



LC321664BJ, BM, BT-70/80

CMOS LSI

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

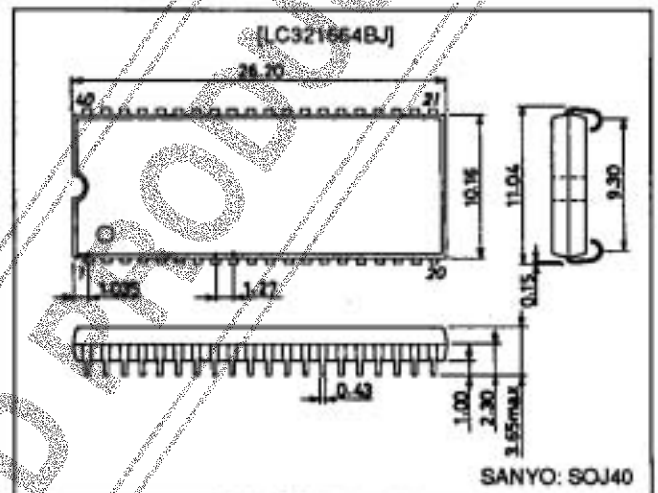
Features

- 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 ($\overline{\text{OE}}$) 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 (400 mil) plastic package : LC321664BJ
 SOP 40-pin (525 mil) plastic package : LC321664BM
 TSOP 44-pin (400 mil) plastic package : LC321664BT
- $\overline{\text{RAS}}$ access time/column address access time/ $\overline{\text{CAS}}$ access time/cycle time/power dissipation

Package Dimensions

unit: mm

3200-SOJ40

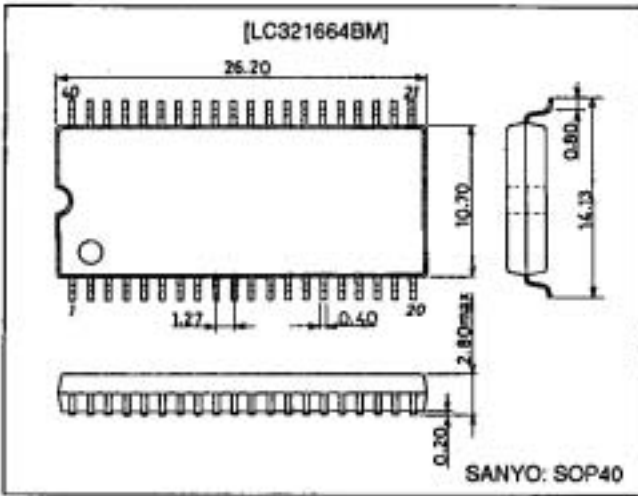


Parameter	LC321664BJ, BM, BT	
	-70	-80
RAS access time	70 ns	80 ns
Column address access time	40 ns	45 ns
CAS access time	25 ns	25 ns
Cycle time	125 ns	135 ns
Power dissipation (max)	During operation	688 mW
	During standby	5.5 mW (CMOS level)/11 mW (TTL level)

LC321664BJ, BM, BT-70/80

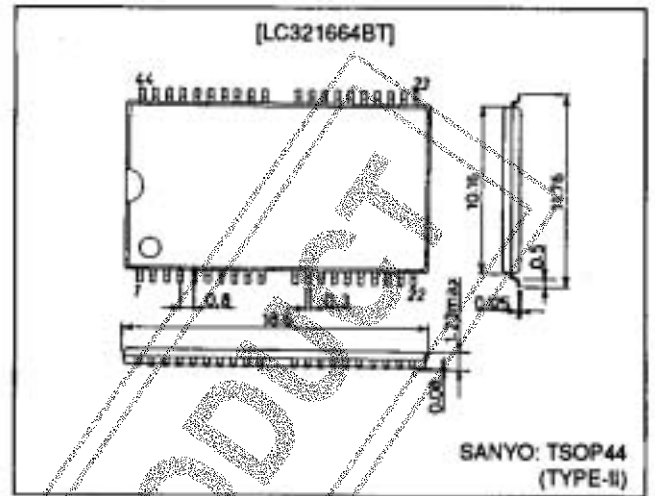
Package Dimensions
unit: mm

3195-SOP40

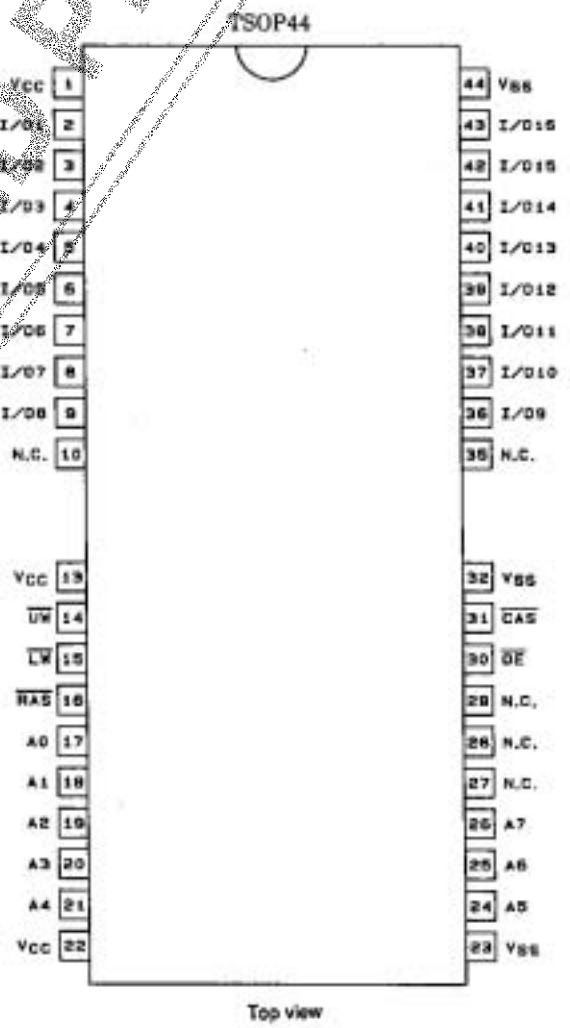
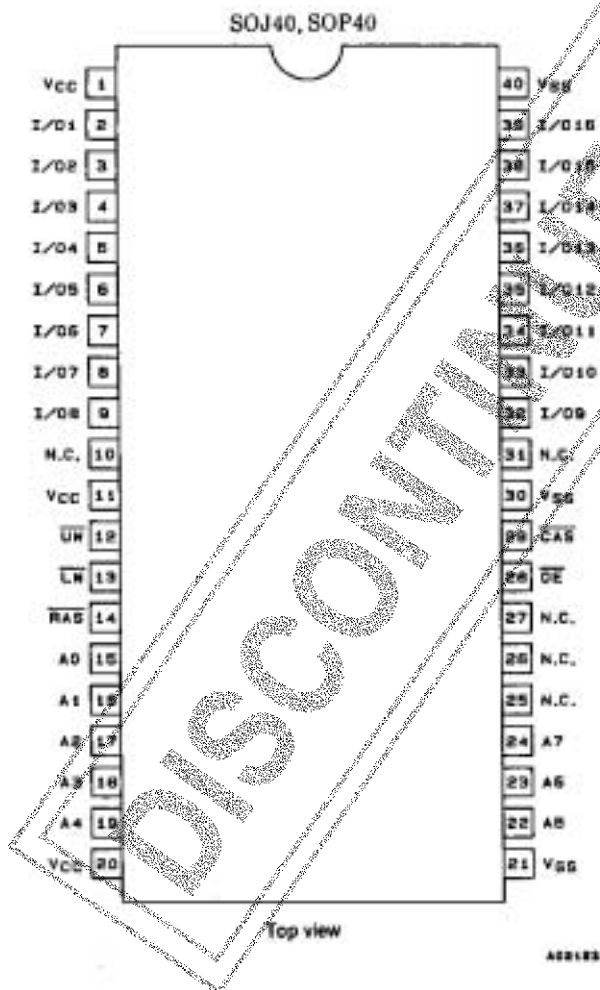


Package Dimensions
unit: mm

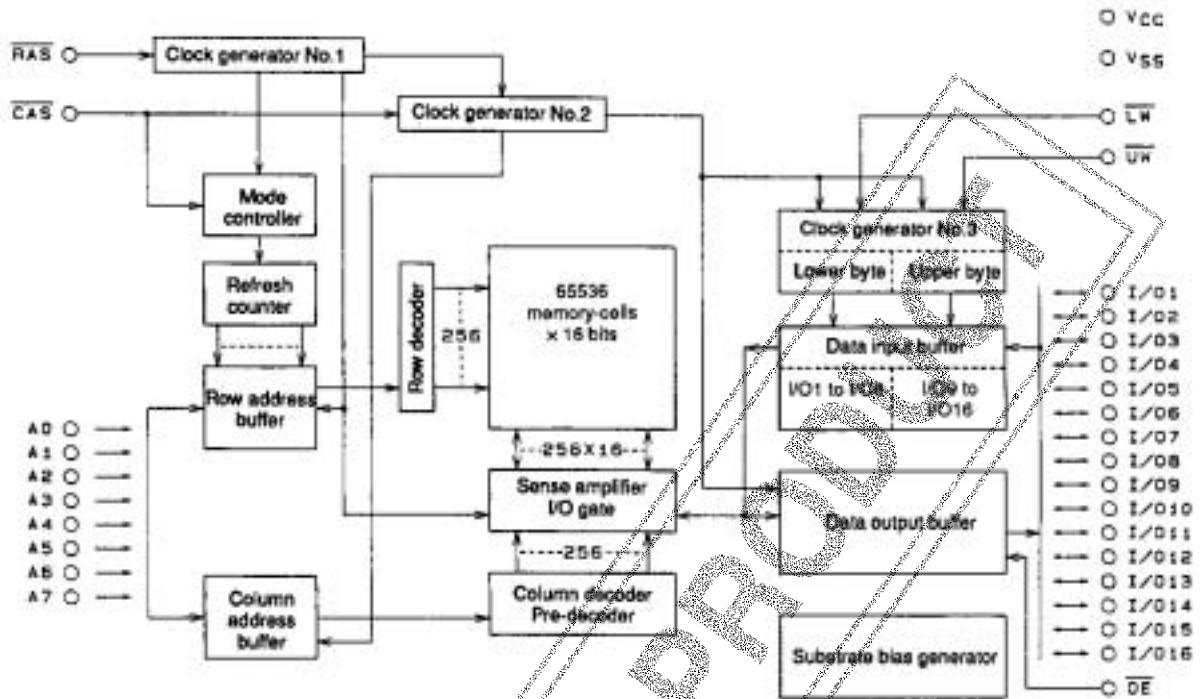
3207-TSOP44



Pin Assignments



Block Diagram



402125

Specifications

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Note
Maximum supply voltage	$V_{CC \text{ max}}$	-1.0 to +7.0	V	1
Input voltage	V_{IH}	-1.0 to +7.0	V	1
Output voltage	V_{OUT}	-1.0 to +7.0	V	1
Allowable power dissipation	$P_d \text{ max}$	LC321664BJ, BM	mW	1
		LC321664BT		
Output short-circuit current	I_{OUT}	50	mA	1
Operating temperature range	T_{op}	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 (A0 to A7, RAS, CAS, LW, UW, CE)	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.

LC321664BJ, BM, BT-70/80

DC Electrical Characteristics at Ta = 0 to +70°C, VCC = 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}	RAS, CAS, address cycling; t _{RC} = t _{RC} min		125		115	mA	3, 4, 5
Standby current	I _{CC2}	RAS = CAS = V _{IH}		2		2	mA	
RAS-only refresh current	I _{CC3}	RAS cycling, CAS = V _{IH} ; t _{RC} = t _{RC} min		125		115	mA	3, 5
Fast page mode current	I _{CC4}	RAS = V _{IL} , CAS, address cycling; t _{RC} = t _{RC} min		60		70	mA	3, 4, 5
Standby current	I _{CC5}	RAS = CAS = V _{CC} - 0.2 V		1		1	mA	
CAS-before-RAS refresh current	I _{CC6}	RAS, CAS cycling; t _{RC} = t _{RC} min		125		115	mA	3
Input leakage current	I _L	0 V ≤ V _{IN} ≤ 5.5 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 impermoderately, 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 RAS = V_{IL}. Concerning I_{CC1}, it is less than or equal to one time during 1 cycle (t_{PC}).

AC Electrical Characteristics at Ta = 0 to +70°C, VCC = 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 _{RWC}	95		100		ns	
RAS access time	t _{RAC}		70		80	ns	9, 14, 15
CAS access time	t _{CAC}		25		25	ns	9, 14
Column address access time	t _{AA}		40		45	ns	9, 15
CAS precharge access time	t _{AP}		45		50	ns	9
Output low-impedance time from CAS low	t _{OLZ}	0		0		ns	9
Output buffer turn-off delay time	t _{OFF}	0	20	0	20	ns	10
Rise, fall time	t _r	3	50	3	50	ns	
RAS precharge time	t _{RP}	45		45		ns	
RAS pulse width	t _{RAS}	70	10000	80	10000	ns	
RAS pulse width for fast page mode only	t _{RASP}	70	100000	80	100000	ns	
RAS hold time	t _{RSH}	25		25		ns	
CAS hold time	t _{CASH}	70		80		ns	
CAS pulse width	t _{CAS}	25	10000	25	10000	ns	
RAS to CAS delay time	t _{RCD}	20	45	20	55	ns	14
RAS to column address delay time	t _{RAD}	15	30	15	35	ns	15
CAS to RAS precharge time	t _{CRP}	10		10		ns	
CAS precharge time	t _{CP}	10		10		ns	
Row address setup time	t _{ASR}	0		0		ns	
Row address hold time	t _{AH}	10		10		ns	
Column address setup time	t _{ASC}	0		0		ns	
Column address hold time	t _{AH}	15		15		ns	
Column address hold time referenced to RAS	t _{AR}	50		55		ns	
Column address to RAS lead time	t _{RA}	35		40		ns	
Read command setup time	t _{ACS}	0		0		ns	
Read command hold time referenced to CAS	t _{ACH}	0		0		ns	11
Read command hold time referenced to RAS	t _{RRH}	0		0		ns	11
Write command hold time	t _{WCH}	15		15		ns	
Write command hold time referenced to RAS	t _{WCR}	50		55		ns	

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LC321664BJ, BM, BT-70/80

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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 RAS lead time	t_{RWL}	20		20		ns	
Write command to 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 RAS	t_{DHR}	50		55		ns	
Refresh time	t_{REF}		4		4	ms	
Write command setup time	t_{WCS}	0		0		ns	13
CAS to \overline{UW} , \overline{LW} delay time	t_{CWD}	45		45		ns	13
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
CAS precharge \overline{UW} , \overline{LW} delay time for fast page mode cycle only	t_{CPWD}	65		70		ns	13
CAS setup time for CAS-before-RAS	t_{CSR}	10		10		ns	
CAS hold time for CAS-before-RAS	t_{CHR}	10		10		ns	
RAS precharge CAS active time	t_{RPC}	10		10		ns	
CAS precharge time for CAS-before-RAS counter test	t_{CPT}	40		40		ns	
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_{ODD}	15		15		ns	
\overline{OE} output buffer turn-off delay time	t_{OET}	0	15	0	15	ns	10
\overline{OE} command hold time	t_{OEH}	20		20		ns	
Data input to 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 RAS	t_{MRH}	0		0		ns	
Masked write hold time referenced to CAS	t_{MCH}	0		0		ns	

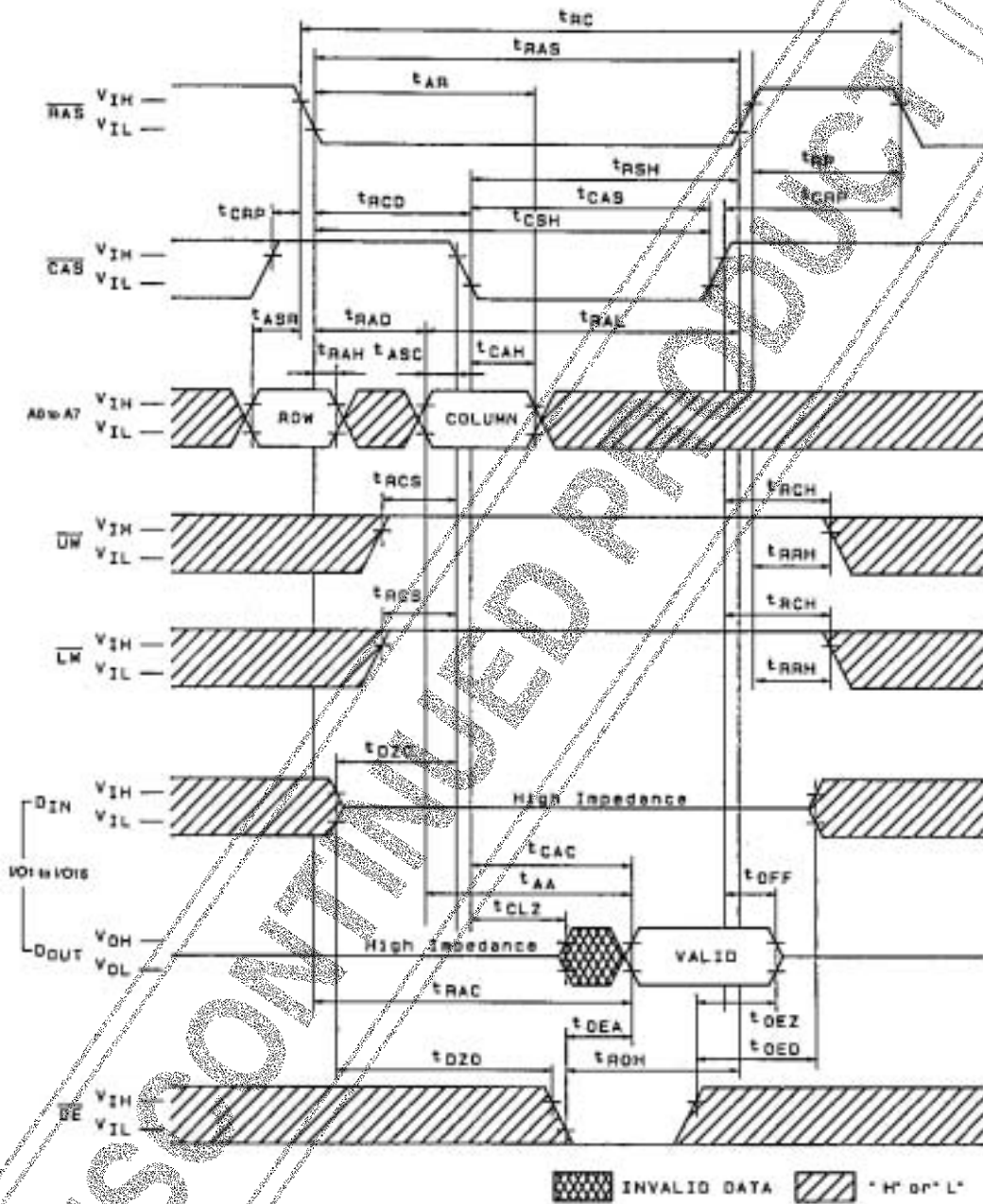
Input/Output Capacitance at $T_a = 25^\circ\text{C}$, $f = 1\text{ MHz}$, $V_{CC} = 5\text{ V} \pm 10\%$

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

- Note:
- An initial pause of 200 μs is required after power-up followed by eight RAS-only refresh cycles before proper device operation is achieved. In case of using refresh counter, a minimum of eight CAS-before-RAS refresh cycles instead of eight RAS-only refresh cycles are required.
 - Measured at $t_r = 5\text{ ns}$.
 - 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} .
 - Measured using an equivalent of 50 pF and the standard TTL loads.
 - t_{OFF} (max) and t_{OZC} (max) are defined as the time until output voltage can no longer be measured when output switches to a high impedance condition.
 - Operation is guaranteed if either t_{ROH} or t_{RCH} is satisfied.
 - These parameters are measured from the falling edge of 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.
 - 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.
 - t_{RCH} (max) is not a restrictive operating parameter but instead represents the point at which the access time t_{RAC} (max) is guaranteed. If $t_{RCH} \geq t_{RCH}$ (max), access time is determined according to t_{CAC} .
 - 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} .
 - Operation is guaranteed if either t_{DZC} or t_{DZO} is satisfied.

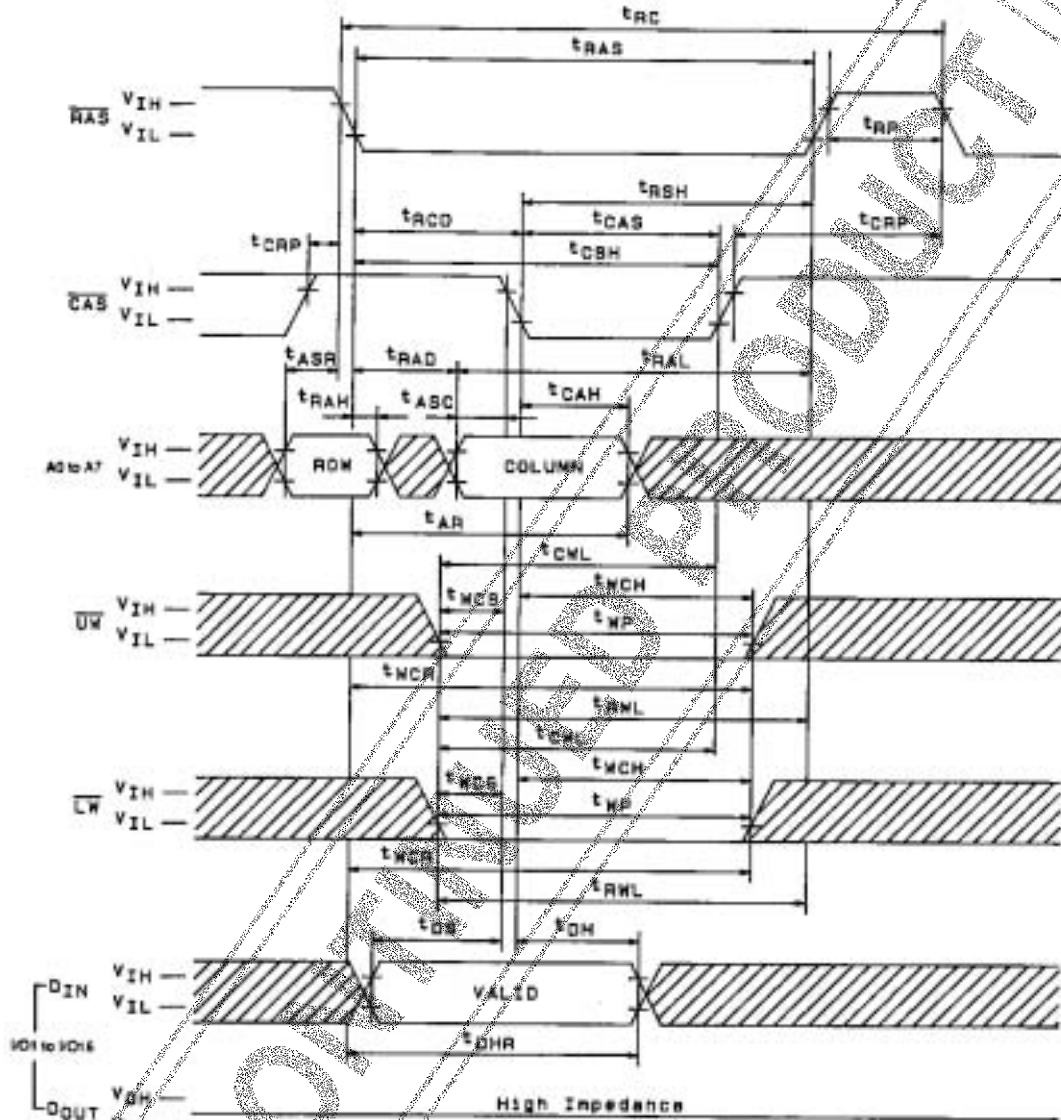
Timing Chart



Read Cycle



A02139

Early Write Cycle

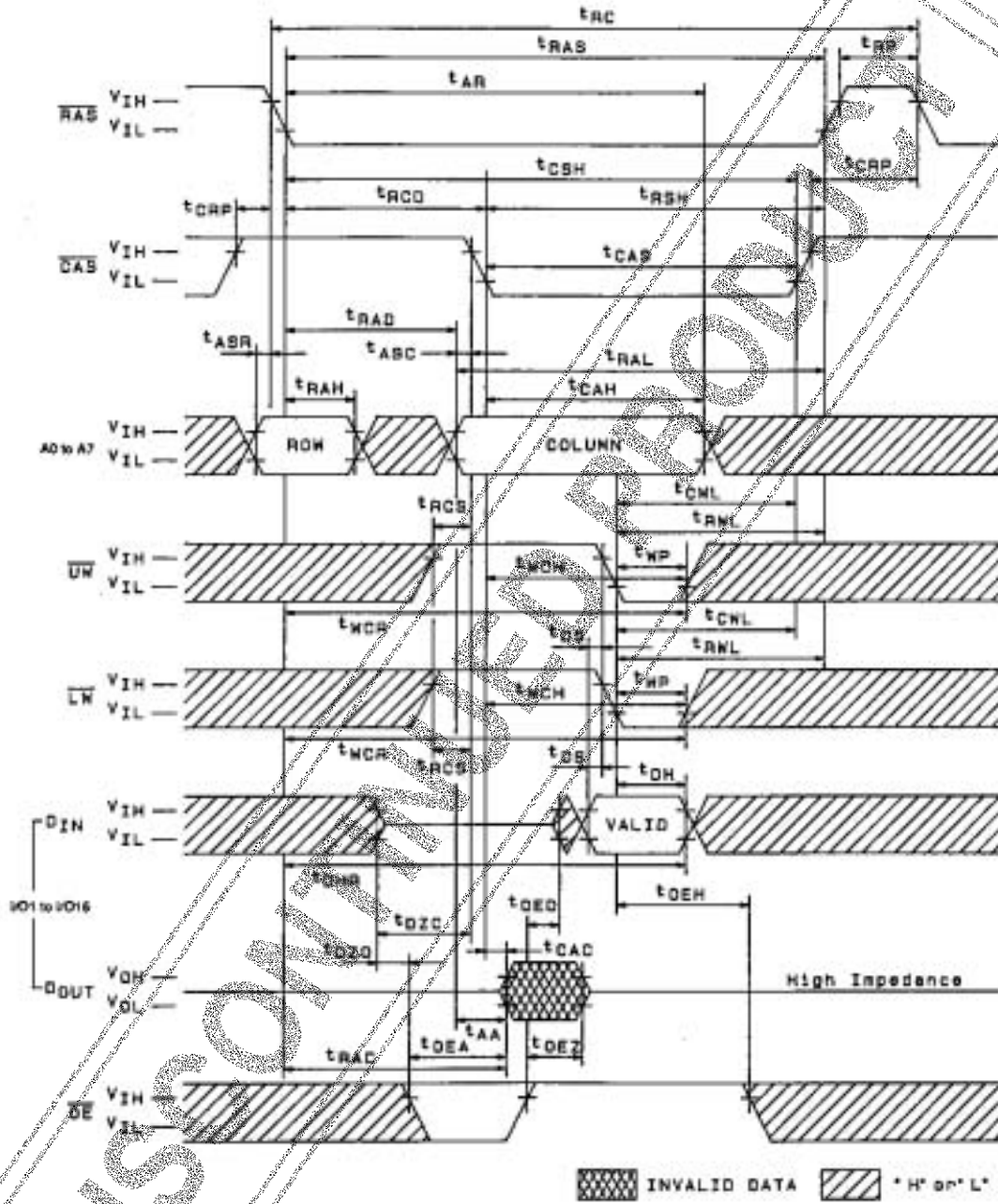


 * H* or* L*
 $\overline{0E}$ * H* or* L*

ADD140

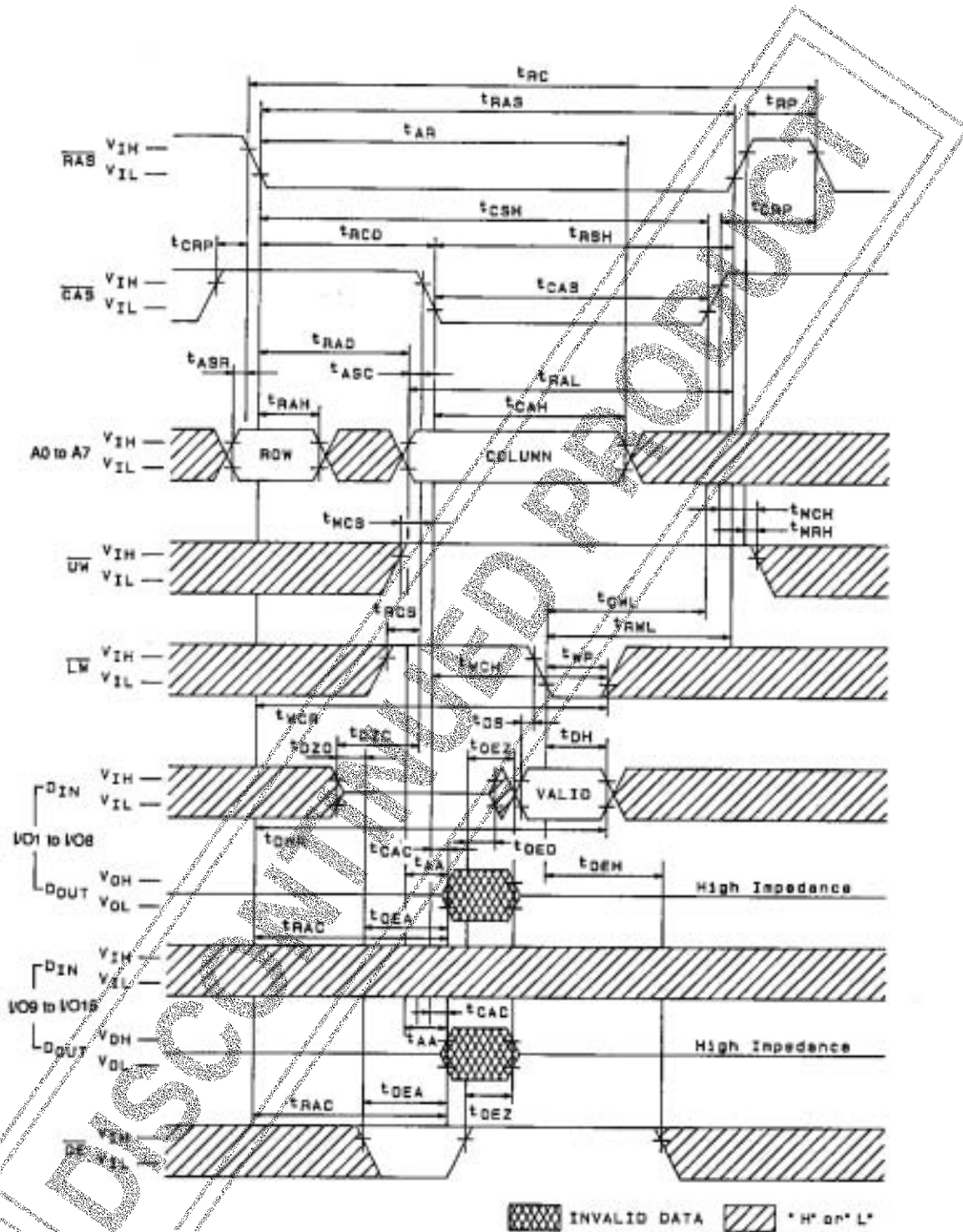
DISCONTINUED PRODUCT

Write Cycle (\overline{OE} Control)



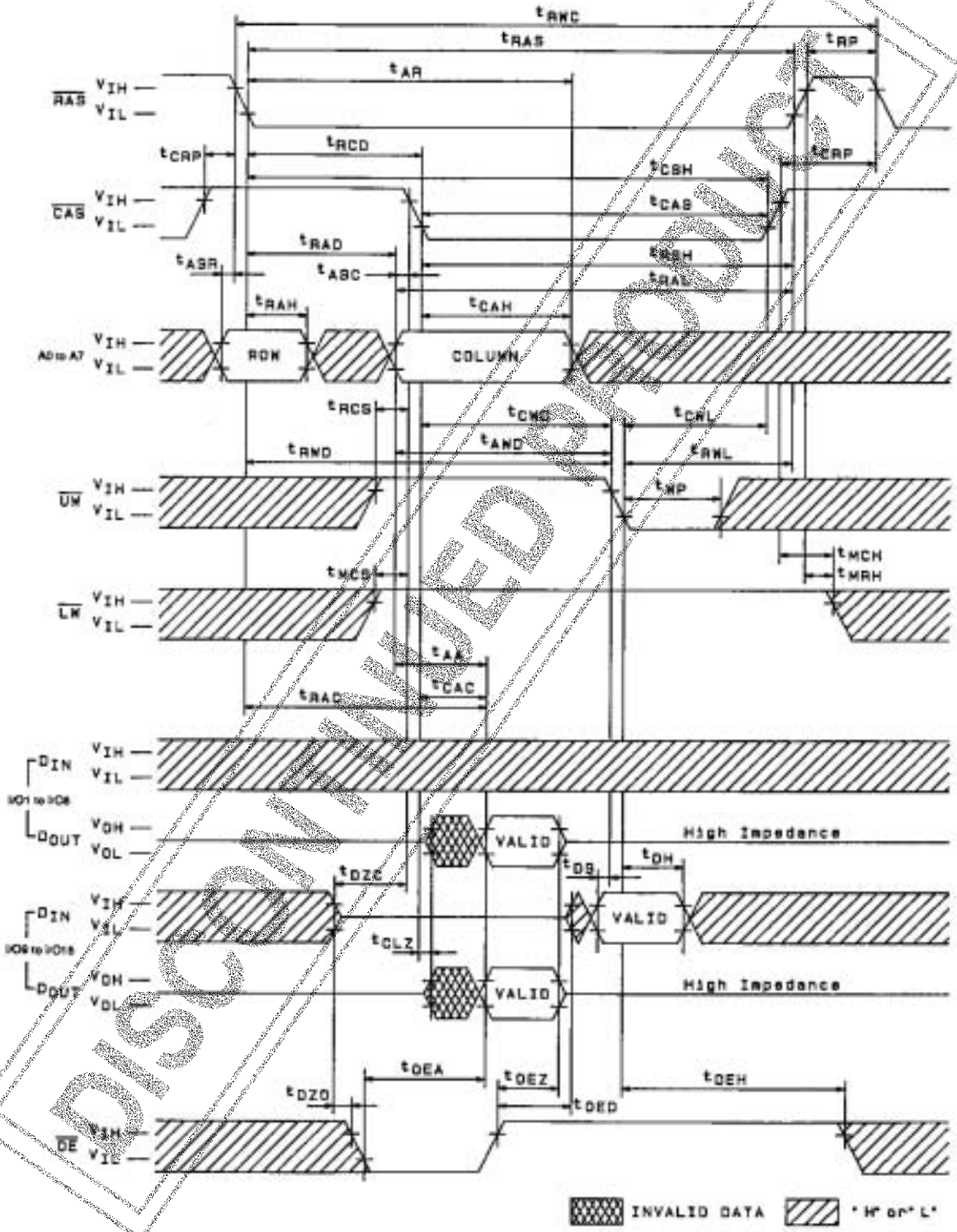
402143

Lower Byte Write Cycle (OE Control)



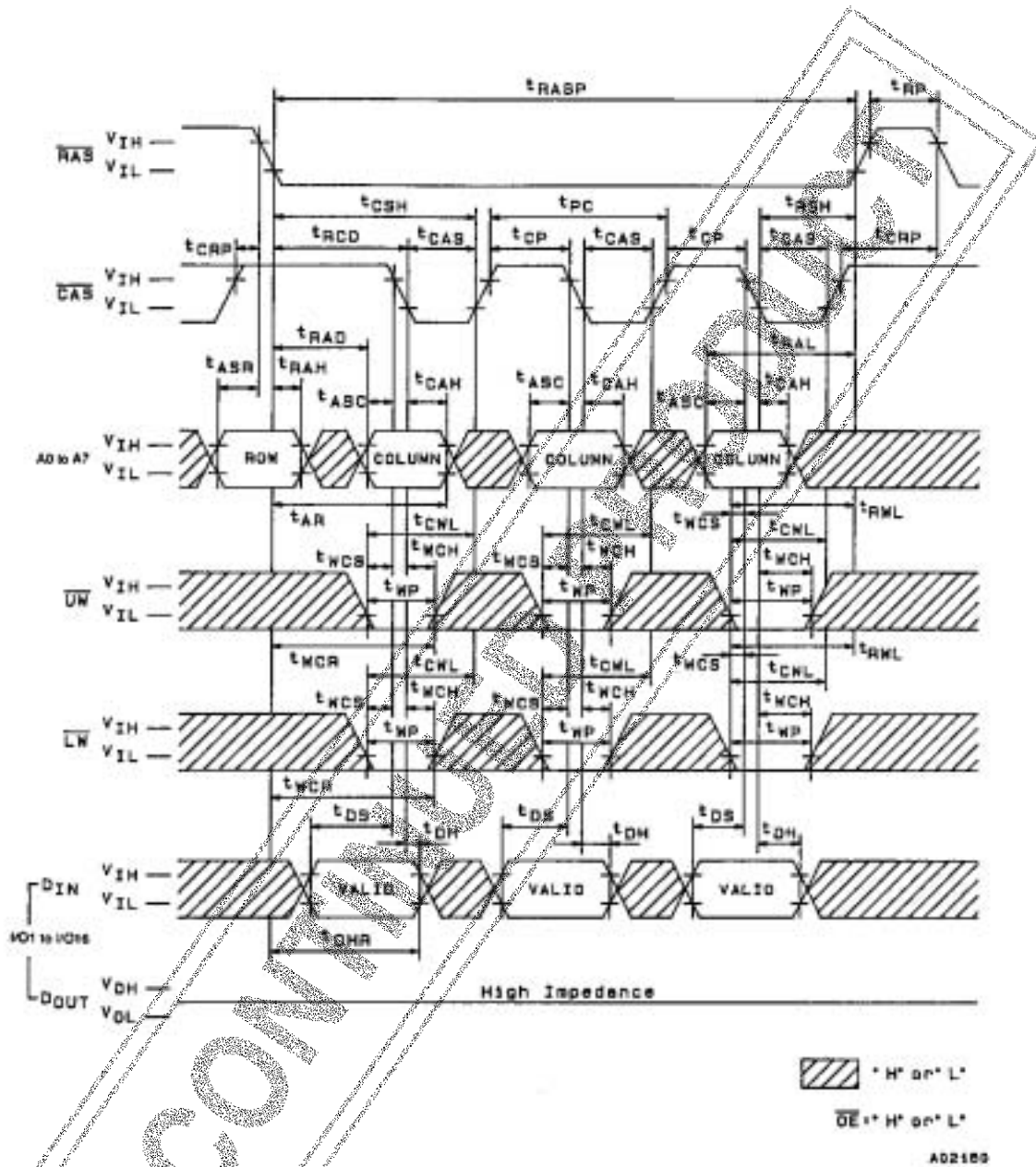
AD214B

Read-Modify Upper Byte Write Cycle



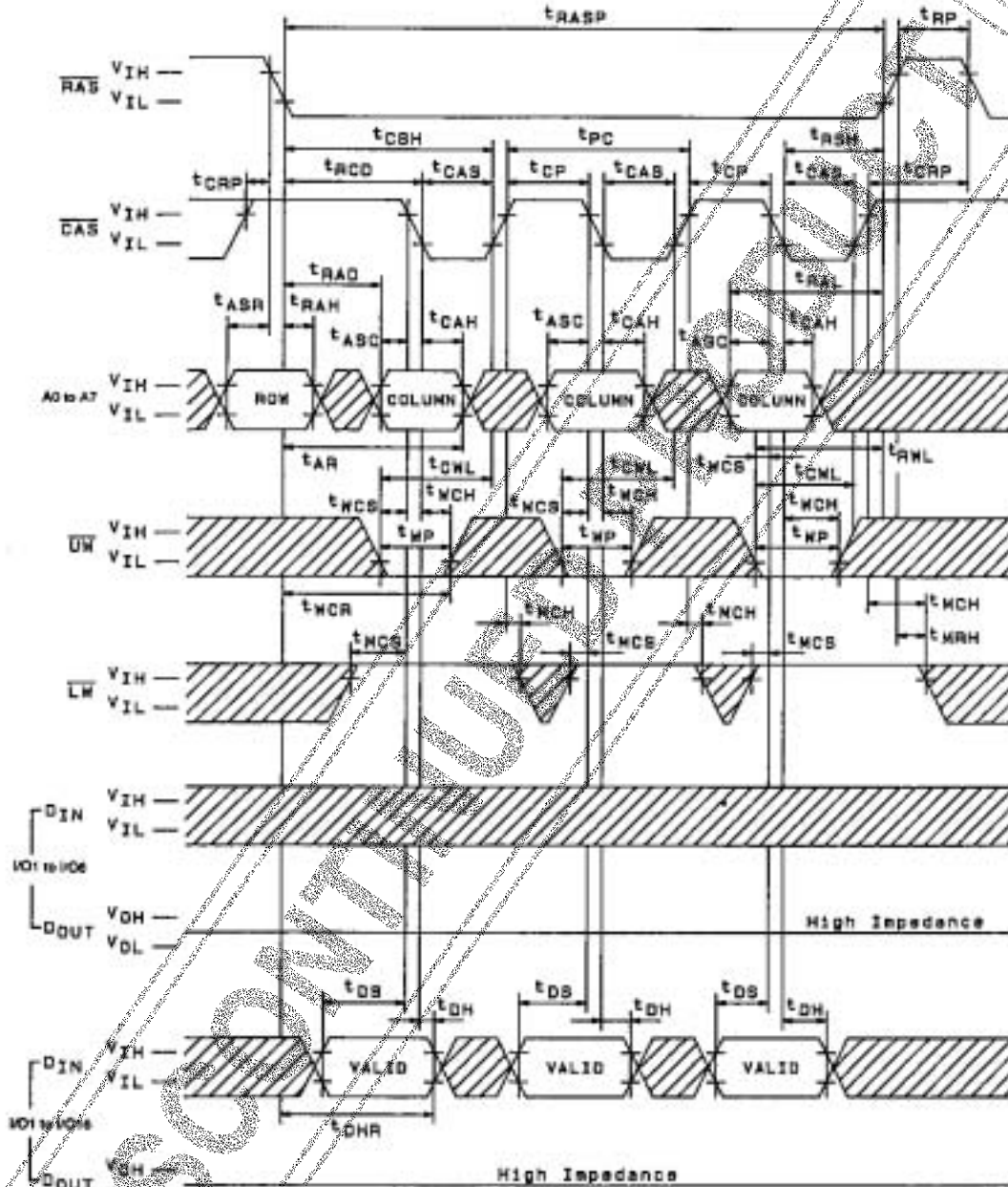
A02147



Fast Page Mode Early Write Cycle



DISCONTINUED

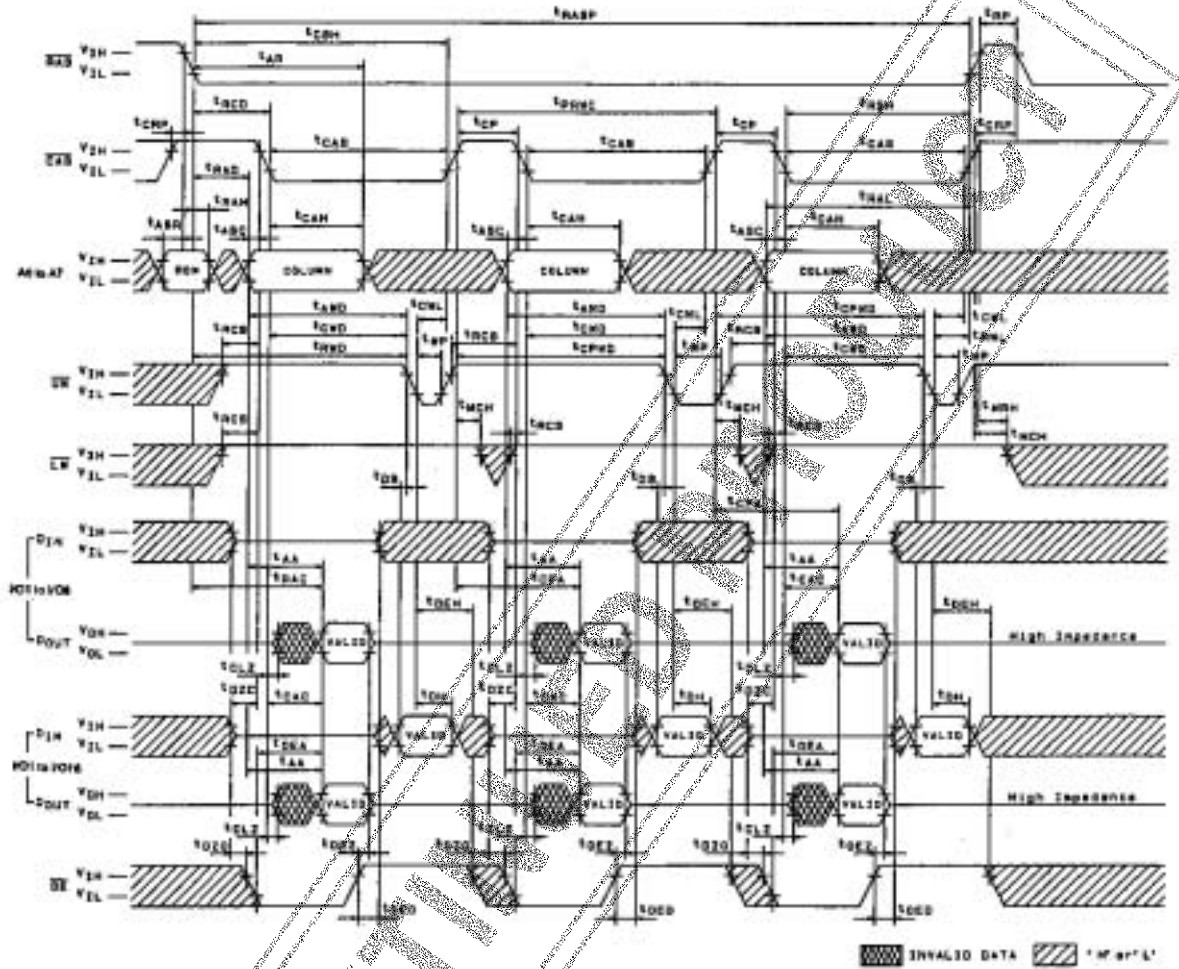
Fast Page Mode Upper Byte Early Write Cycle



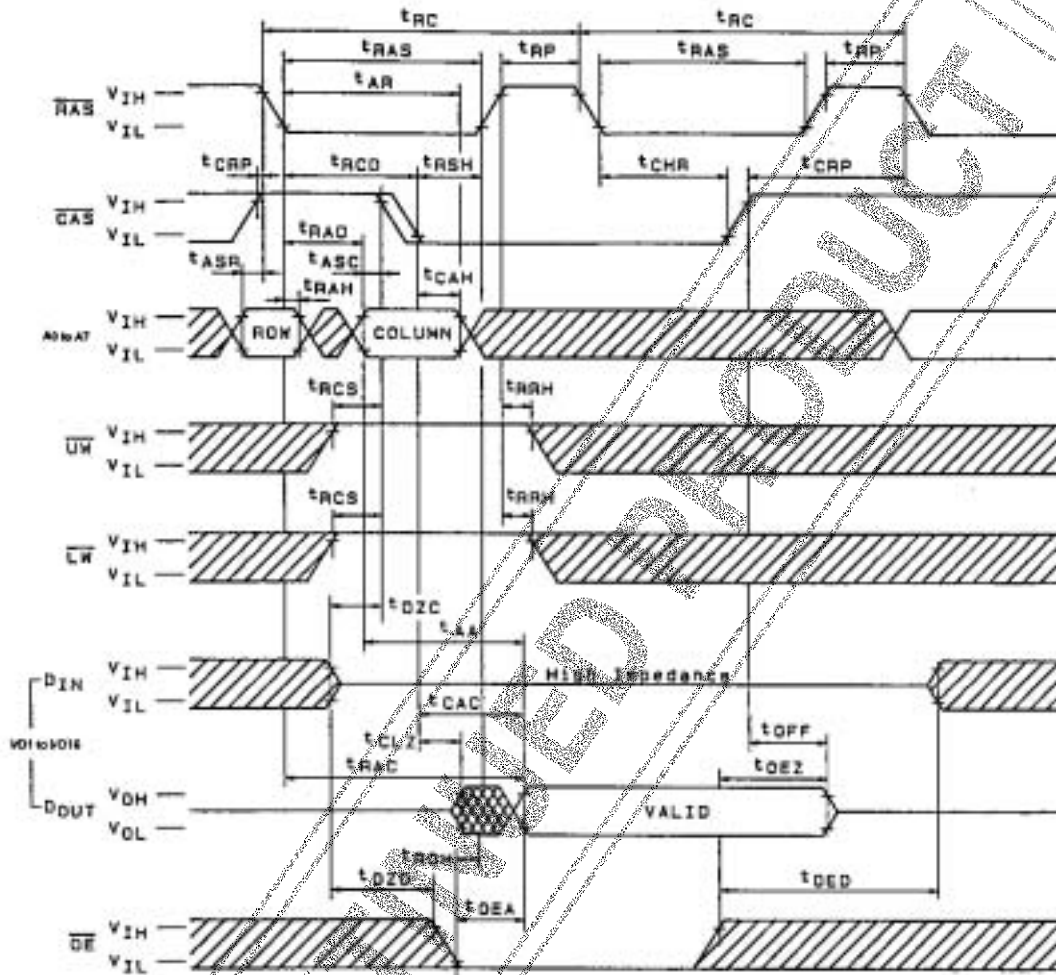
 * H* or * L*
 OE * H* or * L*

A02181

Fast Page Mode Read-Modify Upper Byte Write Cycle



Hidden Refresh Cycle

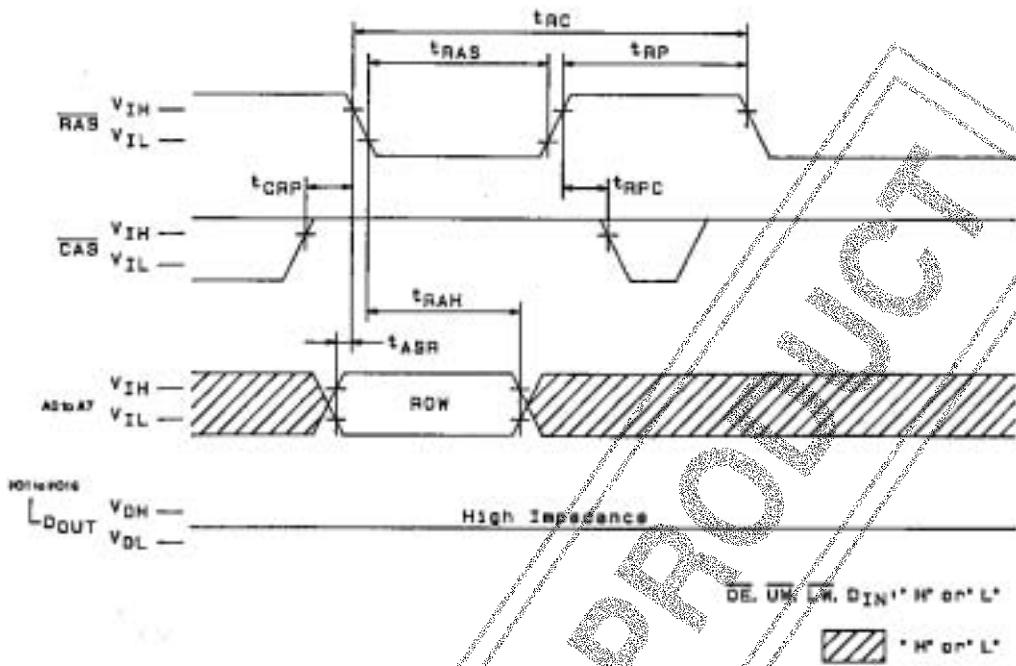


INVALID DATA * H* or * L*

A03280

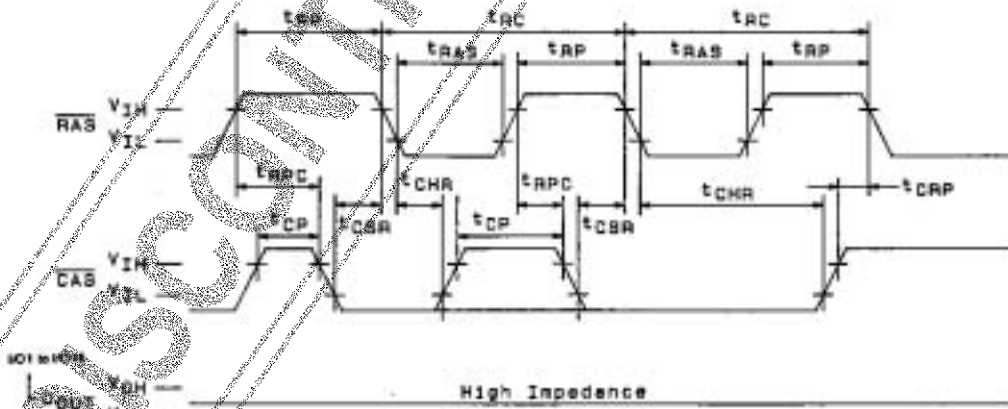
DISCONTINUED PRODUCT

RAS-Only Refresh Cycle



A02187

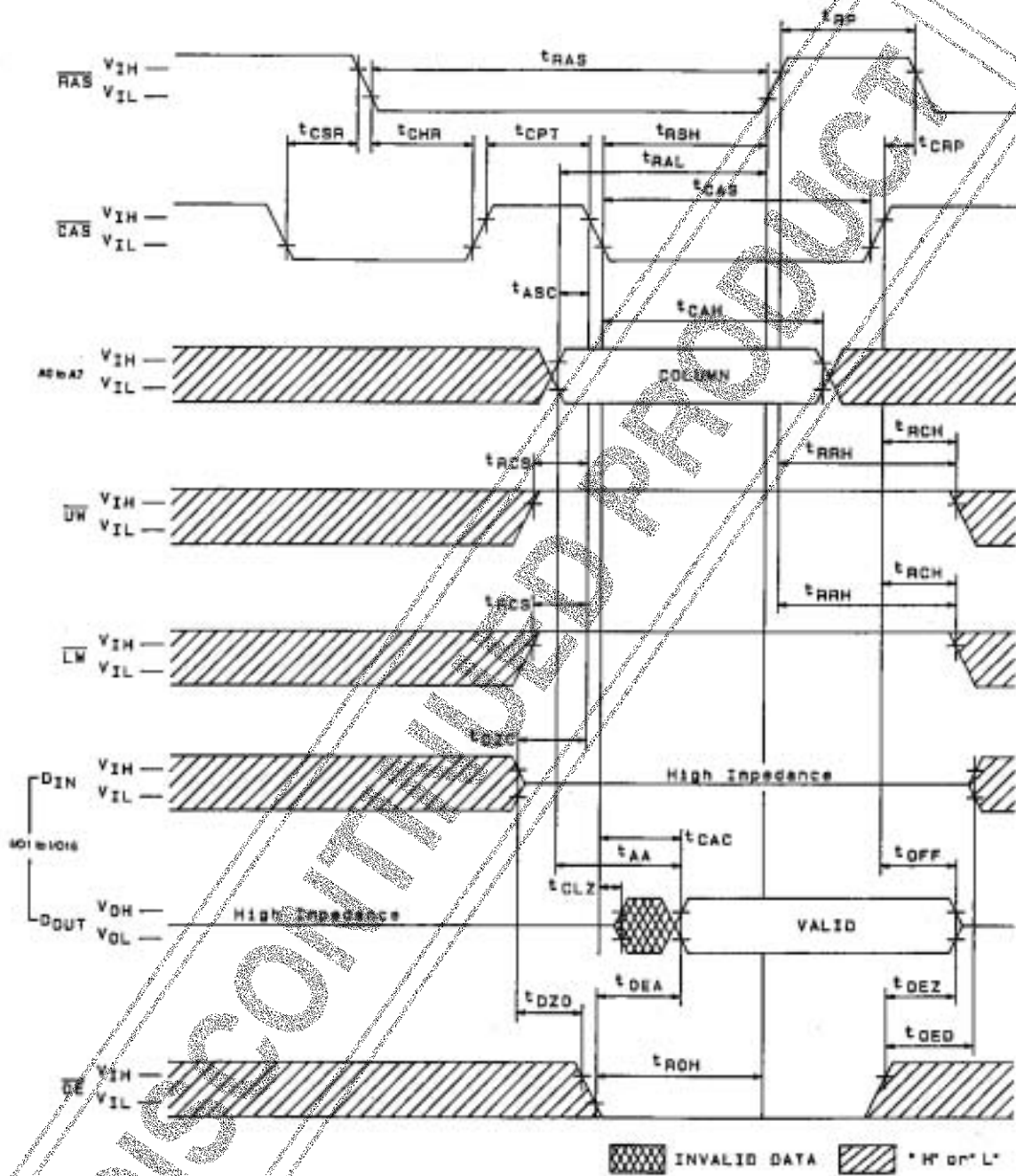
CAS-Before-RAS Refresh Cycle



AD to A7, UW, DW, DE, D_{pp}, 'H' or 'L'

A02188

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



A02159

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