

SANYO

No. ※5083

LC321667BJ, BM, BT-70/80**1 MEG (65536 words × 16 bits) DRAM
EDO Page Mode, Byte Write**

Preliminary

Overview

The LC321667B series is a CMOS dynamic RAM operating on a single 5 V power source and having a 65536 words × 16 bits configuration. Equipped with large capacity capabilities, high speed transfer rates and low power dissipation, this series is suited for a wide variety of applications ranging from computer main memory and expansion memory to commercial equipment.

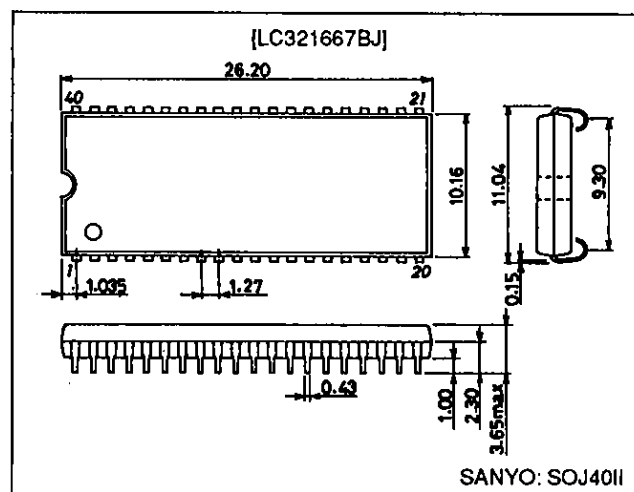
Address input utilizes a multiplexed address bus which permits it to be enclosed in a compact plastic package of 40-pin SOJ. Refresh rates are within 4 ms with 256 row address (A0 to A7) selection and support Row Address Strobe ($\overline{\text{RAS}}$)-only refresh, Column Address Strobe ($\overline{\text{CAS}}$)-before- $\overline{\text{RAS}}$ refresh and hidden refresh settings. There are functions such as Extended Data Out (EDO) page mode, read-modify-write and byte write.

Features

- 65536 words × 16 bits configuration.
- Single 5 V ± 10% power supply.
- All input and output (I/O) TTL compatible.
- Supports EDO page mode, read-modify-write and byte write.
- Supports output buffer 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
 - SOJ 40-pin plastic package (400 mil): LC321667BJ
 - SOP 40-pin plastic package (525 mil): LC321667BM
 - TSOP 44-pin plastic package (400 mil): LC321667BT
- $\overline{\text{RAS}}$ access time/column address access time/ $\overline{\text{CAS}}$ access time/cycle time/power dissipation.

Package Dimensions

unit: mm

3200-SOJ40II

Parameter		LC321667BJ, BM, BT-70	LC321667BJ, BM, BT-80
$\overline{\text{RAS}}$ access time		70 ns	80 ns
Column address access time		40 ns	45 ns
$\overline{\text{CAS}}$ access time		25 ns	25 ns
Cycle time		125 ns	135 ns
Power dissipation (max)	During operation	688 mW	633 mW
	During standby	5.5 mW (CMOS level)/11 mW (TTL level)	

SANYO Electric Co., Ltd. Semiconductor Business Headquarters

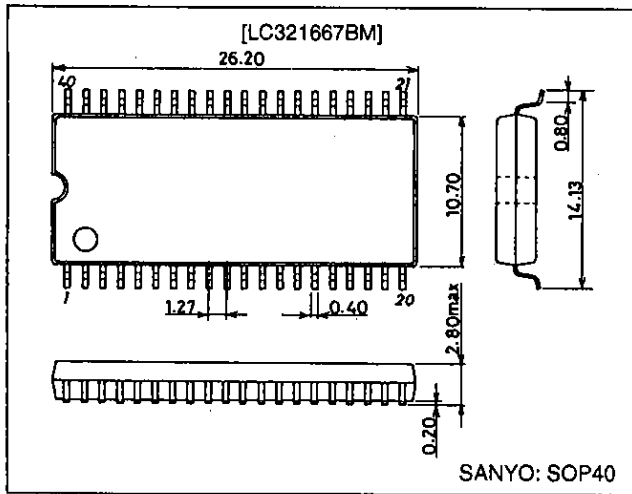
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

LC321667BJ, BM, BT-70/80

Package Dimensions

unit: mm

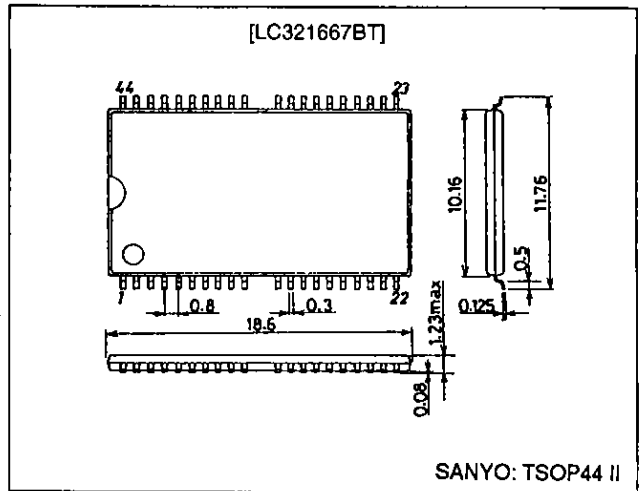
3195-SOP40



Package Dimensions

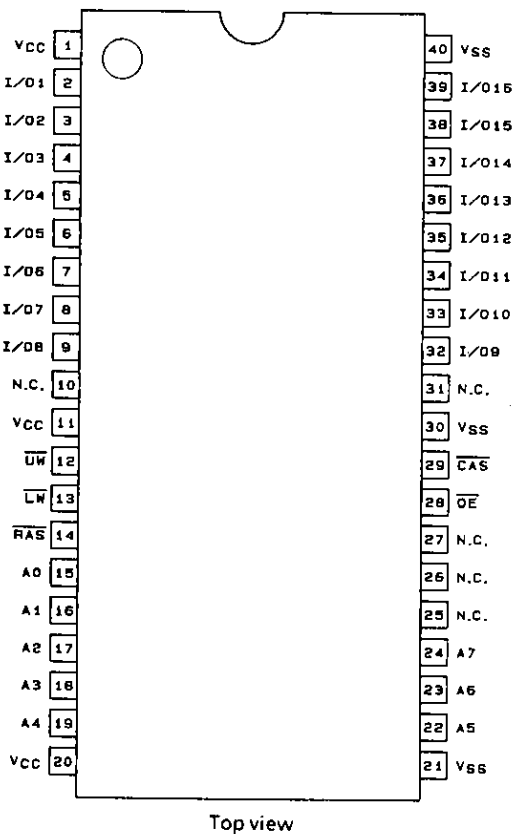
unit: mm

3207-TSOP44 II



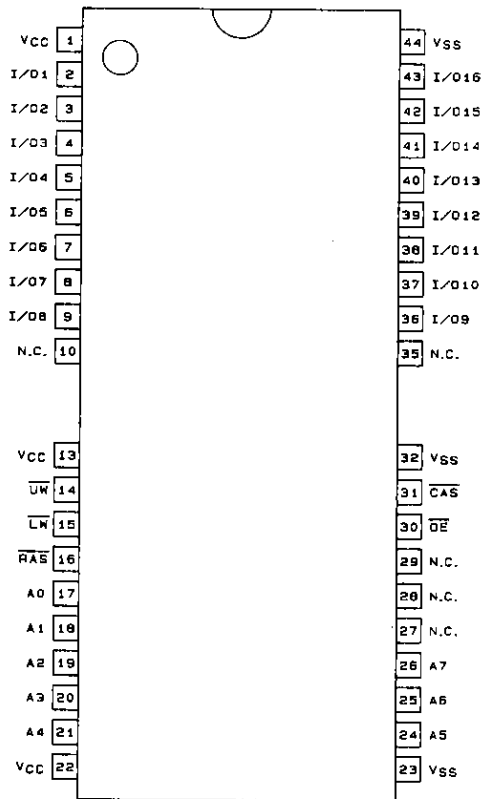
Pin Assignments

SOJ40, SOP40



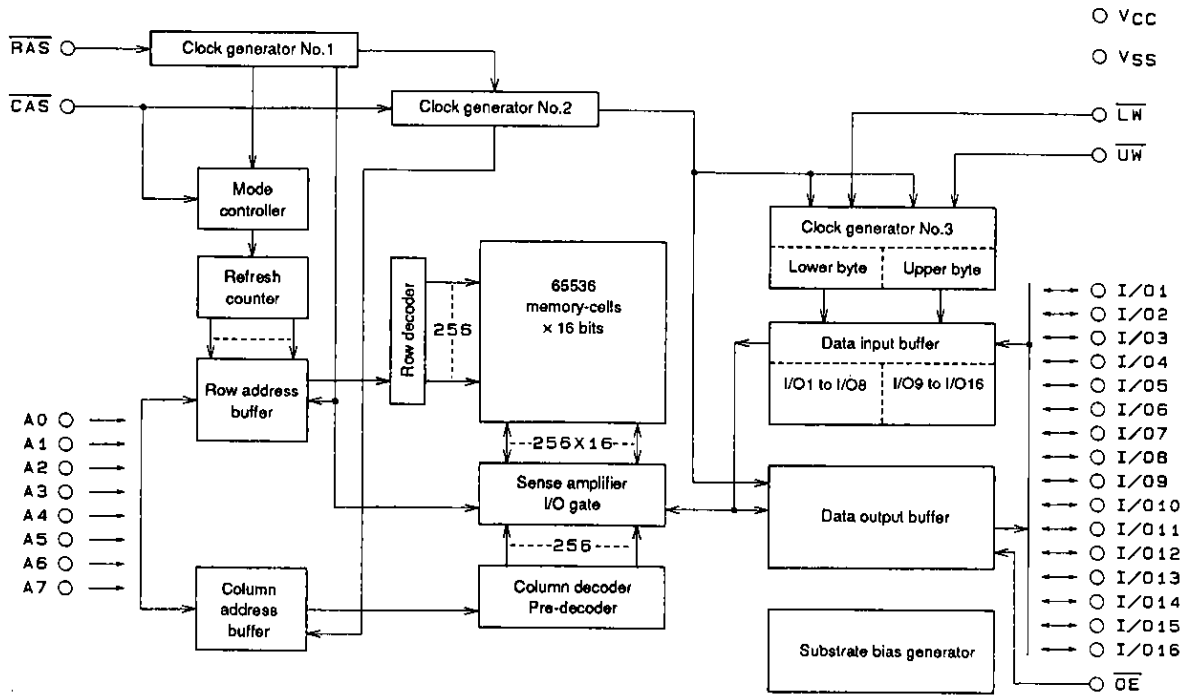
A02123

TSOP44



A02943

Block Diagram



A02125

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
Operating temperature range	T_{opr}	0 to +70	°C	1
Storage temperature range	T_{stg}	-55 to +150	°C	1
Allowable power dissipation	LC321667BJ, BM-70/80	800	mW	1
	LC321667BT-70/80	700		
Output short-circuit current	I_{OUT}	50	mA	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 (A0 to A7, RAS, CAS, UW, LW, OE)	V_{IL}	-1.0*1		+0.8	V	2
Input low level voltage (I/O1 to I/O16)	V_{IL}	-0.5*1		+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 V_{CC} and V_{SS} of the device.

*1: -2.0 V when pulse width is less than 20 ns.

LC321667BJ, BM, BT-70/80

DC Electrical Characteristics at Ta = 0 to +70°C, VCC = 5 V ± 10%

Parameter	Symbol	Conditions	LC321667 BJ, BM, BT-70		LC321667 BJ, BM, BT-80		Unit	Note
			min	max	min	max		
Operating current (Average current during operation)	ICC1	RAS, CAS, address cycling: tRC = tRC min		125		115	mA	3, 4, 5
Standby current	ICC2	RAS = CAS = VIH		2		2	mA	
RAS-only refresh current	ICC3	RAS cycling, CAS = VIH: tRC = tRC min		125		115	mA	3, 5
EDO page mode current	ICC4	RAS = VIL, CAS, address cycling: tPC = tPC min		110		100	mA	3, 4, 5
Standby current	ICC5	RAS = CAS = VCC - 0.2 V		1		1	mA	
CAS-before-RAS refresh current	ICC6	RAS, CAS cycling: tRC = tRC min		125		115	mA	3
Input leakage current	IIL	0 V ≤ VIN ≤ 6.5 V, pins other than test pin = 0 V	-10	+10	-10	+10	µA	
Output leakage current	IOL	DOOUT disable, 0 V ≤ VOUT ≤ 5.5 V	-10	+10	-10	+10	µA	
Output high level voltage	VOH	IOUT = -2.5 mA	2.4		2.4		V	
Output low level voltage	VOL	IOUT = 2.1 mA		0.4		0.4	V	

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

4. ICC1 and ICC4 are dependent on output loads. Maximum values for ICC1 and ICC4 represent values with output open.

5. Address change is less than or equal to one time during RAS = VIL. Concerning ICC4, it is less than or equal to one time during 1 cycle (tPC).

AC Electrical Characteristics at Ta = 0 to +70°C, VCC = 5 V ± 10% (note 6, 7 and 8)

Parameter	Symbol	LC321667BJ, BM, BT-70		LC321667BJ, BM, BT-80		Unit	Note
		min	max	min	max		
Random read, write cycle time	tRC	125		135		ns	
Read-write/read-modify-write cycle time	tRWC	170		180		ns	
EDO page mode cycle time	tPC	35		40		ns	
EDO page mode read-write/read-modify-write cycle time	tPRWC	85		90		ns	
RAS access time	tRAC		70		80	ns	9, 14, 15
CAS access time	tCAC		25		25	ns	9, 14
Column address access time	tAA		40		45	ns	9, 15
CAS precharge access time	tCPA		45		50	ns	9
Output low-impedance time from CAS low	tCLZ	0		0		ns	9
Output buffer turn-off delay time	tOFF	0	20	0	20	ns	10, 17
Rise, fall time	tT	2.5	50	2.5	50	ns	
RAS precharge time	tRP	45		45		ns	
RAS pulse width	tRAS	70	10000	80	10000	ns	
RAS pulse width for EDO page mode cycle only	tRASP	70	100000	80	100000	ns	
RAS hold time	tRSH	20		25		ns	
CAS hold time	tCSH	60		70		ns	
CAS pulse width	tCAS	20	10000	25	10000	ns	
RAS to CAS delay time	tRCD	20	45	20	55	ns	14
RAS to column address delay time	tRAD	15	30	15	35	ns	15
CAS to RAS precharge time	tCRP	10		10		ns	
CAS precharge time	tCP	10		10		ns	
Row address setup time	tASR	0		0		ns	
Row address hold time	tRAH	10		10		ns	
Column address setup time	tASC	0		0		ns	
Column address hold time	tCAH	15		15		ns	
Column address hold time referenced to RAS	tAR	50		55		ns	
Column address to RAS lead time	tRAL	25		30		ns	
Read command setup time	tRCS	0		0		ns	
Read command hold time referenced to CAS	tRCH	0		0		ns	11
Read command hold time referenced to RAS	tRRH	0		0		ns	11
Write command hold time	tWCH	15		15		ns	
Write command hold time referenced to RAS	tWCR	50		55		ns	
Write command pulse width	tWP	15		15		ns	

Continued on next page.

LC321667BJ, BM, BT-70/80

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Parameter	Symbol	LC321667BJ, BM, BT-70		LC321667BJ, BM, BT-80		Unit	Note
		min	max	min	max		
Write command to $\overline{\text{RAS}}$ lead time	t_{RWL}	20		20		ns	
Write command to $\overline{\text{CAS}}$ lead time	t_{CWL}	20		20		ns	
Data input setup time	t_{DS}	0		0		ns	12
Data input hold time	t_{DH}	15		15		ns	12
Data input hold time referenced to $\overline{\text{RAS}}$	t_{DHR}	50		55		ns	
Refresh time	t_{REF}		4		4	ms	
Write command setup time	t_{WCS}	0		0		ns	13
$\overline{\text{CAS}}$ to $\overline{\text{UW}}$, $\overline{\text{LW}}$ delay time	t_{CWD}	45		45		ns	13
$\overline{\text{RAS}}$ to $\overline{\text{UW}}$, $\overline{\text{LW}}$ delay time	t_{RWD}	90		100		ns	13
Column address to $\overline{\text{UW}}$, $\overline{\text{LW}}$ delay time	t_{AWD}	60		65		ns	13
$\overline{\text{CAS}}$ precharge $\overline{\text{UW}}$, $\overline{\text{LW}}$ delay time for EDO page mode cycle only	t_{CPWD}	65		70		ns	13
$\overline{\text{CAS}}$ setup time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$	t_{CSR}	10		10		ns	
$\overline{\text{CAS}}$ hold time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$	t_{CHR}	10		10		ns	
$\overline{\text{RAS}}$ precharge $\overline{\text{CAS}}$ active time	t_{RPC}	10		10		ns	
$\overline{\text{CAS}}$ precharge time for $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ counter test	t_{CPT}	40		40		ns	
$\overline{\text{RAS}}$ hold time referenced to $\overline{\text{OE}}$	t_{ROH}	15		15		ns	
$\overline{\text{OE}}$ access time	t_{OEA}		25		25	ns	9
$\overline{\text{OE}}$ delay time	t_{OED}	15		15		ns	
$\overline{\text{OE}}$ output buffer turn-off delay time	t_{OEZ}	0	15	0	15	ns	10
$\overline{\text{OE}}$ command hold time	t_{OEH}	20		20		ns	
$\overline{\text{OE}}$ setup time to $\overline{\text{CAS}}$ high	t_{OCH}	5		5		ns	16
$\overline{\text{OE}}$ hold time from $\overline{\text{CAS}}$ high	t_{CHO}	10		10		ns	16
$\overline{\text{OE}}$ command pulse width	t_{OEP}	10		10		ns	
Data output hold time	t_{DOH}	5		5		ns	
$\overline{\text{WE}}$ output buffer turn-off delay time	t_{WEZ}	0	15	0	15	ns	
Data input to $\overline{\text{CAS}}$ delay time	t_{DZC}	0		0		ns	16
Data input to $\overline{\text{OE}}$ delay time	t_{DZO}	0		0		ns	16
Masked write setup time	t_{MCS}	0		0		ns	
Masked write hold time referenced to $\overline{\text{RAS}}$	t_{MRH}	0		0		ns	
Masked write hold time referenced to $\overline{\text{CAS}}$	t_{MCH}	0		0		ns	

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

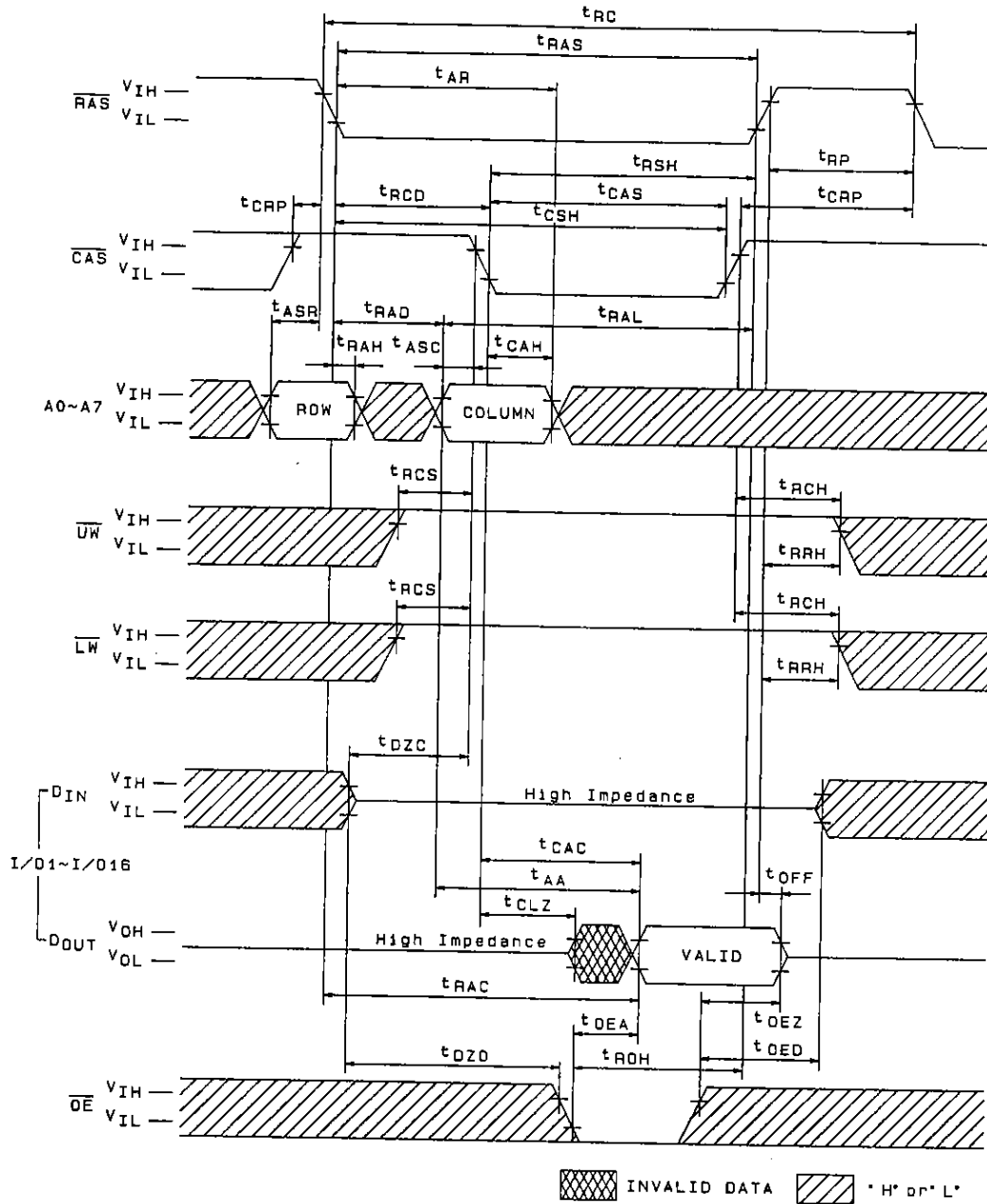
Parameter	Symbol	min	max	Unit	Note
Input capacitance (A0 to A7, $\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{UW}}$, $\overline{\text{LW}}$, $\overline{\text{OE}}$)	C_{IN}		7	pF	
Input/Output capacitance (I/O1 to I/O16)	C_{IO}		7	pF	

Note: 6. An initial pause of 200 μs is required after power-up followed by eight $\overline{\text{RAS}}$ -only refresh cycles before proper device operation is achieved. In case of using refresh counter, a minimum of eight $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh cycles instead of eight $\overline{\text{RAS}}$ -only refresh cycles are required.

7. Measured at $t_T = 2.5\text{ ns}$.
8. 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} .
9. Measured using an equivalent of 50 pF and one standard TTL loads.
10. t_{OFF} (max) and t_{OEZ} (max) are defined as the time until output voltage can no longer be measured when output switches to a high impedance condition.
11. Operation is guaranteed if either t_{RRH} or t_{RCH} is satisfied.
12. These parameters are measured from the falling edge of $\overline{\text{CAS}}$ for an early-write cycle, and from the falling edge of $\overline{\text{UW}}$ and $\overline{\text{LW}}$ for a read-write/read-modify-write cycle.
13. t_{WCS} , t_{CWD} , t_{RWD} , t_{AWD} and t_{CPWD} are not restrictive operating parameters for memory in that they specify the operating mode. If $t_{\text{WCS}} \geq t_{\text{WCS}}$ (min), the cycle switches to an early-write cycle and output pins switch to high impedance throughout the cycle. If $t_{\text{CWD}} \geq t_{\text{CWD}}$ (min), $t_{\text{RWD}} \geq t_{\text{RWD}}$ (min), $t_{\text{AWD}} \geq t_{\text{AWD}}$ (min) and $t_{\text{CPWD}} \geq t_{\text{CPWD}}$ (min) for fast page mode cycle only, the cycle switches to a read-write/read-modify-write cycle and data output equal information in the selected cells. If neither of the above timings are satisfied, output pins are in an undefined state.
14. t_{RCD} (max) is not a restrictive operating parameter but instead represents the point at which the access time t_{RAC} (max) is guaranteed. If $t_{\text{RCD}} \geq t_{\text{RCD}}$ (max), access time is determined according to t_{CAC} .
15. t_{RAD} (max) is not a restrictive operating parameter but instead represents the point at which the access time t_{RAC} (max) is guaranteed. If $t_{\text{RAD}} \geq t_{\text{RAD}}$ (max), access time is determined according to t_{AA} .
16. Operation is guaranteed if either t_{DZC} or t_{DZO} is satisfied.
17. t_{OFF} is referenced from the rising edge of $\overline{\text{RAS}}$ or $\overline{\text{CAS}}$, whichever occurs last.

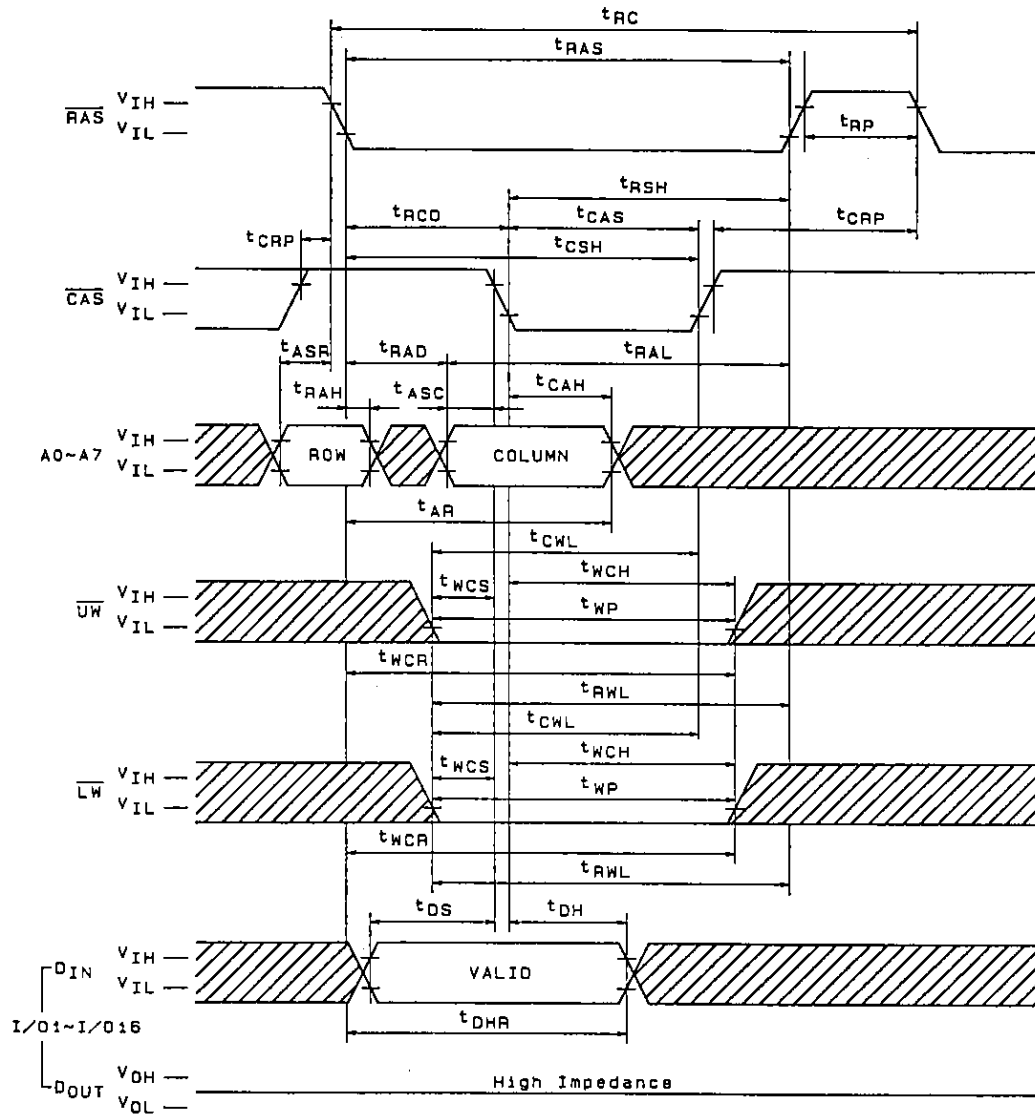
Timing Chart

Read Cycle



A03721

Early Write Cycle

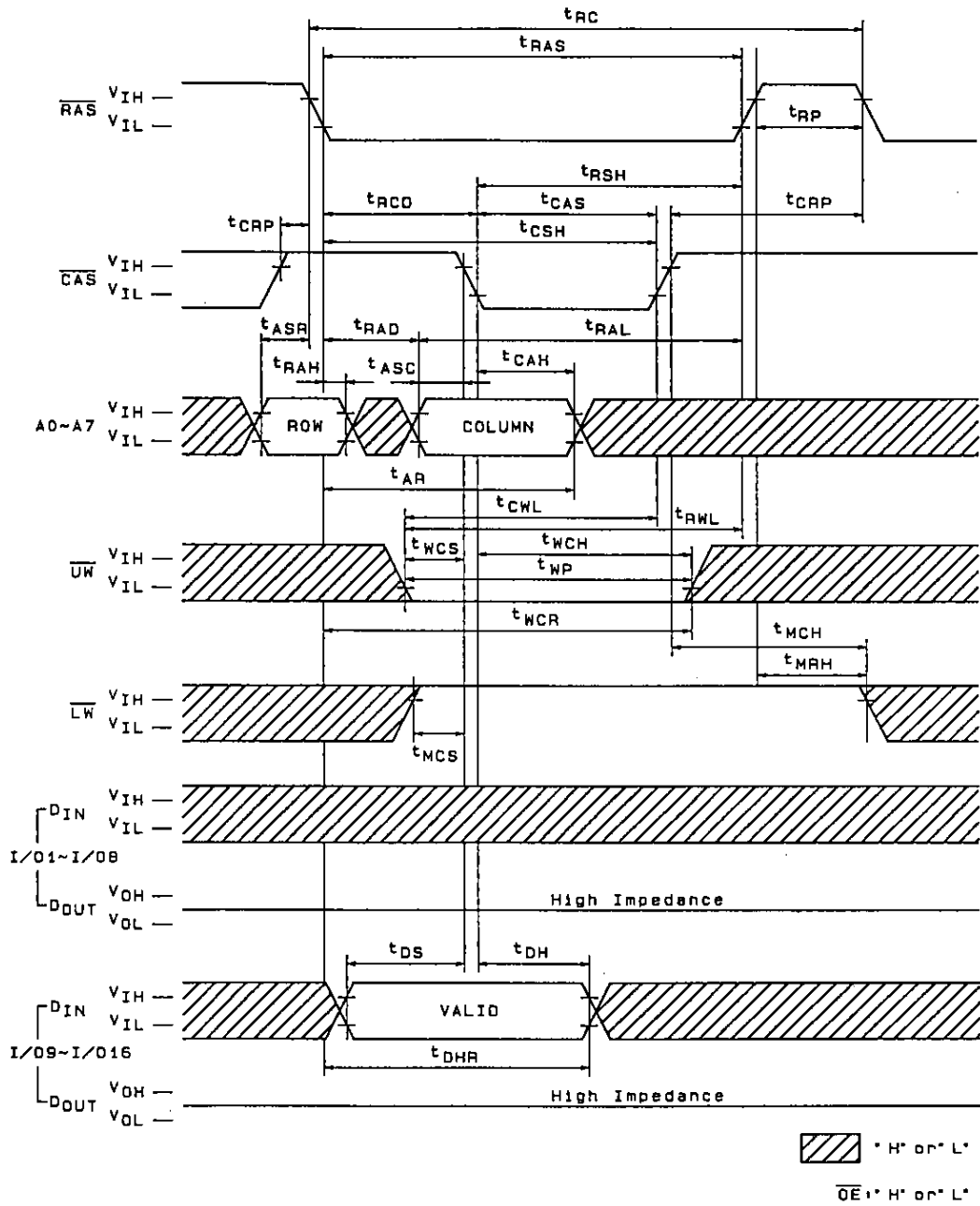


* H* or L*

\overline{OE} * H* or L*

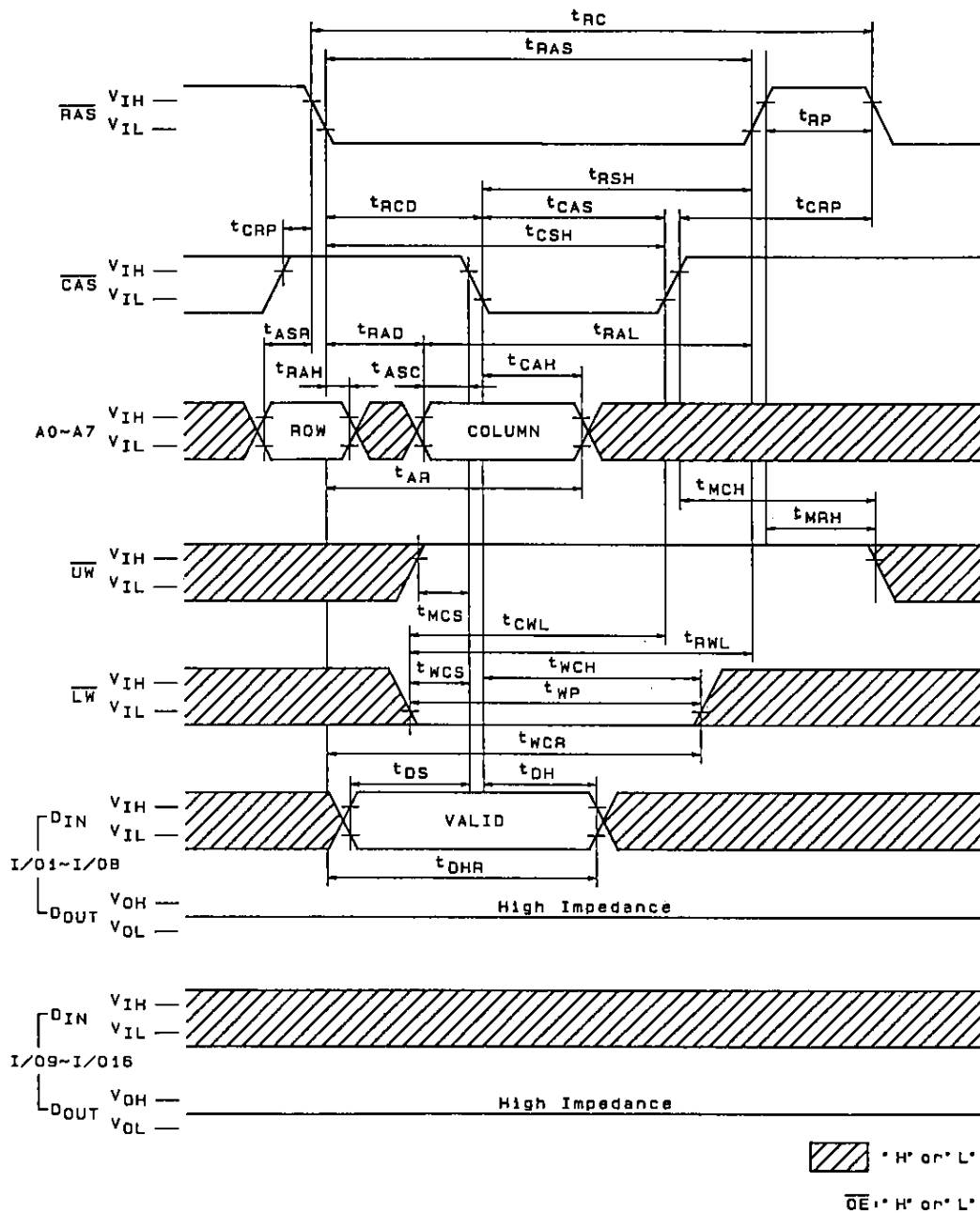
A02140

Upper Byte Early Write Cycle



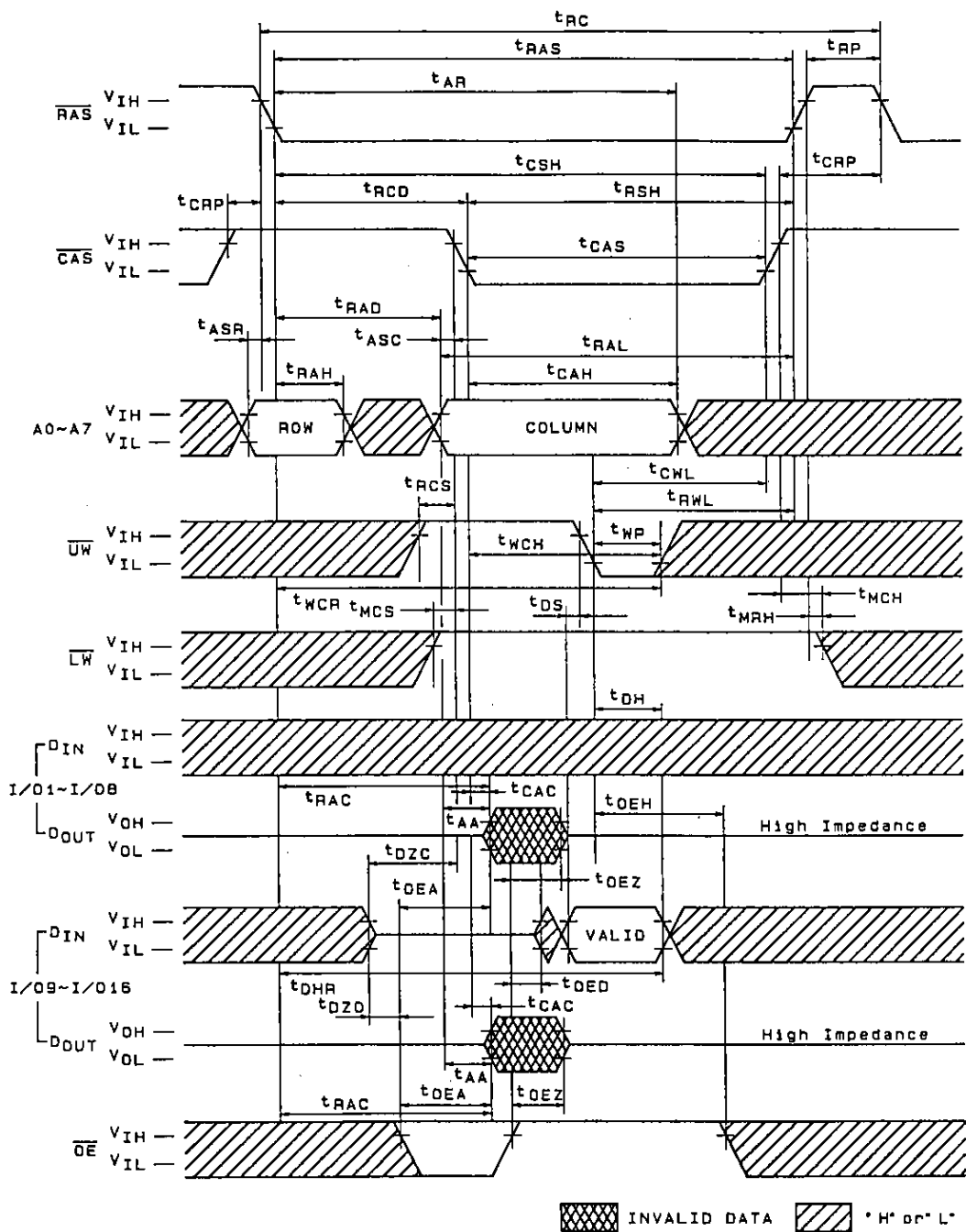
A02141

Lower Byte Early Write Cycle



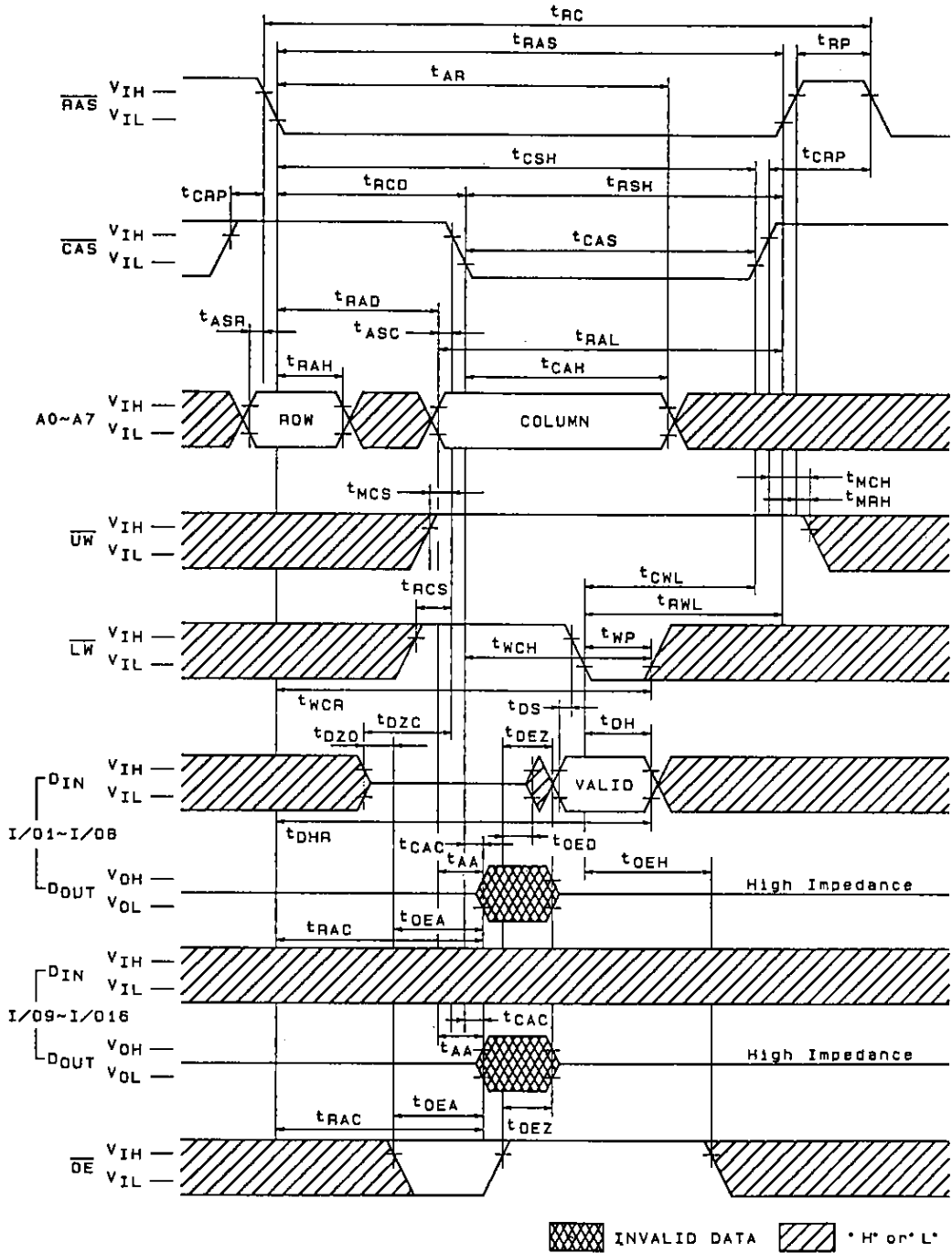
A02142

Upper Byte Write Cycle ($\overline{\text{OE}}$ Control)



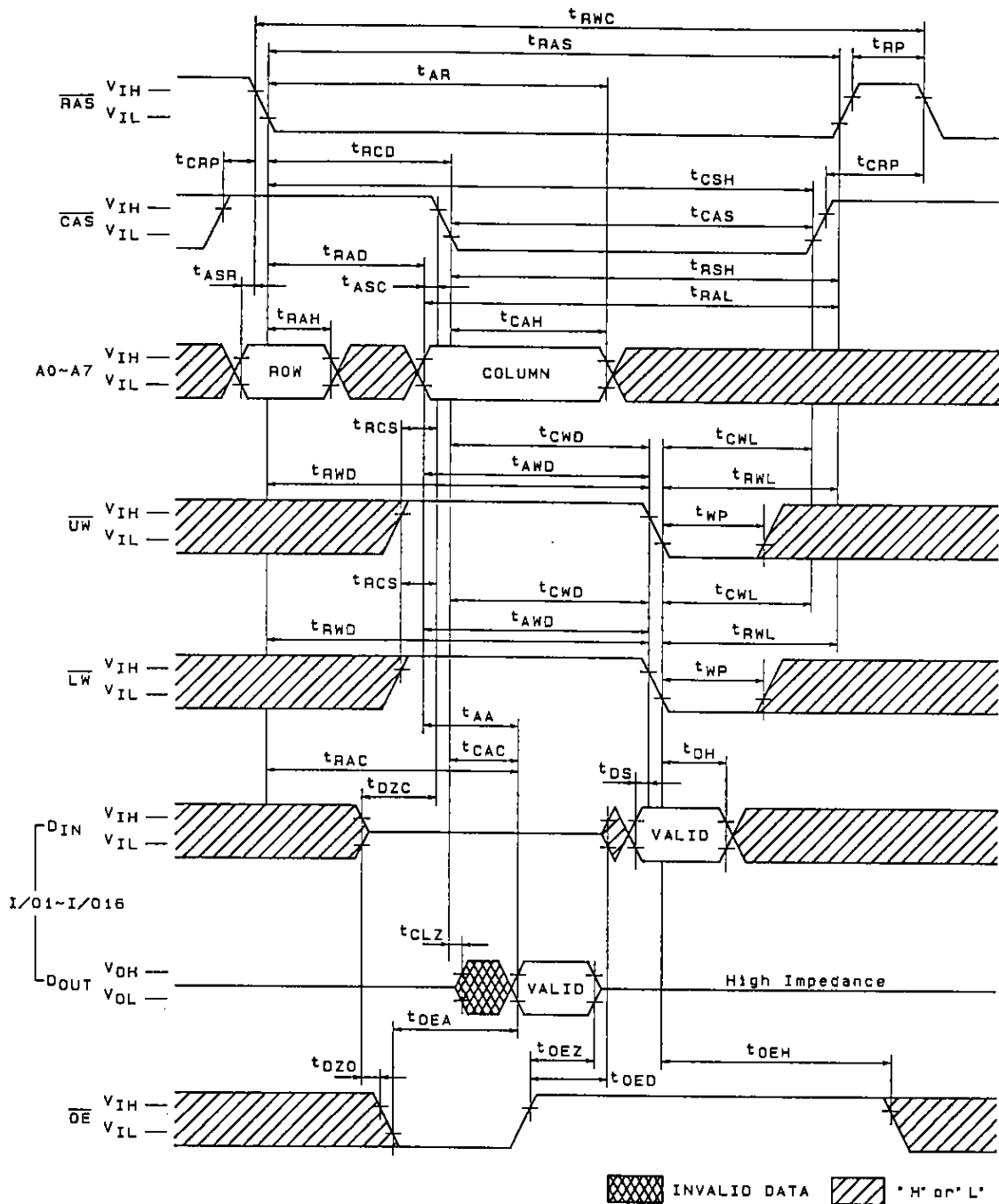
A02144

Lower Byte Write Cycle (OE Control)



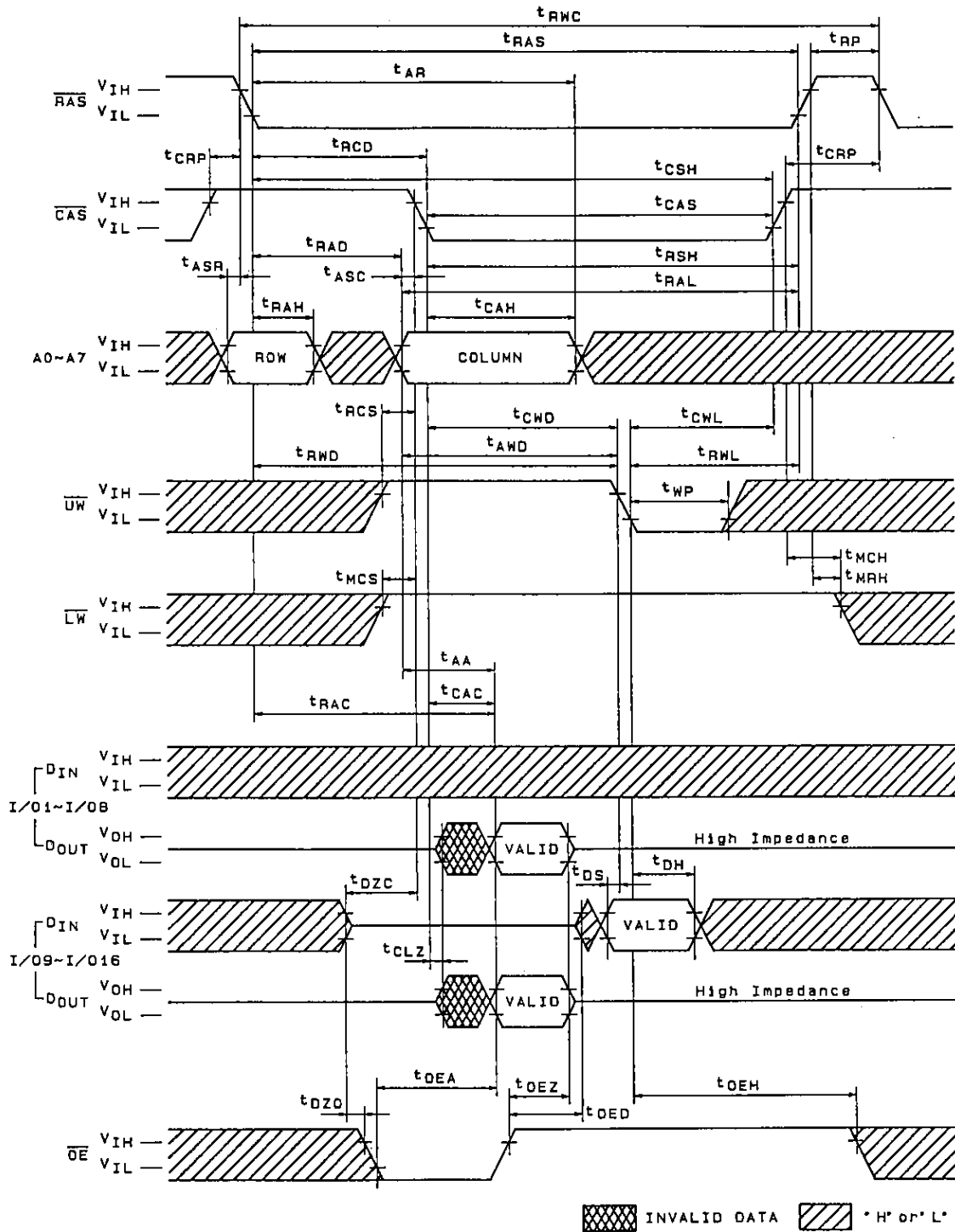
A02145

Read-Modify Write Cycle

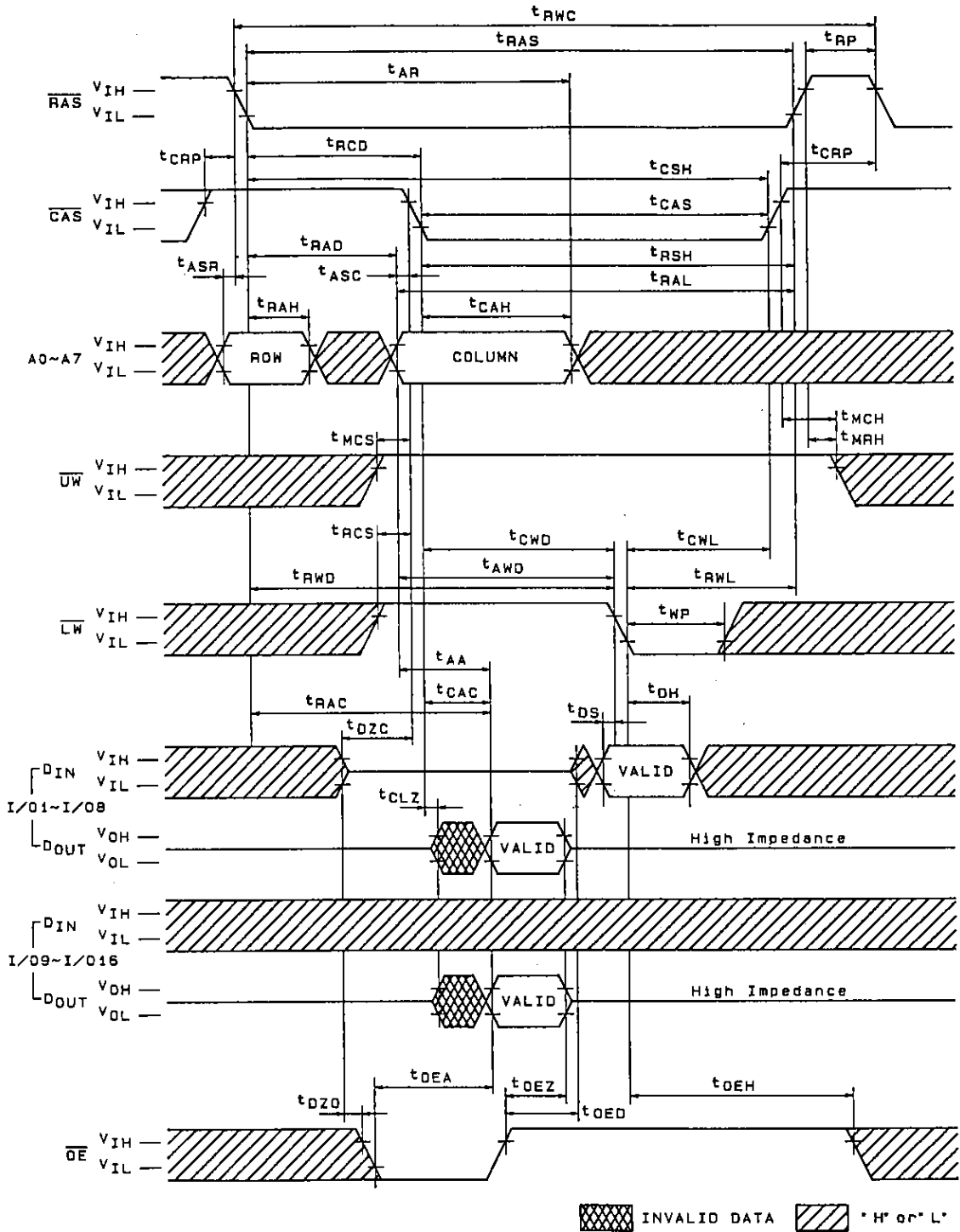


A02146

Read-Modify Upper Byte Write Cycle

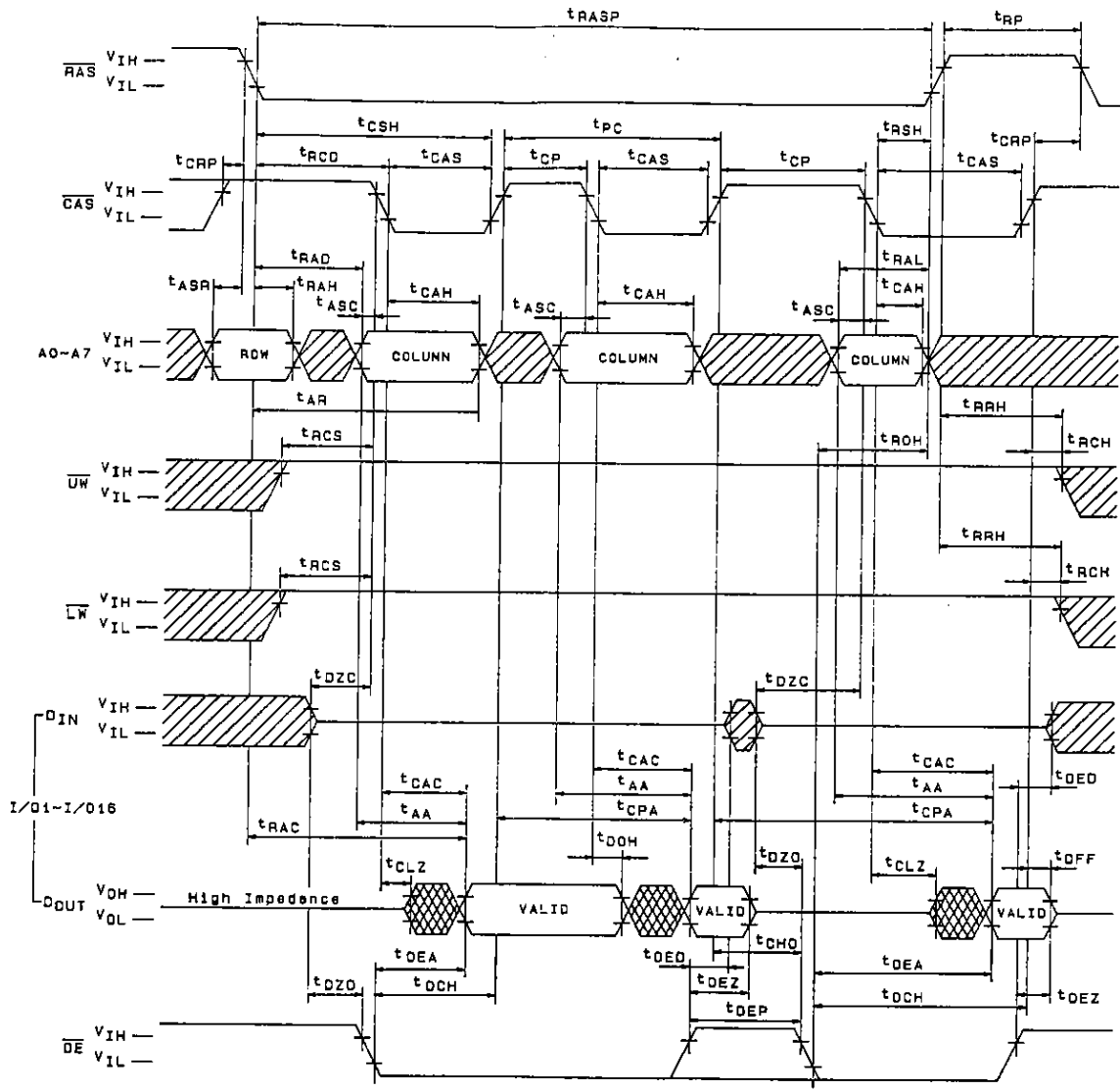


Read-Modify Lower Byte Write Cycle



A02148

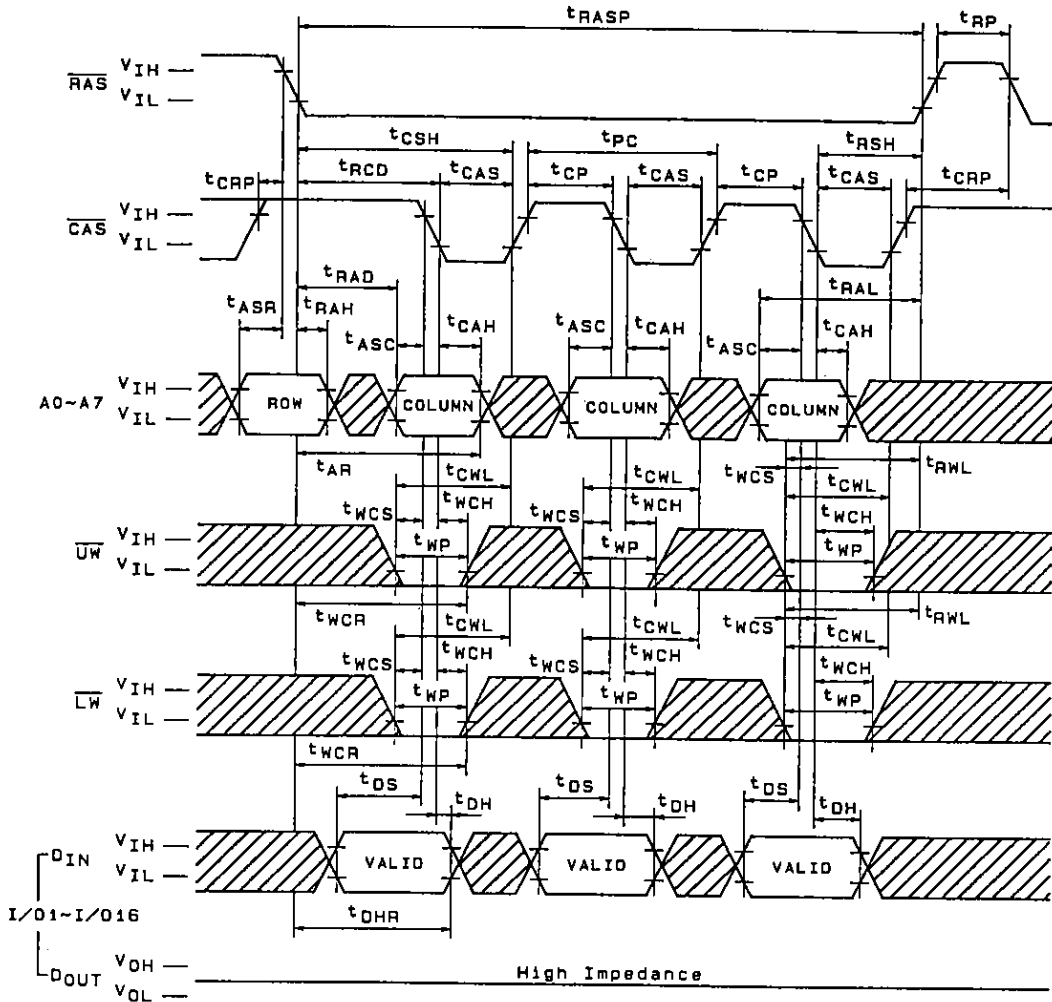
EDO Page Mode Read Cycle



INVALID DATA * H* or * L*

A04085

EDO Page Mode Early Write Cycle

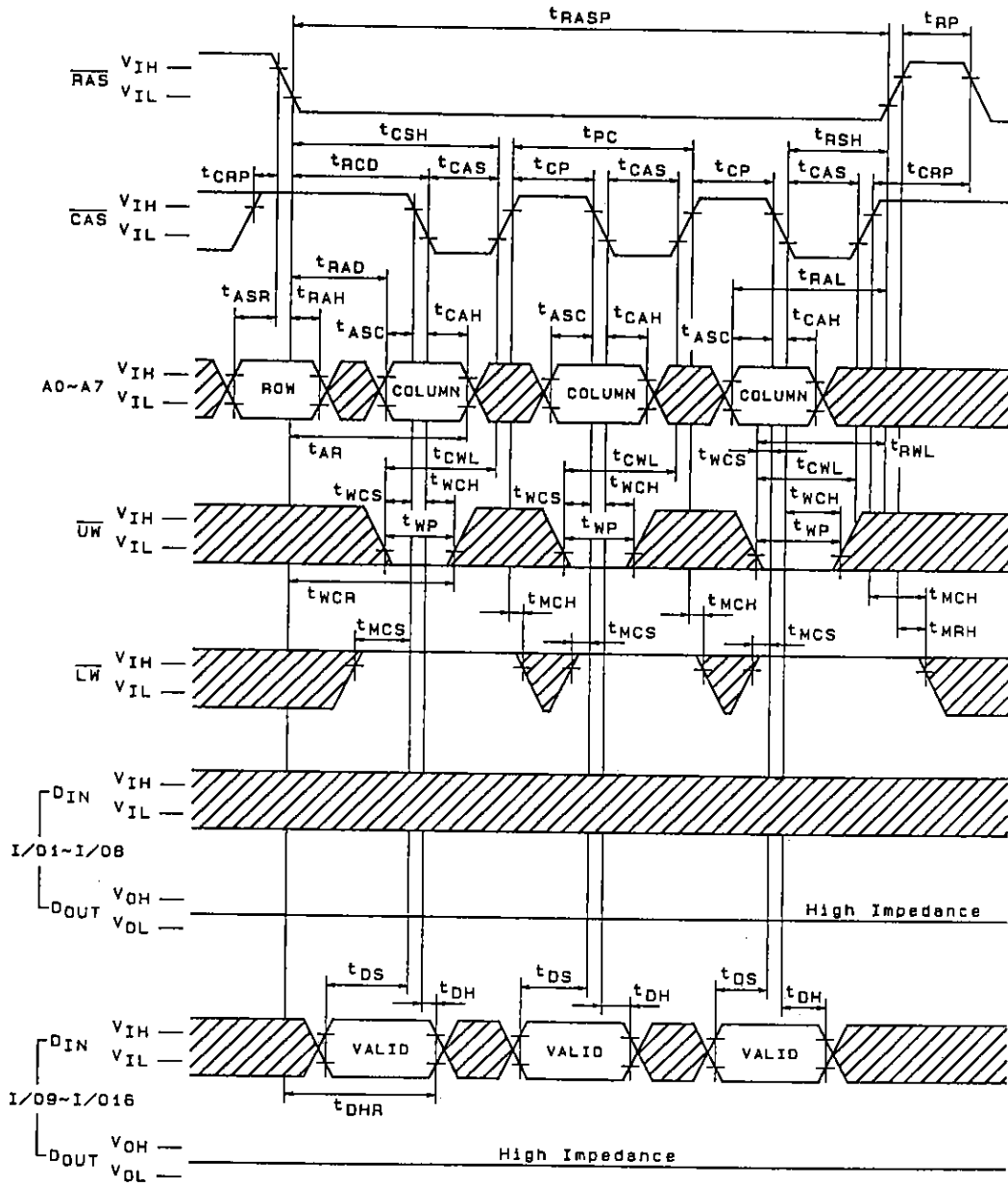


▨ H or L

◻ H or L

A02150

EDO Page Mode Upper Byte Early Write Cycle

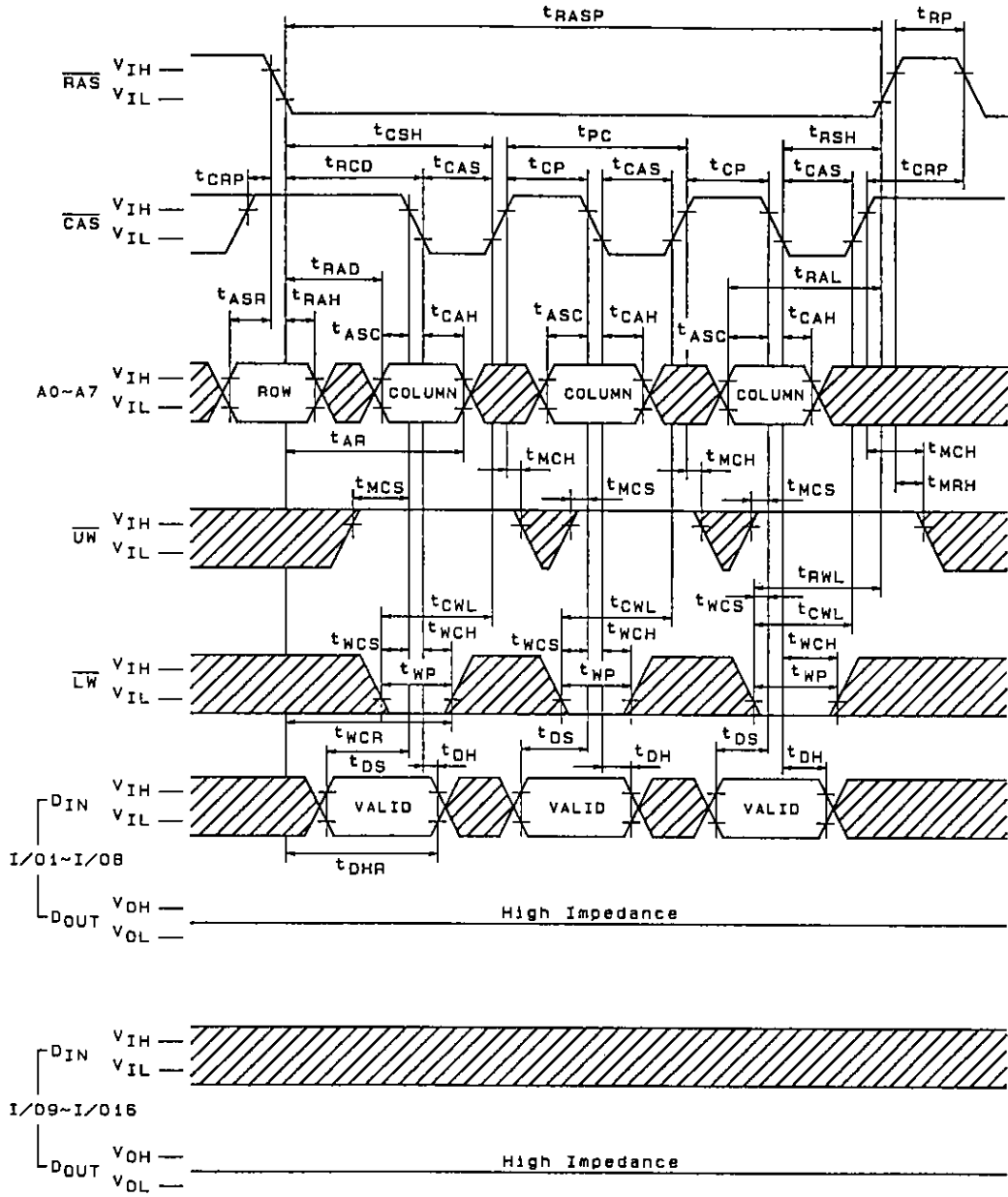




▨ "H" or "L"

▨ "H" or "L"

A02151

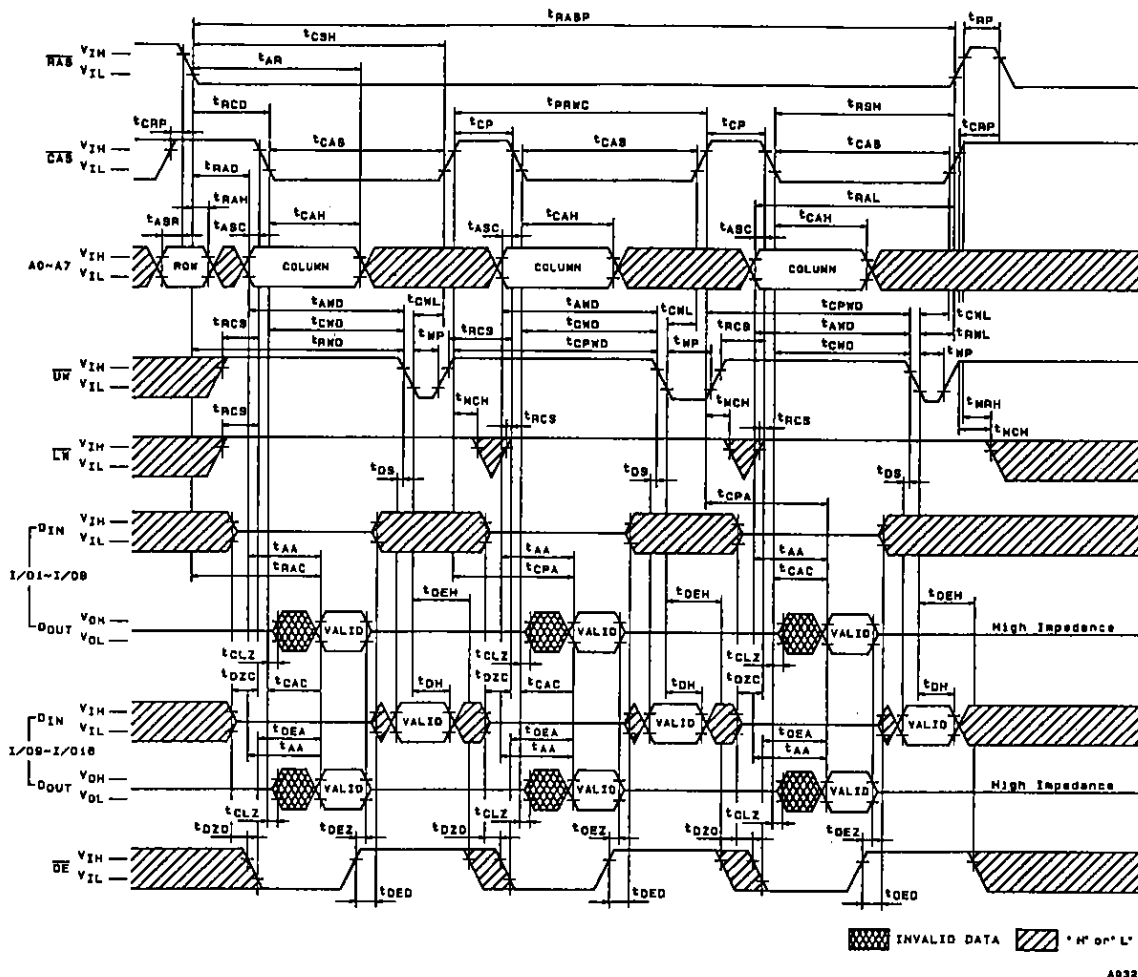
EDO Page Mode Lower Byte Early Write Cycle



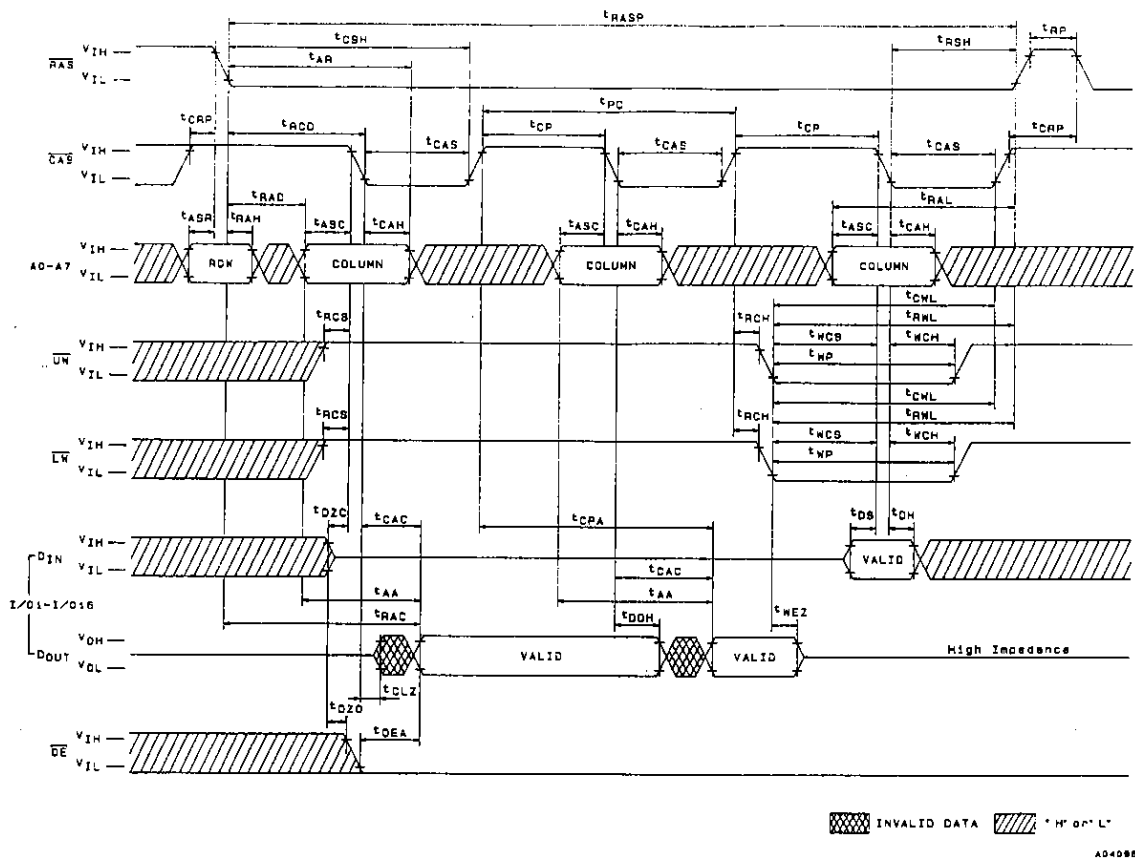
 * H* or * L*
 $\overline{0E}$ * H* or * L*

A02152

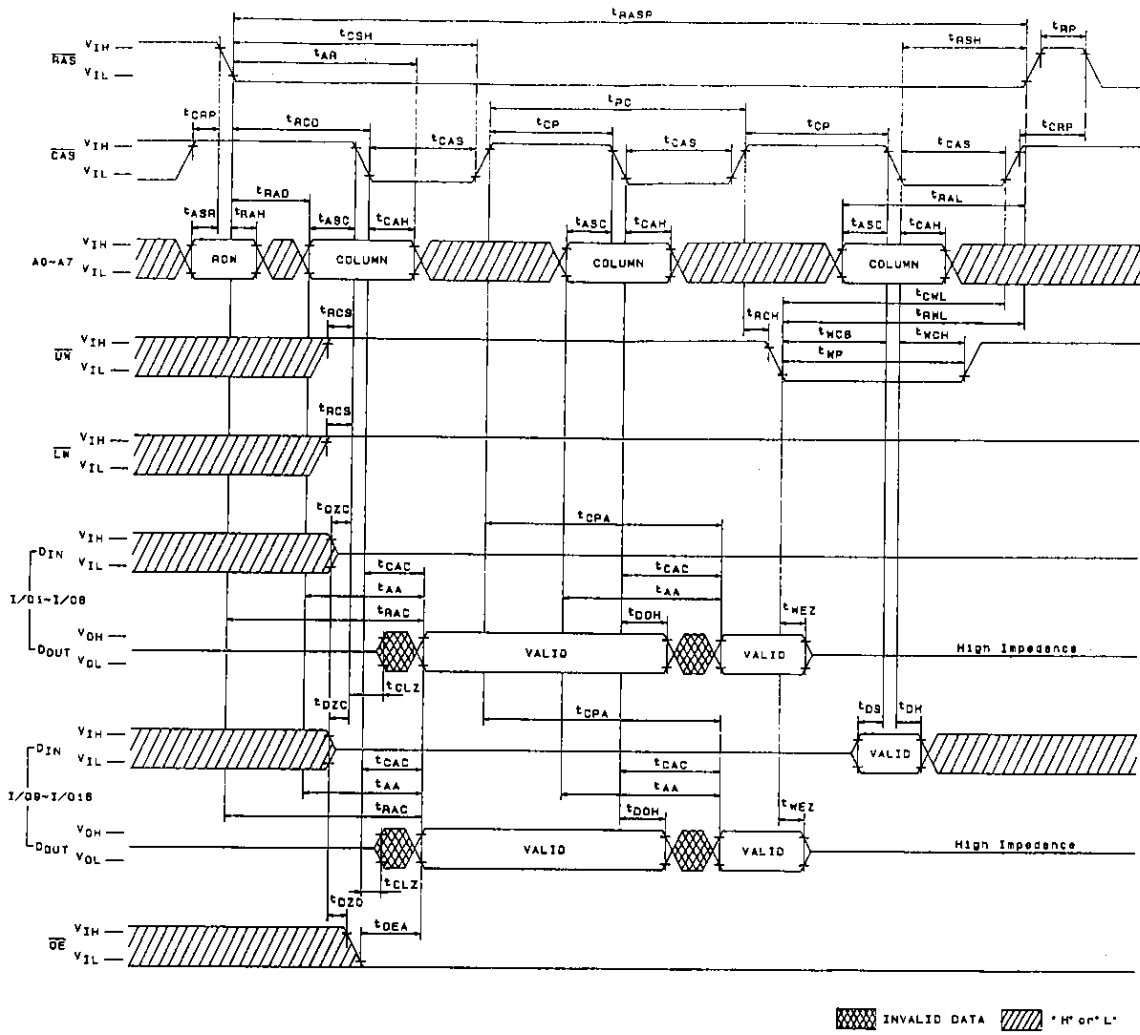
EDO Page Mode Read-Modify Upper Byte Write Cycle



EDO Page Mode Read Early Write Cycle

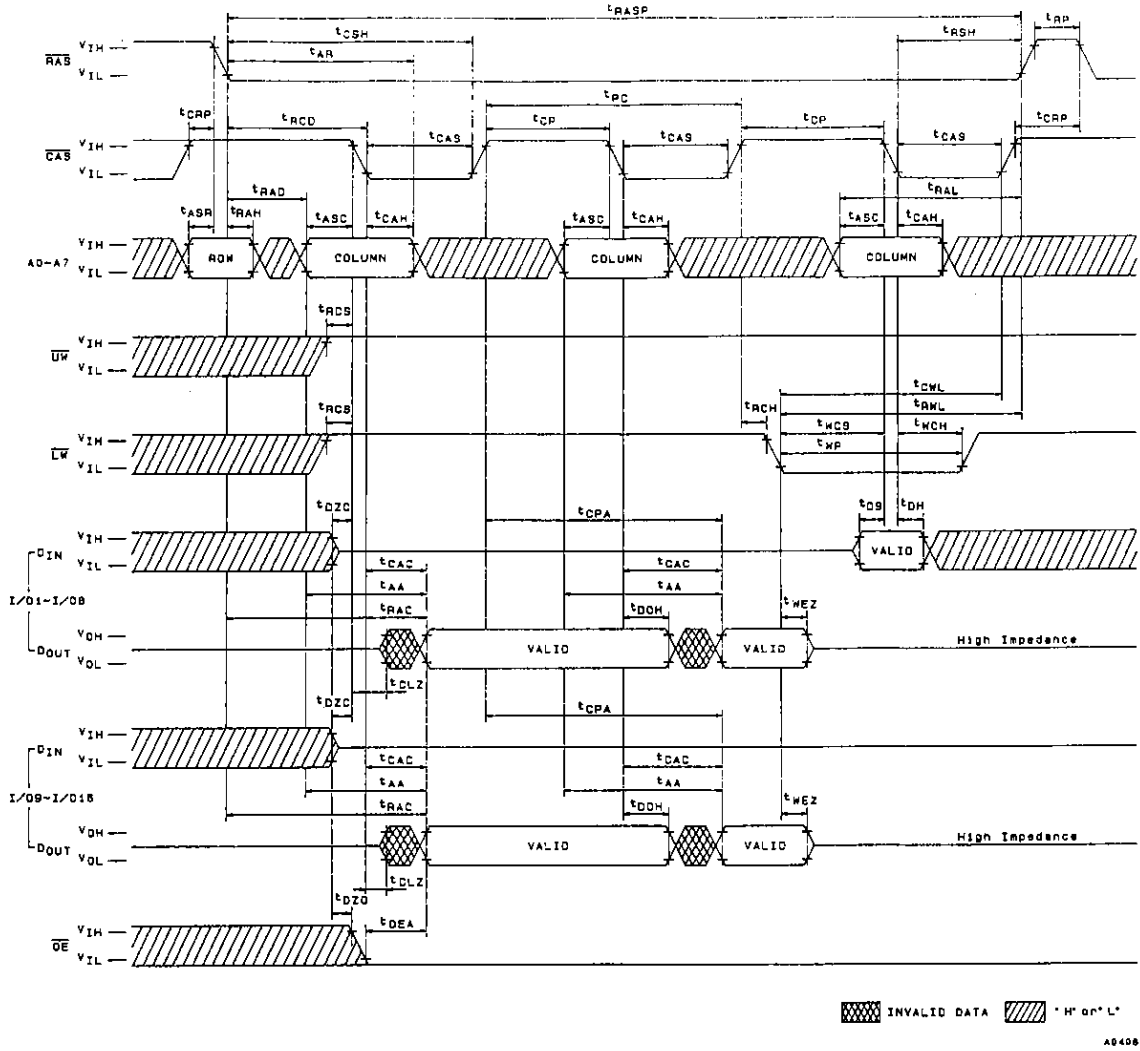


EDO Page Mode Read Upper Byte Early Write Cycle

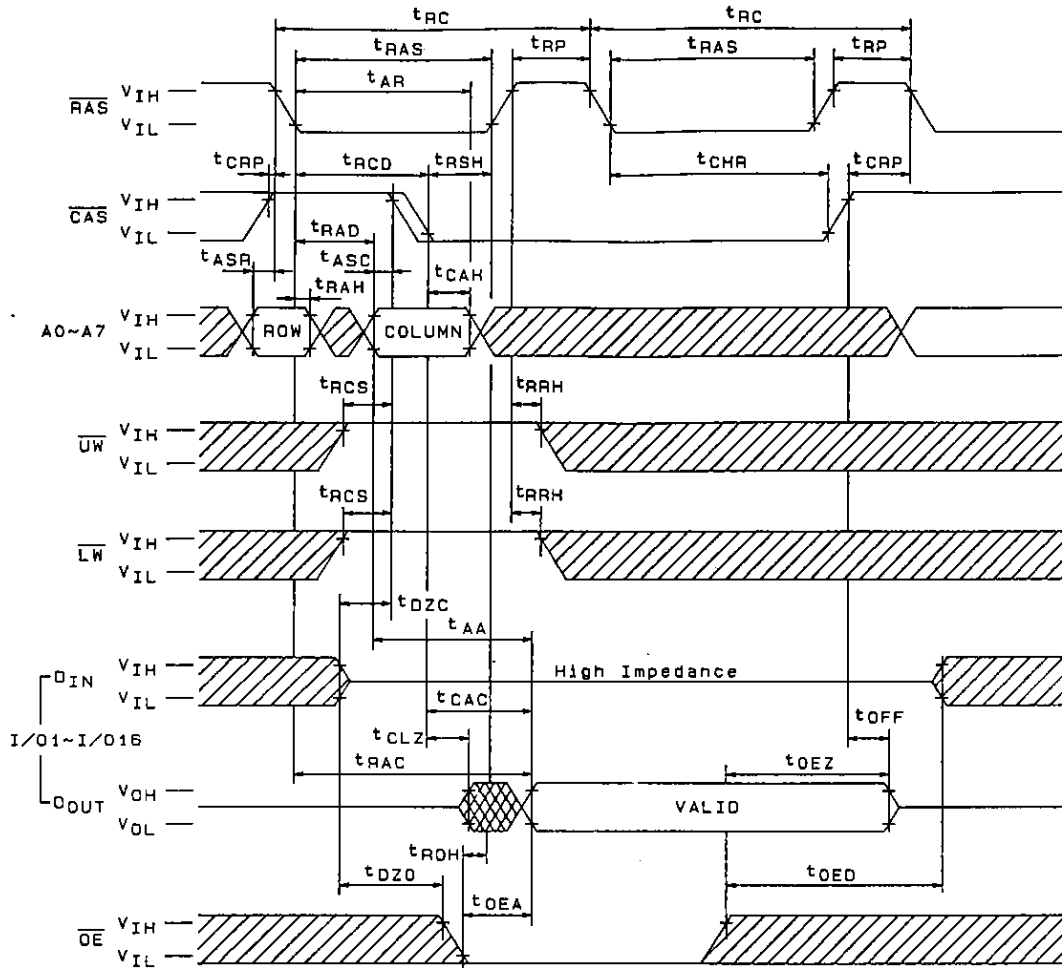


A04087

EDO Page Mode Read Lower Byte Early Write Cycle



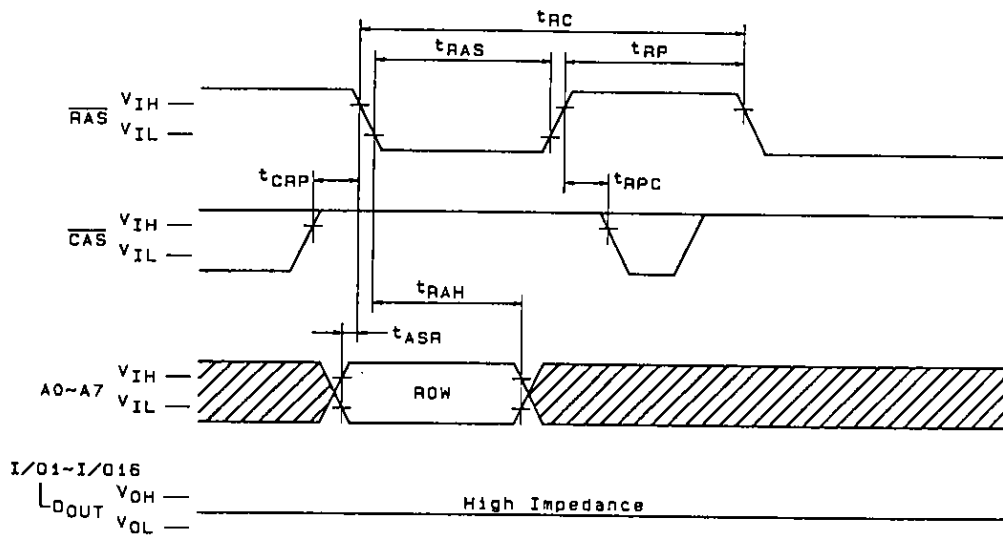
Hidden Refresh Cycle



INVALID DATA "H" or "L"

A03723

RAS-Only Refresh Cycle

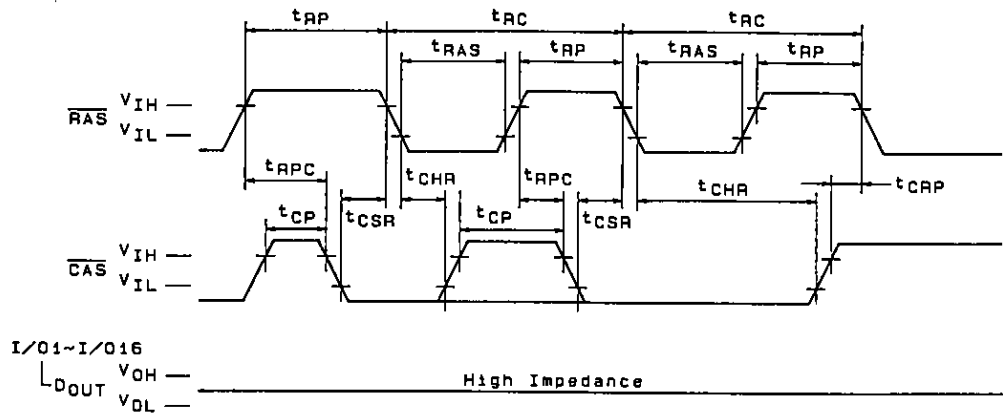


\overline{OE} , \overline{UW} , \overline{LW} , \overline{DIN} , * H* or * L*

* H* or * L*

A02197

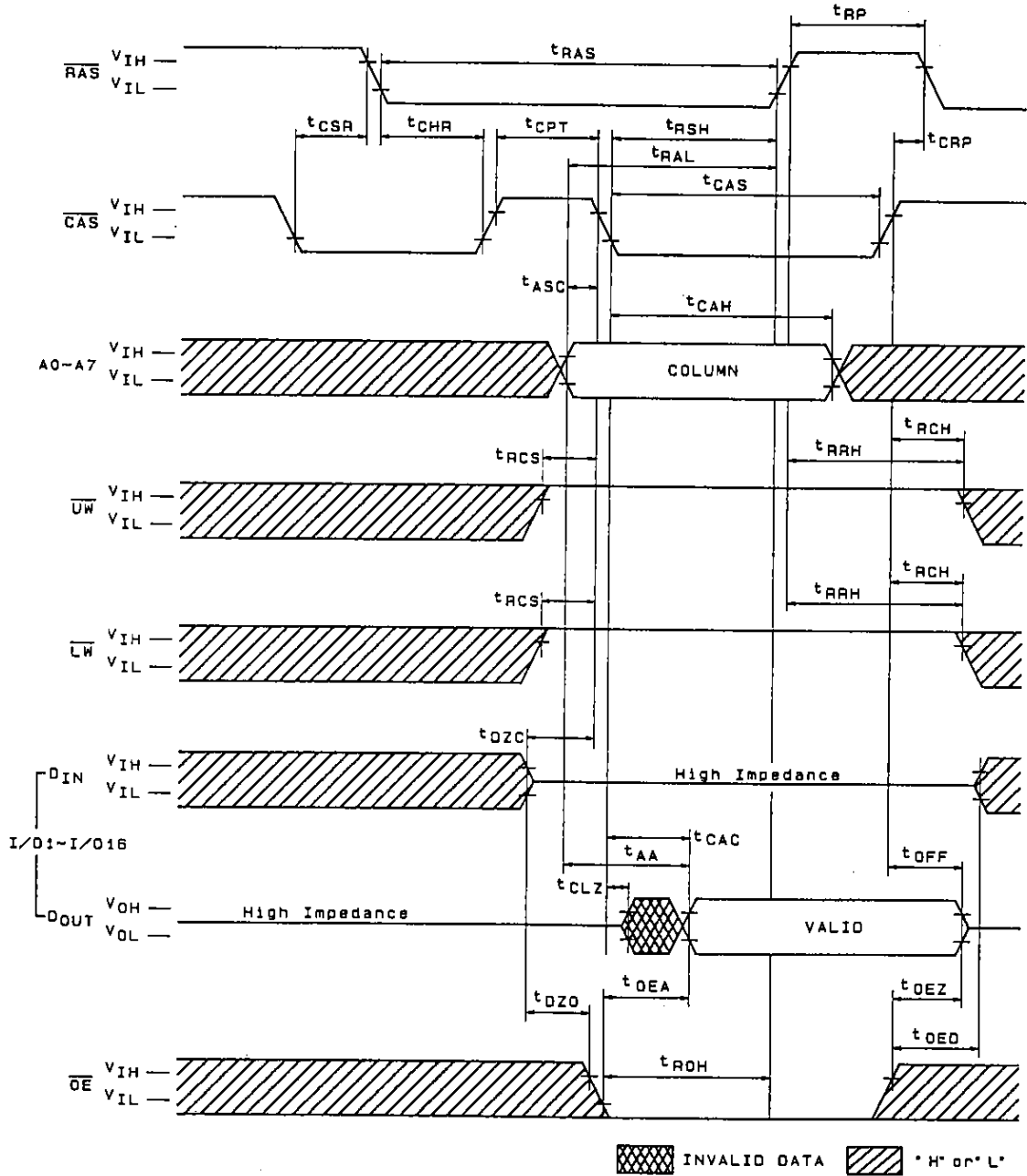
CAS-Before-RAS Refresh Cycle



A0-A7, \overline{UW} , \overline{LW} , \overline{OE} , \overline{DIN} , * H* or * L*

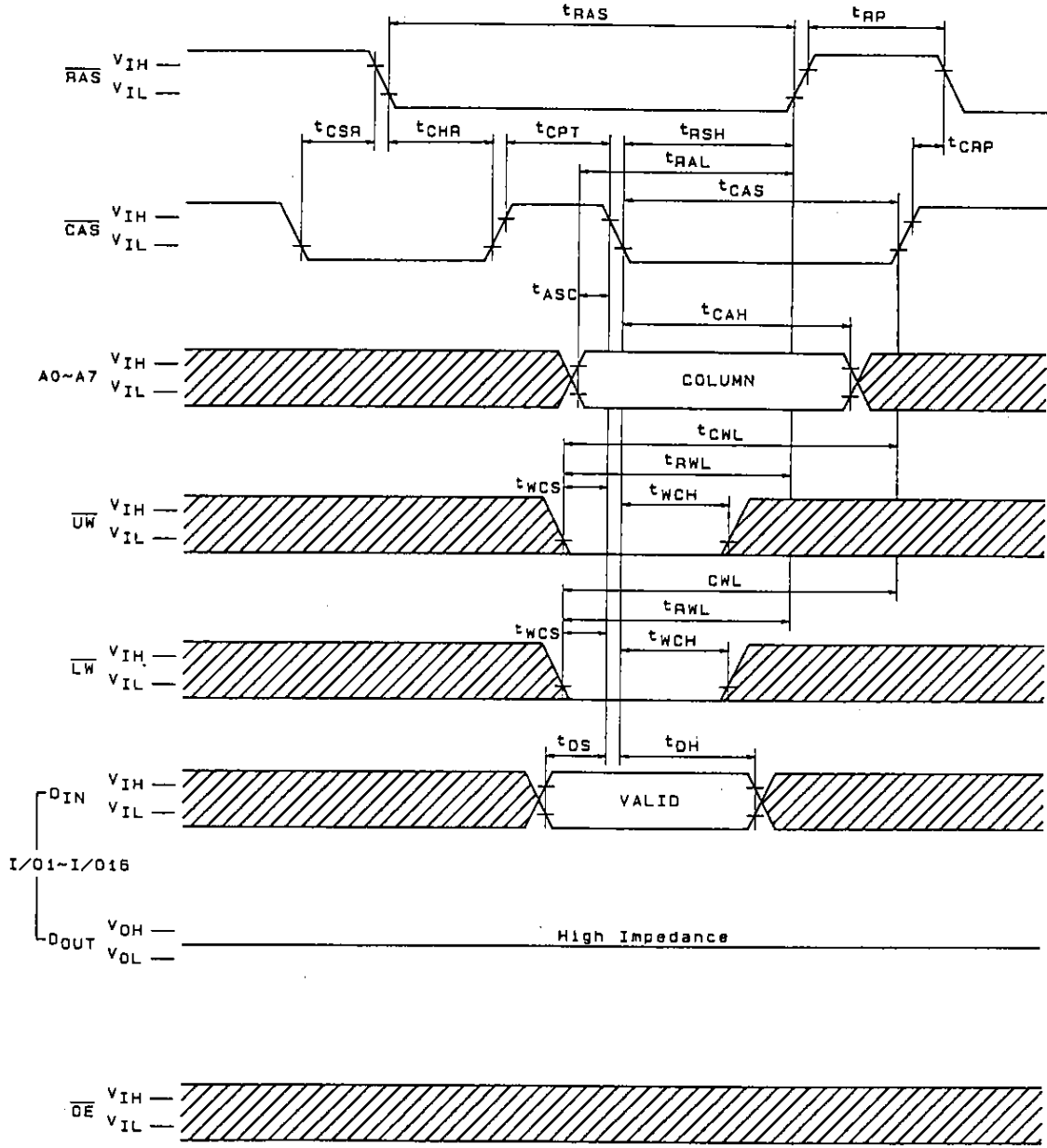
A02198

CAS-Before-RAS Refresh Counter Test Cycle (Read)



A02158

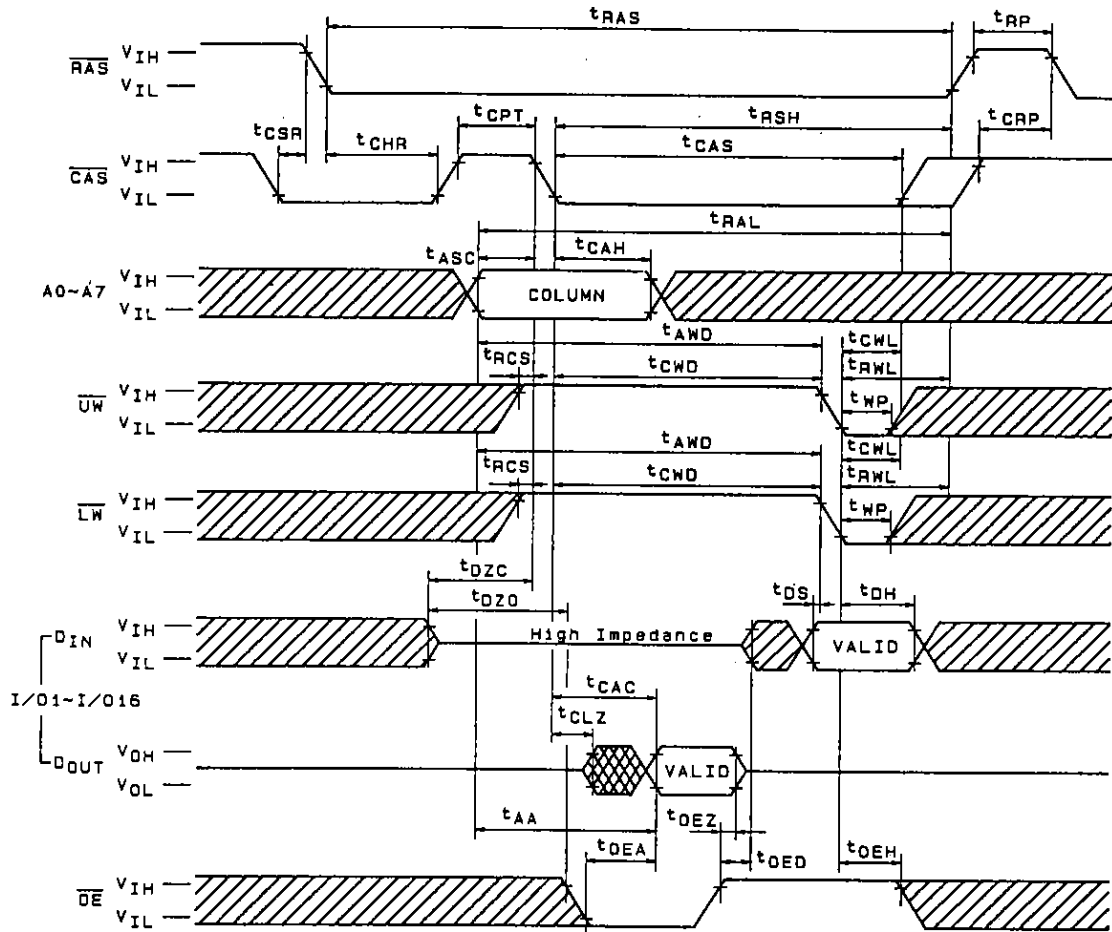
CAS-Before-RAS Refresh Counter Test Cycle (Write)



□ * H* or * L*

A02160

CAS-Before-RAS Refresh Counter Test Cycle (Read-Modify-Write)



INVALID DATA 'H' or 'L'

A02151

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