Discontinued (8/98 - last order; 12/98 - last ship)

IBM11M32735B
IBM11M32735C

32M x 72 DRAM Module

Features

- 168 Pin JEDEC Standard, 8 Byte Dual In-line Memory Module
- 32Mx72 (Dual Bank) Extended Data Out Mode DIMM
- Performance:

		-50	-60
t_{RAC}	$\overline{RAS}$ Access Time	50ns	60ns
t_{CAC}	$\overline{CAS}$ Access Time	18ns	20ns
t_{AA}	Access Time From Address	30ns	35ns
t_{RC}	Cycle Time	89ns	104ns
t_{HPC}	EDO Mode Cycle Time	20ns	25ns

- Inputs and outputs are LVTTL compatible
- Single 3.3V, ± 0.3V Power Supply
- Au contacts
- Optimized for ECC applications
- System Performance Benefits:
  - Buffered inputs (except $\overline{RAS}$, Data)
  - Reduced noise (32 V_{SS}/V_{CC} pins)
  - 4 Byte Interleave enabled
  - Buffered PDs
- Extended Data Out (EDO) Mode, Read-Modify-Write Cycles
- Refresh Modes: $\overline{RAS}$-Only, CBR and Hidden Refresh
- $\overline{CAS}$ before $\overline{RAS}$ Refresh / $\overline{RAS}$ only Refresh - 4096 cycles
- 12/12 or 13/11 addressing (Row/Column)
- Card sizes: 5.25" x 2.0" x 0.354" SOJ
  6.95" x 1.65" x 0.354" SOJ (W)
  5.25" x 2.1" x 0.157" TSOP
- DRAMS in SOJ or TSOP package

Description

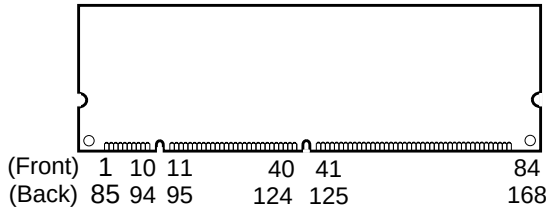
IBM11M32735B/C is an industry standard 168-pin 8-byte Dual In-line Memory Module (DIMM) for ECC applications which is organized as a 32Mx72 high speed memory array and is configured as 2 16Mx72 banks. The DIMM uses 36 16Mx4 EDO DRAMs in TSOP packages. The use of EDO DRAMs allows for a reduction in Page Mode Cycle time from 40ns (Fast Page) to 20ns for 50ns DRAM modules.

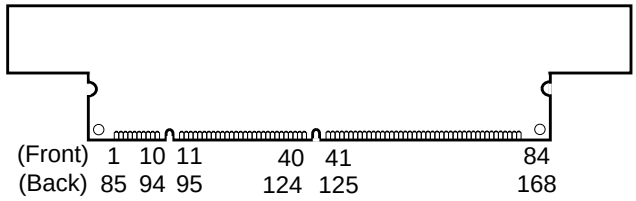
Improved system performance is provided by the on-DIMM buffering of selected input signals. The specified timings include all buffer, net and skew delays, which simplifies the memory subsystem design analysis. The data and $\overline{RAS}$ signals are not buffered, which preserves the DRAM access specifications of 50 & 60ns.

Presence Detect (PD) and Identification Detect (ID) bits provide information about the DIMM density, addressing, performance and features. PD bits can be dotted at the system level and activated for each DIMM position using the PD enable ($\overline{PDE}$) signal. ID bits also allow detection of card features, and may be dot-or'd at the system level to provide information for the entire DIMM bank. For example, the system will determine that ECC DIMMs are installed if PD8 is low (0). ID0 need not be sensed since both x72 and x80 ECC DIMMs will function in a x72 bank.

All IBM 168-pin DIMMs provide a high performance, flexible 8-byte interface in a 5.25" long space-saving footprint. Related products are the x64 and x72 non-parity (3.3V) DIMMs and ECC DIMMs (5V and 3.3V).

Card Outline





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IBM11M32735B
IBM11M32735C
32M x 72 DRAM Module

Pin Description

$\overline{RAS}0$, $\overline{RAS}1$, $\overline{RAS}2$, $\overline{RAS}3$	Row Address Strobe
$\overline{CAS}0$, $\overline{CAS}1$, $\overline{CAS}4$, $\overline{CAS}5$	Column Address Strobe (Buffered)
$\overline{WE}0$, $\overline{WE}2$	Read/write Input (Buffered)
$\overline{OE}0$, $\overline{OE}2$	Output Enable (Buffered)
A0, B0, A1 - A12	Address Inputs (Buffered)
DQx	Data Input/Output
V_{CC}	Power (+3.3V)
V_{SS}	Ground
NC	No Connect
PD1 - PD8	Presence Detects (Buffered)
$\overline{PDE}$	Presence Detect Enable
ID0 - ID1	ID Bits

Pinout

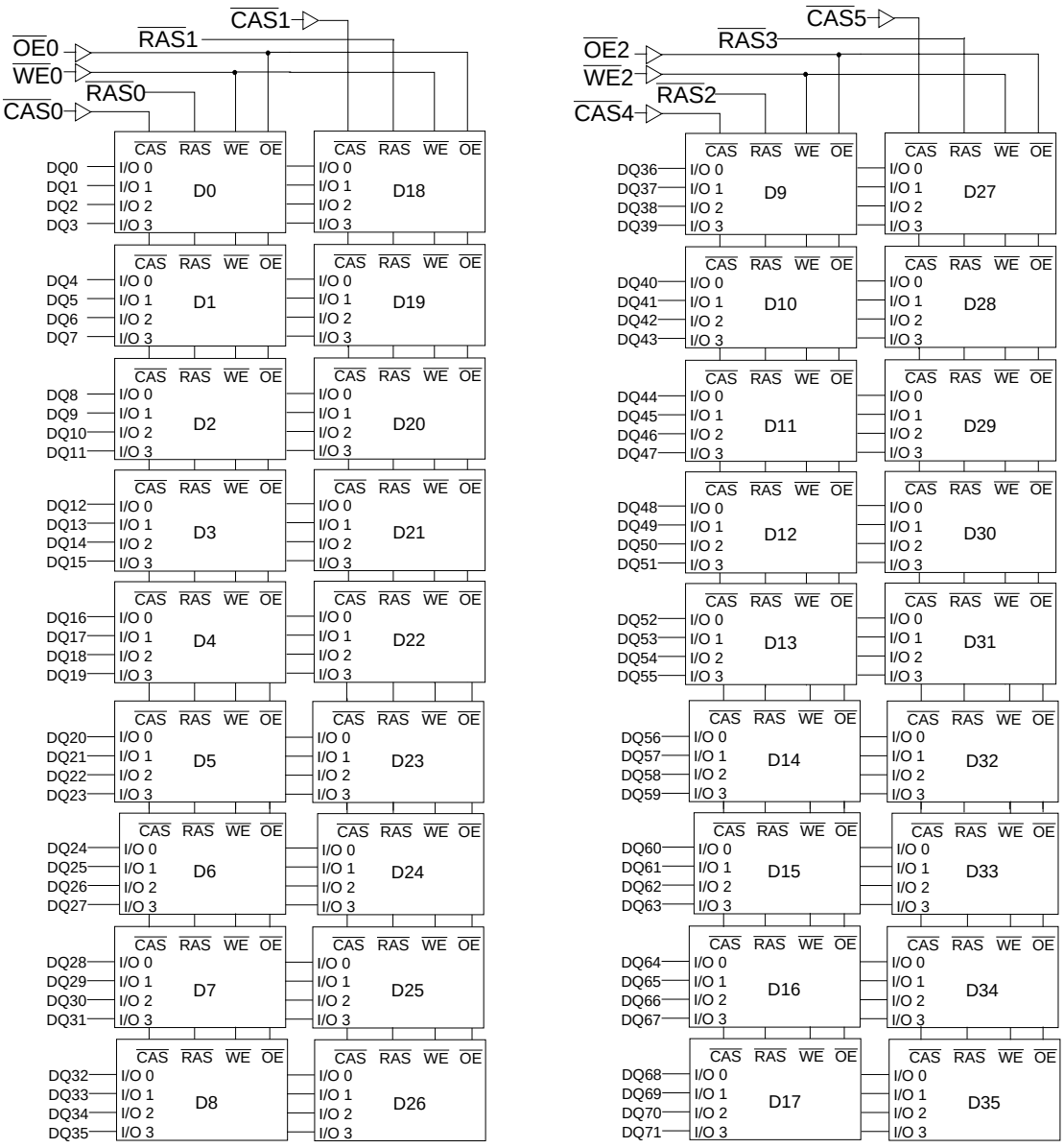
Pin#	Front Side	Pin#	Back Side	Pin#	Front Side	Pin#	Back Side
1	V_{SS}	85	V_{SS}	43	V_{SS}	127	V_{SS}
2	DQ0	86	DQ36	44	$\overline{OE}2$	128	NC
3	DQ1	87	DQ37	45	$\overline{RAS}2$	129	$\overline{RAS}3$
4	DQ2	88	DQ38	46	$\overline{CAS}4$	130	$\overline{CAS}5$
5	DQ3	89	DQ39	47	NC	131	NC
6	V_{CC}	90	V_{CC}	48	$\overline{WE}2$	132	$\overline{PDE}$
7	DQ4	91	DQ40	49	V_{CC}	133	V_{CC}
8	DQ5	92	DQ41	50	NC	134	NC
9	DQ6	93	DQ42	51	NC	135	NC
10	DQ7	94	DQ43	52	DQ18	136	DQ54
11	DQ8	95	DQ44	53	DQ19	137	DQ55
12	V_{SS}	96	V_{SS}	54	V_{SS}	138	V_{SS}
13	DQ9	97	DQ45	55	DQ20	139	DQ56
14	DQ10	98	DQ46	56	DQ21	140	DQ57
15	DQ11	99	DQ47	57	DQ22	141	DQ58
16	DQ12	100	DQ48	58	DQ23	142	DQ59
17	DQ13	101	DQ49	59	V_{CC}	143	V_{CC}
18	V_{CC}	102	V_{CC}	60	DQ24	144	DQ60
19	DQ14	103	DQ50	61	NC	145	NC
20	DQ15	104	DQ51	62	NC	146	NC
21	DQ16	105	DQ52	63	NC	147	NC
22	DQ17	106	DQ53	64	NC	148	NC
23	V_{SS}	107	V_{SS}	65	DQ25	149	DQ61
24	NC	108	NC	66	DQ26	150	DQ62
25	NC	109	NC	67	DQ27	151	DQ63
26	V_{CC}	110	V_{CC}	68	V_{SS}	152	V_{SS}
27	$\overline{WE}0$	111	NC	69	DQ28	153	DQ64
28	$\overline{CAS}0$	112	$\overline{CAS}1$	70	DQ29	154	DQ65
29	NC	113	NC	71	DQ30	155	DQ66
30	$\overline{RAS}0$	114	$\overline{RAS}1$	72	DQ31	156	DQ67
31	$\overline{OE}0$	115	NC	73	V_{CC}	157	V_{CC}
32	V_{SS}	116	V_{SS}	74	DQ32	158	DQ68
33	A0	117	A1	75	DQ33	159	DQ69
34	A2	118	A3	76	DQ34	160	DQ70
35	A4	119	A5	77	DQ35	161	DQ71
36	A6	120	A7	78	V_{SS}	162	V_{SS}
37	A8	121	A9	79	PD1	163	PD2
38	A10	122	A11	80	PD3	164	PD4
39	A12	123	NC	81	PD5	165	PD6
40	V_{CC}	124	V_{CC}	82	PD7	166	PD8
41	NC	125	NC	83	ID0	167	ID1
42	NC	126	B0	84	V_{CC}	168	V_{CC}

Note: All pin assignments are consistent for all 8 Byte versions.

Ordering Information

Part Number	Organization	Speed	Addr.	Leads	Dimension	Power	Package
IBM11M32735BB-50J	32Mx72	50ns	12/12	Gold	5.25" x 2.0" x 0.354"	3.3V	SOJ
IBM11M32735BB-60J		60ns					
IBM11M32735CB-50J		50ns	13/11				
IBM11M32735CB-60J		60ns					
IBM11M32735BB-50T		50ns	12/12		5.25" x 2.1" x 0.175"		TSOP
IBM11M32735BB-60T		60ns					
IBM11M32735CB-50T		50ns	13/11				
IBM11M32735CB-60T		60ns					
IBM11M32735BB-60W		60ns	12/12		6.95" x 1.65" x 0.354"		SOJ (W)
IBM11M32735CB-60W		60ns	13/11				

Block Diagram



Truth Table

Function		$\overline{RAS}$	$\overline{CAS}$	$\overline{WE}$	$\overline{OE}$	Row Address	Column Address	$\overline{PDE}$	DQx
Standby		H	H→X	X	X	X	X	X	High Impedance
Read		L	L	H	L	Row	Col	X	Valid Data Out
Early-Write		L	L	L	X	Row	Col	X	Valid Data In
Late-Write		L	L	H→L	H	Row	Col	X	Valid Data In
RMW		L	L	H→L	L→H	Row	Col	X	Valid Data Out, Valid Data In
EDO Page Mode - Read 1st Cycle		L	H→L	H	L	Row	Col	X	Valid Data Out
Subsequent Cycles		L	H→L	H	L	N/A	Col	X	Valid Data Out
EDO Page Mode - Write 1st Cycle		L	H→L	L	X	Row	Col	X	Valid Data In
Subsequent Cycles		L	H→L	L	X	N/A	Col	X	Valid Data In
EDO Page Mode - RMW 1st Cycle		L	H→L	H→L	L→H	Row	Col	X	Valid Data Out, Valid Data In
Subsequent Cycles		L	H→L	H→L	L→H	N/A	Col	X	Valid Data Out, Valid Data In
$\overline{RAS}$-Only Refresh		L	H	X	X	Row	N/A	X	High Impedance
$\overline{CAS}$-Before-$\overline{RAS}$ Refresh		H→L	L	H	X	X	X	X	High Impedance
Hidden Refresh	Read	L→H→L	L	H	L	Row	Col	X	Data Out
	Write	L→H→L	L	H	X	Row	Col	X	Data In
Read Presence Detects		X	X	X	X	X	X	L	Not Affected (PD Bits Valid)

Presence Detect

Pin	-50	-60
PD1 (PD1 - PD4: Addressing/Density)	1	1
PD2	0	0
PD3	0	0
PD4	0	0
PD5 (EDO Detection)	1	1
PD6 (PD6 - PD7: Speed)	0	1
PD7	0	1
PD8 (Parity/ECC Designator)	0	0
ID0 (DIMM Type/Width)	0	0
ID1 (Refresh Mode)	0	0

1. PD1-8 are buffered outputs (0 = driven to V_{OL}, 1 = open)
2. ID0-1 are unbuffered outputs (0 = V_{SS}, 1 = open)
3. $\overline{PDE}$ should be tied high or low at system level if not used

Absolute Maximum Ratings

Symbol	Parameter	Rating	Units	Notes
V_{CC}	Power Supply Voltage	-0.5 to 4.6	V	1
V_{IN}	Input Voltage	-0.5 to min (V_{CC} + 0.5, 4.6)	V	1
V_{OUT}	Output Voltage	-0.5 to min (V_{CC} + 0.5, 4.6)	V	1
T_{OPR}	Operating Temperature	0 to +70	°C	1
T_{STG}	Storage Temperature	-55 to +125	°C	1
P_D	Power Dissipation	15.6	W	1, 2
I_{OUT}	Short Circuit Output Current	50	mA	1
I_{OUTPD}	Short Circuit Output Current (PD)	60	mA	1

1. Stresses greater than those listed may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated is not implied. Exposure to absolute maximum rating condition for extended periods may affect reliability.
2. Maximum power occurs when all banks are active (refresh cycle).

Recommended DC Operating Conditions (T_A = 0 to 70°C)

Symbol	Parameter		Min	Typ	Max	Units	Notes
V_{CC}	Supply Voltage		3.0	3.3	3.6	V	1
V_{IH}	Input High Voltage	Buffered	2.0	—	V_{CC} + 0.3	V	1, 2
V_{IL}	Input Low Voltage		-0.3	—	0.8	V	1, 2

1. All voltages referenced to V_{SS}.
2. V_{IH} may overshoot to V_{CC} + 1.2V for pulse widths of ≤ 4.0ns. Additionally, V_{IL} may undershoot to -2.0V for pulse widths ≤ 4.0ns (or -1.0V for ≤ 8.0ns). Pulse widths measured at 50% points with amplitude measured peak to DC reference.

Capacitance (T_A = 0 to +70°C, V_{CC} = 3.3V ± 0.3V)

Symbol	Parameter		Max	Units
C_{I1}	Input Capacitance	(A0, B0)	13	pF
		(A1-A12)	18	pF
C_{I2}	Input Capacitance ($\overline{RAS}$)		80	pF
C_{I3}	Input Capacitance ($\overline{CAS}$, $\overline{WE}$, $\overline{OE}$)		18	pF
C_{I4}	Input Capacitance ($\overline{PDE}$)		18	pF
C_{I01}	Input/Output Capacitance (DQx)		25	pF
C_{01}	Output Capacitance (PD)		15	pF
C_{02}	Output Capacitance (ID)		5	pF

DC Electrical Characteristics (T_A = 0 to +70°C, V_{CC} = 3.3V ± 0.3V)

Symbol	Parameter		12/12 Addressing Min	12/12 Addressing Max	13/11 Addressing Min	13/11 Addressing Max	Units	Notes
I_{CC1}	Operating Current Average Power Supply Operating Current ($\overline{RAS}$, $\overline{CAS}$, Address Cycling: t_{RC} = t_{RC} min)	-50	—	2826	—	2286	mA	1, 2, 3
		-60	—	2376	—	1926	mA	1, 2, 3
I_{CC2}	Standby Current (TTL) Power Supply Standby Current ($\overline{RAS}$ = $\overline{CAS}$ ≥ V_{IH})		—	72	—	72	mA	
I_{CC3}	$\overline{RAS}$ Only Refresh Current Average Power Supply Current, $\overline{RAS}$ Only Mode ($\overline{RAS}$ Cycling, $\overline{CAS}$ ≥ V_{IH}: t_{RC} = t_{RC} min)	-50	—	2376	—	1836	mA	1, 3, 4
		-60	—	2016	—	1656	mA	1, 3, 4
I_{CC4}	Fast Page Mode Current Average Power Supply Current, Fast Page Mode ($\overline{RAS}$ ≤ V_{IL}, $\overline{CAS}$, Address Cycling: t_{HPC} = t_{HPC} min)	-50	—	1836	—	1836	mA	1, 2, 3
		-60	—	1476	—	1476	mA	1, 2, 3
I_{CC5}	Standby Current (CMOS) Power Supply Standby Current ($\overline{RAS}$ = $\overline{CAS}$ = V_{CC} - 0.2V)		—	36	—	36	mA	
I_{CC6}	$\overline{CAS}$ before $\overline{RAS}$ Refresh Current Average Power Supply Current, $\overline{CAS}$ Before $\overline{RAS}$ Mode ($\overline{RAS}$, $\overline{CAS}$, Cycling: t_{RC} = t_{RC} min)	-50	—	2646	—	2646	mA	1, 3, 4
		-60	—	2196	—	2196	mA	1, 3, 4
$I_{I(L)}$	Input Leakage Current Input Leakage Current, any Input (0.0 ≤ V_{IN} ≤ (V_{CC} < 6.0V)), All Other Pins Not Under Test = 0V	$\overline{RAS}$	-18	+18	-18	+18	µA	
		$\overline{CAS}$, $\overline{WE}$, $\overline{OE}$, A0, B0	-10	+10	-10	+10		
		A1 - A12	-20	+20	-20	+20		
		DQ	-4	+4	-4	+4		
$I_{O(L)}$	Output Leakage Current (D_{OUT} is disabled, 0.0 ≤ V_{OUT} ≤ V_{CC})		-4	+4	-4	+4	µA	
V_{OH}	Output High Level Output “H” Level Voltage (I_{OUT} = -2mA @ 2.4V)		2.4	—	2.4	—	V	
V_{OL}	Output Low level Output “L” Level Voltage (I_{OUT} = +2mA @ 0.4V)		—	0.4	—	0.4	V	

1. I_{CC1}, I_{CC3}, I_{CC4}, and I_{CC6} depend on cycle rate.
2. I_{CC1} and I_{CC4} depend on output loading. Specified values are obtained with output open.
3. Address can be changed once or less while $\overline{RAS}$ = V_{IL}. In the case of I_{CC4}, it can be changed once or less when $\overline{CAS}$ = V_{IH}.
4. Refresh current is specified for 1 bank active and 1 bank standby.

AC Characteristics (T_A = 0 to +70°C, V_{CC} = 3.3V ± 0.3V)

1. V_{IH} (min) and V_{IL} (max) are reference levels for measuring timing of input signals. Transition times are measured between V_{IH} and V_{IL}.
2. An initial pause of 200µs is required after power-up followed by 8 $\overline{RAS}$ only refresh cycles before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8 $\overline{CAS}$ before $\overline{RAS}$ refresh cycles instead of 8 $\overline{RAS}$ only refresh cycles is required..
3. The specified timings include buffer, loading and skew delay adders: 2ns minimum, 5ns maximum delay, no pulse shrinkage to the DRAM device timings. The data and $\overline{RAS}$ signals are not buffered, which preserves the DRAMs access specification of 50ns and 60ns.
4. AC measurements assume t_T = 2ns.

Read, Write, Read-Modify-Write and Refresh Cycles (Common Parameters)

Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t_{RC}	Random Read or Write Cycle Time	89	—	104	—	ns	
t_{RP}	$\overline{RAS}$ Precharge Time	35	—	40	—	ns	
t_{CP}	$\overline{CAS}$ Precharge Time	8	—	10	—	ns	
t_{RAS}	$\overline{RAS}$ Pulse Width	50	10K	60	10K	ns	
t_{CAS}	$\overline{CAS}$ Pulse Width	8	10K	10	10K	ns	
t_{ASR}	Row Address Setup Time	5	—	5	—	ns	
t_{RAH}	Row Address Hold Time	8	—	8	—	ns	
t_{ASC}	Column Address Setup Time	2	—	2	—	ns	
t_{CAH}	Column Address Hold Time	10	—	10	—	ns	
t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	12	32	12	40	ns	1
t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	10	20	10	25	ns	2
t_{RSH}	$\overline{RAS}$ Hold Time	13	—	15	—	ns	
t_{CSH}	$\overline{CAS}$ Hold Time	43	—	48	—	ns	
t_{CRP}	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	10	—	10	—	ns	
t_{ODD}	$\overline{OE}$ to D_{IN} Delay Time	18	—	20	—	ns	3
t_{DZO}	$\overline{OE}$ Delay Time from D_{IN}	-2	—	-2	—	ns	4
t_{DZC}	$\overline{CAS}$ Delay Time from D_{IN}	-2	—	-2	—	ns	4
t_T	Transition Time (Rise and Fall)	1	30	1	30	ns	

1. Operation within the t_{RCD}(max) limit ensures that t_{RAC}(max) can be met. The t_{RCD}(max) is specified as a reference point only: If t_{RCD} is greater than the specified t_{RCD}(max) limit, then access time is controlled by t_{CAC}.
2. Operation within the t_{RAD}(max) limit ensures that t_{RAC}(max) can be met. The t_{RAD}(max) is specified as a reference point only: If t_{RAD} is greater than the specified t_{RAD}(max) limit, then access time is controlled by t_{AA}.
3. Either t_{CDD} or t_{ODD} must be satisfied.
4. Either t_{DZC} or t_{DZO} must be satisfied.

Write Cycle

Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t_{WCS}	Write Command Set Up Time	2	—	2	—	ns	1
t_{WCH}	Write Command Hold Time	9	—	12	—	ns	
t_{WP}	Write Command Pulse Width	7	—	10	—	ns	
t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	12	—	15	—	ns	
t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	9	—	12	—	ns	
t_{DS}	D_{IN} Setup Time	-2	—	-2	—	ns	2
t_{DH}	D_{IN} Hold Time	12	—	15	—	ns	2

1. t_{WCS}, t_{RWD}, t_{CWD} and t_{AWD} are not restrictive parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$(min.), the entire cycle is an early write cycle and the data pin will remain open circuit (high impedance) through the entire cycle; If $t_{RWD} \geq t_{RWD}$(min.), $t_{CWD} \geq t_{CWD}$(min.) and $t_{AWD} \geq t_{AWD}$(min.), the cycle is a Read-Modify-Write cycle and the data will contain read from the selected cell: If neither of the above sets of conditions are met, the condition of the data (at access time) is indeterminate.
2. Data-in set-up and hold is measured from the latter of the two timings, $\overline{CAS}$ or $\overline{WE}$.

Read Cycle

Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t_{RAC}	Access Time from $\overline{RAS}$	—	50	—	60	ns	1, 2
t_{CAC}	Access Time from $\overline{CAS}$	—	18	—	20	ns	1, 2
t_{AA}	Access Time from Address	—	30	—	35	ns	1, 2
t_{OEA}	Access Time from $\overline{OE}$	—	18	—	20	ns	1, 2
t_{RCS}	Read Command Setup Time	2	—	2	—	ns	
t_{RCH}	Read Command Hold Time to $\overline{CAS}$	2	—	2	—	ns	3
t_{RRH}	Read Command Hold Time to $\overline{RAS}$	0	—	0	—	ns	3
t_{RAL}	Column Address to $\overline{RAS}$ Lead Time	30	—	35	—	ns	
t_{CLZ}	$\overline{CAS}$ to Output in Low-Z	2	—	2	—	ns	
t_{OES}	$\overline{OE}$ setup time prior to $\overline{CAS}$	7	—	10	—	ns	
t_{ORD}	$\overline{OE}$ setup time prior to $\overline{RAS}$ (Hidden Refresh)	2	—	5	—	ns	
t_{CDD}	$\overline{CAS}$ to D_{IN} Delay Time	18	—	20	—	ns	5
t_{OEZ}	Output Buffer Turn-off Delay from $\overline{OE}$	2	18	2	20	ns	4
t_{OFF}	Output Buffer Turn-off Delay	2	18	2	20	ns	4, 6

1. Measured with the specified current load and 100pF.
2. Access time is determined by the latter of t_{RAC}, t_{CAC}, t_{CPA}, t_{AA}, t_{OEA}.
3. Either t_{RCH} or t_{RRH} must be satisfied.
4. t_{OFF} (max) and t_{OEZ} (max) define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
5. Either t_{CDD} or t_{ODD} must be satisfied.
6. t_{OFF} is referenced from the rising edge of $\overline{RAS}$ or $\overline{CAS}$, whichever is last.

Read-Modify-Write Cycle

Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t_{RWC}	Read-Modify-Write Cycle Time	123	—	143	—	ns	
t_{RWD}	$\overline{RAS}$ to $\overline{WE}$ Delay Time	70	—	82	—	ns	1
t_{CWD}	$\overline{CAS}$ to $\overline{WE}$ Delay Time	40	—	44	—	ns	1
t_{AWD}	Column Address to $\overline{WE}$ Delay Time	50	—	57	—	ns	1
t_{OEH}	$\overline{OE}$ Command Hold Time	7	—	10	—	ns	

1. t_{WCS}, t_{RWD}, t_{CWD} and t_{AWD} are not restrictive parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$(min.), the entire cycle is an early write cycle and the data pin will remain open circuit (high impedance) through the entire cycle; If $t_{RWD} \geq t_{RWD}$(min.), $t_{CWD} \geq t_{CWD}$(min.) and $t_{AWD} \geq t_{AWD}$(min.), the cycle is a Read-Modify-Write cycle and the data will contain read from the selected cell: If neither of the above sets of conditions are met, the condition of the data (at access time) is indeterminate.

EDO Mode Cycle

Symbol	Parameter	-50		-60		Units	Notes
		Min.	Max.	Min.	Max.		
t_{HCAS}	$\overline{CAS}$ Pulse Width (EDO Page Mode)	8	10K	10	10K	ns	
t_{HPC}	EDO Page Mode Cycle Time (Read/Write)	20	—	25	—	ns	
t_{HPRWC}	EDO Page Mode Read Modify Write Cycle Time	63	—	72	—	ns	
t_{DOH}	Data-out Hold Time from $\overline{CAS}$	10	—	10	—	ns	
t_{WHZ}	Output buffer Turn-Off Delay from $\overline{WE}$	2	15	2	15	ns	
t_{WPZ}	$\overline{WE}$ Pulse Width to Output Disable at $\overline{CAS}$ High	7	—	10	—	ns	
t_{CPRH}	$\overline{RAS}$ Hold Time from $\overline{CAS}$ Precharge	35	—	40	—	ns	
t_{CPA}	Access Time from $\overline{CAS}$ Precharge	—	35	—	40	ns	1
t_{RASP}	EDO Page Mode $\overline{RAS}$ Pulse Width	50	200K	60	200K	ns	
t_{OEP}	$\overline{OE}$ High Pulse Width	10	—	10	—	ns	
t_{OEHC}	$\overline{OE}$ High Hold Time from $\overline{CAS}$ High	10	—	10	—	ns	

1. Measured with the specified current load and 100pF at V_{OL} = 0.8V and V_{OH} = 2.0V.

Refresh Cycle

Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t_{CHR}	$\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle)	8	—	8	—	ns	
t_{CSR}	$\overline{CAS}$ Setup Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle)	10	—	10	—	ns	
t_{WRP}	$\overline{WE}$ Setup Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle)	15	—	15	—	ns	
t_{WRH}	$\overline{WE}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$ Refresh Cycle)	8	—	8	—	ns	
t_{RPC}	$\overline{RAS}$ Precharge to $\overline{CAS}$ Hold Time	3	—	3	—	ns	
t_{REF}	Refresh Period	—	64	—	64	ms	1, 2
		—	128	—	128	ms	3

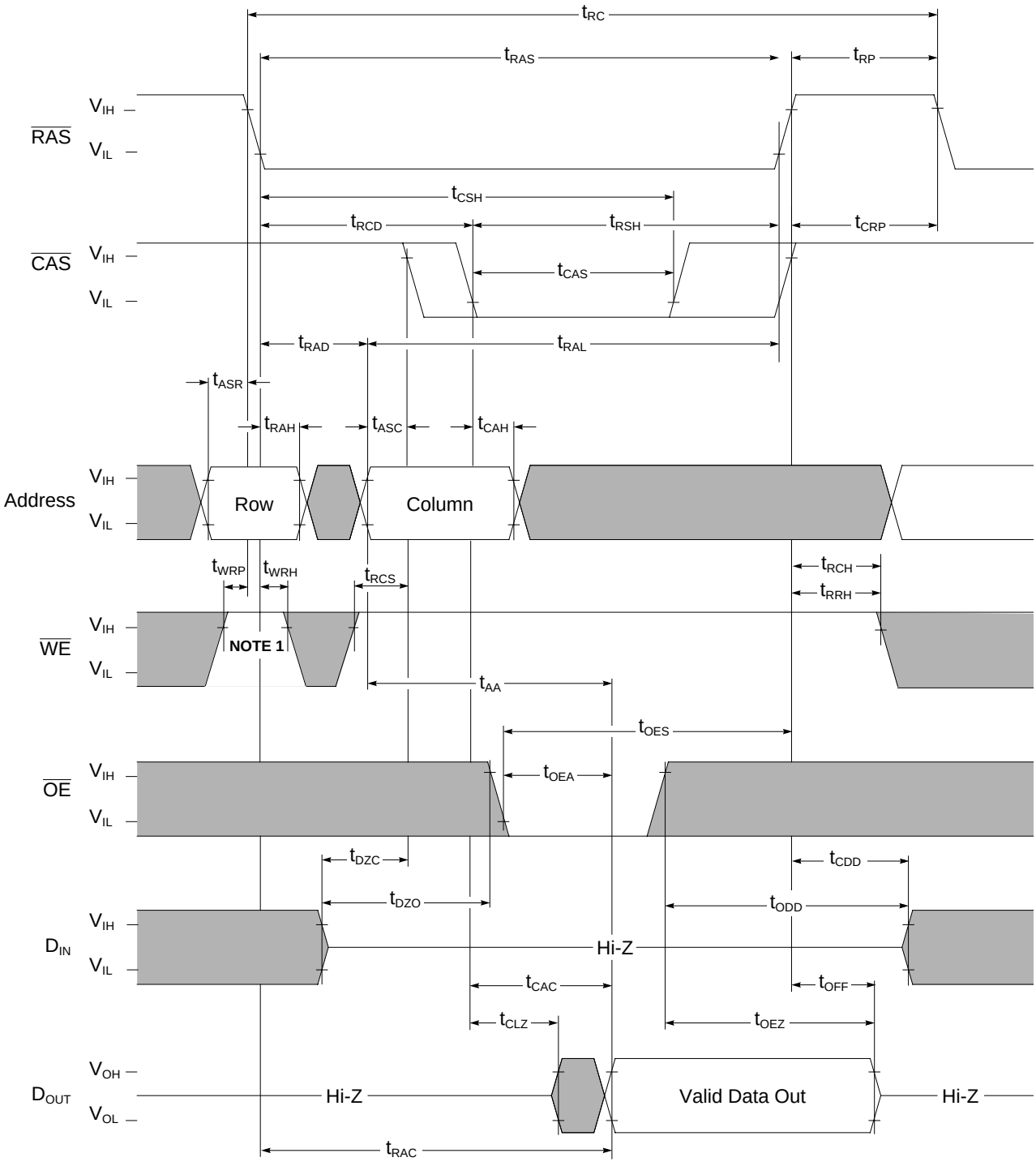
1. 12/12 addressing: 4096 refreshes are required every 64ms.
2. 13/11 addressing: 4096 refreshes for $\overline{RAS}$ Only Refresh.
3. 13/11 addressing: 4096 refreshes for CBR.

Presence Detect Read Cycle

Symbol	Parameter	-50		-60		Unit	Notes
		Min	Max	Min	Max		
t_{PD}	$\overline{PDE}$ to Valid Presence Detect Data	—	10	—	10	ns	1
t_{PDOFF}	$\overline{PDE}$ Inactive to Presence Detects Inactive	0	10	0	10	ns	2

1. Measured with the specified current load and 100pF.
2. t_{PDOFF}(max) defines the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.

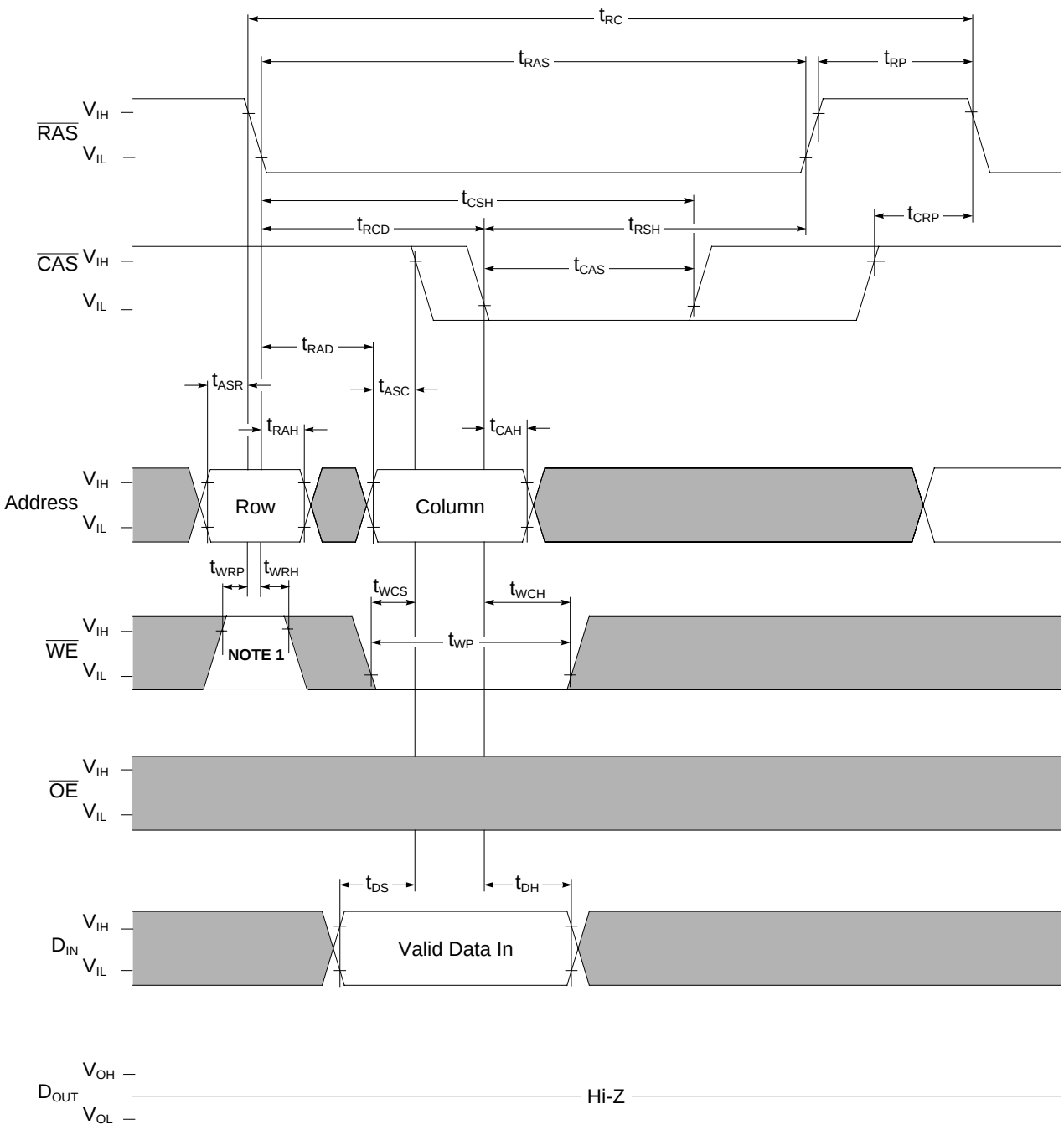
Read Cycle



: "H": or "L"

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

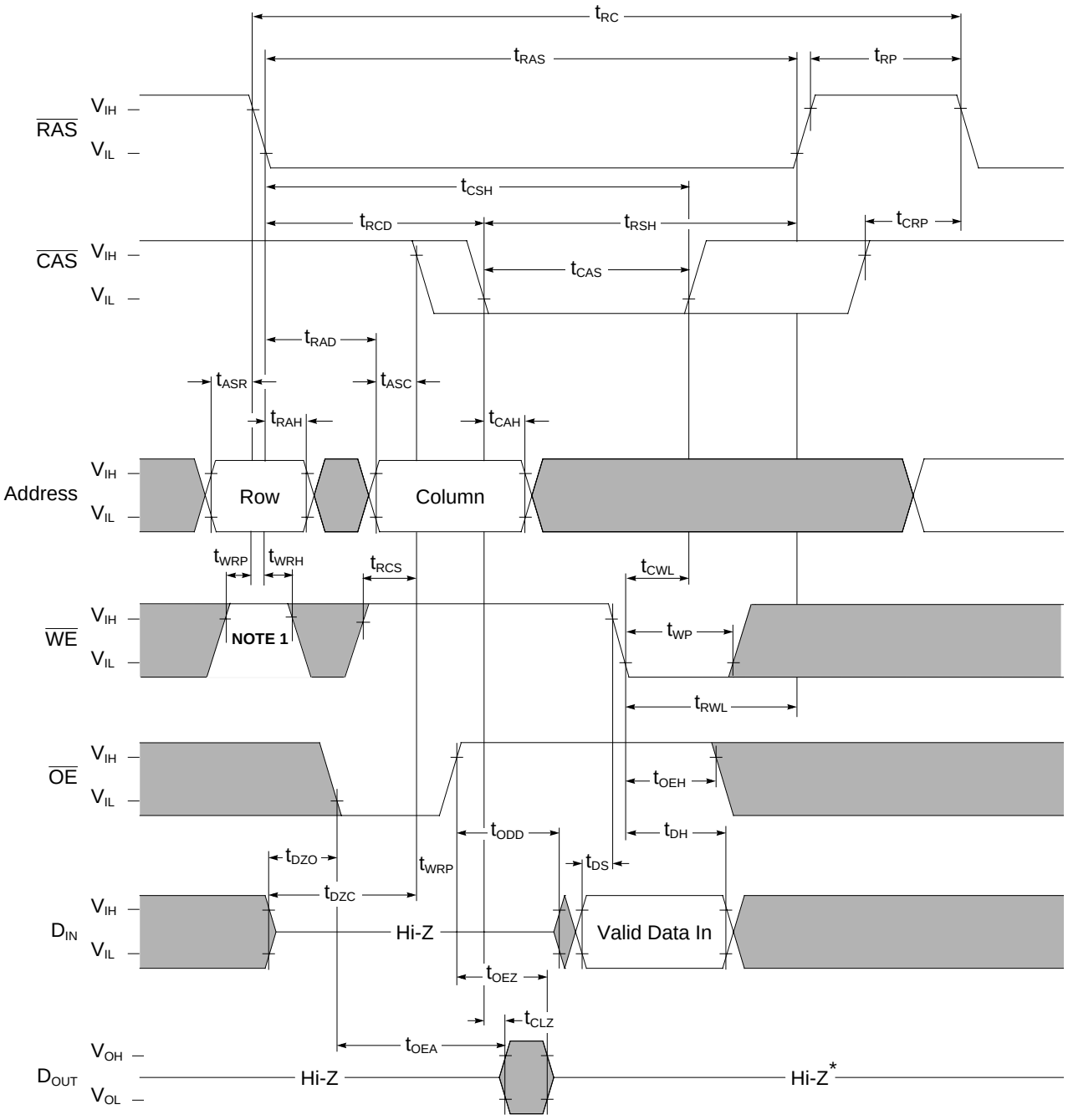
Write Cycle (Early Write)



: "H" or "L"

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

Write Cycle (Late Write)

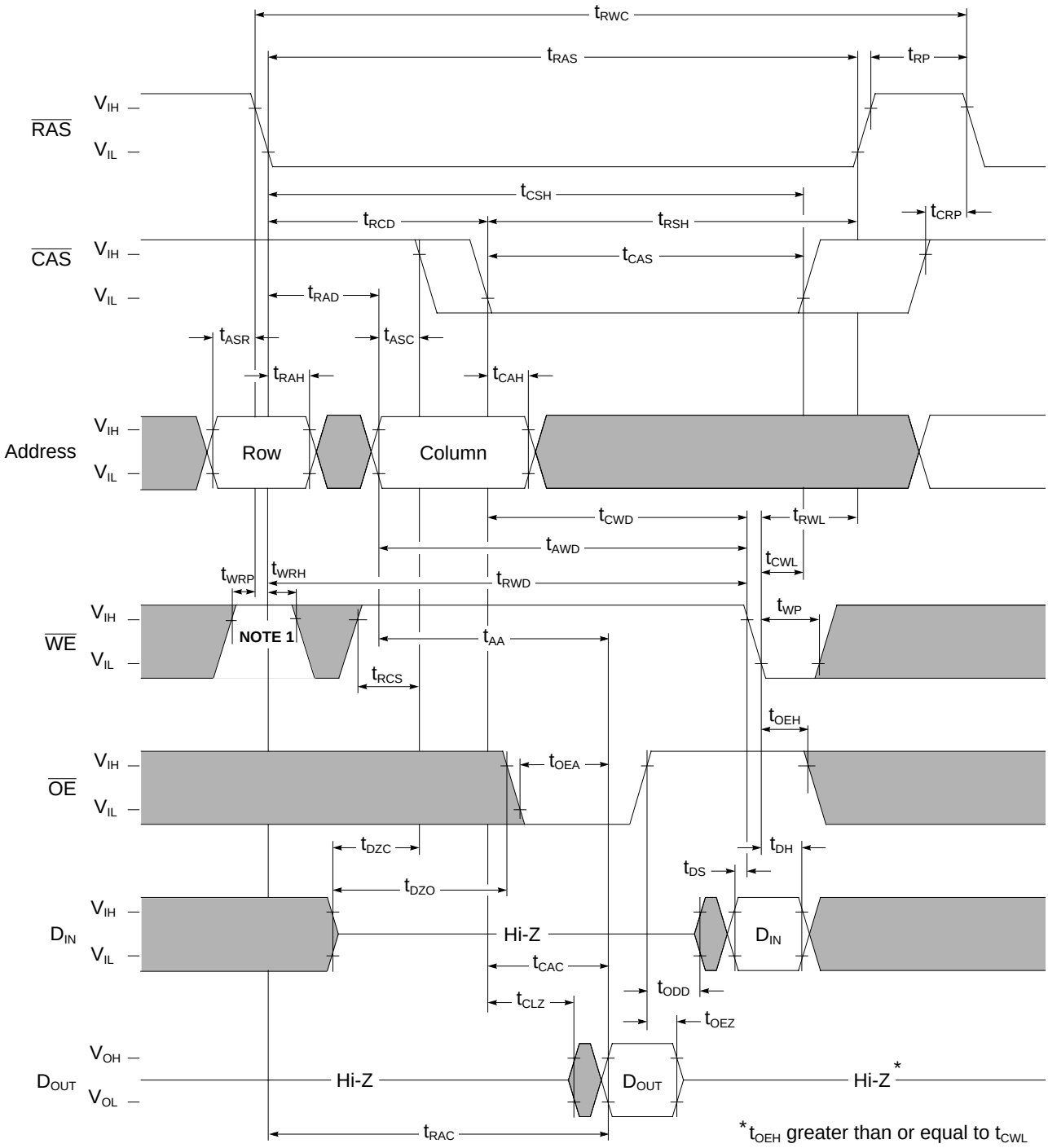


: "H" or "L"

* t_{OEH} greater than or equal to t_{CWL}

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

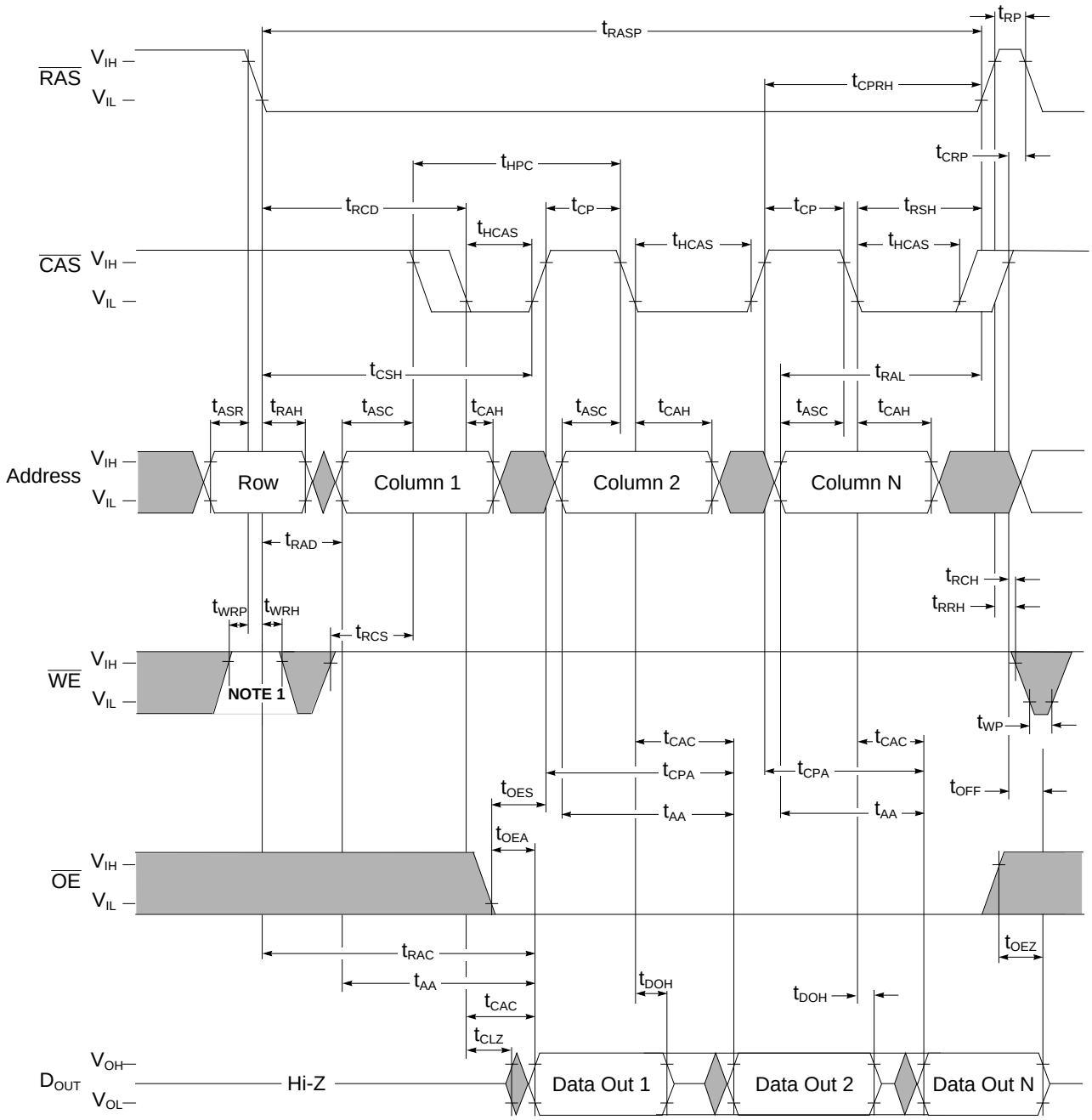
Read-Modify-Write-Cycle



: “H” or “L”

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

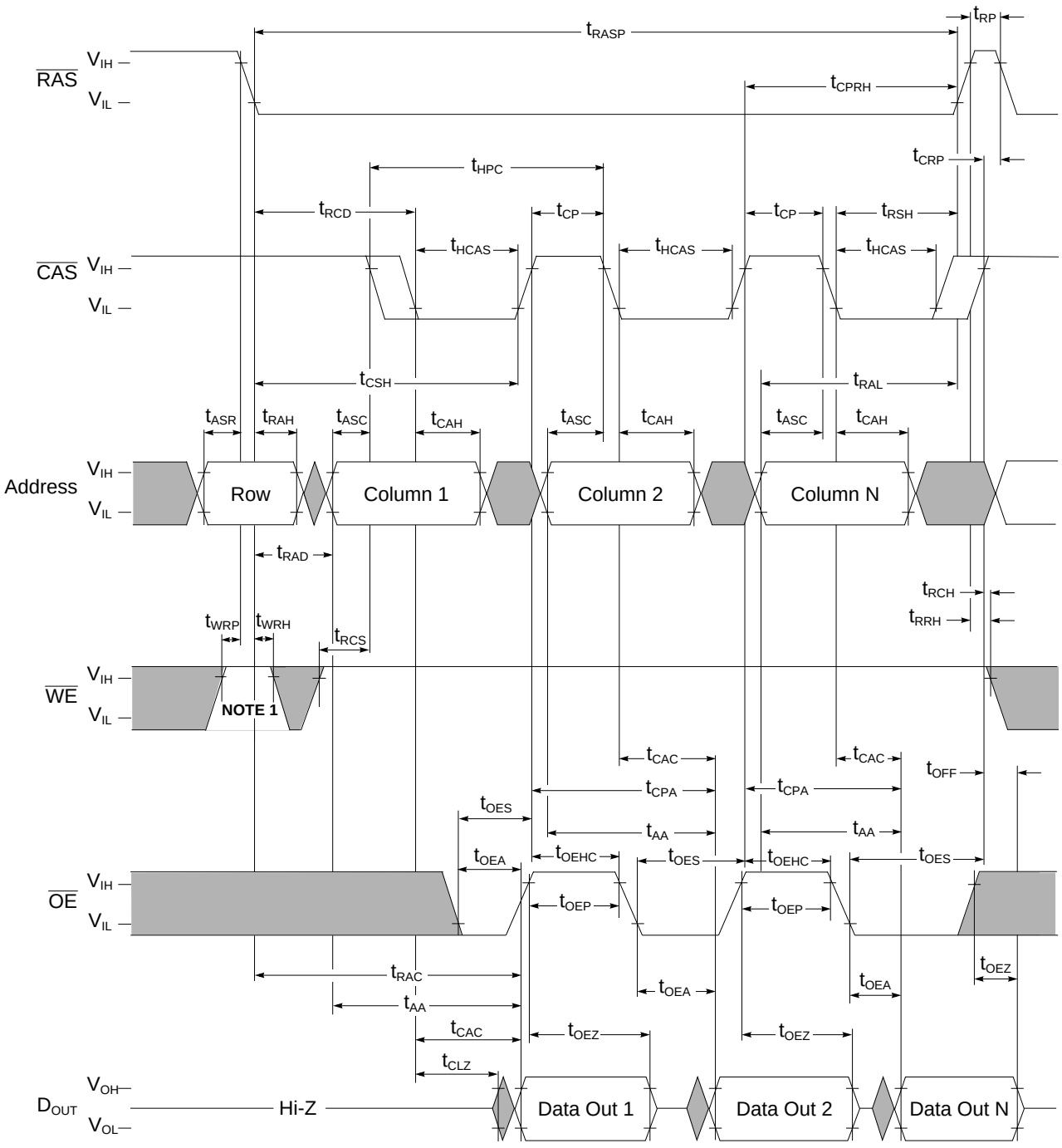
EDO Page Mode Read Cycle



: “H” or “L”

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

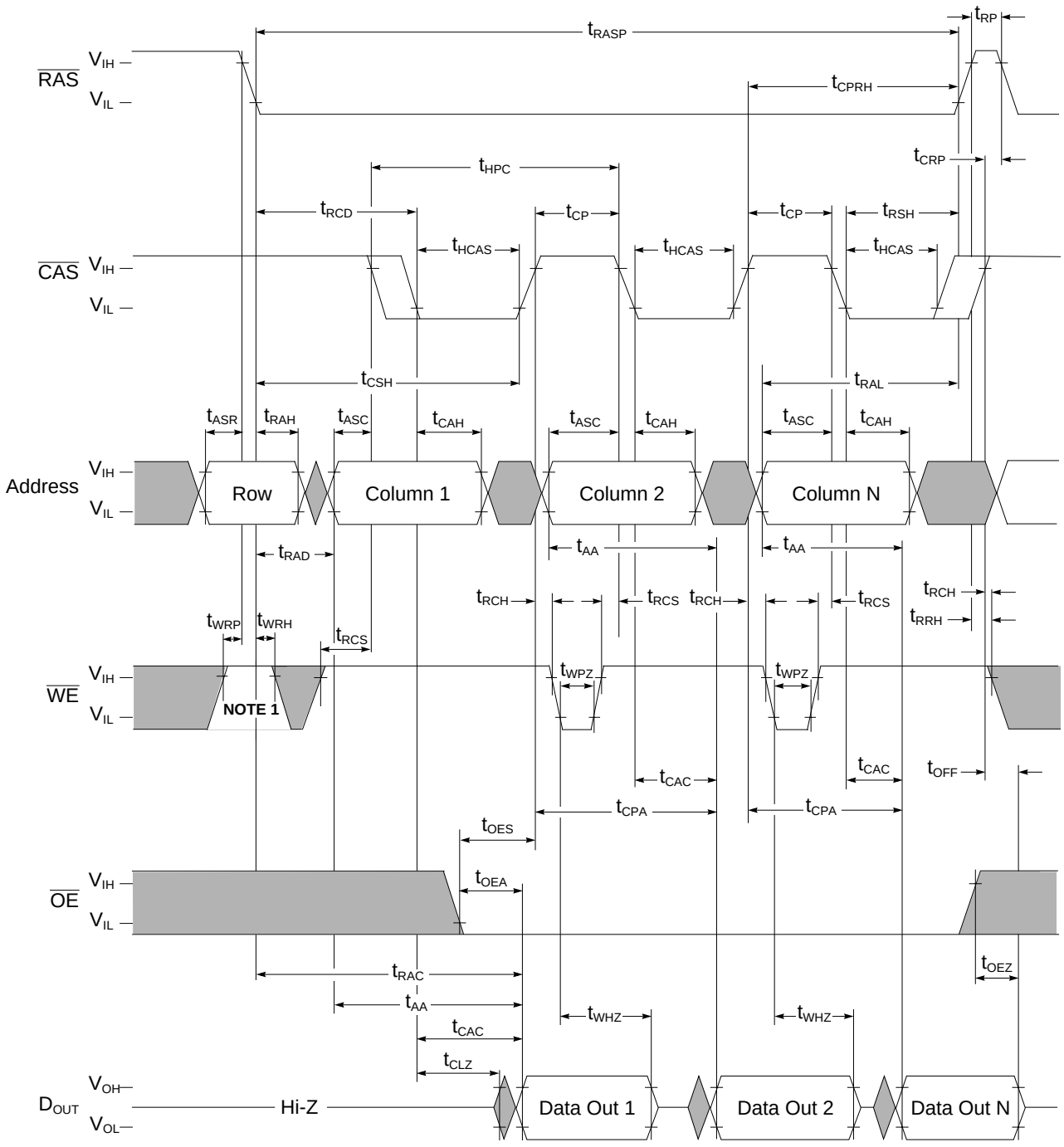
EDO Page Mode Read Cycle ($\overline{OE}$ Control)



: "H" or "L"

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

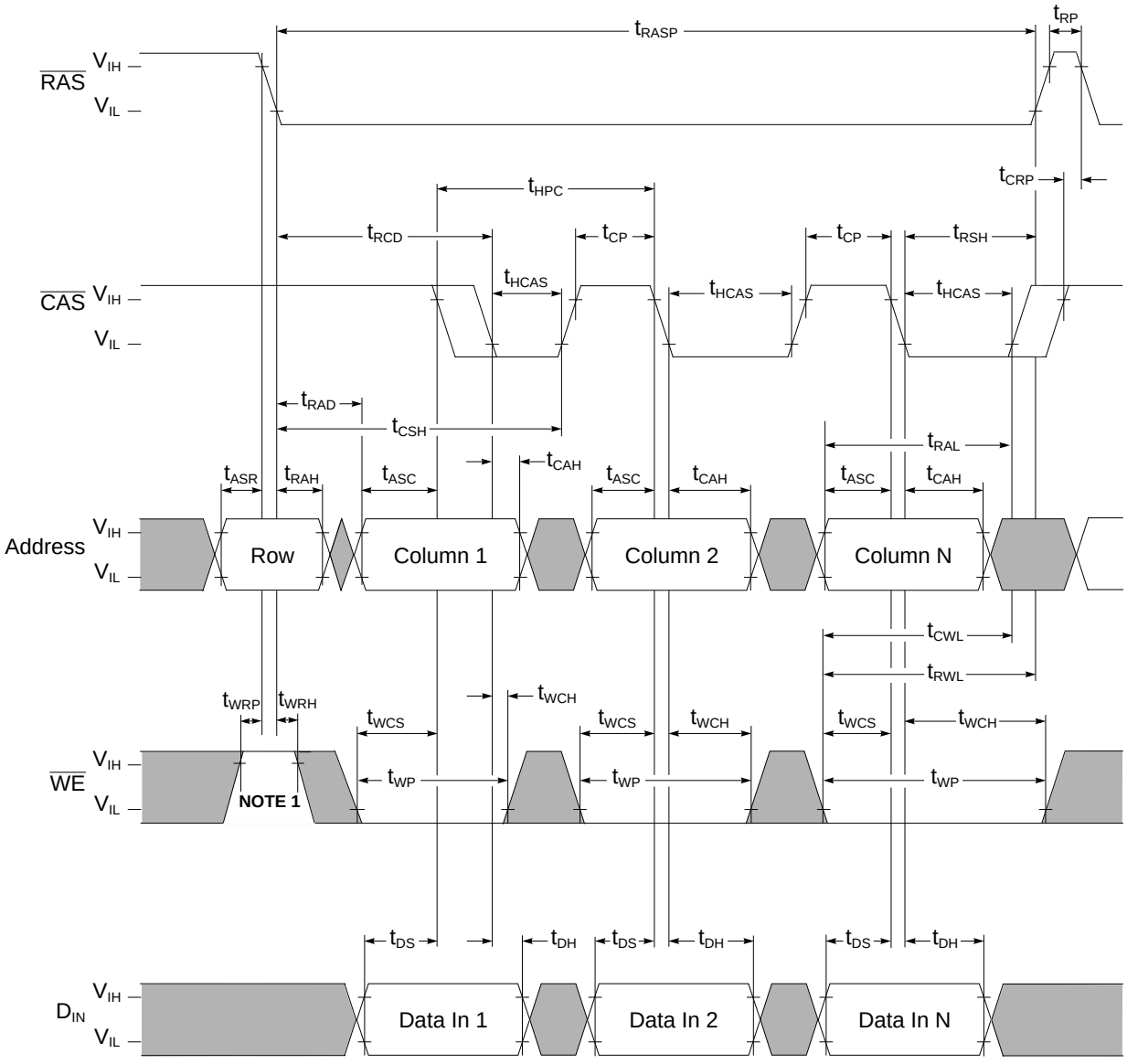
EDO Page Mode Read Cycle ($\overline{WE}$ Control)



: "H" or "L"

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

EDO Page Mode Early Write Cycle

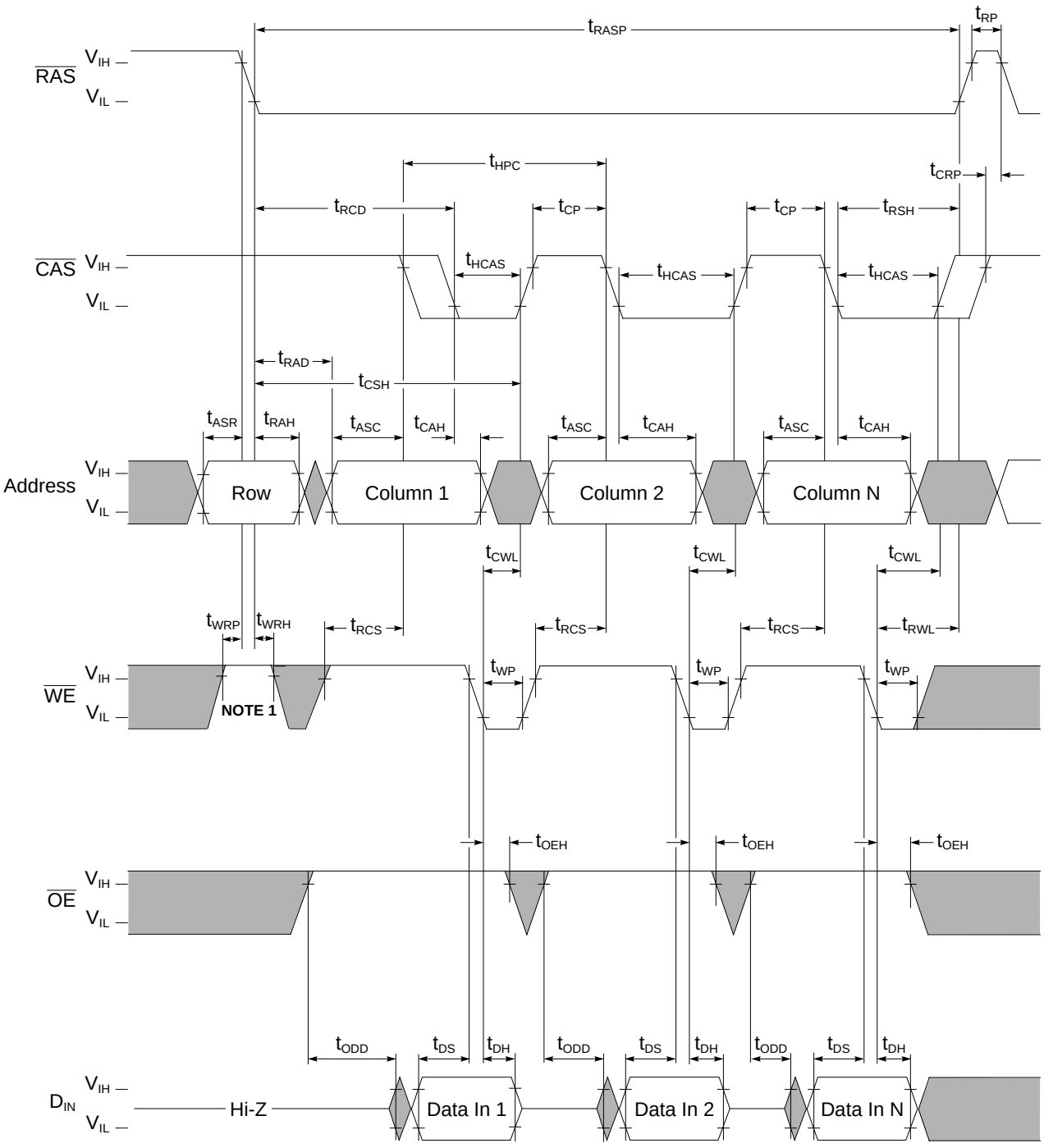


: "H" or "L"

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

$\overline{OE}$ = Don't care

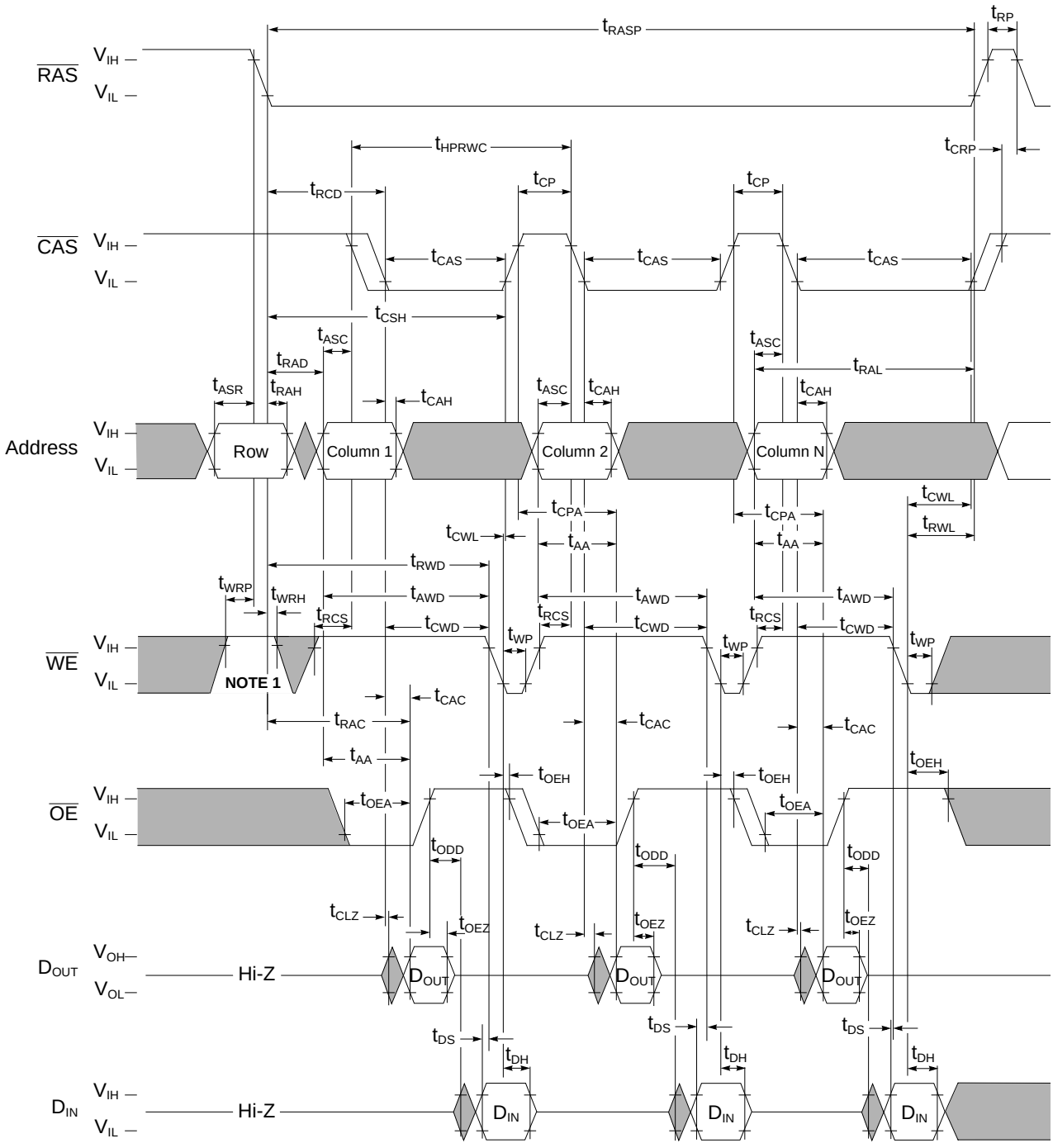
EDO Page Mode Late Write Cycle



: “H” or “L”

NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

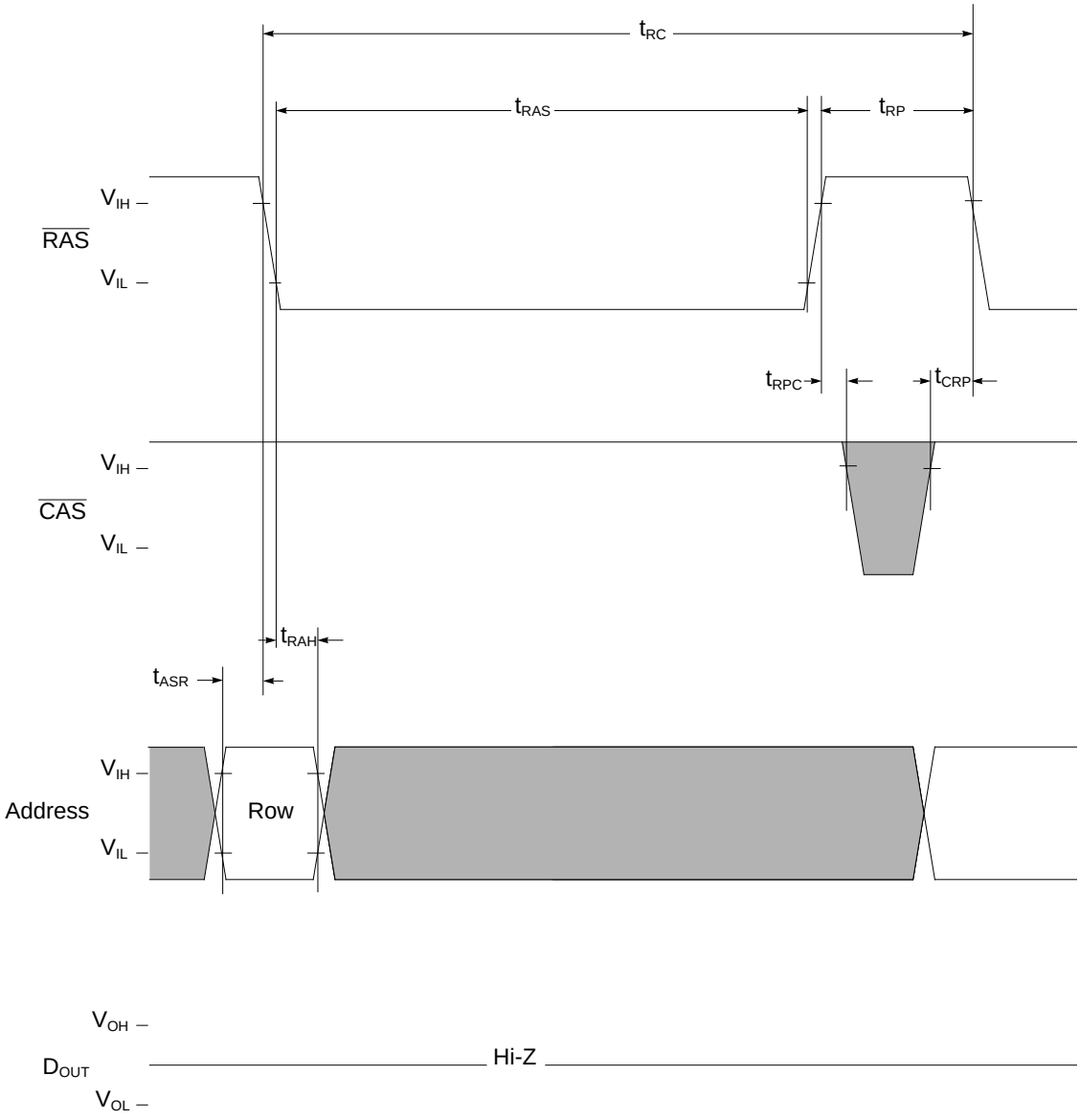
EDO Page Mode Read Modify Write Cycle



: "H" or "L"

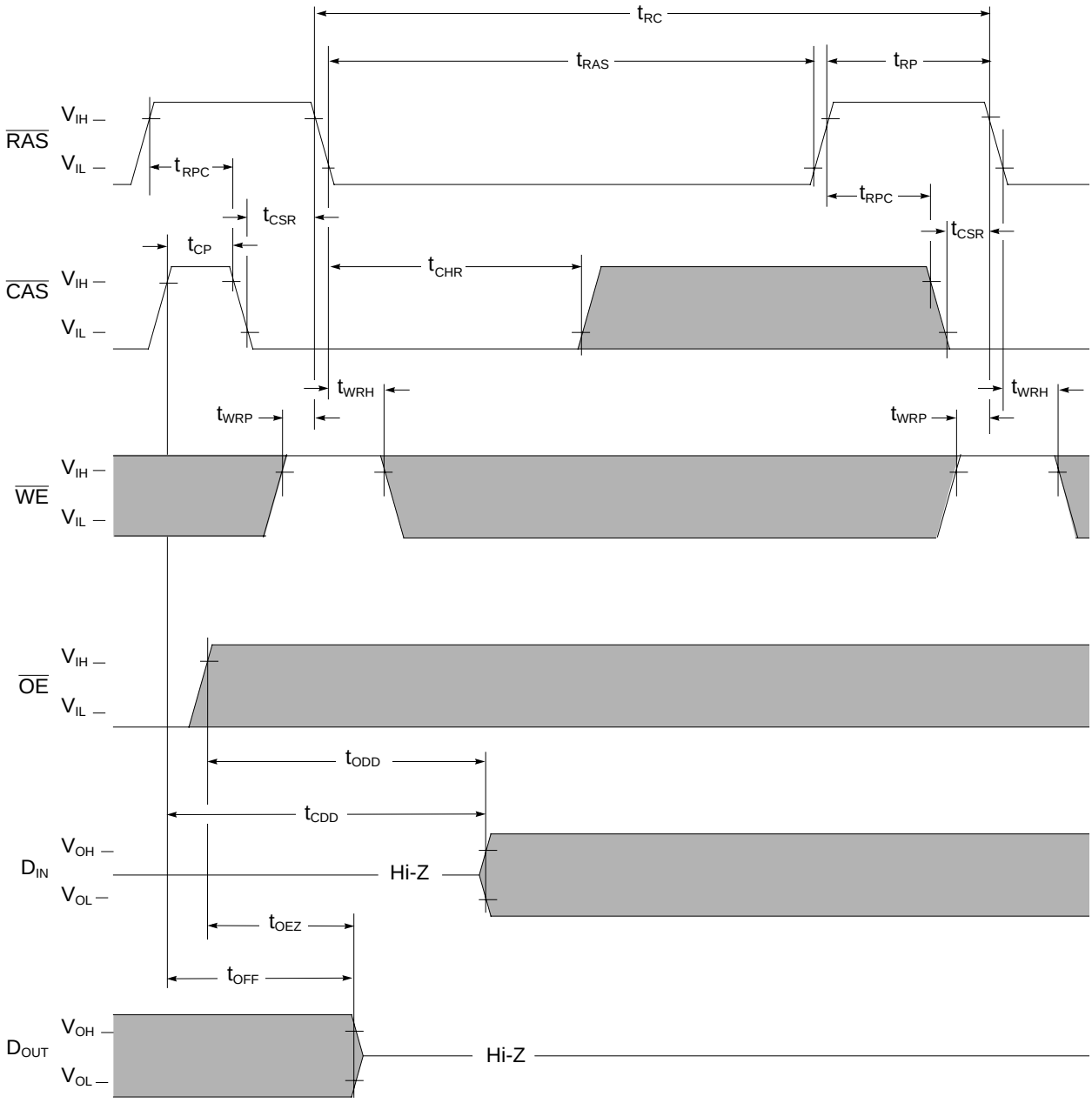
NOTE 1: Implementing $\overline{WE}$ at $\overline{RAS}$ time During a Read or Write Cycle is optional. Doing so will facilitate compatibility with future EDO DRAMs.

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



Note: $\overline{\text{WE}}$, $\overline{\text{OE}}$, D_{IN} are “H” or “L”

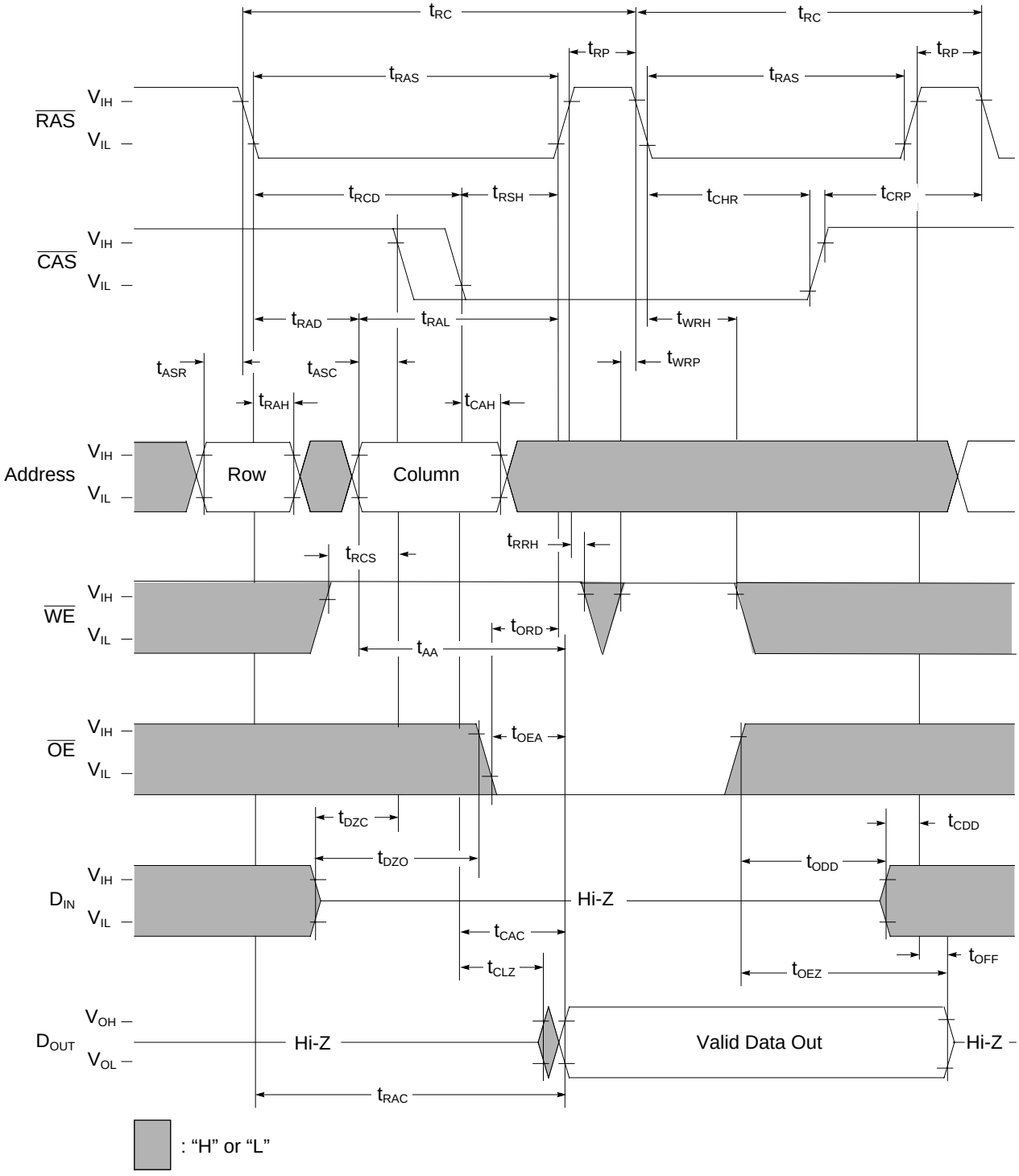
$\overline{CAS}$ Before $\overline{RAS}$ Refresh Cycle



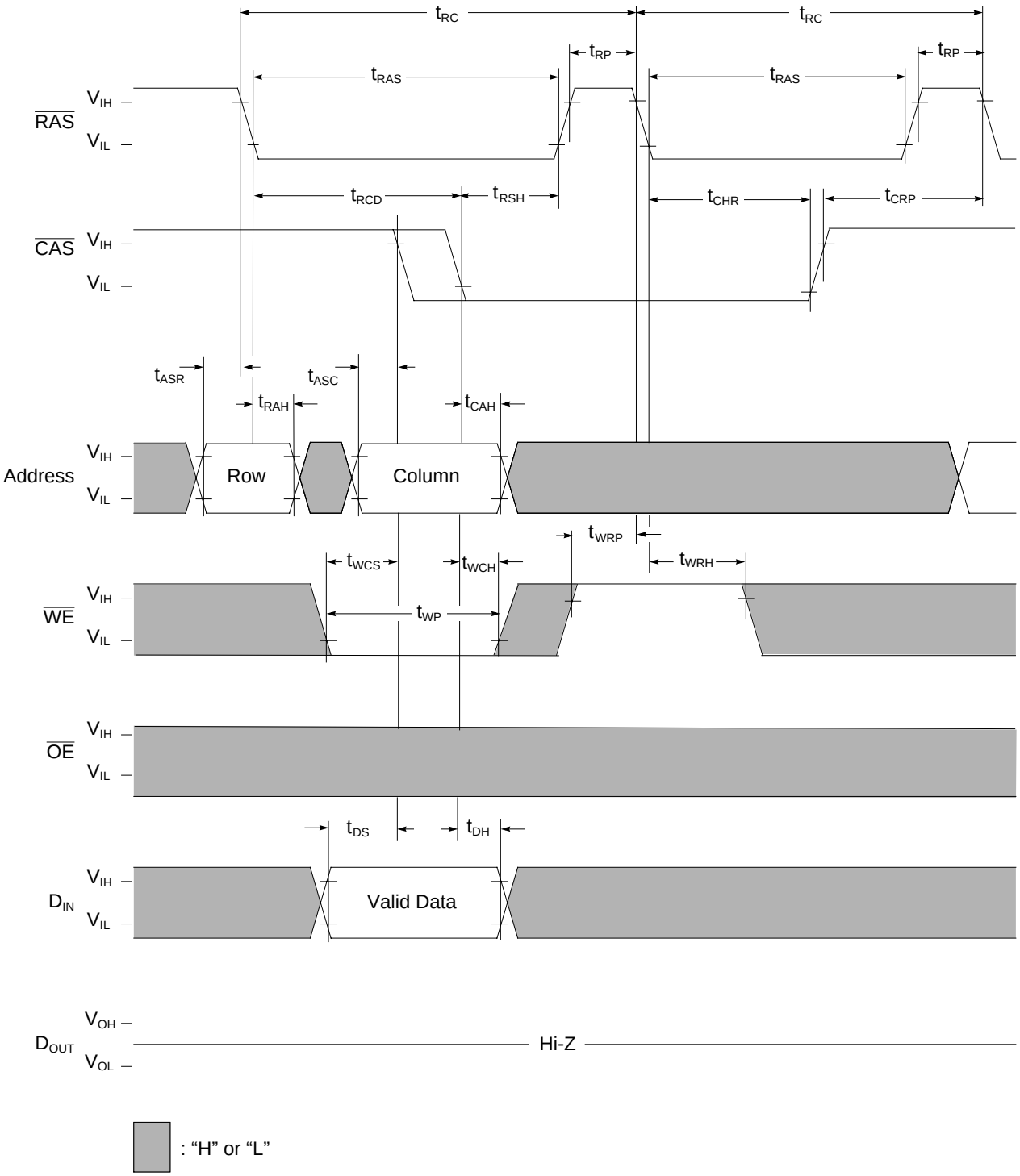
: “H” or “L”

NOTE: Address is “H” or “L”

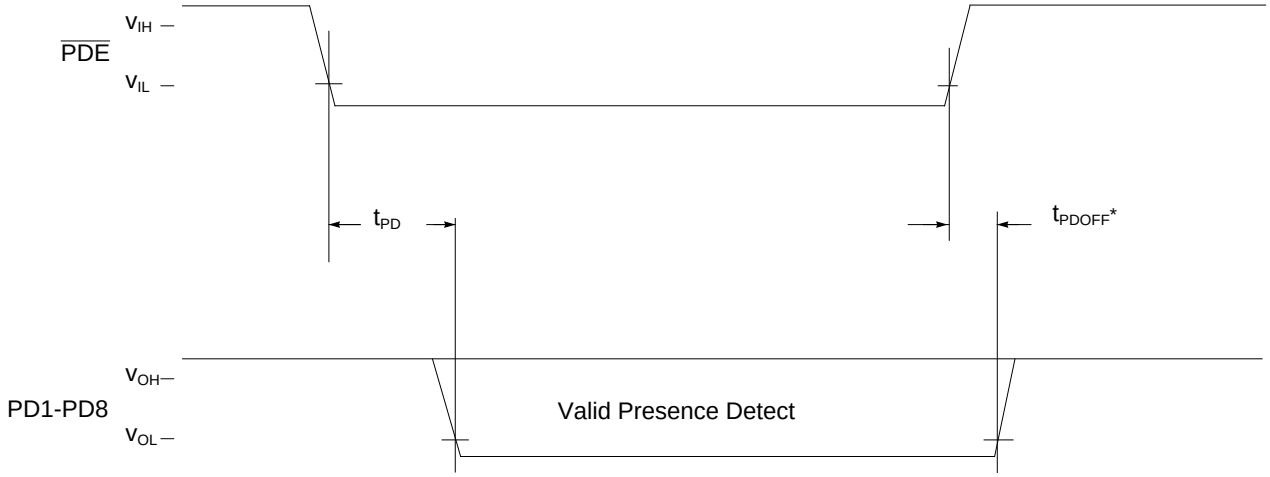
Hidden Refresh Cycle (Read)



Hidden Refresh Cycle (Write)

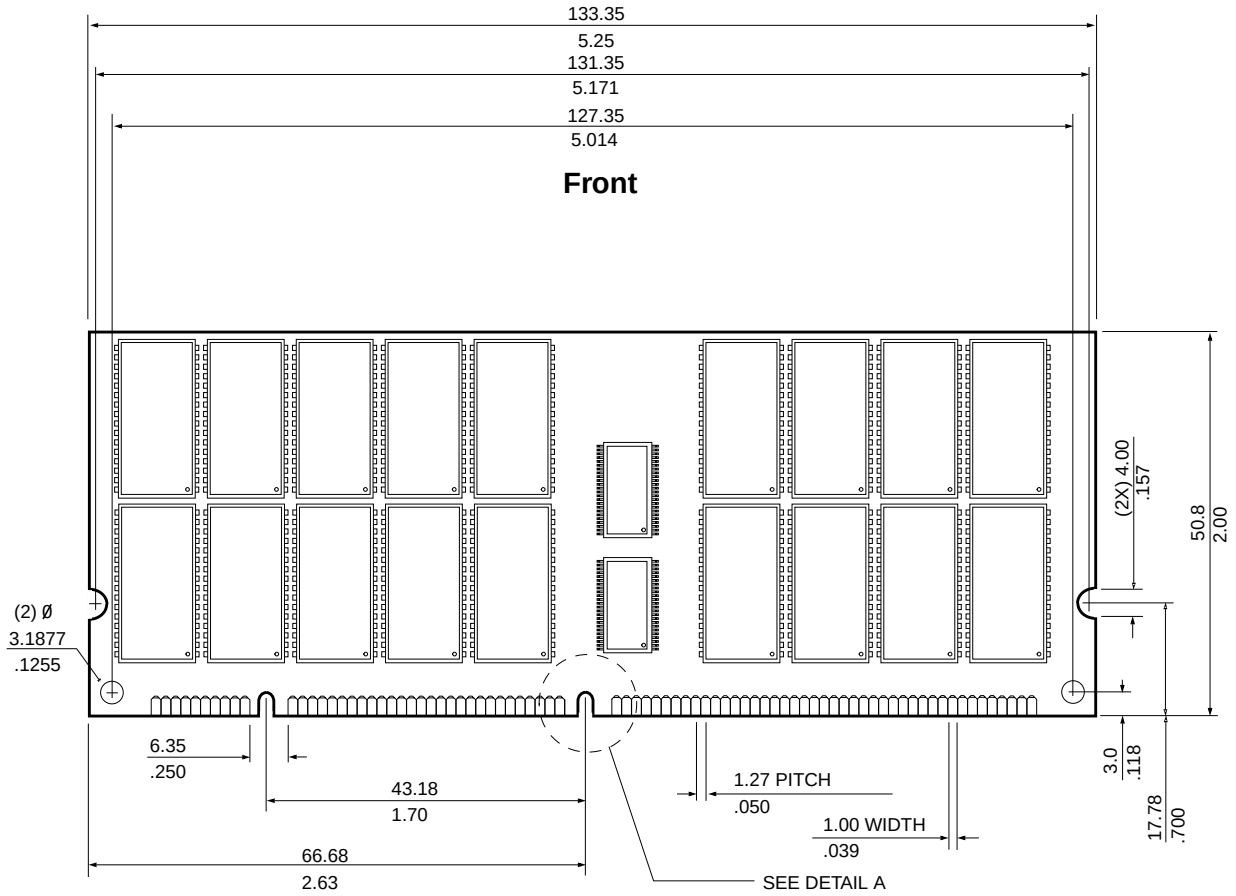


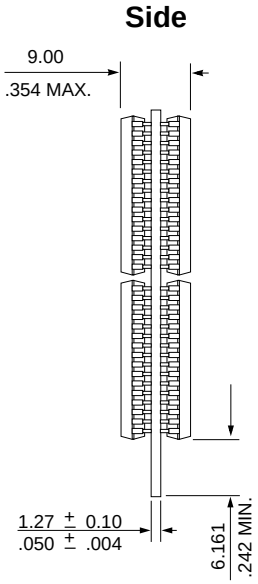
Presence Detect Read Cycle

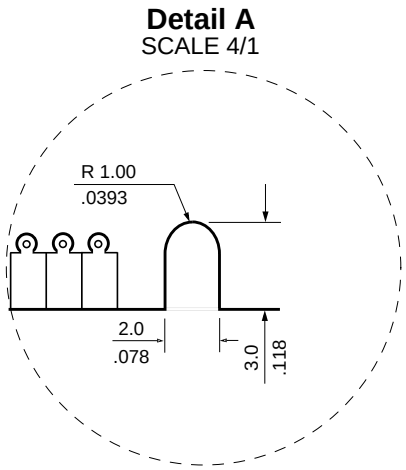


*PD pins must be pulled high at next level of assembly

Layout Drawing SOJ

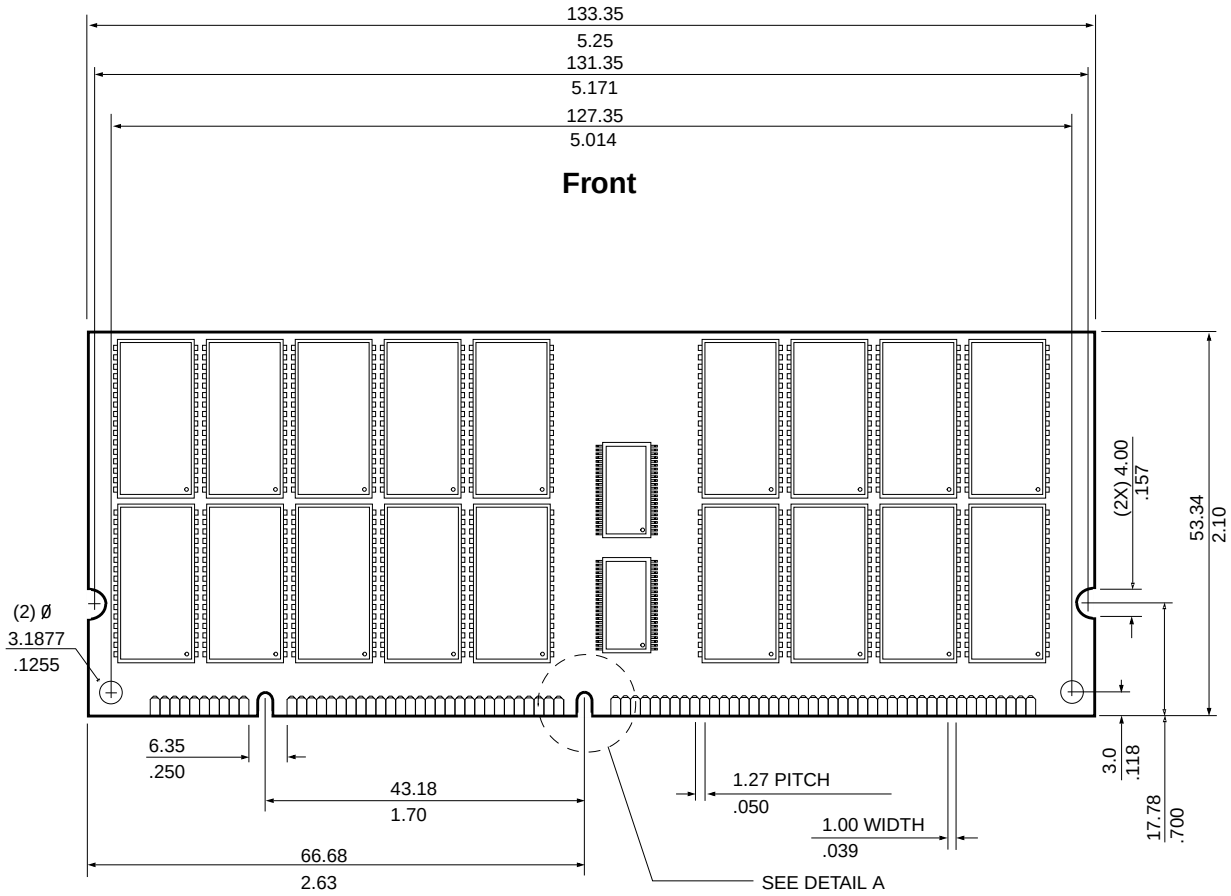


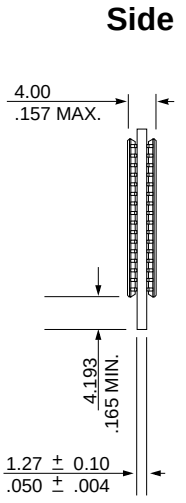


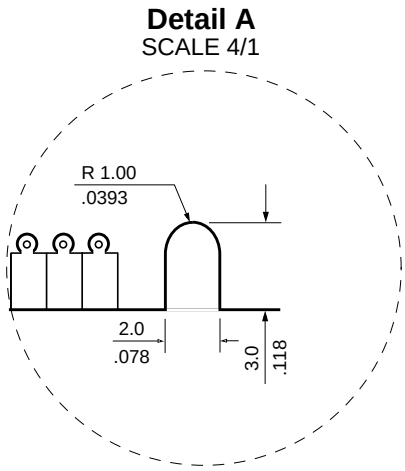


Note: All dimensions are typical unless otherwise stated. Millimeters / Inches

Layout Drawing TSOP



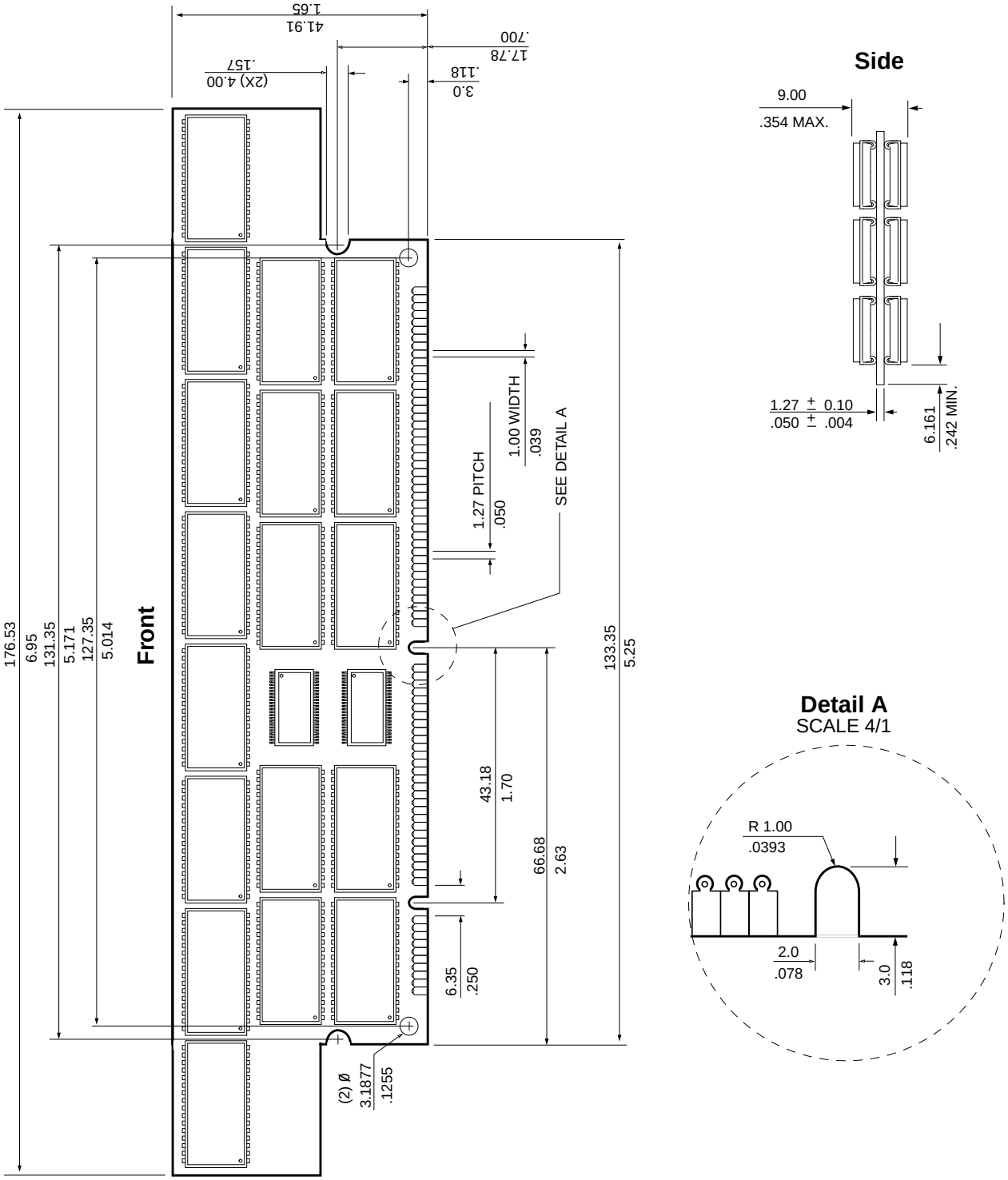




Note: All dimensions are typical unless otherwise stated. Millimeters / Inches

IBM11M32735B
IBM11M32735C
32M x 72 DRAM Module

Layout Drawing SOJ (W)



Note: All dimensions are typical unless otherwise stated. Millimeters / Inches

Revision Log

Rev	Contents of Modification
3/96	Initial Release.
5/96	Updated I_{CC} currents: I_{CC3}, I_{CC5} Updated refresh periods for CBR and RAS Only Refersh
8/96	Corrected typo's
12/96	Added 50ns speed sort Changed Raw Card dimensions from 2.5" to 2.0" (height)
3/97	Changed $\overline{RAS}$ Only Refresh from 128 ms to 64ms for 13/11 address Corrected Presence Detect table for 50ns Added Low Profile -60W Form Factor
4/98	Added TSOP package.
9/98	Corrected demention in ordering table for TSOP. It was 5.25" x 2.0" x 0.175.

Discontinued (8/98 - last order; 12/98 - last ship)

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