	No 4699A	LC32464P, M-80
		256 K (65536 words × 4 bits) DRAM Fast Page Mode

Overview

The LC32464P, M is a CMOS dynamic RAM operating on a single 5 V power source and having a 65536 words × 4 bits configuration. Equipped with high speed and low power dissipation, the LC32464P, M is suited for a wide variety of applications ranging from computer main memory and expansion memory to commercial equipment. Address inputs utilizes a multiplexed address bus which permits it to be enclosed in a compact plastic package. The LC32464P, M supports $\overline{\text{CAS}}$ -before $\overline{\text{RAS}}$ refresh and $\overline{\text{RAS}}$ -only refresh within 4 ms with 256 row address (A0 to A7) selection.

Features

- 65536 words × 4 bits configuration.
- $\overline{\text{RAS}}$ access time/cycle time/power dissipation

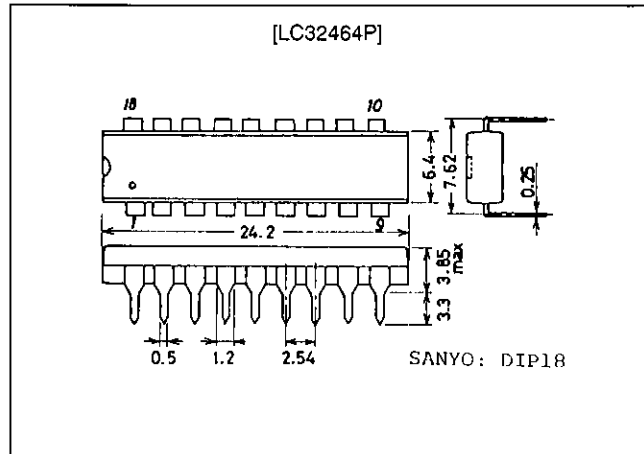
Parameter		LC32464P, M-80
RAS access time		80 ns
Cycle time		160 ns
Power dissipation (max.)	Operating	385 mW
	Standby	5.5 mW (CMOS level)/ 11 mW (TTL level)

- Single 5 V ± 10% power supply.
- All input and output (I/O) TTL compatible.
- Supports fast page mode and read-modify-write.
- Supports output caching control using early write and Output Enable ($\overline{\text{OE}}$) control.
- 4 ms refresh using 256 refresh cycles.
- Supports $\overline{\text{RAS}}$ -only refresh, $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh and hidden refresh.
- Packages
 - DIP 18-pin plastic package: LC32464P
 - MFP 24-pin plastic package: LC32464M

Package Dimensions

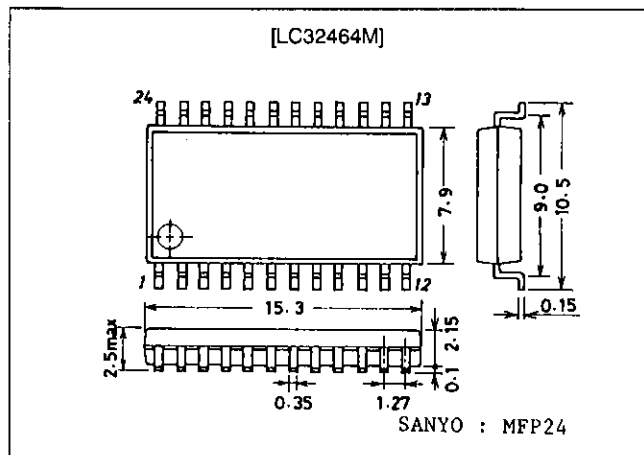
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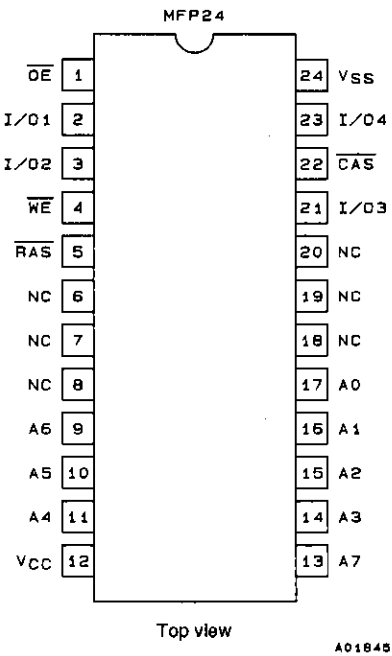
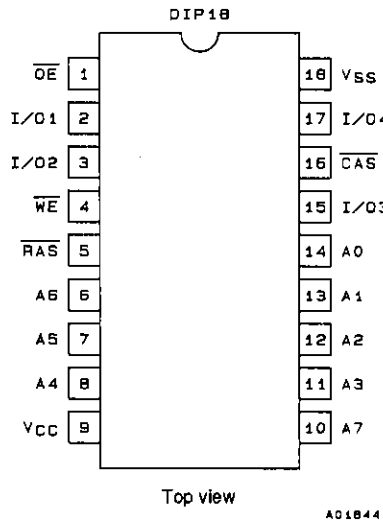


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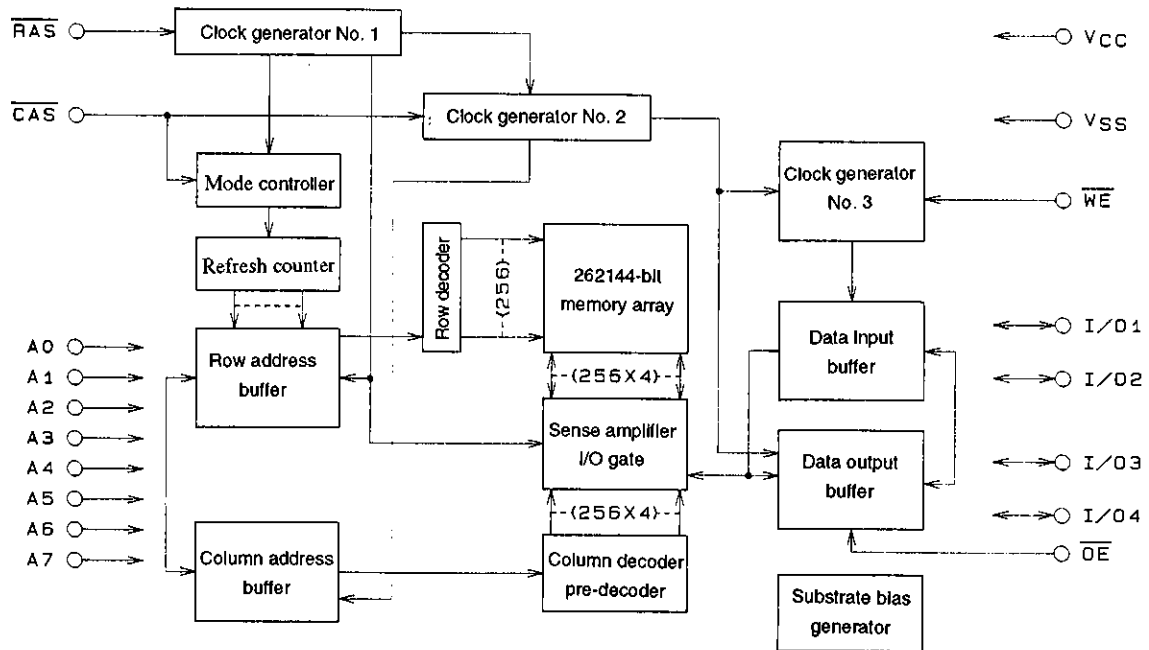
3045B-MFP24



Pin Assignment



Block Diagram



Specifications

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Note
Maximum supply voltage	V_{CC} max	-1.0 to +7.0	V	1
Input voltage	V_{IN}	-1.0 to +7.0	V	1
Output voltage	V_{OUT}	-1.0 to +7.0	V	1
Allowable power dissipation	P_d max	600	mW	1
Output short-circuit current	I_{OUT}	50	mA	1
Operating temperature range	T_{opr}	0 to +70	°C	1
Storage temperature range	T_{stg}	-55 to +150	°C	1

Note: 1) Stresses greater than the above listed maximum values may result in damage to the device.

DC Recommended Operating Ranges at $T_a = 0$ to +70°C

Parameter	Symbol	min	typ	max	Unit	Note
Power supply voltage	V_{CC}	4.5	5.0	5.5	V	2
Input high level voltage	V_{IH}	2.4		6.5	V	2
Input low level voltage	V_{IL}	-1.0		+0.8	V	2

Note: 2) All voltages are referenced to V_{SS} . A bypass capacitor of about 0.1 μ F should be connected between the device V_{CC} and V_{SS} pins.

DC Electrical Characteristics at $T_a = 0$ to +70°C, $V_{CC} = 5\text{ V} \pm 10\%$

Parameter	Symbol	Conditions	min	max	Unit	Note
Operating current (Average current during operation)	I_{CC1}	\overline{RAS} , \overline{CAS} , address cycling: $t_{RC} = t_{RC}$ min		70	mA	3, 4
Standby current	I_{CC2}	$\overline{RAS} = \overline{CAS} = V_{IH}$		2	mA	
\overline{RAS} -only refresh current	I_{CC3}	\overline{RAS} cycling: $\overline{CAS} = V_{IH}$; $t_{RC} = t_{RC}$ min		70	mA	3
Fast page mode current	I_{CC4}	$\overline{RAS} = V_{IL}$, \overline{CAS} , address cycling: $t_{PC} = t_{PC}$ min		55	mA	3, 4
Standby current	I_{CC5}	$\overline{RAS} = \overline{CAS} = V_{CC} - 0.2\text{ V}$		1	mA	
\overline{CAS} -before- \overline{RAS} refresh current	I_{CC6}	\overline{RAS} , \overline{CAS} cycling: $t_{RC} = t_{RC}$ min		70	mA	3
Input leakage current	I_{IL}	$0\text{ V} \leq V_{IN} \leq 6.5\text{ V}$, pins other than measuring pin = 0 V	-10	+10	μ A	
Output leakage current	I_{OL}	D_{OUT} disable, $0\text{ V} \leq V_{OUT} \leq 5.5\text{ V}$	-10	+10	μ A	
Output high level voltage	V_{OH}	$I_{OUT} = -5.0\text{ mA}$	2.4		V	
Output low level voltage	V_{OL}	$I_{OUT} = 4.2\text{ mA}$		0.4	V	

Note: 3) All current values are measured at minimal cycle rate. Since current flows immoderately, if cycle time is longer than shown here, current value becomes smaller.

4) I_{CC1} and I_{CC4} are dependent on output loads. Maximum values for I_{CC1} and I_{CC4} represent values with output open.

AC Electrical Characteristics at $T_a = 0$ to $+70^\circ\text{C}$, $V_{CC} = 5\text{ V} \pm 10\%$ (note 5, 6, 7)

Parameter	Symbol	min	max	Unit	Note
Random read or write cycle time	t_{RC}	160		ns	
Read-write/read-modify-write cycle time	t_{RWC}	215		ns	
Fast page mode cycle time	t_{PC}	55		ns	
Fast page mode read-write/read-modify-write cycle time	t_{PRWC}	100		ns	
$\overline{\text{RAS}}$ access time	t_{RAC}		80	ns	8, 13
$\overline{\text{CAS}}$ access time	t_{CAC}		20	ns	8, 13
Column address access time	t_{AA}		40	ns	8, 14
$\overline{\text{CAS}}$ precharge access time	t_{CPA}		45	ns	8
Output low-impedance time from $\overline{\text{CAS}}$ low	t_{CLZ}	5		ns	8
Output buffer turn-off delay time	t_{OFF}	0	20	ns	9
Rise or fall time	t_T	3	50	ns	7
$\overline{\text{RAS}}$ precharge time	t_{RP}	70		ns	
$\overline{\text{RAS}}$ pulse width	t_{RAS}	80	10000	ns	
$\overline{\text{RAS}}$ pulse width for fast page mode only	t_{RASP}	80	100000	ns	
$\overline{\text{RAS}}$ hold time	t_{RSH}	20		ns	
$\overline{\text{CAS}}$ hold time	t_{CSH}	80		ns	
$\overline{\text{CAS}}$ pulse width	t_{CAS}	20	10000	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ delay time	t_{RCD}	25	60	ns	13
$\overline{\text{RAS}}$ column address delay time	t_{RAD}	17	40	ns	14
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ precharge time	t_{CRP}	10		ns	
$\overline{\text{CAS}}$ precharge time for fast page mode only	t_{CP}	10		ns	
Row address setup time	t_{ASR}	0		ns	
Row address hold time	t_{RAH}	12		ns	
Column address setup time	t_{ASC}	0		ns	
Column address hold time	t_{CAH}	20		ns	
Column address hold time referenced to $\overline{\text{RAS}}$	t_{AR}	60		ns	
Column address to $\overline{\text{RAS}}$ lead time	t_{RAL}	40		ns	
Read command setup time	t_{RCS}	0		ns	
Read command hold time referenced to $\overline{\text{CAS}}$	t_{RCH}	0		ns	10
Read command hold time referenced to $\overline{\text{RAS}}$	t_{RRH}	0		ns	10
Write command hold time	t_{WCH}	15		ns	
Write command hold time referenced to $\overline{\text{RAS}}$	t_{WCR}	60		ns	
Write command pulse width	t_{WP}	15		ns	

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Parameter	Symbol	min	max	Unit	Note
Write command to $\overline{\text{RAS}}$ lead time	t_{RWL}	25		ns	
Write command to $\overline{\text{CAS}}$ lead time	t_{CWL}	20		ns	
Data input setup time	t_{DS}	0		ns	11
Data input hold time	t_{DH}	20		ns	11
Data input hold time referenced to $\overline{\text{RAS}}$	t_{DHR}	60		ns	
Refresh period	t_{REF}		4	ms	
Write command setup time	t_{WCS}	0		ns	12
$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ delay time	t_{CWD}	50		ns	12
$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ delay time	t_{RWD}	105		ns	12
Column address to $\overline{\text{WE}}$ delay time	t_{AWD}	65		ns	12
$\overline{\text{CAS}}$ setup time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh	t_{CSR}	10		ns	
$\overline{\text{CAS}}$ hold time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh	t_{CHR}	20		ns	
$\overline{\text{RAS}}$ precharge time to $\overline{\text{CAS}}$ active time	t_{RPC}	10		ns	
$\overline{\text{CAS}}$ precharge time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ counter test	t_{CPT}	40		ns	
$\overline{\text{CAS}}$ precharge time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh	t_{CPN}	15		ns	
$\overline{\text{RAS}}$ hold time referenced to $\overline{\text{OE}}$	t_{ROH}	20		ns	
$\overline{\text{OE}}$ access time	t_{OEA}		20	ns	
$\overline{\text{OE}}$ delay time	t_{OED}	20		ns	
$\overline{\text{OE}}$ output buffer turn-off delay time	t_{OEZ}	0	20	ns	
$\overline{\text{OE}}$ command hold time	t_{OEH}	20		ns	
Data input to $\overline{\text{CAS}}$ delay time	t_{DZC}	0		ns	15
Data input to $\overline{\text{OE}}$ delay time	t_{DZO}	0		ns	15

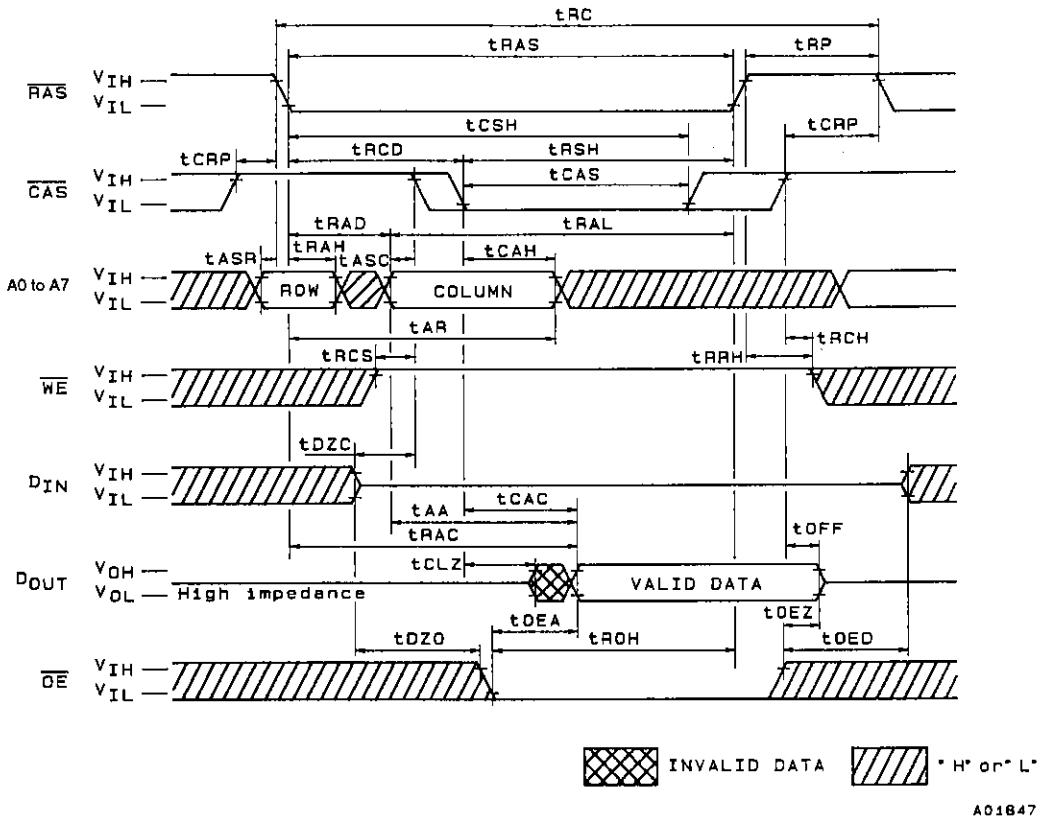
Input/Output Capacitance at $T_a = 25^\circ\text{C}$, $f = 1\text{ MHz}$, $V_{\text{CC}} = 5\text{ V} \pm 10\%$

Parameter	Symbol	min	max	Unit
Input capacitance (A_0 to A_7)	C_{IN1}		5	pF
Input capacitance ($\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{WE}}$, $\overline{\text{OE}}$)	C_{IN2}		7	pF
I/O capacitance (I/O_1 to I/O_4)	$C_{\text{I/O}}$		7	pF

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- Notes:
- 5) After the power is turned on, 200 μ s are required after the arrival of V_{CC} stabilized current before memory is initialized and begins operation. In addition, before memory operation initializes, approximately 8 cycles worth of \overline{RAS} dummy cycles are required. When the on-chip refresh counter is applied, approximately 8 cycles worth of \overline{CAS} -before- \overline{RAS} dummy cycles are required instead of the \overline{RAS} dummy cycles.
 - 6) Measured at $t_T = 5$ ns.
 - 7) When measuring input signal timing, V_{IH} (min) and V_{IL} (max) are used for reference points. In addition, rise and fall time are defined between V_{IH} and V_{IL} .
 - 8) Measured using an equivalent of 100 pF and two standard TTL loads.
 - 9) t_{OFF} (max) is defined as the time until output voltage can no longer be measured when output switches to a high impedance condition.
 - 10) Operation is guaranteed if either t_{RRH} or t_{RCH} is satisfied.
 - 11) These parameters are measured from the falling edge of \overline{CAS} for an early-write cycle, and from the falling edge of \overline{WE} for a read-write/read-modify-write cycle.
 - 12) t_{WCS} , t_{CWD} , t_{RWD} and t_{AWD} are not restrictive operating parameters for memory in that they specify the operating mode. If $t_{WCS} \geq t_{WCS}(\text{min})$, the cycle switches to an early-write cycle and output pins switch to high impedance throughout the cycle. If $t_{CWD} \geq t_{CWD}(\text{min})$, $t_{RWD} \geq t_{RWD}(\text{min})$ and $t_{AWD} \geq t_{AWD}(\text{min})$, the cycle switches to a read-write/read-modify-write cycle and data outputs equal information in the selected cells. If neither of the above conditions are satisfied, output pins are in an undefined state.
 - 13) $t_{RCD}(\text{max})$ does not indicate a restrictive operating parameter but instead represents the point at which the access time $t_{RAC}(\text{max})$ is guaranteed. If $t_{RCD} \geq t_{RCD}(\text{max})$, access time is determined according to t_{CAC} .
 - 14) $t_{RAD}(\text{max})$ does not indicate a restrictive operating parameter but instead represents the point at which the access time $t_{RAC}(\text{max})$ is guaranteed. If $t_{RAD} \geq t_{RAD}(\text{max})$, access time is determined according to t_{AA} .
 - 15) Operation is guaranteed if either t_{DZC} or t_{DZO} is satisfied.

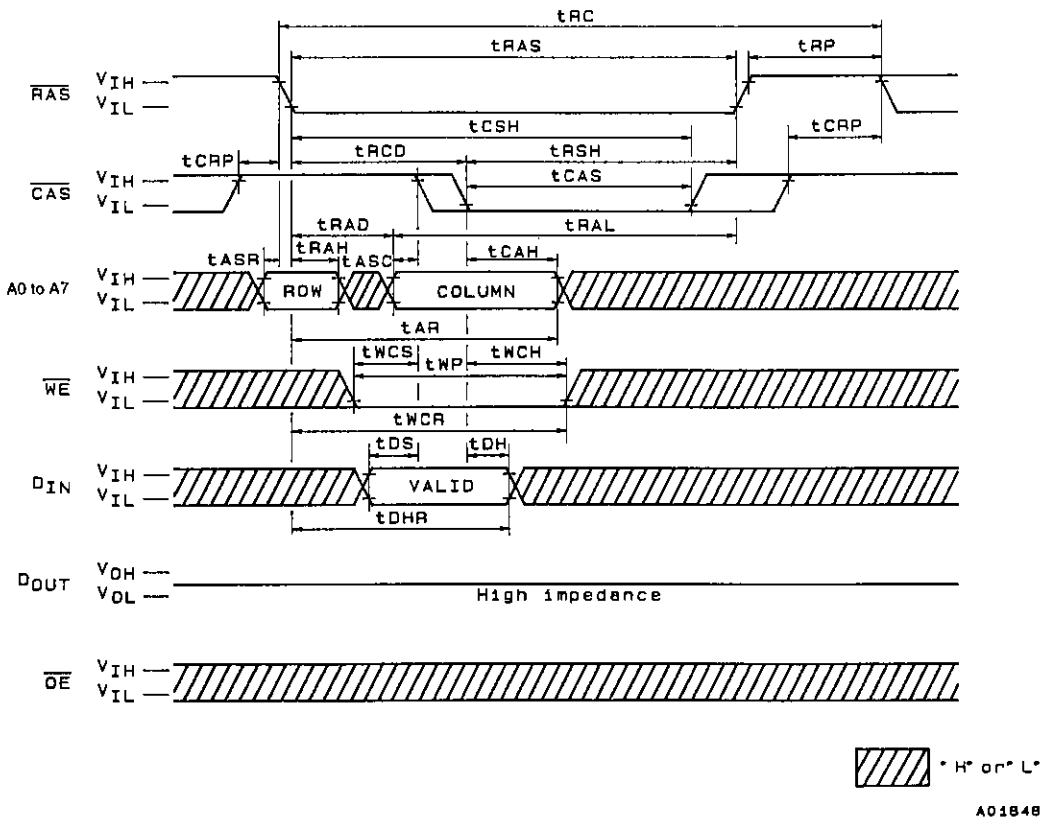
Timing Chart

Read Cycle



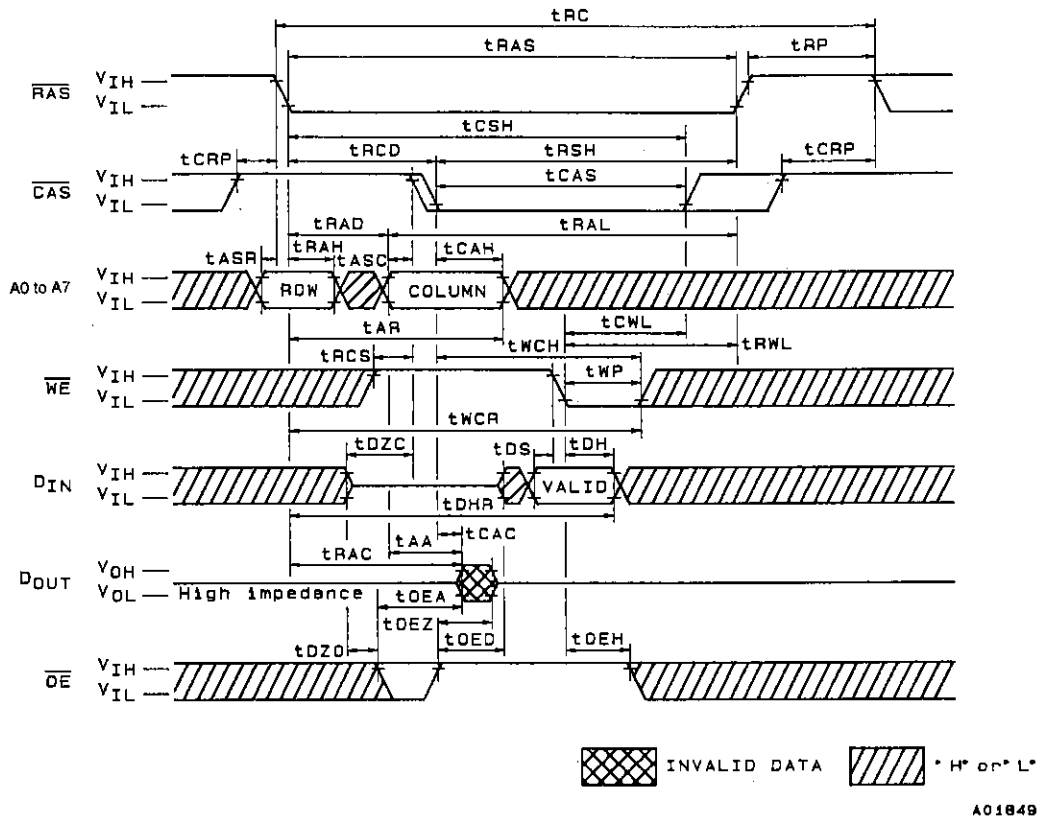
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Write Cycle (Early-write)

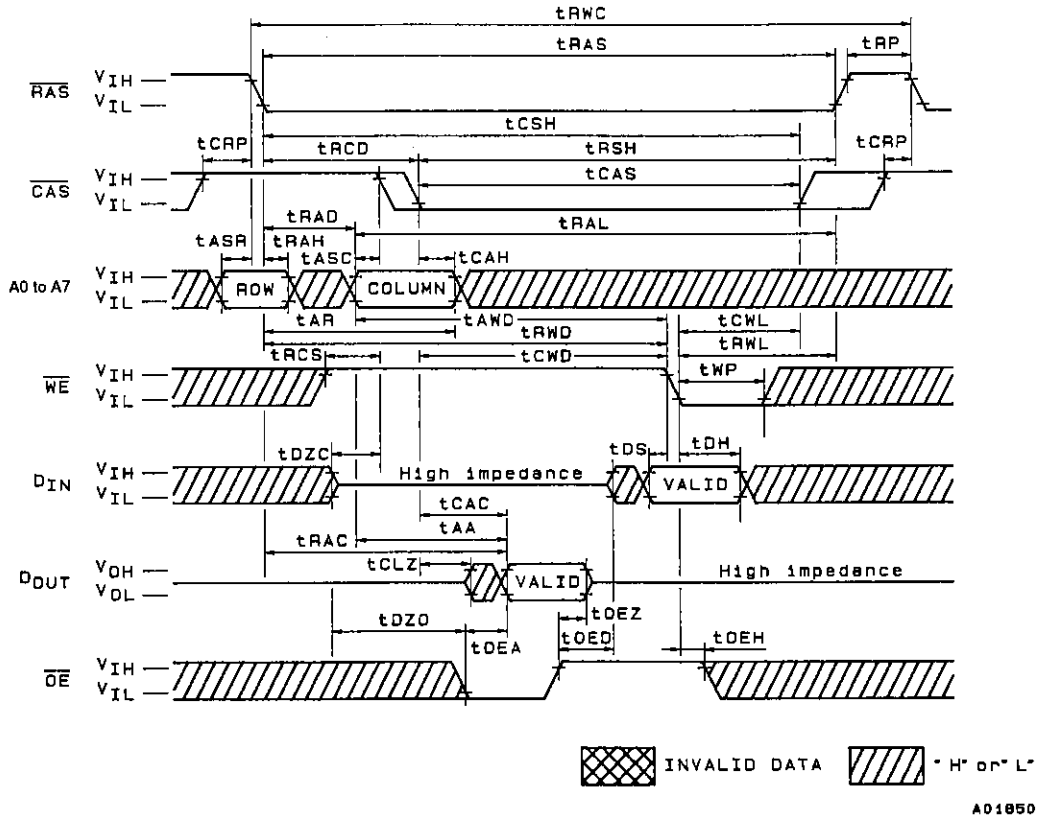


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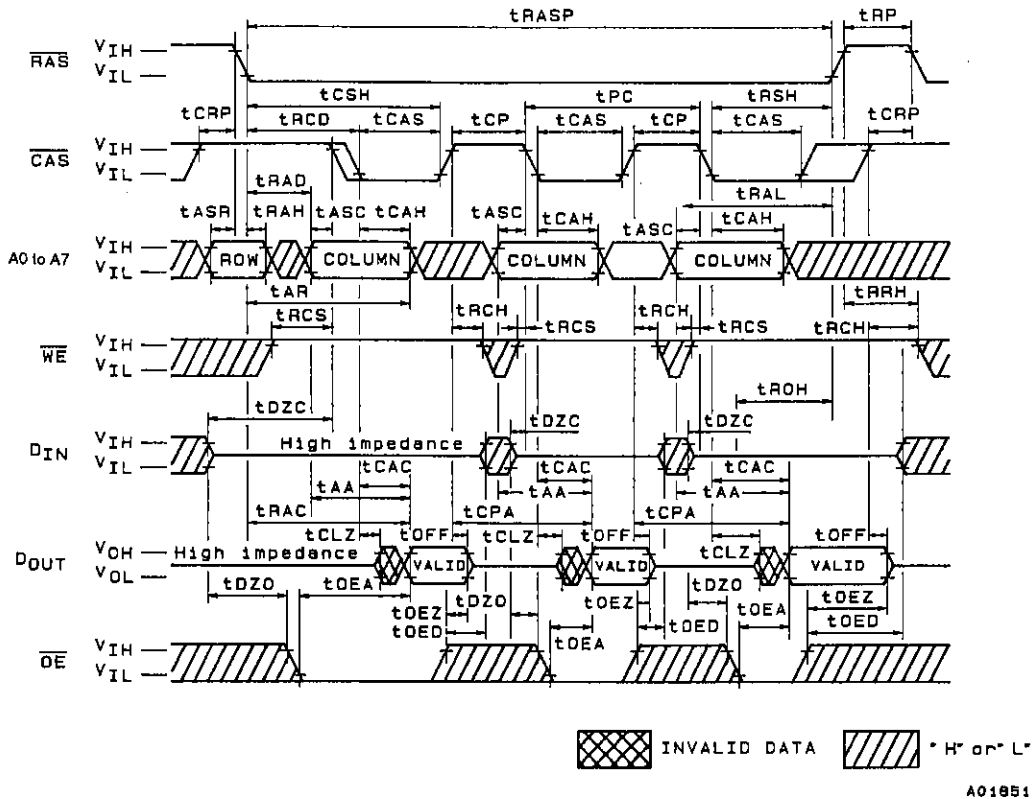
Write Cycle (\overline{OE} Control)



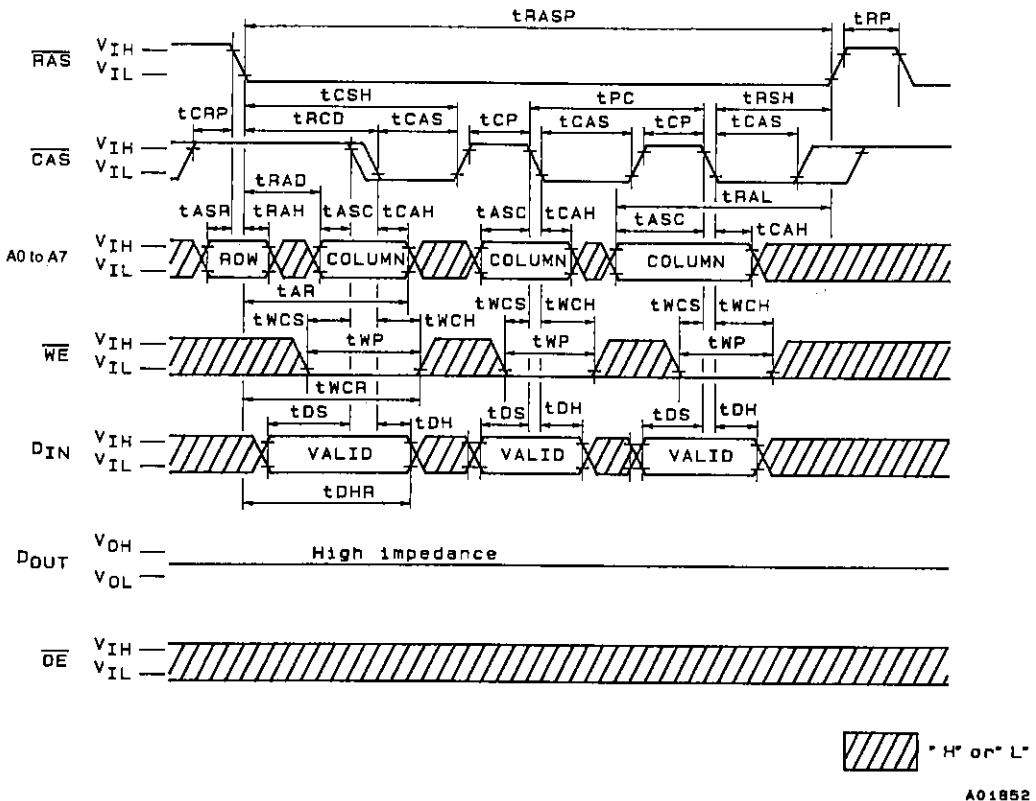
Read-Write/Read-Modify-Write Cycle



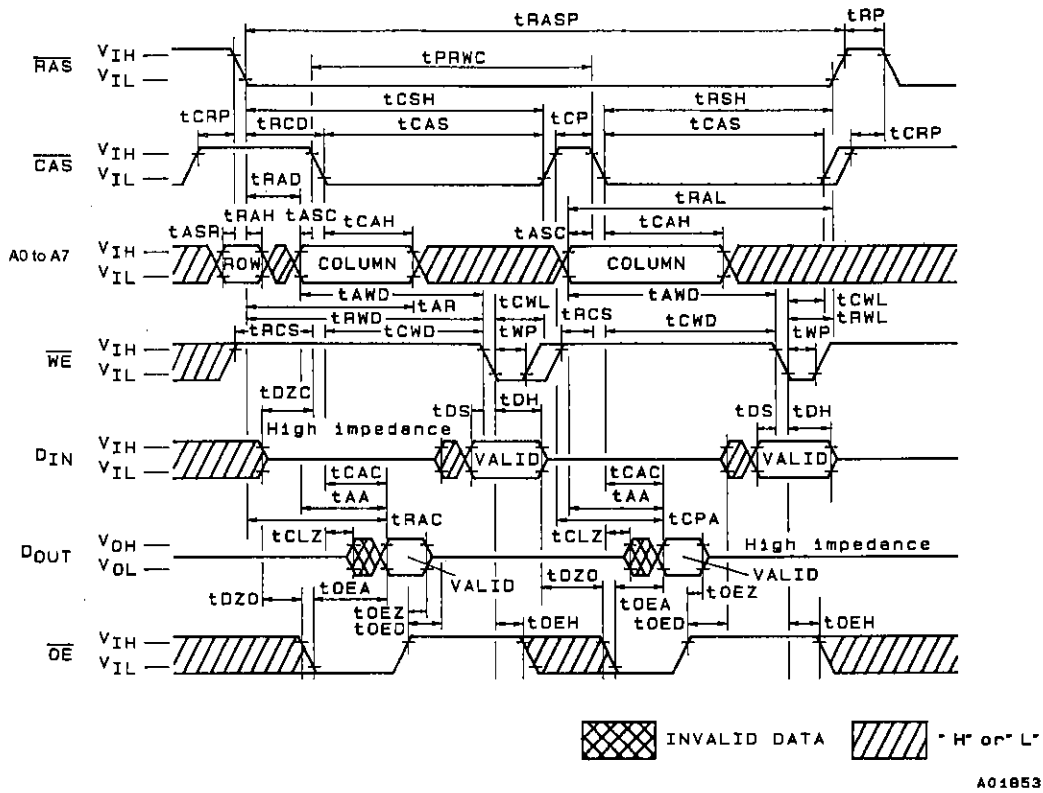
Fast Page Mode Read Cycle



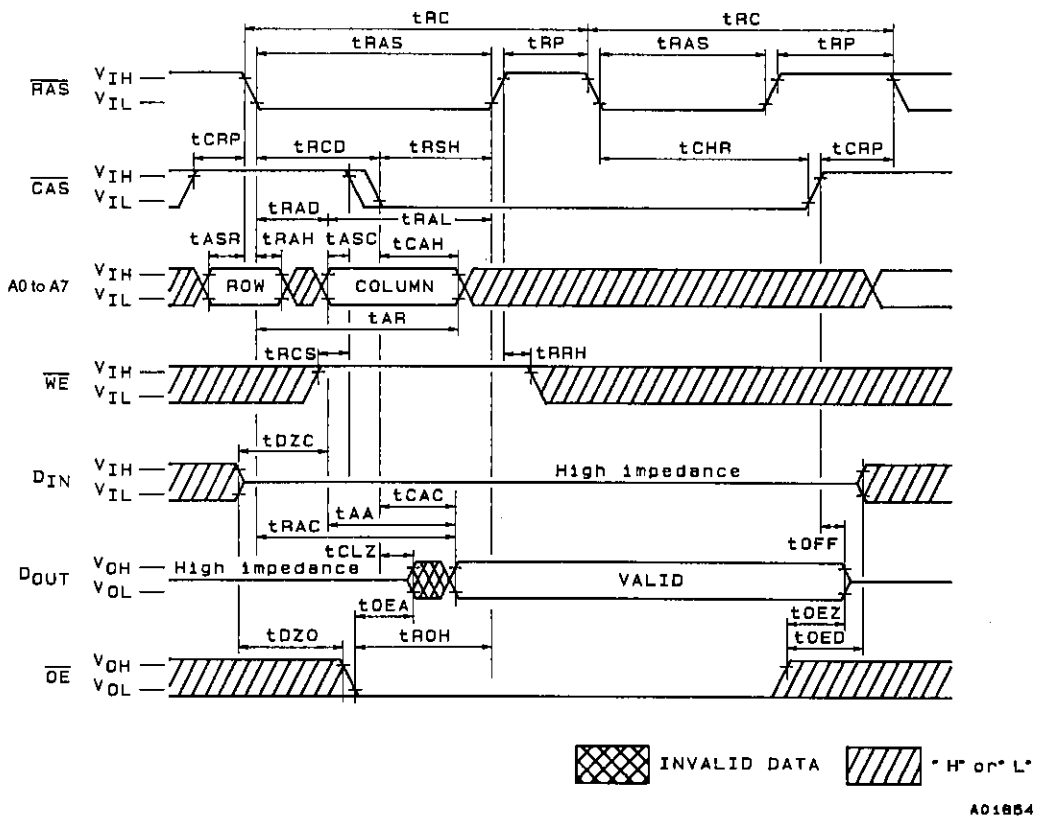
Fast Page Mode Write Cycle



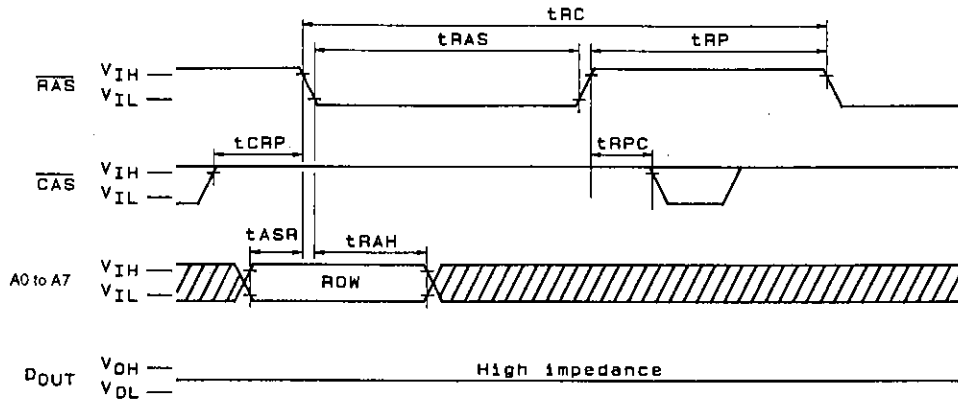
Fast Page Mode Read-Write/Read-Modify-Write Cycle




Hidden Refresh Cycle



RAS-Only Refresh Cycle

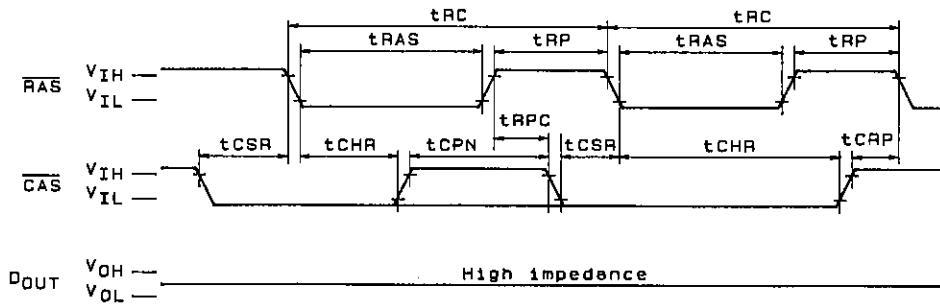


\overline{WE} , D_{IN} , \overline{OE} : "H" or "L"

 "H" or "L"

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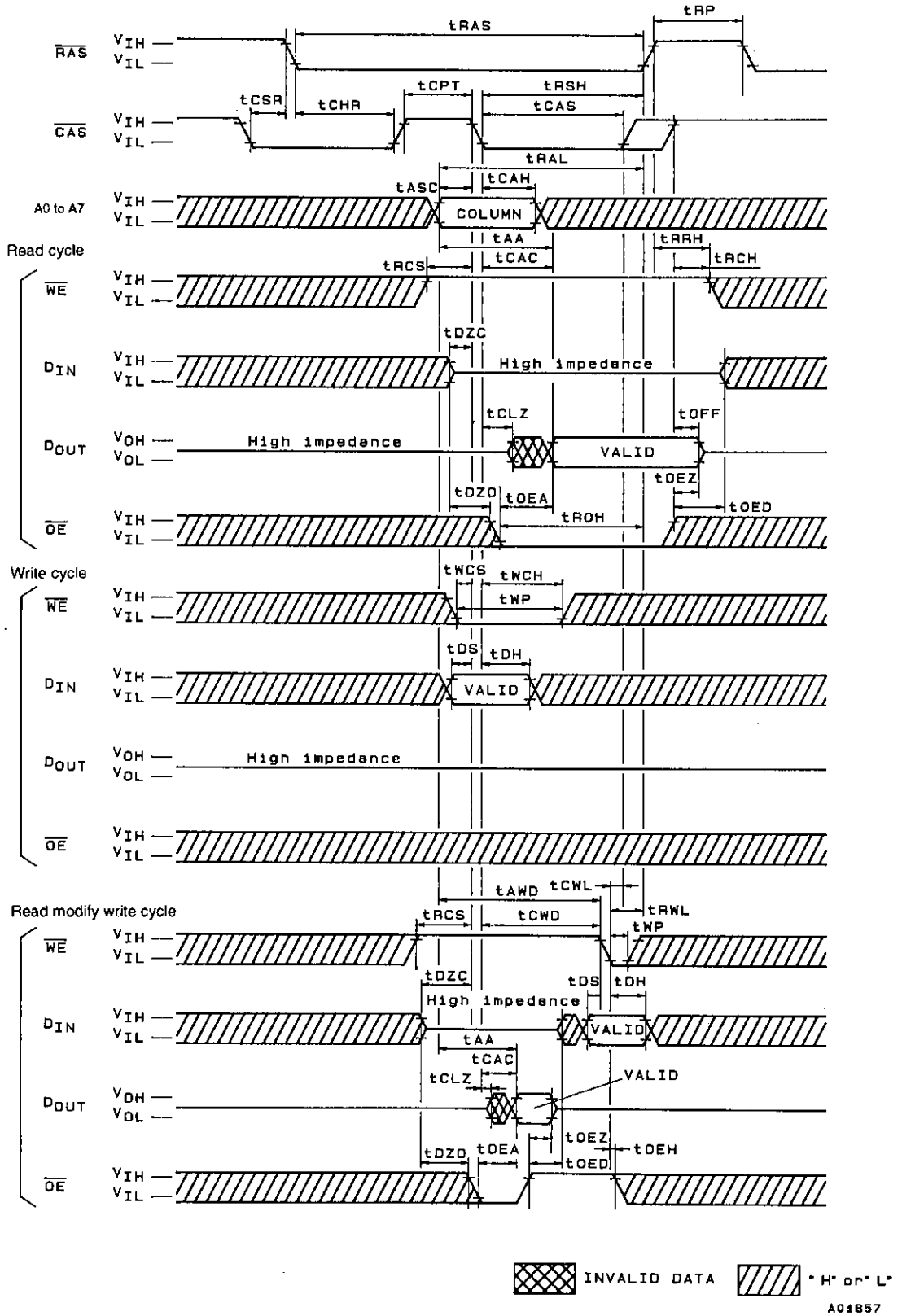
CAS-Before-RAS Refresh Cycle



A0 to A7, \overline{WE} , D_{IN} , \overline{OE} : "H" or "L"

A01856

CAS-Before-RAS Refresh Counter Test Cycle



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