MSM514265E

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

DESCRIPTION

The MSM514265E is a 262,144-word × 16-bit dynamic RAM fabricated in Oki's silicon-gate CMOS technology. The MSM514265E 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 MSM514265E is available in a 40-pin plastic SOJ or 44/40-pin plastic TSOP.

FEATURES

- 262,144-word × 16-bit configuration
- Single 5V power supply, ±10% tolerance
- Input : TTL compatible, low input capacitance
- Output : TTL compatible, 3-state
- Refresh : 512 cycles/8ms
- Fast page mode with EDO, read modify write capability
- $\overline{CAS}$ before $\overline{RAS}$ refresh, hidden refresh, $\overline{RAS}$-only refresh capability
- Package options:

  40-pin 400mil plastic SOJ (SOJ40-P-400-1.27) (Product : MSM514265E-xxJS)

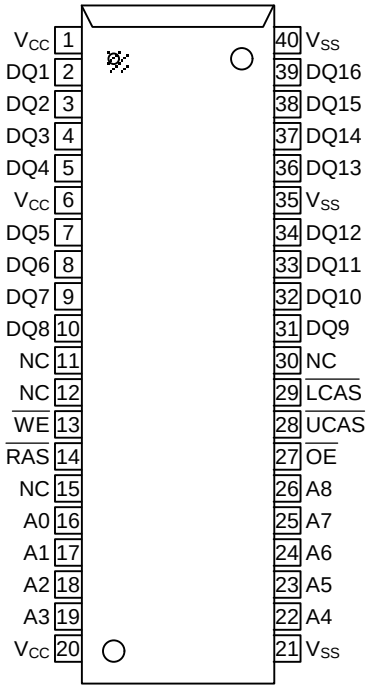
  44/40-pin 400mil plastic TSOP (TSOPII44/40-P-400-0.80-K) (Product : MSM514265E-xxTS-K)

  xx indicates speed rank.

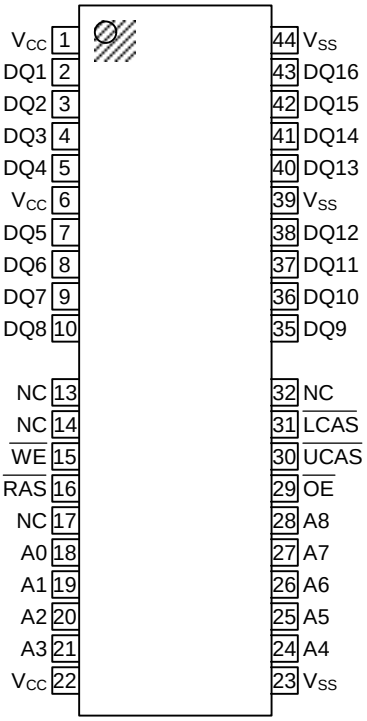
PRODUCT FAMILY

Family	Access Time (Max.)				Cycle Time (Min.)	Power Dissipation	
	t_{RAC}	t_{AA}	t_{CAC}	t_{OEA}		Operating (Max.)	Standby (Max.)
MSM514265E	60ns	30ns	15ns	15ns	104ns	633mW	5.5mW
	70ns	35ns	20ns	20ns	124ns	578mW	

PIN CONFIGRATION (TOP VIEW)



40-Pin Plastic SOJ

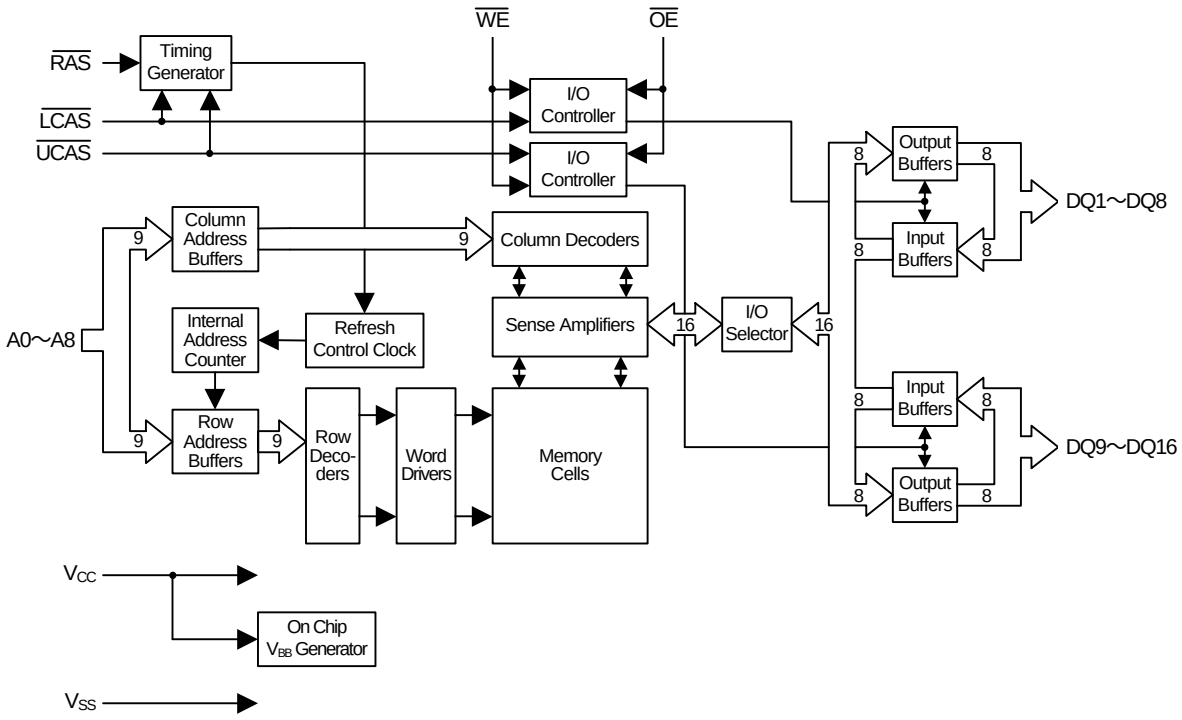


44/40-Pin Plastic TSOP
(K Type)

Pin Name	Function
A0 – A8	Address Input
$\overline{RAS}$	Row Address Strobe
$\overline{LCAS}$	Lower Byte Column Address Strobe
$\overline{UCAS}$	Upper Byte Column Address Strobe
DQ1–DQ16	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



FUNCTION TABLE

Input Pin					DQ Pin		Function Mode
RAS	LCAS	UCAS	WE	OE	DQ1-DQ8	DQ9-DQ16	
H	*	*	*	*	High-Z	High-Z	Standby
L	H	H	*	*	High-Z	High-Z	Refresh
L	L	H	H	L	D_{OUT}	High-Z	Lower Byte Read
L	H	L	H	L	High-Z	D_{OUT}	Upper Byte Read
L	L	L	H	L	D_{OUT}	D_{OUT}	Word Read
L	L	H	L	H	D_{IN}	Don't Care	Lower Byte Write
L	H	L	L	H	Don't Care	D_{IN}	Upper Byte Write
L	L	L	L	H	D_{IN}	D_{IN}	Word Write
L	L	L	H	H	High-Z	High-Z	—

* : "H" or "L"

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 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 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)	C_{IN1}	—	5	pF
Input Capacitance ($\overline{RAS}$, $\overline{LCAS}$, $\overline{UCAS}$, $\overline{WE}$, $\overline{OE}$)	C_{IN2}	—	7	pF
Output Capacitance (DQ1 - DQ16)	$C_{I/O}$	—	7	pF

DC Characteristics

(V_{CC} = 5V ± 10%, Ta = 0°C to 70°C)

Parameter	Symbol	Condition	MSM514265 E-60		MSM514265 E-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 ≤ VCC	– 10	10	– 10	10	µA	
Average Power Supply Current (Operating)	I_{CC1}	$\overline{RAS}$, $\overline{CAS}$ cycling, t_{RC} = Min.	—	115	—	105	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		
Average Power Supply Current ($\overline{RAS}$-only Refresh)	I_{CC3}	$\overline{RAS}$ cycling, $\overline{CAS}$ = V_{IH}, t_{RC} = Min.	—	115	—	105	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 $\overline{RAS}$	—	115	—	105	mA	1,2
Average Power Supply Current (Fast Page Mode)	I_{CC7}	$\overline{RAS}$ = V_{IL}, $\overline{CAS}$ cycling, t_{HPC} = Min.	—	115	—	105	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 $\overline{RAS}$ = V_{IL}.

3. The address can be changed once or less while $\overline{CAS}$ = V_{IH}.

AC Characteristic (1/2)

(V_{CC} = 5V ± 10%, Ta = 0°C to 70°C) Note1,2,3

Parameter	Symbol	MSM514265 E-60		MSM514265 E-70		Unit	Note
		Min.	Max.	Min.	Max.		
Random Read or Write Cycle Time	t_{RC}	104	—	124	—	ns	
Read Modify Write Cycle Time	t_{RWC}	135	—	160	—	ns	
Fast Page Mode Cycle Time	t_{HPC}	25	—	30	—	ns	
Fast Page Mode Read Modify Write Cycle Time	t_{HPRWC}	68	—	78	—	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	4,13
Access Time from $\overline{OE}$	t_{OEA}	—	15	—	20	ns	4
Output Low Impedance Time from $\overline{CAS}$	t_{CLZ}	0	—	0	—	ns	4
Data Output Hold After $\overline{CAS}$ Low	t_{DOH}	5	—	5	—	ns	
$\overline{CAS}$ to Data Output Buffer Turn-off Delay Time	t_{CEZ}	0	15	0	20	ns	7,8
$\overline{RAS}$ to Data Output Buffer Turn-off Delay Time	t_{REZ}	0	15	0	20	ns	7,8
$\overline{OE}$ to Data Output Buffer Turn-off Delay Time	t_{OEZ}	0	15	0	20	ns	7
$\overline{WE}$ to Data Output Buffer Turn-off Delay Time	t_{WEZ}	0	15	0	20	ns	7
Transition Time	t_T	1	50	1	50	ns	3
Refresh Period	t_{REF}	—	8	—	8	ms	
$\overline{RAS}$ 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 with EDO)	t_{RASP}	60	100,000	70	100,000	ns	
$\overline{RAS}$ Hold Time	t_{RSH}	10	—	13	—	ns	
$\overline{RAS}$ Hold Time referenced to $\overline{OE}$	t_{ROH}	10	—	13	—	ns	
$\overline{CAS}$ Precharge Time (Fast Page Mode with EDO)	t_{CP}	10	—	10	—	ns	15
$\overline{CAS}$ Pulse Width	t_{CAS}	10	10,000	10	10,000	ns	
$\overline{CAS}$ Hold Time	t_{CSH}	40	—	45	—	ns	
$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	t_{CRP}	5	—	5	—	ns	13
RAS Hold Time from $\overline{CAS}$ Precharge	t_{RHCP}	35	—	40	—	ns	13
$\overline{OE}$ Hold Time from $\overline{CAS}$ (DQ Disable)	t_{CHO}	5	—	5	—	ns	
$\overline{RAS}$ to $\overline{CAS}$ Delay Time	t_{RCD}	14	45	14	50	ns	5
$\overline{RAS}$ to Column Address Delay Time	t_{RAD}	12	30	12	35	ns	6
Row Address Set-up Time	t_{ASR}	0	—	0	—	ns	
Row Address Hold Time	t_{RAH}	10	—	10	—	ns	

AC Characteristic (2/2)

(V_{CC} = 5V ± 10%, Ta = 0°C to 70°C) Note1,2,3

Parameter	Symbol	MSM514265 E-60		MSM514265 E-70		Unit	Note
		Min.	Max.	Min.	Max.		
Column Address Set-up Time	t_{ASC}	0	—	0	—	ns	12
Column Address Hold Time	t_{CAH}	10	—	13	—	ns	12
Column Address to $\overline{RAS}$ Lead Time	t_{RAL}	30	—	35	—	ns	
Read Command Set-up Time	t_{RCS}	0	—	0	—	ns	12
Read Command Hold Time	t_{RCH}	0	—	0	—	ns	9,12
Read Command Hold Time referenced to $\overline{RAS}$	t_{RRH}	0	—	0	—	ns	9
Write Command Set-up Time	t_{WCS}	0	—	0	—	ns	10,12
Write Command Hold Time	t_{WCH}	10	—	13	—	ns	12
Write Command Pulse Width	t_{WP}	10	—	10	—	ns	
$\overline{WE}$ Pulse Width (DQ Disable)	t_{WPE}	7	—	7	—	ns	
$\overline{OE}$ Command Hold Time	t_{OEH}	10	—	13	—	ns	
$\overline{OE}$ Precharge Time	t_{OEP}	10	—	10	—	ns	
$\overline{OE}$ Command Hold Time	t_{OCH}	10	—	10	—	ns	
Write Command to $\overline{RAS}$ Lead Time	t_{RWL}	10	—	13	—	ns	
Write Command to $\overline{CAS}$ Lead Time	t_{CWL}	10	—	13	—	ns	14
Data-in Set-up Time	t_{DS}	0	—	0	—	ns	11,12
Data-in Hold Time	t_{DH}	10	—	13	—	ns	11,12
$\overline{OE}$ to Data-in Delay Time	t_{OED}	15	—	20	—	ns	
$\overline{CAS}$ to $\overline{WE}$ Delay Time	t_{CWD}	35	—	45	—	ns	10
Column Address to $\overline{WE}$ Delay Time	t_{AWD}	50	—	60	—	ns	10
$\overline{RAS}$ to $\overline{WE}$ Delay Time	t_{RWD}	80	—	95	—	ns	10
$\overline{CAS}$ Precharge $\overline{WE}$ Delay Time	t_{CPWD}	55	—	65	—	ns	10
$\overline{CAS}$ Active Delay Time from $\overline{RAS}$ Precharge	t_{RPC}	5	—	5	—	ns	12
$\overline{RAS}$ to $\overline{CAS}$ Set-up Time ($\overline{CAS}$ before $\overline{RAS}$)	t_{CSR}	5	—	5	—	ns	12
$\overline{RAS}$ to $\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$)	t_{CHR}	10	—	10	—	ns	13

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 = 2ns.

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 1 TTL load and 50pF.
The output timing reference levels are V_{OH} = 2.0V (I_{OH} = −2mA) and V_{OL} = 0.8V (I_{OH} = 2mA).

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_{CEZ} (Max.), t_{REZ} (Max.), t_{WEZ} (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_{CEZ}, and t_{REZ} must be satisfied for open circuit condition.

9. t_{RCH} or t_{RRH} must be satisfied for a read cycle.

10. 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.

11. These parameters are referenced to the $\overline{UCAS}$ and $\overline{LCAS}$, 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.

12. These parameters are determined by the falling edge of either $\overline{UCAS}$ or $\overline{LCAS}$, whichever is earlier.

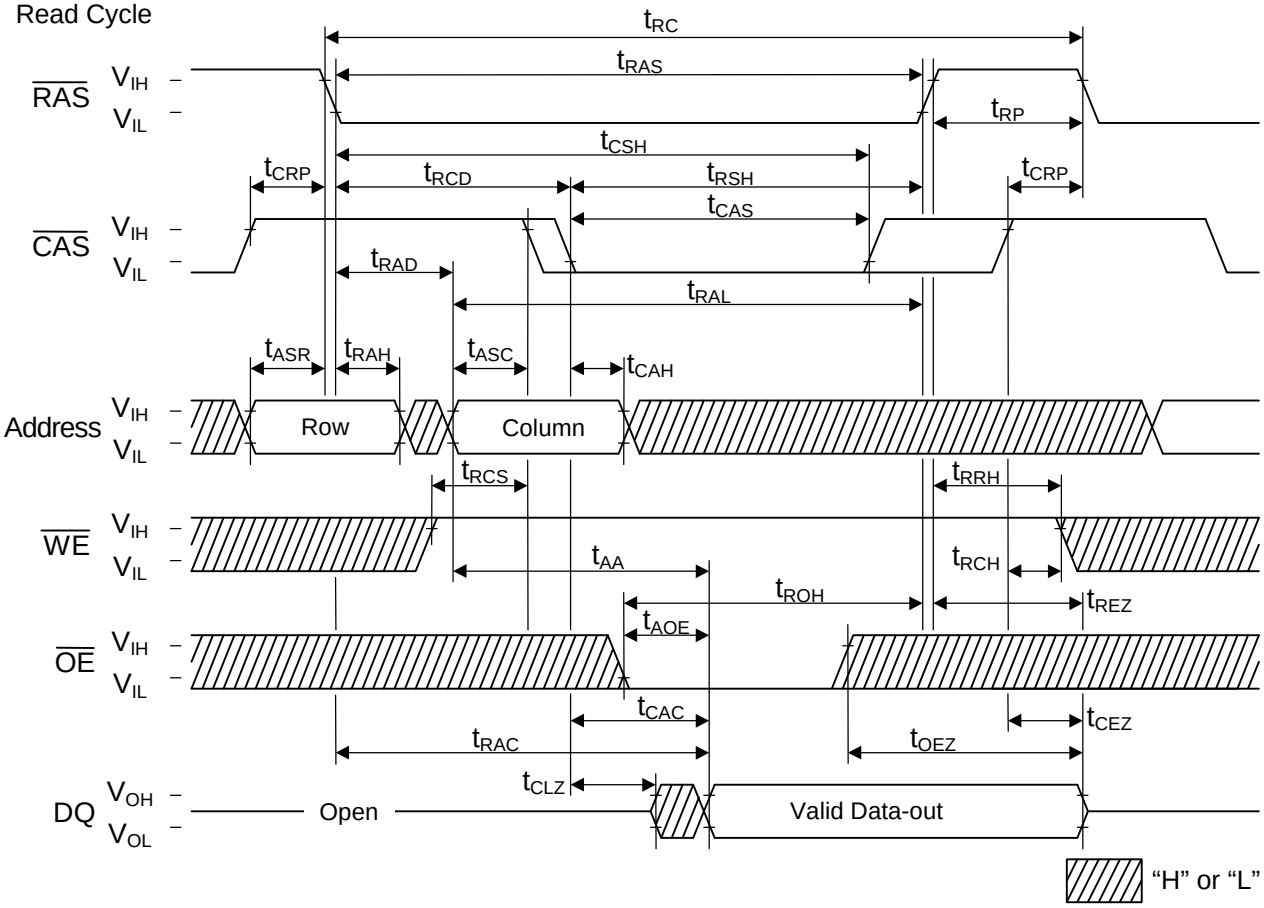
13. These parameters are determined by the rising edge of either $\overline{UCAS}$ or $\overline{LCAS}$, whichever is later.

14. t_{CWL} should be satisfied by both $\overline{UCAS}$ and $\overline{LCAS}$.

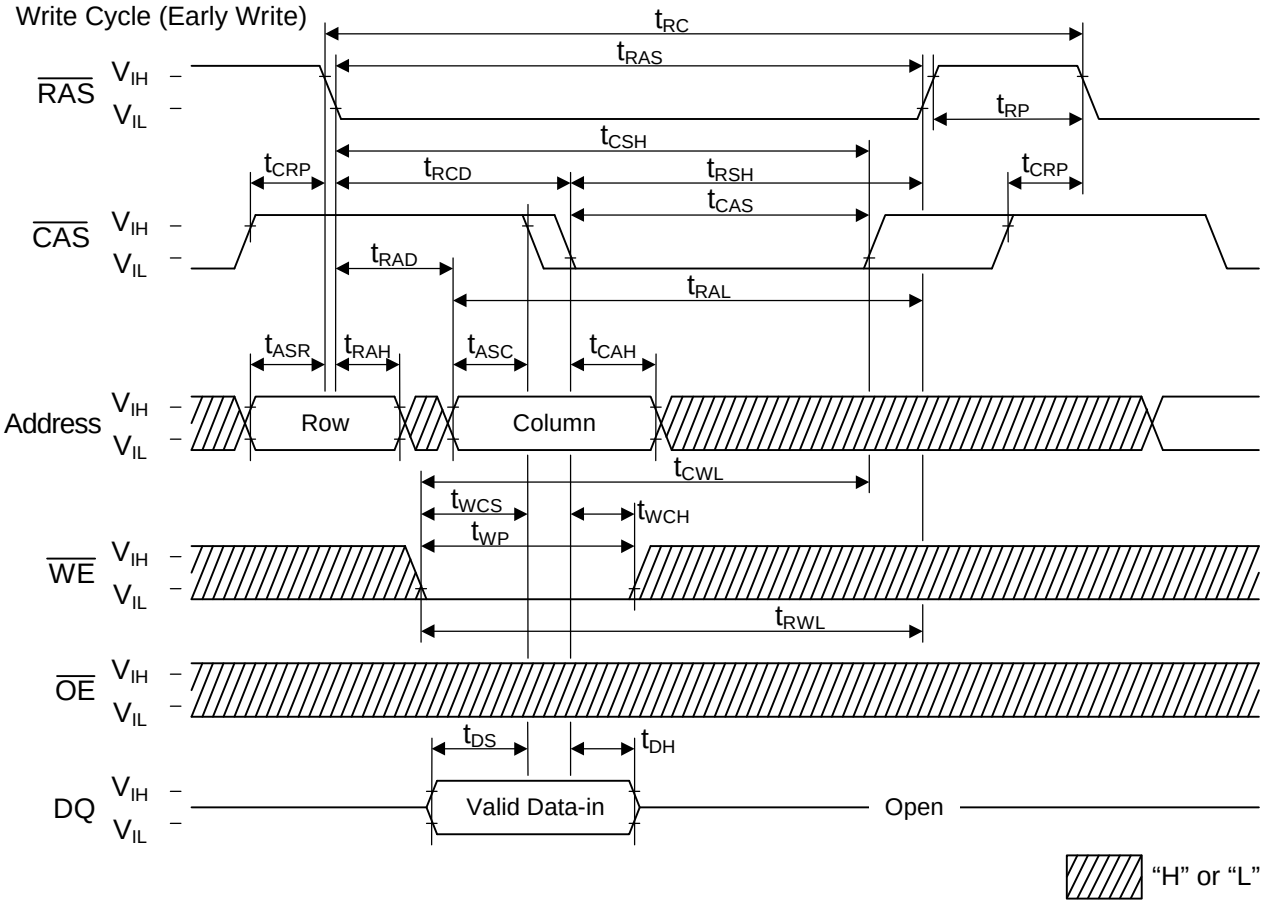
15. t_{CP} is determined by the time both $\overline{UCAS}$ and $\overline{LCAS}$ are high.

Timing Chart

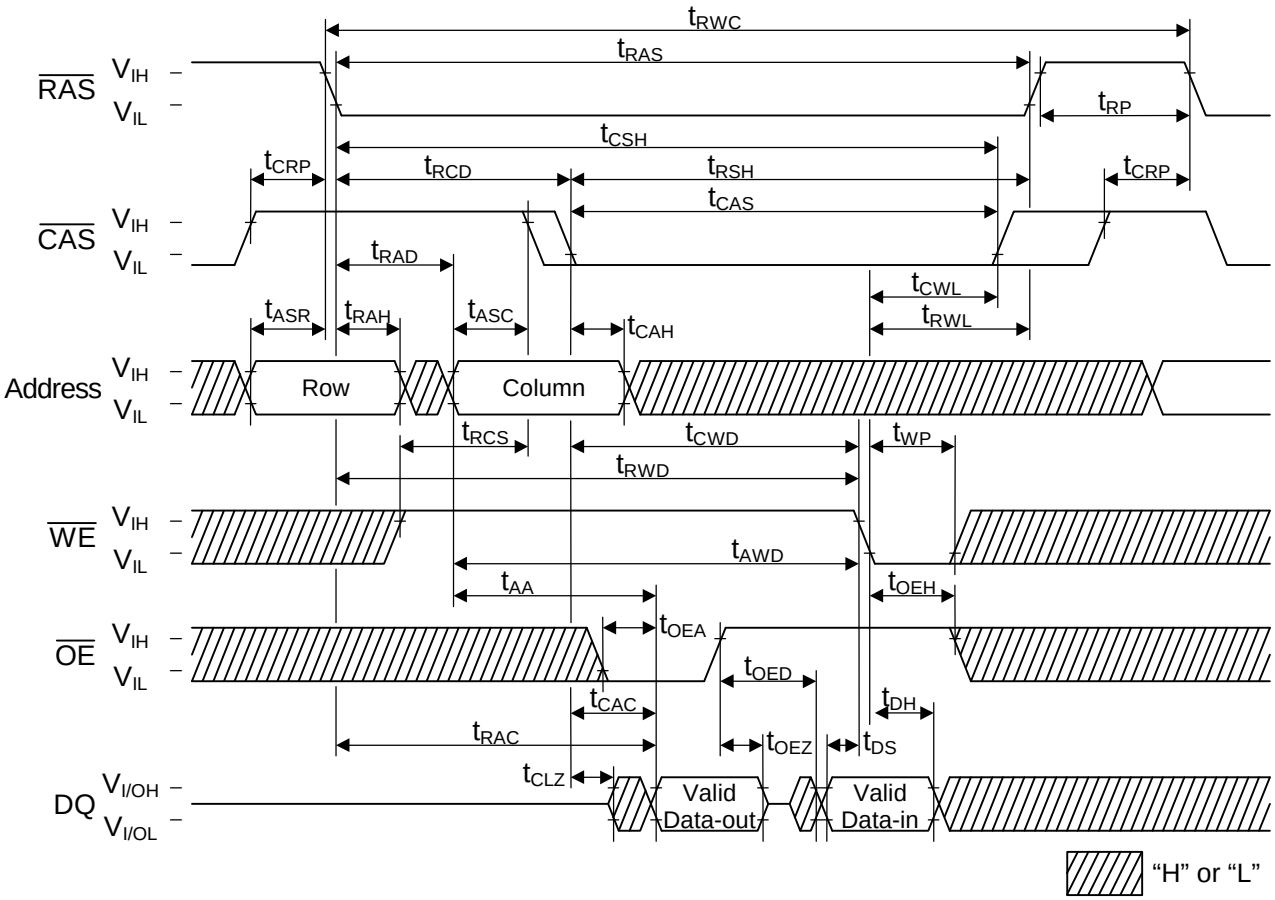
- Read Cycle



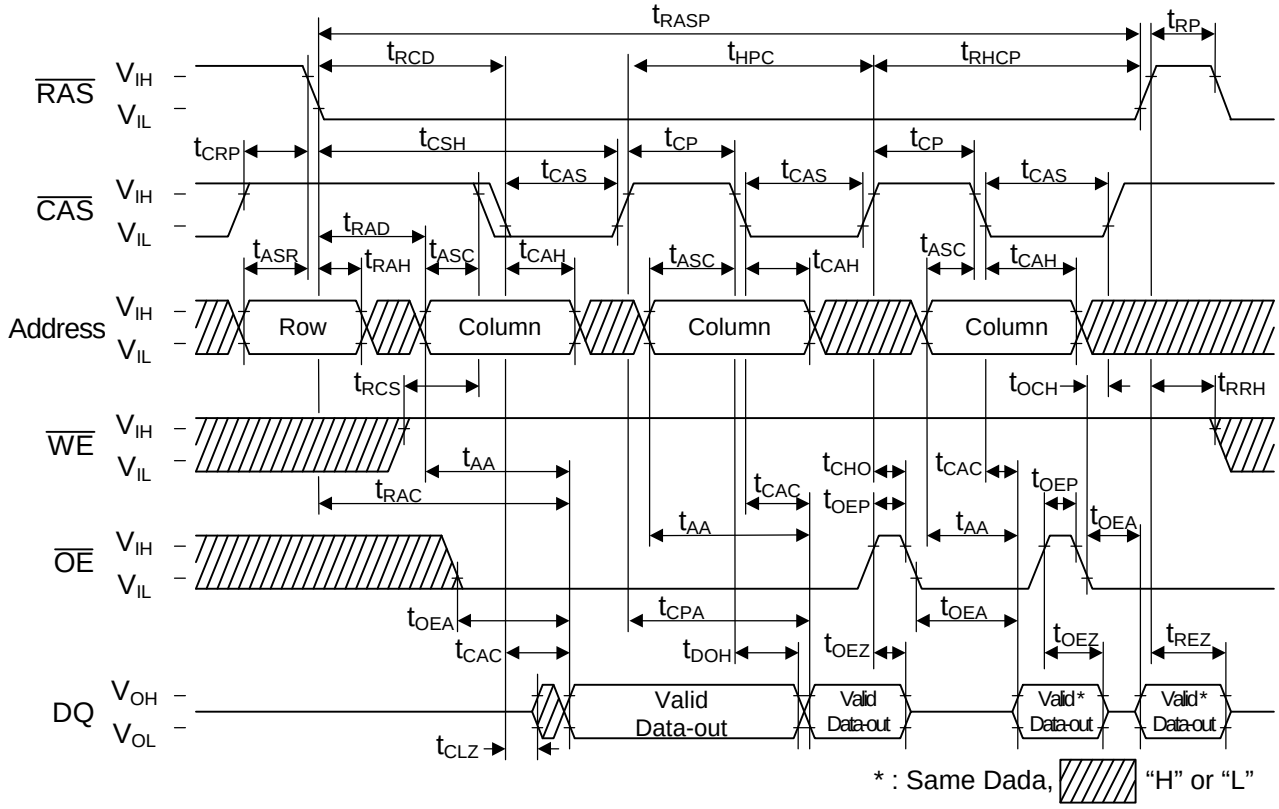
- Write Cycle (Early Write)



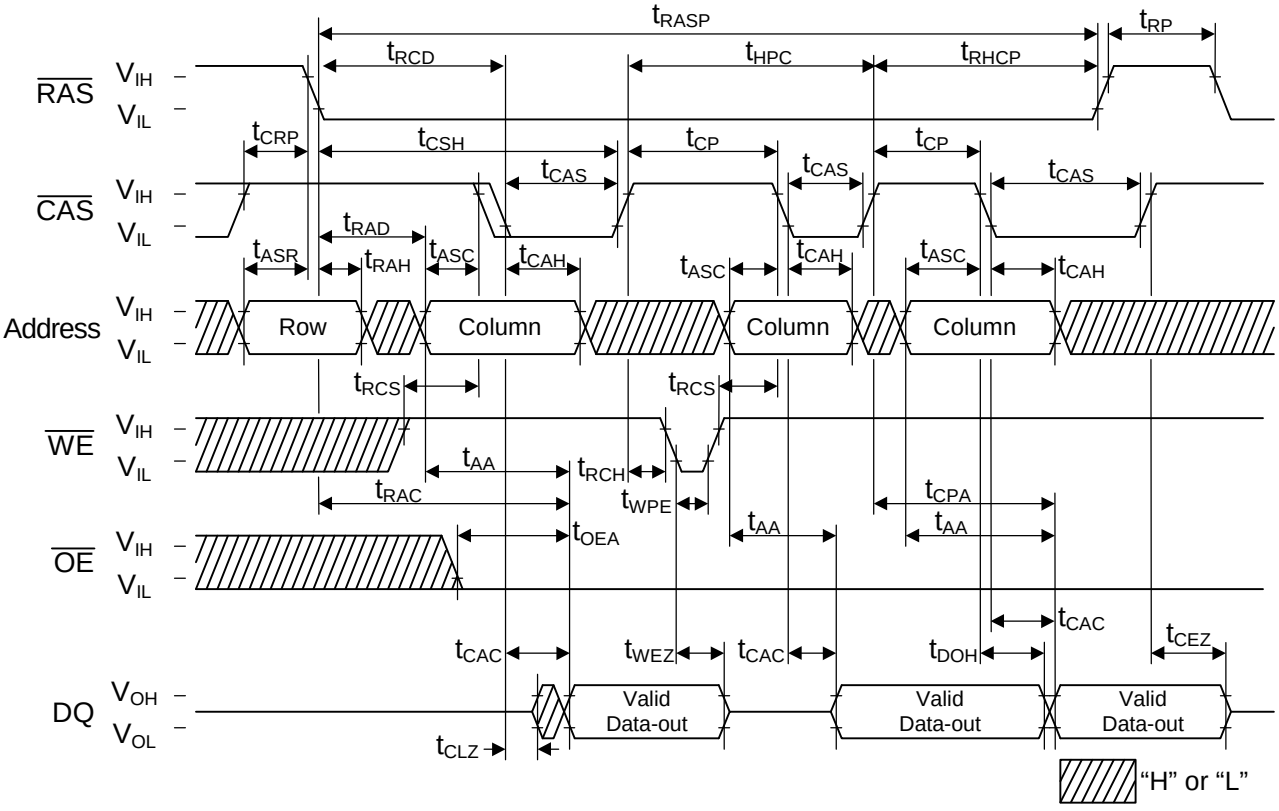
- Read Modify Write Cycle



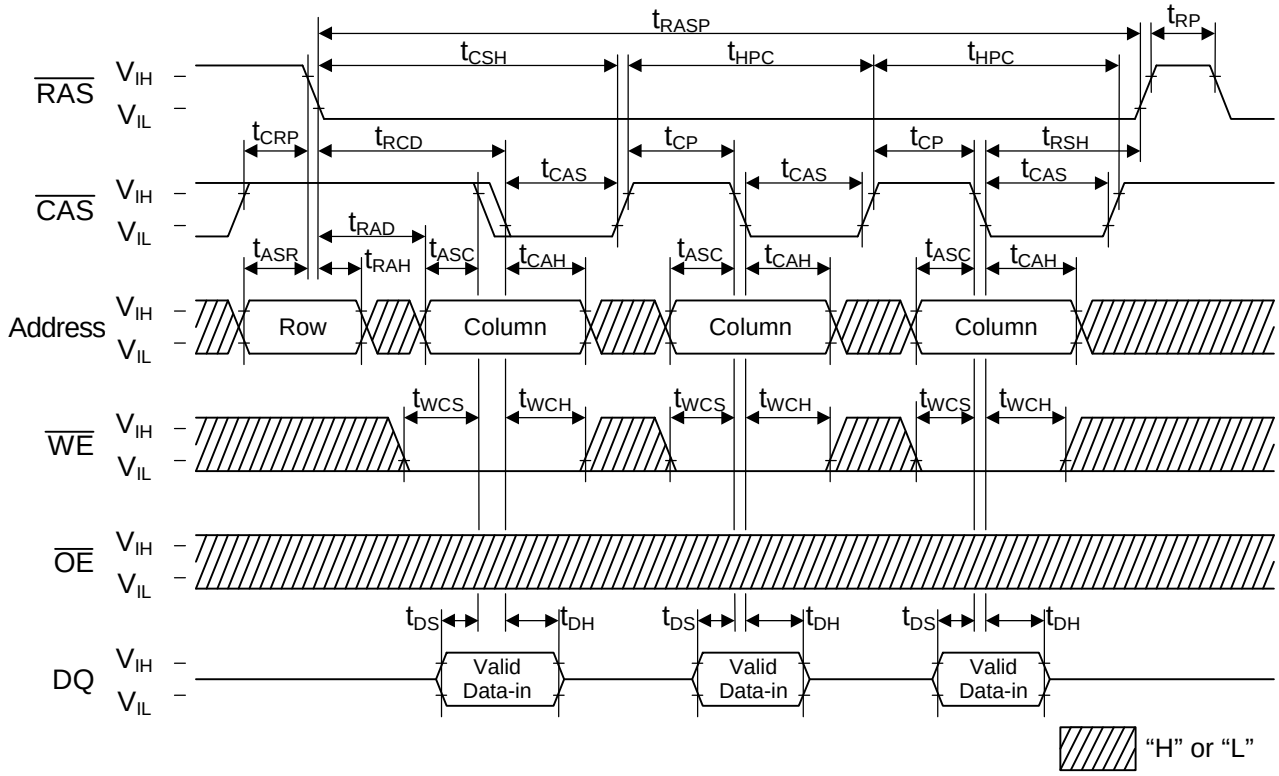
- Fast Page Mode Read Cycle (Part-1)



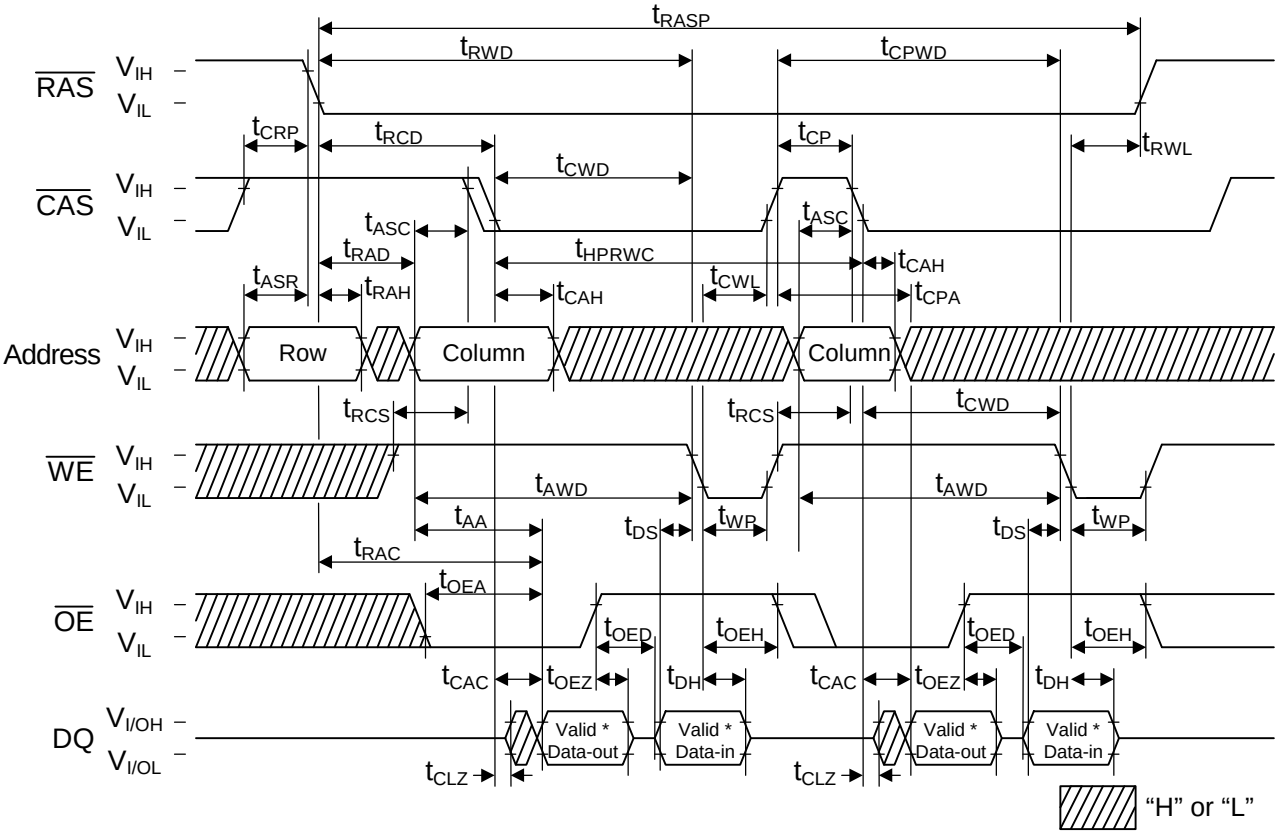
- Fast Page Mode Read Cycle (Part-2)



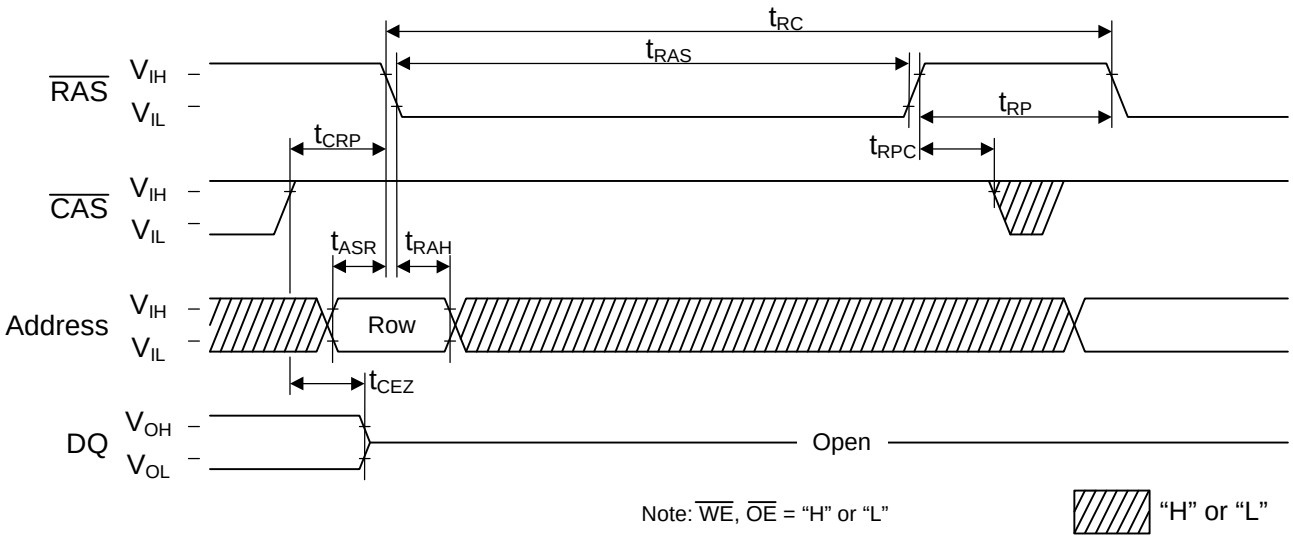
- Fast Page Mode Write Cycle (Early Write)



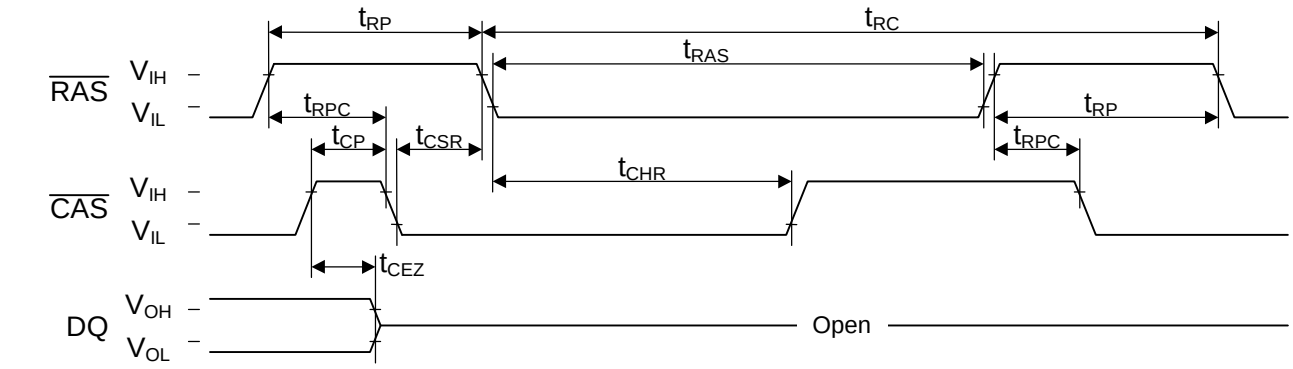
- Fast Page Mode Read Modify Write Cycle



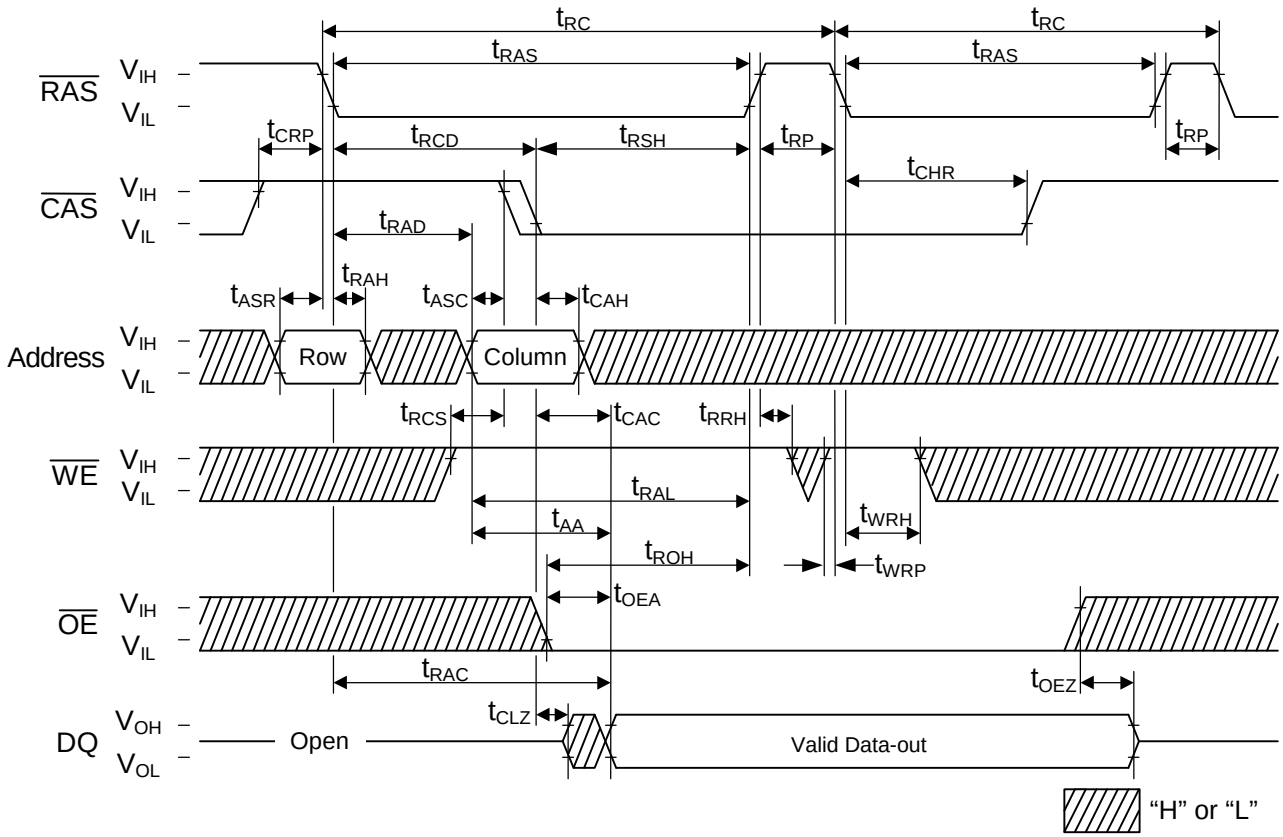
- $\overline{RAS}$-Only Refresh Cycle



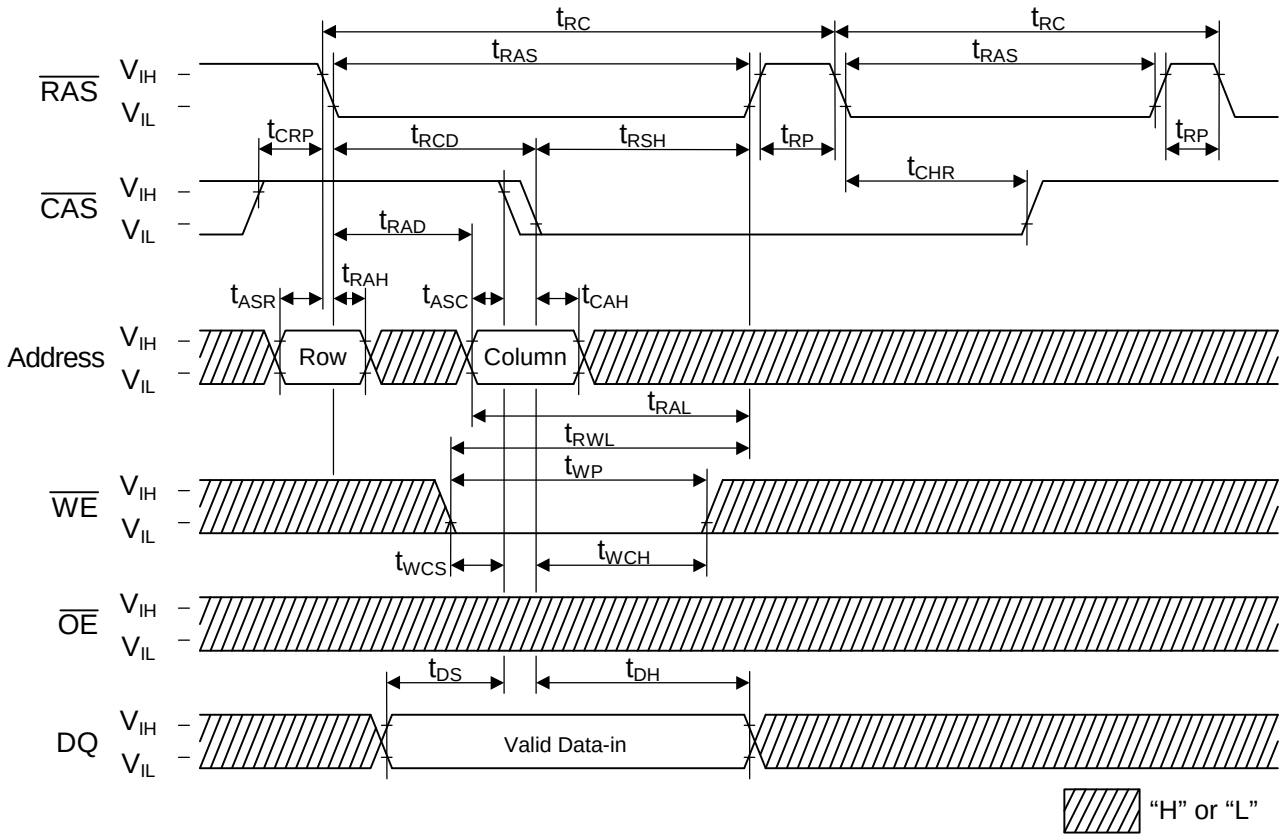
- $\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle



- Hidden Refresh Read Cycle



- Hidden Refresh Write Cycle



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2. The outline of action and examples for application circuits described herein have been chosen as an explanation for the standard action and performance of the product. When planning to use the product, please ensure that the external conditions are reflected in the actual circuit and assembly designs.

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