
HB56AW873E-5/6

64MB Buffered FP DRAM DIMM
8-Mword $\times$ 72-bit, 4k Refresh, 1 Bank Module
(9 pcs of 8M $\times$ 8 components)

HITACHI

ADE-203-858A (Z)
Rev.1.0
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Description

The HB56AW873E 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 HB56AW873E is a 8M $\times$ 72 dynamic RAM module, mounted 9 pieces of 64-Mbit DRAM (HM5165800) sealed in TSOP package and 2 pieces of 16-bit BiCMOS line driver sealed in TSSOP package. An outline of the HB56AW873E is 168-pin socket type package (dual lead out). Therefore, the HB56AW873E makes high density mounting possible without surface mount technology. The HB56AW873E provides common data inputs and outputs. Decoupling capacitors are mounted beside each TSOP on the its module board.

Features

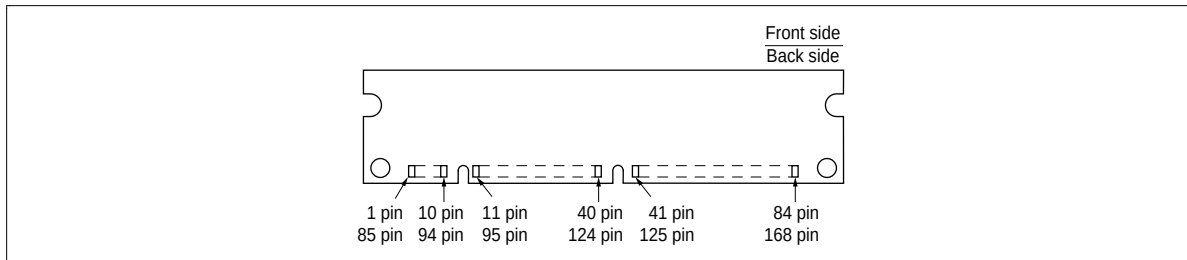
- 168-pin socket type package (Dual lead out)
 - Lead pitch: 1.27 mm
- Single 3.3 V supply: 3.3 V $\pm$ 0.3 V
- High speed
 - Access time: $t_{\text{RAC}} = 50/60$ ns (max)
 - Access time: $t_{\text{CAC}} = 18/20$ ns (max)
- Low power dissipation
 - Active mode: 4.41/3.76 W (max)
 - Standby mode (TTL): 100.8 mW (max)
- Buffered input except $\overline{\text{RAS}}$ and DQ
- 4 byte interleave enabled, dual address input (A0/B0)
- Fast page mode capability
- 4,096 refresh cycle: 64 ms
- 2 variations of refresh
 - $\overline{\text{RAS}}$ -only refresh
 - $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh

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Ordering Information

Type No.	Access time	Package	Contact pad
HB56AW873E-5	50 ns	168-pin dual lead out socket type	Gold
HB56AW873E-6	60 ns		

Pin Arrangement



Pin Arrangement

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
1	V _{SS}	43	V _{SS}	85	V _{SS}	127	V _{SS}
2	DQ0	44	$\overline{\text{OE2}}$	86	DQ36	128	NC
3	DQ1	45	$\overline{\text{RE2}}$	87	DQ37	129	NC
4	DQ2	46	$\overline{\text{CE4}}$	88	DQ38	130	NC
5	DQ3	47	NC	89	DQ39	131	NC
6	V _{CC}	48	$\overline{\text{WE2}}$	90	V _{CC}	132	$\overline{\text{PDE}}$
7	DQ4	49	V _{CC}	91	DQ40	133	V _{CC}
8	DQ5	50	NC	92	DQ41	134	NC
9	DQ6	51	NC	93	DQ42	135	NC
10	DQ7	52	DQ18	94	DQ43	136	DQ54
11	DQ8	53	DQ19	95	DQ44	137	DQ55
12	V _{SS}	54	V _{SS}	96	V _{SS}	138	V _{SS}

Pin Arrangement (cont)

Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name	Pin No.	Pin name
13	DQ9	55	DQ20	97	DQ45	139	DQ56
14	DQ10	56	DQ21	98	DQ46	140	DQ57
15	DQ11	57	DQ22	99	DQ47	141	DQ58
16	DQ12	58	DQ23	100	DQ48	142	DQ59
17	DQ13	59	V _{CC}	101	DQ49	143	V _{CC}
18	V _{CC}	60	DQ24	102	V _{CC}	144	DQ60
19	DQ14	61	NC	103	DQ50	145	NC
20	DQ15	62	NC	104	DQ51	146	NC
21	DQ16	63	NC	105	DQ52	147	NC
22	DQ17	64	NC	106	DQ53	148	NC
23	V _{SS}	65	DQ25	107	V _{SS}	149	DQ61
24	NC	66	DQ26	108	NC	150	DQ62
25	NC	67	DQ27	109	NC	151	DQ63
26	V _{CC}	68	V _{SS}	110	V _{CC}	152	V _{SS}
27	$\overline{\text{WE0}}$	69	DQ28	111	NC	153	DQ64
28	$\overline{\text{CE0}}$	70	DQ29	112	NC	154	DQ65
29	NC	71	DQ30	113	NC	155	DQ66
30	$\overline{\text{RE0}}$	72	DQ31	114	NC	156	DQ67
31	$\overline{\text{OE0}}$	73	V _{CC}	115	NC	157	V _{CC}
32	V _{SS}	74	DQ32	116	V _{SS}	158	DQ68
33	A0	75	DQ33	117	A1	159	DQ69
34	A2	76	DQ34	118	A3	160	DQ70
35	A4	77	DQ35	119	A5	161	DQ71
36	A6	78	V _{SS}	120	A7	162	V _{SS}
37	A8	79	PD1	121	A9	163	PD2
38	A10	80	PD3	122	A11	164	PD4
39	NC	81	PD5	123	NC	165	PD6
40	V _{CC}	82	PD7	124	V _{CC}	166	PD8
41	NC	83	ID0 (V _{SS})	125	NC	167	ID1 (V _{SS})
42	NC	84	V _{CC}	126	B0	168	V _{CC}

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Pin Description

Pin name	Function
A0 to A11, B0	Address Input (D0 to D8) : A0 to A11, B0 Row Address (D0 to D8) : A0 to A11, B0 Column Address (D0 to D8) : A0 to A10, B0 Refresh Address (D0 to D8) : A0 to A11, B0
DQ0 to DQ71	Data-in/Data-out
$\overline{RE0}$, $\overline{RE2}$	Row Address Strobe ($\overline{RAS}$)
$\overline{CE0}$, $\overline{CE4}$	Column Address Strobe ($\overline{CAS}$)
$\overline{WE0}$, $\overline{WE2}$	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	Non Connection

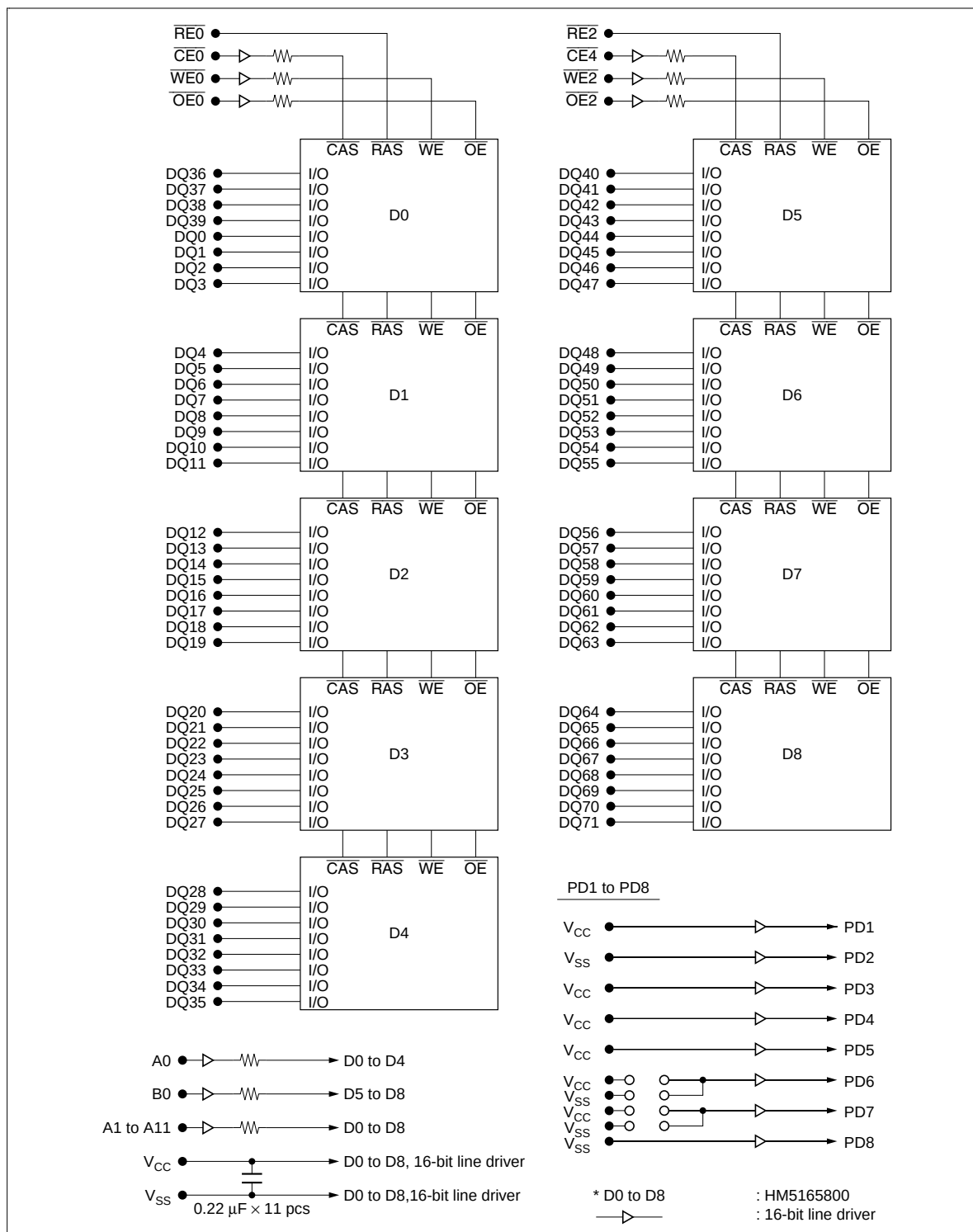
Presence Detect Pin Assignment

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

1 : High Level (Driver Output)

0 : Low Level (Driver Output)

Block Diagram



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Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Terminal voltage on any pin relative to V_{SS}	V_T	−0.5 to +4.6	V
Power supply voltage relative to V_{SS}	V_{CC}	−0.5 to +4.6	V
Short circuit output current	I_{out}	50	mA
Power dissipation	P_t	10	W
Storage temperature range	T_{stg}	−55 to +125	°C

DC Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply voltage	V_{CC}	3.0	3.3	3.6	V	1, 2
	V_{SS}	0	0	0	V	2
Input high voltage	V_{IH}	2.0	—	$V_{CC} + 0.3$	V	1
Input low voltage	V_{IL}	−0.3	—	0.8	V	1
Ambient temperature	T_a	0	—	70	°C	

Note: 1. All voltage referenced to V_{SS} .
2. The supply voltage with all V_{CC} pins must be on the same level. The supply voltage with all V_{SS} pins must be on the same level.

DC Characteristics

Parameter	Symbol	50 ns		60 ns		Unit	Test condition	Note
		Min	Max	Min	Max			
Operating current	I_{CC1}	—	1225	—	1045	mA	$t_{RC} = \min$	1, 2
Standby current	I_{CC2}	—	28	—	28	mA	TTL interface $\overline{RAS}, \overline{CAS} = V_{IH}$ Dout = High-Z	
		—	14.5	—	14.5	mA	CMOS interface $\overline{RAS}, \overline{CAS} \geq V_{CC} - 0.2 \text{ V}$ Dout = High-Z	
RAS-only refresh current	I_{CC3}	—	1225	—	1045	mA	$t_{RC} = \min$	2
Standby current	I_{CC5}	—	55	—	55	mA	$\overline{RAS} = V_{IH}, \overline{CAS} = V_{IL}$ Dout = enable	1
CAS-before-RAS refresh current	I_{CC6}	—	1225	—	1045	mA	$t_{RC} = \min$	
Fast page mode current	I_{CC7}	—	910	—	820	mA	$\overline{RAS} = V_{IL}, \overline{CAS}$ cycle, $t_{PC} = t_{PC} \min$	1, 3
Input leakage current	I_{LI}	-5	5	-5	5	μA	$0 \text{ V} \leq V_{in} \leq V_{CC} + 0.3 \text{ V}$	
Output leakage current	I_{LO}	-5	5	-5	5	μA	$0 \text{ V} \leq V_{out} \leq V_{CC}$ 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. Measured with one sequential address change per fast page mode cycle, t_{PC} .

Capacitance ($T_a = 25^\circ\text{C}$, $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$)

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}	—	55	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.

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AC Characteristics ($T_a = 0$ to 70°C , $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$, $V_{SS} = 0\text{ V}$)^{*1, *2, *19}

Test Conditions

- Input rise and fall times: 5 ns
- Input levels: $V_{IL} = 0\text{ V}$, $V_{IH} = 3.0\text{ V}$
- Input timing reference levels: 0.8 V, 2.0 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)

Parameter	Symbol	50 ns		60 ns		Unit	Notes
		Min	Max	Min	Max		
Random read or write cycle time	t_{RC}	90	—	110	—	ns	
$\overline{\text{RAS}}$ precharge time	t_{RP}	30	—	40	—	ns	
$\overline{\text{CAS}}$ precharge time	t_{CP}	8	—	10	—	ns	
$\overline{\text{RAS}}$ pulse width	t_{RAS}	50	10000	60	10000	ns	
$\overline{\text{CAS}}$ pulse width	t_{CAS}	13	10000	15	10000	ns	
Row address setup time	t_{ASR}	5	—	5	—	ns	
Row address hold time	t_{RAH}	8	—	10	—	ns	
Column address setup time	t_{ASC}	0	—	0	—	ns	
Column address hold time	t_{CAH}	8	—	10	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ delay time	t_{RCD}	18	32	20	40	ns	3
$\overline{\text{RAS}}$ to column address delay time	t_{RAD}	13	20	15	25	ns	4
$\overline{\text{RAS}}$ hold time	t_{RSH}	18	—	20	—	ns	
$\overline{\text{CAS}}$ hold time	t_{CSH}	50	—	60	—	ns	
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ precharge time	t_{CRP}	10	—	10	—	ns	
$\overline{\text{OE}}$ to Din delay time	t_{OED}	18	—	20	—	ns	5
$\overline{\text{OE}}$ delay time from Din	t_{DZO}	0	—	0	—	ns	6
$\overline{\text{CAS}}$ delay time from Din	t_{DZC}	0	—	0	—	ns	6
Transition time (rise and fall)	t_T	3	50	3	50	ns	7

Read Cycle

Parameter	Symbol	50 ns		60 ns		Unit	Notes
		Min	Max	Min	Max		
Access time from $\overline{\text{RAS}}$	t_{RAC}	—	50	—	60	ns	8, 9
Access time from $\overline{\text{CAS}}$	t_{CAC}	—	18	—	20	ns	9, 10, 17
Access time from address	t_{AA}	—	30	—	35	ns	9, 11, 17
Access time from $\overline{\text{OE}}$	t_{OEA}	—	18	—	20	ns	9
Read command setup time	t_{RCS}	0	—	0	—	ns	
Read command hold time to $\overline{\text{CAS}}$	t_{RCH}	0	—	0	—	ns	12
Read command hold time to $\overline{\text{RAS}}$	t_{RRH}	0	—	0	—	ns	12
Column address to $\overline{\text{RAS}}$ lead time	t_{RAL}	30	—	35	—	ns	
Column address to $\overline{\text{CAS}}$ lead time	t_{CAL}	25	—	30	—	ns	
$\overline{\text{CAS}}$ to output in low-Z	t_{CLZ}	2	—	2	—	ns	
Output data hold time	t_{OH}	3	—	3	—	ns	
Output data hold time from $\overline{\text{OE}}$	t_{OHO}	3	—	3	—	ns	
Output buffer turn-off time	t_{OFF}	—	18	—	20	ns	13
Output buffer turn-off to $\overline{\text{OE}}$	t_{OEZ}	—	18	—	20	ns	13
$\overline{\text{CAS}}$ to Din delay time	t_{CDD}	18	—	20	—	ns	5

Write Cycle

Parameter	Symbol	50 ns		60 ns		Unit	Notes
		Min	Max	Min	Max		
Write command setup time	t_{WCS}	0	—	0	—	ns	14
Write command hold time	t_{WCH}	8	—	10	—	ns	
Write command pulse width	t_{WP}	8	—	10	—	ns	
Write command to $\overline{\text{RAS}}$ lead time	t_{RWL}	18	—	20	—	ns	
Write command to $\overline{\text{CAS}}$ lead time	t_{CWL}	13	—	15	—	ns	
Data-in setup time	t_{DS}	0	—	0	—	ns	15
Data-in hold time	t_{DH}	13	—	15	—	ns	15

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Read-Modify-Write Cycle

Parameter	Symbol	50 ns		60 ns		Unit	Notes
		Min	Max	Min	Max		
Read-modify-write cycle time	t_{RWC}	131	—	155	—	ns	
$\overline{RAS}$ to $\overline{WE}$ delay time	t_{RWD}	73	—	85	—	ns	14
CAS to $\overline{WE}$ delay time	t_{CWD}	36	—	40	—	ns	14
Column address to $\overline{WE}$ delay time	t_{AWD}	48	—	55	—	ns	14
$\overline{OE}$ hold time from $\overline{WE}$	t_{OEh}	13	—	15	—	ns	

Refresh Cycle

Parameter	Symbol	50 ns		60 ns		Unit	Notes
		Min	Max	Min	Max		
CAS setup time (CBR refresh cycle)	t_{CSR}	10	—	10	—	ns	
CAS hold time (CBR refresh cycle)	t_{CHR}	8	—	10	—	ns	
$\overline{WE}$ setup time (CBR refresh cycle)	t_{WRP}	5	—	5	—	ns	
$\overline{WE}$ hold time (CBR refresh cycle)	t_{WRH}	8	—	10	—	ns	
RAS precharge to CAS hold time	t_{RPC}	5	—	5	—	ns	

Fast Page Mode Cycle

Parameter	Symbol	50 ns		60 ns		Unit	Notes
		Min	Max	Min	Max		
Fast page mode cycle time	t_{PC}	35	—	40	—	ns	
Fast page mode $\overline{RAS}$ pulse width	t_{RASP}	—	100000	—	100000	ns	16
Access time from CAS precharge	t_{CPA}	—	35	—	40	ns	9, 17
$\overline{RAS}$ hold time from $\overline{CAS}$ precharge	t_{CPRH}	35	—	40	—	ns	

Fast Page Mode Read-Modify-Write Cycle

Parameter	Symbol	50 ns		60 ns		Unit	Notes
		Min	Max	Min	Max		
Fast page mode read-modify-write cycle time	t_{HPRWC}	76	—	85	—	ns	
$\overline{WE}$ delay time from $\overline{CAS}$ precharge	t_{CPW}	53	—	60	—	ns	14

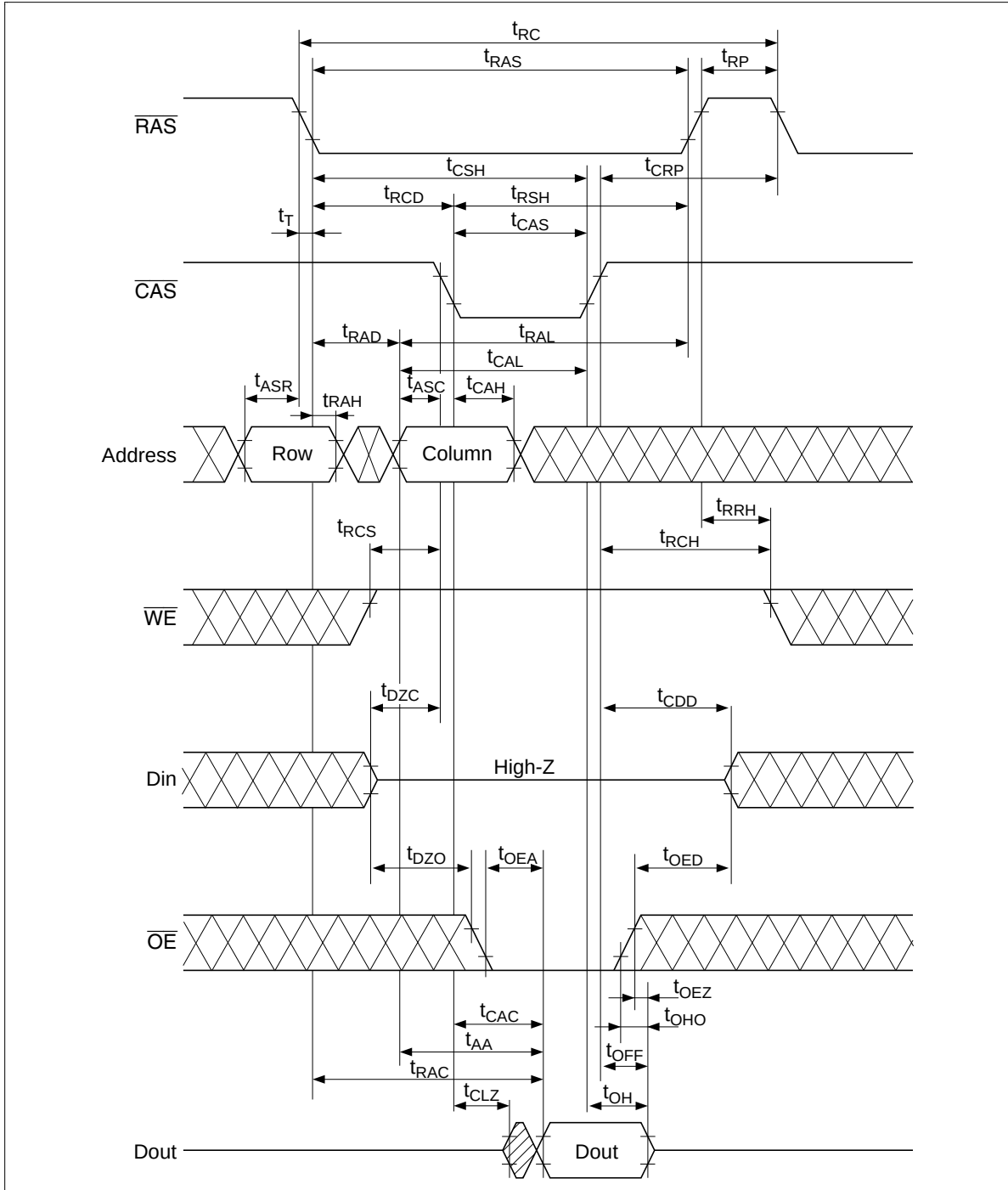
Refresh

Parameter	Symbol	Min	Unit	Notes
Refresh period	t_{REF}	64	ms	4096 cycles

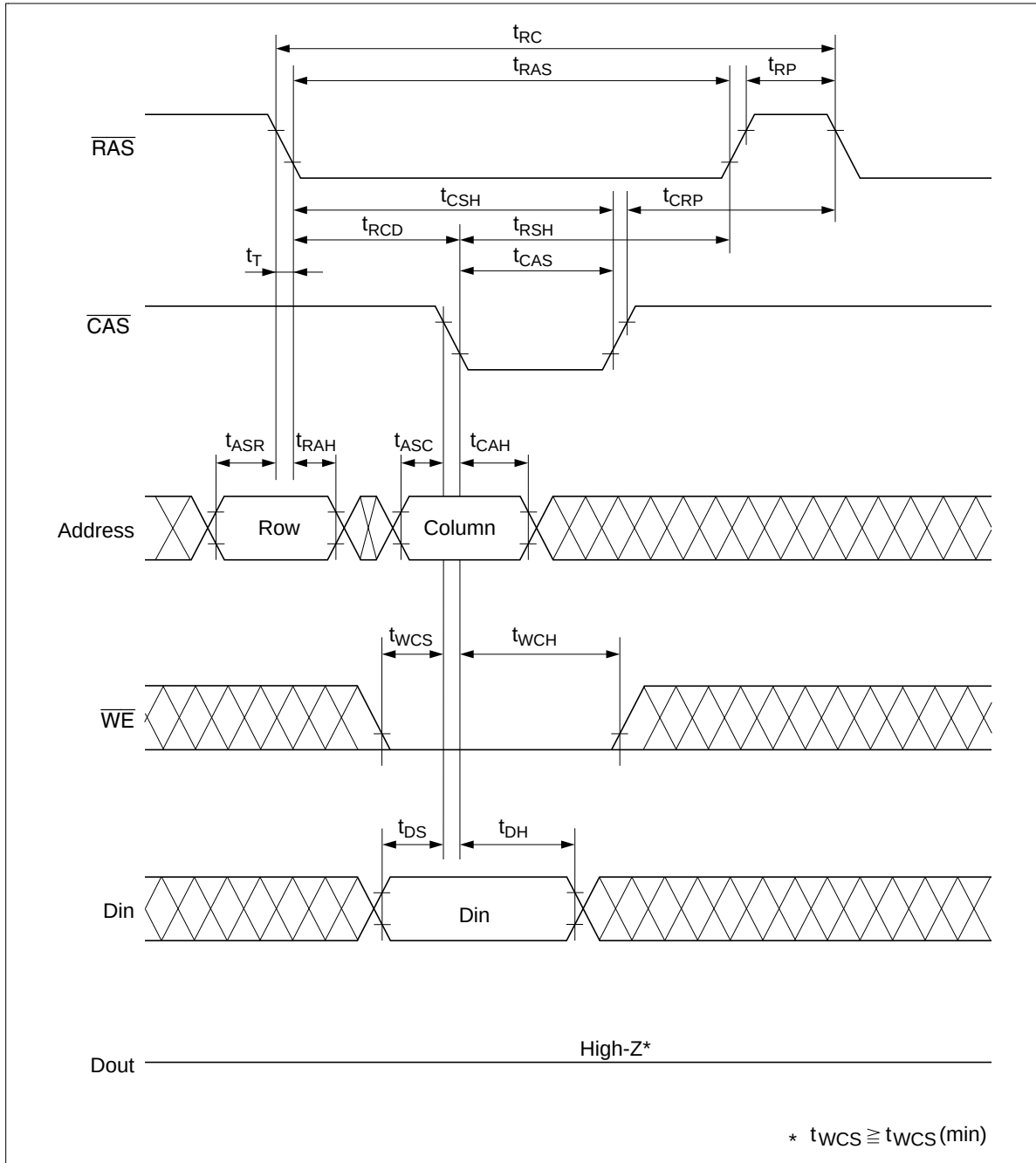
- Notes:
1. AC measurements assume $t_T = 5$ ns.
 2. An initial pause of 200 μ s is required after power up followed by a minimum of eight initialization cycles (any combination of cycles containing RAS-only refresh or CAS-before-RAS refresh).
 3. Operation with the t_{RCD} (max) limit insures that t_{RAC} (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 1 TTL 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) 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. t_{DS} , t_{DH} are referred to $\overline{CAS}$ leading edge in early write cycles and to $\overline{WE}$ leading edge in delayed write or read-modify-write cycles.
 16. t_{RASP} defines $\overline{RAS}$ pulse width in fast page mode cycles.
 17. Access time is determined by the longest among t_{AA} , t_{CAC} and t_{CPA} .
 18. In delayed write or read-modify-write cycles, $\overline{OE}$ must disable output buffer prior to applying data to the device.
 19. 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.
 20. XXX: H or L (H: V_{IH} (min) $\leq V_{IN} \leq V_{IH}$ (max), L: V_{IL} (min) $\leq V_{IN} \leq V_{IL}$ (max))
 /////: Invalid Dout
 When the address, clock and input pins are not described on timing waveforms, their pins must be applied V_{IH} or V_{IL} .

Timing Waveform ^{*20}

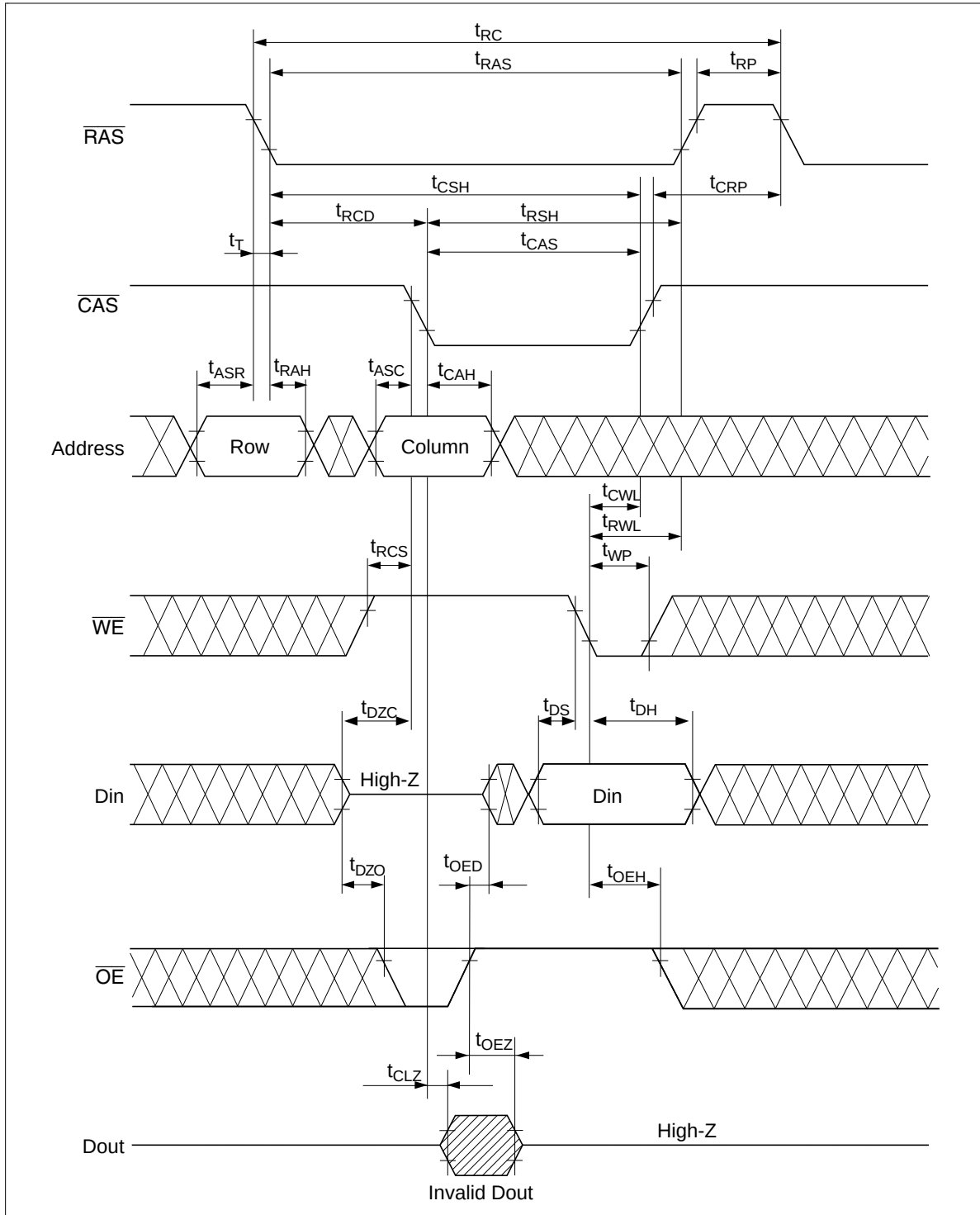
Read Cycle



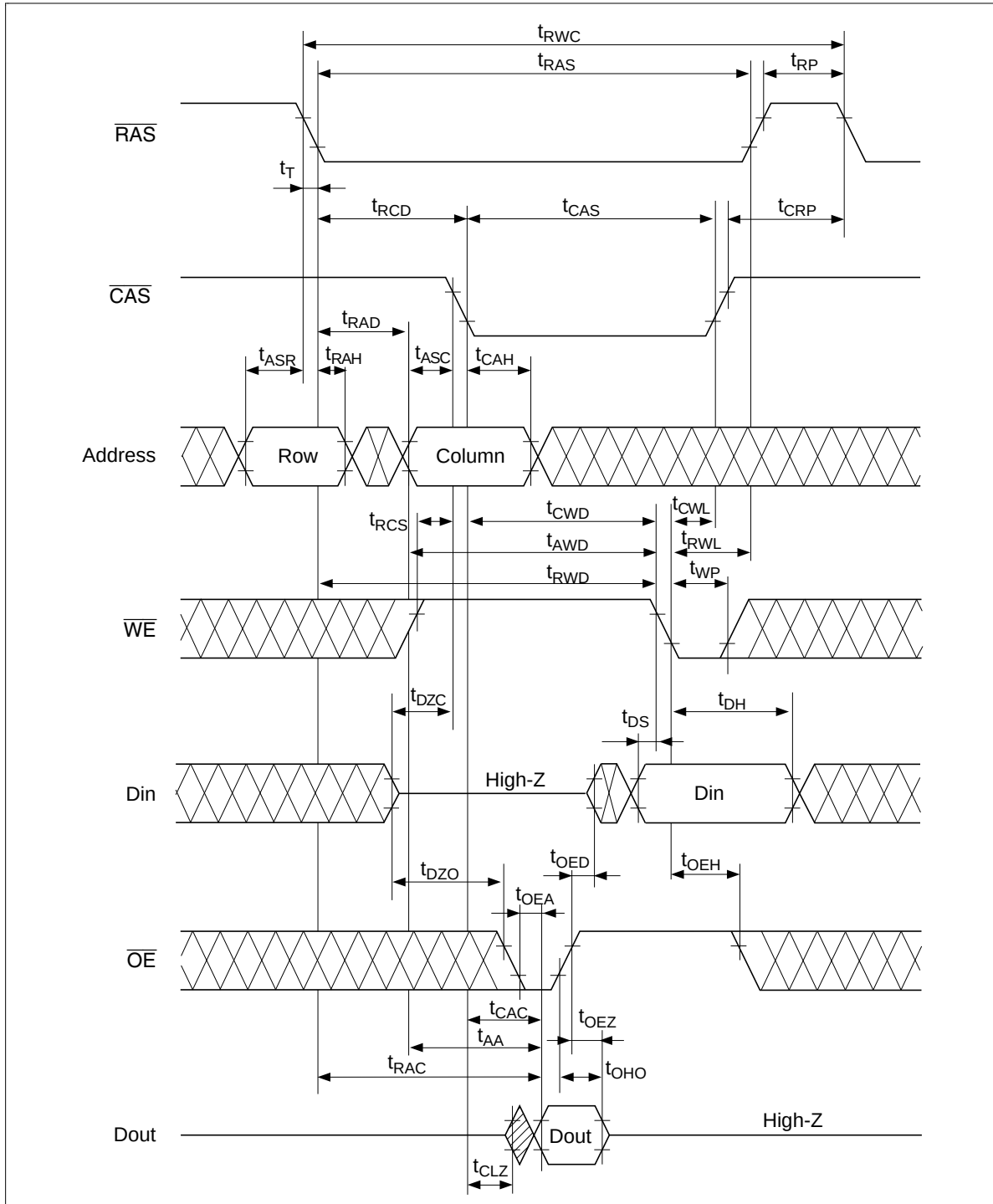
Early Write Cycle

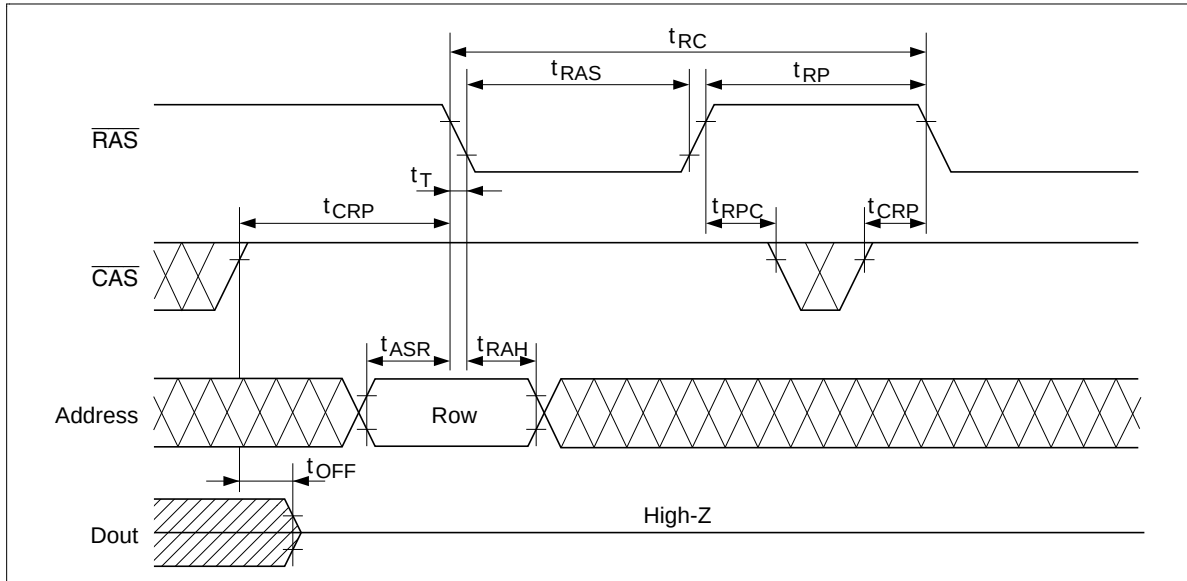


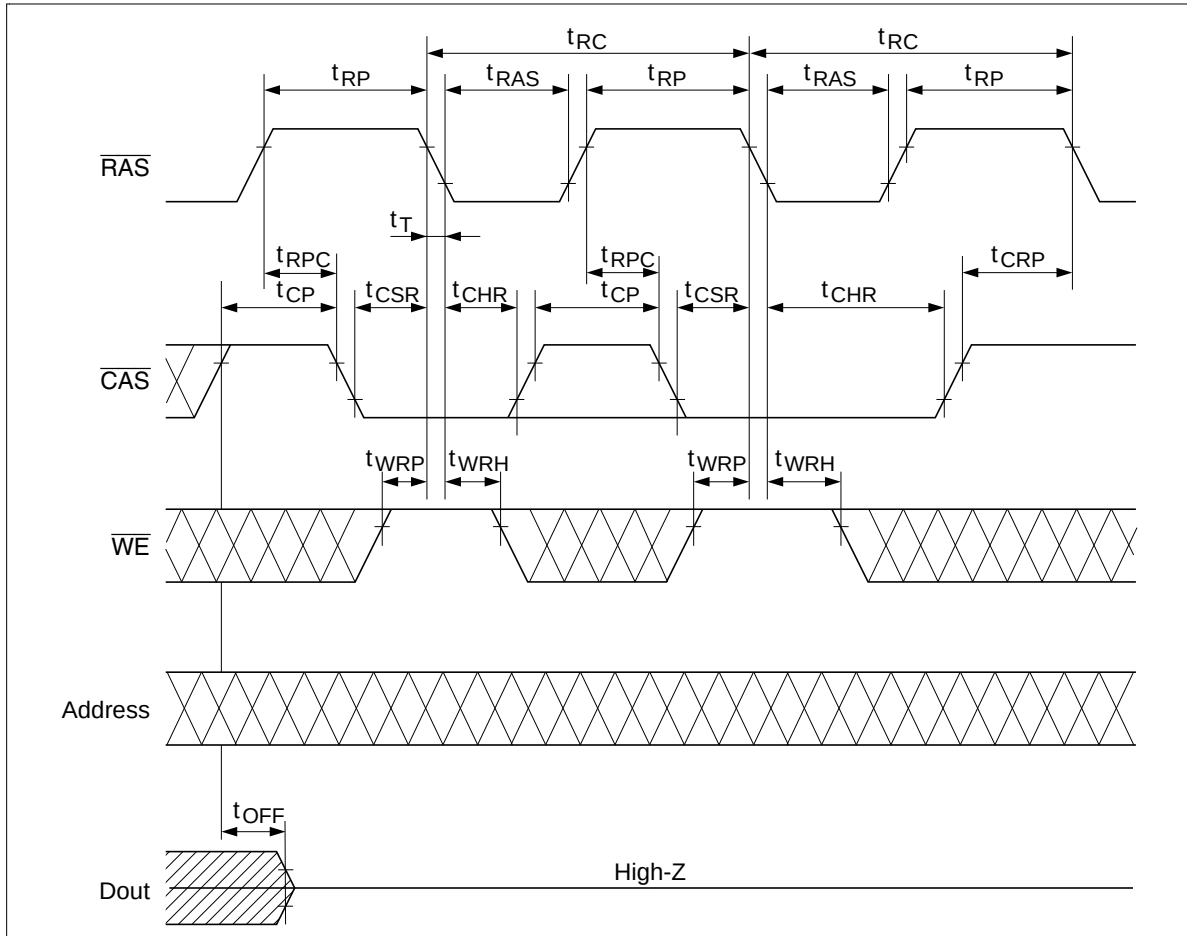
Delayed Write Cycle ^{*18}



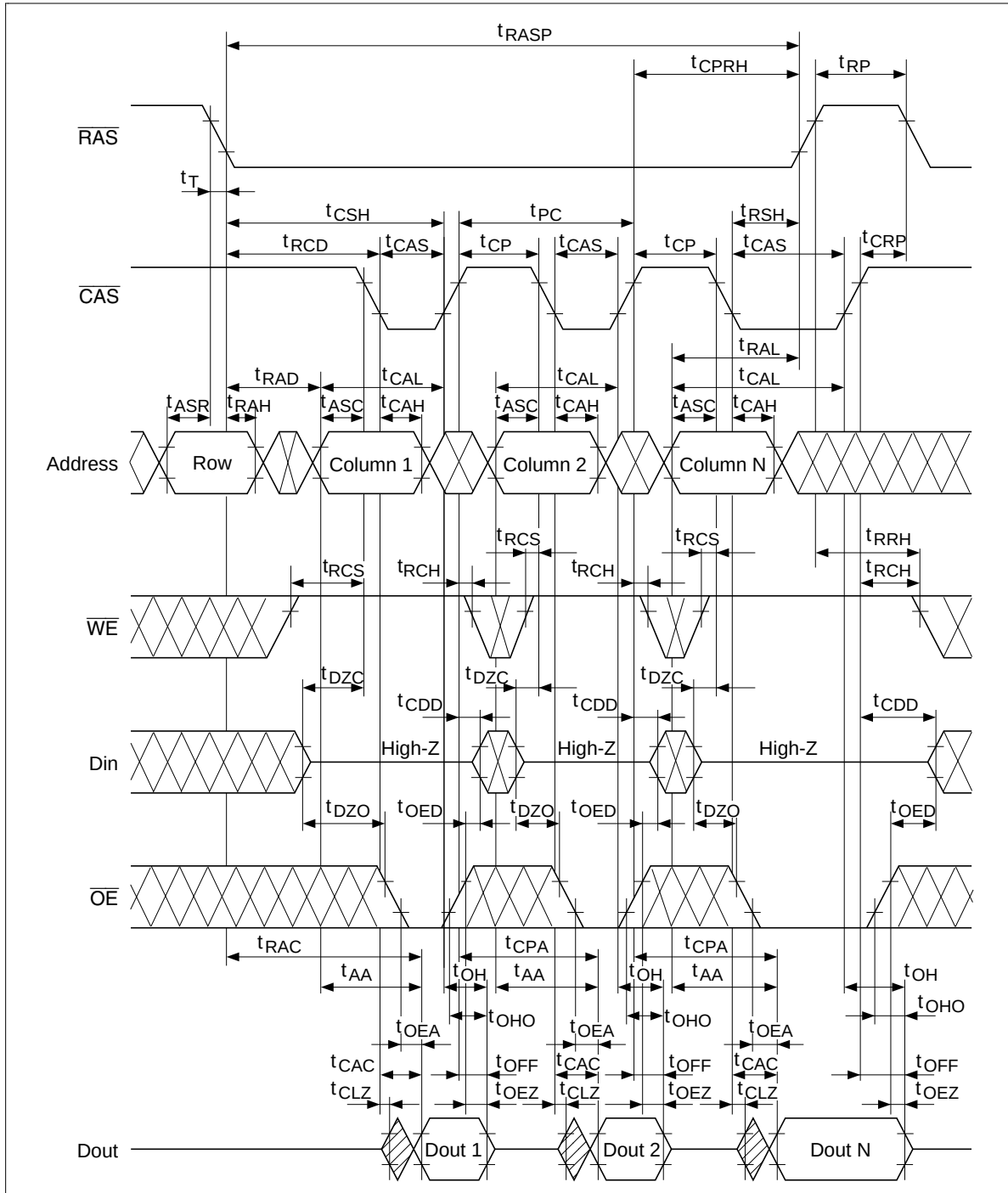
Read-Modify-Write Cycle ^{*18}



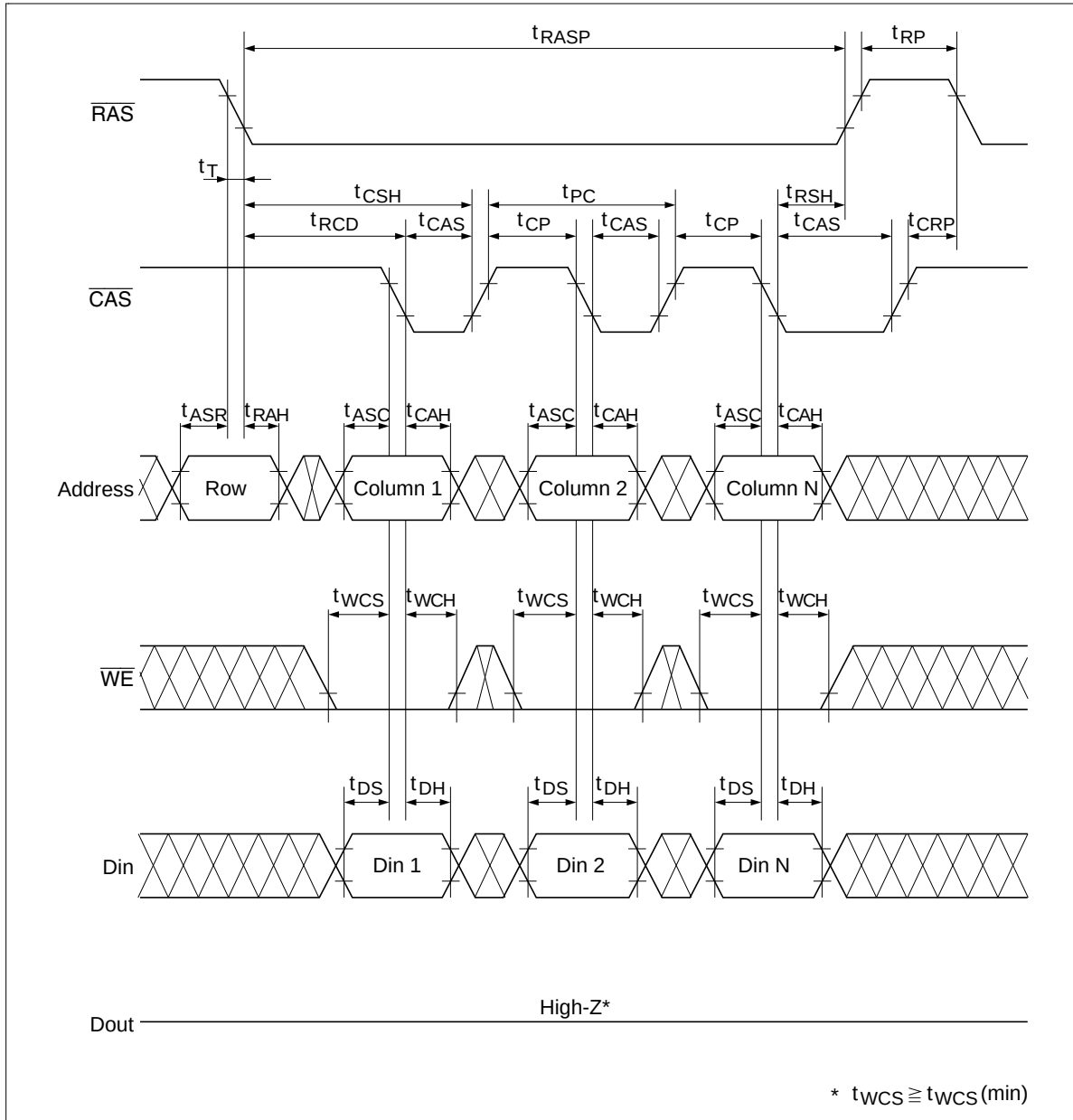
$\overline{\text{RAS}}$ -Only Refresh Cycle

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

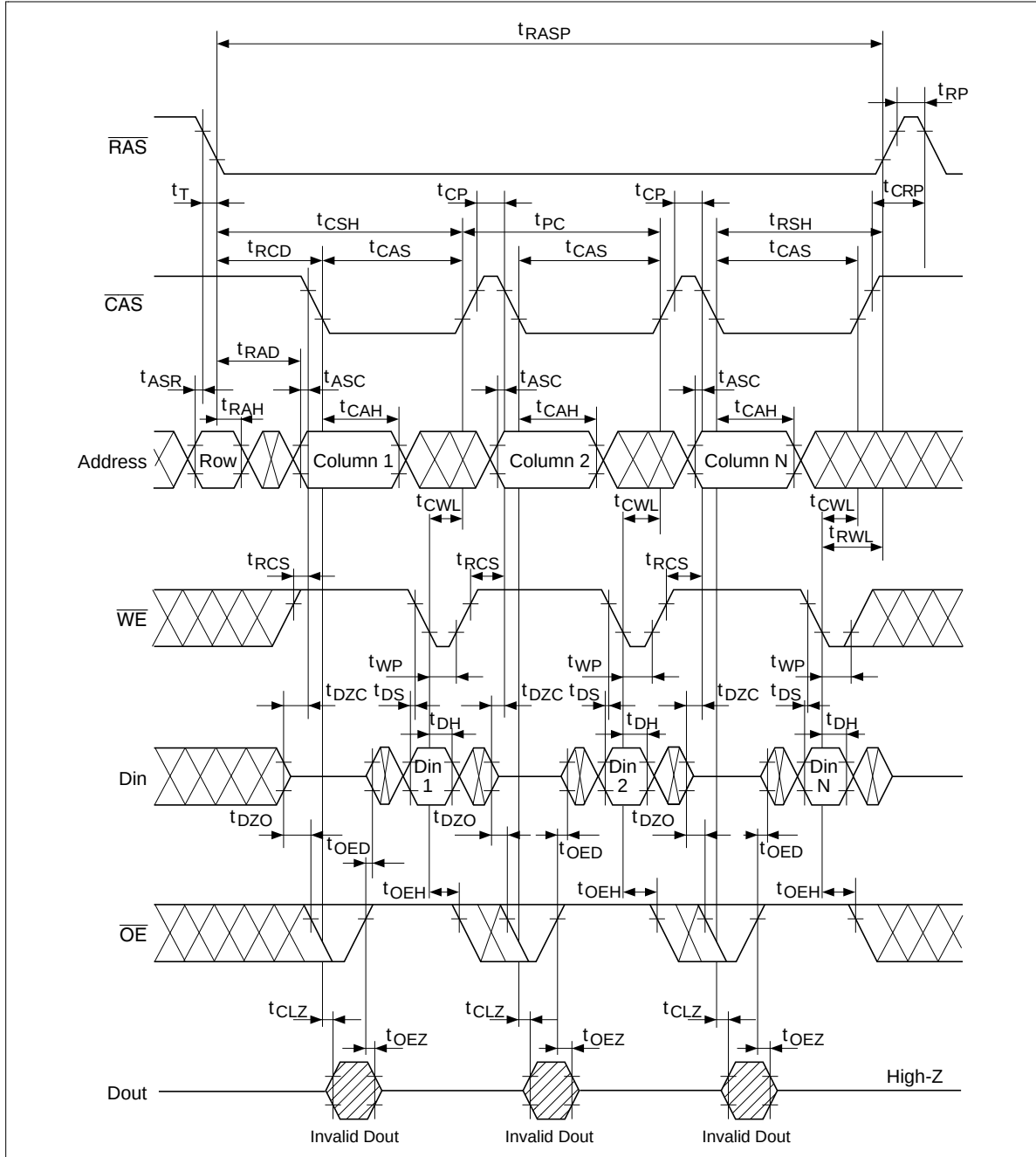
Fast Page Mode Read Cycle

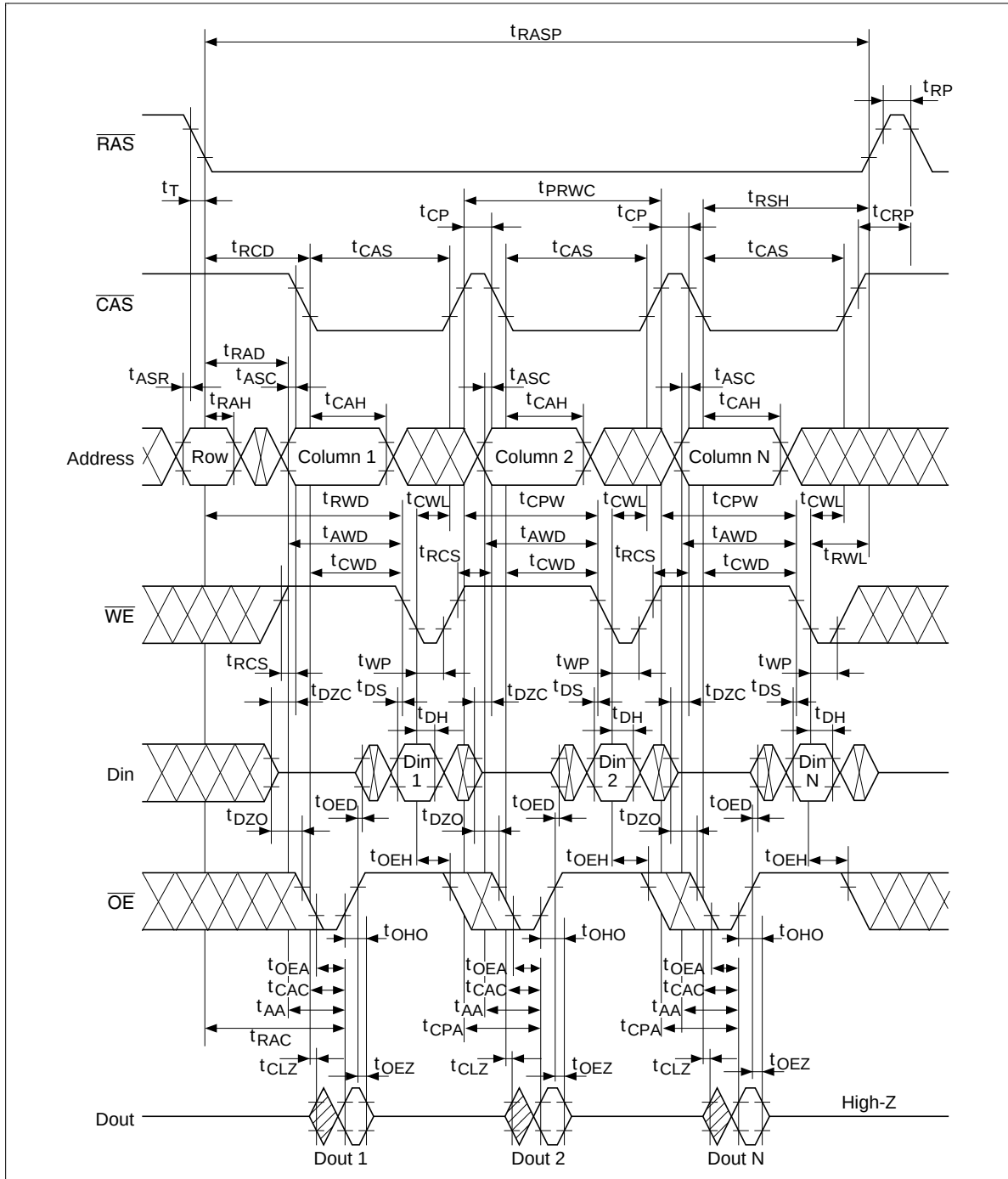


Fast Page Mode Early Write Cycle



Fast Page Mode Delayed Write Cycle ^{*18}

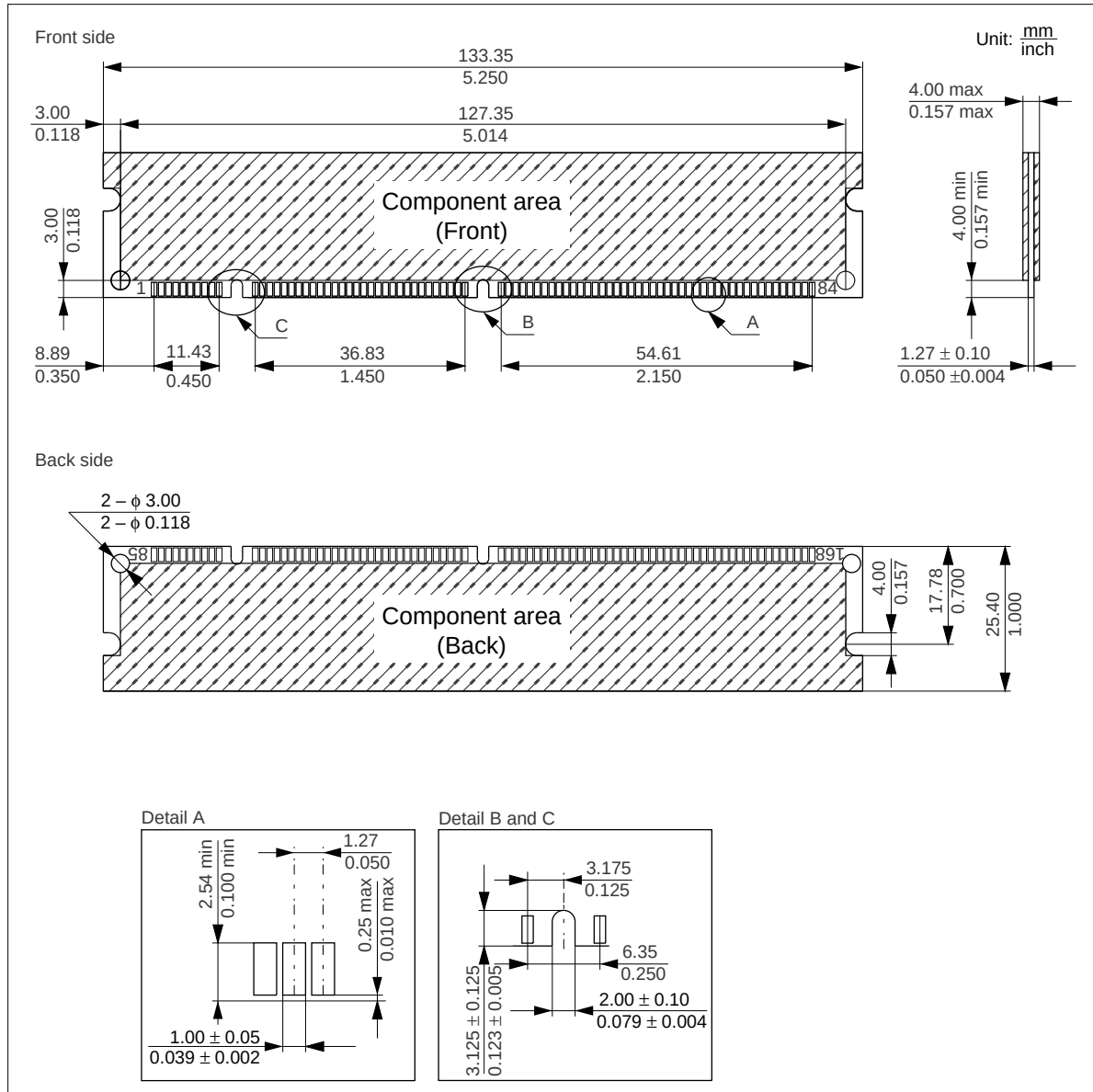


Fast Page Mode Read-Modify-Write Cycle ^{*18}

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Physical Outline

HB56AW873E Series



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Revision Record

Rev.	Date	Contents of Modification	Drawn by	Approved by
0.0	Nov. 19, 1997	Initial issue (referred to HM5164800/HM5165800 Series rev. 0.0)	S.Tsukui	K.Yoshizaki
1.0	Jul. 31, 1998	Deletion of Preliminary (referred to HM5164800/HM5165800 Series rev. 1.0)		