TOSHIBA

TC514800AJLL-/AFTLL-70/80

524,288 WORD X 8 BIT DYNAMIC RAM

DESCRIPTION

The TC514800AJLL/AFTLL is the new generation dynamic RAM organized 524,288 word by 8 bit. The TC514800AJLL/AFTLL utilizes Toshiba's CMOS silicon gate process technology as well as advanced circuit techniques to provide wide operating margins, both internally and to the system user. Multiplexed address inputs permit the TC514800AJLL/AFTLL to be packaged in a standard 28 pin plastic SOJ, and 28 pin plastic TSOP. The package size provides high system bit densities and is compatible with widely available automated testing and insertion equipment. System oriented features include single power supply of 5V± 10% tolerance, direct interfacing capability with high performance logic families such as Schottky TTL.

FEATURES

- 524,288 word by 8 bit organization
- Fast access time and cycle time
- Single power supply of 5V± 10% with a built-in V_{BB} generator
- Low Power
  578mW MAX .Operating
  (TC514800AJLL/AFTLL-70)
  495mW MAX. Operating
  (TC514800AJLL/AFTLL-80)
  1.1mW MAX. Standby
- Outputs unlatched at cycle end allows two-dimensional chip selection
- Read-Modify-Write, $\overline{CAS}$ before $\overline{RAS}$ refresh, $\overline{RAS}$-only refresh, Hidden refresh, Self Refresh Fast Page Mode capability
- All inputs and outputs TTL compatible
- 1024 refresh cycles/128ms
- Package TC514800AJLL : SOJ28-P-400
  TC514800AFTLL : TSOP28-P-400

KEY PARAMETERS

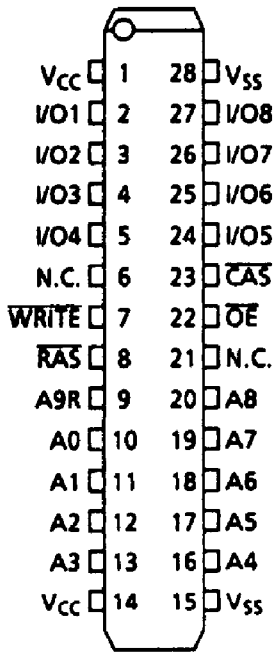
ITEM		TC514800AJLL/AFTLL	
		-70	-80
t_{RAC}	$\overline{RAS}$ Access Time	70ns	80ns
t_{AA}	Column Address Access Time	35ns	40ns
t_{CAC}	$\overline{CAS}$ Access Time	20ns	20ns
t_{RC}	Cycle Time	130ns	150ns
t_{PC}	Fast Page Mode Cycle Time	45ns	50ns

PIN NAME

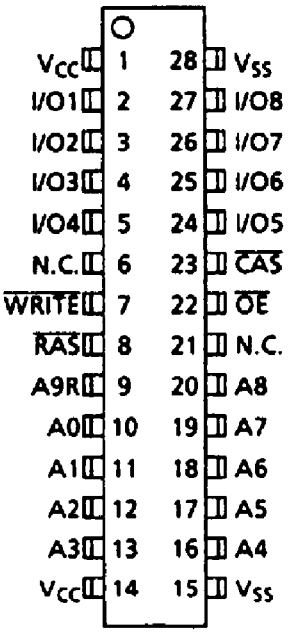
A0~A8, A9R	Address Inputs
$\overline{RAS}$	Row Address Strobe
$\overline{CAS}$	Column Address Strobe
$\overline{WRITE}$	Read/Write Input
$\overline{OE}$	Output Enable
I/O1~I/O8	Data Input/Output
V_{CC}	Power (+5V)
V_{SS}	Ground
N.C.	No Connection

PIN CONNECTION (TOP VIEW)

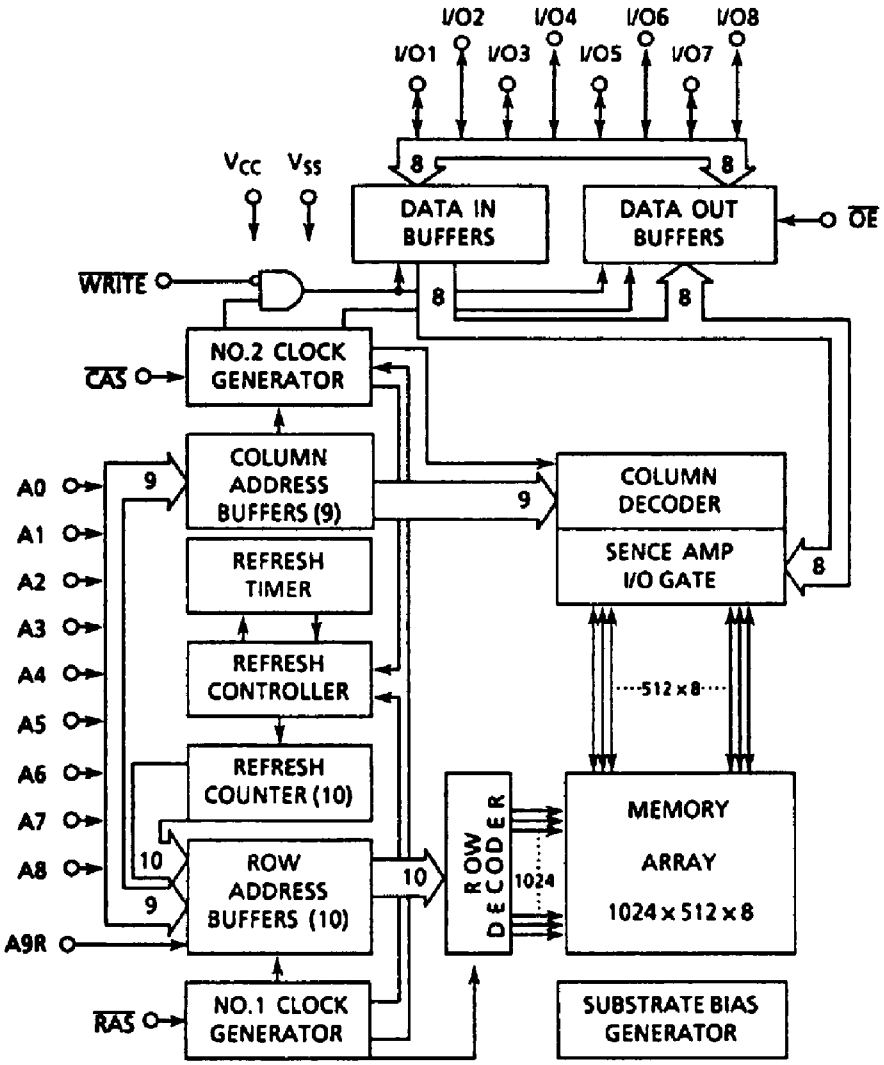
Plastic SOJ



Plastic TSOP
(Normal Bend Type)



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT	NOTE
Input Voltage	V_{IN}	— 1~7	V	1
Output Voltage	V_{OUT}	— 1~7	V	1
Power Supply Voltage	V_{CC}	— 1~7	V	1
Operating Temperature	T_{OPR}	0~70	°C	1
Storage Temperature	T_{STG}	— 55~150	°C	1
Soldering Temperature • Time	T_{SOLDER}	260 • 10	°C • sec	1
Power Dissipation	P_D	700	mW	1
Short Circuit Output Current	I_{OUT}	50	mA	1

RECOMMENDED D.C. OPERATING CONDITIONS (Ta = 0~70°C)

SYMBOL	PARAMETER	MIN.	TYP	MAX	UNIT	NOTE
V_{CC}	Supply Voltage	4.5	5.0	5.5	V	2
V_{IH}	Input HighVoltage	2.4	-	6.5	V	2
V_{IL}	Input LowVoltage (A0~A8, A9R, $\overline{RAS}$, $\overline{CAS}$, $\overline{WRITE}$, $\overline{OE}$)	-1.0*1	-	0.8	V	2
V_{IL}	Input LowVoltage (I/01~I/08)	-0.5*2	-	0.8	V	2

*1 -2.5V at pulse width ≤ 20ns
*2 -2.0V at pulse width ≤ 20ns

D.C. ELECTRICAL CHARACTERISTICS (V_{CC} = 5V ± 10%, Ta = 0~70°C)

SYMBOL	PARAMETER		MIN.	MAX	UNIT	NOTE
I_{CC1}	OPERATING CURRENT Average Power Supply Operating Current ($\overline{RAS}$, $\overline{CAS}$, Address Cycling: t_{RC}=t_{RC} MIN)	TC514800AJLL/AFTL-70	-	105	mA	3,4 5
		TC514800AJLL/AFTL-80	-	90		
I_{CC2}	STANDBY CURRENT Power Supply Standby Current ($\overline{RAS}$=$\overline{CAS}$=V_{IH})			2	mA	
I_{CC3}	RAS ONLY REFRESH CURRENT Average Power Supply Current, $\overline{RAS}$ Only Mode ($\overline{RAS}$ Cycling, $\overline{CAS}$=V_{IH}: t_{RC}=t_{RC} MIN.)	TC514800AJLL/AFTL-70	-	105	mA	3, 5
		TC514800AJLL/AFTL-80	-	90		
I_{CC4}	FAST PAGE MODE CURRENT Average Power Supply Current, Fast Page Mode ($\overline{RAS}$ =V_{IL}, $\overline{CAS}$, Address Cycling: t_{PC}=t_{PC} MIN.)	TC514800AJLL/AFTL-70	-	75	mA	3,4 5
		TC514800AJLL/AFTL-80	-	65		
I_{CC5}	STANDBY CURRENT Power Supply Standby Current ($\overline{RAS}$=$\overline{CAS}$=V_{CC}-0.2V)			200	µA	
I_{CC6}	$\overline{CAS}$ BEFORE $\overline{RAS}$ REFRESH CURRENT Average Power Supply Current, $\overline{CAS}$ Before $\overline{RAS}$ Mode ($\overline{RAS}$, $\overline{CAS}$, Cycling: t_{RC}=t_{RC} MIN.)	TC514800AJLL/AFTL-70	-	105	mA	3
		TC514800AJLL/AFTL-80	-	90		
I_{CC7}	BATTERY BACK UP CURRENT Average Power Suuply Current, Battery Back Up Mode ($\overline{RAS}$=$\overline{CAS}$ Before $\overline{RAS}$ Cycling or 0.2V, $\overline{OE}$=V_{CC}-0.2V or 0.2V $\overline{WRITE}$ =V_{CC}-0.2V or 0.2V, A0~A8, A9R=V_{CC}-0.2V or 0.2V, I/O~I/O8=Vcc-0.2V, 0.2V or OPEN:t_{RC}=125µs, t_{RAS}=t_{RAS} MIN. ~1µs)		-	300	µA	3,6
I_{CCS}	SELF REFRESH CURRENT Average Power Supply Current, Self Refresh Mode ($\overline{RAS}$=$\overline{CAS}$=V_{IL}, $\overline{WRITE}$=V_{CC}-0.2V or 0.2V, $\overline{OE}$=V_{CC}-0.2V or 0.2V A0~8=V_{CC}-0.2V or 0.2V, I/O1~8=V_{CC}-0.2V, 0.2V or OPEN		-	200	µA	
$I_{I(L)}$	INPUT LEAKAGE CURRENT Input Leakage Current, any input (OV≤V_{IN}≤0.5V, All Other Pins Not Under Test=OV)		-10	10	µA	
$I_{O(L)}$	OUTPUT LEAKAGE CURRENT (D_{OUT} is disabled, (OV≤V_{OUT}≤5.5V),		-10	10	µA	
V_{OH}	OUTPUT LEVEL Output "H" Level Voltage (I_{OUT}=-5mA)		2.4	-	V	
V_{OL}	OUTPUT LEVEL Output "L" Level Voltage (I_{OUT}=4.2mA)		-	0.4	V	

ELECTRICAL CHARACTERISTICS AND RECOMMENDED A.C. OPERATING CONDITIONS (V_{CC} = 5V ± 10%, Ta = 0~70°C)(Notes 7,8,9)

SYMBOL	PARAMETER	TC514800AJLL/AFTLL				UNIT	NOTES
		-70		-80			
		MIN	MAX	MIN	MAX		
t_{RC}	Random Read or Write Cycle Time	130	-	150	-	ns	
t_{RMW}	Read-Modify-Write Cycle	185	-	205	-	ns	
t_{PC}	Fast Page Mode Cycle Time	45	-	50	-	ns	
t_{PRMW}	Fast Page Mode Read-Modify-Write Cycle Time	100	-	105	-	ns	
t_{RAC}	Access Time from $\overline{RAS}$	-	70	-	80	ns	10,15,16
t_{CAC}	Access Time from $\overline{CAS}$	-	20	-	20	ns	10,15
t_{AA}	Access Time from Column Address	-	35	-	40	ns	10,16
t_{CPA}	Access Time from $\overline{CAS}$ Precharge	-	40	-	45	-	10
t_{CLZ}	$\overline{CAS}$ to Output in Low-Z	0	-	0	-	ns	10
t_{OFF}	Output Buffer Turn-off Delay	0	20	0	20	ns	11
t_T	Transition Time (Rise and Fall)	3	50	3	50	ns	9
t_{RP}	$\overline{RAS}$ Presharge Time	50	-	60	-	ns	
t_{RAS}	$\overline{RAS}$ Pulse Width	70	10,000	80	10,000	ns	
t_{RASP}	$\overline{RAS}$ Pulse Width (Fast Page Mode)	70	100,000	80	100,000	ns	
t_{RSH}	$\overline{RAS}$ Hold Time	20	-	20	-	ns	
t_{RHCP}	$\overline{RAS}$ Hold Time From $\overline{CAS}$ Precharge (Fast Page Mode)	40	-	45	-	ns	
t_{CSH}	$\overline{CAS}$ Hold Time	70	-	80	-	ns	
t_{CAS}	$\overline{CAS}$ Pulse Width	20	10,000	20	10,000	ns	
t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	20	50	20	60	ns	15
t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	15	35	15	40	ns	16
t_{CRP}	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5		5	-	ns	
t_{CP}	$\overline{CAS}$ Precharge Time	10	-	10	-	ns	
t_{ASR}	Row Address Set-Up Time	0	-	0	-	ns	
t_{RAH}	Row Address Hold Time	10	-	10	-	ns	
t_{ASC}	Column Address Set-Up Time	0	-	0	0	ns	
t_{CAH}	Column Address Hold Time	15	-	15	-	ns	
t_{AR}	Column Address Hold Time referenced to $\overline{RAS}$	55	-	60		ns	
t_{RAL}	Column Address To $\overline{RAS}$ Lead Time	35	-	40		ns	
t_{RCS}	Read Command Set-Up Time	0	-	0	-	ns	
t_{RCH}	Read Command Hold Time	0	-	0	-	ns	12
t_{RRH}	Read Command Hold Time referenced to $\overline{RAS}$	0	-	0	-	ns	12
t_{WCH}	Write Command Hold Time	15	-	15	-	ns	

ELECTRICAL CHARACTERISTICS AND RECOMMENDED A.C. OPERATING CONDITIONS (CONT)

SYMBOL	PARAMETER	TC514400AJLL/AFTLL				UNIT	NOTES
		-70		-80			
		MIN	MAX	MIN	MAX		
t_{WCR}	Write Command Hold Time referenced $\overline{RAS}$	55	-	60	-	ns	
t_{WP}	Write Command Pulse Width	15	-	15	-	ns	
t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	20	-	20	-	ns	
t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	20	-	20	-	ns	
t_{DS}	Data Set-Up Time	0	-	0	-	ns	13
t_{DH}	Data Hold Time	15	-	15	-	ns	13
t_{DHR}	Data Hold Time referenced to $\overline{RAS}$	55	-	60	-	ns	
t_{REF}	Refresh Period	-	128	-	128	ms	
t_{WCS}	Write Command Set-Up Time	0	-	0	-	ns	14
t_{CWD}	$\overline{CAS}$ to $\overline{WRITE}$ Delay Time	50	-	50	-	ns	14
t_{RWD}	$\overline{RAS}$ to $\overline{WRITE}$ Delay Time	100	-	110	-	ns	14
t_{AWD}	Column Address to $\overline{WRITE}$ Delay Time	65	-	70	-	ns	14
t_{CPWD}	$\overline{CAS}$ Precharge to $\overline{WRITE}$ Delay Time	70	-	75	-	ns	14
t_{CSR}	$\overline{CAS}$ Set-up Time ($\overline{CAS}$ before $\overline{RAS}$ Cycle)	5	-	5	-	ns	
t_{CHR}	$\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$ Cycle)	15	-	15	-	ns	
t_{RPC}	$\overline{RAS}$ to $\overline{CAS}$ Precharge Time	0	-	0	-	ns	
t_{CPT}	$\overline{CAS}$ Precharge Time ($\overline{CAS}$ before $\overline{RAS}$ Counter Test Cycle	40	-	40	-	ns	
t_{ROH}	$\overline{RAS}$ Hold Time referenced to $\overline{OE}$	10	-	10	-	ns	
t_{OEA}	$\overline{OE}$ Access Time	-	20	-	20	ns	10
t_{OED}	$\overline{OE}$ to Data Delay	20	-	20	-	ns	
t_{OEZ}	Output buffer turn off Delay Time from $\overline{OE}$	0	20	0	20	ns	11
t_{OEH}	$\overline{OE}$ Command Hold Time	20	-	20	-	ns	
t_{ODS}	Output Disable Set-Up Time	0	-	0	-	ns	
t_{RASS}	$\overline{RAS}$ Pulse Width ($\overline{CAS}$ before $\overline{RAS}$ Self Refresh)	100	-	100	-		
t_{RPS}	$\overline{RAS}$ Precharge Time ($\overline{CAS}$ before $\overline{RAS}$ Self Refresh)	130	-	150	-	ns	
t_{CHS}	$\overline{CAS}$ Hold time ($\overline{CAS}$ before $\overline{RAS}$ Self Refresh)	-50	-	-60	-	ns	

CAPACITANCE (V_{CC} = 5V ± 10%, f = 1MHz, Ta = 0~70°C)

SYMBOL	PARAMETER	MIN	MAX	UNIT
C_{I1}	Input Capacitance (A0~A8, A9R)	-	5	pF
C_{I2}	Input Capacitance ($\overline{RAS}$, $\overline{CAS}$, $\overline{WRITE}$, $\overline{OE}$)	-	7	pF
C_O	Input/Output Capacitance (I/O1~I/O8)	-	7	pF

NOTES:

1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

2. All voltages are referenced to V_{SS}.

3. I_{CC1}, I_{CC3}, I_{CC4}, I_{CC6} depend on cycle rate.

4. I_{CC1}, I_{CC4} depend on output loading. Specified values are obtained with the output open.

5. Address can be changed one or less while $\overline{RAS}$=V_{IL}. In case of I_{CC4}, it can be changed once or less during a fast page mode cycle (t_{PC}).

6. t_{RAS}(max.)=1μs is only applied to refresh of battery-back up. t_{RAS}(max.)=10μs is applied to functional operating.

7. An initial pause of 200μs is required after pwoer-up followed by 8 $\overline{RAS}$ only refresh cycles before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8 $\overline{CAS}$ before $\overline{RAS}$ refresh cycles instead 8 $\overline{RAS}$ only refresh cycles are required.

8. AC measurements assume t_T=5ns.

9. 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}.

10. Measured with a load equivalent to 2 TTL loads and 100pF.

11. t_{OFF} (max.) and t_{OEZ} (max.) define the time at which the output achieves the open circuit condition and are not referenced to output voltage levels.

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

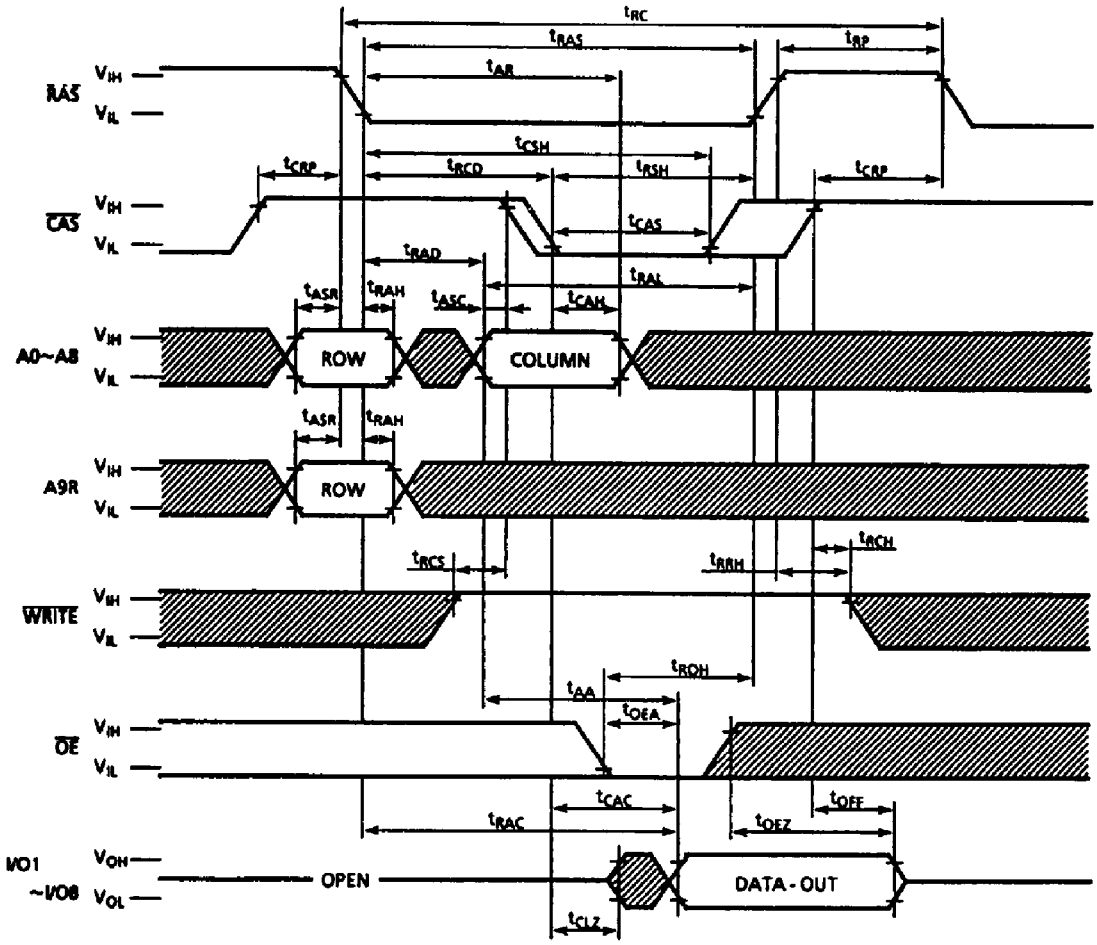
13. These parameters are referenced to $\overline{CAS}$ leading edge in early write cycles and to $\overline{WRITE}$ leading edge in Read-Modify-Write cycles.

14. t_{WCS}, t_{RWD}, t_{CWD}, t_{AWD} and t_{CPWD} are not restictive operating parameters. They are included in the date sheet as electrical characteristics only. If t_{WCS} >t_{WCS} (min.), the cycle is an early write cycle and the data output will remain open circuit (high impedance) through the entire cycle; If t_{RWD}>t_{RWD} (min.), t_{CWD}>t_{CWD} (min.), t_{AWD}>t_{AWD} (min.) and t_{CPWP}>t_{CPWD} (min.), (Fast Page Mode), the cycle is a Read-Modify-Write cycle and the data out will contain data read from the selected cell: If neither of the above sets of condifition is satisfied, the condition of the data out (at access time) is indeterminate.

15. Operation within the t_{RCD} (max.) limit insures that t_{RAC} 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_{CAC}.

16. Operation within the t_{RAD} (max.) limit insures 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}.

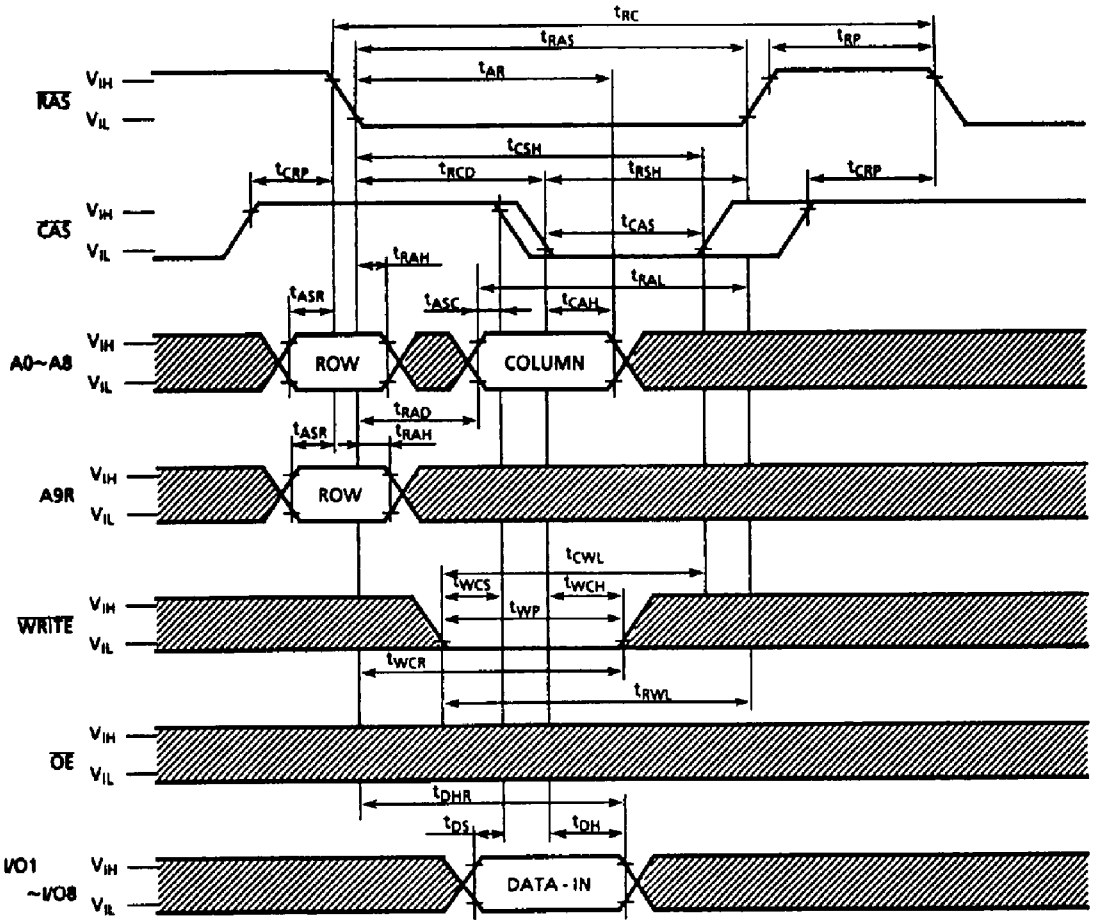
READ CYCLE



Note : D_{IN} = OPEN

▨ : "H" or "L"

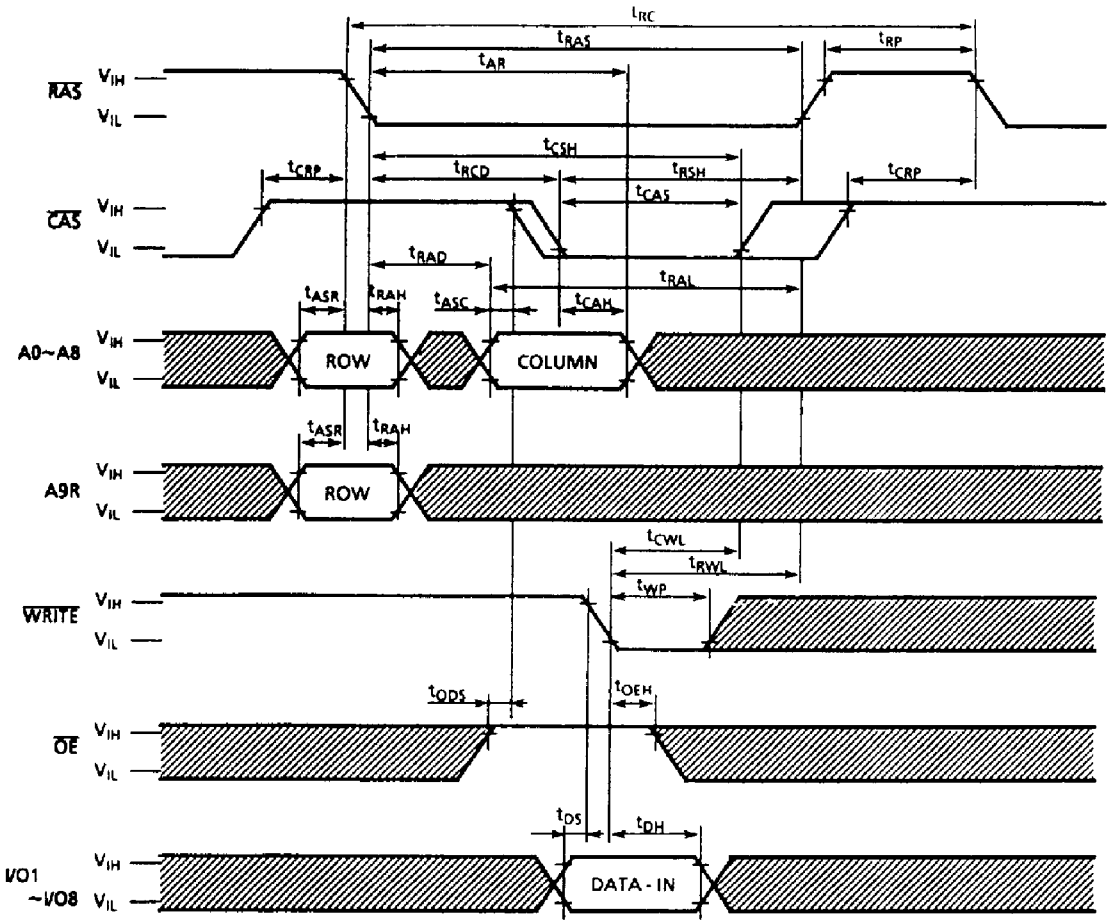
WRITE CYCLE (EARLY WRITE)



Note : D_{OUT} = OPEN

▨ : "H" or "L"

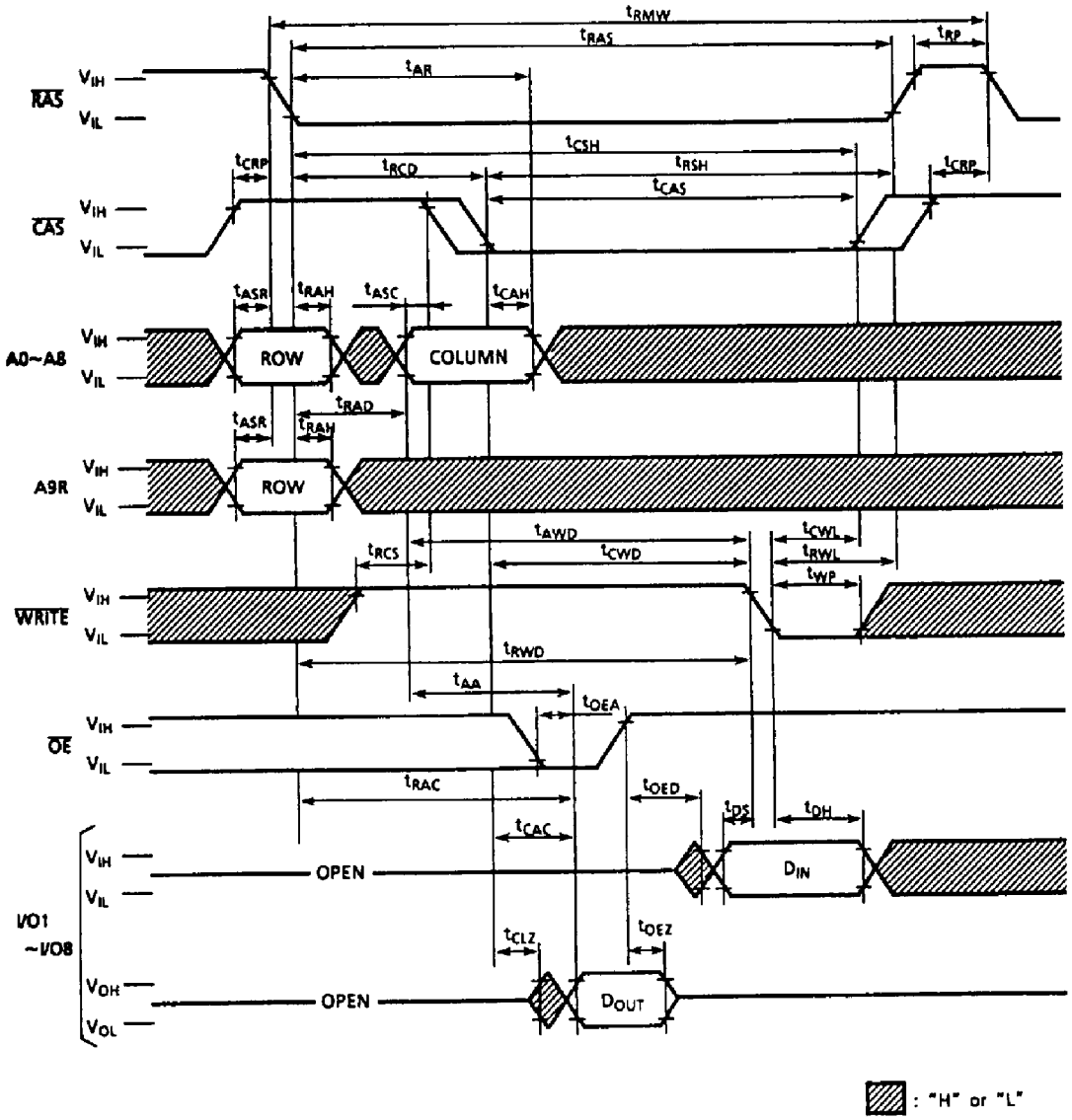
WRITE CYCLE ($\overline{OE}$ CONTROLLED WRITE)



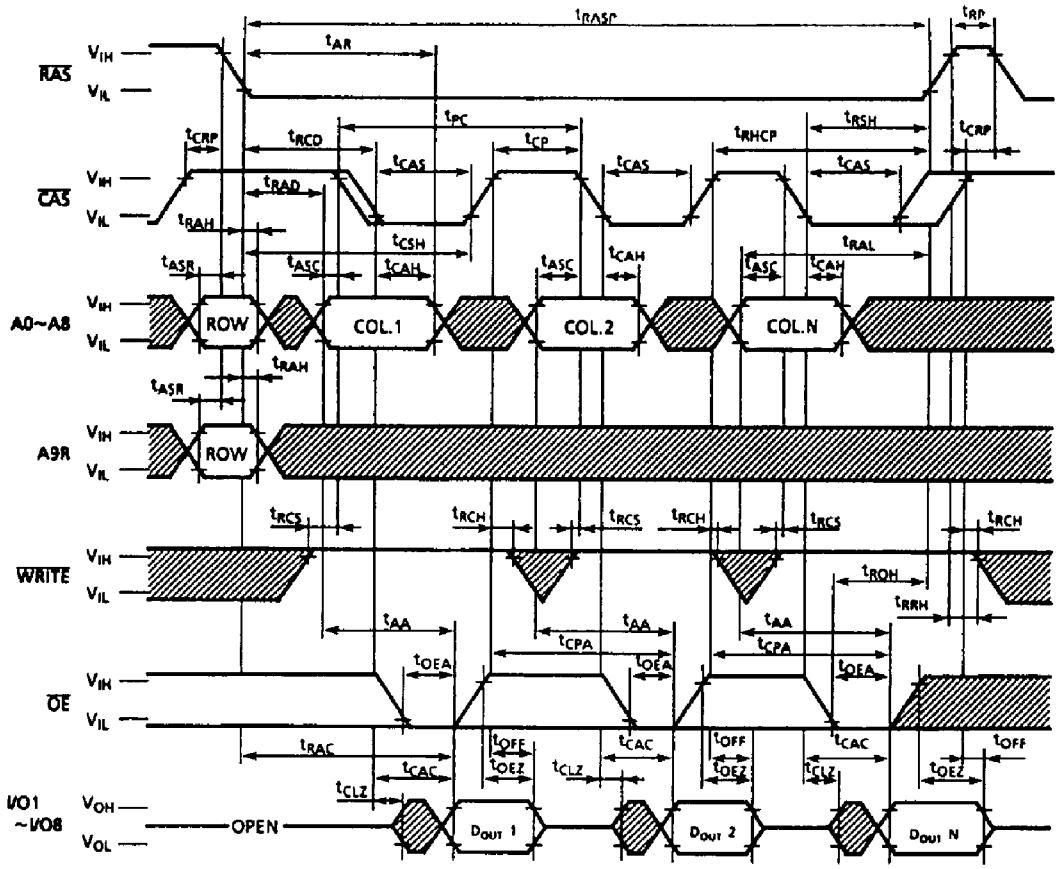
Note : D_{OUT} = OPEN

▨ : "H" or "L"

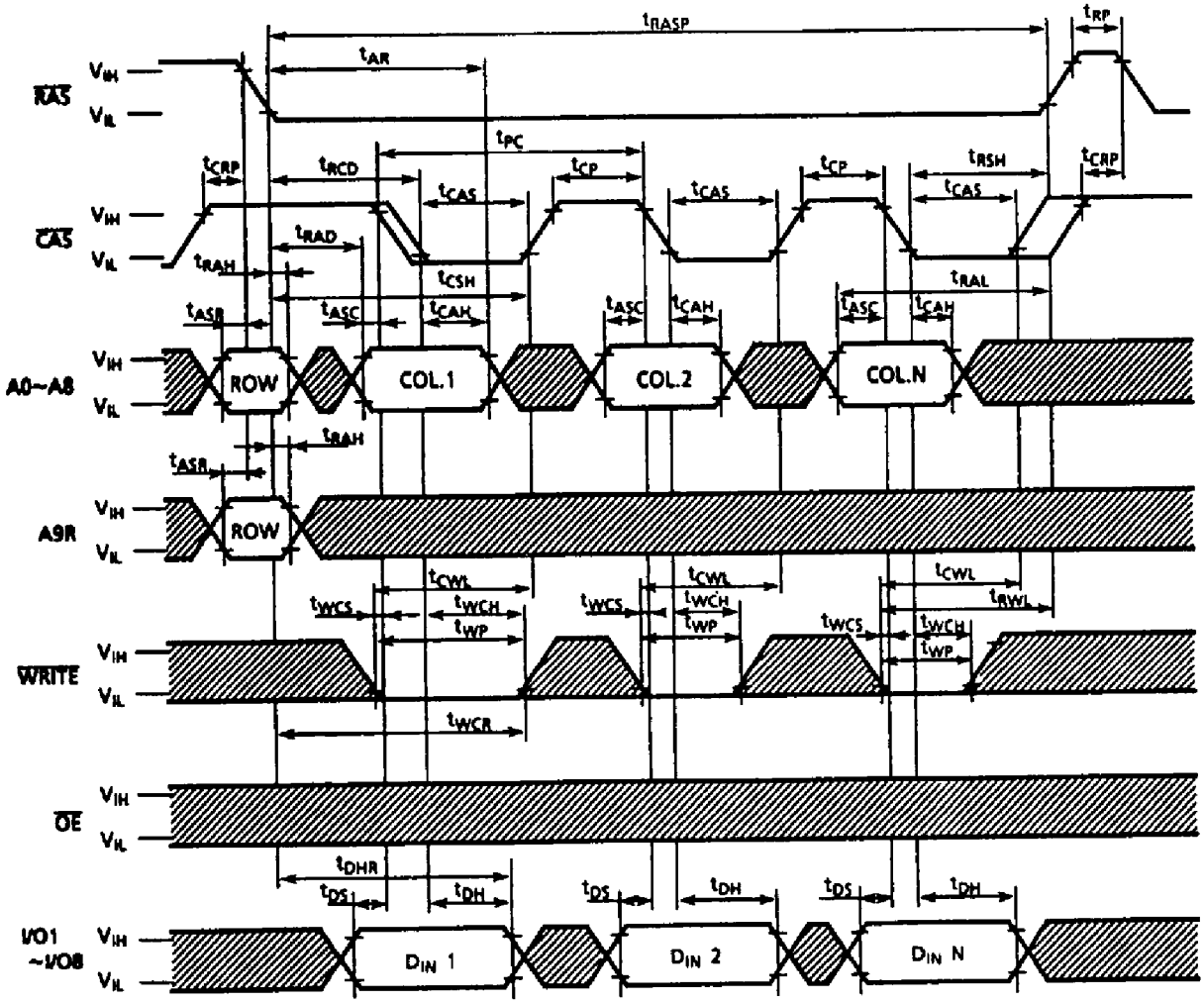
READ-MODIFY-WRITE CYCLE



FAST PAGE MODE READ CYCLE



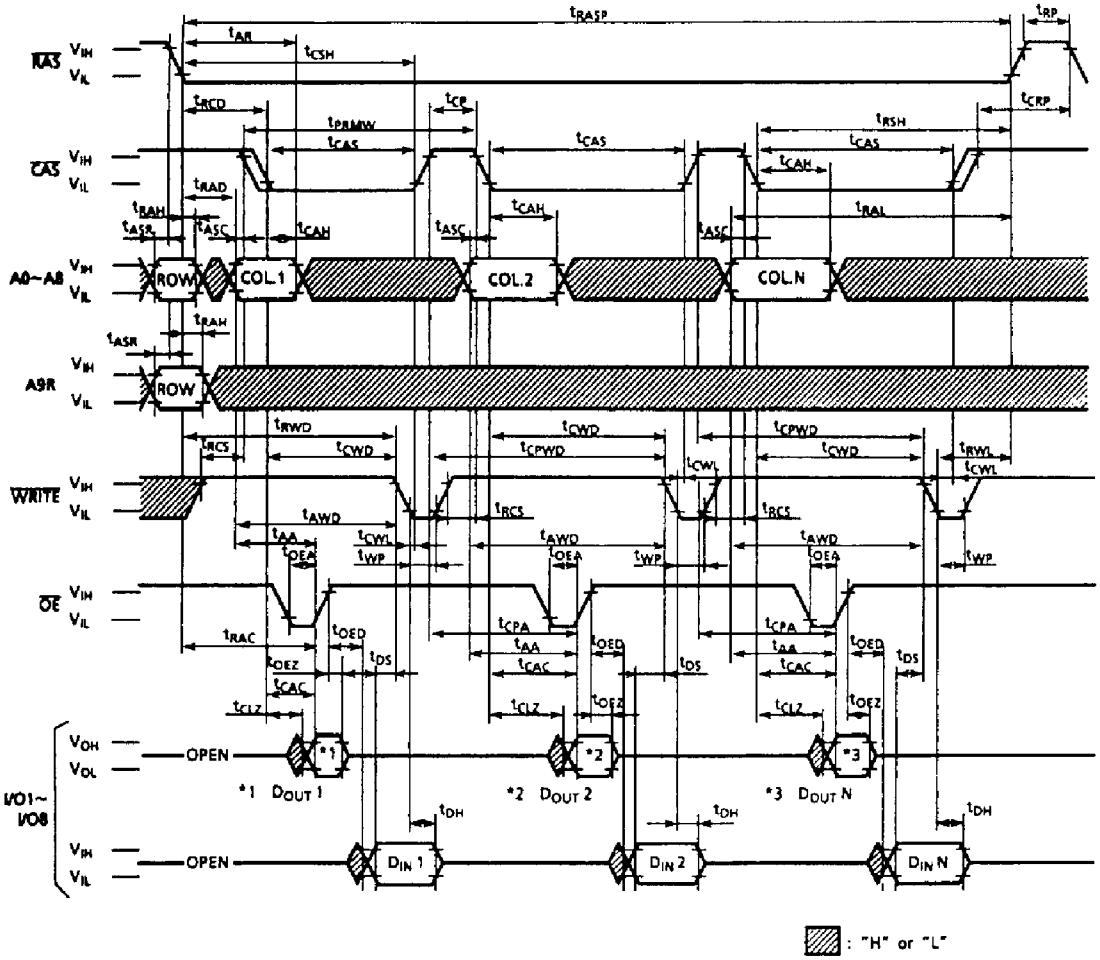
FAST PAGE MODE WRITE CYCLE



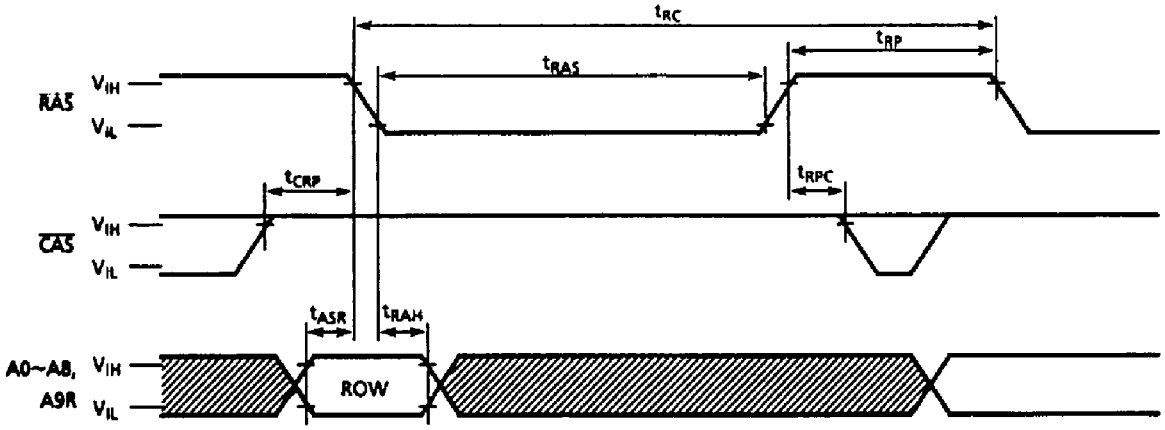
Note : D_{OUT} = OPEN

▨ : "H" or "L"

FAST PAGE MODE READ-MODIFY-WRITE CYCLE



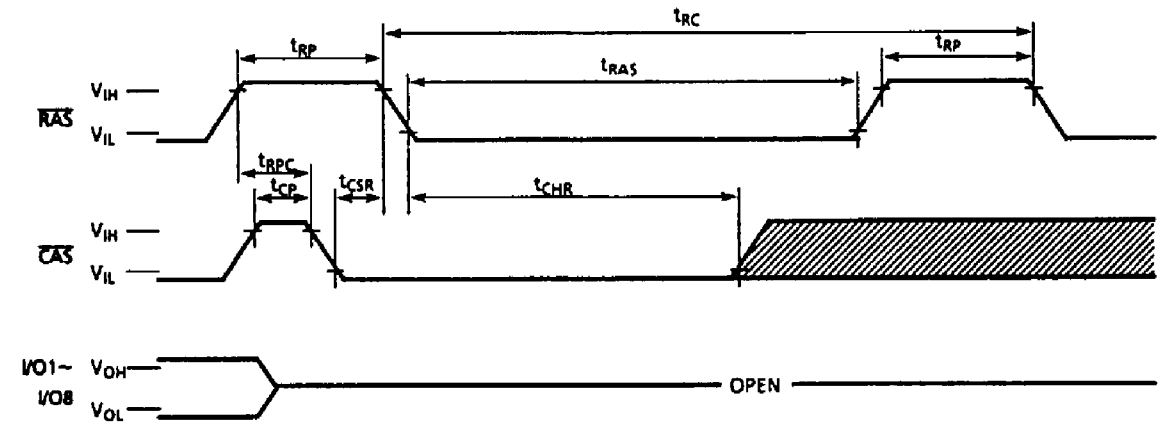
$\overline{RAS}$ ONLY REFRESH CYCLE



Note: $\overline{WRITE}$, $\overline{OE}$, D_{IN} = "H" or "L"
D_{OUT} = OPEN

▨: "H" or "L"

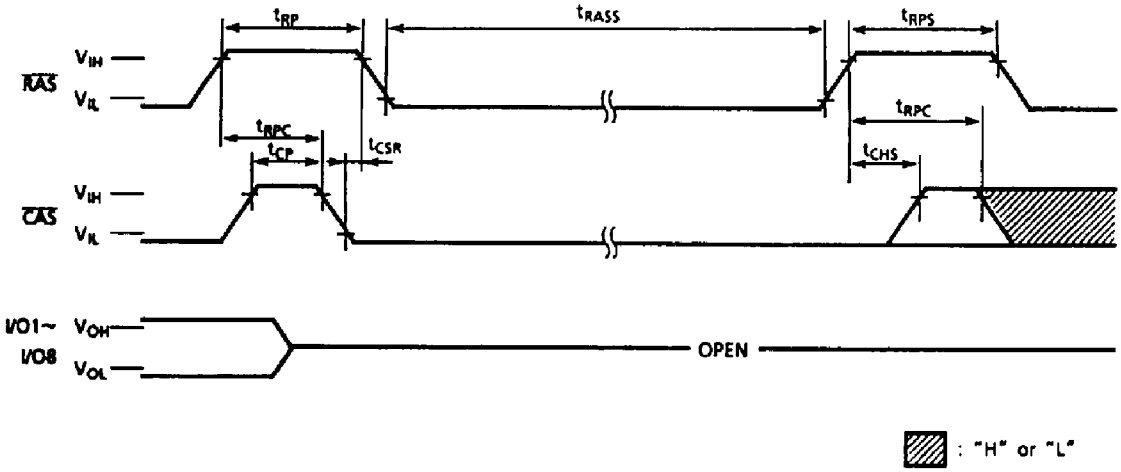
$\overline{CAS}$ BEFORE $\overline{RAS}$ REFRESH CYCLE



Note: D_{IN}, $\overline{WRITE}$, $\overline{OE}$, A0~A8, A9R = "H" or "L"

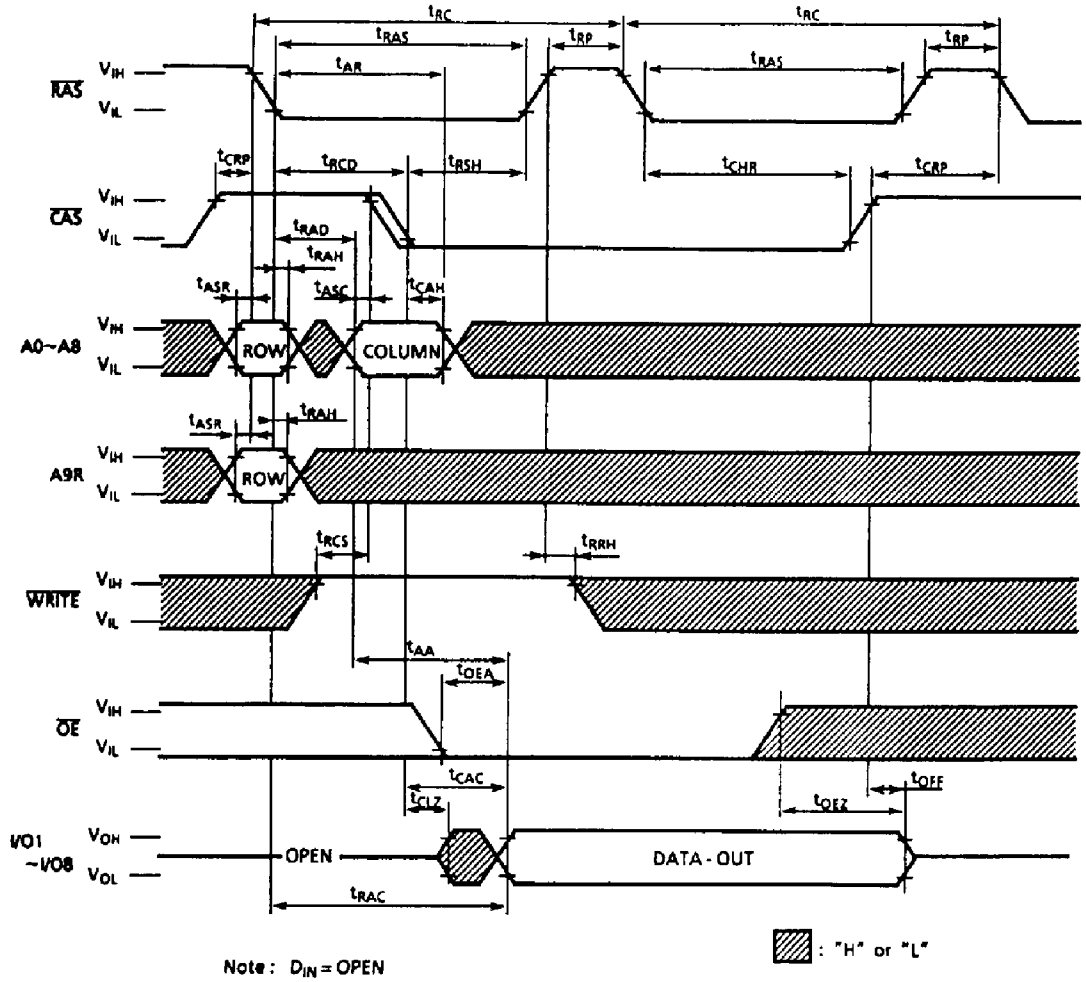
▨: "H" or "L"

$\overline{CAS}$ BEFORE $\overline{RAS}$ SELF REFRESH CYCLE



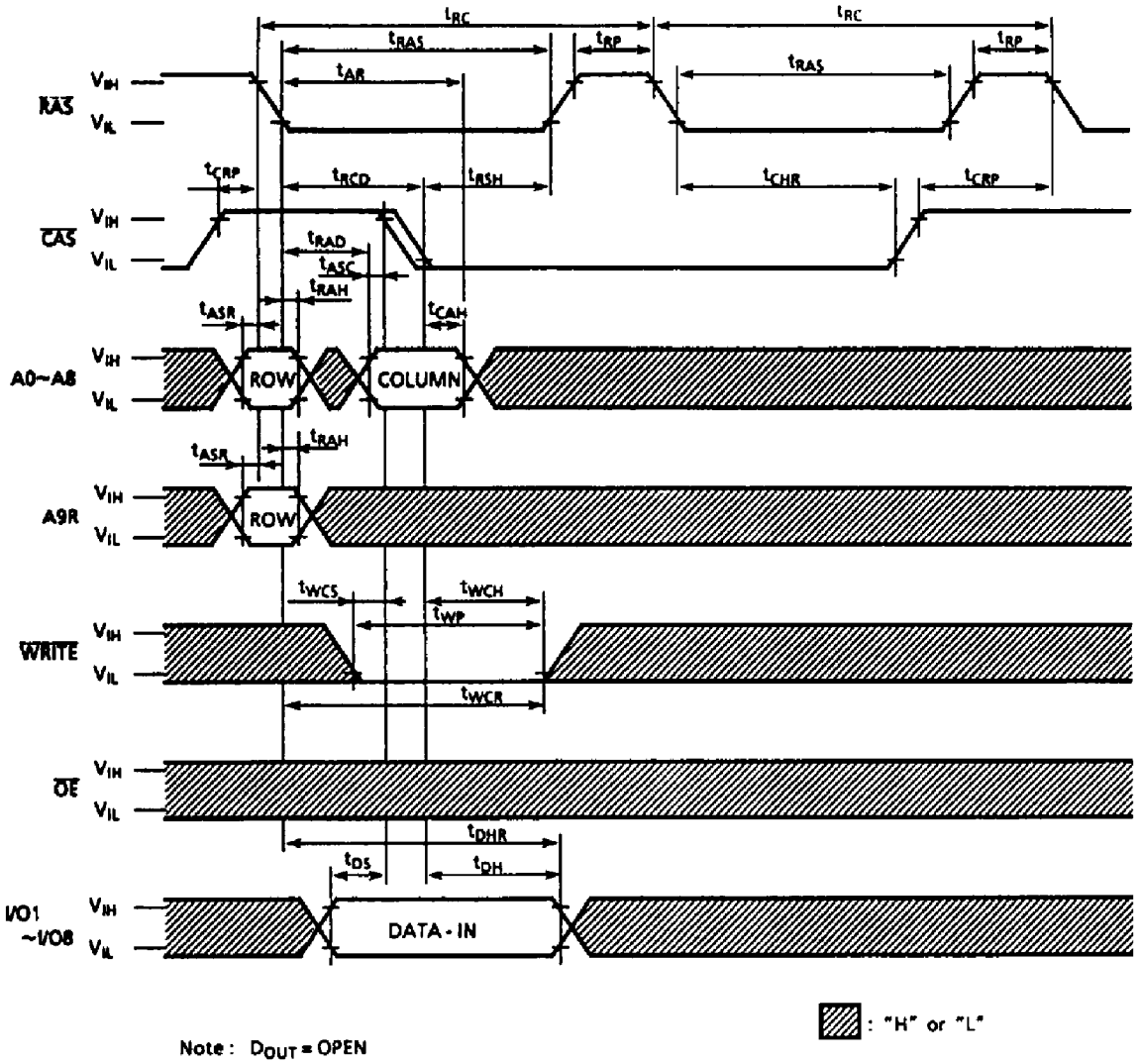
Note : D_{IN}, $\overline{WRITE}$, $\overline{OE}$, A0~A8, A9R = "H" or "L"

HIDDEN REFRESH CYCLE (READ)



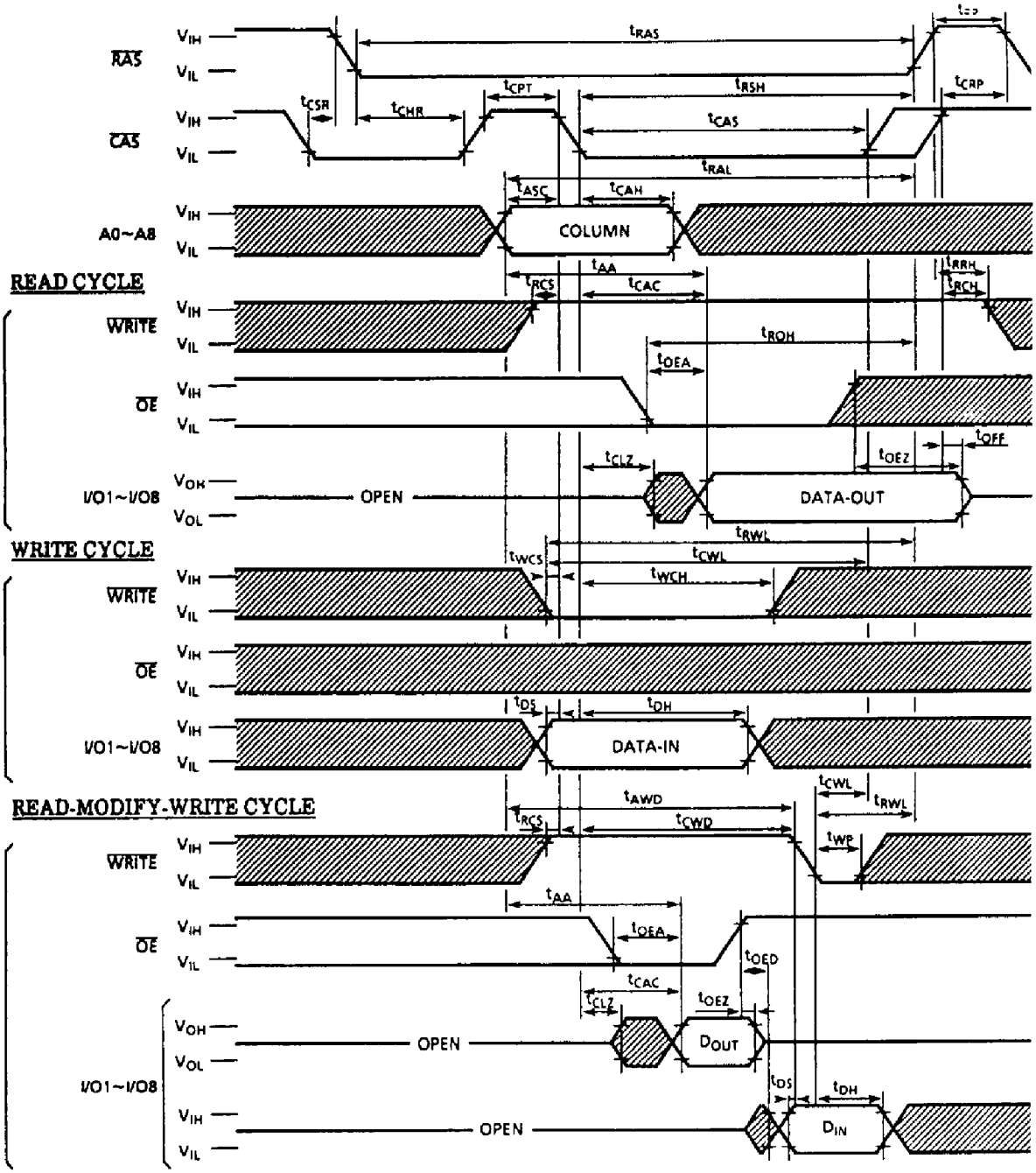
Note : D_{IN} = OPEN

HIDDEN REFRESH CYCLE (WRITE)



Note : D_{OUT} = OPEN

CAS BEFORE RAS REFRESH COUNTER TEST CYCLE



: "H" or "L"

Note : A9R = "H" or "L"