HB56U464EJ-6B/7B

4,194,304-word × 64-bit High Density Dynamic RAM Module
168-pin JEDEC Standard Outline Buffered 8 BYTE DIMM

HITACHI

ADE-203-590(Z)
Preliminary
Rev. 0.0
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Description

The HB56U464EJ belongs to 8 Byte DIMM (Dual In-line Memory Module) family, and has been developed as an optimized main memory solution for 4 and 8 Byte processor applications.

The HB56U464EJ is a 4M × 64 dynamic RAM module, mounted 16 pieces of 16-Mbit DRAM (HM5116405BS) sealed in SOJ package, 1 piece of 16-bit BiCMOS line driver (74ABT16244) sealed in TSSOP package and 1 piece of 20-bit BiCMOS line driver (74ABT16827) sealed in TSSOP package.

The HB56U464EJ offers Extended Data Out (EDO) Page Mode as a high speed access mode.

An outline of the HB56U464EJ is 168-pin socket type package (dual lead out).

Therefore, the HB56U464EJ makes high density mounting possible without surface mount technology. The HB56U464EJ provides common data inputs and outputs.

Decoupling capacitors are mounted beneath each SOJ on the module board.

Features

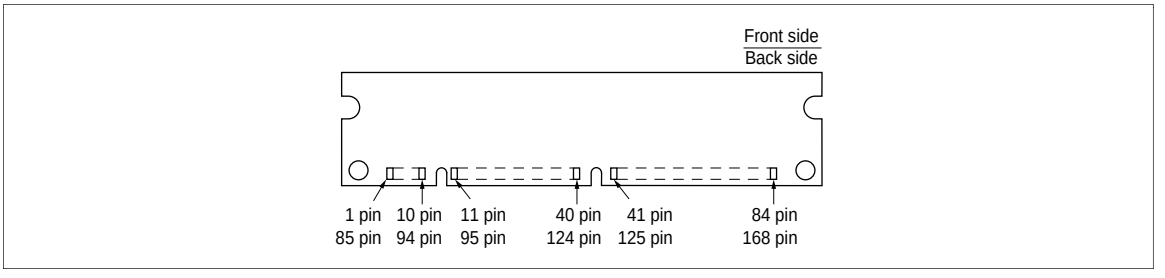
- 168-pin socket type package (Dual lead out)
  - — Lead pitch: 1.27 mm
- Single 5 V (±5%) supply
- High speed
  - — Access time: t_{RAC} = 60/70 ns (max)
  - — Access time: t_{CAC} = 20/23 ns (max)
- Low power dissipation
  - — Active mode: 7.06/6.22 W (max)
  - — Standby mode (TTL): 504 mW (max)
  - — Standby mode (CMOS): 420 mW (max)

- Buffered input except $\overline{RAS}$ and DQ
- 4 byte interleave enabled, duel address input (A0/B0)
- EDO page mode capability
- 4,096 refresh cycles: 64 ms
- 2 variations of refresh
  - $\overline{RAS}$-only refresh
  - $\overline{CAS}$-before-$\overline{RAS}$ refresh
- TTL compatible

Ordering Information

Type No.	Access time	Package	Contact pad
HB56U464EJ-6B	60 ns	168-pin dual lead out socket type	Gold
HB56U464EJ-7B	70 ns		

Pin Arrangement



Pin Arrangement

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	V_{SS}	12	V_{SS}	23	V_{SS}	34	A2
2	DQ0	13	DQ9	24	NC	35	A4
3	DQ1	14	DQ10	25	NC	36	A6
4	DQ2	15	DQ11	26	V_{CC}	37	A8
5	DQ3	16	DQ12	27	$\overline{WE0}$	38	A10
6	V_{CC}	17	DQ13	28	$\overline{CE0}$	39	NC
7	DQ4	18	V_{CC}	29	$\overline{CE2}$	40	V_{CC}
8	DQ5	19	DQ14	30	$\overline{RE0}$	41	NC
9	DQ6	20	DQ15	31	$\overline{OE0}$	42	NC
10	DQ7	21	DQ16	32	V_{SS}	43	V_{SS}
11	NC	22	NC	33	A0	44	$\overline{OE2}$

Pin Arrangement (cont)

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
45	$\overline{RE2}$	76	DQ34	107	V_{SS}	138	V_{SS}
46	$\overline{CE4}$	77	NC	108	NC	139	DQ56
47	$\overline{CE6}$	78	V_{SS}	109	NC	140	DQ57
48	$\overline{WE2}$	79	PD1	110	V_{CC}	141	DQ58
49	V_{CC}	80	PD3	111	NC	142	DQ59
50	NC	81	PD5	112	$\overline{CE1}$	143	V_{CC}
51	NC	82	PD7	113	$\overline{CE3}$	144	DQ60
52	DQ18	83	ID0 (V_{SS})	114	NC	145	NC
53	DQ19	84	V_{CC}	115	NC	146	NC
54	V_{SS}	85	V_{SS}	116	V_{SS}	147	NC
55	DQ20	86	DQ36	117	A1	148	NC
56	DQ21	87	DQ37	118	A3	149	DQ61
57	DQ22	88	DQ38	119	A5	150	NC
58	DQ23	89	DQ39	120	A7	151	DQ63
59	V_{CC}	90	V_{CC}	121	A9	152	V_{SS}
60	DQ24	91	DQ40	122	A11	153	DQ64
61	NC	92	DQ41	123	NC	154	DQ65
62	NC	93	DQ42	124	V_{CC}	155	DQ66
63	NC	94	DQ43	125	NC	156	DQ67
64	NC	95	NC	126	B0	157	V_{CC}
65	DQ25	96	V_{SS}	127	V_{SS}	158	DQ68
66	NC	97	DQ45	128	NC	159	DQ69
67	DQ27	98	DQ46	129	NC	160	DQ70
68	V_{SS}	99	DQ47	130	$\overline{CE5}$	161	NC
69	DQ28	100	DQ48	131	$\overline{CE7}$	162	V_{SS}
70	DQ29	101	DQ49	132	$\overline{PDE}$	163	PD2
71	DQ30	102	V_{CC}	133	V_{CC}	164	PD4
72	DQ31	103	DQ50	134	NC	165	PD6
73	V_{CC}	104	DQ51	135	NC	166	PD8
74	DQ32	105	DQ52	136	DQ54	167	ID1 (V_{SS})
75	DQ33	106	NC	137	DQ55	168	V_{CC}

Pin Description

Pin Name	Function
A0 to A11, B0	Address Input : A0 to A11, B0 Row Address : A0 to A11, B0 Column Address : A0 to A9, B0 Refresh Address : A0 to A11, B0
DQ0 to DQ7, DQ9 to DQ16, DQ18 to DQ25, DQ27 to DQ34, DQ36 to DQ43, DQ45 to DQ52, DQ54 to DQ61, DQ63 to DQ70	Data-in/Data-out
$\overline{RE0}$, $\overline{RE2}$	Row Address Strobe
$\overline{CE0}$ to $\overline{CE7}$	Column Address Strobe
$\overline{WE0}$, $\overline{WE2}$	Read/Write Enable
$\overline{OE0}$, $\overline{OE2}$	Output Enable
V_{CC}	Power Supply
V_{SS}	Ground
PD1 to PD8	Presence Detect
ID0, ID1	ID bit
$\overline{PDE}$	Presence Detect Enable
NC	No Connection

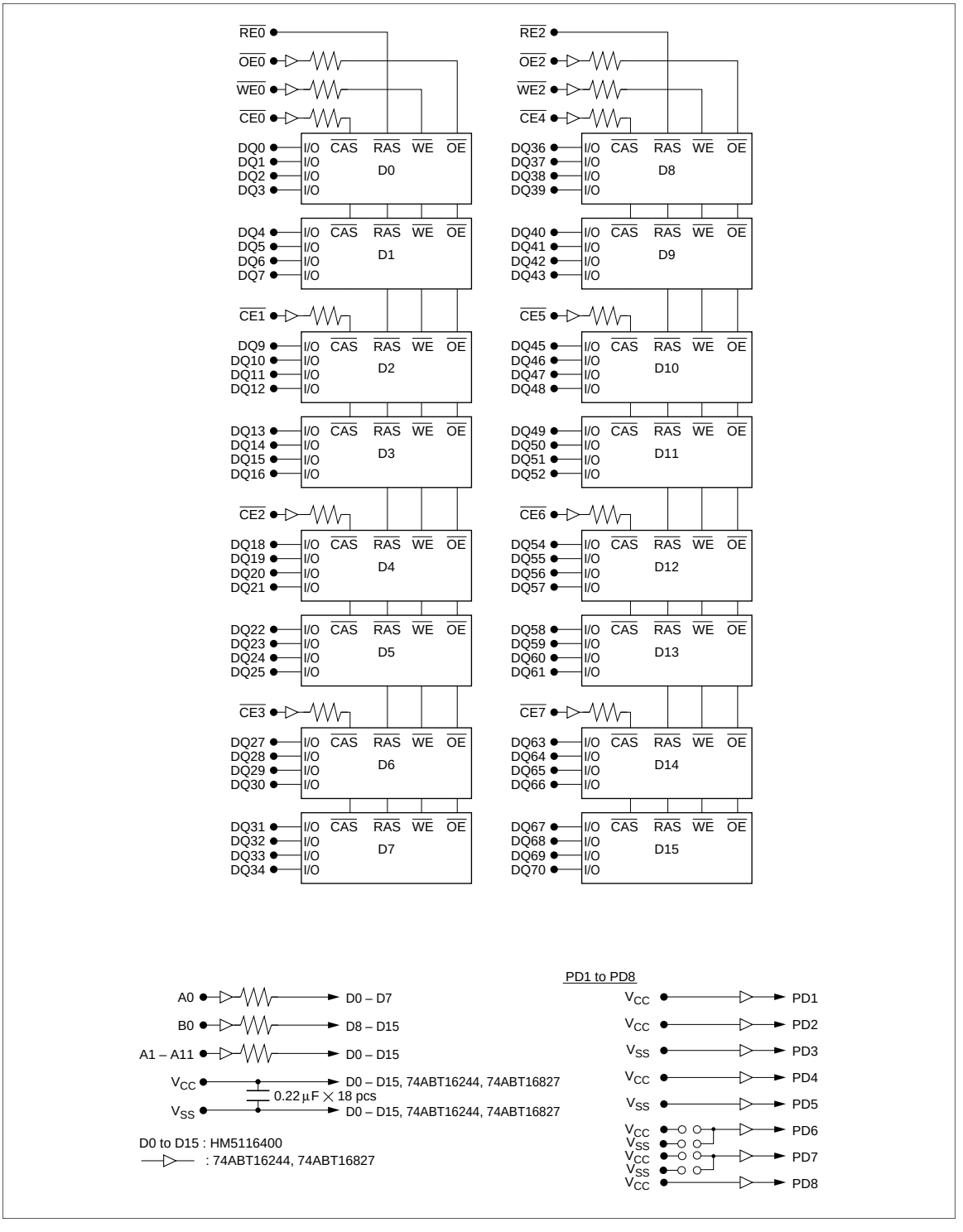
Presence Detect Pin Assignment

		$\overline{PDE}$ = Low		$\overline{PDE}$ = High
Pin Name	**Pin No.**	**60 ns**	**70 ns**	**All**
PD1	79	1	1	High-Z
PD2	163	1	1	High-Z
PD3	80	0	0	High-Z
PD4	164	1	1	High-Z
PD5	81	1	1	High-Z
PD6	165	1	0	High-Z
PD7	82	1	1	High-Z
PD8	166	1	1	High-Z

1: High Level (Driver Output)

0: Low Level (Driver Output)

Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Voltage on any pin relative to V_{SS}	V_T	–1.0 to +7.0	V

Supply voltage relative to V_{SS}	V_{CC}	–1.0 to +7.0	V
Short circuit output current	Iout	50	mA
Power dissipation	Pt	17	W
Operating temperature	Topr	0 to +70	°C
Storage temperature	Tstg	–55 to +125	°C

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

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply voltage	V_{SS}	0	0	0	V	
	V_{CC}	4.75	5.0	5.25	V	1
Input high voltage	V_{IH}	2.4	—	5.5	V	1
Input low voltage	V_{IL}	–0.5	—	0.8	V	1

Note: 1. All voltage referenced to V_{SS}.

DC Characteristics (Ta = 0 to +70°C, V_{CC} = 5 V ± 5%, V_{SS} = 0 V)

		60 ns		70 ns				
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Test condition**	**Note**
Operating current	I_{CC1}	—	1344	—	1184	mA	t_{RC} = min	1, 2
Standby current	I_{CC2}	—	96	—	96	mA	TTL interface $\overline{RAS}$, $\overline{CAS}$ = V_{IH} Dout = High-Z	
		—	80	—	80	mA	CMOS interface $\overline{RAS}$, $\overline{CAS}$ ≥ V_{CC} – 0.2 V Dout = High-Z	
$\overline{RAS}$-only refresh current	I_{CC3}	—	1344	—	1184	mA	t_{RC} = min	2
Standby current	I_{CC5}	—	144	—	144	mA	$\overline{RAS}$ = V_{IH} $\overline{CAS}$ = V_{IL} Dout = enable	1
$\overline{CAS}$-before-$\overline{RAS}$ refresh current	I_{CC6}	—	1344	—	1184	mA	t_{RC} = min	
EDO page mode current	I_{CC7}	—	1664	—	1504	mA	t_{HPC} = min	1, 3
Input leakage current	I_{LI}	–10	10	–10	10	µA	0 V ≤ Vin ≤ 5.5 V	
Output leakage current	I_{LO}	–10	10	–10	10	µA	0 V ≤ Vout ≤ 5.5 V Dout = disable	
Output high voltage	V_{OH}	2.4	V_{CC}	2.4	V_{CC}	V	High Iout = –2 mA	
Output low voltage	V_{OL}	0	0.4	0	0.4	V	Low Iout = 2 mA	

Notes: 1. I_{CC} depends on output load condition when the device is selected, I_{CC} max is specified at the output open condition.
2. Address can be changed once or less while $\overline{RAS}$ = V_{IL}.
3. Address can be changed once or less while $\overline{CAS}$ = V_{IH}.

Capacitance (Ta = 25°C, V_{CC} = 5 V ± 5%)

Parameter	**Symbol**	**Typ**	**Max**	**Unit**	**Notes**
Input capacitance (Address)	C_{I1}	—	20	pF	1
Input capacitance ($\overline{CAS}$, $\overline{WE}$, $\overline{OE}$)	C_{I2}	—	20	pF	1
Input capacitance ($\overline{RAS}$)	C_{I3}	—	71	pF	1
I/O capacitance (DQ)	$C_{I/O}$	—	20	pF	1, 2

Notes: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.
2. $\overline{CAS}$ = V_{IH} to disable Dout.

AC Characteristics (Ta = 0 to 70°C, V_{CC} = 5 V ± 5%, V_{SS} = 0 V)[*1, *2, *18, *19]

Test Conditions

- Input rise and fall times: 2 ns
- Input levels: V_{IL} = 0 V, V_{IH} = 3.0 V
- Input timing reference levels: 0.8 V, 2.4 V
- Output timing reference levels: 0.8 V, 2.0 V
- Output load: 1 TTL gate + C_L (100 pF) (Including scope and jig)

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

		60 ns		70 ns			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Random read or write cycle time	t_{RC}	104	—	124	—	ns	
$\overline{RAS}$ precharge time	t_{RP}	40	—	50	—	ns	
$\overline{CAS}$ precharge time	t_{CP}	10	—	13	—	ns	
$\overline{RAS}$ pulse width	t_{RAS}	60	10000	70	10000	ns	
$\overline{CAS}$ pulse width	t_{CAS}	10	10000	13	10000	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}	10	—	13	—	ns	
$\overline{RAS}$ to $\overline{CAS}$ delay time	t_{RCD}	20	40	20	47	ns	3
$\overline{RAS}$ to column address delay time	t_{RAD}	15	25	15	30	ns	4
$\overline{RAS}$ hold time	t_{RSH}	20	—	23	—	ns	
$\overline{CAS}$ hold time	t_{CSH}	48	—	58	—	ns	
$\overline{CAS}$ to $\overline{RAS}$ precharge time	t_{CRP}	10	—	10	—	ns	
$\overline{OE}$ to Din delay time	t_{OED}	20	—	23	—	ns	5
$\overline{OE}$ delay time from Din	t_{DZO}	0	—	0	—	ns	6
$\overline{CAS}$ delay time from Din	t_{DZC}	0	—	0	—	ns	6
Transition time (rise and fall)	t_T	2	50	2	50	ns	7
Refresh period (4,096 cycles)	t_{REF}	—	64	—	64	ms	

Read Cycle

		60 ns		70 ns			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Access time from $\overline{RAS}$	t_{RAC}	—	60	—	70	ns	8, 9
Access time from $\overline{CAS}$	t_{CAC}	—	20	—	23	ns	9, 10, 17
Access time from address	t_{AA}	—	35	—	40	ns	9, 11, 17
Access time from $\overline{OE}$	t_{OEA}	—	20	—	23	ns	9
Read command setup time	t_{RCS}	0	—	0	—	ns	
Read command hold time to $\overline{CAS}$	t_{RCH}	0	—	0	—	ns	12
Read command hold time from $\overline{RAS}$	t_{RCHR}	60	—	70	—	ns	
Read command hold time to $\overline{RAS}$	t_{RRH}	0	—	0	—	ns	12
Column address to $\overline{RAS}$ lead time	t_{RAL}	35	—	40	—	ns	
Column address to $\overline{CAS}$ lead time	t_{CAL}	18	—	23	—	ns	
$\overline{CAS}$ to output in low-Z	t_{CLZ}	2	—	2	—	ns	
Output data hold time	t_{OH}	3	—	3	—	ns	
Output data hold time from $\overline{OE}$	t_{OHO}	3	—	3	—	ns	
Output buffer turn-off time	t_{OFF}	—	20	—	20	ns	13
Output buffer turn-off to $\overline{OE}$	t_{OEZ}	—	20	—	20	ns	13
$\overline{CAS}$ to Din delay time	t_{CDD}	20	—	23	—	ns	5
Output data hold time from $\overline{RAS}$	t_{OHR}	3	—	3	—	ns	
Output buffer turn-off to $\overline{RAS}$	t_{OFR}	—	15	—	15	ns	
Output buffer turn-off to $\overline{WE}$	t_{WEZ}	—	20	—	20	ns	
$\overline{WE}$ to Din delay time	t_{WED}	20	—	23	—	ns	
$\overline{RAS}$ to Din delay time	t_{RDD}	15	—	18	—	ns	

Write Cycle

		60 ns		70 ns			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Write command setup time	t_{WCS}	0	—	0	—	ns	14
Write command hold time	t_{WCH}	10	—	13	—	ns	
Write command pulse width	t_{WP}	10	—	10	—	ns	
Write command to $\overline{RAS}$ lead time	t_{RWL}	15	—	18	—	ns	
Write command to $\overline{CAS}$ lead time	t_{CWL}	10	—	13	—	ns	
Data-in setup time	t_{DS}	0	—	0	—	ns	15
Data-in hold time	t_{DH}	15	—	18	—	ns	15

Read-Modify-Write Cycle

		60 ns		70 ns			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Read-modify-write cycle time	t_{RWC}	149	—	175	—	ns	
$\overline{RAS}$ to $\overline{WE}$ delay time	t_{RWD}	87	—	100	—	ns	14
$\overline{CAS}$ to $\overline{WE}$ delay time	t_{CWD}	37	—	43	—	ns	14
Column address to $\overline{WE}$ delay time	t_{AWD}	52	—	60	—	ns	14
$\overline{OE}$ hold time from $\overline{WE}$	t_{OEH}	15	—	18	—	ns	

Refresh Cycle

		60 ns		70 ns			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
$\overline{CAS}$ setup time (CBR refresh cycle)	t_{CSR}	10	—	10	—	ns	
$\overline{CAS}$ hold time (CBR refresh cycle)	t_{CHR}	10	—	10	—	ns	
$\overline{WE}$ setup time (CBR refresh cycle)	t_{WRP}	5	—	5	—	ns	
$\overline{WE}$ hold time (CBR refresh cycle)	t_{WRH}	10	—	10	—	ns	
$\overline{RAS}$ precharge to $\overline{CAS}$ hold time	t_{RPC}	0	—	0	—	ns	

EDO Page Mode Cycle

		60 ns		70 ns			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
EDO page mode cycle time	t_{HPC}	25	—	30	—	ns	20
EDO page mode $\overline{RAS}$ pulse width	t_{RASP}	—	100000	—	100000	ns	16
Access time from $\overline{CAS}$ precharge	t_{CPA}	—	40	—	45	ns	9, 17
$\overline{RAS}$ hold time from $\overline{CAS}$ precharge	t_{CPRH}	40	—	45	—	ns	
Output data hold time from $\overline{CAS}$ low	t_{DOH}	3	—	3	—	ns	9, 17
$\overline{CAS}$ hold time referenced $\overline{OE}$	t_{COL}	10	—	13	—	ns	
$\overline{CAS}$ to $\overline{OE}$ setup time	t_{COP}	5	—	5	—	ns	
Read command hold time from $\overline{CAS}$ precharge	t_{RCHC}	35	—	40	—	ns	

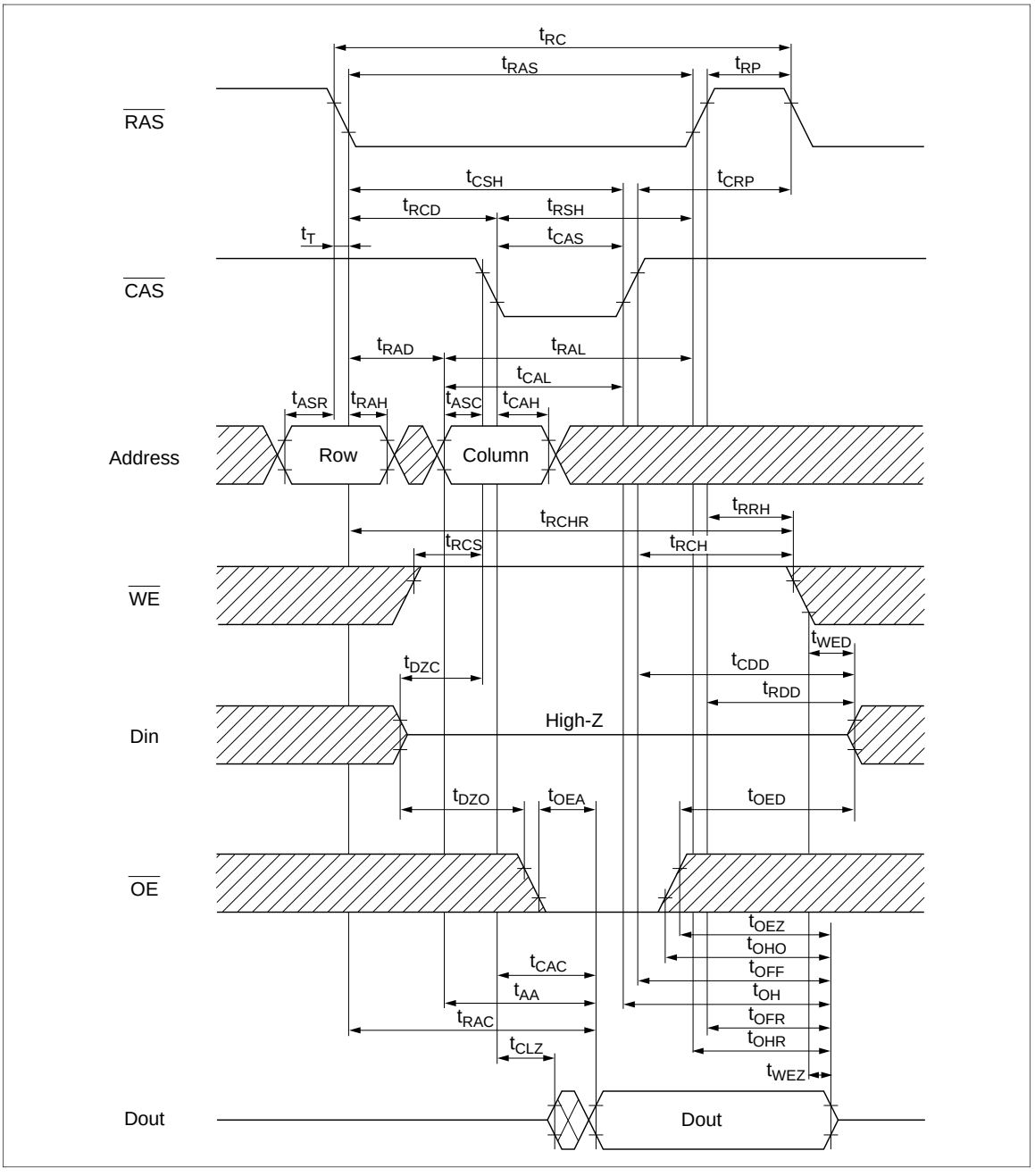
EDO Page Mode Read-Modify-Write Cycle

		60 ns		70 ns			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
EDO page mode read-modify-write cycle time	t_{PRWC}	79	—	90	—	ns	
$\overline{WE}$ delay time from $\overline{CAS}$ precharge	t_{CPW}	54	—	62	—	ns	14

Notes:
1. AC measurements assume t_T = 2 ns.
2. An initial pause of 200 μs is required after power up followed by a minimum of eight initialization cycles (any combination of cycles containing $\overline{RAS}$-only refresh or $\overline{CAS}$-before-$\overline{RAS}$ refresh).
3. Operation with the t_{RCD} (max) limit insures that t_{RAC} (max) can be met, 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 exclusively by t_{CAC}.
4. Operation with the t_{RAD} (max) limit insures that t_{RAC} (max) can be met, 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 exclusively by t_{AA}.
5. Either t_{OED} or t_{CDD} must be satisfied.
6. Either t_{DZO} or t_{DZC} must be satisfied.
7. V_{IH} (min) and V_{IL} (max) are reference levels for measuring timing of input signals. Also, transition times are measured between V_{IH} (min) and V_{IL} (max).
8. Assumes that $t_{RCD} \leq t_{RCD}$ (max) and $t_{RAD} \leq t_{RAD}$ (max). If t_{RCD} or t_{RAD} is greater than the maximum recommended value shown in this table, t_{RAC} exceeds the value shown.
9. Measured with a load circuit equivalent to 1TTL loads and 100 pF.
10. Assumes that $t_{RCD} \geq t_{RCD}$ (max) and $t_{RCD} + t_{CAC}$ (max) $\geq t_{RAD} + t_{AA}$ (max).
11. Assumes that $t_{RAD} \geq t_{RAD}$ (max) and $t_{RCD} + t_{CAC}$ (max) $\leq t_{RAD} + t_{AA}$ (max).
12. Either t_{RCH} or t_{RRH} must be satisfied for a read cycles.
13. t_{OFF} (max) and t_{OEZ} (max) is define the time at which the outputs achieve the open circuit condition and are not referred to output voltage levels.
14. t_{WCS}, t_{RWD}, t_{CWD}, t_{AWD} and t_{CPW} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only; if $t_{WCS} \geq t_{WCS}$ (min), the cycle is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle; if $t_{RWD} \geq t_{RWD}$ (min), $t_{CWD} \geq t_{CWD}$ (min), and $t_{AWD} \geq t_{AWD}$ (min) or $t_{CWD} \geq t_{CWD}$ (min), $t_{AWD} \geq t_{AWD}$ (min) and $t_{CPW} \geq t_{CPW}$ (min), the cycle is a read-modify-write and the data output will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indeterminate.
15. These parameters are referred to $\overline{CAS}$ leading edge in early write cycle and to $\overline{WE}$ leading edge in delayed write or read-modify-write cycles.
16. t_{RASP} defines $\overline{RAS}$ pulse width in EDO page mode cycles.
17. Access time is determined by the longest among t_{AA} or t_{CAC} or t_{CPA}.
18. In delayed write or read-modify-write cycles, $\overline{OE}$ must disable output buffer prior to applying data to the device. After $\overline{RAS}$ is reset, if $t_{OEH} \geq t_{CWL}$, the DQ pin will remain open circuit (high impedance); $t_{OEH} \leq t_{CWL}$, invalid data will be out at each DQ.
19. All the V_{CC} and V_{SS} pins shall be supplied with the same voltages.
20. t_{HPC} (min) can be achieved during a series of EDO page mode write cycles or EDO page mode read cycles. If both write and read operation are mixed in a EDO page mode $\overline{RAS}$ cycle (EDO page mode mix cycle (1), (2)), minimum value of $\overline{CAS}$ cycle ($t_{CAS} + t_{CP} + 2t_T$) becomes greater than the specified t_{HPC} (min) value. The value of $\overline{CAS}$ cycle time of mixed EDO page mode is shown in EDO page mode mix cycle (1) and (2).
21. When output buffers are enabled once, sustain the low impedance state until valid data is obtained. When output buffer is turned on and off within a very short time, generally it causes large V_{CC}/V_{SS} line noise, which causes to degrade V_{IH} min/V_{IL} max level.

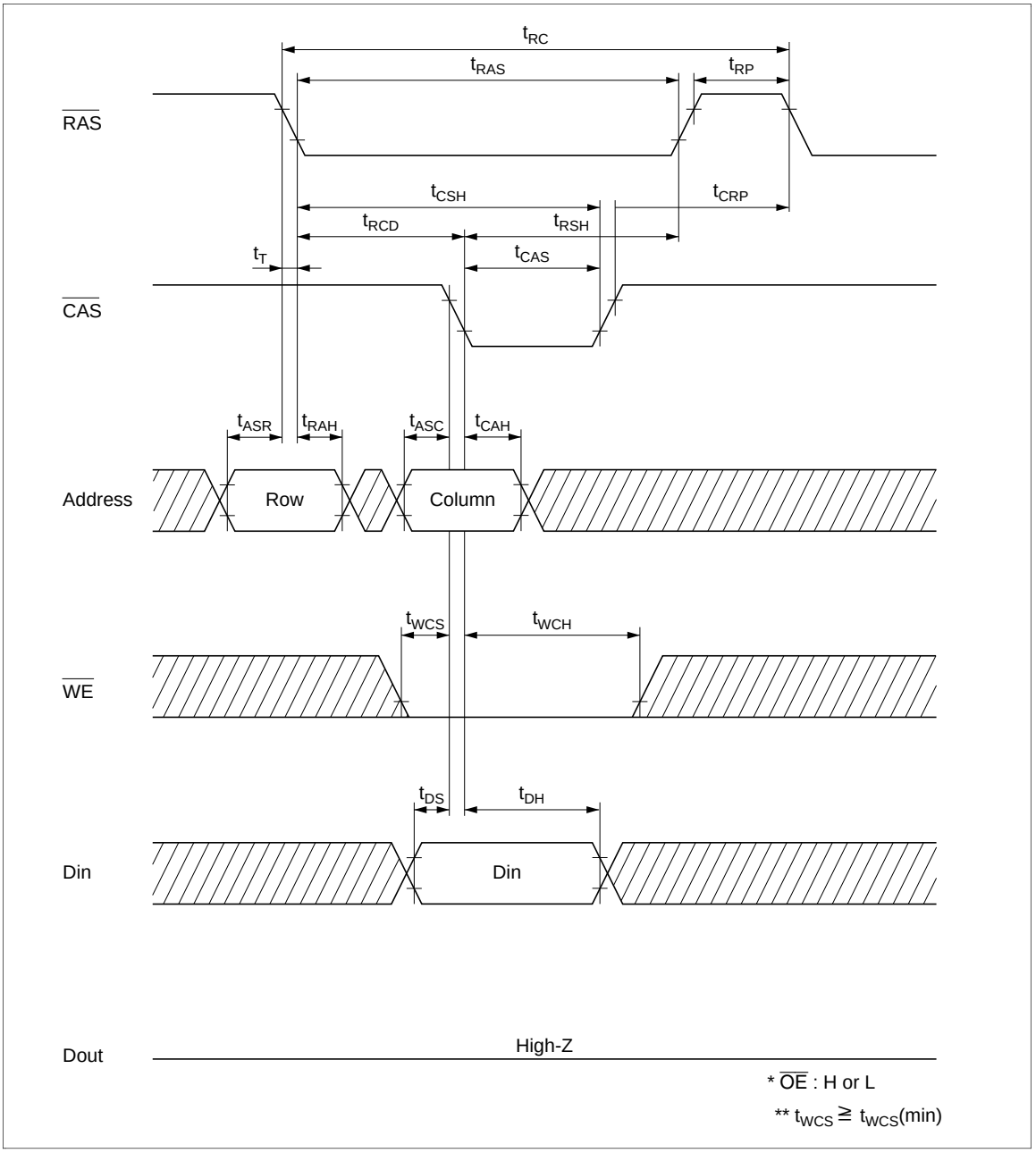
Timing Waveforms*[22]

Read Cycle

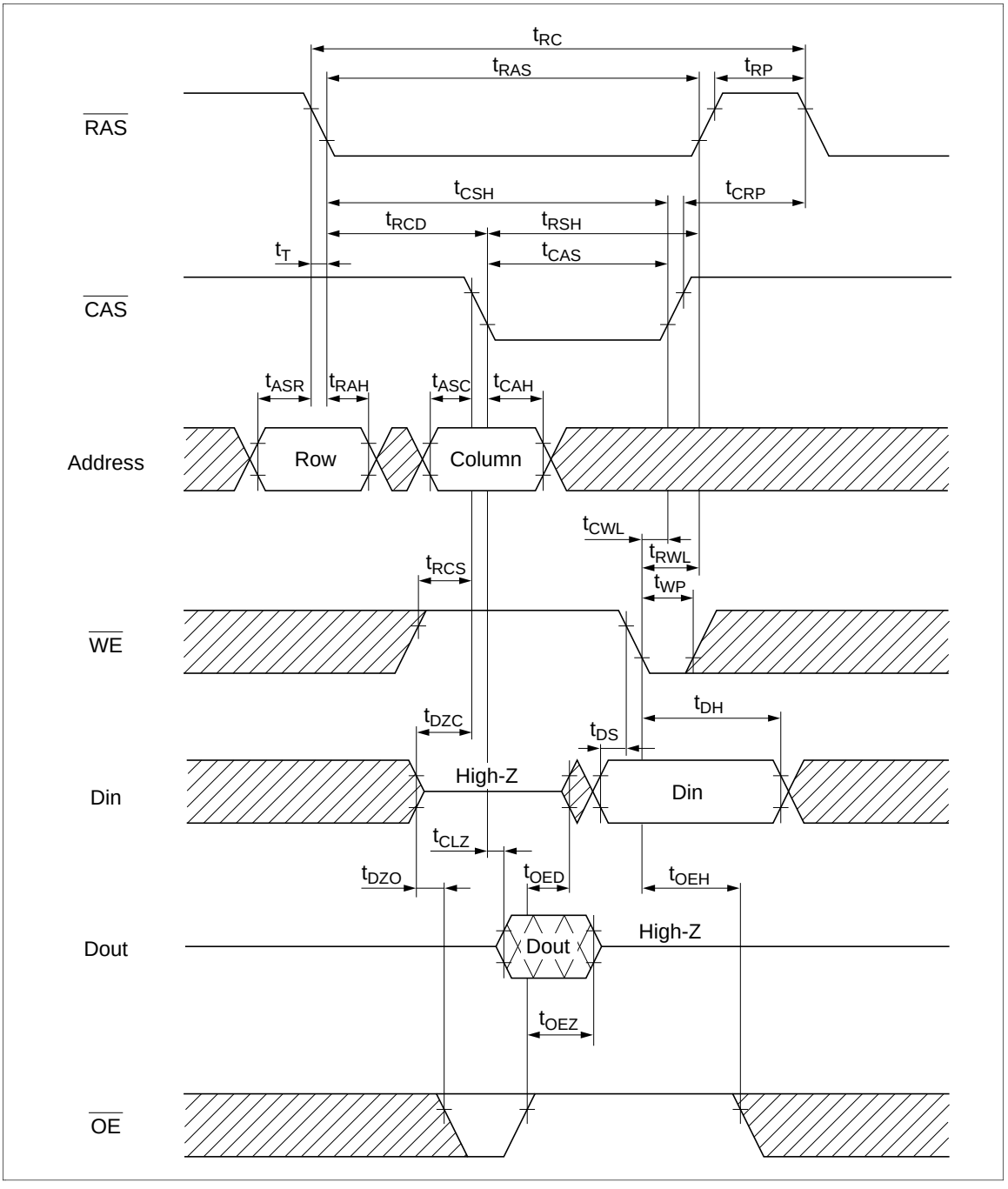


Note : 22. ▨ : H or L (H: V_{IH} (min) ≤ Vin ≤ V_{IH} (max), L: V_{IL} (min) ≤ Vin ≤ V_{IL} (max))
▩ : Invalid Dout

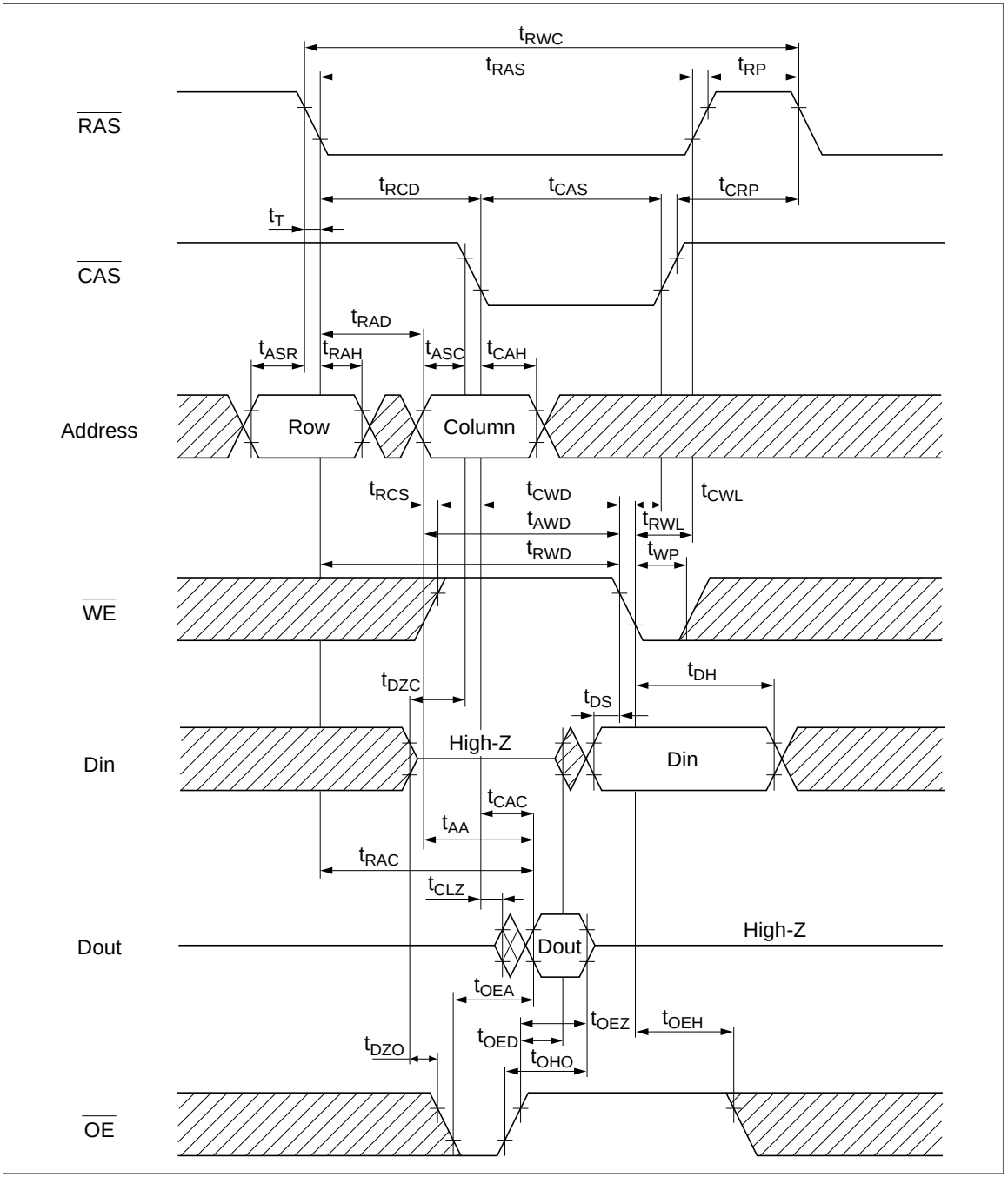
Early Write Cycle



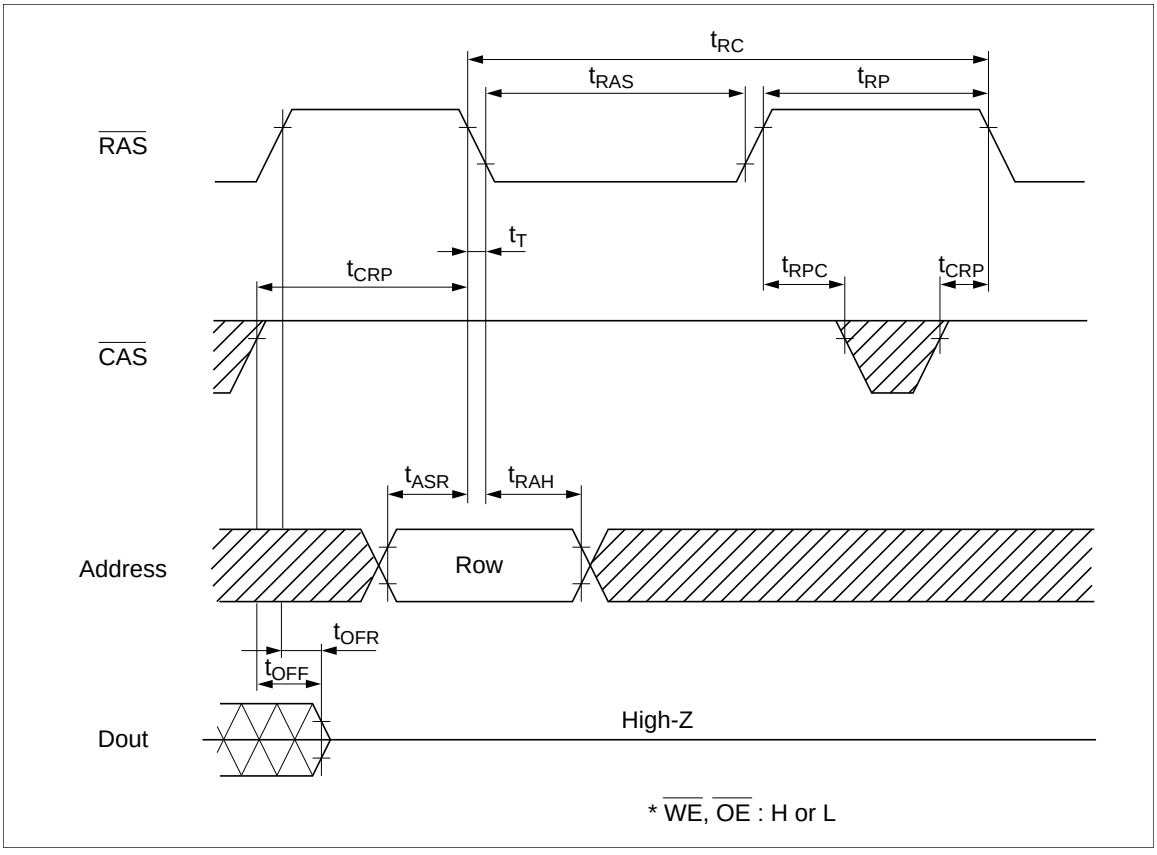
Delayed Write Cycle



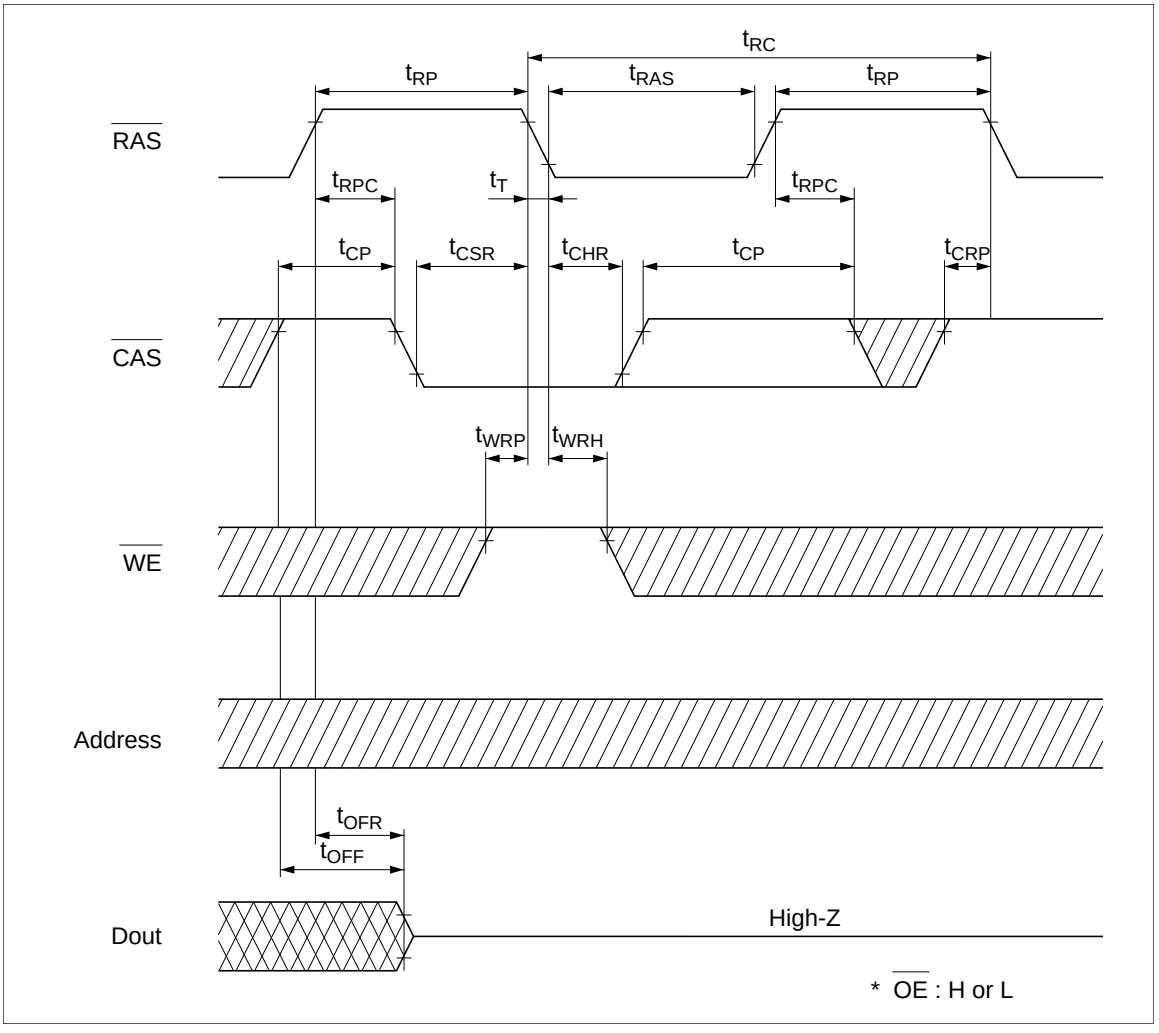
Read-Modify-Write Cycle



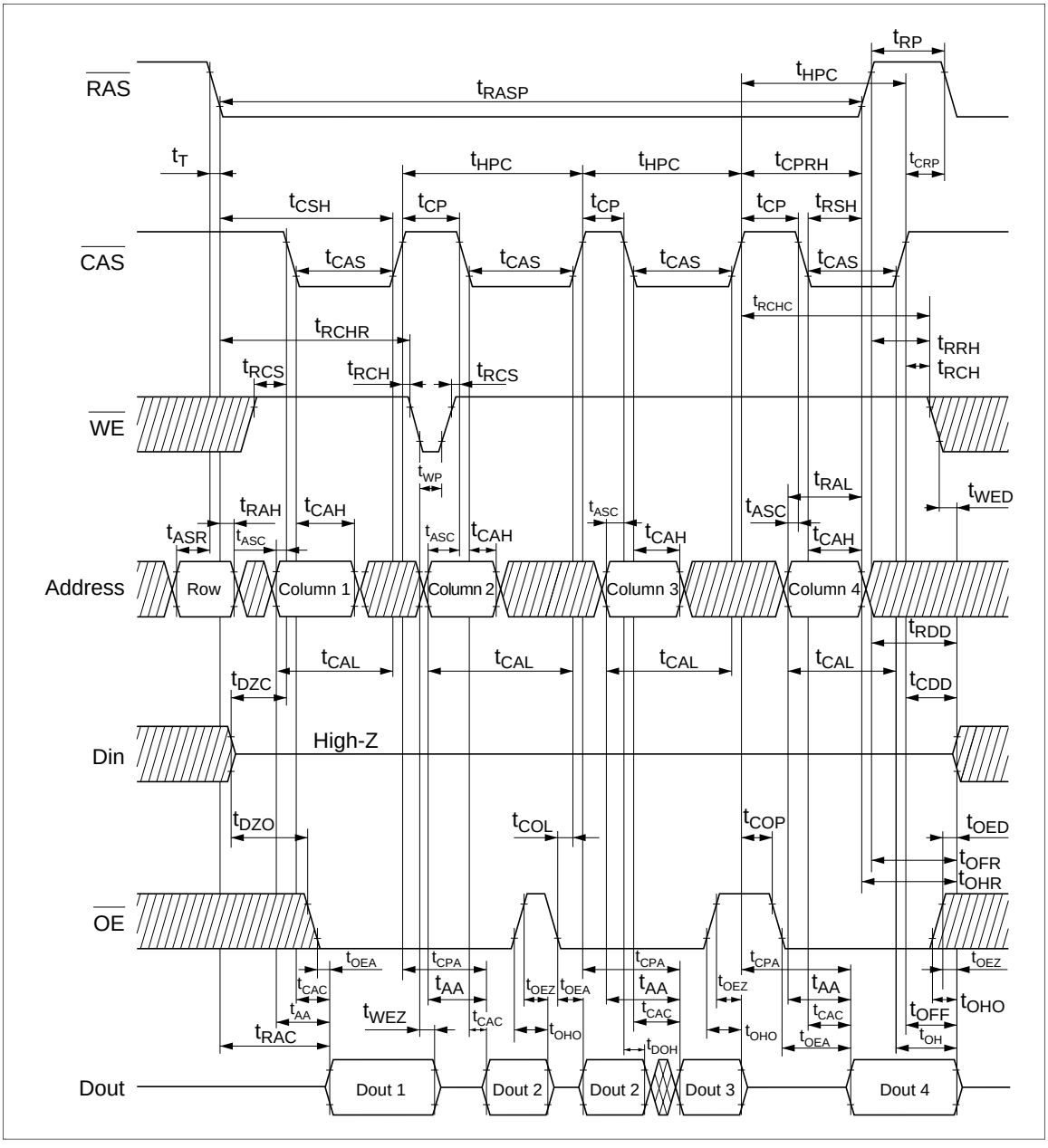
$\overline{\text{RAS}}$-Only Refresh Cycle



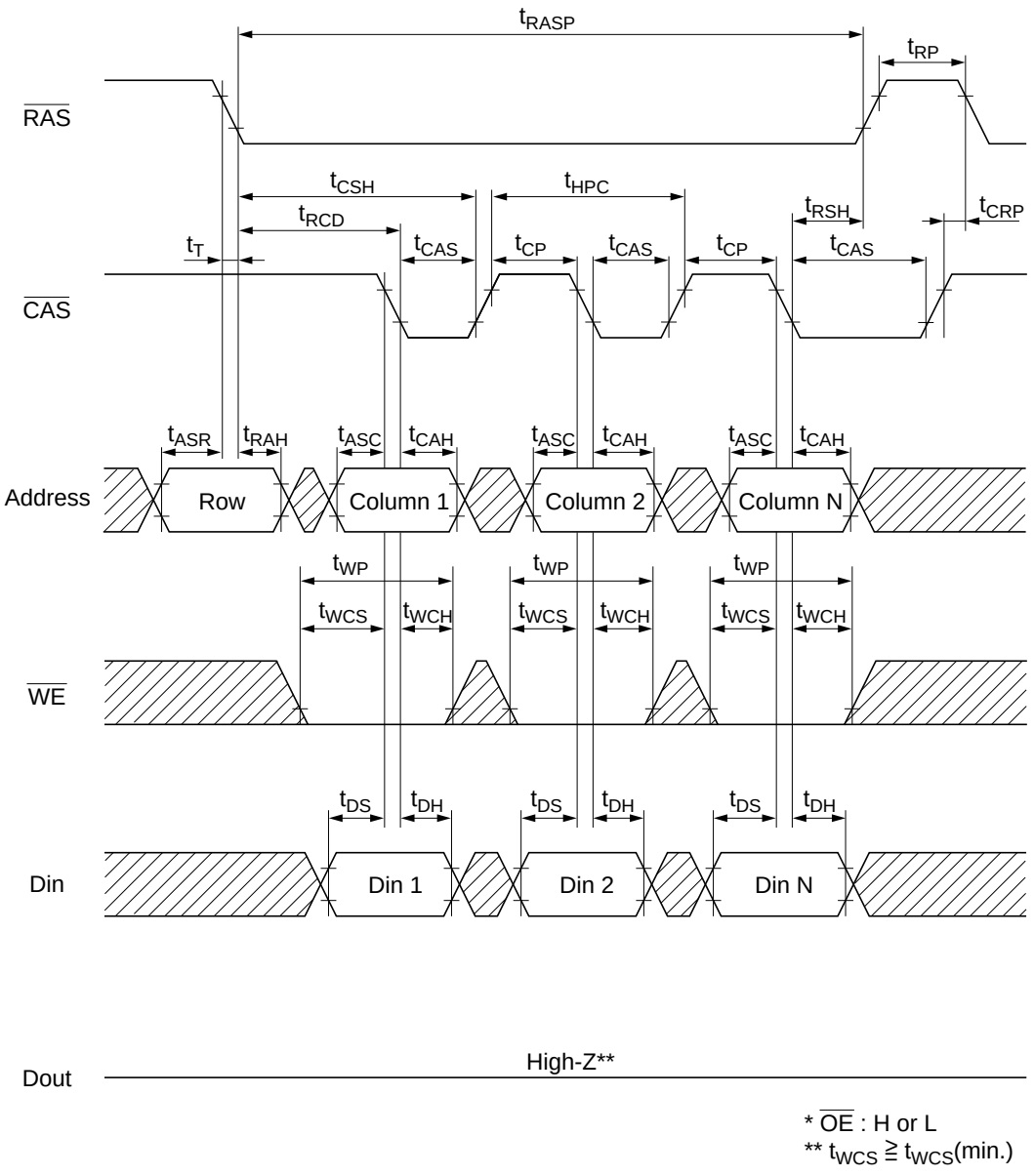
$\overline{\text{CAS}}$-Before-$\overline{\text{RAS}}$ Refresh Cycle



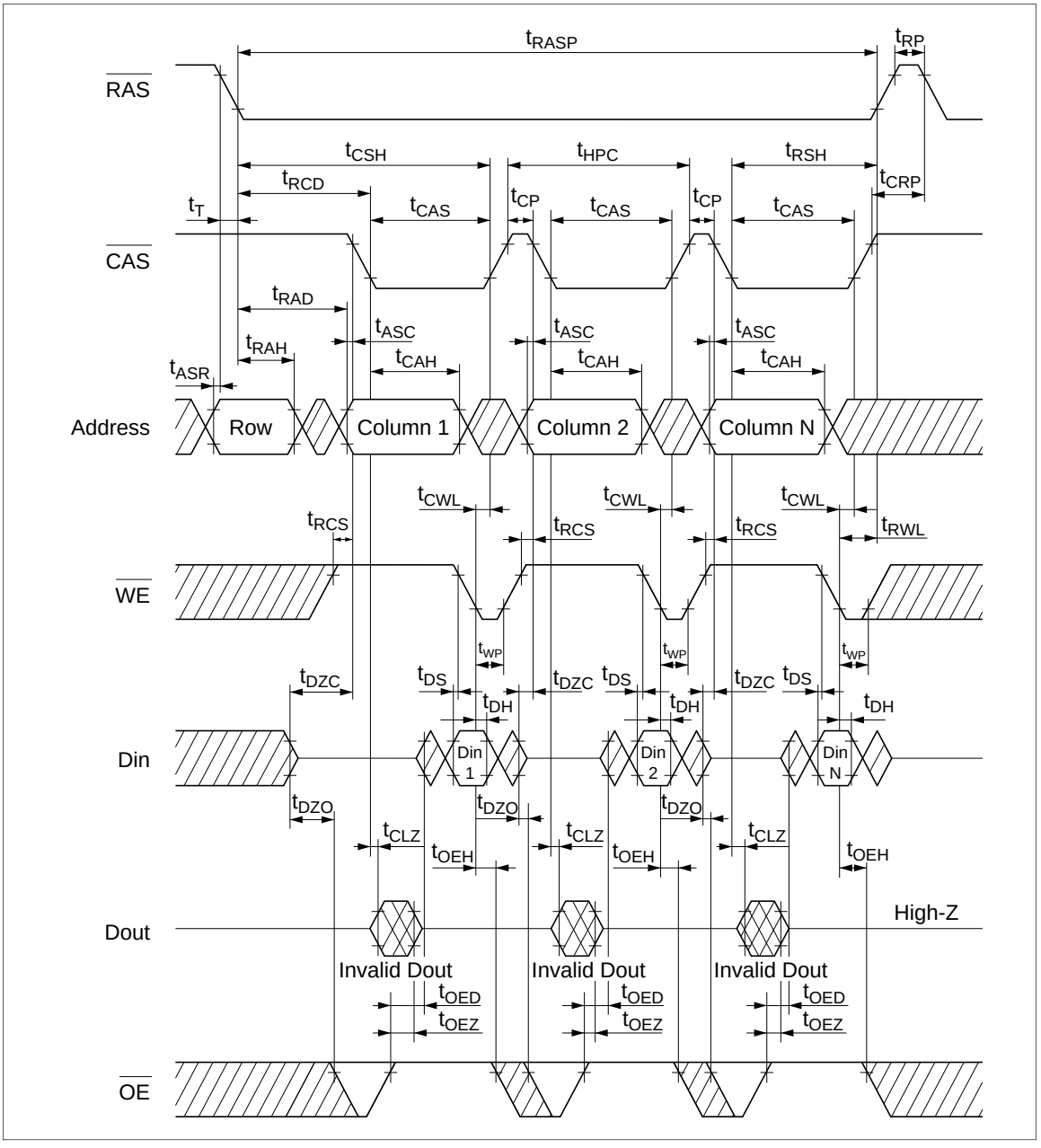
EDO Page Mode Read Cycle



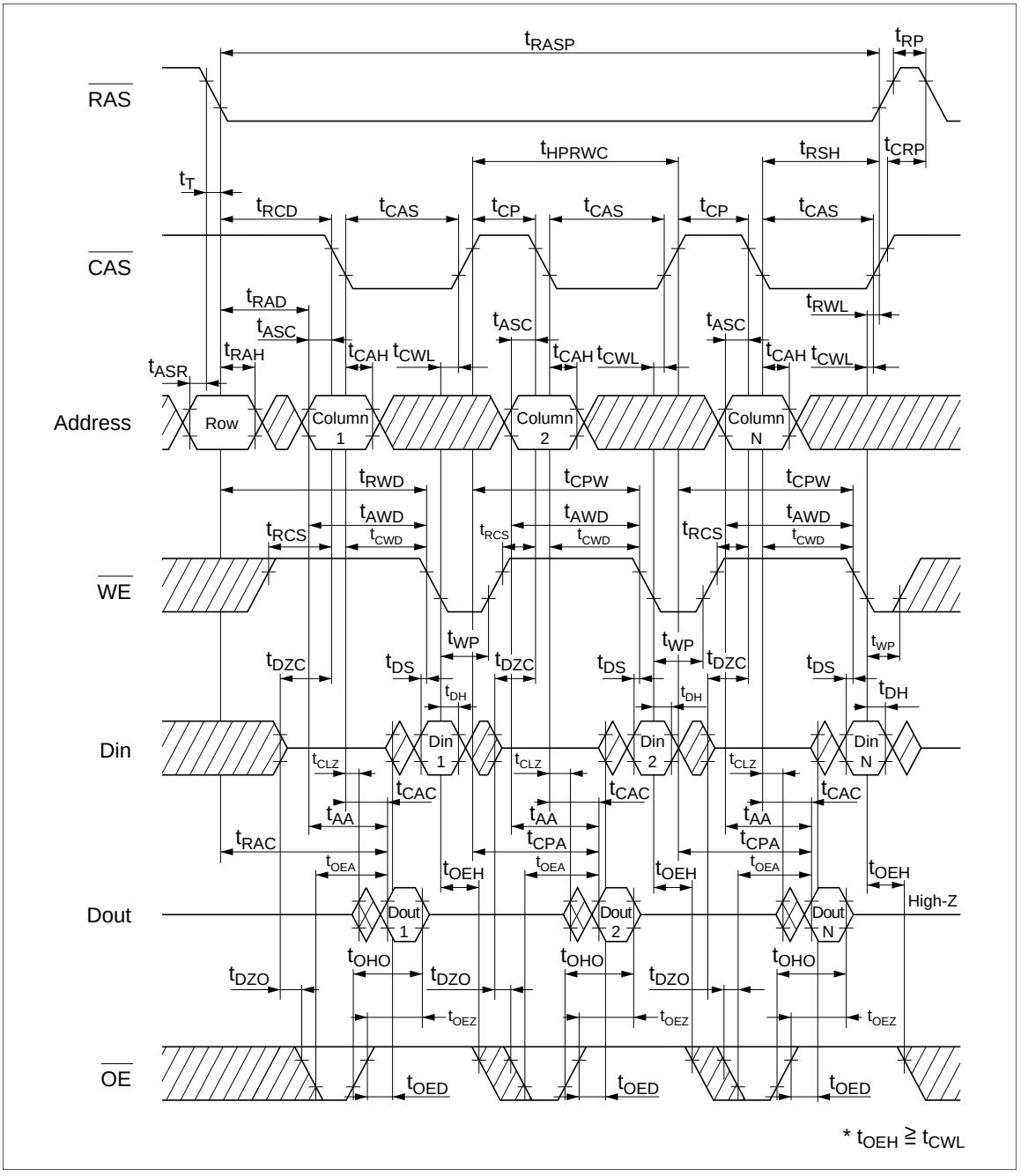
EDO Page Mode Eary Write Cycle



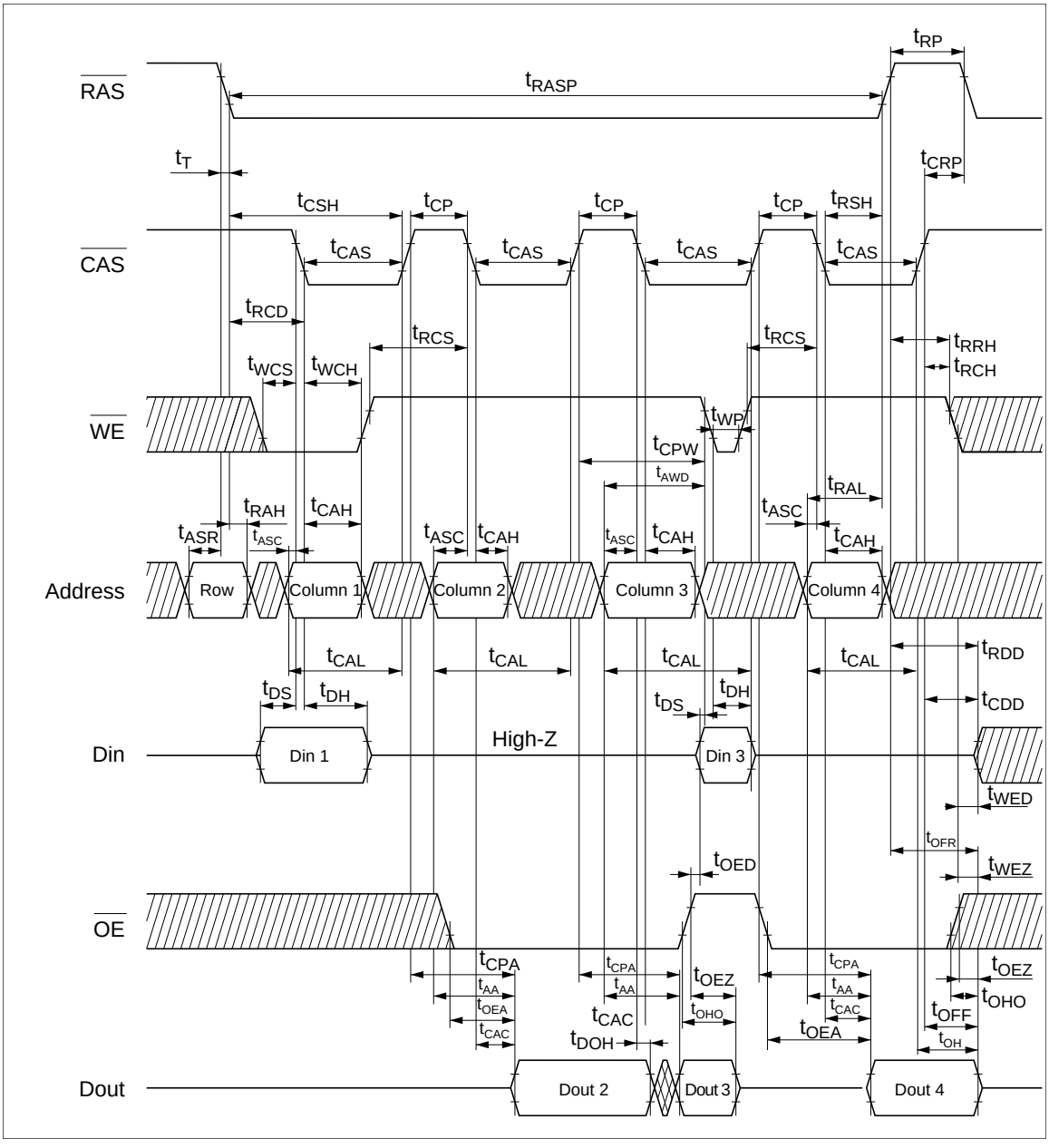
EDO Page Mode Delayed Write Cycle



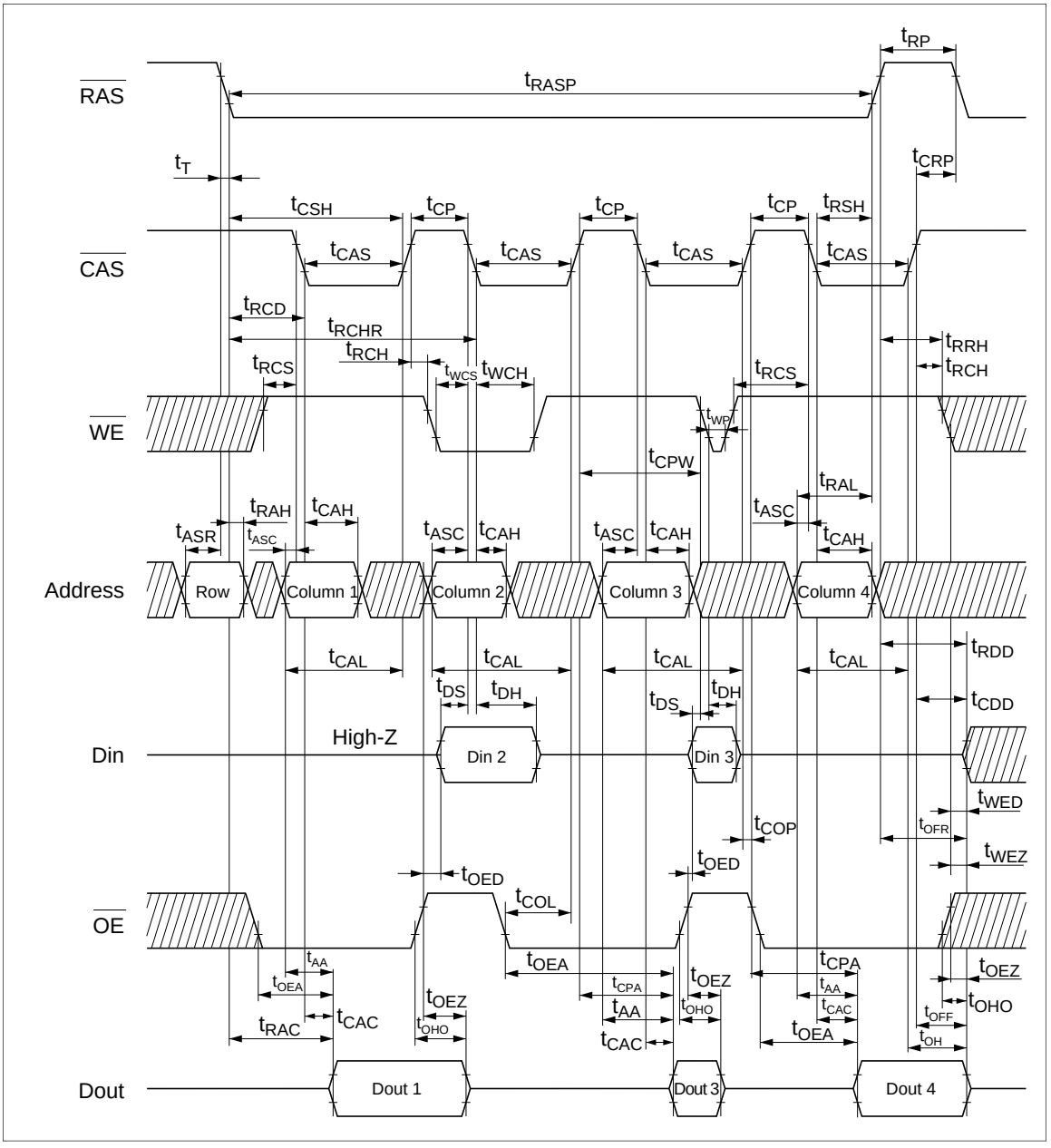
EDO Page Mode Read-Modify-Write Cycle



EDO Page Mode Mix Cycle (1)

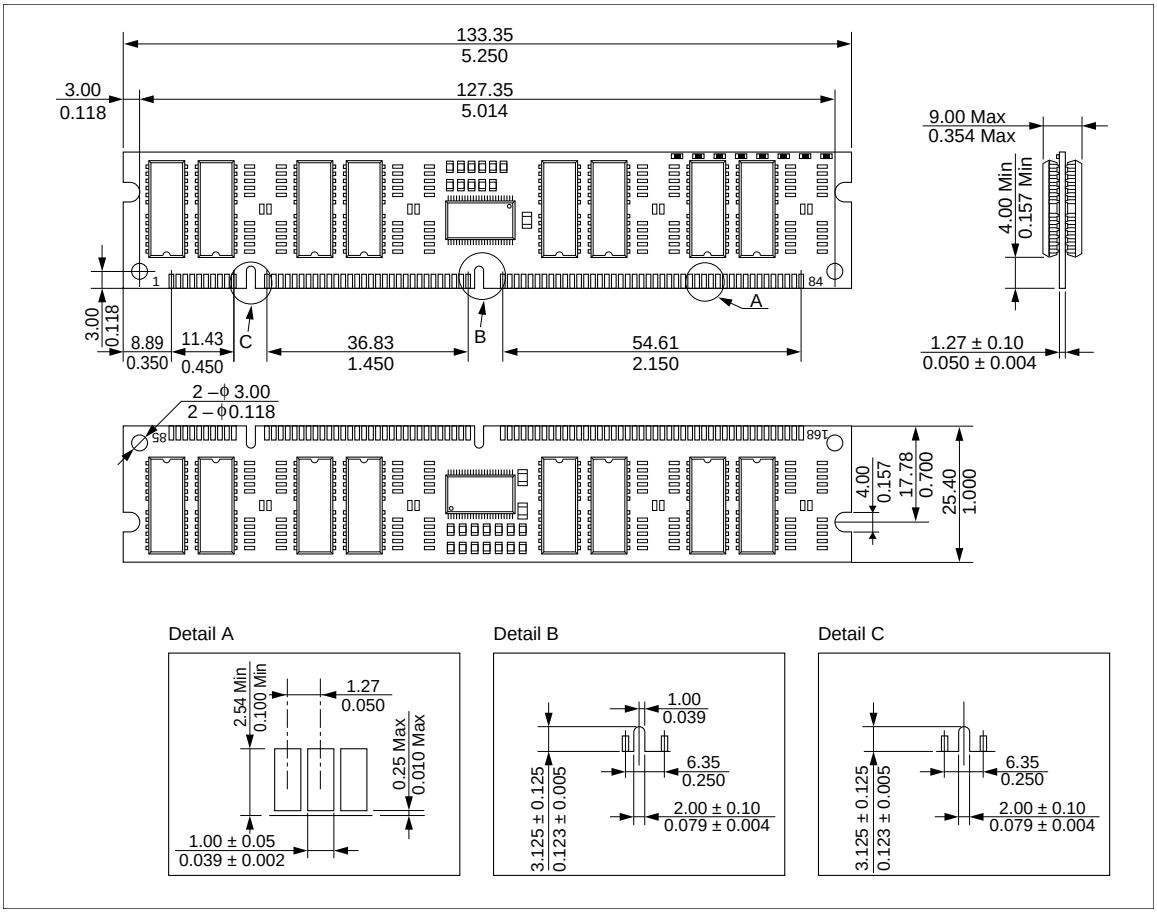


EDO Page Mode Mix Cycle (2)



Physical Outline

Unit: mm/inch



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