This version : Dec. 2000

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 × 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 × 8-bit configuration
- Single 5V power supply, ±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:

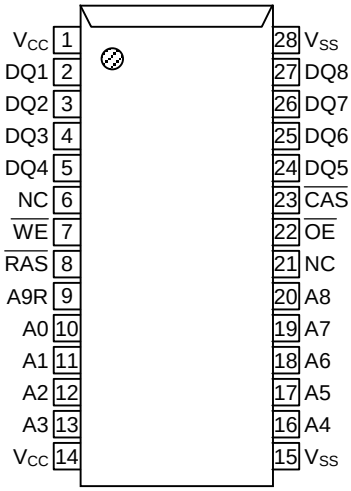
  28-pin 400mil plastic SOJ (SOJ28-P-400-1.27) (Product : MSM514800E/ESL-xxJS)

  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 CONFIGRATION (TOP VIEW)

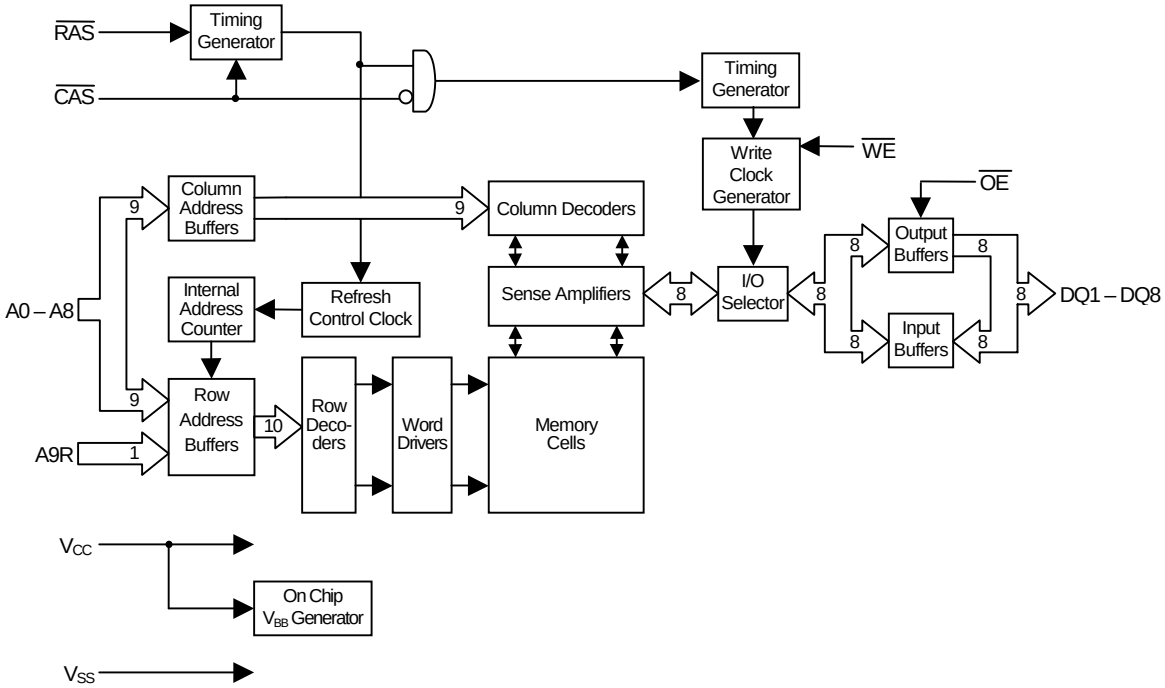


28-Pin Plastic SOJ

Pin Name	Function
A0 - A8, A9R	Address Input
$\overline{RAS}$	Row Address Strobe
$\overline{CAS}$	Column Address Strobe
DQ1 – DQ8	Data Input/Data Output
$\overline{OE}$	Output Enable
$\overline{WE}$	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

*: Ta = 25°C

Recommended Operating Conditions

(Ta = 0°C to 70°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} + 2.0V 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} – 2.0V 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} = 5V ± 10%, Ta = 25°C, f=1MHz)

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

DC Characteristics

(V_{CC} = 5V ± 10%, Ta = 0°C to 70°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 ≤ V_I ≤ 6.5V ; All other pins not under test = 0V	–10	10	–10	10	µA	
Output Leakage Current	I_{LO}	DQ disable 0V ≤ V_O ≤ 5.5V	–10	10	–10	10	µA	
Average Power Supply Current (Operating)	I_{CC1}	$\overline{RAS}$, $\overline{CAS}$ cycling, t_{RC} = Min.	—	100	—	90	mA	1,2
Power Supply Current (Standby)	I_{CC2}	$\overline{RAS}$, $\overline{CAS}$ = V_{IH}	—	2	—	2	mA	1
		$\overline{RAS}$, $\overline{CAS}$ ≥ V_{CC} – 0.2V	—	1	—	1		
			—	200	—	200	µA	1,5
Average Power Supply Current ($\overline{RAS}$-only Refresh)	I_{CC3}	$\overline{RAS}$ cycling, $\overline{CAS}$ = V_{IH}, t_{RC} = 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}	$\overline{RAS}$ = 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} = Min.	—	95	—	85	mA	1,3
Average Power Supply Current (Battery Backup)	I_{CC10}	t_{RC} = 125µs, $\overline{CAS}$ before $\overline{RAS}$, t_{RAS} ≤ 1µs	—	300	—	300	µA	1,4,5
Average Power Supply Current ($\overline{CAS}$ before $\overline{RAS}$ Self-Refresh)	I_{CCS}	$\overline{RAS}$ ≤ 0.2V, $\overline{CAS}$ ≤ 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 ≤ V_{IH} ≤ 6.5V, – 1.0V ≤ V_{IL} ≤ 0.2V.
5. SL version.

AC Characteristic (1/2)

(V_{CC} = 5V ± 10%, Ta = 0°C to 70°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 ± 10%, Ta = 0°C to 70°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_{WP}	10	—	10	—	ns	
$\overline{OE}$ Command Hold Time	t_{OEH}	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 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 200μs is required after power-up, followed by a minimum of eight initialization cycles ($\overline{RAS}$-only refresh or $\overline{CAS}$ before $\overline{RAS}$ refresh) before proper device operation is achieved.

2. The AC characteristics assume t_T = 5ns.

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.

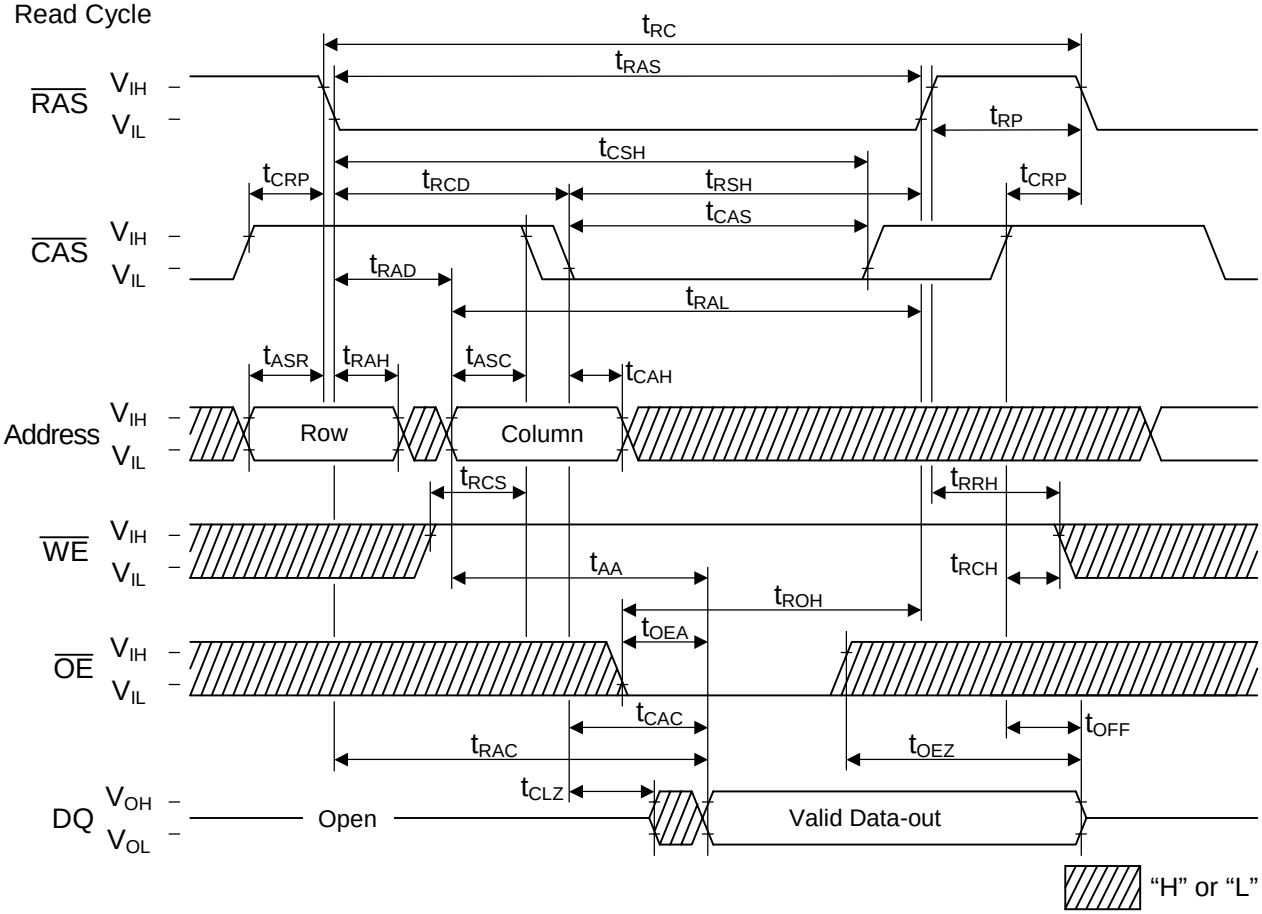
9. t_{WCS}, t_{CWD}, t_{RWD}, t_{AWD} and t_{CPWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$ (Min.), then the cycle is an early write cycle and the data out will remain open circuit (high impedance) throughout 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 $\overline{CAS}$, leading edges in an early write cycle, and to the $\overline{WE}$ leading edge in an $\overline{OE}$ control write cycle, or a read modify write cycle.

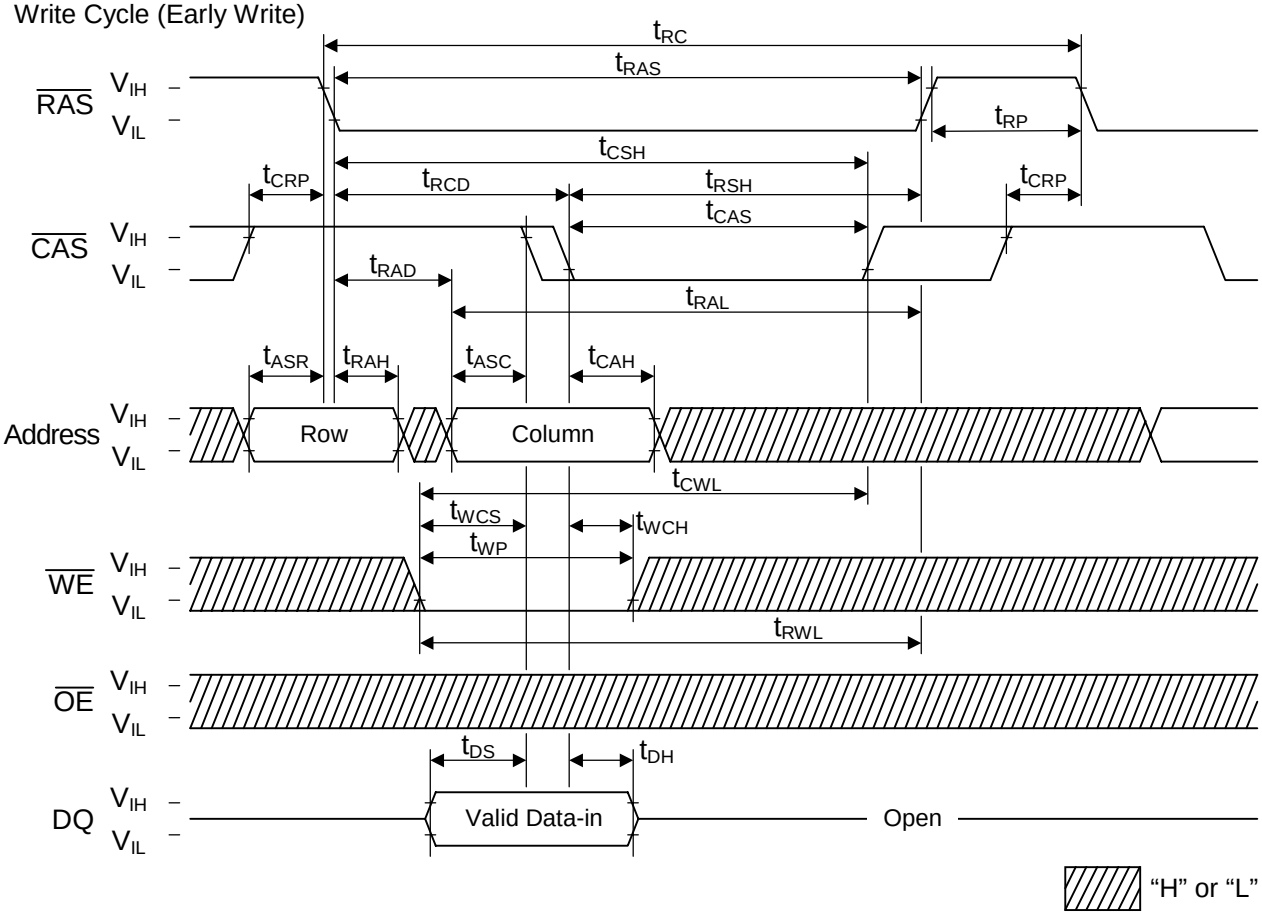
11. SL version only.

Timing Chart

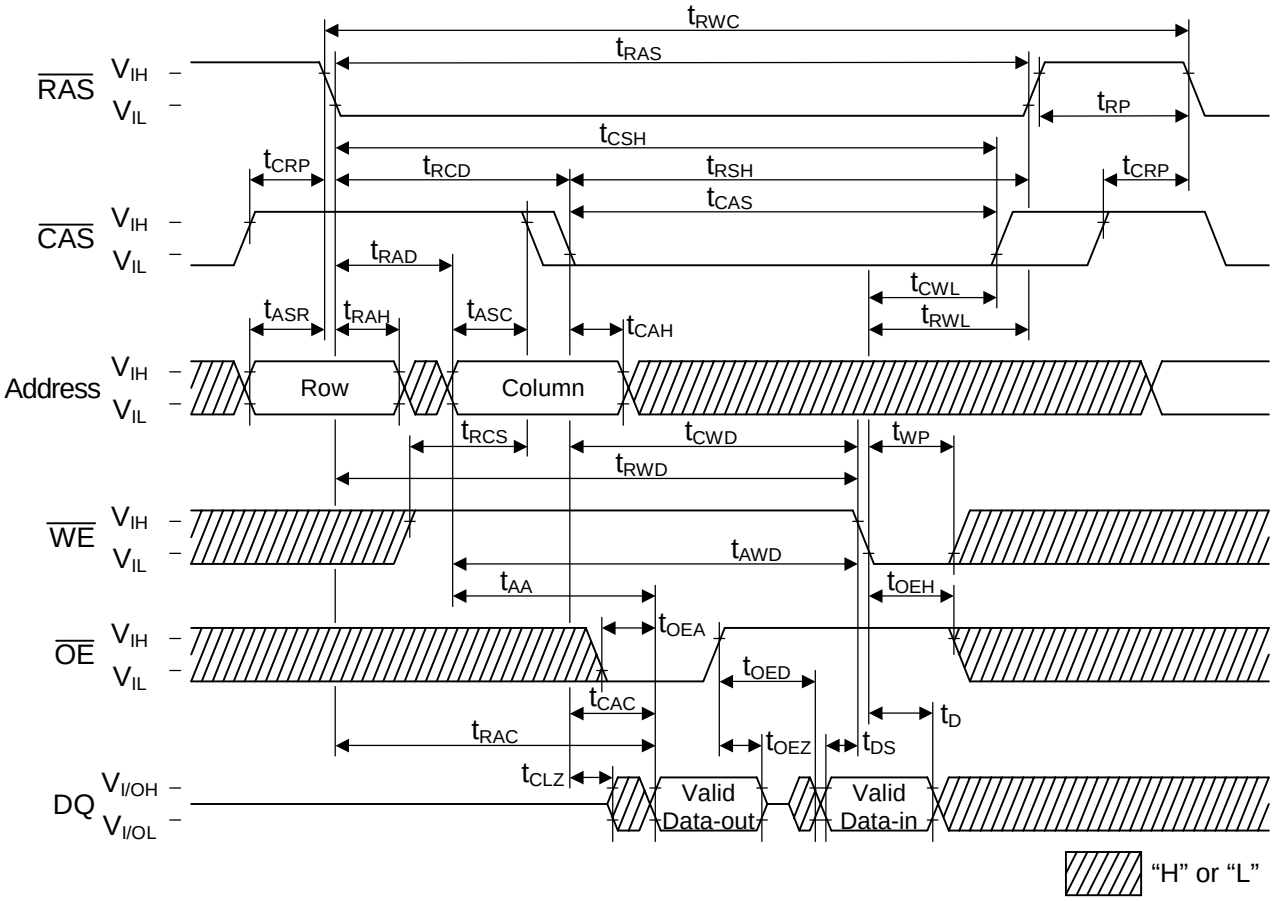
- Read Cycle



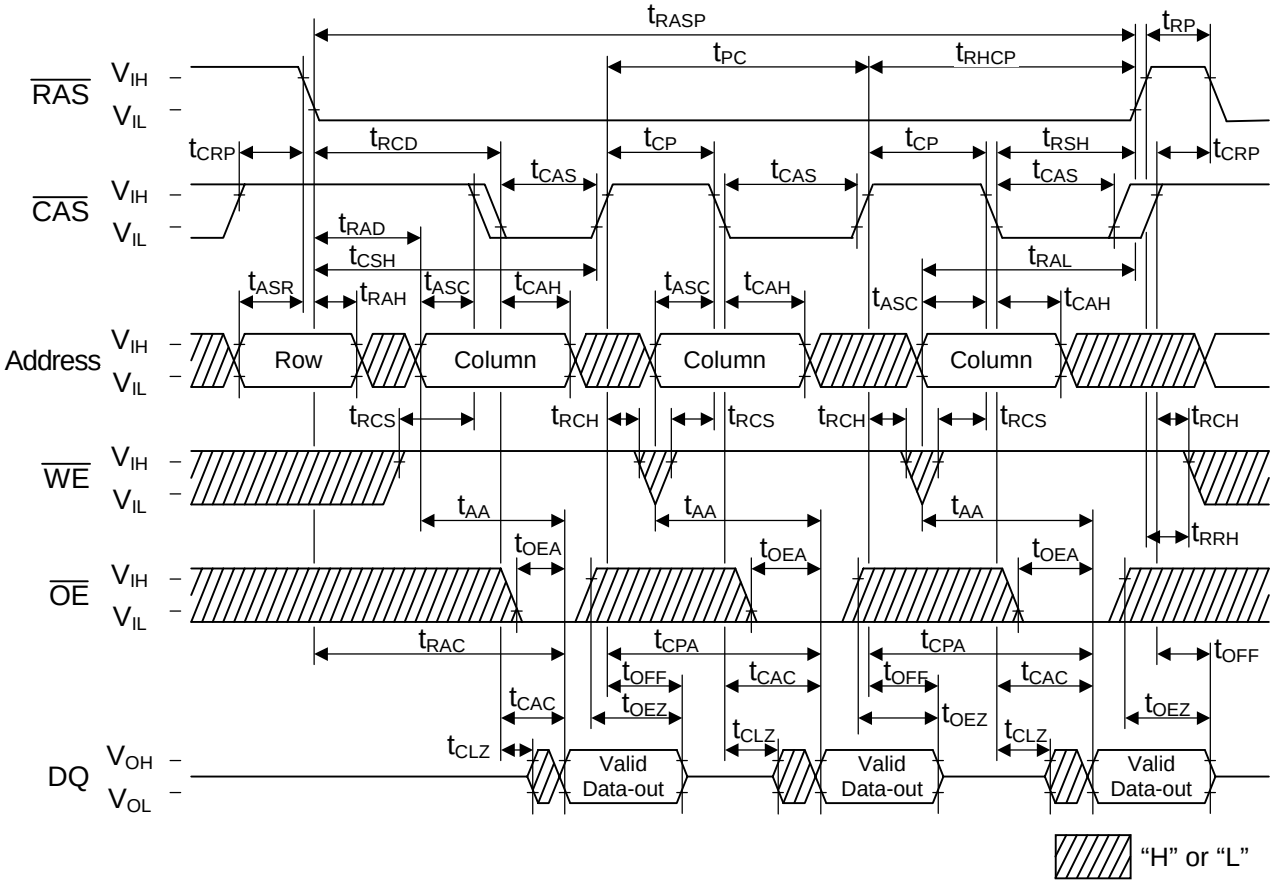
- Write Cycle (Early Write)



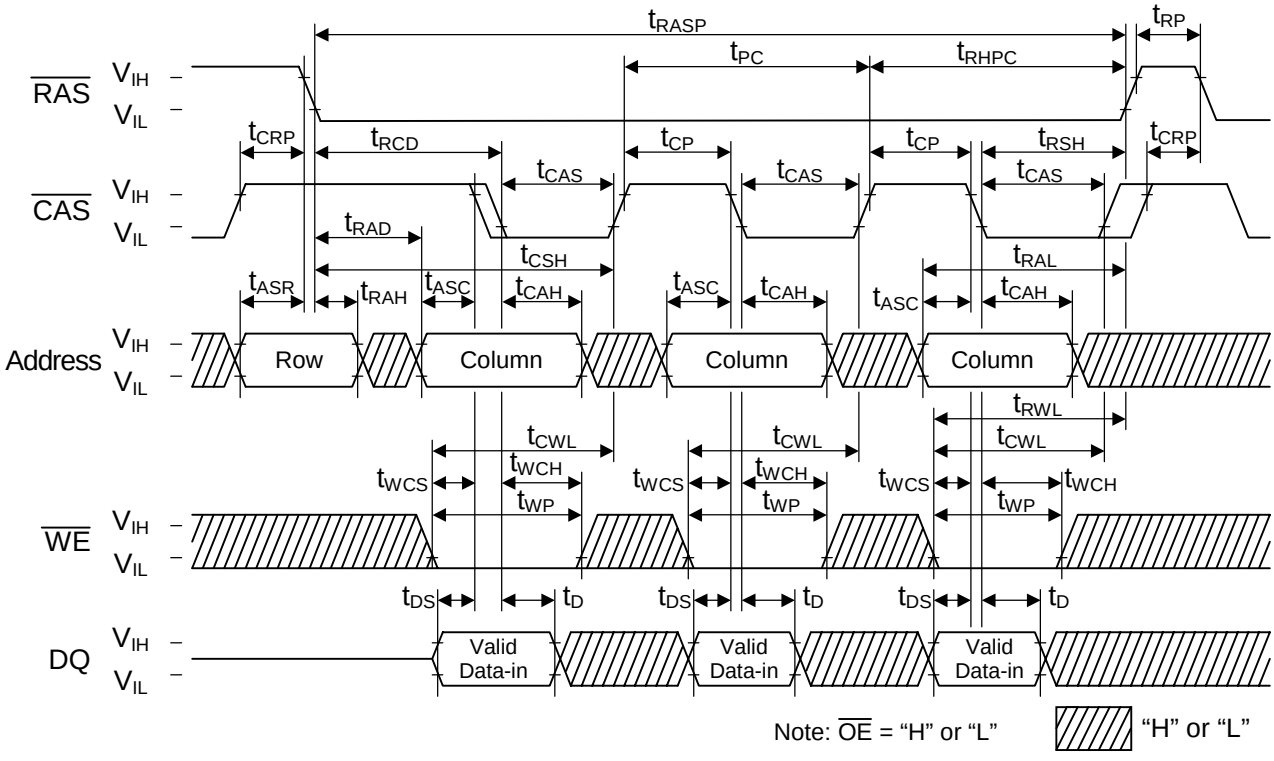
- Read Modify Write Cycle



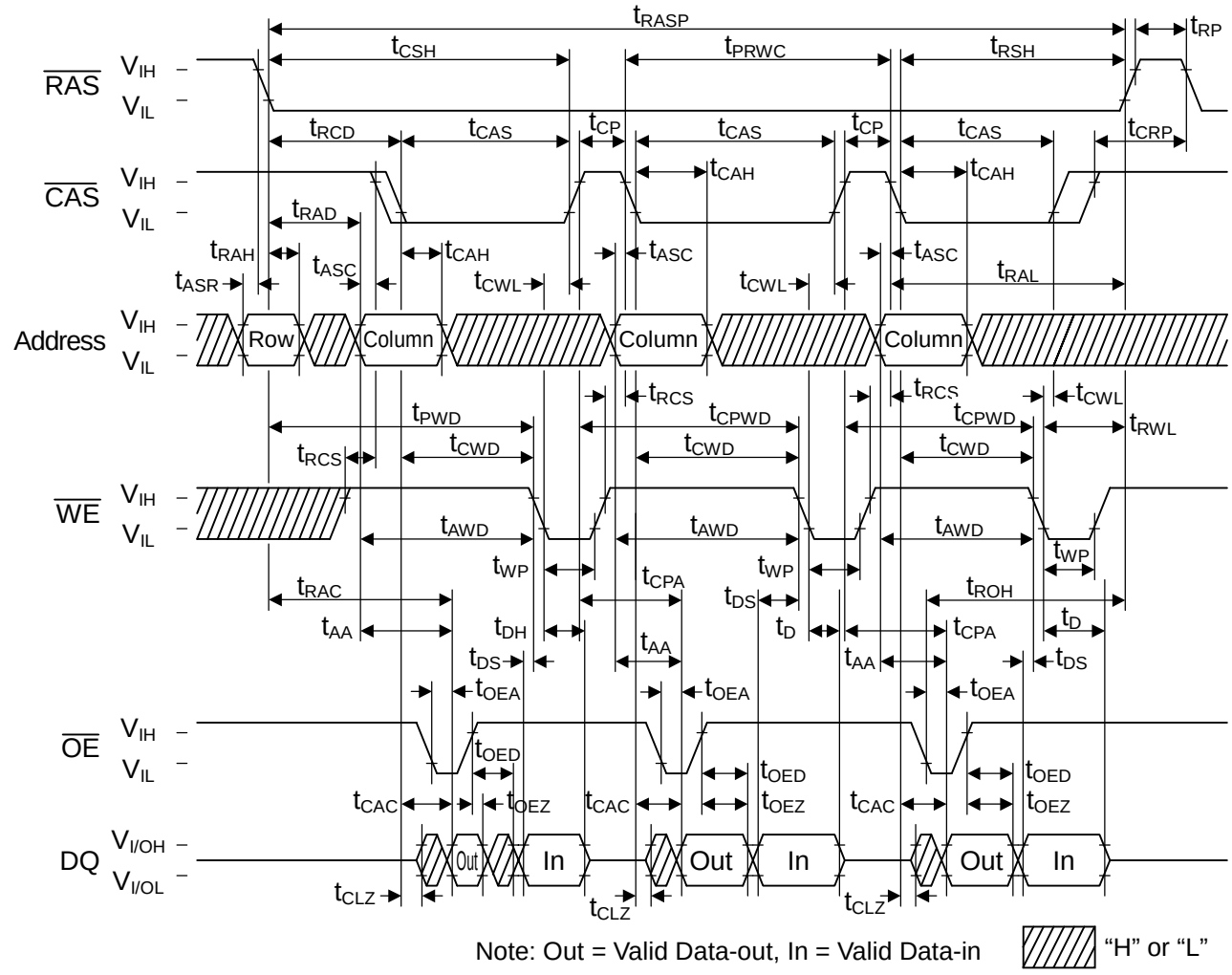
- Fast Page Mode Read Cycle



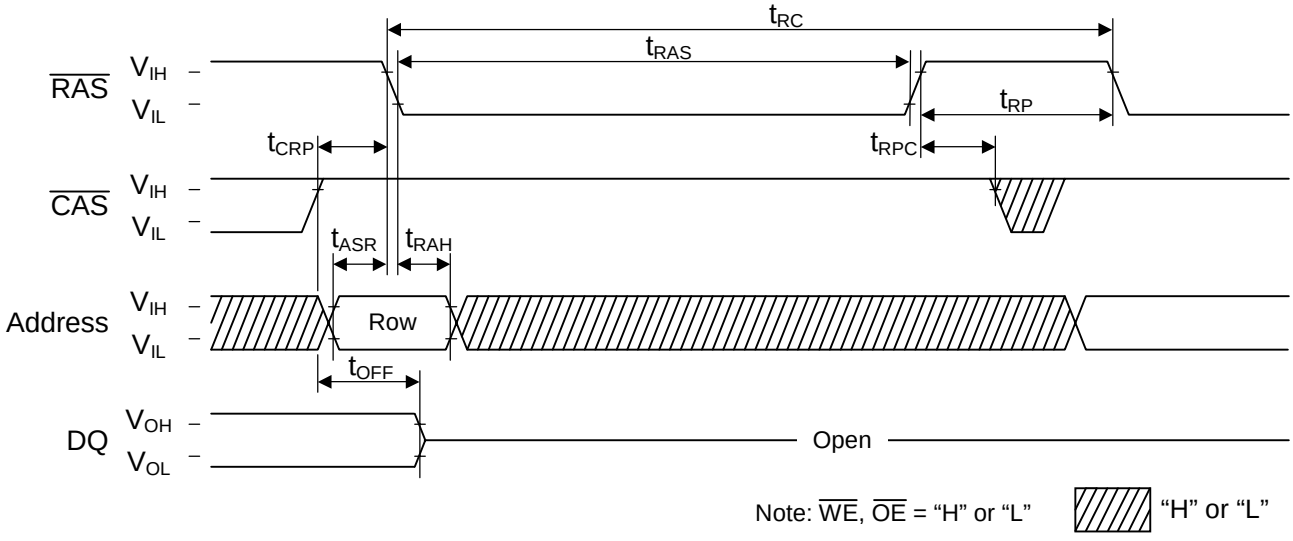
- Fast Page Mode Write Cycle (Early Write)



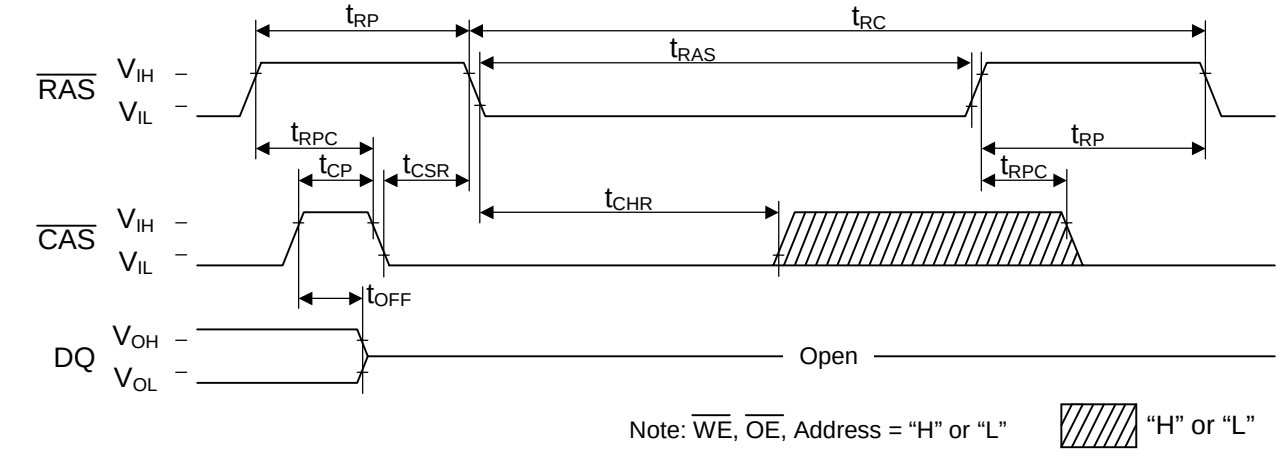
- Fast Page Mode Read Modify Write Cycle



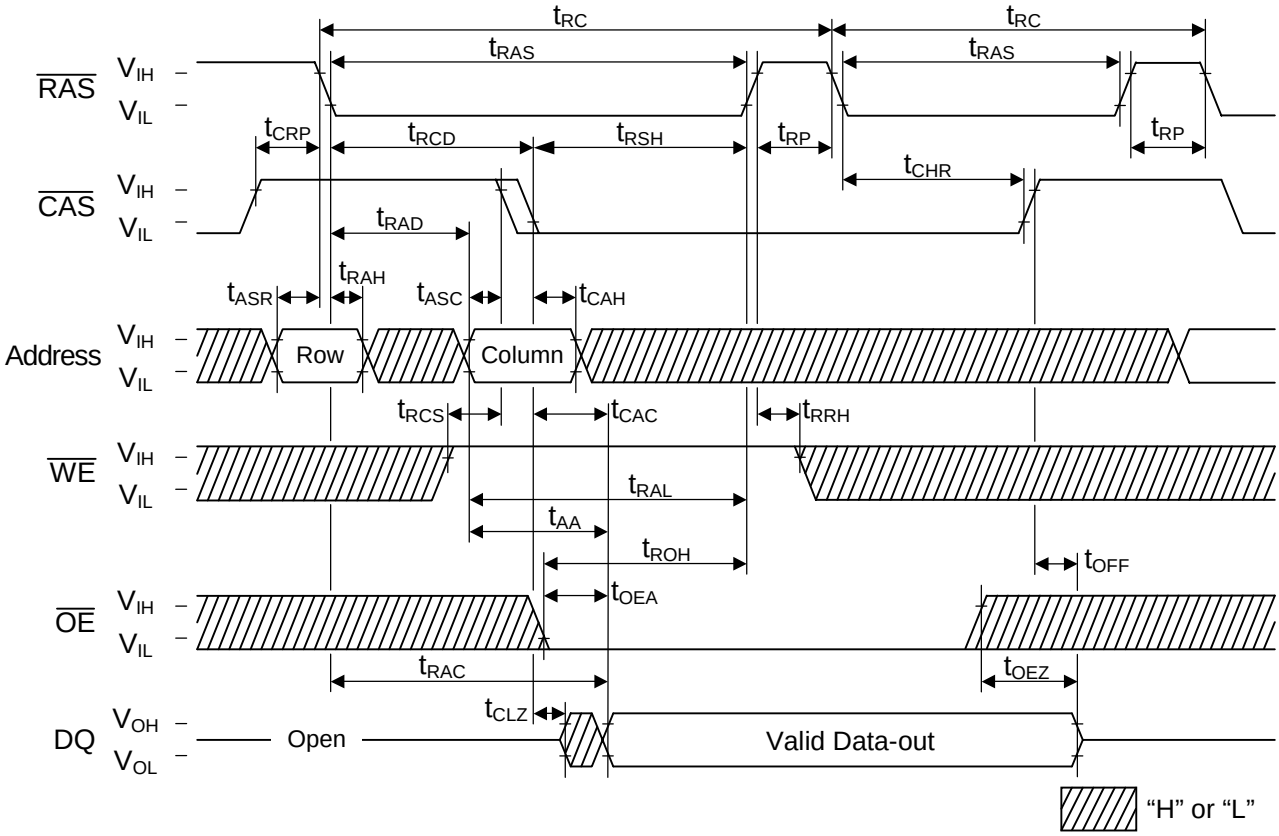
- $\overline{RAS}$-only Refresh Cycle



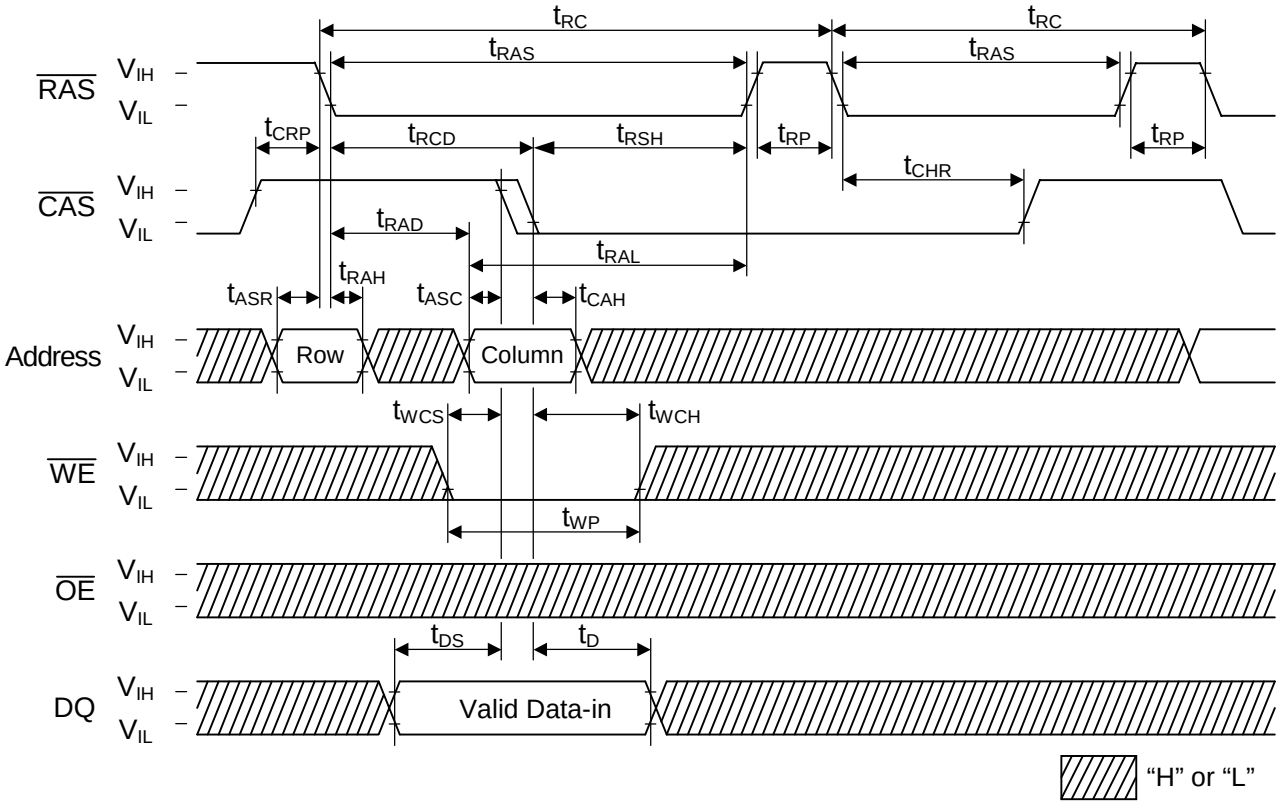
- $\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle



- Hidden Refresh Read Cycle



Hidden Refresh Write Cycle



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