Ordering number : EN4699A

CMOS LSI

SANYO

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 $\overline{CAS}$- before $\overline{RAS}$ refresh and $\overline{RAS}$-only refresh within 4 ms with 256 row address (A0 to A7) selection.

Features

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

Parameter		LC32464P, M-80
$\overline{RAS}$ 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 ($\overline{OE}$) control.
- 4 ms refresh using 256 refresh cycles.
- Supports $\overline{RAS}$-only refresh, $\overline{CAS}$-before-$\overline{RAS}$ refresh and hidden refresh.
- Packages

  DIP 18-pin plastic package: LC32464P

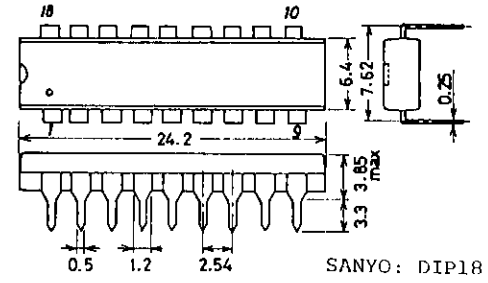
  MFP 24-pin plastic package: LC32464M

Package Dimensions

unit : mm

3007A-DIP18

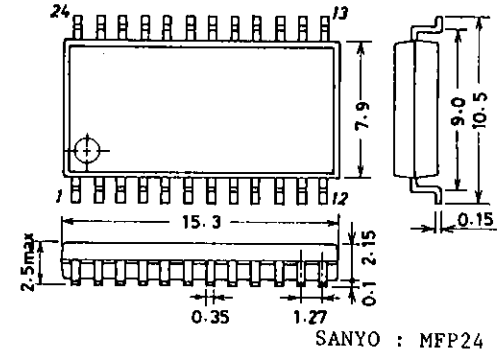
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unit : mm

3045B-MFP24

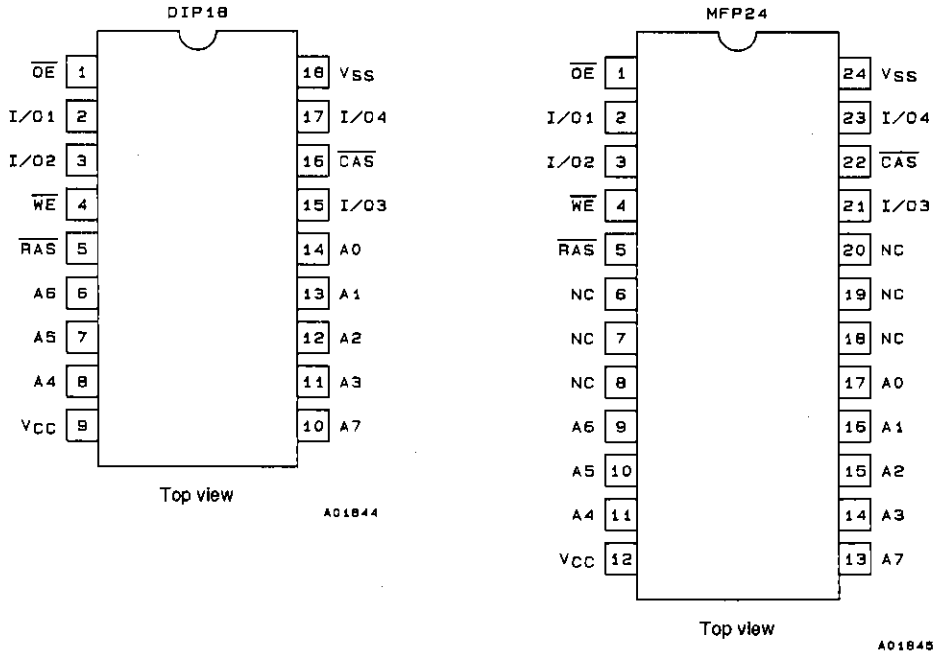
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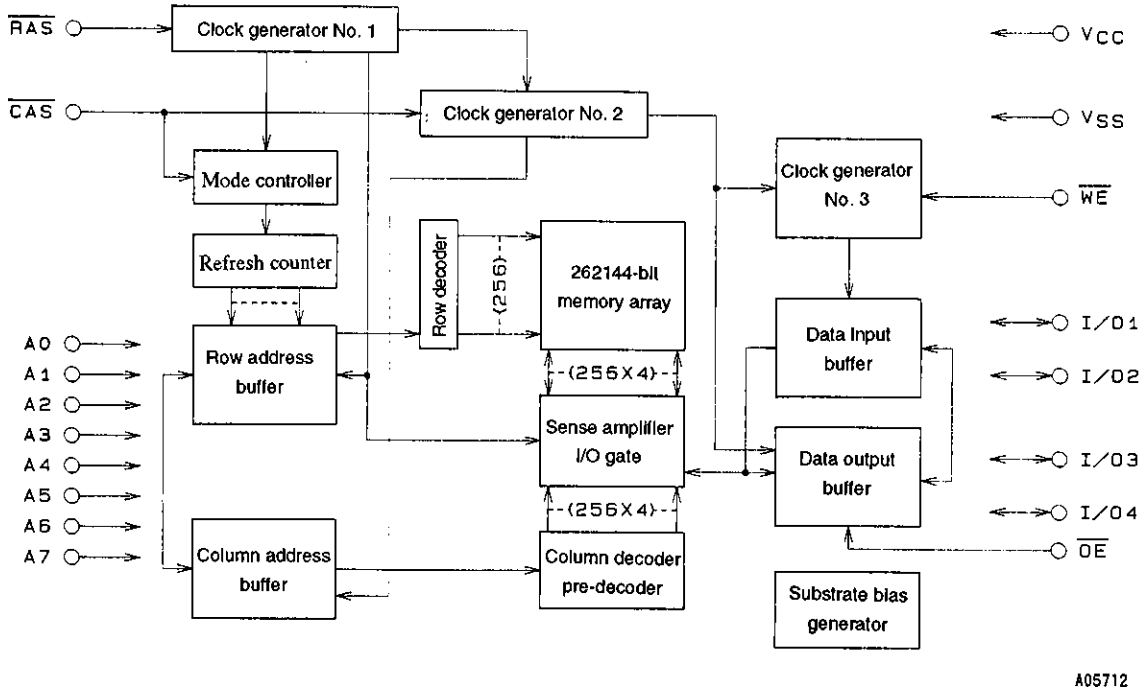
SANYO Electric Co., Ltd. Semiconductor Business Headquarters

TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO JAPAN

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	Pd max	600	mW	1
Output short-circuit current	I_{OUT}	50	mA	1
Operating temperature range	Topr	0 to +70	°C	1
Storage temperature range	Tstg	−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 Ta = 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 μF should be connected between the device V_{CC} and V_{SS} pins.

DC Electrical Characteristics at Ta = 0 to +70°C, V_{CC} = 5 V ± 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}	$\overline{RAS} = \overline{CAS} = V_{CC} - 0.2$ 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 V ≤ V_{IN} ≤ 6.5 V, pins other than measuring pin = 0 V	−10	+10	μA	
Output leakage current	I_{OL}	D_{OUT} disable, 0 V ≤ V_{OUT} ≤ 5.5 V	−10	+10	μA	
Output high level voltage	V_{OH}	I_{OUT} = −5.0 mA	2.4		V	
Output low level voltage	V_{OL}	I_{OUT} = 4.2 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 Ta = 0 to +70°C, V_{CC} = 5 V ± 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	
$\overline{RAS}$ access time	t_{RAC}		80	ns	8, 13
$\overline{CAS}$ access time	t_{CAC}		20	ns	8, 13
Column address access time	t_{AA}		40	ns	8, 14
$\overline{CAS}$ precharge access time	t_{CPA}		45	ns	8
Output low-impedance time from $\overline{CAS}$ 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
$\overline{RAS}$ precharge time	t_{RP}	70		ns	
$\overline{RAS}$ pulse width	t_{RAS}	80	10000	ns	
$\overline{RAS}$ pulse width for fast page mode only	t_{RASP}	80	100000	ns	
$\overline{RAS}$ hold time	t_{RSH}	20		ns	
$\overline{CAS}$ hold time	t_{CSH}	80		ns	
$\overline{CAS}$ pulse width	t_{CAS}	20	10000	ns	
$\overline{RAS}$ to $\overline{CAS}$ delay time	t_{RCD}	25	60	ns	13
$\overline{RAS}$ column address delay time	t_{RAD}	17	40	ns	14
$\overline{CAS}$ to $\overline{RAS}$ precharge time	t_{CRP}	10		ns	
$\overline{CAS}$ 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 $\overline{RAS}$	t_{AR}	60		ns	
Column address to $\overline{RAS}$ lead time	t_{RAL}	40		ns	
Read command setup time	t_{RCS}	0		ns	
Read command hold time referenced to $\overline{CAS}$	t_{RCH}	0		ns	10
Read command hold time referenced to $\overline{RAS}$	t_{RRH}	0		ns	10
Write command hold time	t_{WCH}	15		ns	
Write command hold time referenced to $\overline{RAS}$	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 $\overline{RAS}$ lead time	t_{RWL}	25		ns	
Write command to $\overline{CAS}$ 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 $\overline{RAS}$	t_{DHR}	60		ns	
Refresh period	t_{REF}		4	ms	
Write command setup time	t_{WCS}	0		ns	12
$\overline{CAS}$ to $\overline{WE}$ delay time	t_{CWD}	50		ns	12
$\overline{RAS}$ to $\overline{WE}$ delay time	t_{RWD}	105		ns	12
Column address to $\overline{WE}$ delay time	t_{AWD}	65		ns	12
$\overline{CAS}$ setup time for $\overline{CAS}$-before-$\overline{RAS}$ refresh	t_{CSR}	10		ns	
$\overline{CAS}$ hold time for $\overline{CAS}$-before-$\overline{RAS}$ refresh	t_{CHR}	20		ns	
$\overline{RAS}$ precharge time to $\overline{CAS}$ active time	t_{RPC}	10		ns	
$\overline{CAS}$ precharge time for $\overline{CAS}$-before-$\overline{RAS}$ counter test	t_{CPT}	40		ns	
$\overline{CAS}$ precharge time for $\overline{CAS}$-before-$\overline{RAS}$ refresh	t_{CPN}	15		ns	
$\overline{RAS}$ hold time referenced to $\overline{OE}$	t_{ROH}	20		ns	
$\overline{OE}$ access time	t_{OEA}		20	ns	
$\overline{OE}$ delay time	t_{OED}	20		ns	
$\overline{OE}$ output buffer turn-off delay time	t_{OEZ}	0	20	ns	
$\overline{OE}$ command hold time	t_{OEH}	20		ns	
Data input to $\overline{CAS}$ delay time	t_{DZC}	0		ns	15
Data input to $\overline{OE}$ delay time	t_{DZO}	0		ns	15

Input/Output Capacitance at Ta = 25°C, f = 1 MHz, V_{CC} = 5 V ± 10%

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

Notes: 5) After the power is turned on, 200 μs 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 $t_{WCS} \geq t_{WCS}$ (min), the cycle switches to an early-write cycle and output pins switch to high impedance throughout the cycle. If $t_{CWD} \geq t_{CWD}$ (min), $t_{RWD} \geq t_{RWD}$ (min) and $t_{AWD} \geq t_{AWD}$ (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.

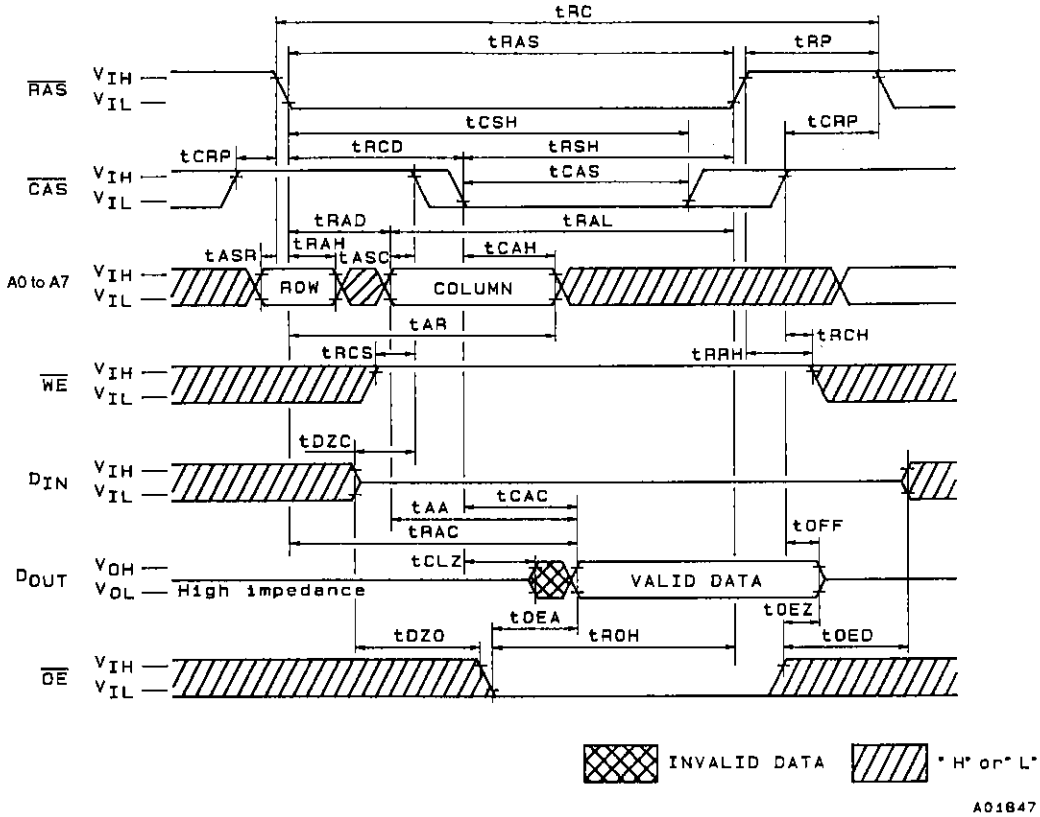
13) t_{RCD} (max) does not indicate a restrictive operating parameter but instead represents the point at which the access time t_{RAC} (max) is guaranteed. If $t_{RCD} \geq t_{RCD}$ (max), access time is determined according to t_{CAC}.

14) t_{RAD} (max) does not indicate a restrictive operating parameter but instead represents the point at which the access time t_{RAC} (max) is guaranteed. If $t_{RAD} \geq t_{RAD}$ (max), access time is determined according to t_{AA}.

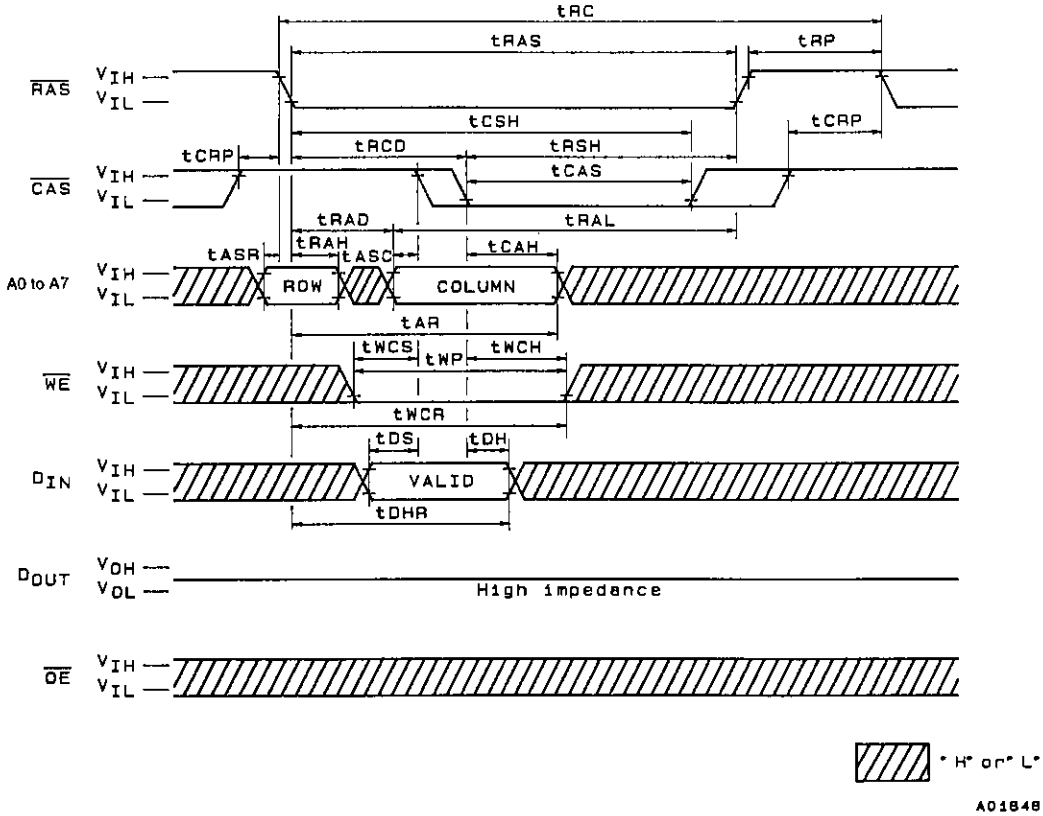
15) Operation is guaranteed if either t_{DZC} or t_{DZO} is satisfied.

Timing Chart

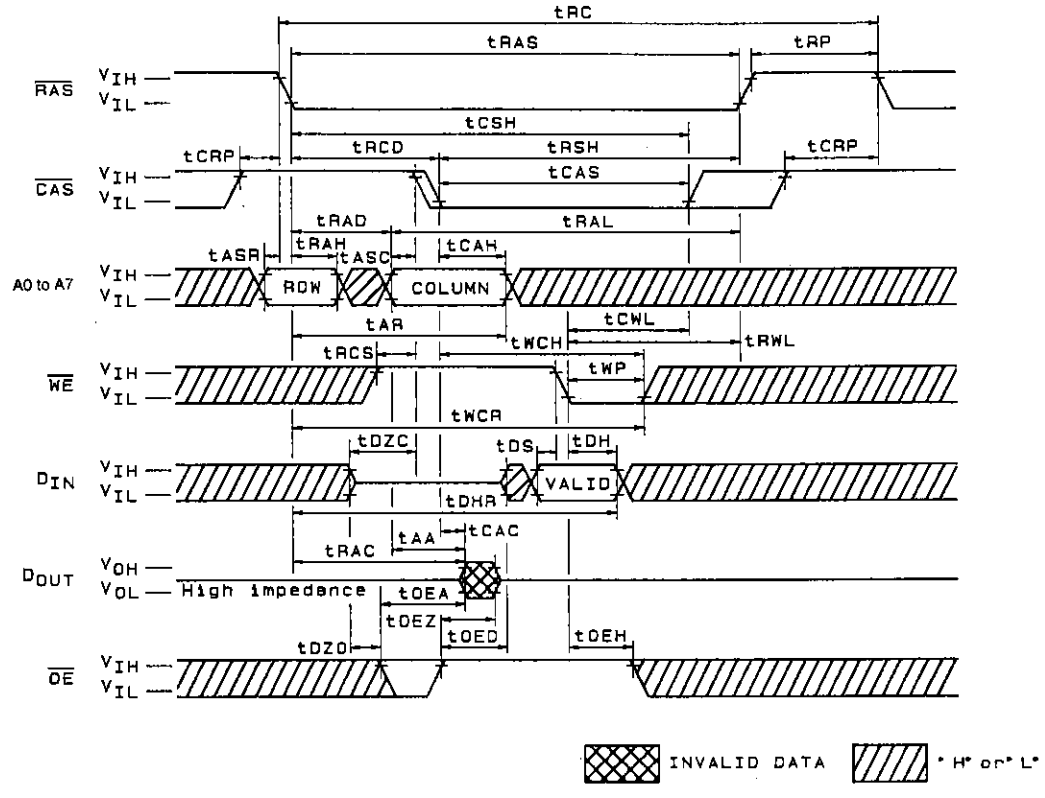
Read Cycle



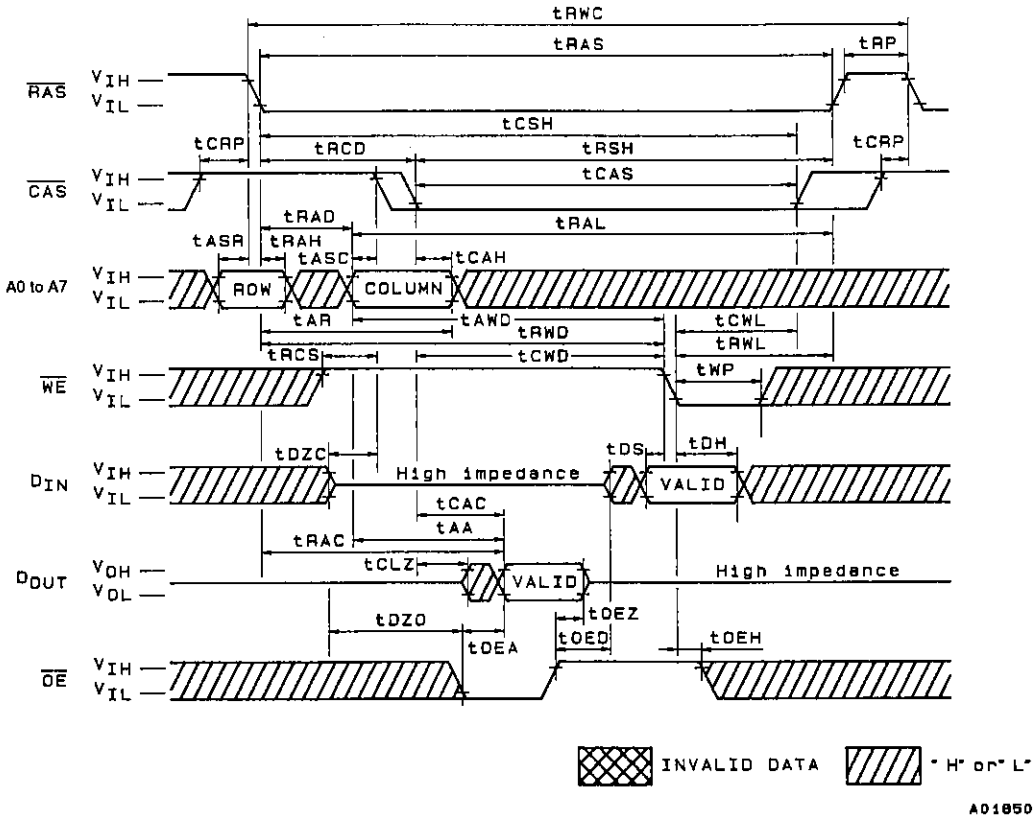
Write Cycle (Early-write)



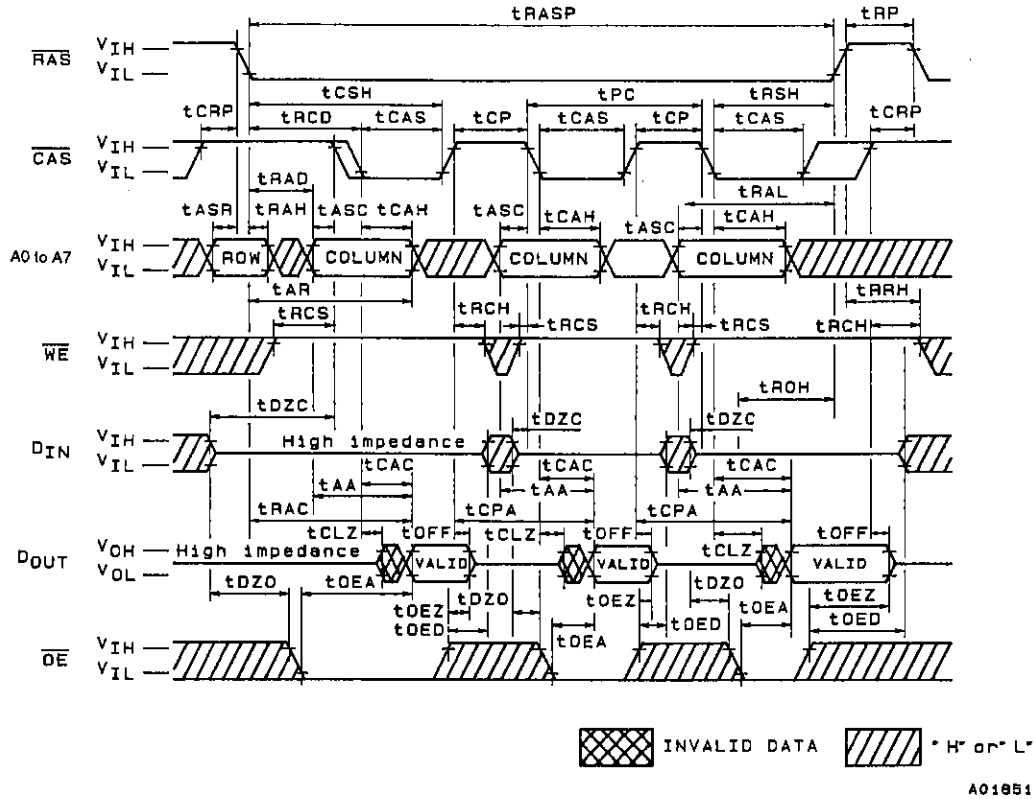
Write Cycle ($\overline{OE}$ Control)



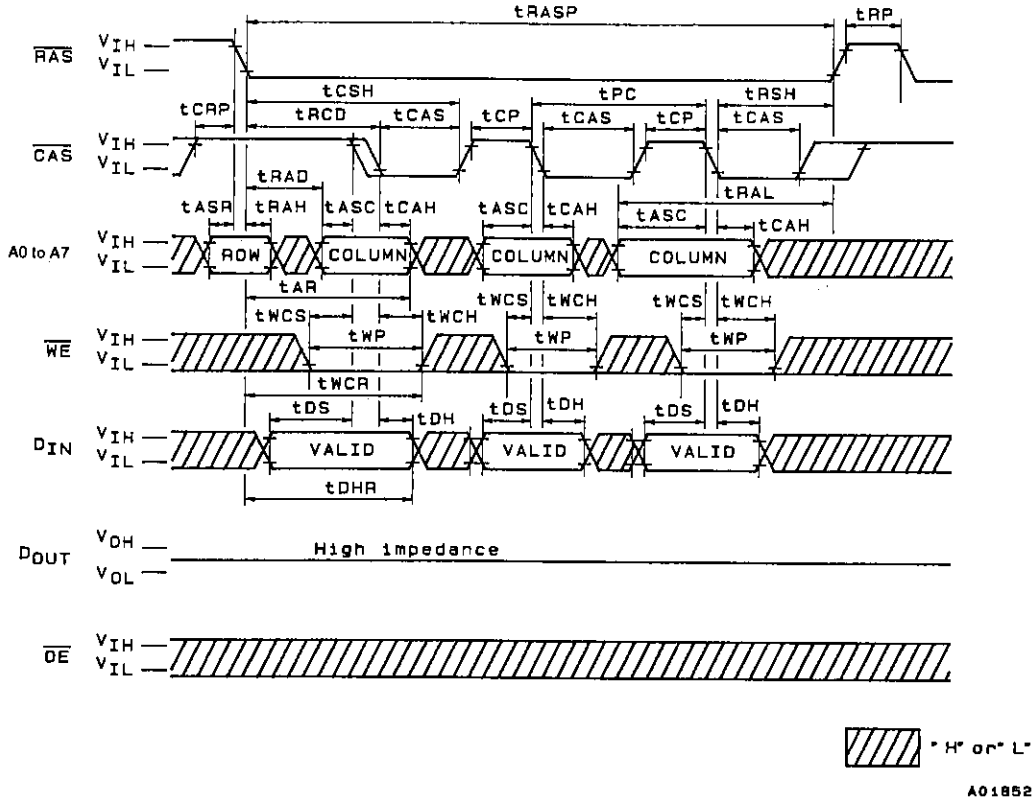
Read-Write/Read-Modify-Write Cycle



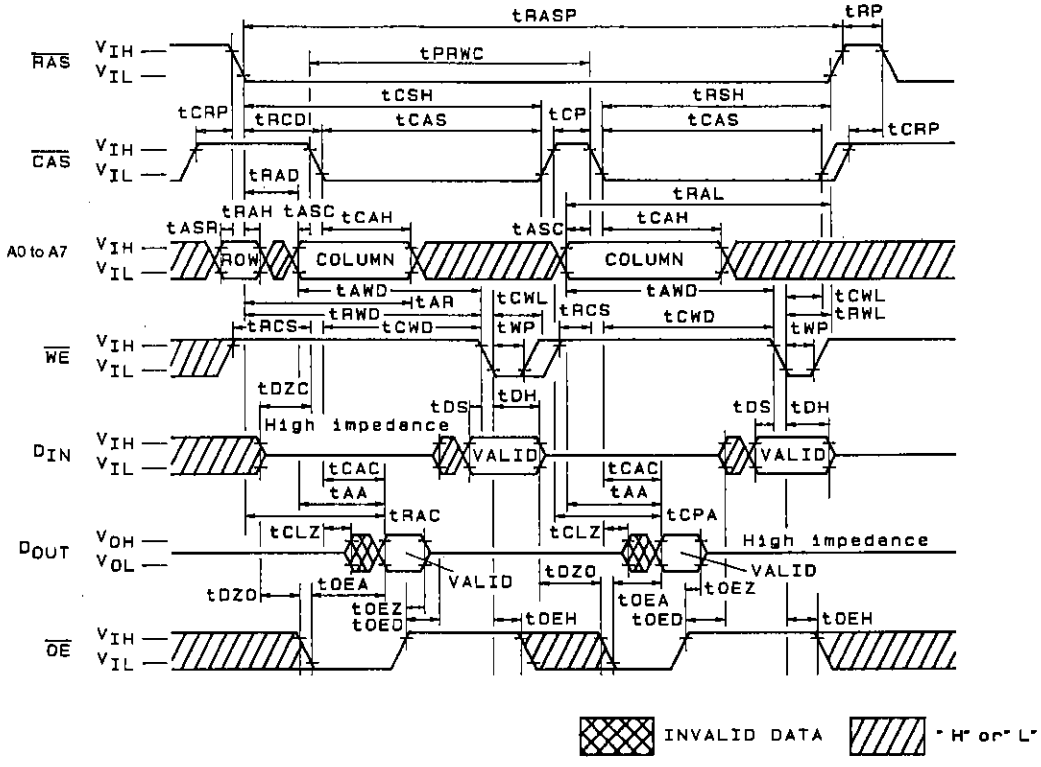
Fast Page Mode Read Cycle



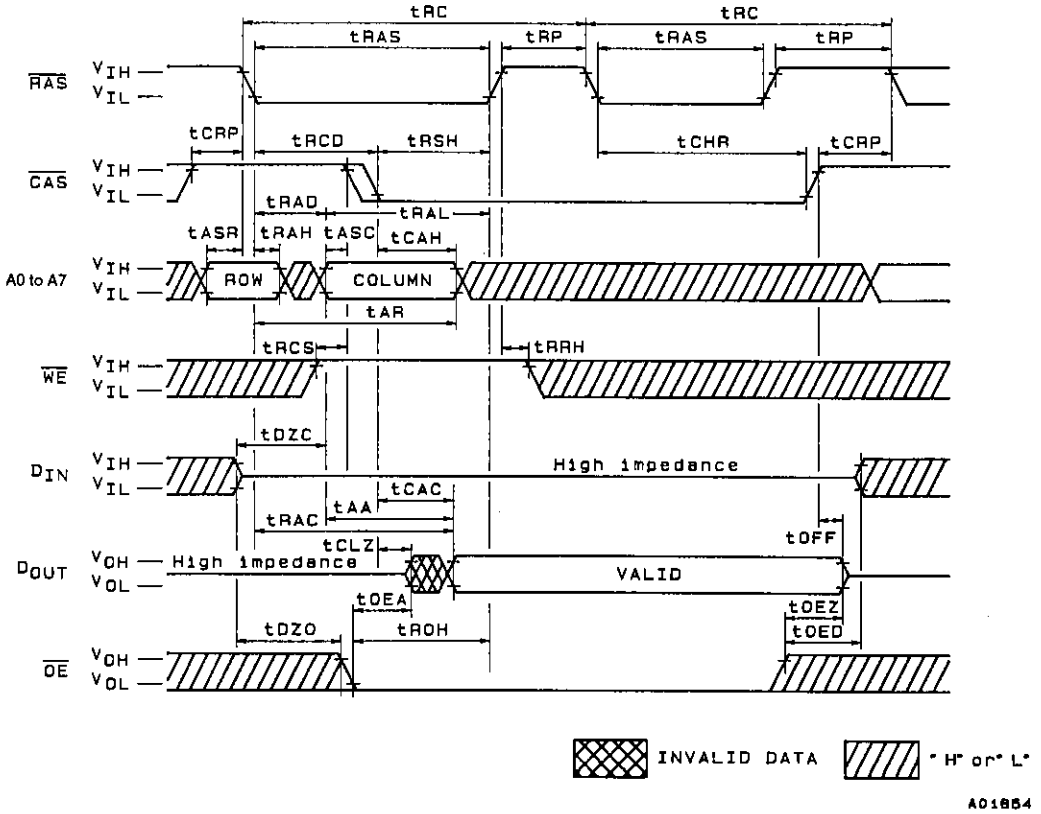
Fast Page Mode Write Cycle



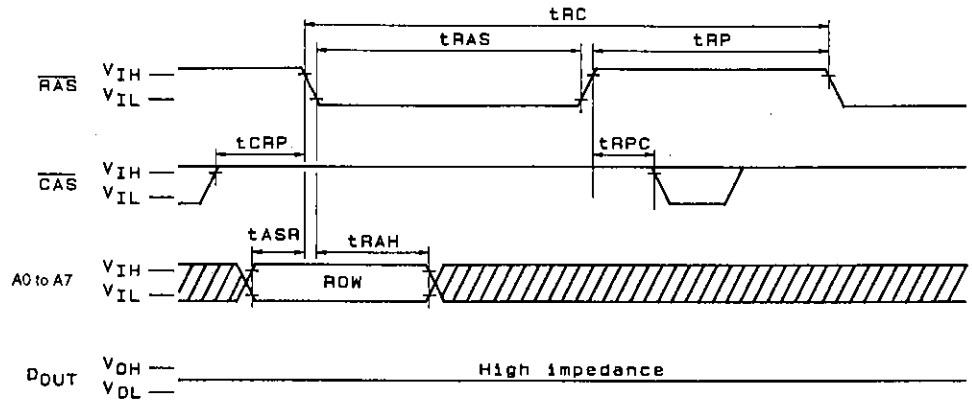
Fast Page Mode Read-Write/Read-Modify-Write Cycle



Hidden Refresh Cycle



$\overline{RAS}$-Only Refresh Cycle

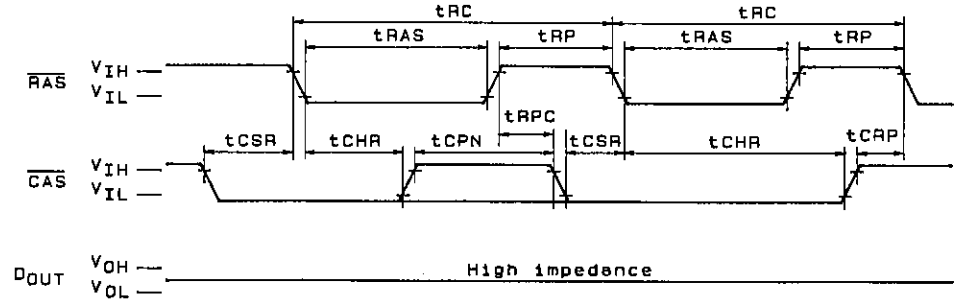


$\overline{WE}$, D_{IN}, $\overline{OE}$: "H" or "L"

: "H" or "L"

A01855

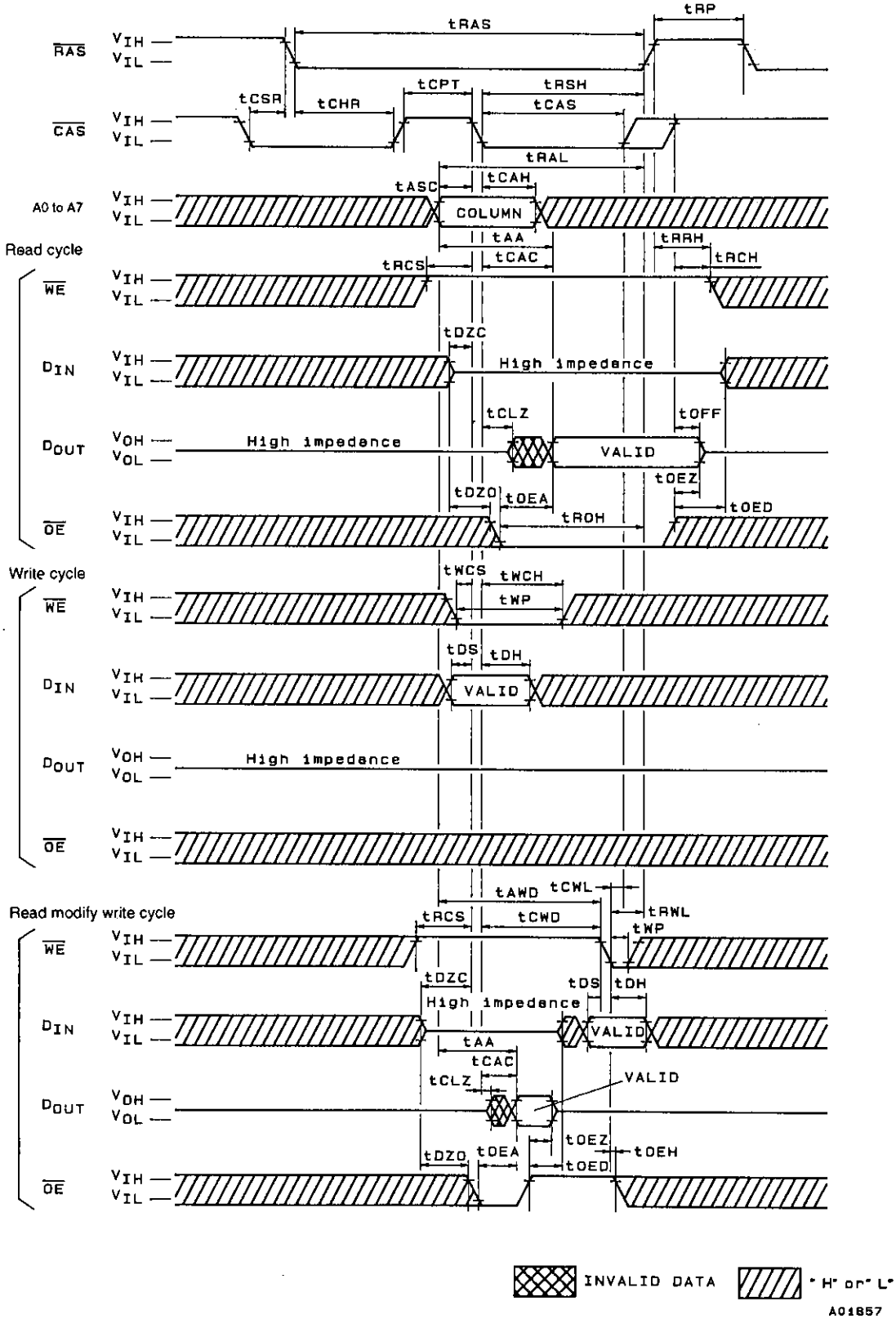
$\overline{CAS}$-Before-$\overline{RAS}$ Refresh Cycle



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

A01856

$\overline{\text{CAS}}$-Before-$\overline{\text{RAS}}$ Refresh Counter Test Cycle



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