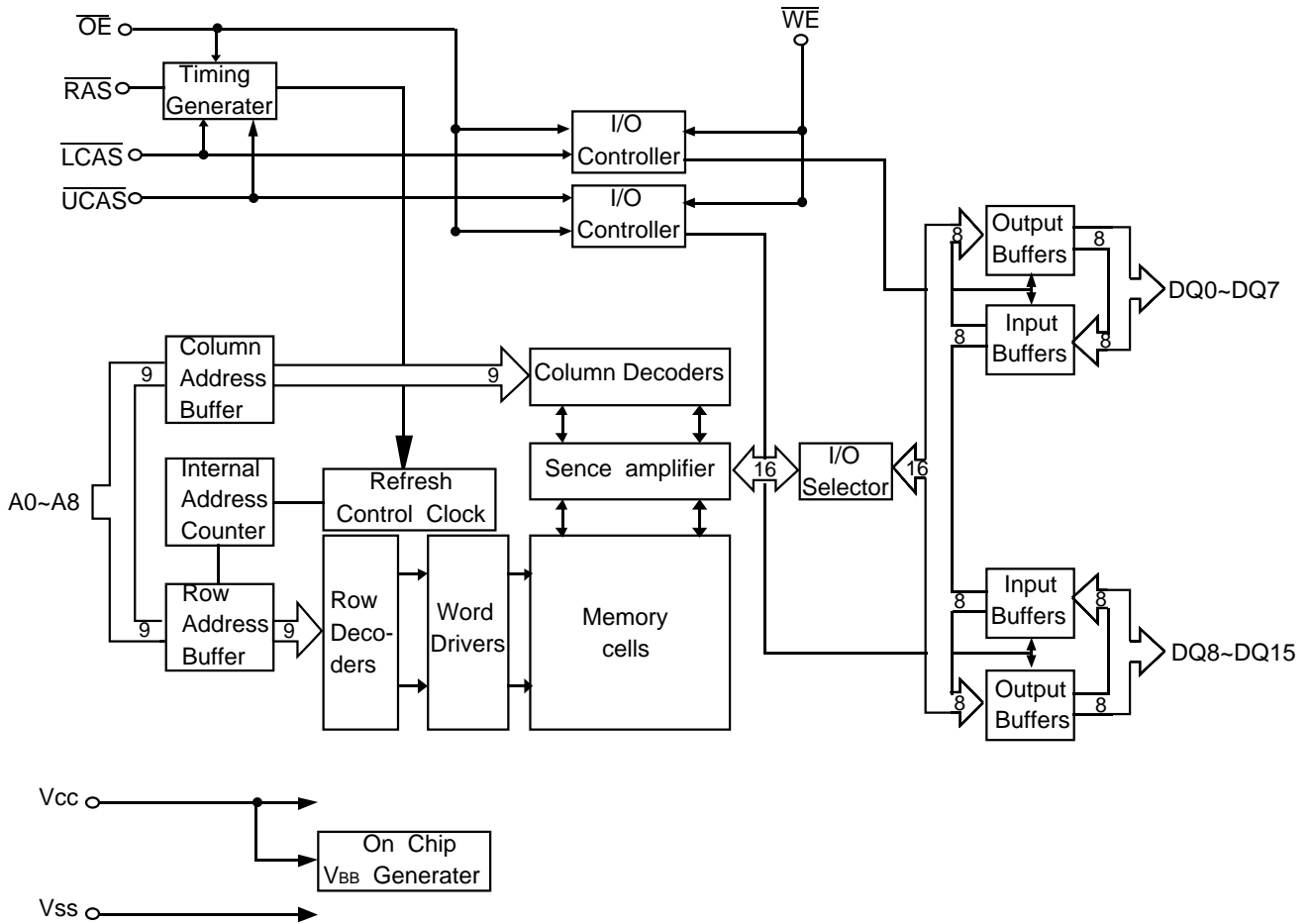
| Pin Names | Function |
|--|-------------------------|
| A0-A8 | Address Input |
| $\overline{\text{RAS}}$ | Row Address Strobe |
| $\overline{\text{LCAS}}, \overline{\text{UCAS}}$ | Column Address Strobe |
| DQ0-15 | Data-Input/ Data-Output |
| $\overline{\text{WE}}$ | Write Enable |
| $\overline{\text{OE}}$ | Output Enable |
| Vcc | Power Supply (+5V) |
| Vss | Ground (0V) |
| NC | No Connection |

Note1 : The same power supply voltage must be provided to every Vcc pin, and the same GND voltage level must be provided to every Vss pin.

40Pin 400mil SOJ

REVISION-2 1997.11.10, specification are subject to change without advanced notice.

BLOCK DIAGRAM



FUNCTION TABLE

| Input Pin | | | | | DQPin | | Functional Mode |
|-----------|------|------|----|----|-----------|-----------|------------------|
| RAS | LCAS | UCAS | WE | OE | DQ0~DQ7 | DQ8~DQ15 | |
| H | * | * | * | * | High-Z | High-Z | Standby |
| L | H | H | * | * | High-Z | High-Z | Refresh |
| L | L | H | H | L | Dout | High-Z | Lower Byte Read |
| L | H | L | H | L | High-Z | Dout | Upper Byte Read |
| L | L | L | H | L | Dout | Dout | Word Read |
| L | L | H | L | H | Din | Dont Care | Lower Byte Write |
| L | H | L | L | H | Dont Care | Din | Upper Byte Write |
| L | L | L | L | H | Din | Din | Word Write |
| L | L | L | H | H | High-Z | High-Z | - |

ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

| Rating | Symbol | Conditions | Value | Unit |
|------------------------------------|--------|------------|-------------|------|
| Voltage on any pin relative to Vss | Vt | Ta=25°C | -1.0 ~ +7.0 | V |
| Short circuit output current | Ios | Ta=25°C | 50 | mA |
| Power dissipation | Pd | Ta=25°C | 1.5 | W |
| Operating temperature | Topr | — | 0 ~ +70 | °C |
| Storage temperature | Tstg | — | -55 ~ +150 | °C |

Recommended Operating Conditions

(Ta=0°C to 70°C)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|--------------------|-----------------|------------|------|------|------|------|
| Supply voltage | Vcc | — | 4.5 | 5.0 | 5.5 | V |
| | Vss | — | 0 | 0 | 0 | V |
| Input high voltage | V _{IH} | — | 2.4 | — | 6.5 | V |
| Input low voltage | V _{IL} | — | -1.0 | — | 0.8 | V |

Capacitance

(Vcc=5V±10%, Ta=25°C, f=1MHz)

| Parameter | Symbol | Conditions | Typ. | Max. | Unit |
|---|------------------|------------|------|------|------|
| Input capacitance (A0~A8) | C _{IN1} | — | — | 8 | pf |
| Input capacitance ($\overline{\text{RAS}}$, $\overline{\text{LCAS}}$, $\overline{\text{UCAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$) | C _{IN2} | — | — | 8 | pf |
| Input / output capacitance (DQ0~DQ15) | C _{I/O} | — | — | 9 | pf |

DC CHARACTERISTICS

($V_{CC}=5V\pm 10\%$, $T_a=0$ to $70^\circ C$)

| Parameter | Symbol | Condition | MSM5416258B -28 | | MSM5416258B -30 | | MSM5416258B -35 | | Unit | Note |
|--|-----------|--|--------------------|----------|--------------------|----------|--------------------|----------|---------|------|
| | | | Min. | Max. | Min. | Max. | Min. | Max. | | |
| Output High Voltage | V_{OH} | $I_{OH} = -1.0mA$ | 2.4 | V_{CC} | 2.4 | V_{CC} | 2.4 | V_{CC} | V | |
| Output Low Voltage | V_{OL} | $I_{OL} = 2.0mA$ | 0 | 0.4 | 0 | 0.4 | 0 | 0.4 | V | |
| Input Leakage Current | I_{LI} | $0V \leq V_{IN} \leq V_{CC}$ | -10 | 10 | -10 | 10 | -10 | 10 | μA | |
| Output Leakage Current | I_{LO} | DQ _i Disable $0V \leq V_o \leq 5.5V$ | -10 | 10 | -10 | 10 | -10 | 10 | μA | |
| Average Power Supply Current (Operating) | I_{CC1} | $\overline{RAS}, \overline{CAS}$ Cycling $t_{RC} = \text{Min.}$ | - | 270 | - | 265 | - | 260 | mA | 1,2 |
| Power Supply Current (Standby) | I_{CC2} | $\overline{RAS}, \overline{CAS} = V_{IH}$ | - | 3 | - | 3 | - | 3 | mA | 1 |
| Average Power Supply Current (\overline{RAS} only Refresh) | I_{CC3} | $\overline{RAS} = \text{Cycling}$ $\overline{CAS} = V_{IH}$ $t_{RC} = \text{Min.}$ | - | 270 | - | 265 | - | 260 | mA | 1,2 |
| Average Power Supply Current (Fast Page Mode) | I_{CC4} | $\overline{RAS} = V_{IL}$ \overline{CAS} Cycling $t_{HPC} = \text{Min.}$ | - | 270 | - | 265 | - | 260 | mA | 1,3 |
| Average Power Supply Current (\overline{CAS} Before \overline{RAS} Refresh) | I_{CC5} | $\overline{RAS} = \text{Cycling}$ \overline{CAS} Befor \overline{RAS} | - | 270 | - | 265 | - | 260 | mA | 1,2 |

- Notes : 1. I_{CC} Max. is specified as I_{CC} for the output open cindition.
 2. Address can be changed once or less while $\overline{RAS} = V_{IL}$.
 3. Address can be changed once or less while $\overline{CAS} = V_{IH}$.

AC CHARACTERISTICS (1/2)

(V_{CC} =5V±10%, Ta =0~70°C)

| Parameter | Symbol | MSM5416258B -28 | | MSM5416258B -30 | | MSM5416258B -35 | | Unit | Note |
|---|-------------------|--------------------|---------|--------------------|---------|--------------------|---------|------|---------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | | |
| Random read or write cycle time | t _{RC} | 48 | — | 55 | — | 60 | — | ns | |
| Read/Write cycle time | t _{RMW} | 70 | — | 75 | — | 85 | — | ns | |
| Hyper page mode cycle time | t _{HPC} | 12 | — | 13 | — | 13 | — | ns | |
| Fast page mode read/write cycle time | t _{PRMW} | 34 | — | 35 | — | 45 | — | ns | |
| Access time from $\overline{\text{RAS}}$ | t _{RAC} | — | 28 | — | 30 | — | 35 | ns | 7,12,13 |
| Access time from $\overline{\text{CAS}}$ | t _{CAC} | — | 9 | — | 9 | — | 10 | ns | 7,12 |
| Access time from column address | t _{AA} | — | 15 | — | 16 | — | 19 | ns | 7,13 |
| Access time from $\overline{\text{OE}}$ | t _{OE A} | — | 9 | — | 9 | — | 10 | ns | |
| Access time from $\overline{\text{CAS}}$ precharge | t _{CPA} | — | 17 | — | 18 | — | 21 | ns | 7,12 |
| Data hold after $\overline{\text{CAS}}$ low | t _{COH} | 3 | — | 3 | — | 3 | — | ns | 17 |
| Output buffer turn-off delay time | t _{OFF} | 3 | 7 | 3 | 8 | 3 | 8 | ns | 8 |
| $\overline{\text{OE}}$ to data output buffer turn-off delay time | t _{OEZ} | 3 | 7 | 3 | 8 | 3 | 8 | ns | 8 |
| $\overline{\text{RAS}}$ to data output buffer turn-off delay time | t _{REZ} | 3 | 7 | 3 | 8 | 3 | 8 | ns | 8 |
| $\overline{\text{WE}}$ to data output buffer turn-off delay time | t _{WEZ} | 3 | 7 | 3 | 8 | 3 | 8 | ns | 8 |
| Transition time | t _t | 2 | 35 | 2 | 35 | 2 | 35 | ns | |
| Refresh period | t _{REF} | — | 8 | — | 8 | — | 8 | ms | |
| $\overline{\text{RAS}}$ precharge time | t _{RP} | 17 | — | 18 | — | 20 | — | ns | |
| $\overline{\text{RAS}}$ pulse width | t _{RAS} | 28 | 10,000 | 30 | 10,000 | 35 | 10,000 | ns | |
| $\overline{\text{RAS}}$ pulse width (Fast page mode) | t _{RASP} | 28 | 100,000 | 30 | 100,000 | 35 | 100,000 | ns | |
| $\overline{\text{RAS}}$ hold time | t _{RSH} | 7 | — | 7 | — | 8 | — | ns | |
| $\overline{\text{RAS}}$ hold time reference to $\overline{\text{OE}}$ | t _{ROH} | 7 | — | 7 | — | 8 | — | ns | |
| $\overline{\text{CAS}}$ precharge time | t _{CP} | 4 | — | 4 | — | 4 | — | ns | |
| $\overline{\text{CAS}}$ pulse width | t _{CAS} | 5 | 10,000 | 5 | 10,000 | 5 | 10,000 | ns | |
| $\overline{\text{CAS}}$ hold time | t _{CSH} | 22 | — | 25 | — | 30 | — | ns | |
| $\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ precharge time | t _{CRP} | 5 | — | 5 | — | 5 | — | ns | |
| $\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ delay time | t _{RCD} | 10 | 19 | 11 | 22 | 13 | 26 | ns | 12 |
| $\overline{\text{RAS}}$ to column address delay time | t _{RAD} | 8 | 13 | 8 | 15 | 10 | 16 | ns | |
| Row address set-up time | t _{ASR} | 0 | — | 0 | — | 0 | — | ns | 13 |
| Row address hold time | t _{RAH} | 6 | — | 6 | — | 7 | — | ns | |
| Column address set-up time | t _{ASC} | 0 | — | 0 | — | 0 | — | ns | |
| Column address hold time | t _{CAH} | 5 | — | 5 | — | 5 | — | ns | |
| Column address hold time from $\overline{\text{RAS}}$ | t _{AR} | 21 | — | 22 | — | 25 | — | ns | |
| Column address to $\overline{\text{RAS}}$ lead time | t _{RAL} | 15 | — | 18 | — | 20 | — | ns | |
| Read command set-up time | t _{RCS} | 0 | — | 0 | — | 0 | — | ns | 9 |
| Read command hold time | t _{RCH} | 0 | — | 0 | — | 0 | — | ns | |
| Read command hold time reference to $\overline{\text{RAS}}$ | t _{RRH} | 0 | — | 0 | — | 0 | — | ns | 9 |
| $\overline{\text{WE}}$ pulse width | t _{WEP} | 10 | — | 10 | — | 10 | — | ns | |

AC CHARACTERISTICS (2/2)

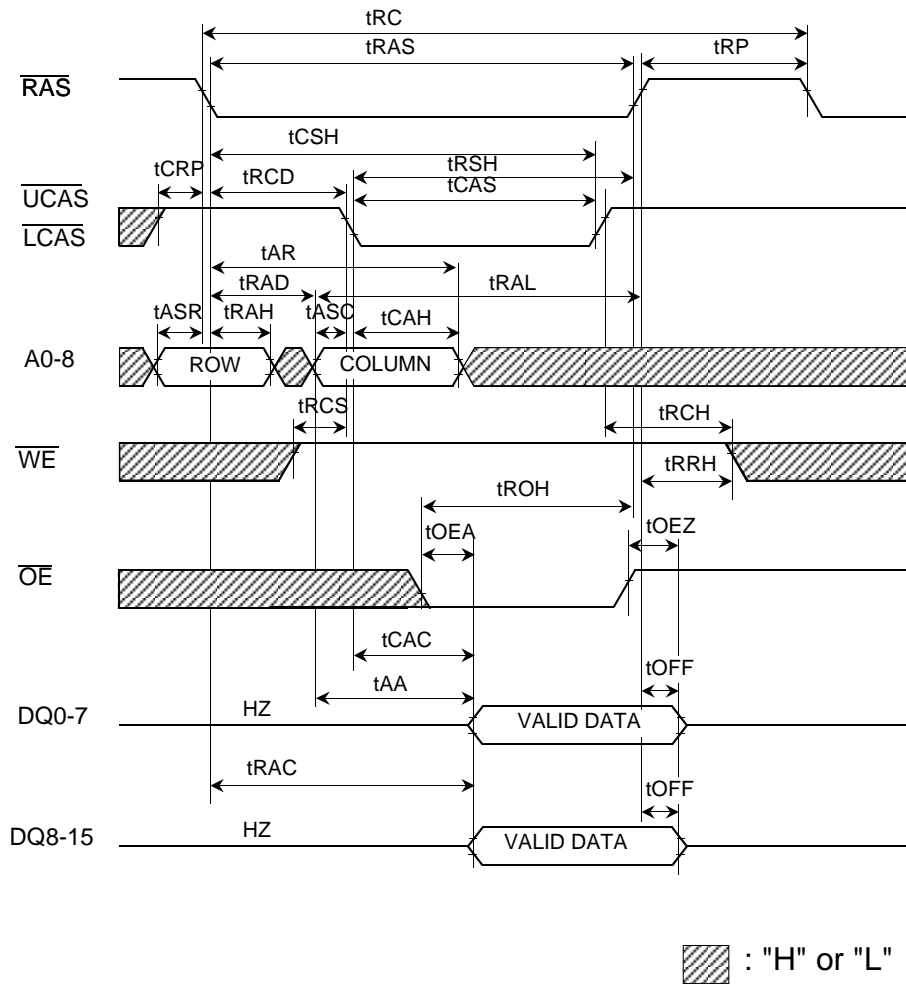
(V_{CC}=5V±10%, T_a=0~70°C)

| Parameter | Symbol | MSM5416258B -28 | | MSM5416258B -30 | | MSM5416258B -35 | | Unit | Note |
|---|-------------------|--------------------|-----|--------------------|-----|--------------------|-----|------|------|
| | | MIN | MAX | MIN | MAX | MIN | MAX | | |
| Write command set-up time | t _{WCS} | 0 | — | 0 | — | 0 | — | ns | |
| Write command hold time | t _{WCH} | 5 | — | 5 | — | 6 | — | ns | |
| Write command pulse width | t _{WP} | 5 | — | 5 | — | 6 | — | ns | |
| Write command hold time from $\overline{\text{RAS}}$ | t _{WCR} | 21 | — | 22 | — | 26 | — | ns | |
| $\overline{\text{OE}}$ command hold time | t _{OEH} | 5 | — | 5 | — | 6 | — | ns | |
| Write command to $\overline{\text{CAS}}$ lead time | t _{CWL} | 5 | — | 5 | — | 6 | — | ns | |
| Write command to $\overline{\text{RAS}}$ lead time | t _{RWL} | 7 | — | 7 | — | 8 | — | ns | |
| Data to $\overline{\text{CAS}}$ delay time | t _{DZC} | 0 | — | 0 | — | 0 | — | ns | |
| Data to $\overline{\text{OE}}$ delay time | t _{DZO} | 0 | — | 0 | — | 0 | — | ns | |
| Data-in set-up time | t _{DS} | 0 | — | 0 | — | 0 | — | ns | 10 |
| Data-in hold time | t _{DH} | 5 | — | 5 | — | 6 | — | ns | 10 |
| Data-in hold time referenced to $\overline{\text{RAS}}$ | t _{DHR} | 21 | — | 22 | — | 26 | — | ns | |
| $\overline{\text{OE}}$ to Data-in delay time | t _{OEED} | 7 | — | 7 | — | 8 | — | ns | |
| $\overline{\text{OE}}$ "L" to $\overline{\text{CAS}}$ "H" lead time | t _{OCH} | 5 | — | 5 | — | 8 | — | ns | |
| $\overline{\text{CAS}}$ "H" to $\overline{\text{OE}}$ "L" lead time | t _{CHO} | 5 | — | 5 | — | 8 | — | ns | |
| Hi-Z command pulse width | t _{OEP} | 5 | — | 6 | — | 8 | — | ns | |
| $\overline{\text{CAS}}$ to $\overline{\text{WE}}$ delay time | t _{CWD} | 18 | — | 18 | — | 20 | — | ns | 11 |
| Column address to $\overline{\text{WE}}$ delay time | t _{AWD} | 24 | — | 27 | — | 30 | — | ns | 11 |
| $\overline{\text{RAS}}$ to $\overline{\text{WE}}$ delay time | t _{RWD} | 37 | — | 40 | — | 45 | — | ns | 11 |
| $\overline{\text{CAS}}$ active delay time from $\overline{\text{RAS}}$ precharge | t _{RPC} | 0 | — | 0 | — | 0 | — | ns | |
| $\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ set-up time ($\overline{\text{CAS}}$ before $\overline{\text{RAS}}$) | t _{CSR} | 5 | — | 6 | — | 8 | — | ns | |
| $\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ hold time ($\overline{\text{CAS}}$ before $\overline{\text{RAS}}$) | t _{CHR} | 6 | — | 6 | — | 8 | — | ns | |

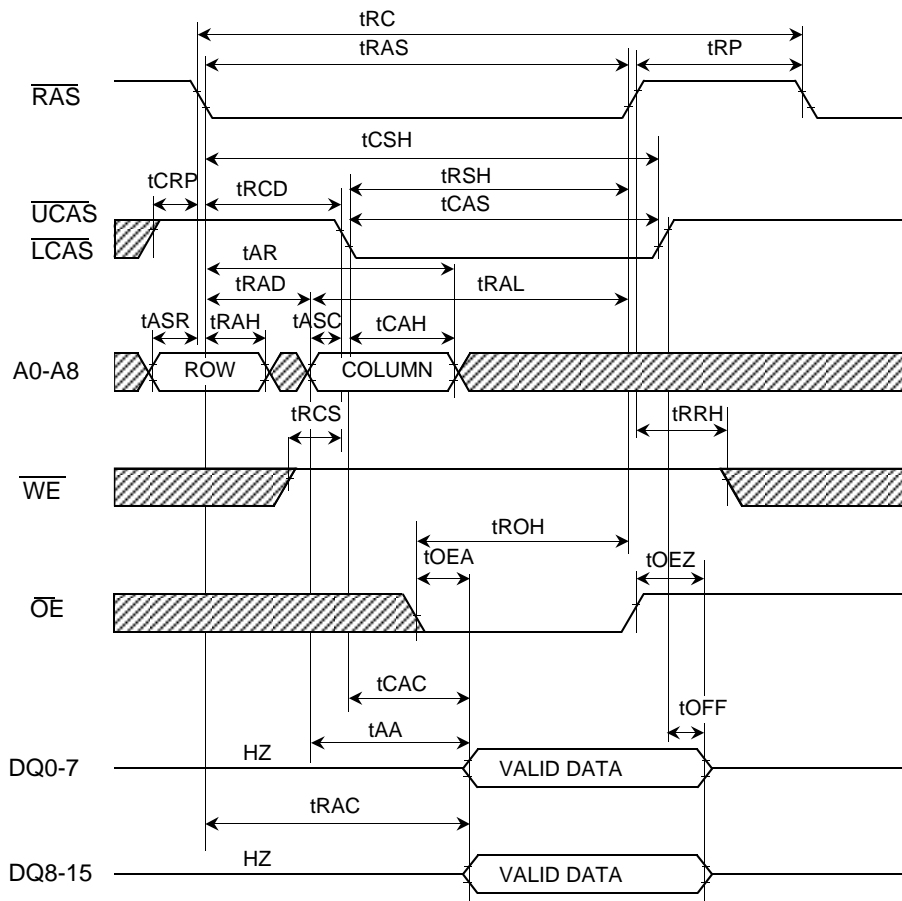
Notes:

1. All voltages are referenced to V_{SS} .
2. This parameter is dependent upon the cycle rate.
3. This parameter is dependent upon the output loading. Specified values are obtained with the output open.
4. An initial pause of 200 μ s is required after power-up, followed by any $8\overline{RAS}$ cycles. (Example: \overline{RAS} -only-refresh) before proper device operation is achieved. In case of using internal refresh counter, a minimum of $8\overline{CAS}$ before \overline{RAS} cycles instead of $8\overline{RAS}$ cycles are required.
5. The AC characteristics assume $t_r=5$ ns.
6. V_{IH} (Min.) and V_{IL} (Max.) are reference levels for measuring timing of input signals. Also, transition times are measured between V_{IH} and V_{IL} .
7. Data outputs are measured with a load of 30 pF.
DOUT reference levels: $V_{OH}/V_{OL}=1.8V/1.4V$.
8. t_{REZ} (Max.), t_{OFF} (Max.), t_{WEZ} (Max.) and t_{OEZ} (Max.) define the time at which the outputs achieve the open circuit condition and are not referenced to output voltage levels. This parameter is sampled and not 100 % tested.
9. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
10. These parameters are referenced to \overline{CAS} leading edge of early write cycles and to \overline{WE} leading edge in \overline{OE} -controlled write cycles and read-modify-write cycles.
11. t_{WCS} , t_{RWD} , t_{CWD} and t_{AWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$ (Min.), the cycle is an early write cycle and the data out pins will remain open circuit throughout the entire cycle. If $t_{RWD} \geq t_{RWD}$ (Min.), $t_{CWD} \geq t_{CWD}$ (Min.) and $t_{AWD} \geq t_{AWD}$ (Min.), the cycle is a read-modify-write cycle and the data out will contain data read from the selected cell. If neither or the above sets of conditions is satisfied, the condition of the data out is indeterminate.
12. Operation within the t_{RCD} (Max.) limit insures that t_{RAC} (Max.) can be met. t_{RCD} (Max.) is specified as a reference point only. If t_{RCD} is greater than the specified t_{RCD} (Max.) limit, then access time is controlled by t_{CDC} .
13. Operation within the t_{RAD} (Max.) limit ensures that t_{RAC} (Max.) can be met. t_{RAD} (Max.) is specified as a reference point only: If t_{RAD} is greater than the specified t_{RAD} (Max.) limit, then access time is controlled by t_{AA} .
14. Input levels at the AC testing are 3.0V/0V.
15. Addresses (A0 - A8) may be changed two times or less while $\overline{RAS} = V_{IL}$.
16. Addresses (A0 - A8) may be changed once or less while $\overline{CAS} = V_{IH}$ and $\overline{RAS} = V_{IL}$.
17. This is guaranteed by design. ($t_{COH} = t_{CAC}$ - output transition time). This parameter is not 100 % tested.
18. This parameter is dependent upon the number of address transitions. Specified values are measured with a maximum of two transitions per address cycle in Fast Page Mode.

READ CYCLE (RAS output control)

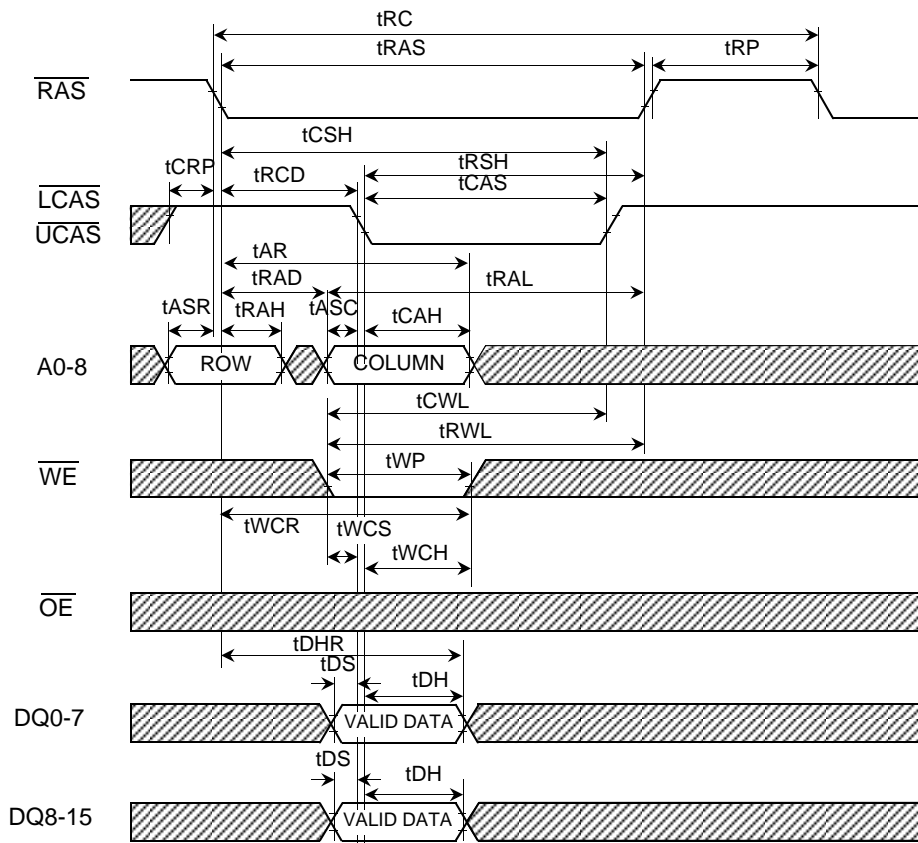


READ CYCLE (CAS output control)



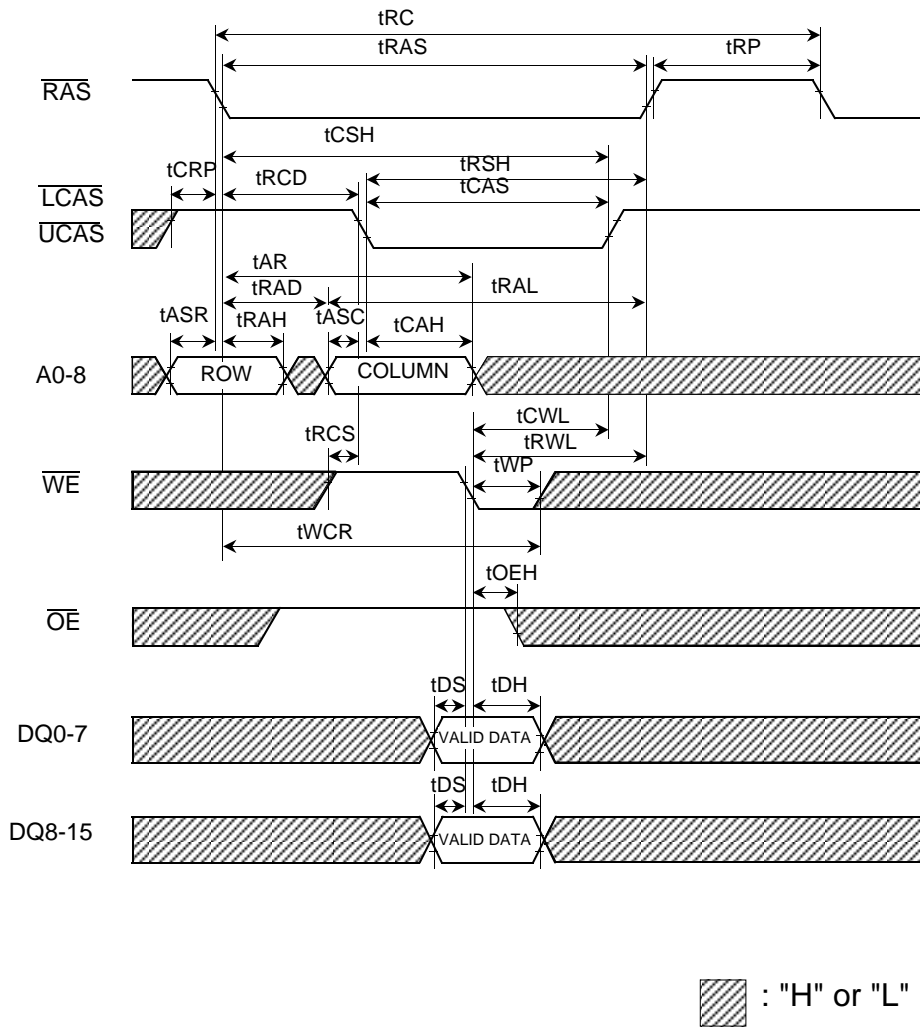
 : "H" or "L"

EARLY WRITE CYCLE (LCAS and UCAS active)

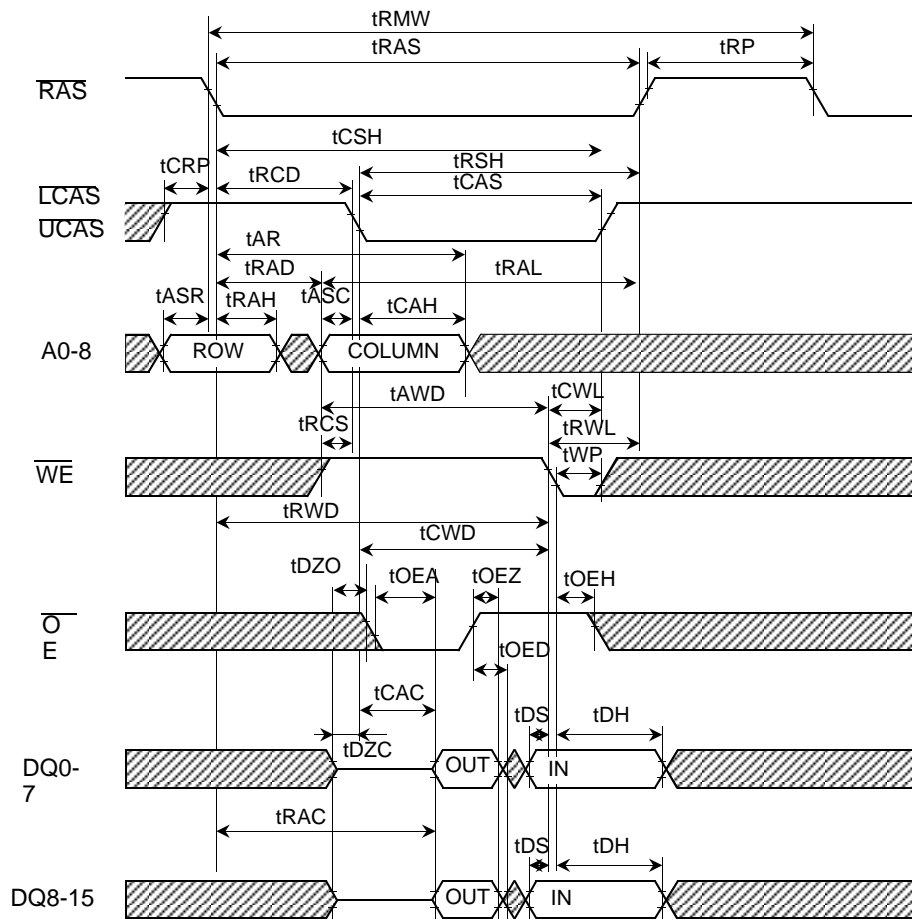


 : "H" or "L"

LATE WRITE CYCLE (LCAS and UCAS active)

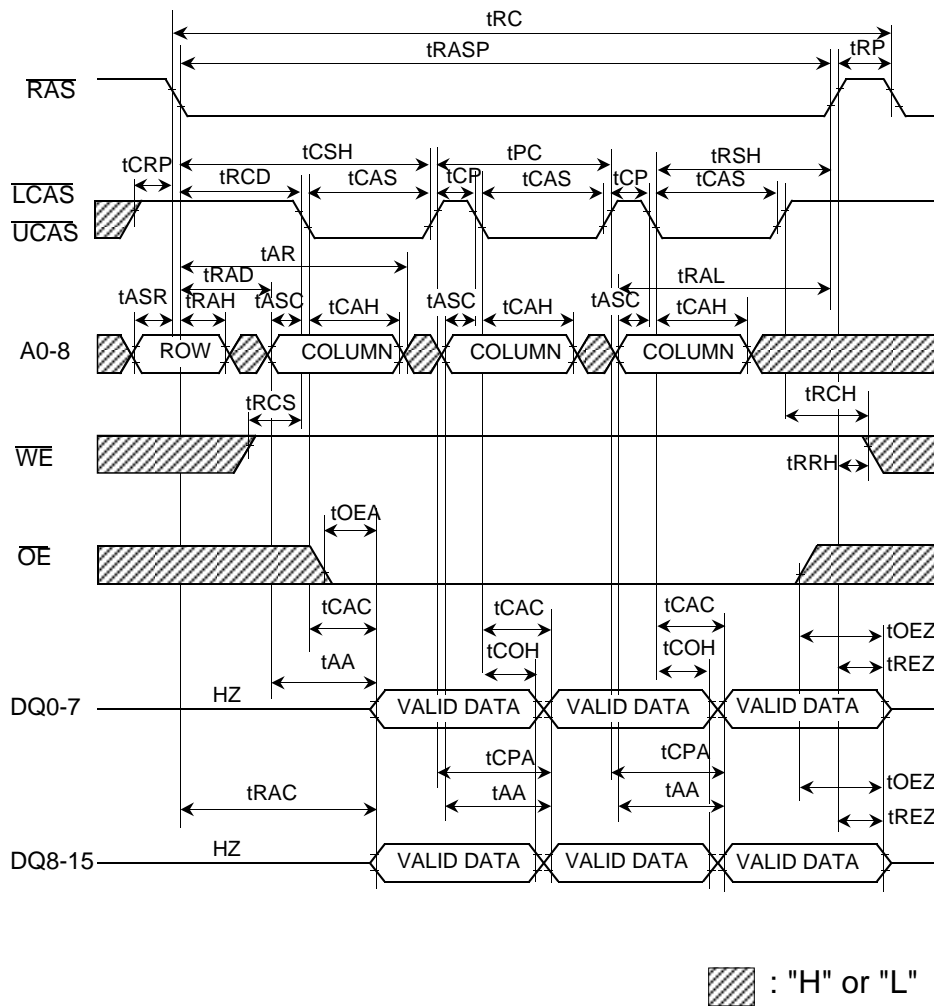


READ MODIFY WRITE CYCLE (LCAS and UCAS active)

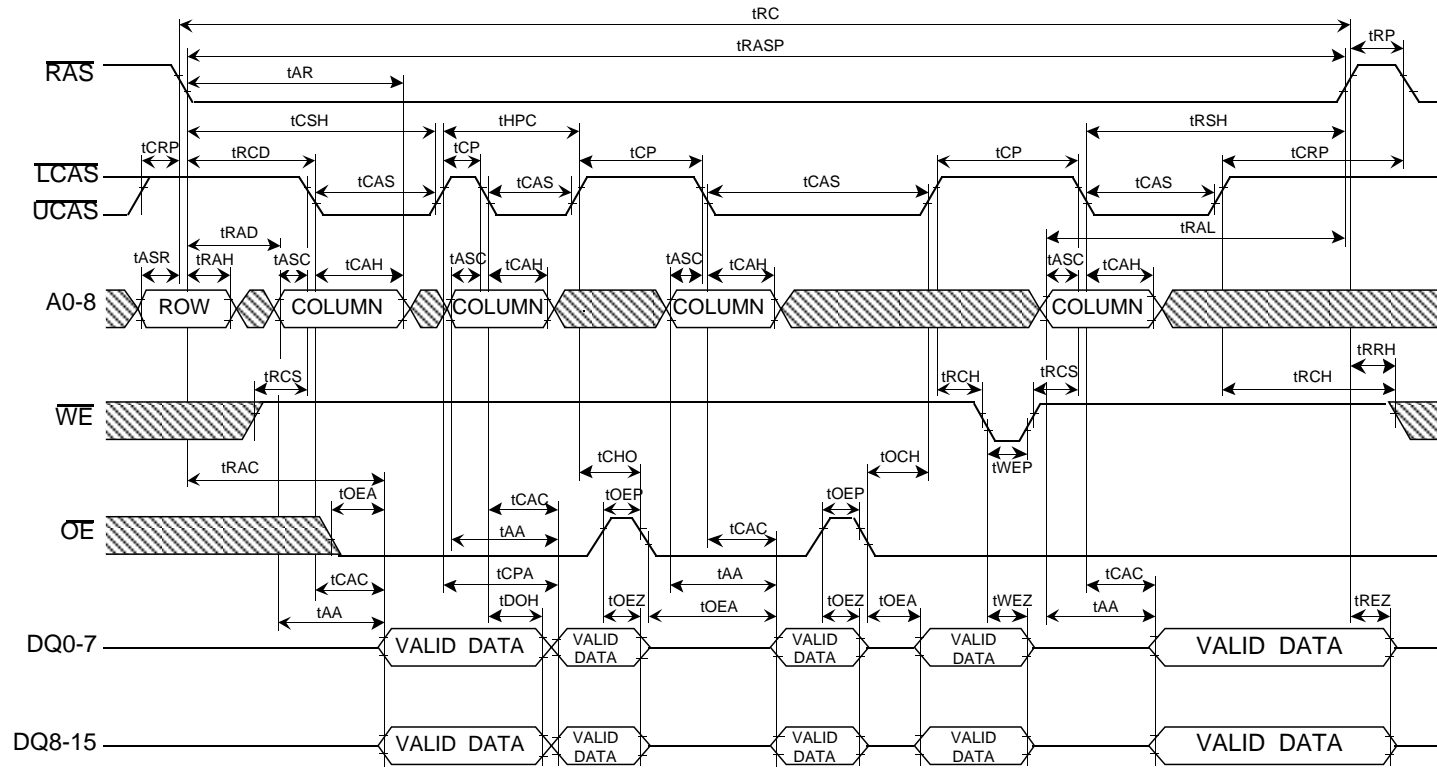


▨ : "H" or "L"

FAST PAGE MODE READ CYCLE with Extended Data Out

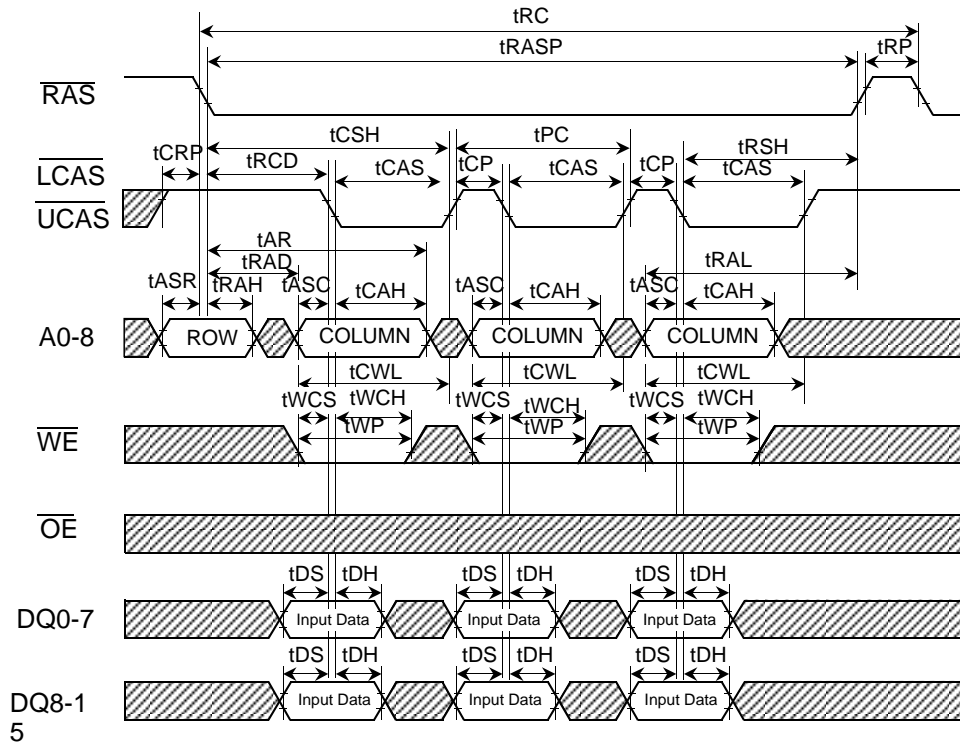


FAST PAGE MODE READ Hi-Z OPERATION



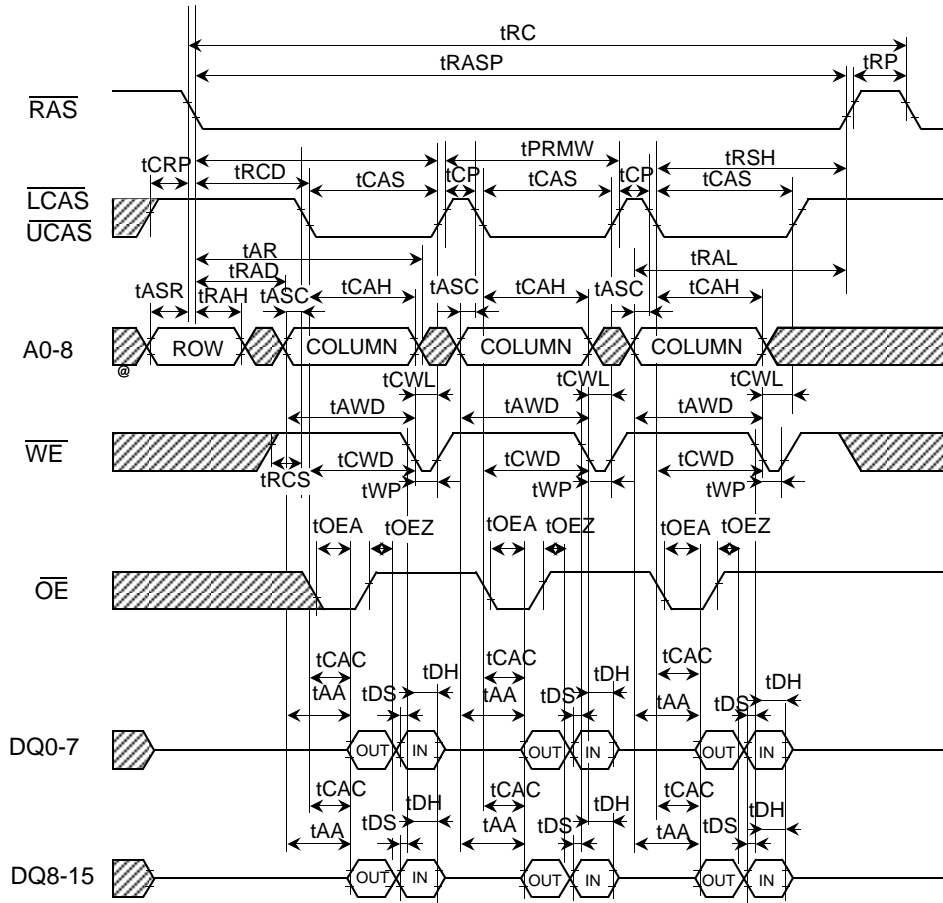
▨ : "H" or "L"

FAST PAGE MODE EARLY WRITE CYCLE



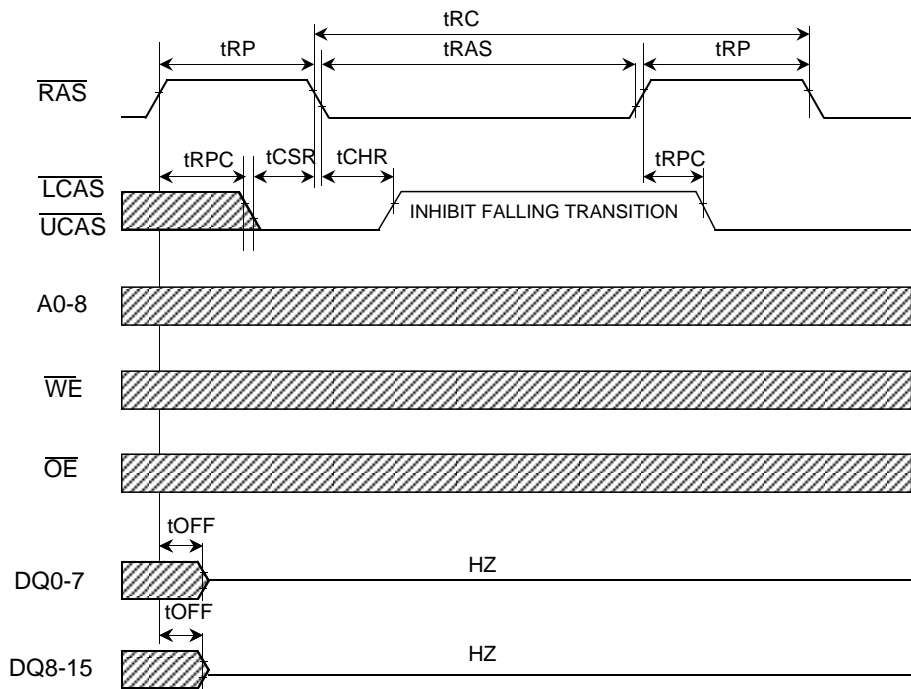
▨ : "H" or "L"


FAST PAGE MODE READ MODIFY WRITE CYCLE



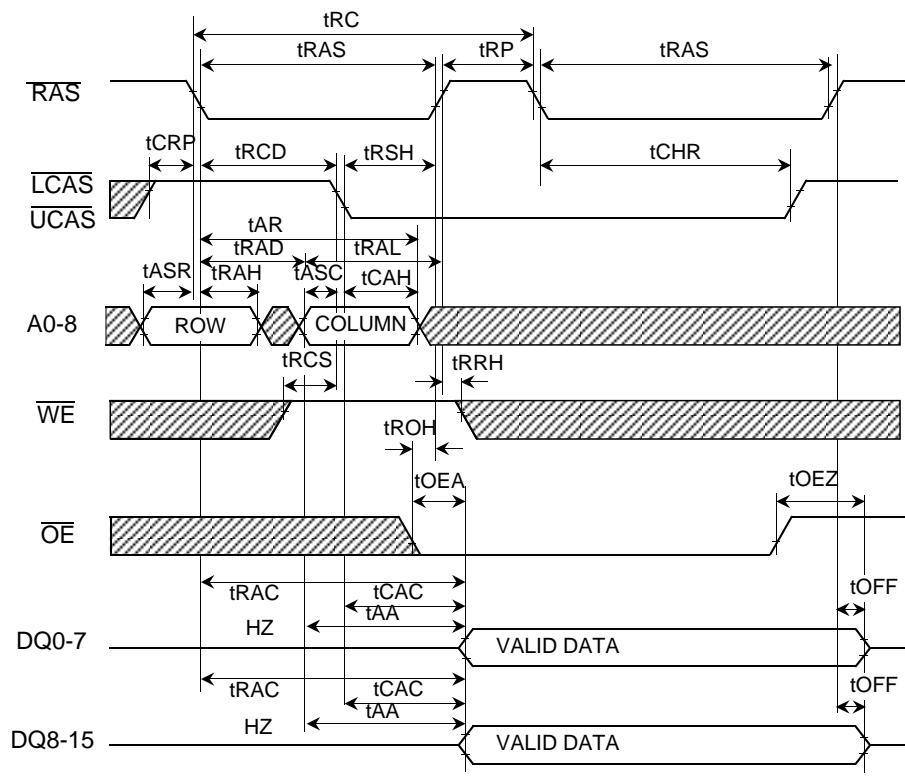
▨ : "H" or "L"


CAS BEFORE RAS REFRESH CYCLE



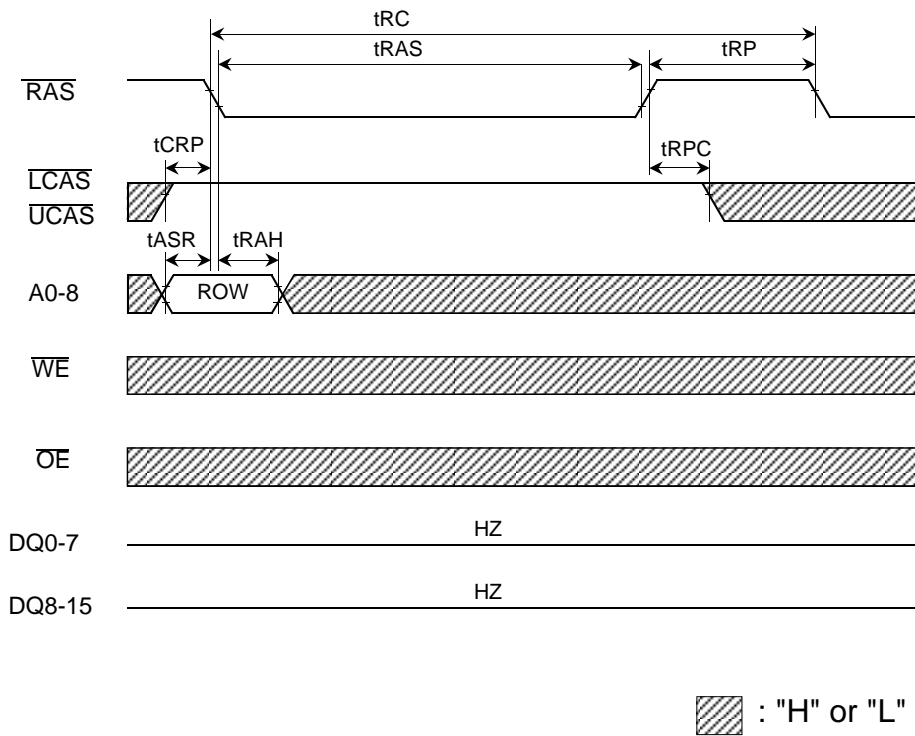
 : "H" or "L"

HIDDEN REFRESH CYCLE



 : "H" or "L"

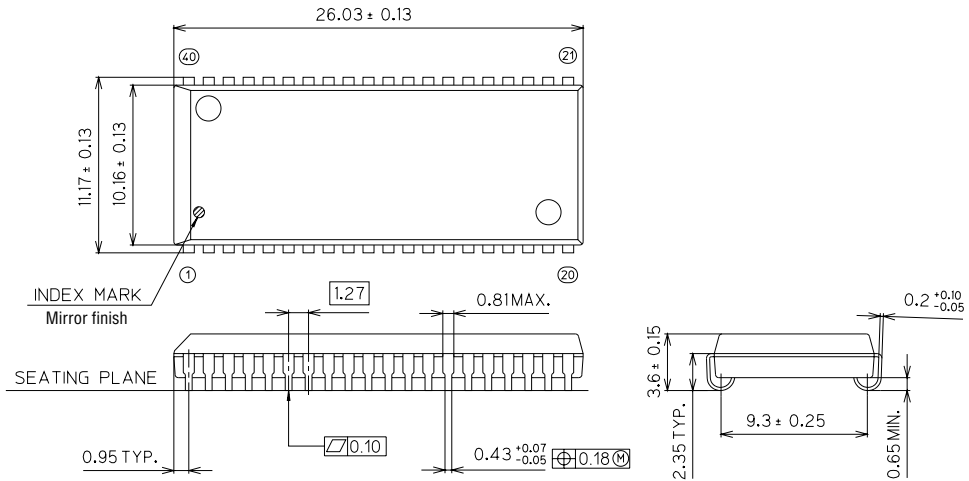
$\overline{\text{RAS}}$ ONLY REFRESH CYCLE



PACKAGE OUTLINES AND DIMENSIONS

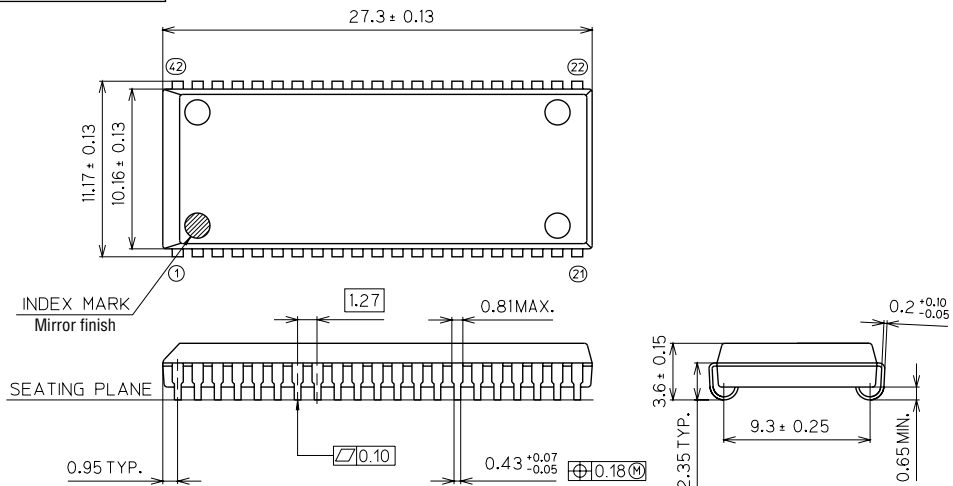
(Unit: mm)

SOJ40-P-400-1.27



| | |
|------------------------|-------------------|
| Package material | Epoxy resin |
| Lead frame material | 42 alloy |
| Pin treatment | Solder plating |
| Solder plate thickness | 5 μ m or more |
| Package weight (g) | 1.70 TYP. |

SOJ42-P-400-1.27



| | |
|------------------------|-------------------|
| Package material | Epoxy resin |
| Lead frame material | 42 alloy |
| Pin treatment | Solder plating |
| Solder plate thickness | 5 μ m or more |
| Package weight (g) | 1.86 TYP. |