CMOS LSI

SANYO

No. 5082A

LC321664BJ, BM, BT-70/80

1 MEG (65536 words × 16 bits) DRAM Fast Page Mode, Byte Write

Overview

The LC321664BJ, BM, BT 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 ($\overline{RAS}$)-only refresh, Column Address Strobe ($\overline{CAS}$)-before-$\overline{RAS}$ refresh and hidden refresh settings. There are functions such as fast page mode, read-modify-write and byte write.

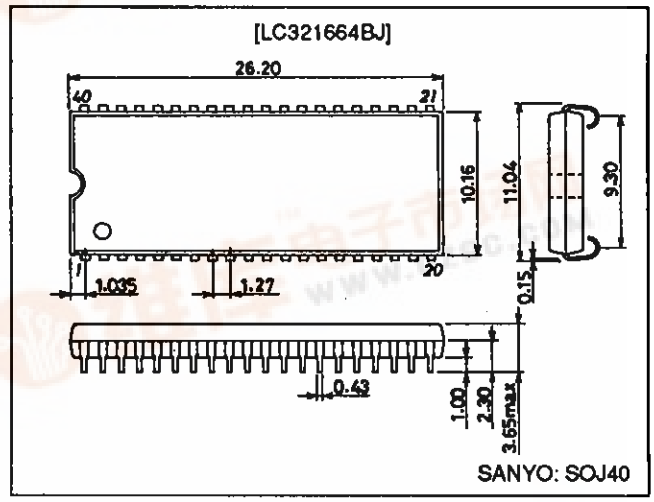
Features

- 65536 words × 16 bits configuration.
- Single 5 V ± 10% power supply.
- All input and output (I/O) TTL compatible.
- Supports fast page mode, read-modify-write and byte write.
- Supports output buffer 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
  SOJ 40-pin (400 mil) plastic package : LC321664BJ
  SOP 40-pin (525 mil) plastic package : LC321664BM
  TSOP 44-pin (400 mil) plastic package : LC321664BT
- $\overline{RAS}$ access time/column address access time/$\overline{CAS}$ access time/cycle time/power dissipation

Package Dimensions

unit: mm

3200-SOJ40



Parameter		LC321664BJ, BM, BT	
		-70	-80
$\overline{RAS}$ access time		70 ns	80 ns
Column address access time		40 ns	45 ns
$\overline{CAS}$ 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)	

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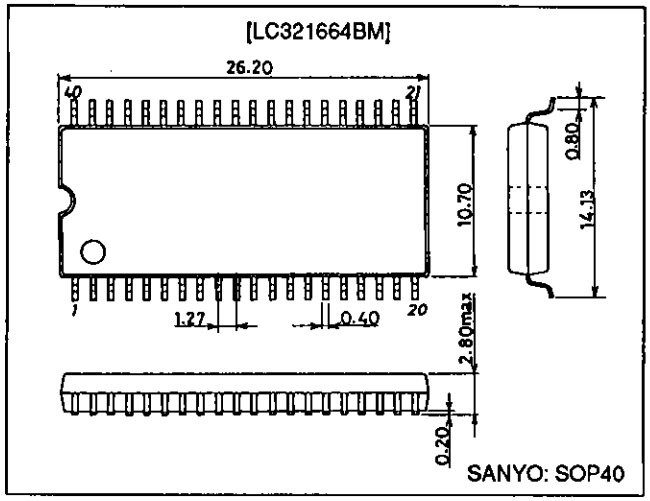
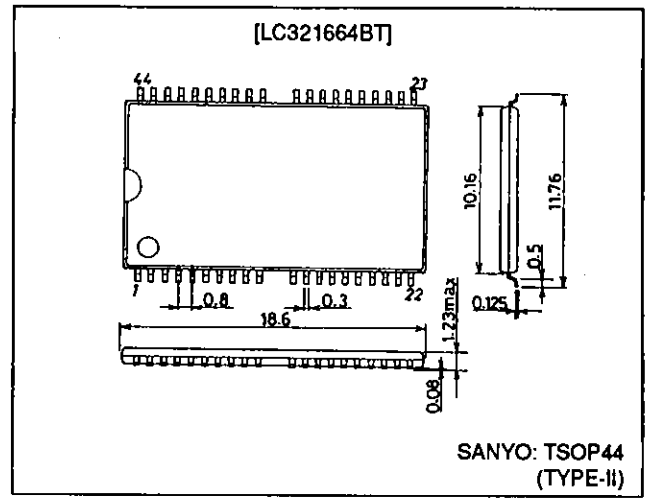
Package Dimensions
unit: mm

3195-SOP40



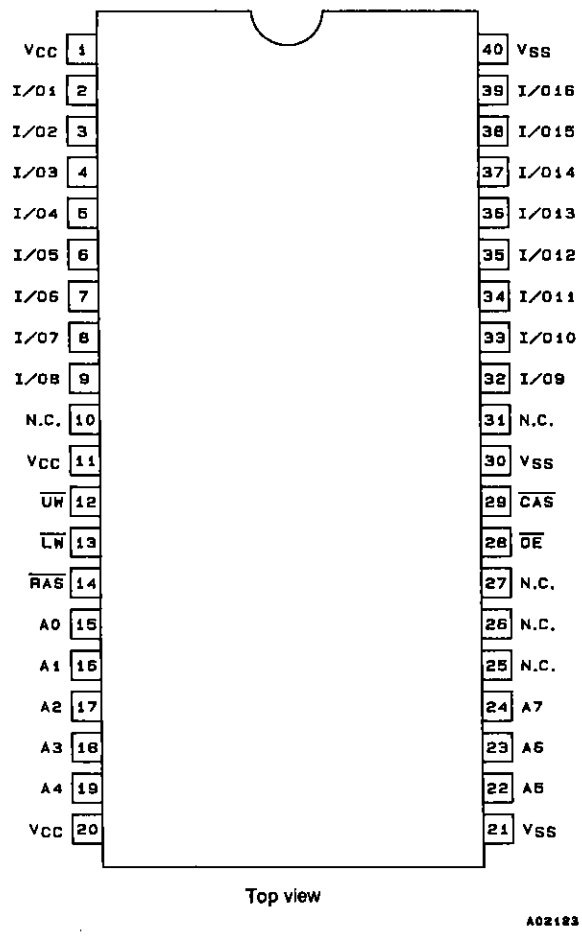
Package Dimensions
unit: mm

3207-TSOP44

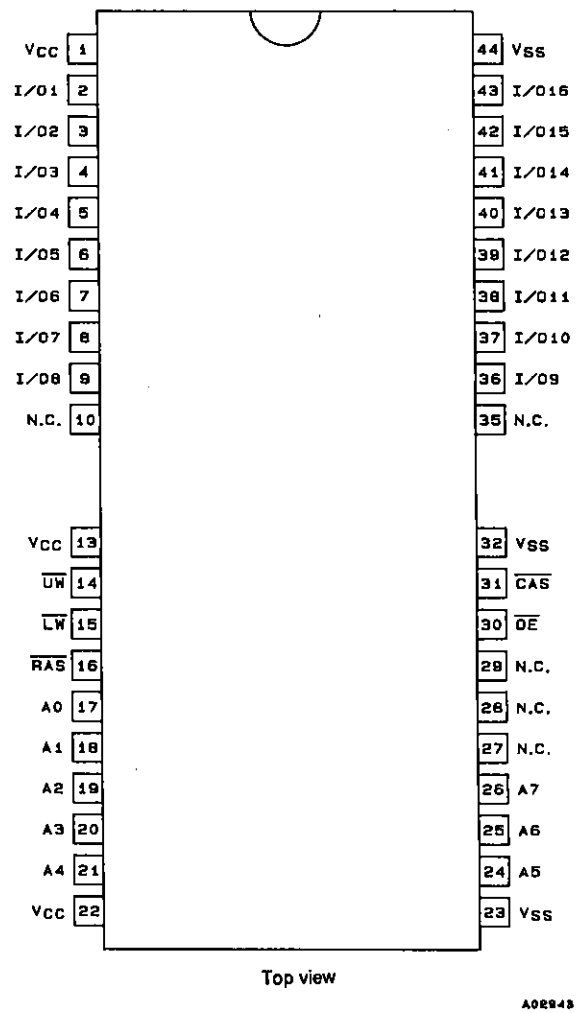


Pin Assignments

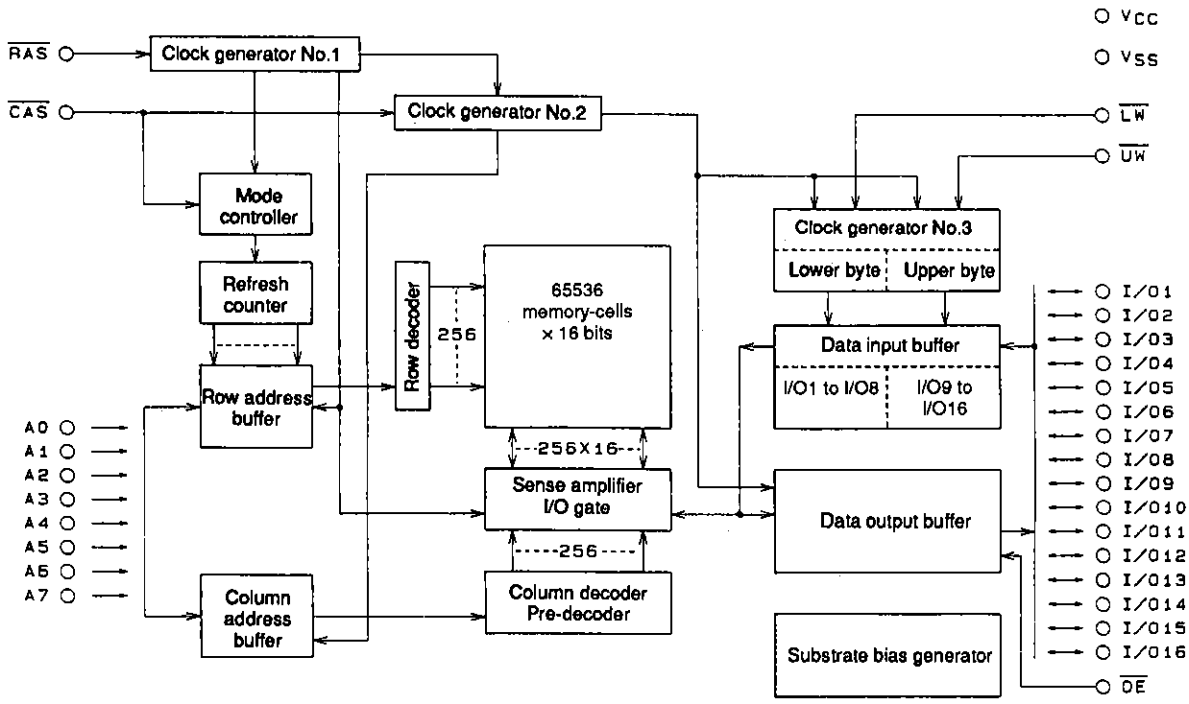
SOJ40, SOP40



TSOP44



Block Diagram



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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	LC321664BJ, BM	Pd max	800	mW	1
	LC321664BT		700		
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 (A0 to A7, $\overline{RAS}$, $\overline{CAS}$, $\overline{UW}$, $\overline{LW}$, $\overline{OE}$)	V_{IL}	−1.0*		+0.8	V	2
Input low level voltage (I/O1 to I/O16)	V_{IL}	−0.5*		+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 V_{CC} and V_{SS} of the device.
*: −2.0 V when pulse width is less than 20 ns.

DC Electrical Characteristics at Ta = 0 to +70°C, V_{CC} = 5 V ± 10%

Parameter	Symbol	Conditions	LC321664BJ, BM, BT				Unit	Note
			-70		-80			
			min	max	min	max		
Operating current (Average current during operation)	I_{CC1}	$\overline{RAS}$, $\overline{CAS}$, address cycling: t_{RC} = t_{RC} min		125		115	mA	3, 4, 5
Standby current	I_{CC2}	$\overline{RAS}$ = $\overline{CAS}$ = V_{IH}		2		2	mA	
$\overline{RAS}$-only refresh current	I_{CC3}	$\overline{RAS}$ cycling, $\overline{CAS}$ = V_{IH}: t_{RC} = t_{RC} min		125		115	mA	3, 5
Fast page mode current	I_{CC4}	$\overline{RAS}$ = V_{IL}, $\overline{CAS}$, address cycling: t_{PC} = t_{PC} min		80		70	mA	3, 4, 5
Standby current	I_{CC5}	$\overline{RAS}$ = $\overline{CAS}$ = V_{CC} – 0.2 V		1		1	mA	
$\overline{CAS}$-before-$\overline{RAS}$ refresh current	I_{CC6}	$\overline{RAS}$, $\overline{CAS}$ cycling: t_{RC} = t_{RC} min		125		115	mA	3
Input leakage current	I_{IL}	0 V ≤ V_{IN} ≤ 6.5 V, pins other than test pin = 0 V	–10	+10	–10	+10	µA	
Output leakage current	I_{OL}	D_{OUT} disable, 0 V ≤ V_{OUT} ≤ 5.5 V	–10	+10	–10	+10	µA	
Output high level voltage	V_{OH}	I_{OUT} = –2.5 mA	2.4		2.4		V	
Output low level voltage	V_{OL}	I_{OUT} = 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. I_{CC1} and I_{CC4} are dependent on output loads. Maximum values for I_{CC1} and I_{CC4} represent values with output open.
5. Address change is less than or equal to one time during $\overline{RAS}$ = V_{IL}. Concerning I_{CC4}, it is less than or equal to one time during 1 cycle (t_{PC}).

AC Electrical Characteristics at Ta = 0 to +70°C, V_{CC} = 5 V ± 10% (Notes 6, 7 and 8)

Parameter	Symbol	LC321664BJ, BM, BT				Unit	Note
		-70		-80			
		min	max	min	max		
Random read, write cycle time	t_{RC}	125		135		ns	
Read-write/read-modify-write cycle time	t_{RWC}	170		180		ns	
Fast page mode cycle time	t_{PC}	50		55		ns	
Fast page mode read-write/read-modify-write cycle time	t_{PRWC}	95		100		ns	
$\overline{RAS}$ access time	t_{RAC}		70		80	ns	9, 14, 15
$\overline{CAS}$ access time	t_{CAC}		25		25	ns	9, 14
Column address access time	t_{AA}		40		45	ns	9, 15
$\overline{CAS}$ precharge access time	t_{CPA}		45		50	ns	9
Output low-impedance time from $\overline{CAS}$ low	t_{CLZ}	0		0		ns	9
Output buffer turn-off delay time	t_{OFF}	0	20	0	20	ns	10
Rise, fall time	t_T	3	50	3	50	ns	
$\overline{RAS}$ precharge time	t_{RP}	45		45		ns	
$\overline{RAS}$ pulse width	t_{RAS}	70	10000	80	10000	ns	
$\overline{RAS}$ pulse width for fast page mode only	t_{RASP}	70	100000	80	100000	ns	
$\overline{RAS}$ hold time	t_{RSH}	25		25		ns	
$\overline{CAS}$ hold time	t_{CSH}	70		80		ns	
$\overline{CAS}$ pulse width	t_{CAS}	25	10000	25	10000	ns	
$\overline{RAS}$ to $\overline{CAS}$ delay time	t_{RCD}	20	45	20	55	ns	14
$\overline{RAS}$ to column address delay time	t_{RAD}	15	30	15	35	ns	15
$\overline{CAS}$ to $\overline{RAS}$ precharge time	t_{CRP}	10		10		ns	
$\overline{CAS}$ precharge time	t_{CP}	10		10		ns	
Row address setup time	t_{ASR}	0		0		ns	
Row address hold time	t_{RAH}	10		10		ns	
Column address setup time	t_{ASC}	0		0		ns	
Column address hold time	t_{CAH}	15		15		ns	
Column address hold time referenced to $\overline{RAS}$	t_{AR}	50		55		ns	
Column address to $\overline{RAS}$ lead time	t_{RAL}	35		40		ns	
Read command setup time	t_{RCS}	0		0		ns	
Read command hold time referenced to $\overline{CAS}$	t_{RCH}	0		0		ns	11
Read command hold time referenced to $\overline{RAS}$	t_{RRH}	0		0		ns	11
Write command hold time	t_{WCH}	15		15		ns	
Write command hold time referenced to $\overline{RAS}$	t_{WCR}	50		55		ns	

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Parameter	Symbol	LC321664BJ, BM, BT				Unit	Note
		-70		-80			
		min	max	min	max		
Write command pulse width	t_{WP}	15		15		ns	
Write command to $\overline{RAS}$ lead time	t_{RWL}	20		20		ns	
Write command to $\overline{CAS}$ 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 $\overline{RAS}$	t_{DHR}	50		55		ns	
Refresh time	t_{REF}		4		4	ms	
Write command setup time	t_{WCS}	0		0		ns	13
$\overline{CAS}$ to $\overline{UW}$, $\overline{LW}$ delay time	t_{CWD}	45		45		ns	13
$\overline{RAS}$ to $\overline{UW}$, $\overline{LW}$ delay time	t_{RWD}	90		100		ns	13
Column address to $\overline{UW}$, $\overline{LW}$ delay time	t_{AWD}	60		65		ns	13
$\overline{CAS}$ precharge $\overline{UW}$, $\overline{LW}$ delay time for fast page mode cycle only	t_{CPWD}	65		70		ns	13
$\overline{CAS}$ setup time for $\overline{CAS}$-before-$\overline{RAS}$	t_{CSR}	10		10		ns	
$\overline{CAS}$ hold time for $\overline{CAS}$-before-$\overline{RAS}$	t_{CHR}	10		10		ns	
$\overline{RAS}$ precharge $\overline{CAS}$ active time	t_{RPC}	10		10		ns	
$\overline{CAS}$ precharge time for $\overline{CAS}$-before-$\overline{RAS}$ counter test	t_{CPT}	40		40		ns	
$\overline{RAS}$ hold time referenced to $\overline{OE}$	t_{ROH}	15		15		ns	
$\overline{OE}$ access time	t_{OEA}		25		25	ns	9
$\overline{OE}$ delay time	t_{OED}	15		15		ns	
$\overline{OE}$ output buffer turn-off delay time	t_{OEZ}	0	15	0	15	ns	10
$\overline{OE}$ command hold time	t_{OEH}	20		20		ns	
Data input to $\overline{CAS}$ delay time	t_{DZC}	0		0		ns	16
Data input to $\overline{OE}$ delay time	t_{DZO}	0		0		ns	16
Masked write setup time	t_{MCS}	0		0		ns	
Masked write hold time referenced to $\overline{RAS}$	t_{MRH}	0		0		ns	
Masked write hold time referenced to $\overline{CAS}$	t_{MCH}	0		0		ns	

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

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

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

7. Measured at t_T = 5 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 $\overline{CAS}$ for an early-write cycle, and from the falling edge of $\overline{UW}$ and $\overline{LW}$ 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 $t_{WCS} \geq t_{WCS}$ (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), $t_{AWD} \geq t_{AWD}$ (min) and $t_{CPWD} \geq t_{CPWD}$ (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.

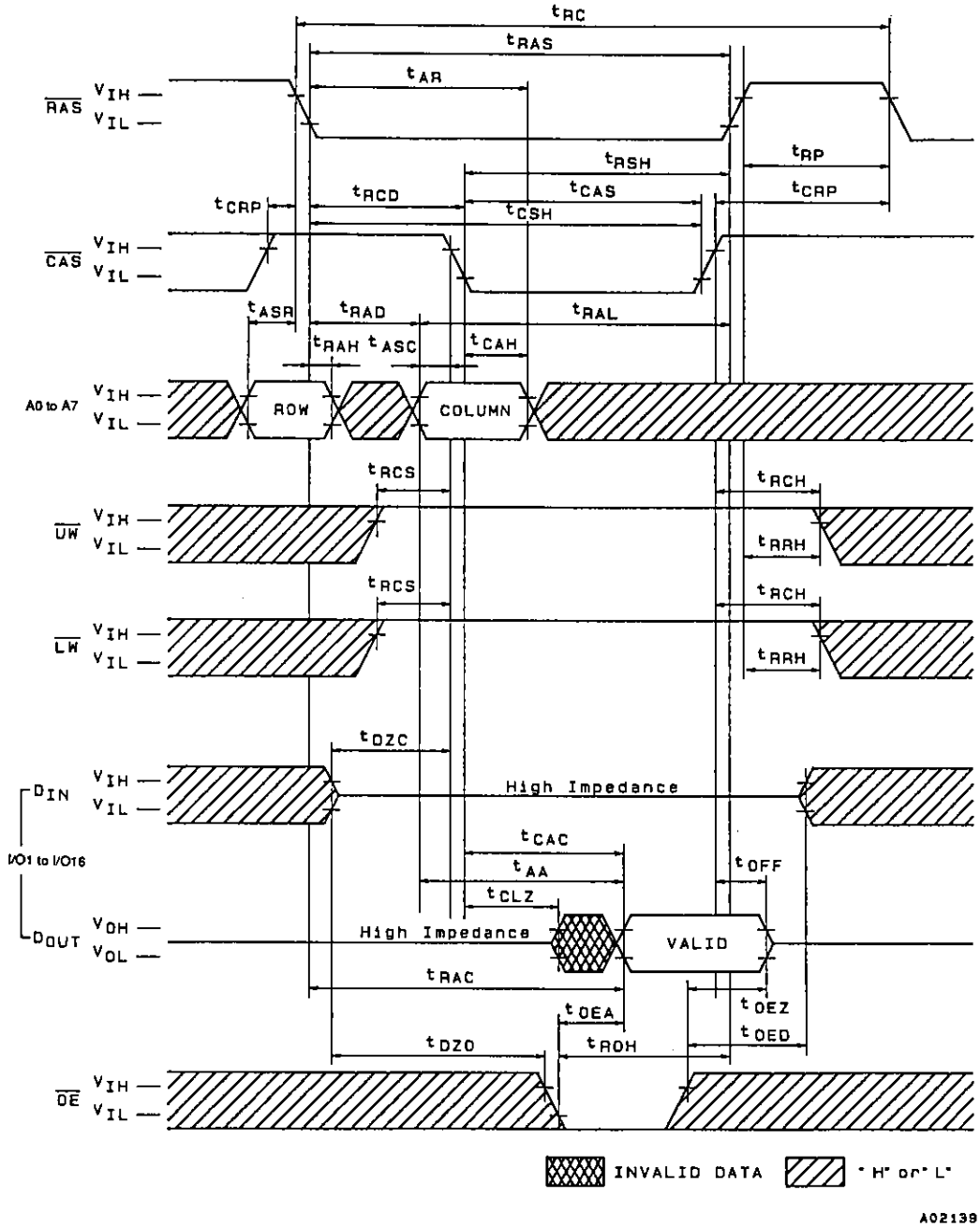
14. t_{RCD} (max) is not a restrictive operating parameter but instead represents the point at which the access time t_{RAC} (max) is guaranteed. If $t_{RCD} \geq t_{RCD}$ (max), access time is determined according to t_{CAC}.

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 $t_{RAD} \geq t_{RAD}$ (max), access time is determined according to t_{AA}.

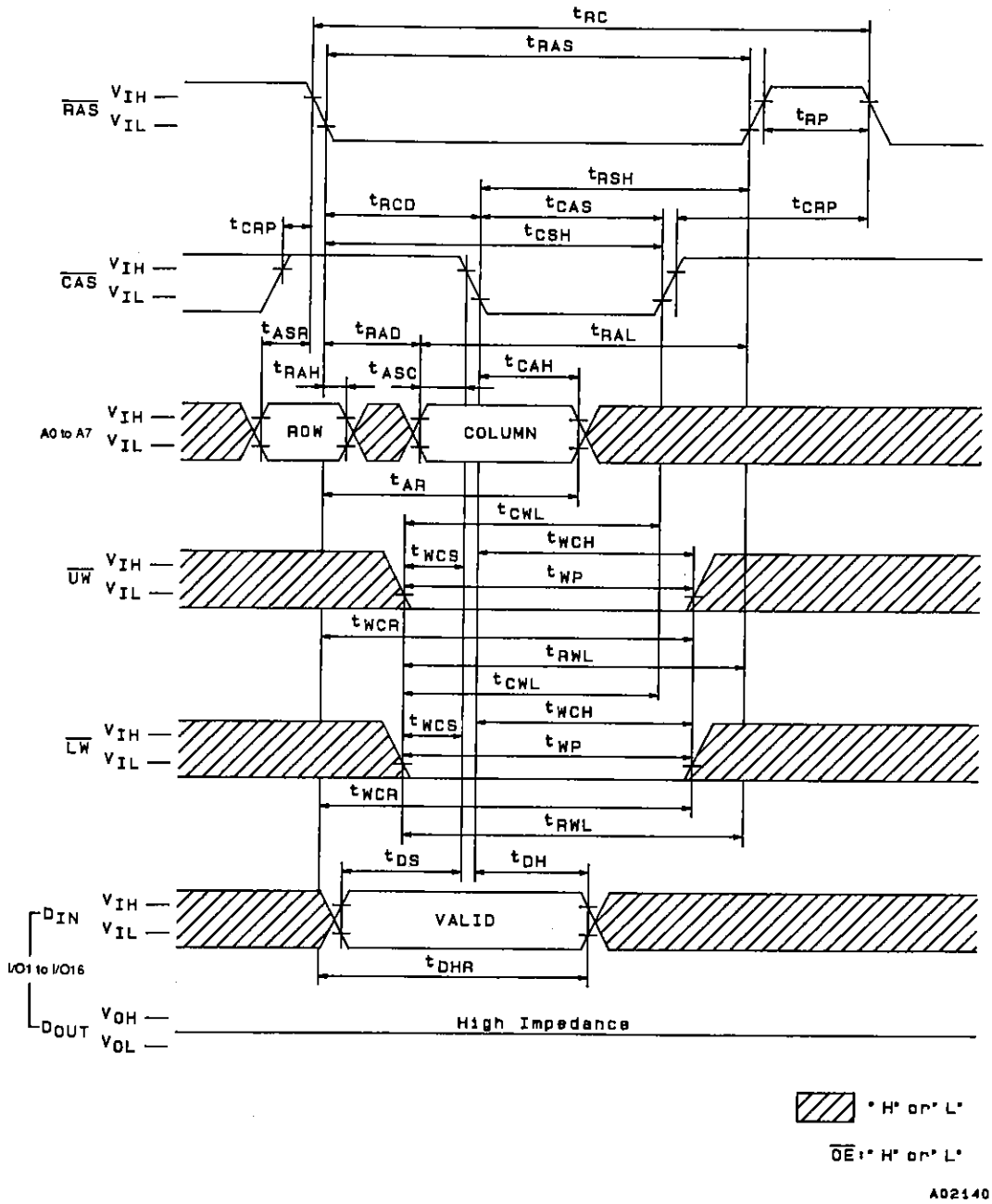
16. Operation is guaranteed if either t_{DZC} or t_{DZO} is satisfied.

Timing Chart

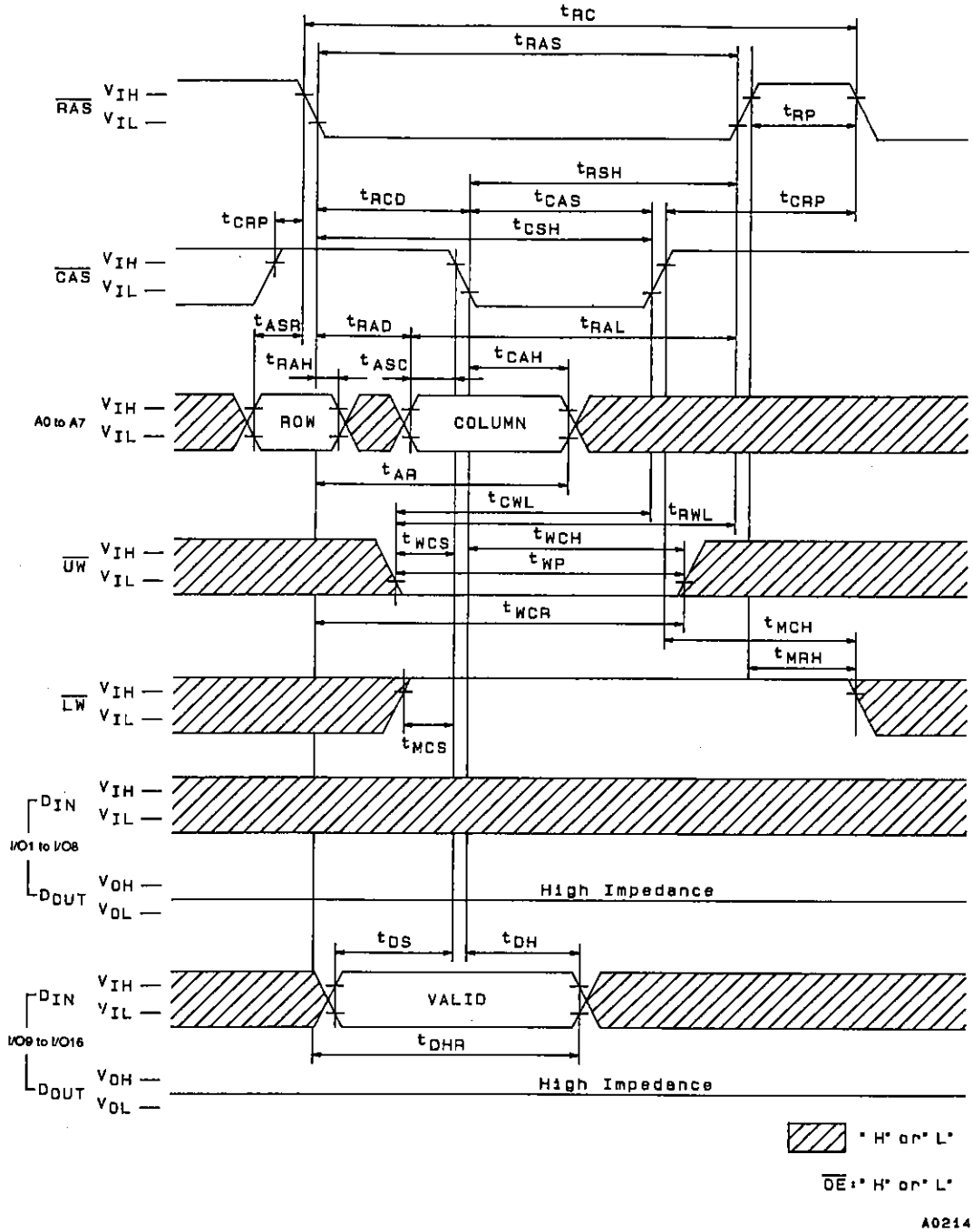
Read Cycle



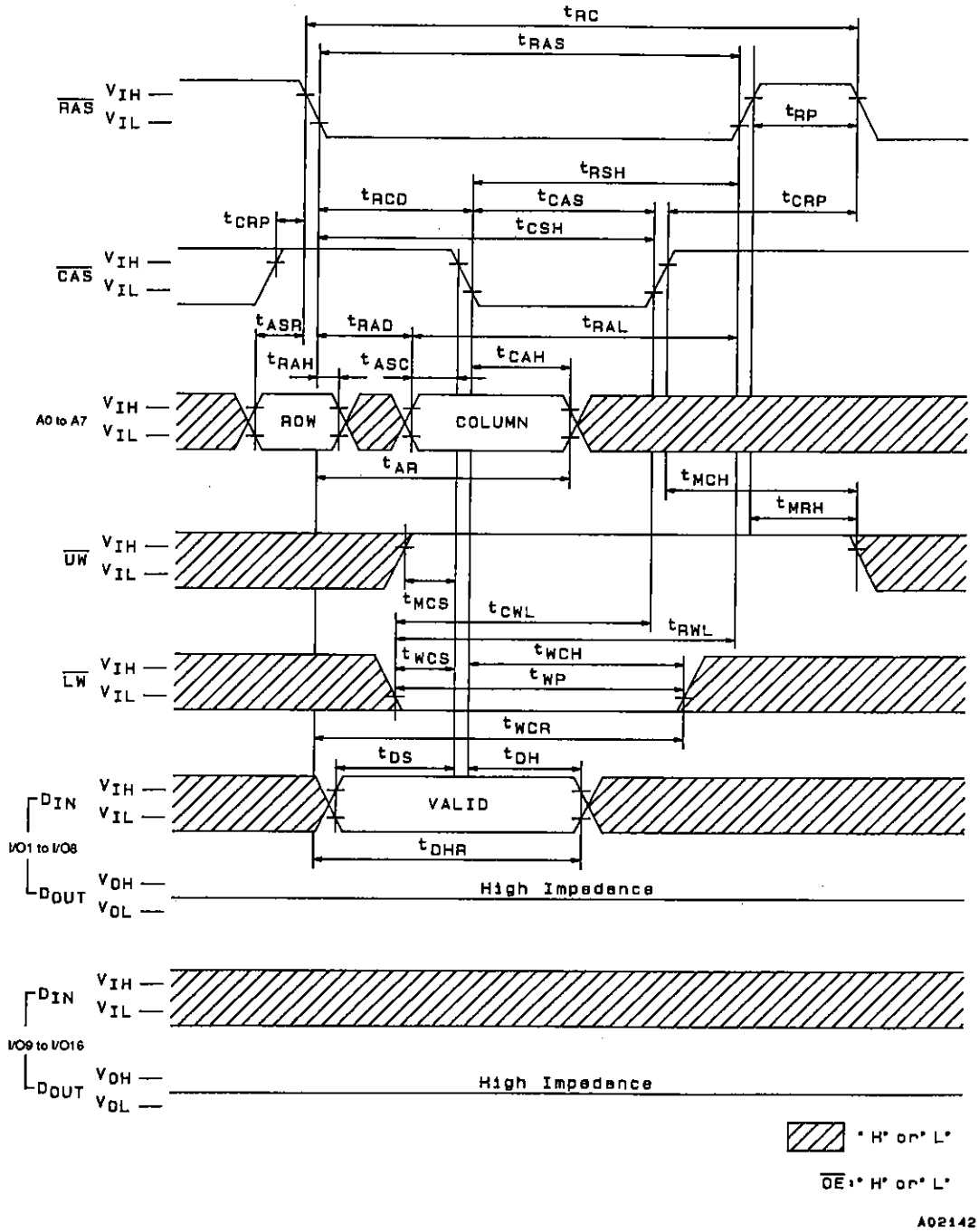
Early Write Cycle



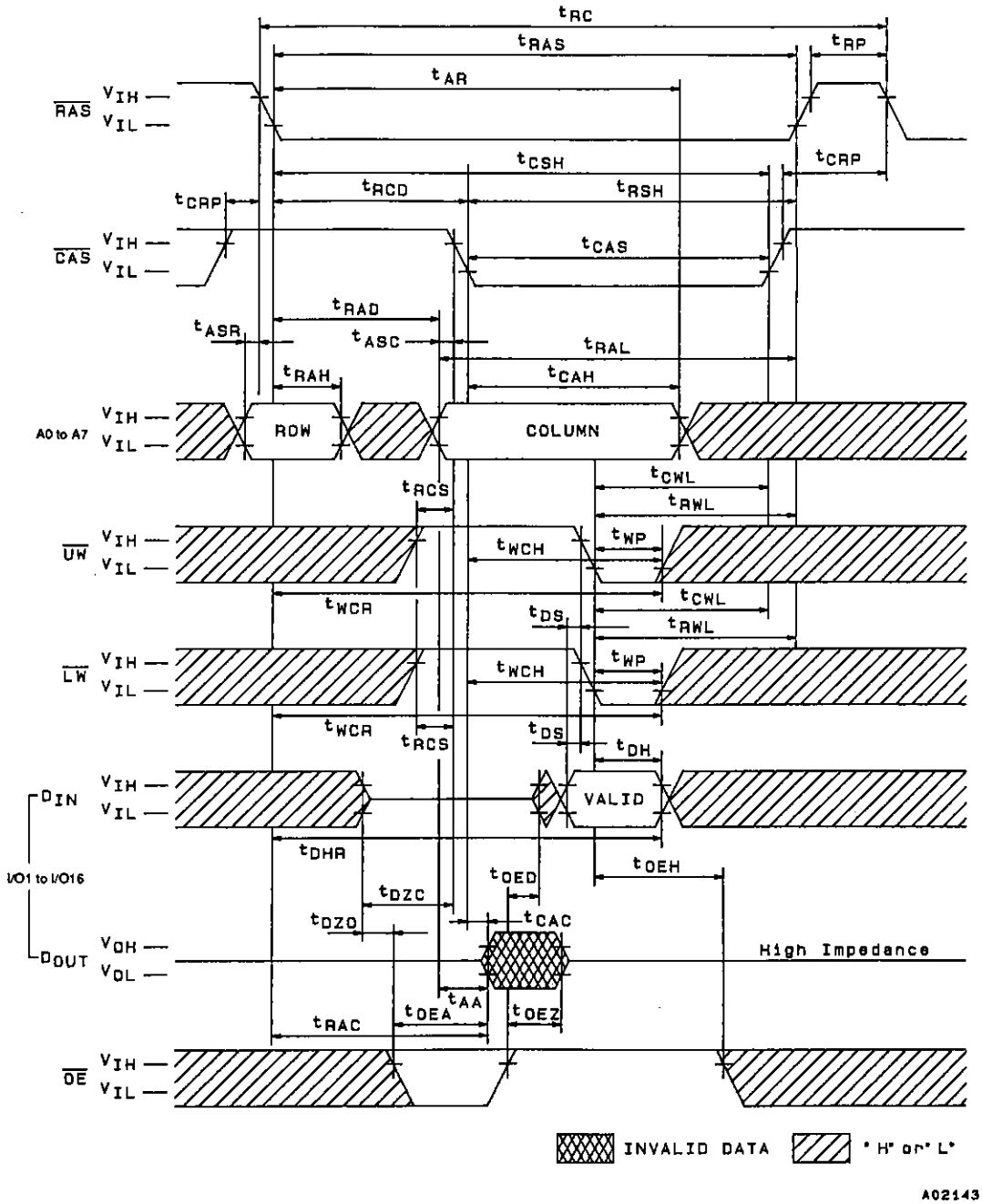
Upper Byte Early Write Cycle



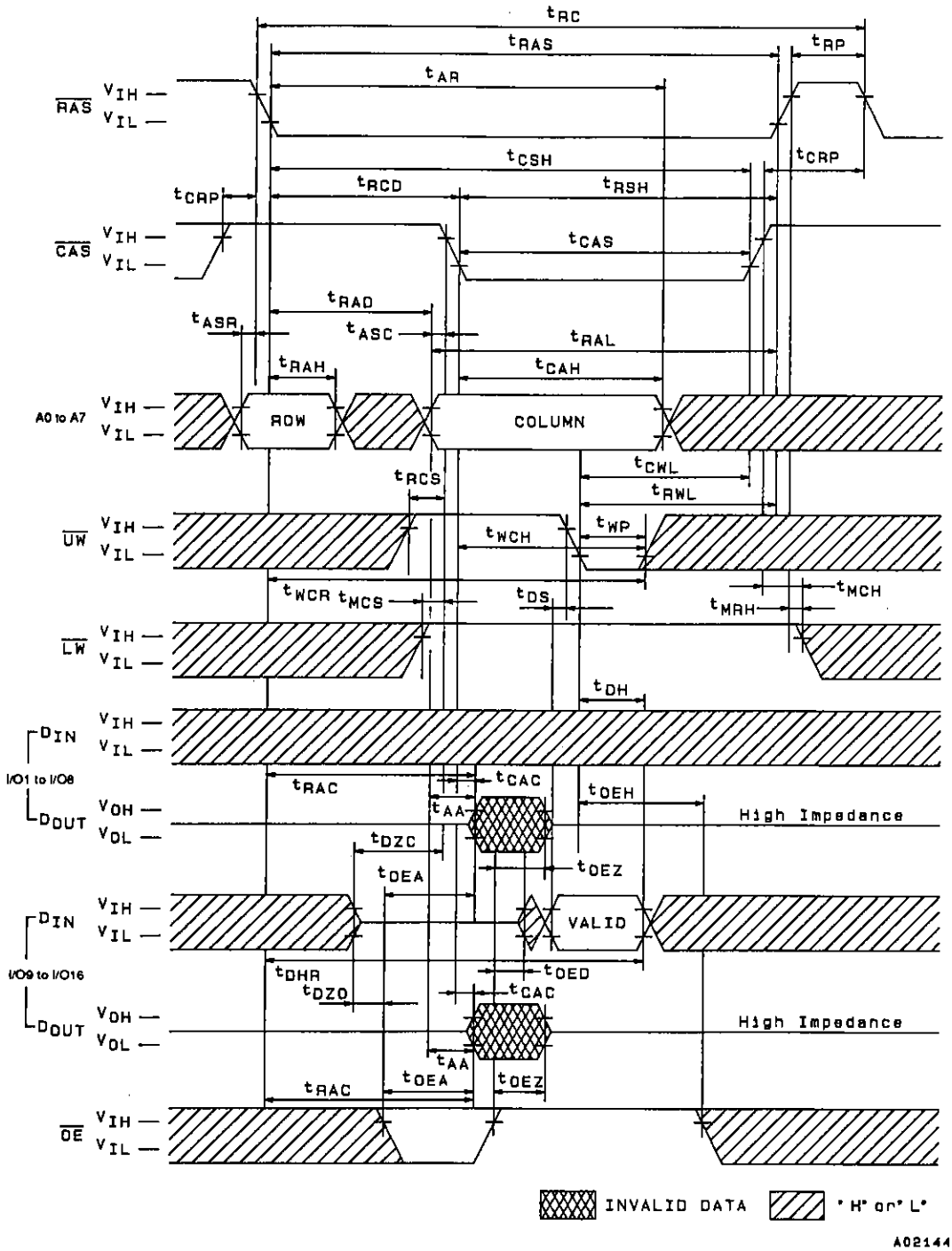
Lower Byte Early Write Cycle



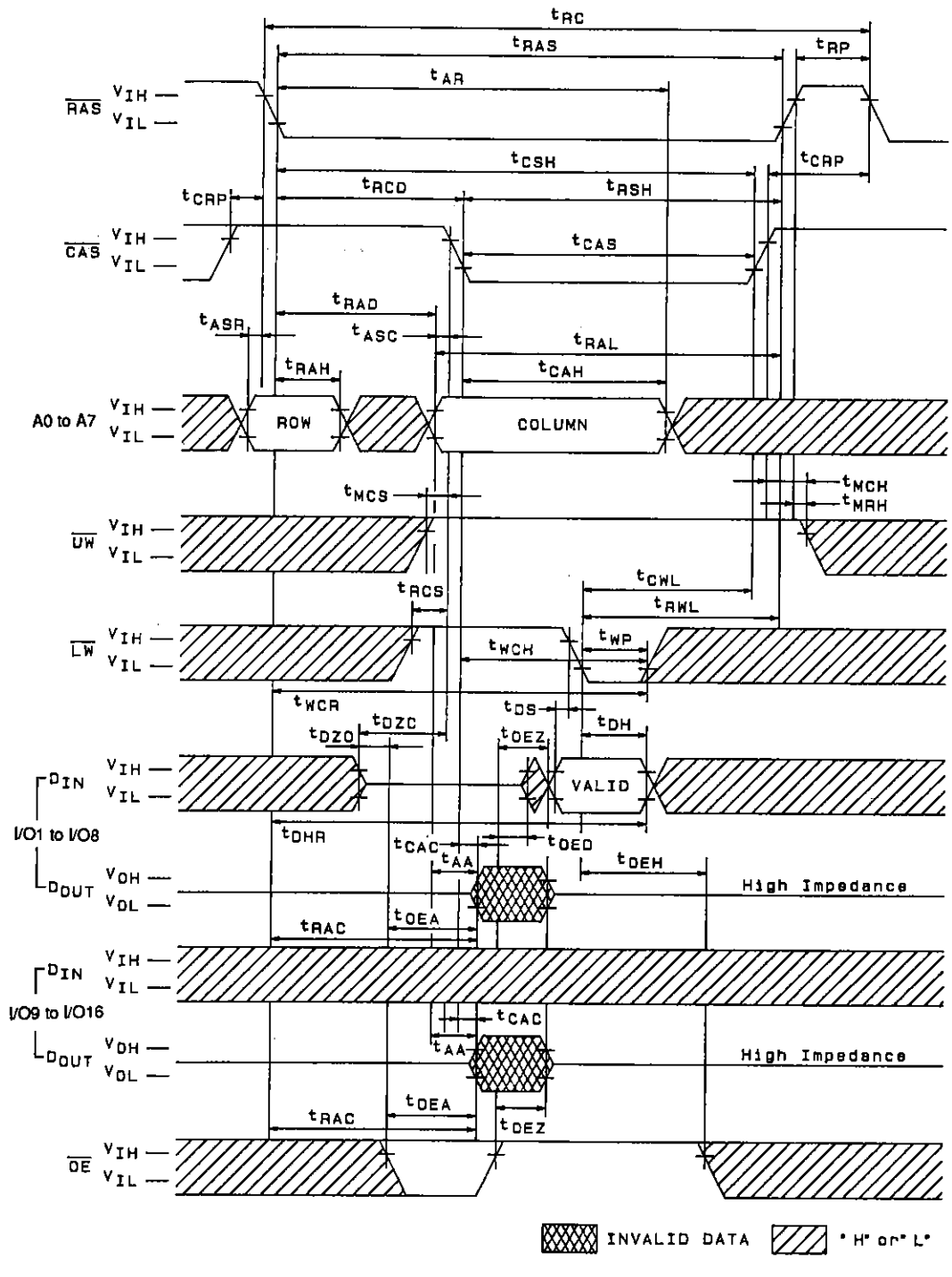
Write Cycle ($\overline{OE}$ Control)



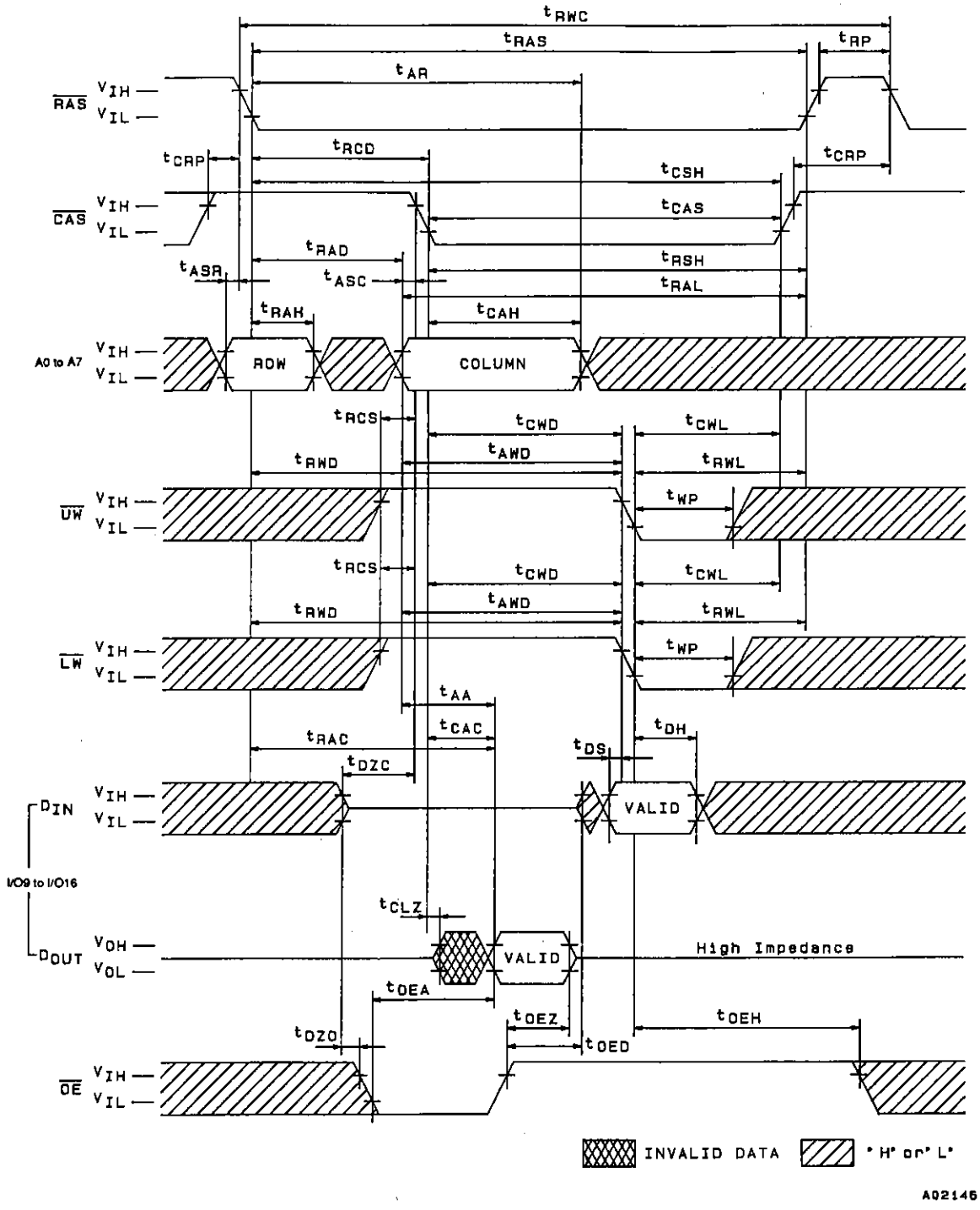
Upper Byte Write Cycle ($\overline{OE}$ Control)



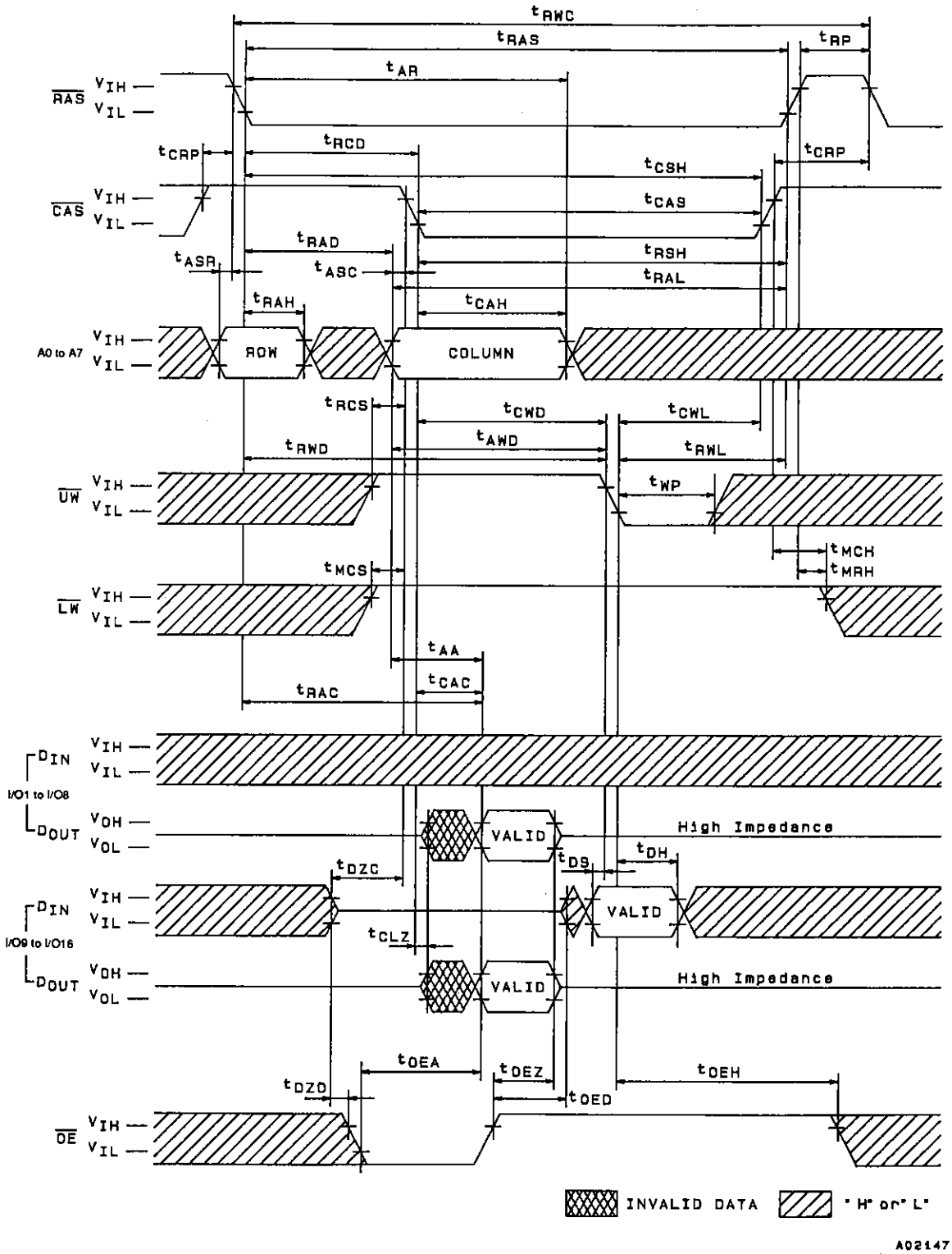
Lower Byte Write Cycle ($\overline{OE}$ Control)



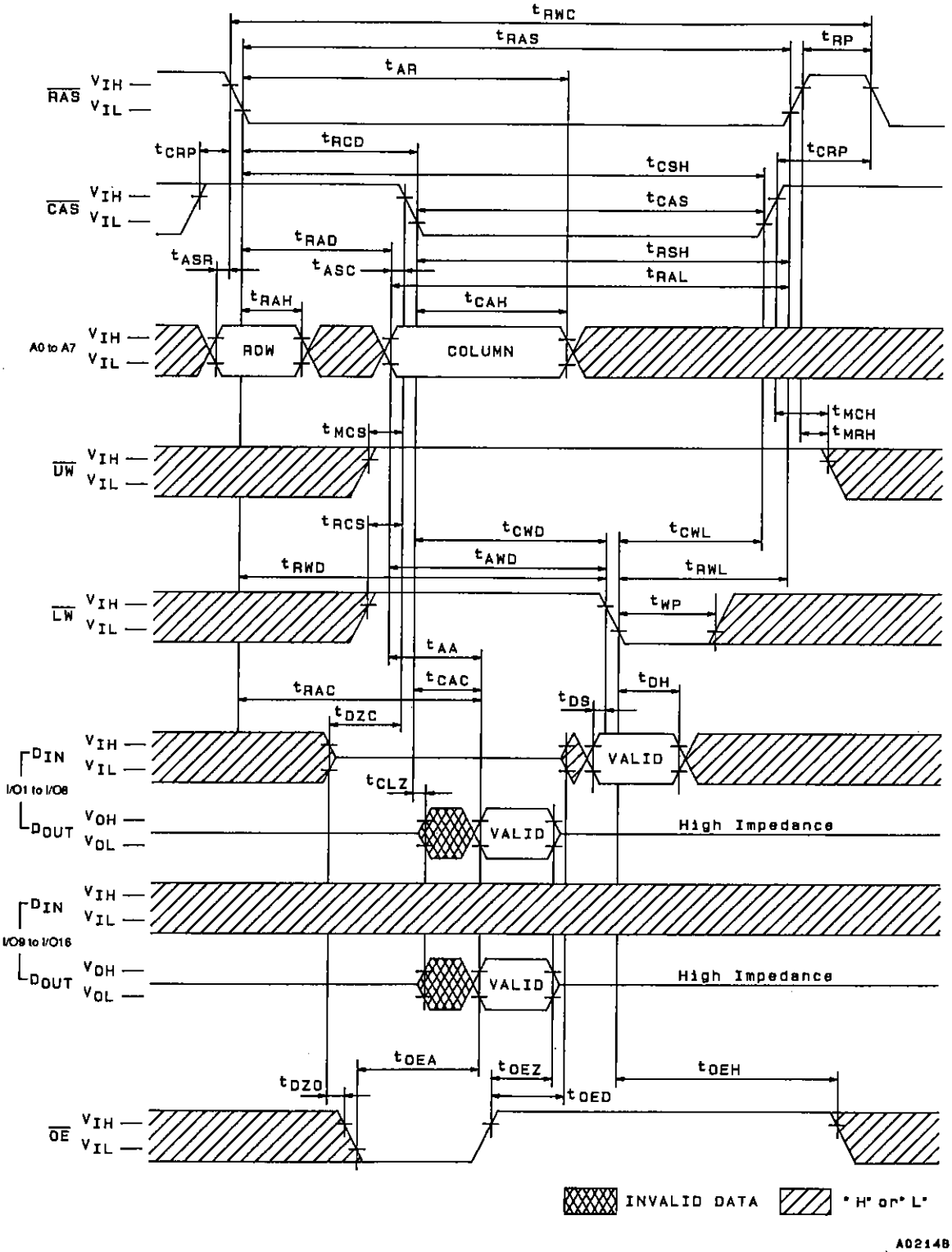
Read-Modify Write Cycle



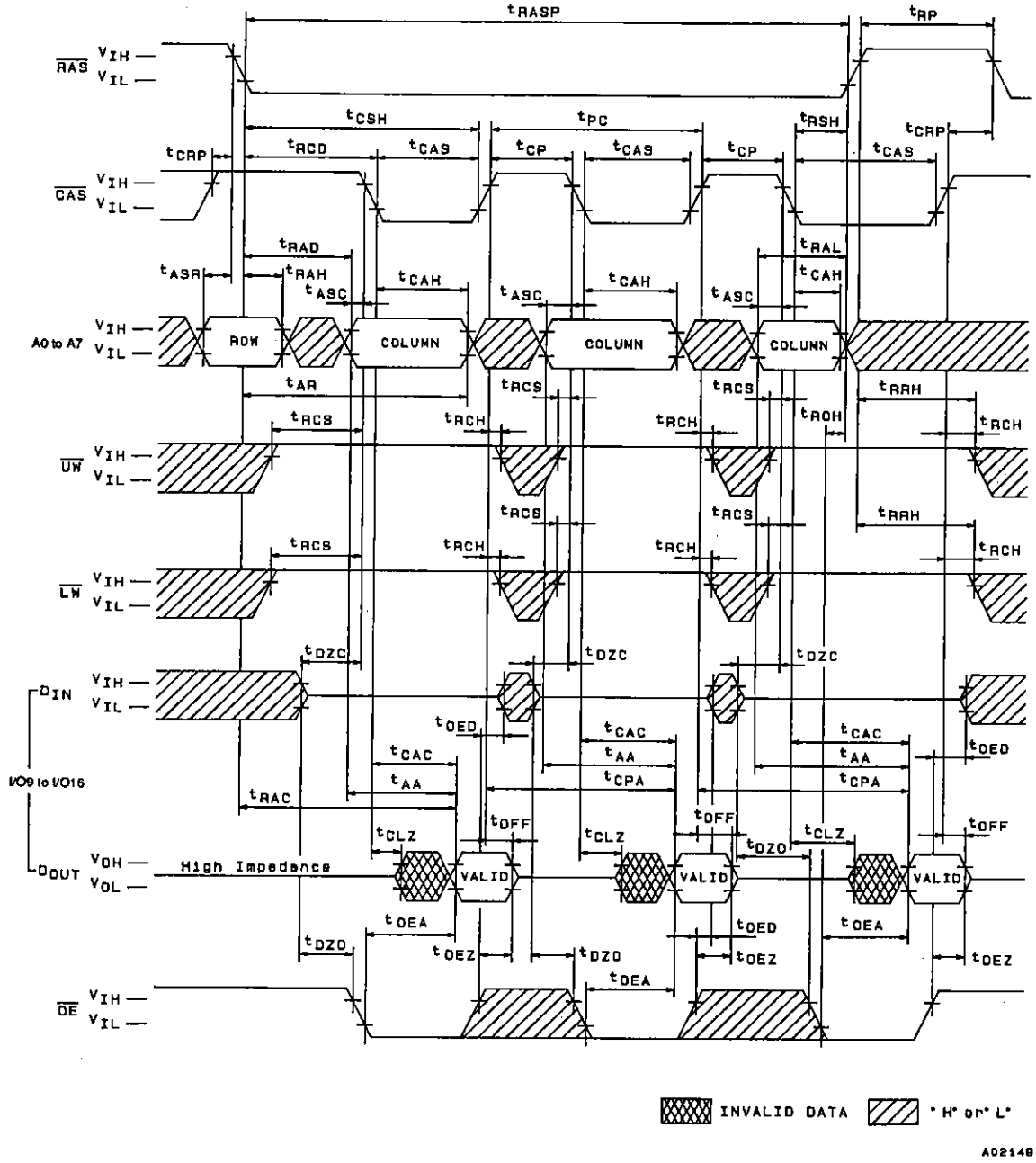
Read-Modify Upper Byte Write Cycle



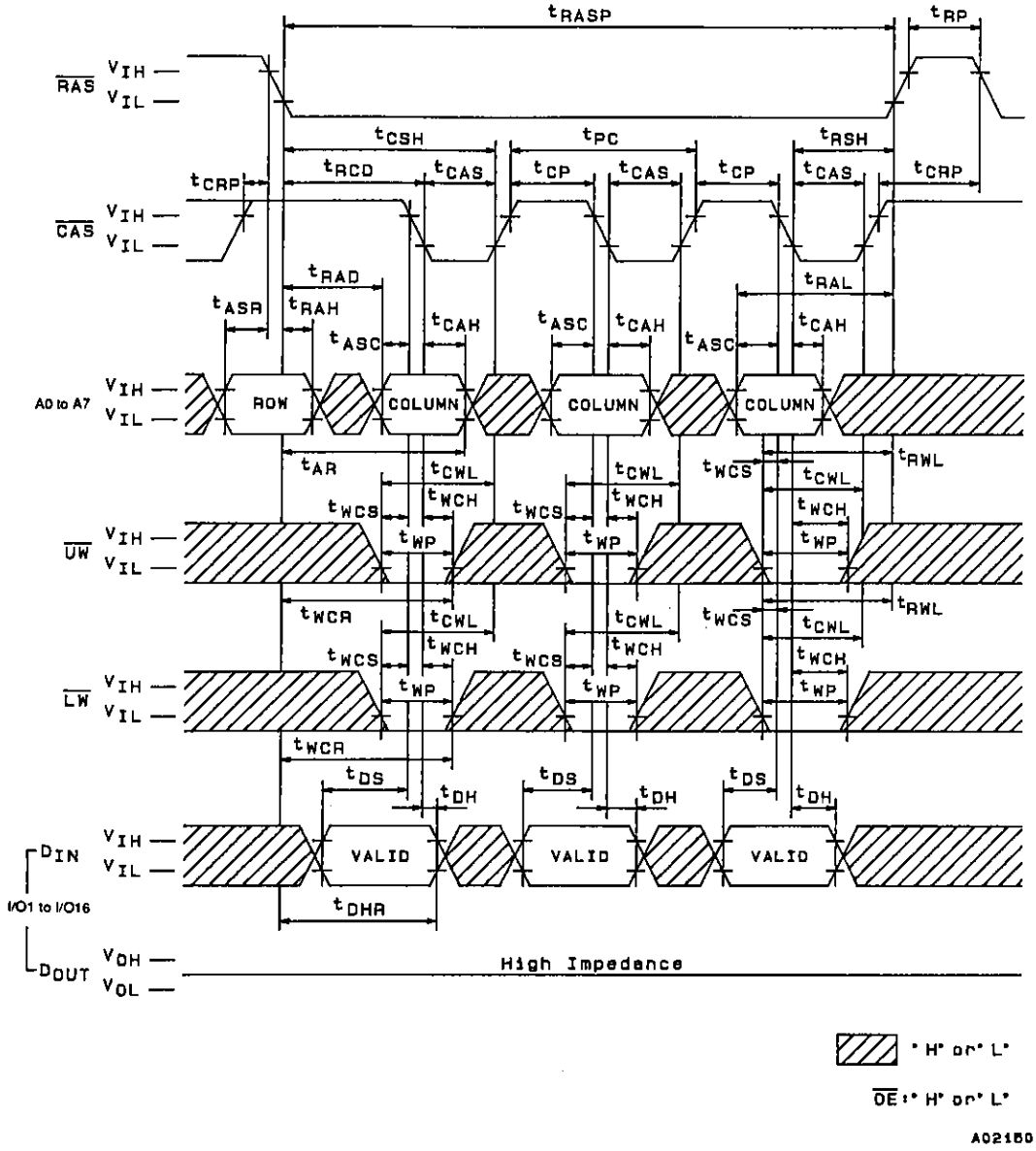
Read-Modify Lower Byte Write Cycle



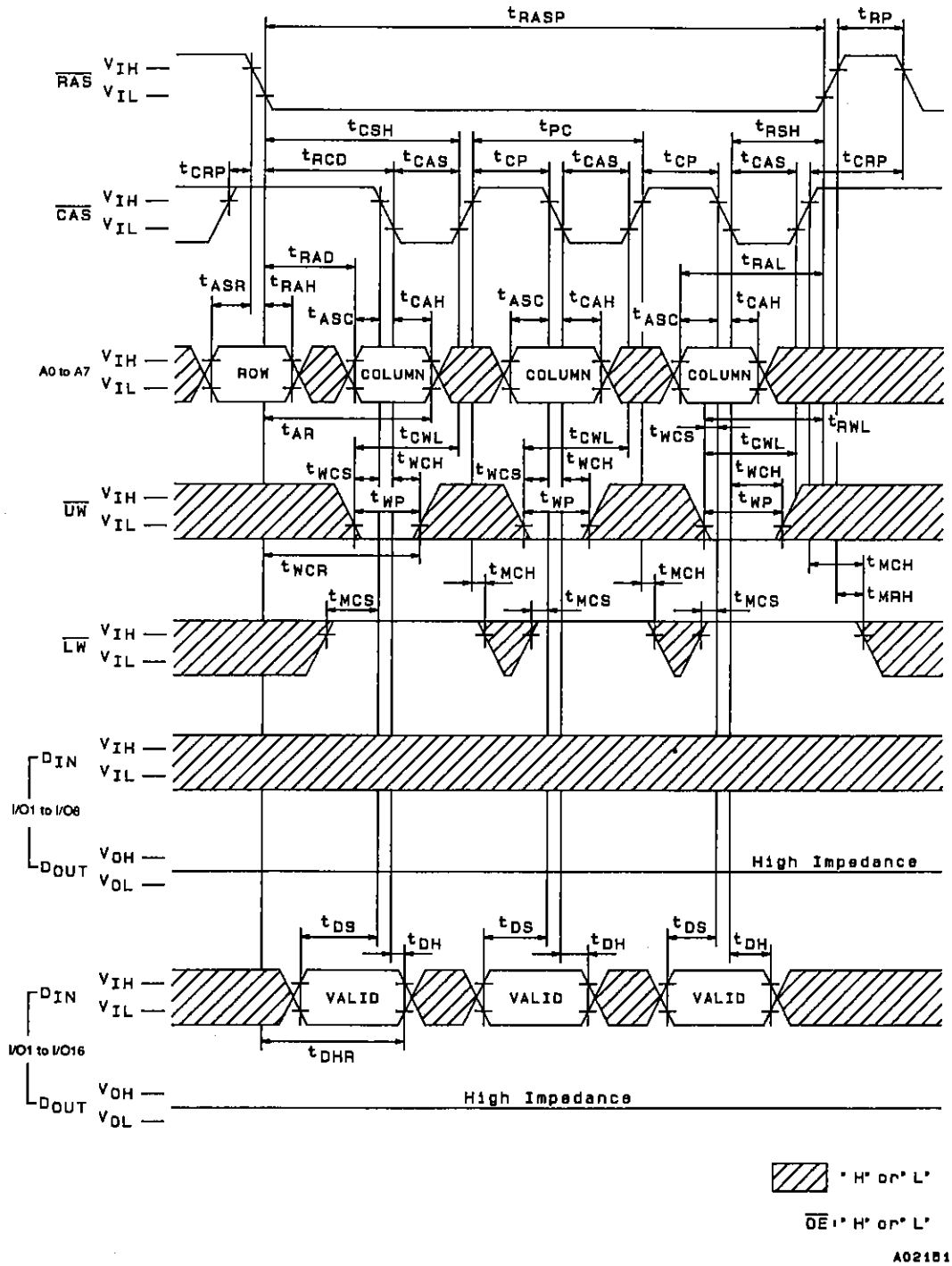
Fast Page Mode Read Cycle



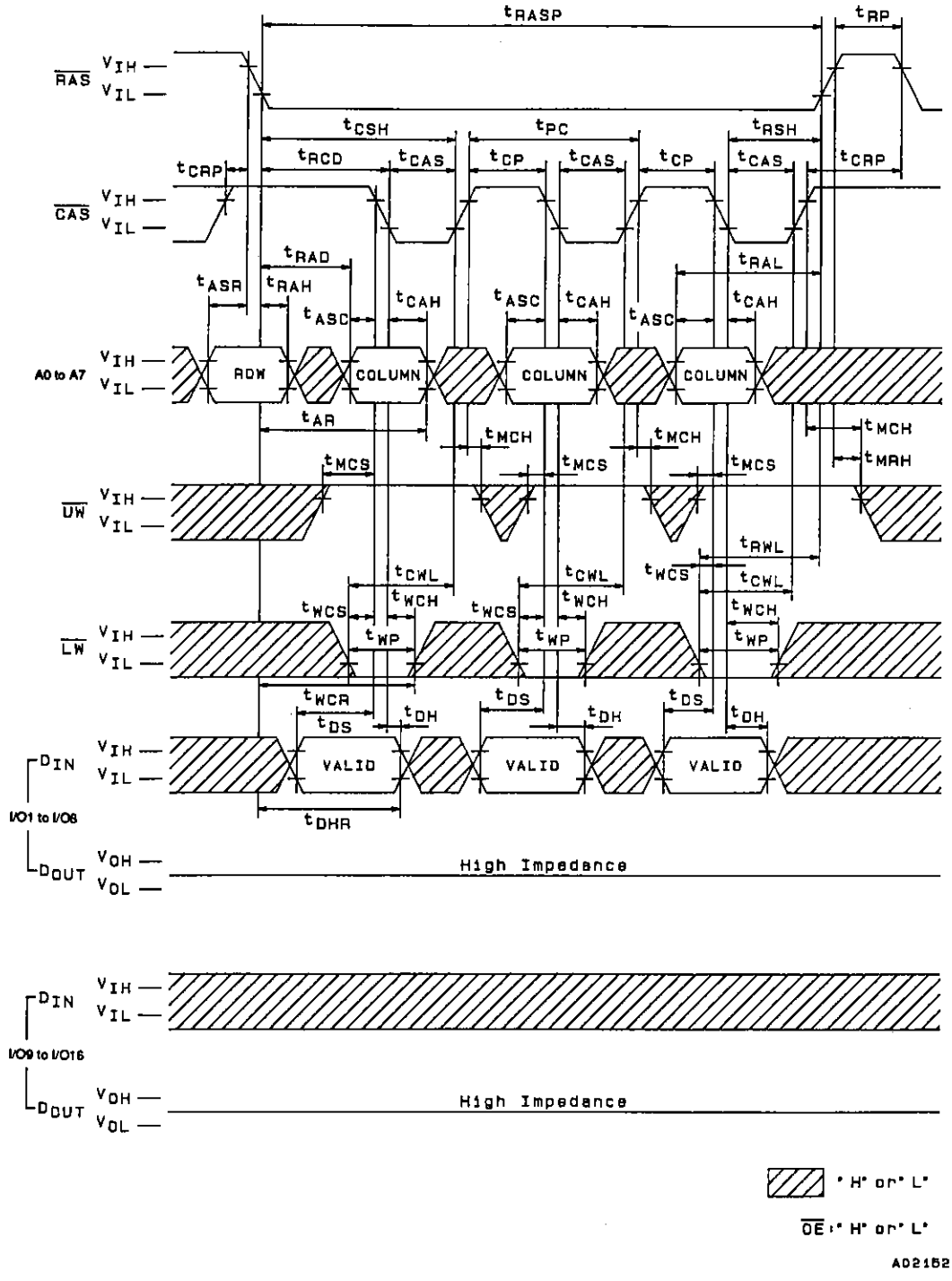
Fast Page Mode Early Write Cycle



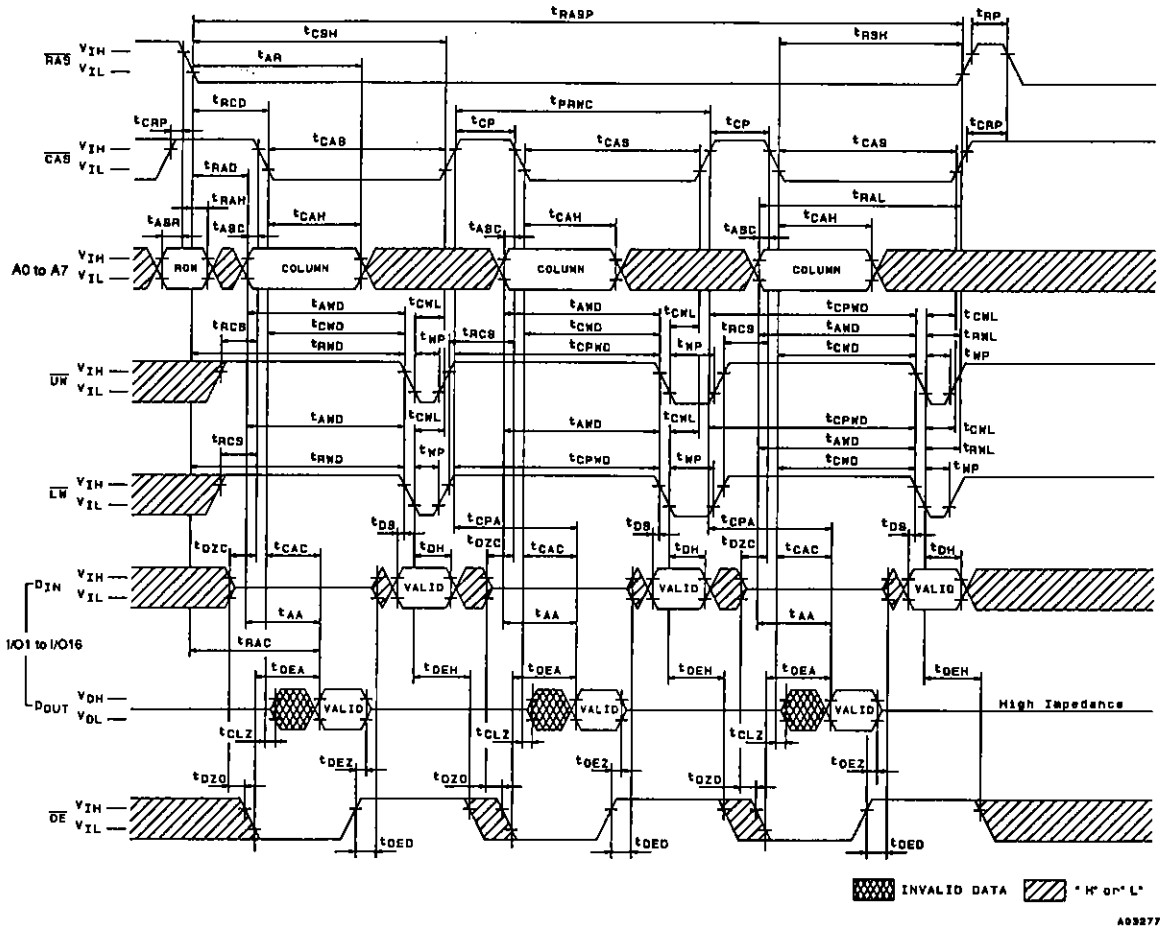
Fast Page Mode Upper Byte Early Write Cycle



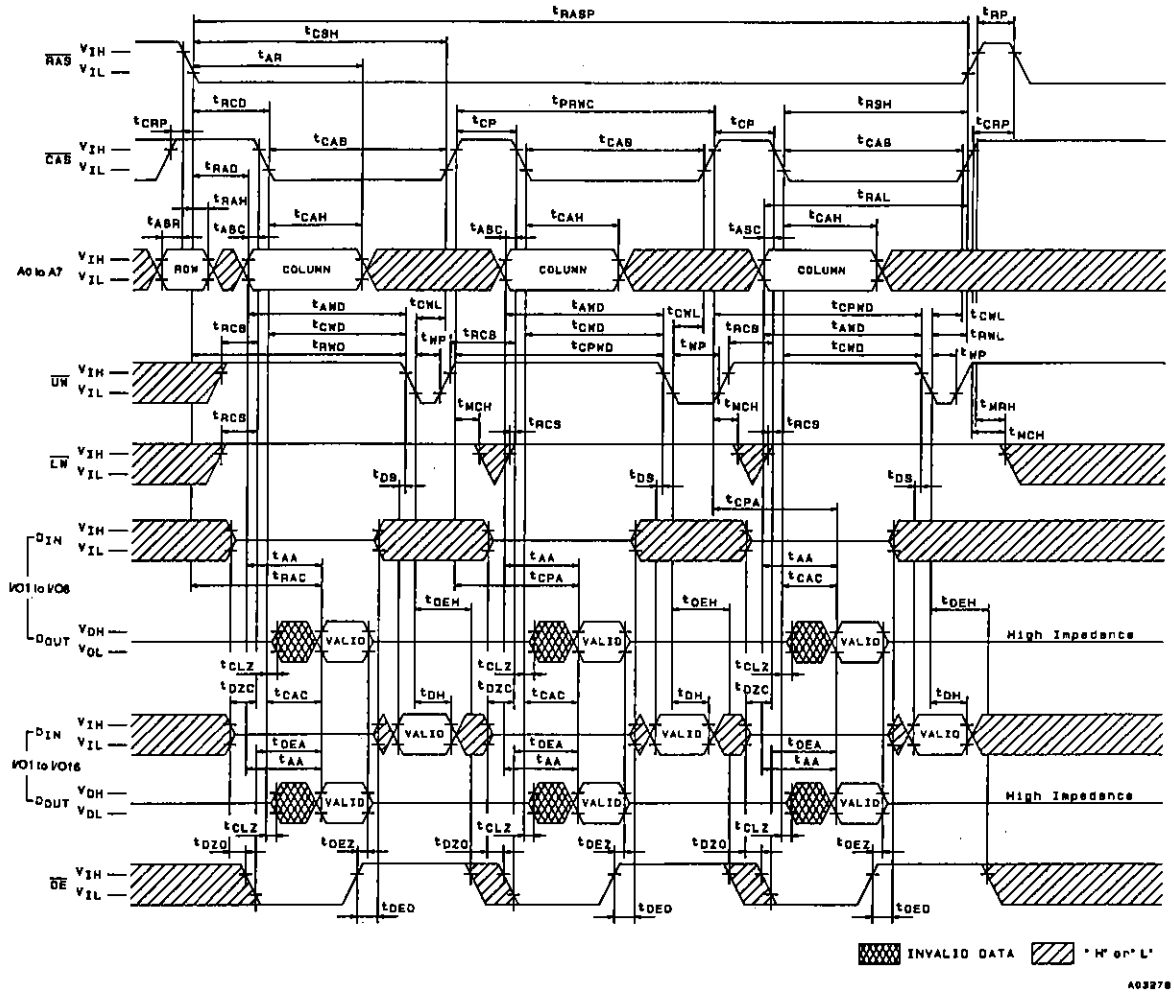
Fast Page Mode Lower Byte Early Write Cycle



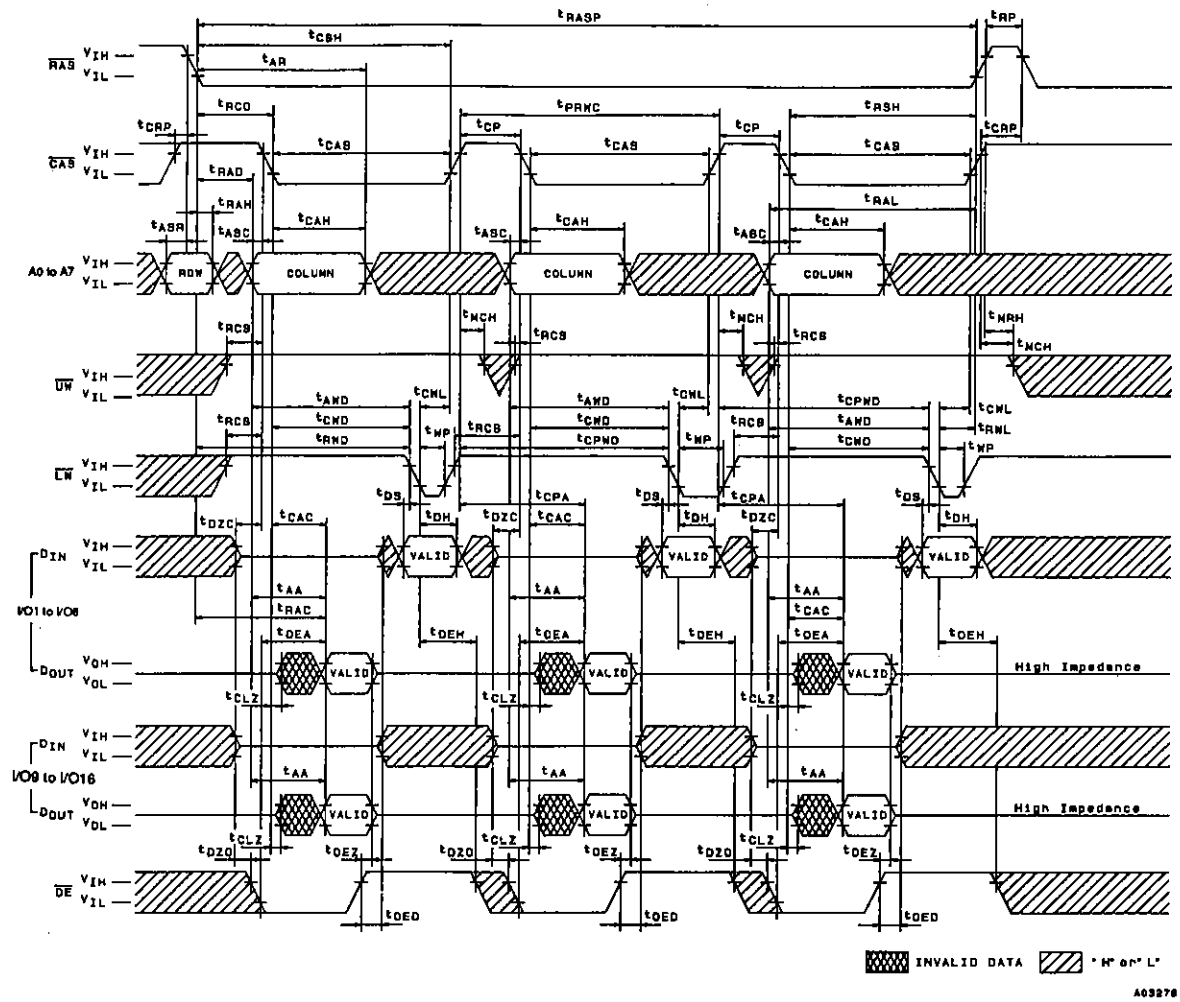
Fast Page Mode Read-Modify-Write Cycle



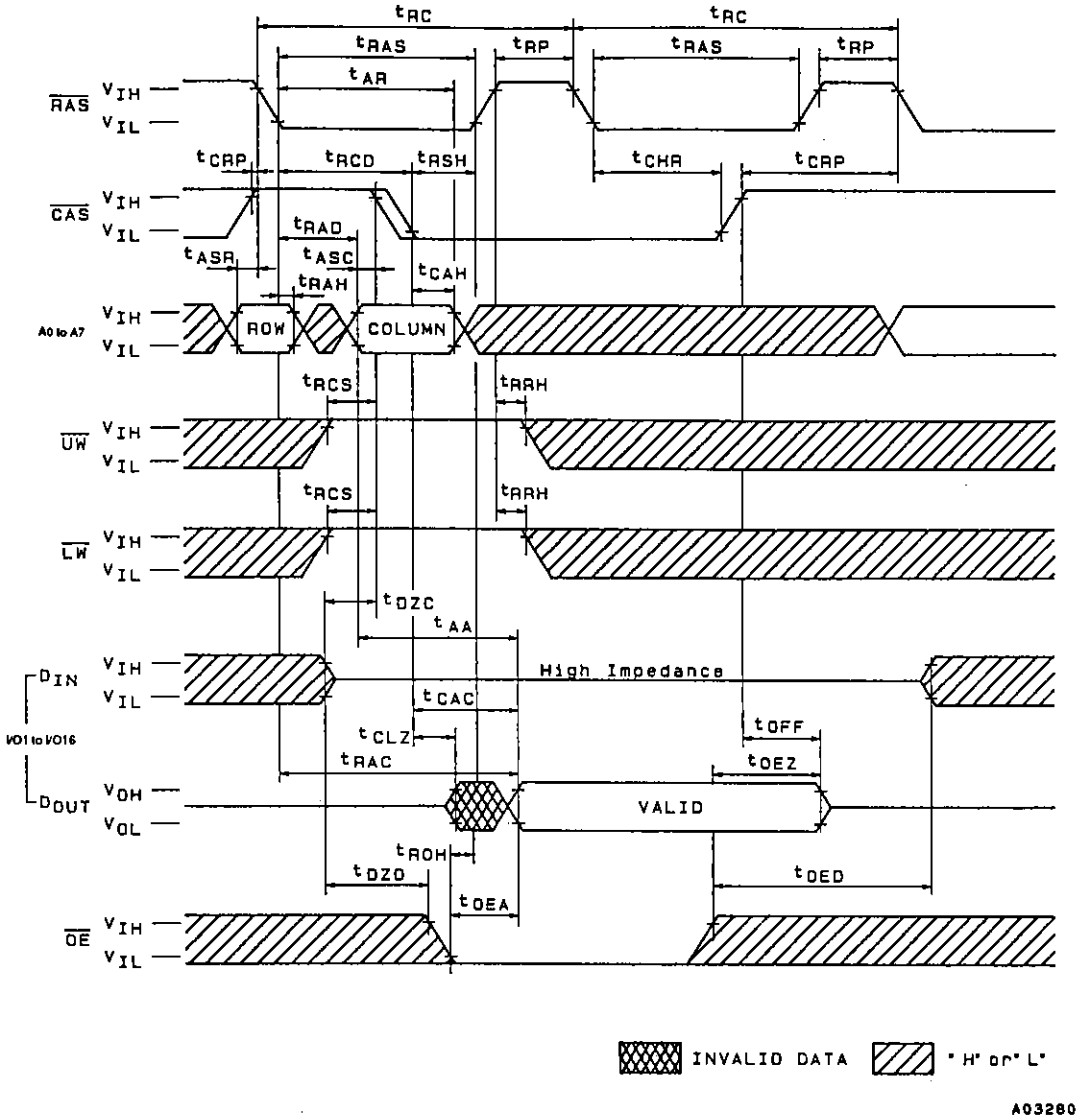
Fast Page Mode Read-Modify Upper Byte Write Cycle



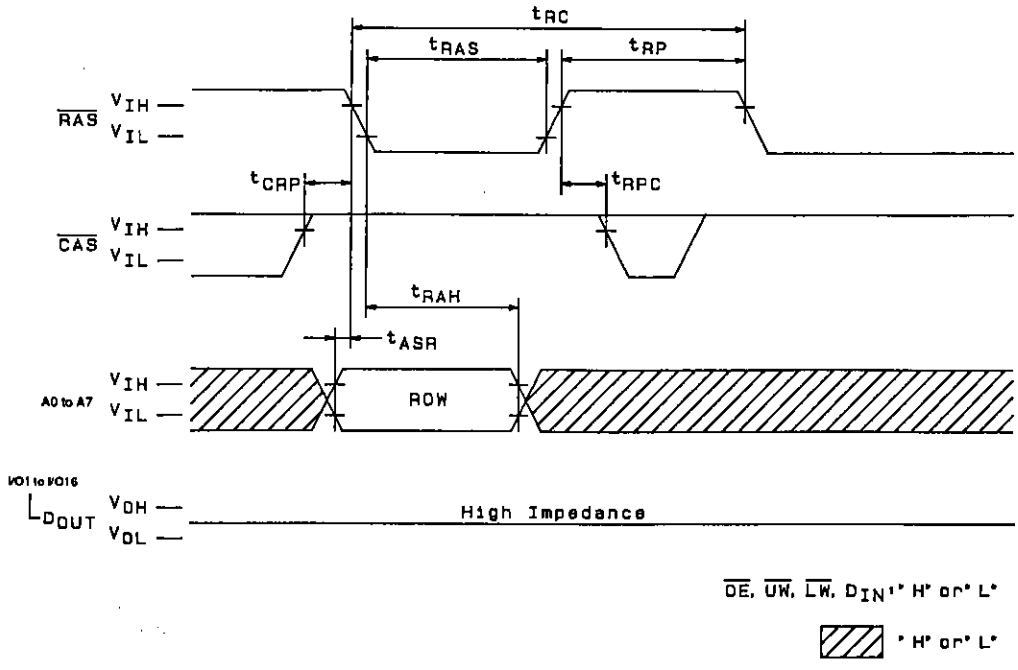
Fast Page Mode Read-Modify Lower Byte Write Cycle



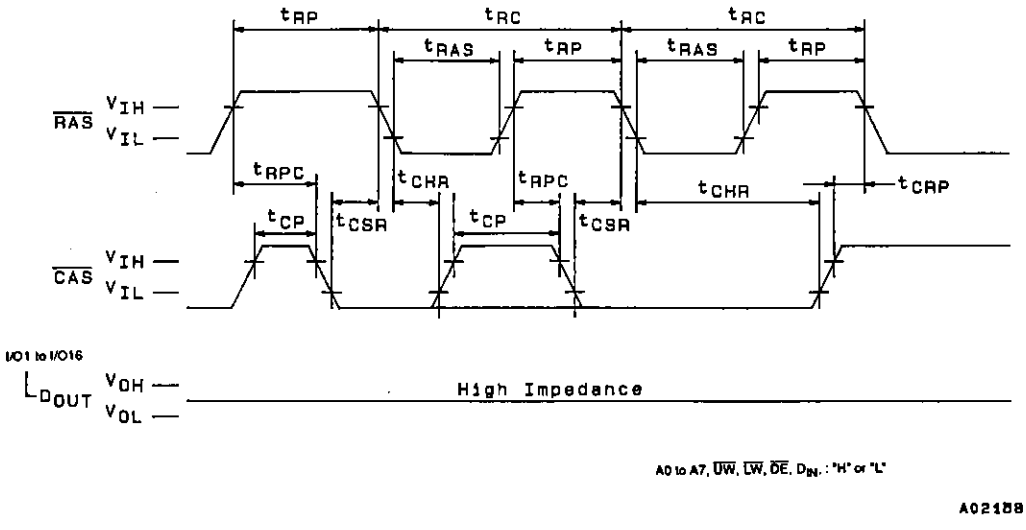
Hidden Refresh Cycle



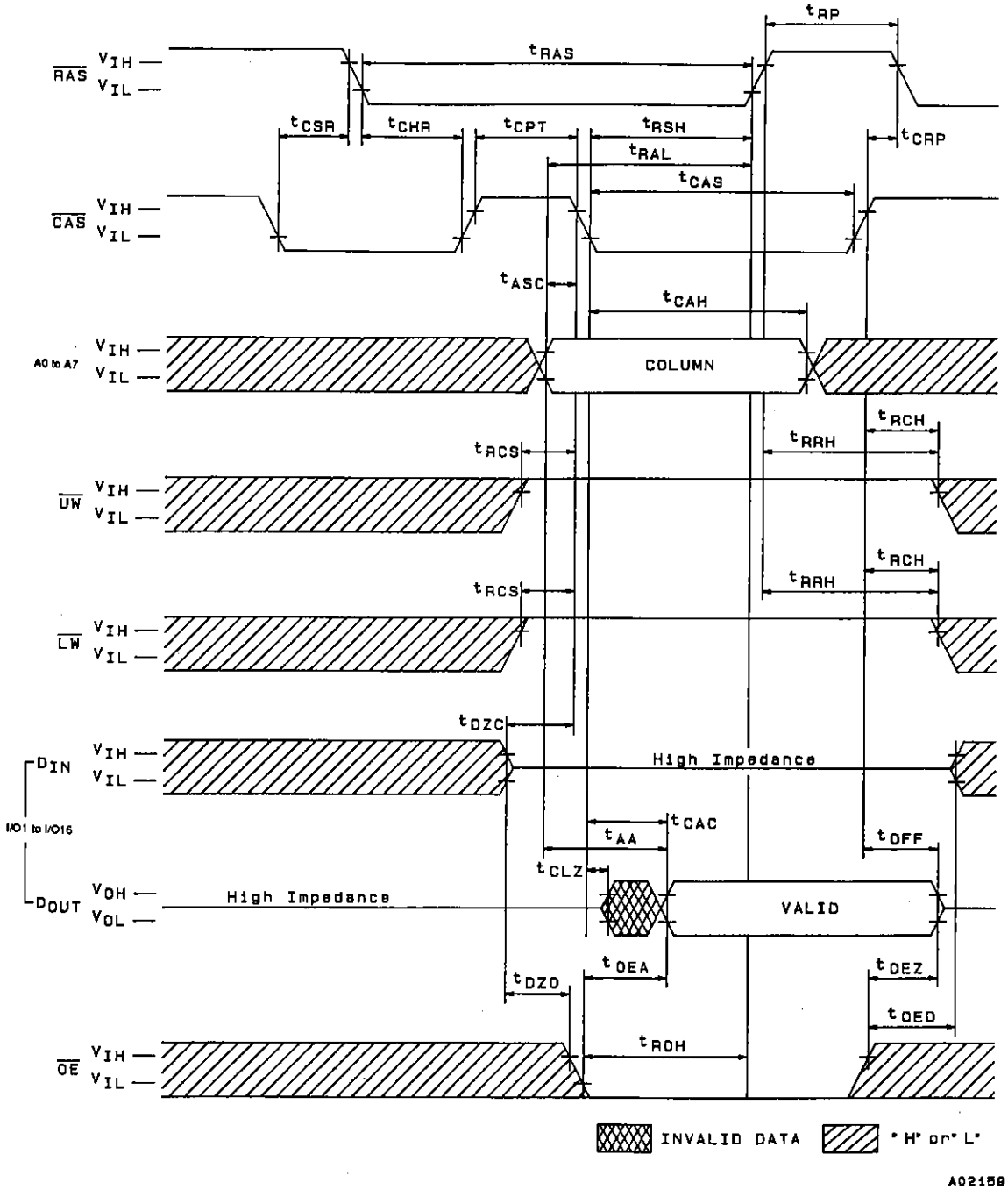
$\overline{\text{RAS}}$-Only Refresh Cycle



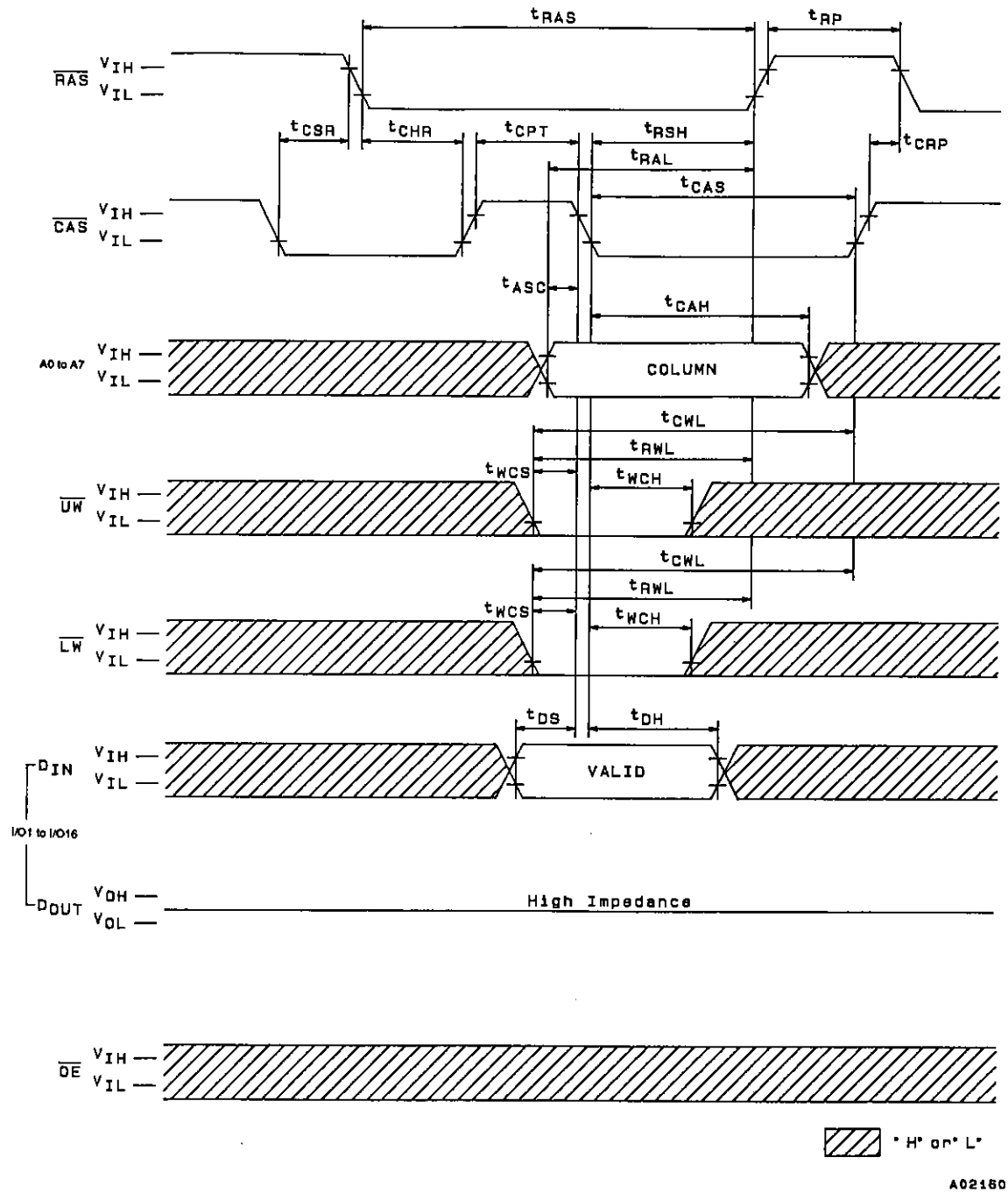
$\overline{\text{CAS}}$-Before-$\overline{\text{RAS}}$ Refresh Cycle



$\overline{CAS}$-Before-$\overline{RAS}$ Refresh Counter Test Cycle (Read)



$\overline{CAS}$-Before-$\overline{RAS}$ Refresh Counter Test Cycle (Write)



$\overline{CAS}$-Before-$\overline{RAS}$ Refresh Counter Test Cycle (Read-Modify-Write)