

MSM51V17400F

4,194,304-Word × 4-Bit DYNAMIC RAM : FAST PAGE MODE TYPE

DESCRIPTION

The MSM51V17400F is a 4,194,304-word × 4-bit dynamic RAM fabricated in LAPIS Semiconductor's silicon-gate CMOS technology. The MSM51V17400F achieves high integration, high-speed operation, and low-power consumption because LAPIS Semiconductor manufactures the device in a quadruple-layer polysilicon/double-layer metal CMOS process. The MSM51V17400F is available in a 26/24-pin plastic TSOP.

FEATURES

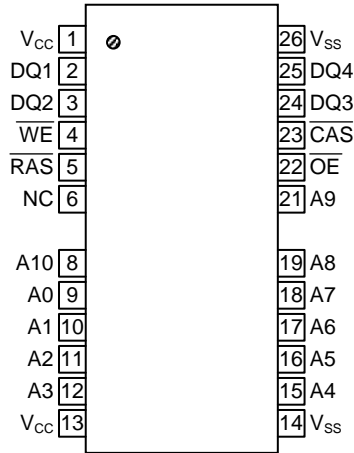
- 4,194,304-word × 4-bit configuration
- Single 3.3V power supply, ±0.3V tolerance
- Input : LVTTL compatible, low input capacitance
- Output : LVTTL compatible, 3-state
- Refresh : 2048 cycles/32ms
- Fast page mode, read modify write capability
- CAS before RAS refresh, hidden refresh, RAS-only refresh capability
- Packages:
 26/24-pin 300mil plastic TSOP (P-TSOP(2)26/24-300-1.27-Z3K)

PRODUCT FAMILY

| Family | Access Time (Max.) | | | | Cycle Time (Min.) | Power Dissipation | |
|-----------------|--------------------|-----------------|------------------|------------------|-------------------|-------------------|----------------|
| | t _{RAC} | t _{AA} | t _{CAC} | t _{OEA} | | Operating (Max.) | Standby (Max.) |
| MSM51V17400F-60 | 60ns | 30ns | 15ns | 15ns | 110ns | 324mW | 1.8mW |



PIN CONFIGURATION (TOP VIEW)



26/24-Pin Plastic TSOP
(K Type)

| Pin Name | Function |
|-------------------------|------------------------|
| A0–A10 | Address Input |
| $\overline{\text{RAS}}$ | Row Address Strobe |
| $\overline{\text{CAS}}$ | Column Address Strobe |
| DQ1–DQ4 | Data Input/Data Output |
| $\overline{\text{OE}}$ | Output Enable |
| $\overline{\text{WE}}$ | Write Enable |
| V _{CC} | Power Supply (3.3V) |
| V _{SS} | Ground (0V) |
| NC | No Connection |

Note : The same power supply voltage must be provided to every V_{CC} pin, and the same GND voltage level must be provided to every V_{SS} pin.

ELECTRICAL CHARACTERISTICS**ABSOLUTE MAXIMUM RATINGS**

| Parameter | Symbol | Value | Unit |
|--|-------------------|------------------------|------|
| Voltage on Any Pin Relative to V_{SS} | V_{IN}, V_{OUT} | -0.5 to $V_{CC} + 0.5$ | V |
| Voltage V_{CC} Supply relative to V_{SS} | V_{CC} | -0.5 to 4.6 | V |
| Short Circuit Output Current | I_{OS} | 50 | mA |
| Power Dissipation | P_{D^*} | 1 | W |
| Operating Temperature | T_{opr} | 0 to 70 | °C |
| Storage Temperature | T_{stg} | -55 to 150 | °C |

*: $T_a = 25^{\circ}\text{C}$ **RECOMMENDED OPERATING CONDITIONS**

(Ta = 0 to 70°C)

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|----------------------|----------|--------------------|------|---------------------|------|
| Power Supply Voltage | V_{CC} | 3.0 | 3.3 | 3.6 | V |
| | 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 |

Notes: *1. The input voltage is $V_{CC} + 1.0\text{V}$ when the pulse width is less than 20ns (the pulse width is with respect to the point at which V_{CC} is applied).

*2. The input voltage is $V_{SS} - 1.0\text{V}$ when the pulse width is less than 20ns (the pulse width respect to the point at which V_{SS} is applied).

PIN CAPACITANCE

(Vcc = 3.3V ± 0.3V, Ta = 25°C, f = 1 MHz)

| Parameter | Symbol | Min. | Min. | Unit |
|---|-----------|------|------|------|
| Input Capacitance (A0 – A10) | C_{IN1} | — | 5 | pF |
| Input Capacitance ($\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$) | C_{IN2} | — | 7 | pF |
| Output Capacitance (DQ1 – DQ4) | $C_{I/O}$ | — | 7 | pF |

DC CHARACTERISTICS

(V_{CC} = 3.3V ± 0.3V, Ta = 0 to 70°C)

| Parameter | Symbol | Condition | MSM51V17400 F-60 | | Unit | Note |
|--|------------------|--|---------------------|-----------------|------|------|
| | | | Min. | Max. | | |
| Output High Voltage | V _{OH} | I _{OH} = -2.0mA | 2.4 | V _{CC} | V | |
| Output Low Voltage | V _{OL} | I _{OL} = 2.0mA | 0 | 0.4 | V | |
| Input Leakage Current | I _{LI} | 0V ≤ V _I ≤ V _{CC} + 0.3V; All other pins not under test = 0V | - 10 | 10 | μA | |
| Output Leakage Current | I _{LO} | DQ disable 0V ≤ V _O ≤ V _{CC} | - 10 | 10 | μA | |
| Average Power Supply Current (Operating) | I _{CC1} | $\overline{\text{RAS}}$, $\overline{\text{CAS}}$ cycling, t _{RC} = Min. | — | 90 | mA | 1,2 |
| Power Supply Current (Standby) | I _{CC2} | $\overline{\text{RAS}}$, $\overline{\text{CAS}} = V_{IH}$ | — | 2 | mA | 1 |
| | | $\overline{\text{RAS}}$, $\overline{\text{CAS}} \geq V_{CC} - 0.2V$ | — | 0.5 | | |
| Average Power Supply Current ($\overline{\text{RAS}}$ -only Refresh) | I _{CC3} | $\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}} = V_{IH}$, t _{RC} = Min. | — | 90 | mA | 1,2 |
| Power Supply Current (Standby) | I _{CC5} | $\overline{\text{RAS}} = V_{IH}$, $\overline{\text{CAS}} = V_{IL}$, DQ = enable | — | 5 | mA | 1 |
| Average Power Supply Current ($\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Refresh) | I _{CC6} | $\overline{\text{RAS}} = \text{cycling}$, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ | — | 90 | mA | 1,2 |
| Average Power Supply Current (Fast Page Mode) | I _{CC7} | $\overline{\text{RAS}} = V_{IL}$, $\overline{\text{CAS}}$ cycling, t _{PC} = Min. | — | 70 | mA | 1,3 |

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

AC CHARACTERISTICS (1/2)

(V_{CC} = 3.3V ± 0.3V, Ta = 0 to 70°C) Note1,2,3,11,12

| Parameter | Symbol | MSM51V17400 F-60 | | Unit | Note |
|--|-------------------|---------------------|---------|------|---------|
| | | Min. | Max. | | |
| Random Read or Write Cycle Time | t _{RC} | 110 | — | ns | |
| Read Modify Write Cycle Time | t _{RWC} | 155 | — | ns | |
| Fast Page Mode Cycle Time | t _{PC} | 40 | — | ns | |
| Fast Page Mode Read Modify Write Cycle Time | t _{PRWC} | 85 | — | ns | |
| Access Time from $\overline{\text{RAS}}$ | t _{RAC} | — | 60 | ns | 4, 5, 6 |
| Access Time from $\overline{\text{CAS}}$ | t _{CAC} | — | 15 | ns | 4, 5 |
| Access Time from Column Address | t _{AA} | — | 30 | ns | 4, 6 |
| Access Time from $\overline{\text{CAS}}$ Precharge | t _{CPA} | — | 35 | ns | 4 |
| Access Time from $\overline{\text{OE}}$ | t _{OEA} | — | 15 | ns | 4 |
| Output Low Impedance Time from $\overline{\text{CAS}}$ | t _{CLZ} | 0 | — | ns | 4 |
| $\overline{\text{CAS}}$ to Data Output Buffer Turn-off Delay Time | t _{OFF} | 0 | 15 | ns | 7 |
| $\overline{\text{OE}}$ to Data Output Buffer Turn-off Delay Time | t _{OEZ} | 0 | 15 | ns | 7 |
| Transition Time | t _T | 3 | 50 | ns | 3 |
| Refresh Period | t _{REF} | — | 32 | ms | |
| $\overline{\text{RAS}}$ Precharge Time | t _{RP} | 40 | — | ns | |
| $\overline{\text{RAS}}$ Pulse Width | t _{RAS} | 60 | 10,000 | ns | |
| $\overline{\text{RAS}}$ Pulse Width (Fast Page Mode) | t _{RASP} | 60 | 100,000 | ns | |
| $\overline{\text{RAS}}$ Hold Time | t _{RSH} | 15 | — | ns | |
| $\overline{\text{RAS}}$ Hold Time referenced to $\overline{\text{OE}}$ | t _{ROH} | 15 | — | ns | |
| $\overline{\text{CAS}}$ Precharge Time (Fast Page Mode) | t _{CP} | 10 | — | ns | |
| $\overline{\text{CAS}}$ Pulse Width | t _{CAS} | 15 | 10,000 | ns | |
| $\overline{\text{CAS}}$ Hold Time | t _{CSH} | 60 | — | ns | |
| $\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ Precharge Time | t _{CRP} | 5 | — | ns | |
| $\overline{\text{RAS}}$ Hold Time from $\overline{\text{CAS}}$ Precharge | t _{RHCP} | 35 | — | ns | |
| $\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Delay Time | t _{RCD} | 20 | 45 | ns | 5 |
| $\overline{\text{RAS}}$ to Column Address Delay Time | t _{RAD} | 15 | 30 | ns | 6 |
| Row Address Set-up Time | t _{ASR} | 0 | — | ns | |

AC CHARACTERISTICS (2/2)

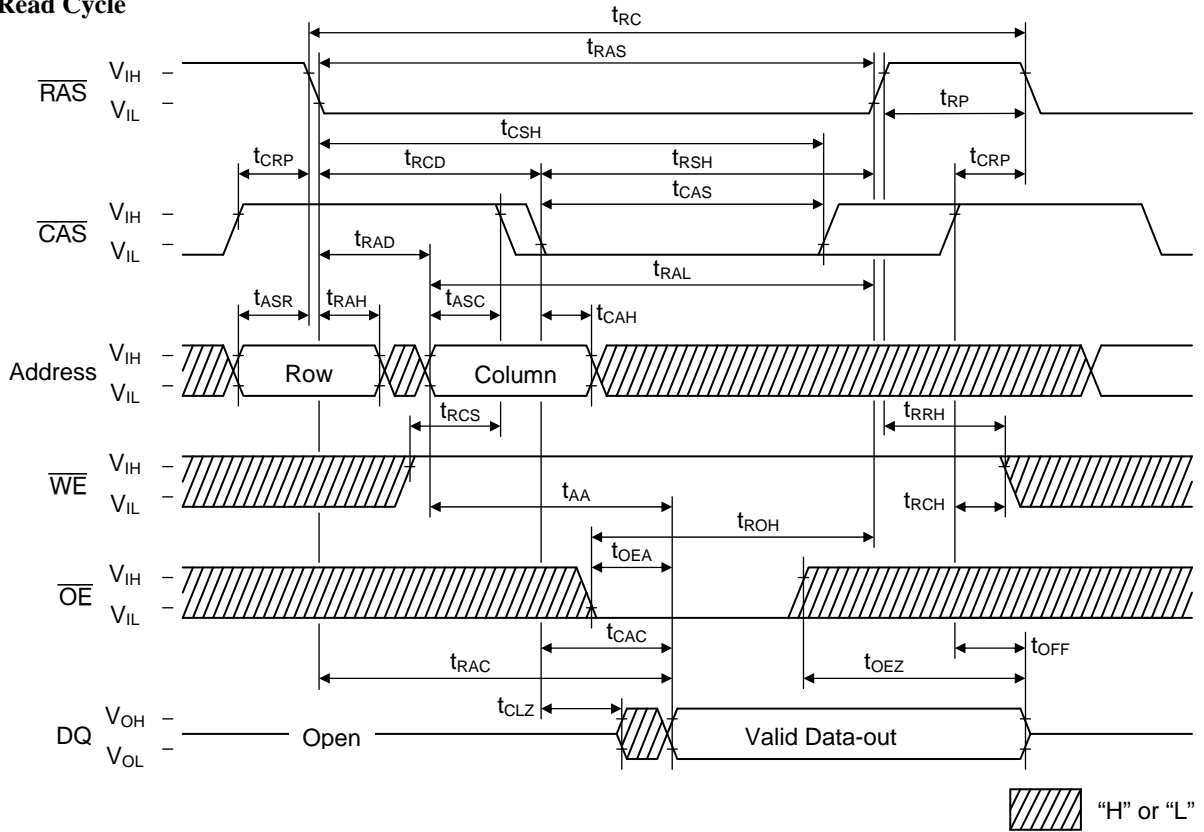
 $(V_{CC} = 3.3V \pm 0.3V, T_a = 0 \text{ to } 70^\circ\text{C})$ Note1,2,3,11,12

| Parameter | Symbol | MSM51V17400 F-60 | | Unit | Note |
|---|------------|---------------------|------|------|------|
| | | Min. | Max. | | |
| Row Address Hold Time | t_{RAH} | 10 | — | ns | |
| Column Address Set-up Time | t_{ASC} | 0 | — | ns | |
| Column Address Hold Time | t_{CAH} | 10 | — | ns | |
| Column Address to \overline{RAS} Lead Time | t_{RAL} | 30 | — | ns | |
| Read Command Set-up Time | t_{RCS} | 0 | — | ns | |
| Read Command Hold Time | t_{RCH} | 0 | — | ns | 8 |
| Read Command Hold Time referenced to \overline{RAS} | t_{RRH} | 0 | — | ns | 8 |
| Write Command Set-up Time | t_{WCS} | 0 | — | ns | 9 |
| Write Command Hold Time | t_{WCH} | 10 | — | ns | |
| Write Command Pulse Width | t_{WP} | 10 | — | ns | |
| \overline{OE} Command Hold Time | $t_{OE H}$ | 15 | — | ns | |
| Write Command to \overline{RAS} Lead Time | t_{RWL} | 15 | — | ns | |
| Write Command to \overline{CAS} Lead Time | t_{CWL} | 15 | — | ns | |
| Data-in Set-up Time | t_{DS} | 0 | — | ns | 10 |
| Data-in Hold Time | t_{DH} | 10 | — | ns | 10 |
| \overline{OE} to Data-in Delay Time | t_{OED} | 15 | — | ns | |
| \overline{CAS} to \overline{WE} Delay Time | t_{CWD} | 40 | — | ns | 9 |
| Column Address to \overline{WE} Delay Time | t_{AWD} | 55 | — | ns | 9 |
| \overline{RAS} to \overline{WE} Delay Time | t_{RWD} | 85 | — | ns | 9 |
| \overline{CAS} Precharge \overline{WE} Delay Time | t_{CPWD} | 60 | — | ns | 9 |
| \overline{CAS} Active Delay Time from \overline{RAS} Precharge | t_{RPC} | 5 | — | ns | |
| \overline{RAS} to \overline{CAS} Set-up Time (CAS before \overline{RAS}) | t_{CSR} | 10 | — | ns | |
| \overline{RAS} to \overline{CAS} Hold Time (CAS before \overline{RAS}) | t_{CHR} | 10 | — | ns | |
| \overline{WE} to \overline{RAS} Precharge Time (CAS before \overline{RAS}) | t_{WRP} | 10 | — | ns | |
| \overline{WE} Hold Time from \overline{RAS} (CAS before \overline{RAS}) | t_{WRH} | 10 | — | ns | |
| \overline{RAS} to \overline{WE} Set-up Time (Test Mode) | t_{WTS} | 10 | — | ns | |
| \overline{RAS} to \overline{WE} Hold Time (Test Mode) | t_{WTH} | 10 | — | ns | |

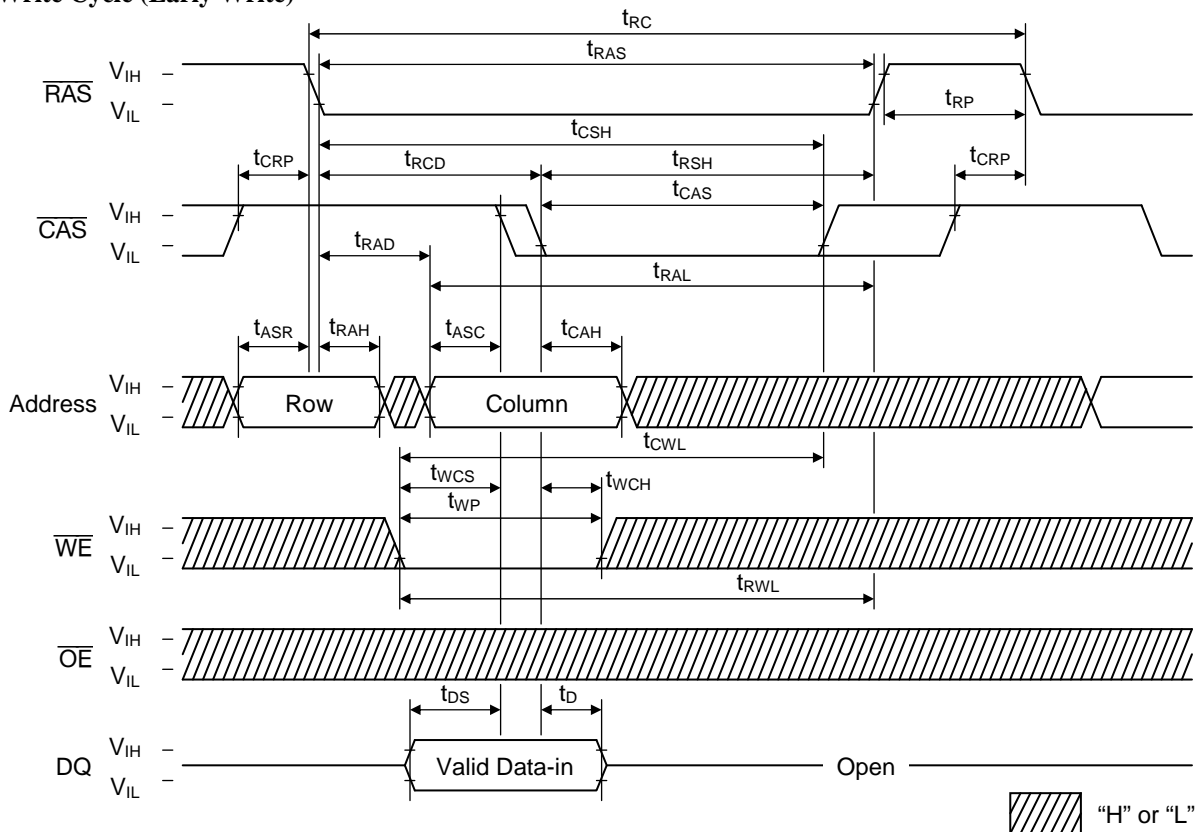
- Notes:
1. A start-up delay of 200 μ s is required after power-up, followed by a minimum of eight initialization cycles ($\overline{\text{RAS}}$ -only refresh or $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh) before proper device operation is achieved.
 2. The AC characteristics assume $t_T = 5\text{ns}$.
 3. V_{IH} (Min.) and V_{IL} (Max.) are reference levels for measuring input timing signals. Transition times (t_T) are measured between V_{IH} and V_{IL} .
 4. This parameter is measured with a load circuit equivalent to 1TTL load and 100pF.
 5. Operation within the t_{RCD} (Max.) limit ensures 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 the access time is controlled by t_{CAC} .
 6. 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 the access time is controlled by t_{AA} .
 7. t_{OFF} (Max.) and t_{OEZ} (Max.) define the time at which the output achieved the open circuit condition and are not referenced to output voltage levels.
 8. t_{RCH} or t_{RRH} must be satisfied for a read cycle.
 9. t_{WCS} , t_{CWD} , t_{RWD} , t_{AWD} and t_{CPWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$ (Min.), then the cycle is an early write cycle and the data out will remain open circuit (high impedance) throughout the entire cycle. If $t_{CWD} \geq t_{CWD}$ (Min.), $t_{RWD} \geq t_{RWD}$ (Min.), $t_{AWD} \geq t_{AWD}$ (Min.) and $t_{CPWD} \geq t_{CPWD}$ (Min.), then the cycle is a read modify write cycle and data out will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, then the condition of the data out (at access time) is indeterminate.
 10. These parameters are referenced to the $\overline{\text{CAS}}$, leading edges in an early write cycle, and to the $\overline{\text{WE}}$ leading edge in an $\overline{\text{OE}}$ control write cycle, or a read modify write cycle.
 11. The test mode is initiated by performing a $\overline{\text{WE}}$ and $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycle. This mode is latched and remains in effect until the exit cycle is generated. In a test CA9 and CA10 are not used and each DQ pin now access 4-bit locations. Since all 4 DQ pins are used, a total 16 data bits can be written in parallel into the memory array. In a read cycle, if 4 data bits are equal, the DQ pin will indicate a high level. If the 4 data 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 performing a $\overline{\text{RAS}}$ -only refresh cycle or a $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycle.
 12. In a test mode read cycle, the value of access time parameter 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.

TIMING CHART

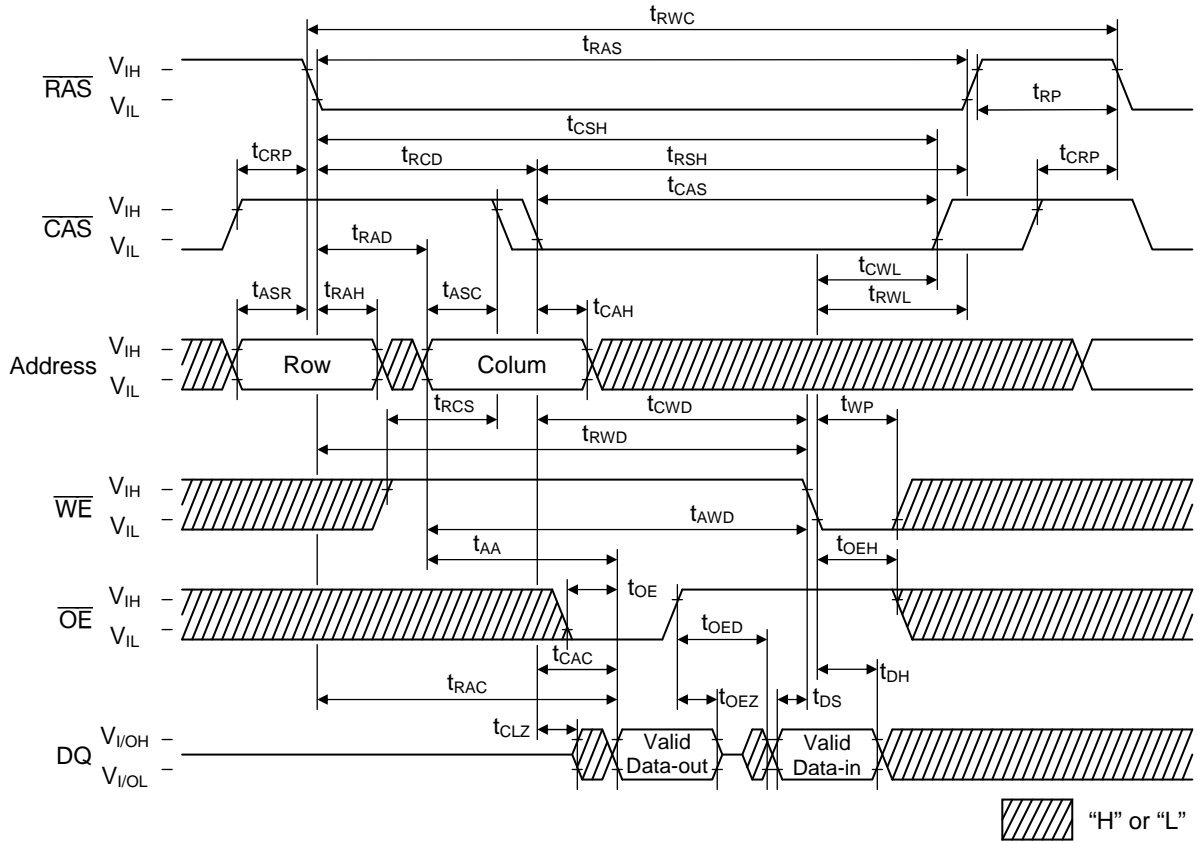
Read Cycle



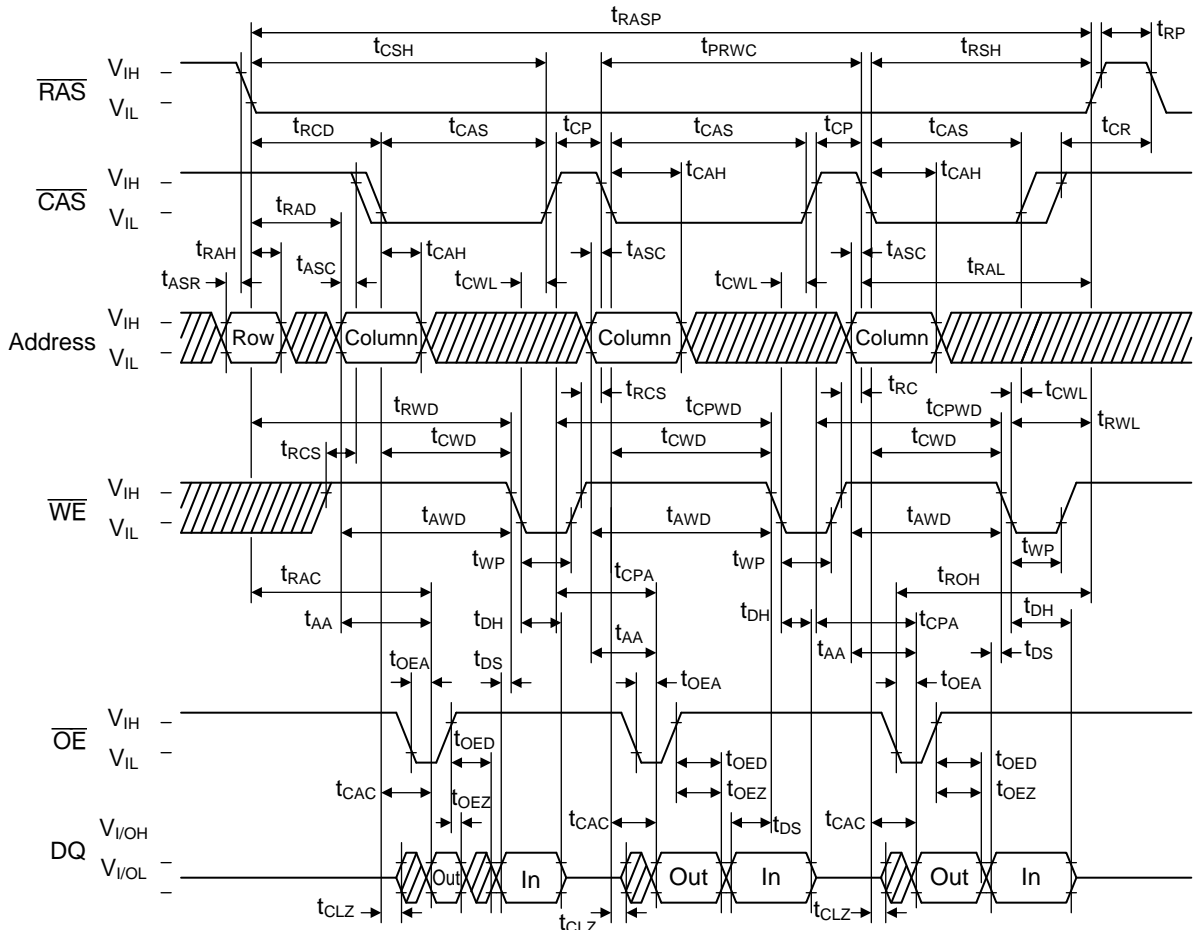
Write Cycle (Early Write)



Read Modify Write Cycle

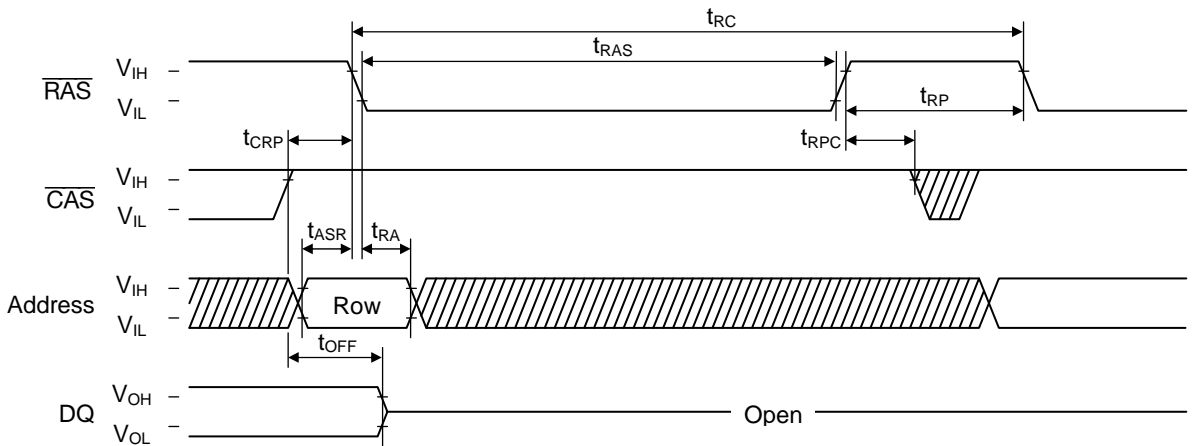


Fast Page Mode Read Modify Write Cycle



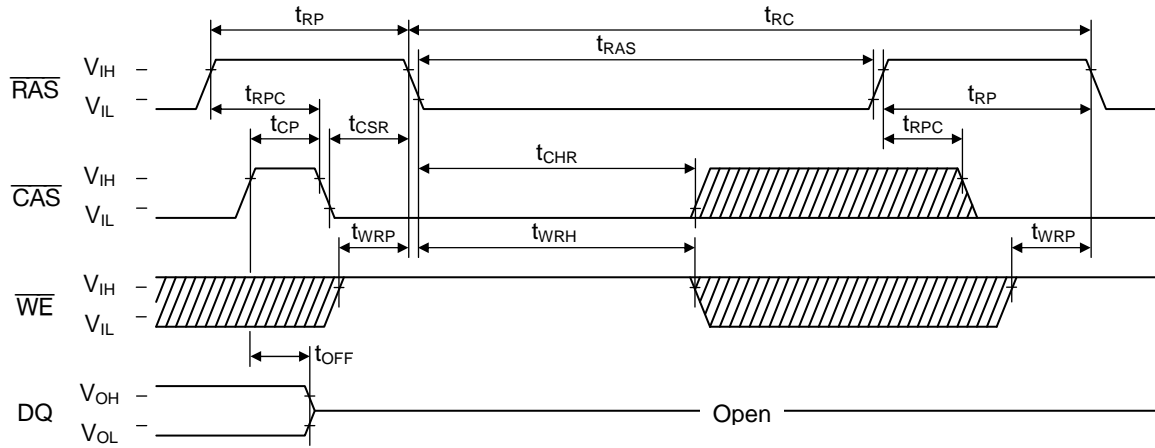
Note: In = Valid Data-in, Out = Valid Data-out "H" or "L"


RAS-only Refresh Cycle



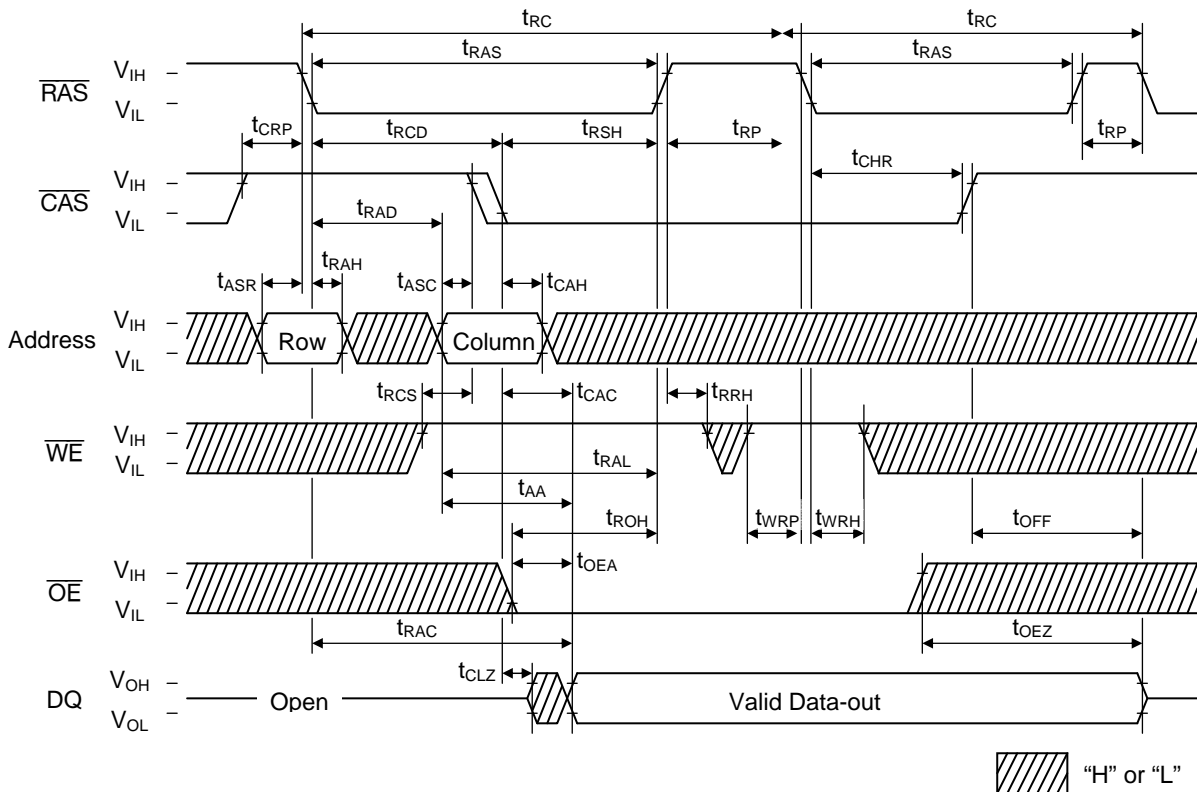
Note: \overline{WE} , \overline{OE} = "H" or "L" "H" or "L"

CAS before RAS Refresh Cycle



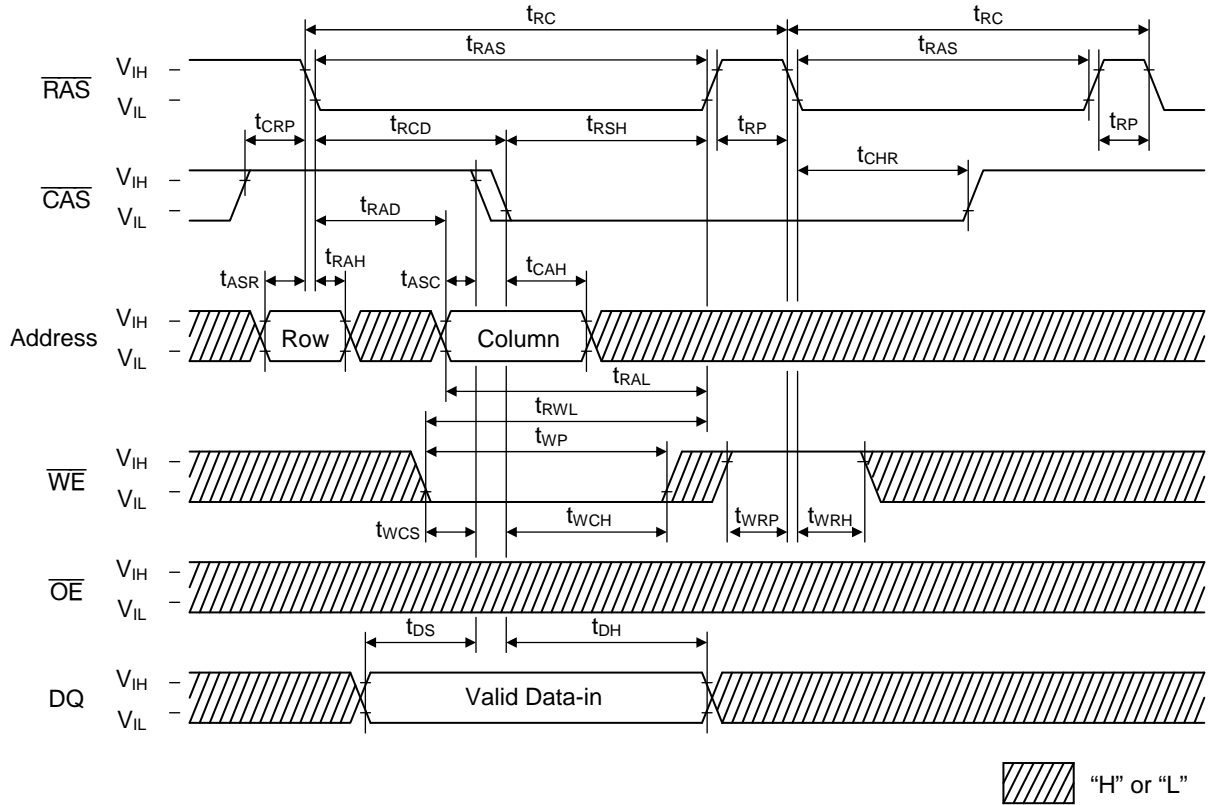
Note: \overline{OE} , Address = "H" or "L"  "H" or "L"

Hidden Refresh Read Cycle

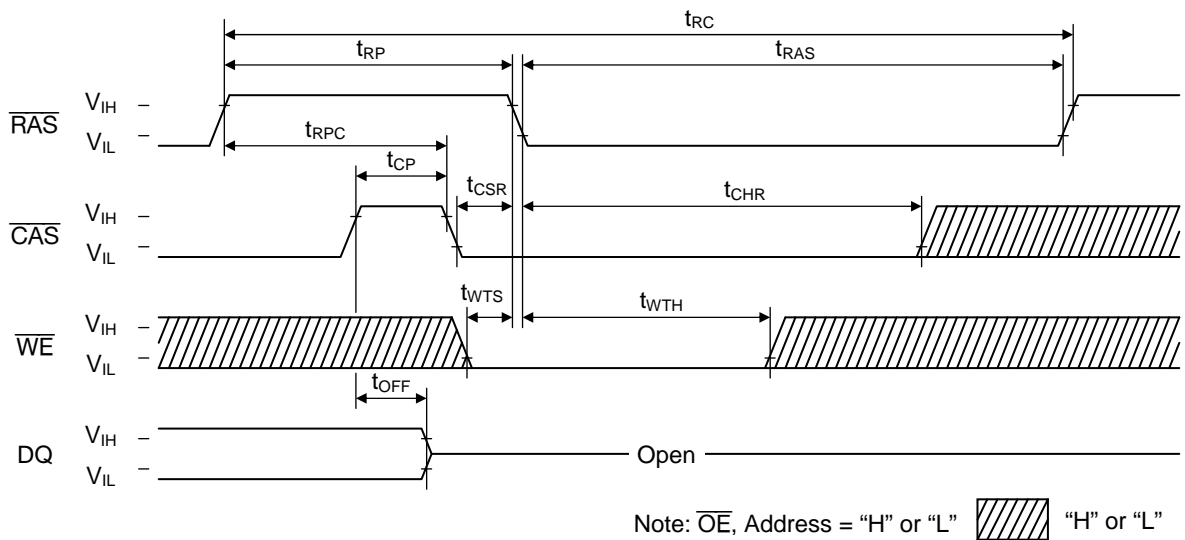


 "H" or "L"

Hidden Refresh Write Cycle



Test Mode-in Cycle



REVISION HISTORY

| Document No. | Date | Page | | Description |
|------------------|---------------|------------------|-----------------|--|
| | | Previous Edition | Current Edition | |
| FEDD51V17400F-01 | Mar.23, 2004 | – | – | Final edition 1 from FEDD5117400F-04 |
| FEDD51V17400F-02 | Feb.01, 2012 | 1,2 1 3 | 1,2 1 – | Deleted SOJ26/24 Changed pb-free device name Deleted Block diagram |
| FEDD51V17400F-03 | Nov. 27, 2014 | 1 | 1 | Changed package code(Cu frame) Added ROHM logo mark Changed company Logo |

NOTES

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