

OKI Semiconductor

MSM514800E/ESL

524,288-Word x 8-Bit DYNAMIC RAM : FAST PAGE MODE TYPE

DESCRIPTION

The MSM514800E/ESL is a 524,288-word \times 8-bit dynamic RAM fabricated in Oki's silicon-gate CMOS technology. The MSM514800E/ESL achieves high integration, high-speed operation, and low-power consumption because Oki manufactures the device in a quadruple-layer polysilicon/double-layer metal CMOS process. The MSM514800E/ESL is available in a 28-pin plastic SOJ. The MSM514800ESL (the self-refresh and lower-power version) is specially designed for lower-power applications.

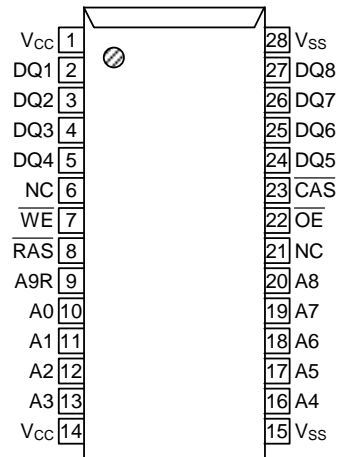
FEATURES

- 524,288-word \times 8-bit configuration
- Single 5V power supply, $\pm 10\%$ tolerance
- Input : TTL compatible, low input capacitance
- Output : TTL compatible, 3-state
- Refresh : 1,024 cycles/16 ms, 1,024 cycles/128 ms (SL Version)
- Fast page mode, read modify write capability
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, hidden refresh, $\overline{\text{RAS}}$ -only refresh capability
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ self-refresh capability (SL version)
- Package options:
28-pin 400mil plastic SOJ (SOJ28-P-400-1.27) (Product : MSM514800E/ESL-xxJS)
xx : indicates speed rank.

PRODUCT FAMILY

Family	Access Time (Max.)				Cycle Time (Min.)	Power Dissipation	
	t_{RAC}	t_{AA}	t_{CAC}	t_{OEA}		Operating (Max.)	Standby (Max.)
MSM514800E/ESL	60ns	30ns	15ns	15ns	110ns	550mW	5.5mW/ 1.1mW (SL Version)
	70ns	35ns	20ns	20ns	130ns	495mW	

PIN CONFIGURATION (TOP VIEW)

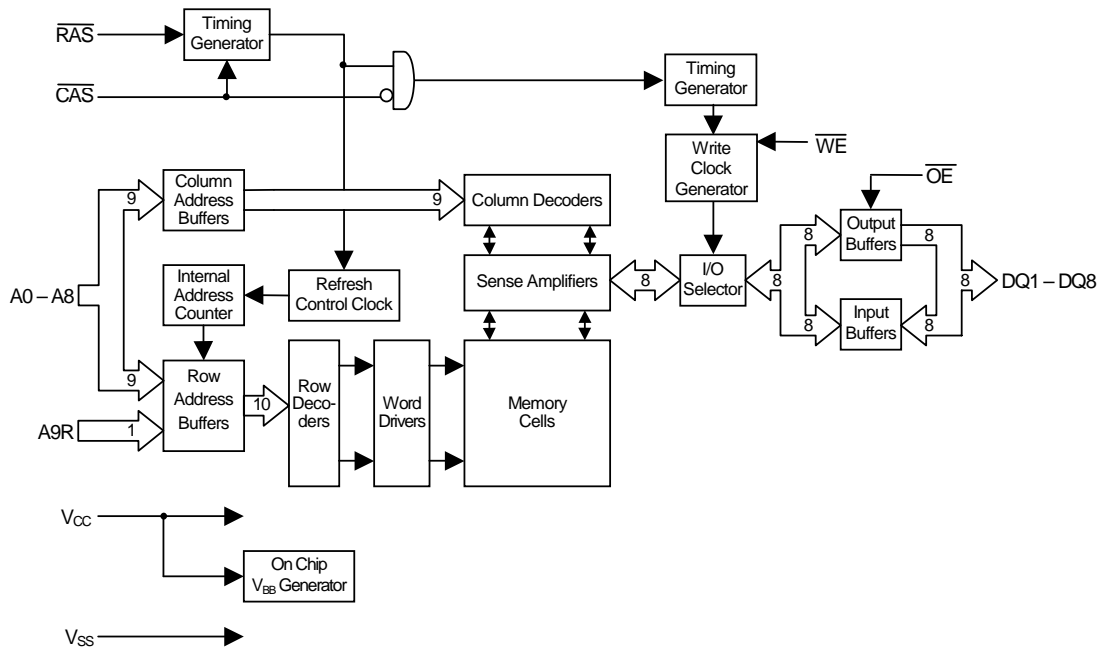


28-Pin Plastic SOJ

Pin Name	Function
A0 - A8, A9R	Address Input
$\overline{\text{RAS}}$	Row Address Strobe
$\overline{\text{CAS}}$	Column Address Strobe
DQ1 – DQ8	Data Input/Data Output
$\overline{\text{OE}}$	Output Enable
$\overline{\text{WE}}$	Write Enable
V _{CC}	Power Supply (5V)
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.

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 $V_{CC} + 0.5$	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^*}	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

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

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	—	$V_{CC} + 0.5^{*1}$	V
Input Low Voltage	V_{IL}	-0.5^{*2}	—	0.8	V

Notes: *1. The input voltage is $V_{CC} + 2.0\text{V}$ 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 $V_{SS} - 2.0\text{V}$ when the pulse width is less than 20ns (the pulse width is with respect to the point at which V_{SS} is applied).

Capacitance

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

Parameter	Symbol	Typ.	Max.	Unit
Input Capacitance (A0 – A8, A9R)	C_{IN1}	—	7	pF
Input Capacitance ($\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$)	C_{IN2}	—	7	pF
Output Capacitance (DQ1 – DQ8)	$C_{I/O}$	—	8	pF

DC Characteristics

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

Parameter	Symbol	Condition	MSM514800 E/ESL-60		MSM514800 E/ESL-70		Unit	Note
			Min.	Max.	Min.	Max.		
Output High Voltage	V_{OH}	$I_{OH} = -5.0mA$	2.4	V_{CC}	2.4	V_{CC}	V	
Output Low Voltage	V_{OL}	$I_{OL} = 4.2mA$	0	0.4	0	0.4	V	
Input Leakage Current	I_{LI}	$0V \leq V_I \leq 6.5V$; All other pins not under test = 0V	-10	10	-10	10	μA	
Output Leakage Current	I_{LO}	DQ disable $0V \leq V_O \leq 5.5V$	-10	10	-10	10	μA	
Average Power Supply Current (Operating)	I_{CC1}	\overline{RAS} , \overline{CAS} cycling, $t_{RC} = \text{Min.}$	—	100	—	90	mA	1,2
Power Supply Current (Standby)	I_{CC2}	\overline{RAS} , $\overline{CAS} = V_{IH}$	—	2	—	2	mA	1
		\overline{RAS} , $\overline{CAS} \geq$ $V_{CC} - 0.2V$	—	1	—	1	μA	1,5
Average Power Supply Current (\overline{RAS} -only Refresh)	I_{CC3}	\overline{RAS} cycling, $\overline{CAS} = V_{IH}$, $t_{RC} = \text{Min.}$	—	100	—	90	mA	1,2
Power Supply Current (Standby)	I_{CC5}	$\overline{RAS} = V_{IH}$, $\overline{CAS} = V_{IL}$, DQ = enable	—	5	—	5	mA	1
Average Power Supply Current (\overline{CAS} before \overline{RAS} Refresh)	I_{CC6}	$\overline{RAS} = \text{cycling}$, \overline{CAS} before \overline{RAS}	—	100	—	90	mA	1,2
Average Power Supply Current (Fast Page Mode)	I_{CC7}	$\overline{RAS} = V_{IL}$, \overline{CAS} cycling, $t_{PC} = \text{Min.}$	—	95	—	85	mA	1,3
Average Power Supply Current (Battery Backup)	I_{CC10}	$t_{RC} = 125\mu s$, \overline{CAS} before \overline{RAS} , $t_{RAS} \leq 1\mu s$	—	300	—	300	μA	1,4,5
Average Power Supply Current (\overline{CAS} before \overline{RAS} Self-Refresh)	I_{CC8}	$\overline{RAS} \leq 0.2V$, $\overline{CAS} \leq 0.2V$	—	300	—	300	μA	1,5

- Notes: 1. I_{CC} Max. is specified as I_{CC} for output open condition.
2. The address can be changed once or less while $\overline{RAS} = V_{IL}$.
3. The address can be changed once or less while $\overline{CAS} = V_{IH}$.
4. $V_{CC} - 0.2V \leq V_{IH} \leq 6.5V$, $-1.0V \leq V_{IL} \leq 0.2V$.
5. SL version.

AC Characteristic (1/2)

 $(V_{CC} = 5V \pm 10\%, T_a = 0^\circ C \text{ to } 70^\circ C)$ Note1,2,3

Parameter	Symbol	MSM514800 E/ESL-60		MSM514800 E/ESL-70		Unit	Note
		Min.	Max.	Min.	Max.		
Random Read or Write Cycle Time	t_{RC}	110	—	130	—	ns	
Read Modify Write Cycle Time	t_{RWC}	155	—	185	—	ns	
Fast Page Mode Cycle Time	t_{PC}	40	—	45	—	ns	
Fast Page Mode Read Modify Write Cycle Time	t_{PRWC}	85	—	100	—	ns	
Access Time from \overline{RAS}	t_{RAC}	—	60	—	70	ns	4,5,6
Access Time from \overline{CAS}	t_{CAC}	—	15	—	20	ns	4,5
Access Time from Column Address	t_{AA}	—	30	—	35	ns	4,6
Access Time from \overline{CAS} Precharge	t_{CPA}	—	35	—	40	ns	4
Access Time from \overline{OE}	t_{OEA}	—	15	—	20	ns	4
Output Low Impedance Time from \overline{CAS}	t_{CLZ}	0	—	0	—	ns	4
\overline{CAS} to Data Output Buffer Turn-off Delay Time	t_{OFF}	0	15	0	20	ns	7
\overline{OE} to Data Output Buffer Turn-off Delay Time	t_{OEZ}	0	15	0	20	ns	7
Transition Time	t_T	3	50	3	50	ns	3
Refresh Period	t_{REF}	—	16	—	16	ms	
Refresh Period	t_{REF}	—	128	—	128	ms	11
\overline{RAS} Precharge Time	t_{RP}	40	—	50	—	ns	
\overline{RAS} Pulse Width	t_{RAS}	60	10,000	70	10,000	ns	
\overline{RAS} Pulse Width (Fast Page Mode)	t_{RASP}	60	100,000	70	100,000	ns	
\overline{RAS} Hold Time	t_{RSH}	15	—	20	—	ns	
\overline{RAS} Hold Time referenced to \overline{OE}	t_{ROH}	15	—	20	—	ns	
\overline{CAS} Precharge Time (Fast Page Mode)	t_{CP}	10	—	10	—	ns	
\overline{CAS} Pulse Width	t_{CAS}	15	10,000	20	10,000	ns	
\overline{CAS} Hold Time	t_{CSH}	60	—	70	—	ns	
\overline{CAS} to \overline{RAS} Precharge Time	t_{CRP}	5	—	5	—	ns	
\overline{RAS} Hold Time from \overline{CAS} Precharge	t_{RHCP}	35	—	40	—	ns	
\overline{RAS} to \overline{CAS} Delay Time	t_{RCD}	20	45	20	50	ns	5
\overline{RAS} to Column Address Delay Time	t_{RAD}	15	30	15	35	ns	6
Row Address Set-up Time	t_{ASR}	0	—	0	—	ns	
Row Address Hold Time	t_{ASR}	10	—	0	—	ns	

AC Characteristic (2/2)

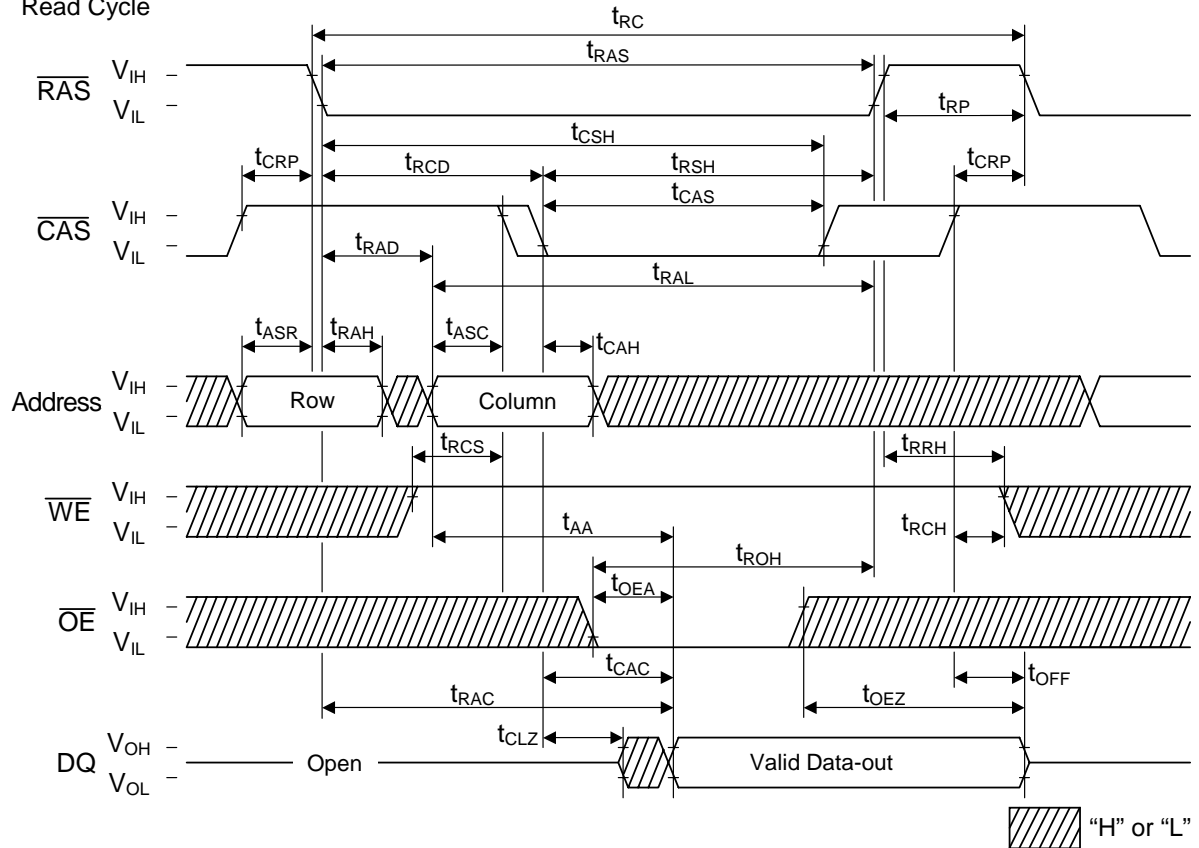
 $(V_{CC} = 5V \pm 10\%, T_a = 0^\circ C \text{ to } 70^\circ C)$ Note1,2,3

Parameter	Symbol	MSM514800 E/ESL-60		MSM514800 E/ESL-70		Unit	Note
		Min.	Max.	Min.	Max.		
Column Address Set-up Time	t_{ASC}	0	—	0	—	ns	
Column Address Hold Time	t_{CAH}	10	—	15	—	ns	
Column Address to \overline{RAS} Lead Time	t_{RAL}	30	—	35	—	ns	
Read Command Set-up Time	t_{RCS}	0	—	0	—	ns	
Read Command Hold Time	t_{RCH}	0	—	0	—	ns	8
Read Command Hold Time referenced to \overline{RAS}	t_{RRH}	0	—	0	—	ns	8
Write Command Set-up Time	t_{WCS}	0	—	0	—	ns	9
Write Command Hold Time	t_{WCH}	10	—	15	—	ns	
Write Command Pulse Width	t_{WCP}	10	—	10	—	ns	
\overline{OE} Command Hold Time	t_{OEHL}	15	—	20	—	ns	
Write Command to \overline{RAS} Lead Time	t_{RWL}	15	—	20	—	ns	
Write Command to \overline{CAS} Lead Time	t_{CWL}	15	—	20	—	ns	
Data-in Set-up Time	t_{DS}	0	—	0	—	ns	10
Data-in Hold Time	t_{DH}	10	—	15	—	ns	10
\overline{OE} to Data-in Delay Time	t_{OED}	15	—	20	—	ns	
\overline{CAS} to \overline{WE} Delay Time	t_{CWD}	40	—	50	—	ns	9
Column Address to \overline{WE} Delay Time	t_{AWD}	55	—	65	—	ns	9
\overline{RAS} to \overline{WE} Delay Time	t_{RWD}	85	—	100	—	ns	9
\overline{CAS} Precharge \overline{WE} Delay Time	t_{CPWD}	60	—	70	—	ns	9
\overline{CAS} Active Delay Time from \overline{RAS} Precharge	t_{RPC}	5	—	5	—	ns	
\overline{RAS} to \overline{CAS} Set-up Time (\overline{CAS} before \overline{RAS})	t_{CSR}	10	—	10	—	ns	
\overline{RAS} to \overline{CAS} Hold Time (\overline{CAS} before \overline{RAS})	t_{CHR}	10	—	10	—	ns	
\overline{RAS} Pulse Width (\overline{CAS} before \overline{RAS} Self-Refresh)	t_{RASS}	100	—	100	—	μs	11
\overline{RAS} Precharge Time (\overline{CAS} before \overline{RAS} Self-Refresh)	t_{RPS}	110	—	130	—	ns	11
\overline{CAS} Hold Time (\overline{CAS} before \overline{RAS} Self-Refresh)	t_{CHS}	-40	—	-50	—	ns	11

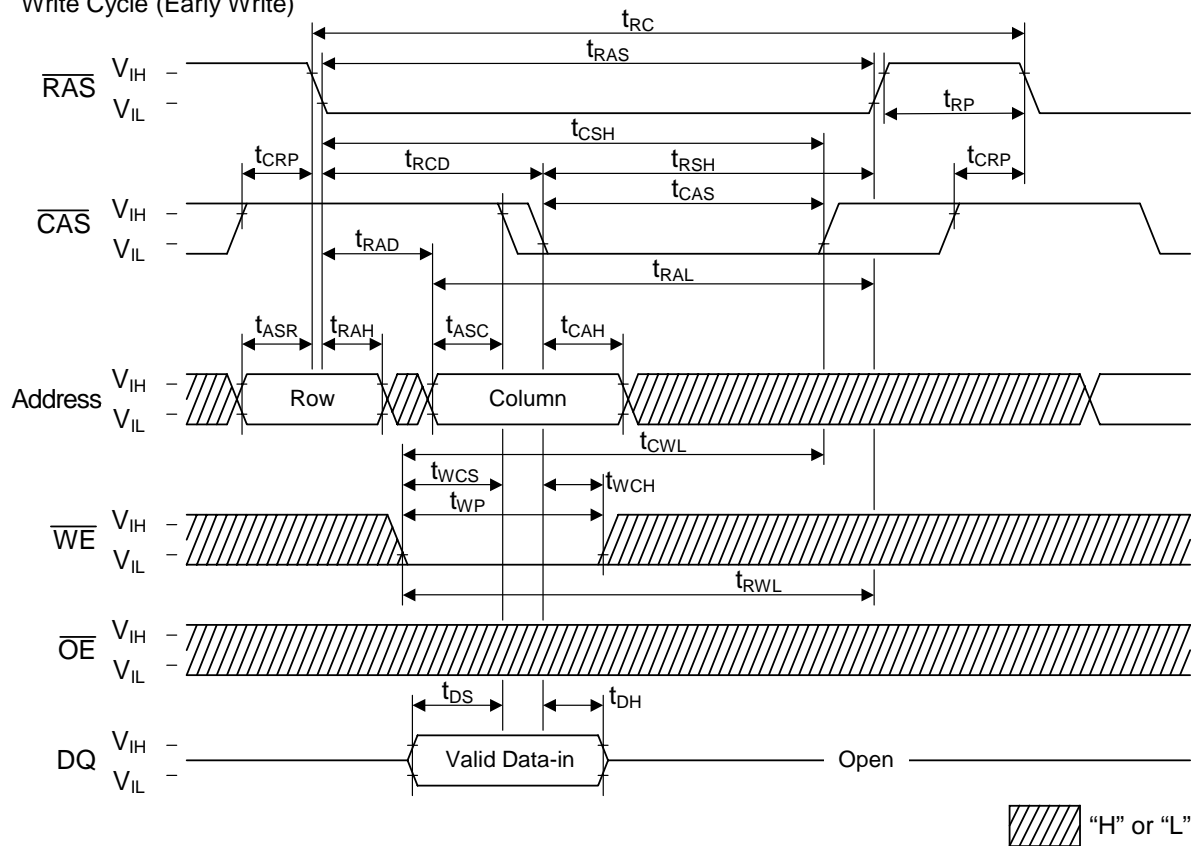
- Notes:
1. A start-up delay of 200 μ s is required after power-up, followed by a minimum of eight initialization cycles ($\overline{\text{RAS}}$ -only refresh or $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh) before proper device operation is achieved.
 2. The AC characteristics assume $t_T = 5\text{ns}$.
 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 2 TTL 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. SL version only.

Timing Chart

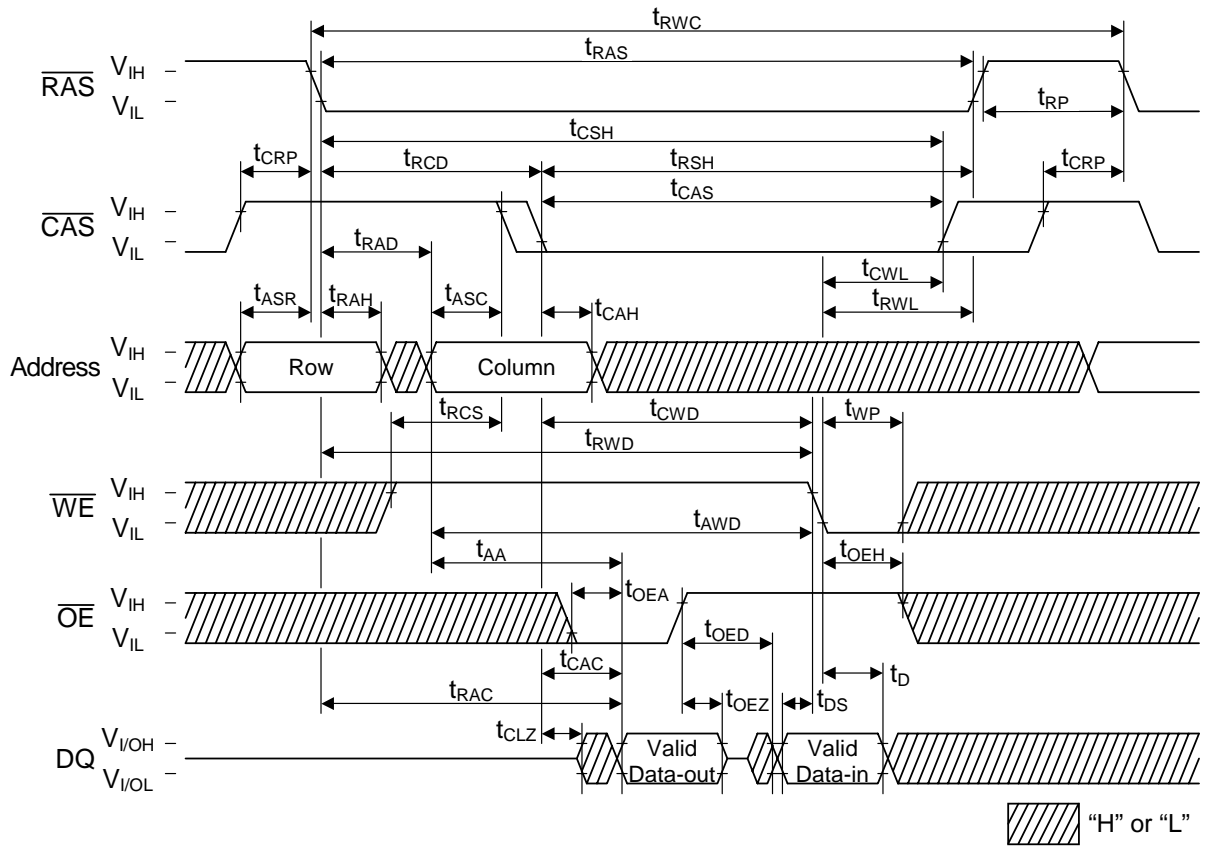
• Read Cycle



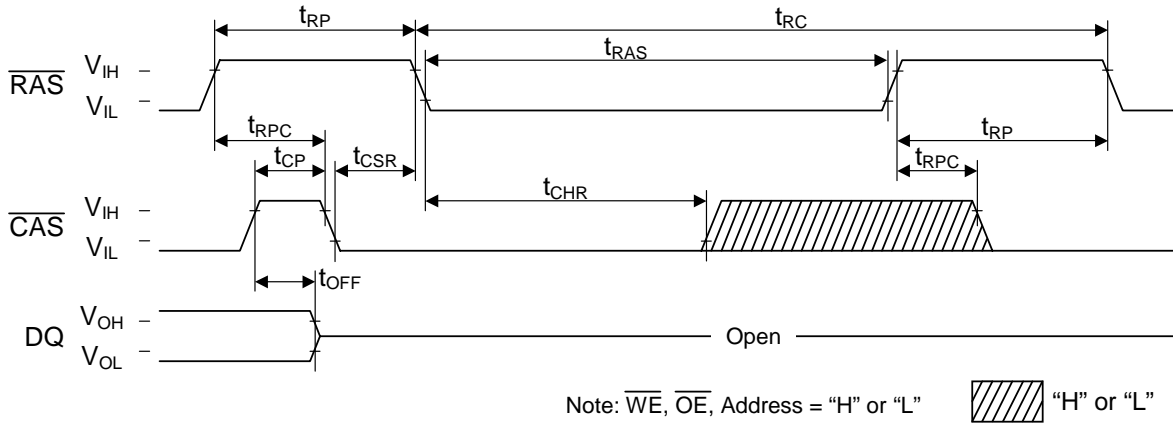
• Write Cycle (Early Write)



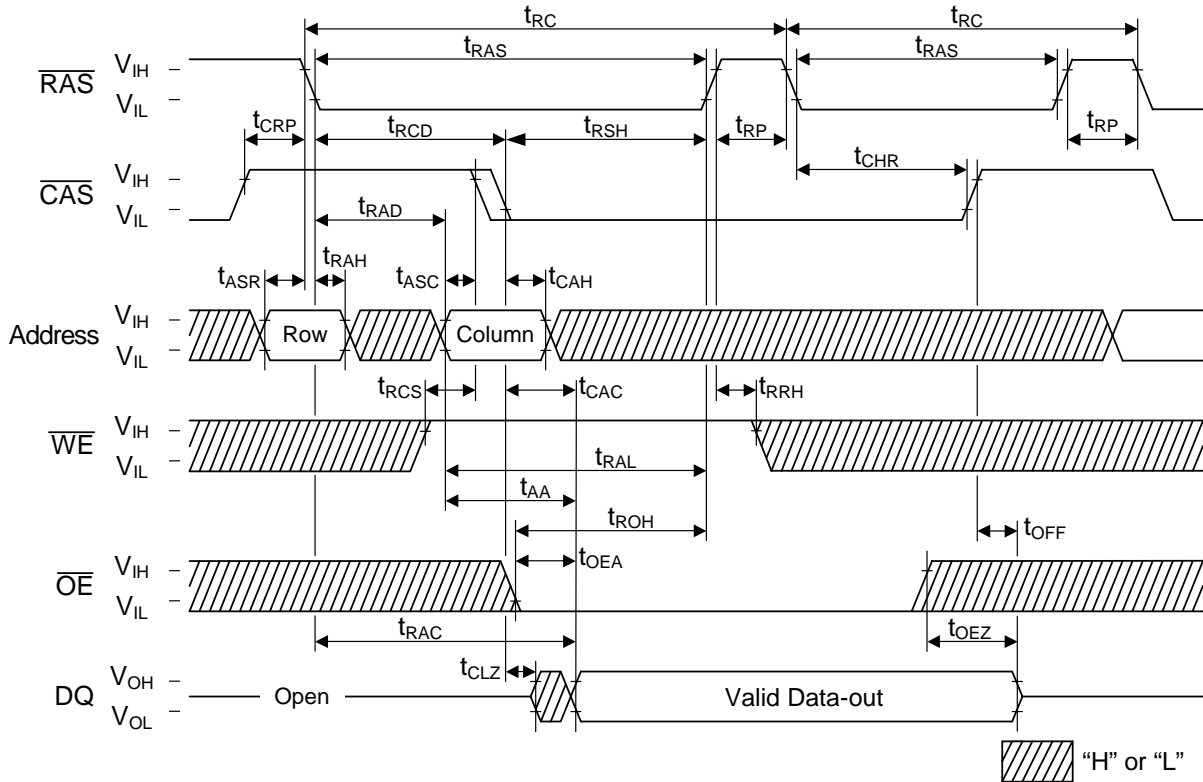
• Read Modify Write Cycle



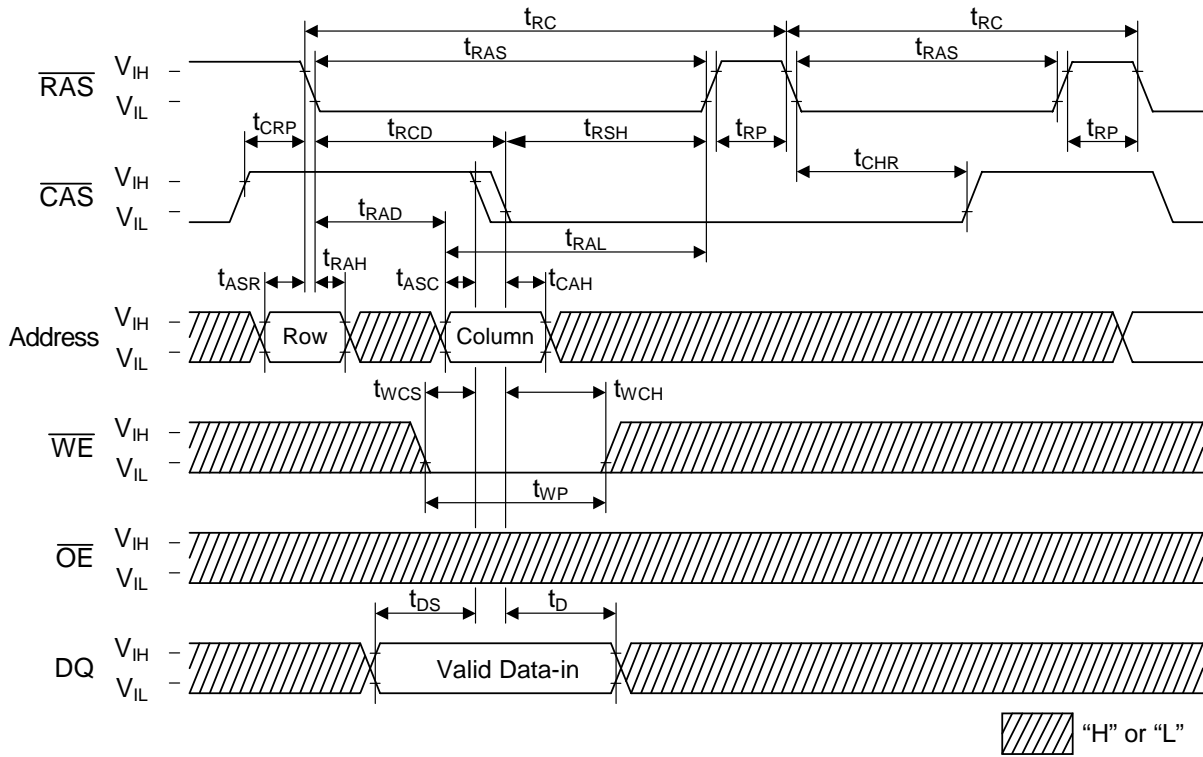
• $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Refresh Cycle



• Hidden Refresh Read Cycle



Hidden Refresh Write Cycle



$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Self-Refresh Cycle

