
HB56G232B/SB-6B/7B

2,097,152-word $\times$ 32-bit High Density Dynamic RAM Module

HITACHI

ADE-203-547A(Z)

Rev. 1.0

Feb. 20, 1996

Description

The HB56G232 is a $2\text{M} \times 32$ dynamic RAM module, mounted 4 pieces of 16-Mbit DRAM (HM5118160BJ) sealed in SOJ package.

An outline of the HB56G232 is 72-pin single in-line package. Therefore, the HB56G232 makes high density mounting possible without surface mount technology.

The HB56G232 provides common data inputs and outputs. Decoupling capacitors are mounted beneath each SOJ on the its module board.

Features

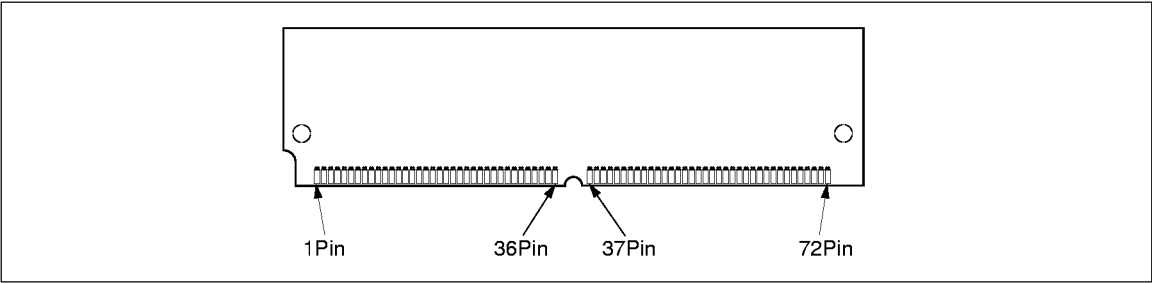
- 72-pin single in-line package
 - Lead pitch: 1.27 mm
- Single 5 V ($\pm 5\%$) supply
- High speed
 - Access time: $t_{\text{RAC}} = 60 \text{ ns}/70 \text{ ns}$ (max)
- Low power dissipation
 - Active mode: 1.84 W/1.63W (max)
 - Standby mode (TTL): 42 mW (max)
- Fast page mode capability
- 1,024 refresh cycles: 16 ms
- 3 variations of refresh
 - $\overline{\text{RAS}}$ -only refresh
 - $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ refresh
 - Hidden refresh
- TTL compatible

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Ordering Information

Type No.	Access time	Package	Contact pad
HB56G232B-6B	60 ns	72-pin SIP socket type	Gold
HB56G232B-7B	70 ns		
HB56G232SB-6B	60 ns	72-pin SIP socket type	Solder
HB56G232SB-7B	70 ns		

Pin Arrangement



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Pin Arrangement

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	V _{SS}	19	NC	37	NC	55	DQ11
2	DQ0	20	DQ4	38	NC	56	DQ27
3	DQ16	21	DQ20	39	V _{SS}	57	DQ12
4	DQ1	22	DQ5	40	$\overline{\text{CAS0}}$	58	DQ28
5	DQ17	23	DQ21	41	$\overline{\text{CAS2}}$	59	V _{CC}
6	DQ2	24	DQ6	42	$\overline{\text{CAS3}}$	60	DQ29
7	DQ18	25	DQ22	43	$\overline{\text{CAS1}}$	61	DQ13
8	DQ3	26	DQ7	44	$\overline{\text{RAS0}}$	62	DQ30
9	DQ19	27	DQ23	45	$\overline{\text{RAS1}}$	63	DQ14
10	V _{CC}	28	A7	46	NC	64	DQ31
11	NC	29	NC	47	$\overline{\text{WE}}$	65	DQ15
12	A0	30	V _{CC}	48	NC	66	NC
13	A1	31	A8	49	DQ8	67	PD1
14	A2	32	A9	50	DQ24	68	PD2
15	A3	33	$\overline{\text{RAS3}}$	51	DQ9	69	PD3
16	A4	34	$\overline{\text{RAS2}}$	52	DQ25	70	PD4
17	A5	35	NC	53	DQ10	71	NC
18	A6	36	NC	54	DQ26	72	V _{SS}

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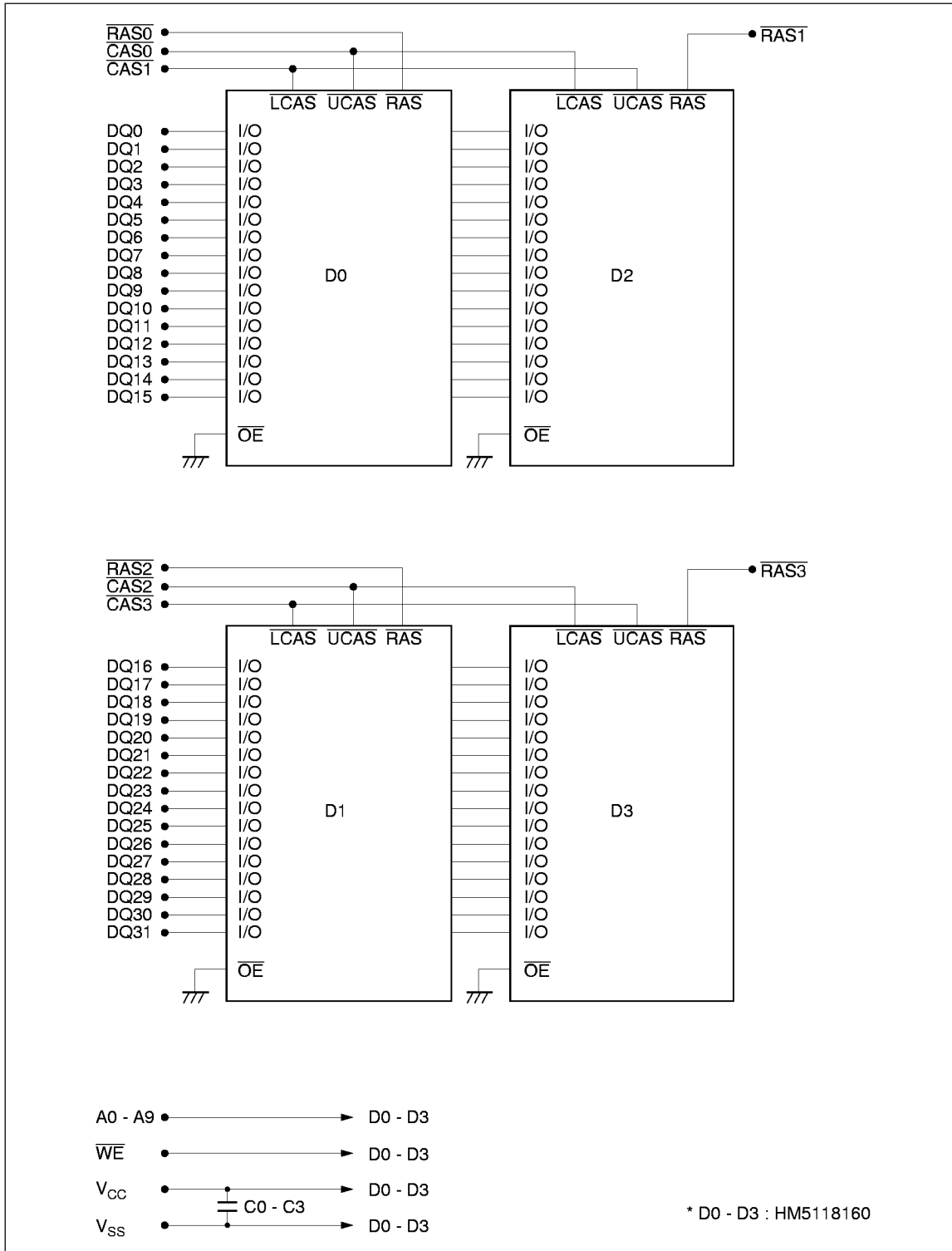
Pin Description

Pin Name	Function
A0 – A9	Address Input: A0 – A9 — Row Address: A0 – A9 — Column Address: A0 – A9 — Refresh Address: A0 – A9
DQ0 – DQ31	Data-in/Data-out
$\overline{\text{CAS0}} - \overline{\text{CAS3}}$	Column Address Strobe
$\overline{\text{RAS0}} - \overline{\text{RAS3}}$	Row Address Strobe
$\overline{\text{WE}}$	Read/Write Enable
V_{CC}	Power Supply (+5 V)
V_{SS}	Ground
PD1 – PD4	Presence Detect Pin
NC	Non Connection

Presence Detect Pin Arrangement

Pin No.	Pin Name	Function	
		60 ns	70 ns
67	PD1	NC	NC
68	PD2	NC	NC
69	PD3	NC	V_{SS}
70	PD4	NC	NC

Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
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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	I_{out}	50	mA
Power dissipation	P_t	2	W
Operating temperature	T_{opr}	0 to +70	°C
Storage temperature	T_{stg}	−55 to +125	°C

Recommended DC Operating Conditions ($T_a = 0$ 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}	−1.0	—	0.8	V	1

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

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

Parameter	Symbol	60 ns		70 ns		Unit	Test condition	Note
		Min	Max	Min	Max			
Operating current	I _{CC1}	—	350	—	310	mA	t _{RC} = min	1, 2
Standby current	I _{CC2}	—	8	—	8	mA	TTL interface R _{AS} , C _{AS} = V _{IH} Dout = High-Z	
		—	4	—	4	mA	CMOS interface R _{AS} , C _{AS} ≥ V _{CC} − 0.2 V Dout = High-Z	
RAS-only refresh current	I _{CC3}	—	350	—	310	mA	t _{RC} = min	2
Standby current	I _{CC5}	—	20	—	20	mA	R _{AS} = V _{IH} , C _{AS} = V _{IL} Dout = enable	1
CAS-before-RAS refresh current	I _{CC6}	—	350	—	310	mA	t _{RC} = min	
Fast page mode current	I _{CC7}	—	350	—	310	mA	t _{PC} = 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 = −5 mA	
Output low voltage	V _{OL}	0	0.4	0	0.4	V	Low Iout = 4.2 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 R_{AS} = V_{IL}.

3. Address can be changed once or less while C_{AS} = V_{IH}.

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

Parameter	Symbol	Typ	Max	Unit	Notes
Input capacitance (Address)	C _{I1}	—	40	pF	1
Input capacitance (WE)	C _{I2}	—	48	pF	1
Input capacitance (R _{AS})	C _{I3}	—	27	pF	1
Input capacitance (C _{AS})	C _{I4}	—	34	pF	1
I/O capacitance (DQ)	C _{I/O}	—	34	pF	1, 2

Notes: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.

2. C_{AS} = V_{IH} to disable Dout.

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AC Characteristics ($T_a = 0$ to 70°C , $V_{CC} = 5\text{ V} \pm 5\%$, $V_{SS} = 0\text{ V}$)^{*1, *2, *17}

Test Conditions

- Input rise and fall times: 5 ns
- Input timing reference levels: 0.8 V, 2.4 V
- Output timing reference levels: 0.4 V, 2.4 V
- Output load: 2 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}	110	—	130	—	ns	
RAS precharge time	t_{RP}	40	—	50	—	ns	
CAS precharge time	t_{CP}	10	—	10	—	ns	
RAS pulse width	t_{RAS}	60	10000	70	10000	ns	
CAS pulse width	t_{CAS}	15	10000	18	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	—	15	—	ns	
RAS to CAS delay time	t_{RCD}	20	45	20	52	ns	3
RAS to column address delay time	t_{RAD}	15	30	15	35	ns	4
RAS hold time	t_{RSH}	15	—	18	—	ns	
CAS hold time	t_{CSH}	60	—	70	—	ns	
CAS to RAS precharge time	t_{CRP}	5	—	5	—	ns	
CAS delay time from Din	t_{DZC}	0	—	0	—	ns	
Transition time (rise and fall)	t_T	3	50	3	50	ns	5
Refresh period (1,024 cycles)	t_{REF}	—	16	—	16	ms	

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Read Cycle

Parameter	Symbol	60 ns		70 ns		Unit	Notes
		Min	Max	Min	Max		
Access time from $\overline{\text{RAS}}$	t_{RAC}	—	60	—	70	ns	6, 7
Access time from $\overline{\text{CAS}}$	t_{CAC}	—	15	—	18	ns	7, 8, 15
Access time from address	t_{AA}	—	30	—	35	ns	7, 9, 15
Read command setup time	t_{RCS}	0	—	0	—	ns	
Read command hold time to $\overline{\text{CAS}}$	t_{RCH}	0	—	0	—	ns	10
Read command hold time to $\overline{\text{RAS}}$	t_{RRH}	5	—	5	—	ns	10
Column address to $\overline{\text{RAS}}$ lead time	t_{RAL}	30	—	35	—	ns	
Column address to $\overline{\text{CAS}}$ lead time	t_{CAL}	30	—	35	—	ns	
$\overline{\text{CAS}}$ to output in low-Z	t_{CLZ}	0	—	0	—	ns	
Output data hold time	t_{OH}	3	—	3	—	ns	
Output buffer turn-off time	t_{OFF}	—	15	—	15	ns	11
$\overline{\text{CAS}}$ to Din delay time	t_{CDD}	15	—	18	—	ns	

Write Cycle

Parameter	Symbol	60 ns		70 ns		Unit	Notes
		Min	Max	Min	Max		
Write command setup time	t_{WCS}	0	—	0	—	ns	12
Write command hold time	t_{WCH}	10	—	15	—	ns	
Write command pulse width	t_{WP}	10	—	10	—	ns	
Data-in setup time	t_{DS}	0	—	0	—	ns	13
Data-in hold time	t_{DH}	10	—	15	—	ns	13

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Refresh Cycle

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

Fast Page Mode Cycle

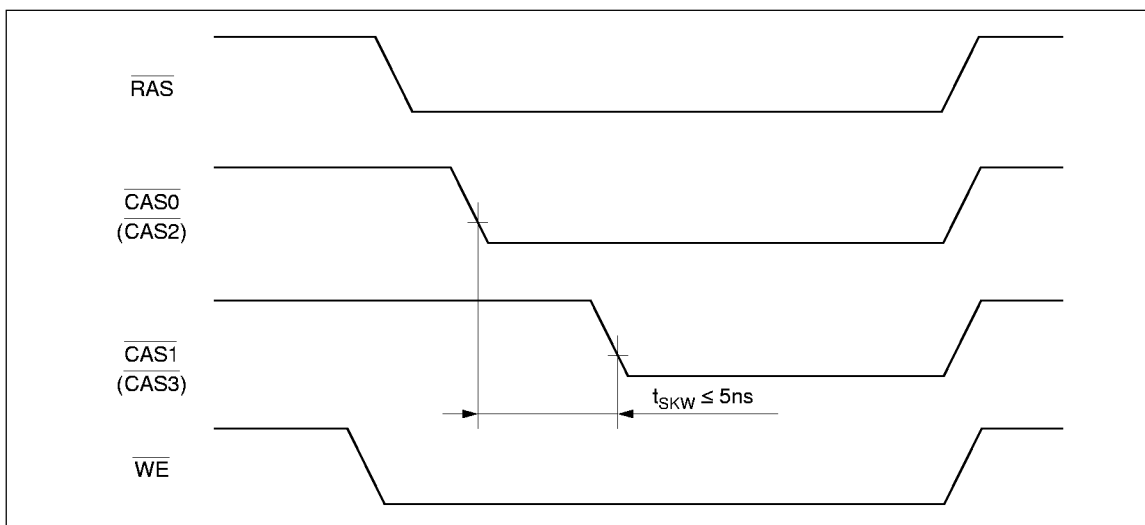
Parameter	Symbol	60 ns		70 ns		Unit	Notes
		Min	Max	Min	Max		
Fast page mode cycle time	t_{PC}	40	—	45	—	ns	
Fast page mode $\overline{\text{RAS}}$ pulse width	t_{RASP}	—	100000	—	100000	ns	14
Access time from $\overline{\text{CAS}}$ precharge	t_{CPA}	—	35	—	40	ns	7, 15
RAS hold time from $\overline{\text{CAS}}$ precharge	t_{CPRH}	35	—	40	—	ns	

- Notes:
1. AC measurements assume $t_r = 5$ 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 $\overline{\text{RAS}}$ -only refresh cycle or $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ 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. 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).
 6. Assumes that $t_{\text{RCD}} \leq t_{\text{RCD}}$ (max) and $t_{\text{RAD}} \leq t_{\text{RAD}}$ (max). If t_{RCD} or t_{RAD} is greater than the maximum recommended value shown in this table, t_{RAC} exceeds the value shown.
 7. Measured with a load circuit equivalent to 2 TTL loads and 100 pF.
 8. Assumes that $t_{\text{RCD}} \geq t_{\text{RCD}}$ (max) and $t_{\text{RCD}} + t_{\text{CAC}}$ (max) $\geq t_{\text{RAD}} + t_{\text{AA}}$ (max).
 9. Assumes that $t_{\text{RAD}} \geq t_{\text{RAD}}$ (max) and $t_{\text{RCD}} + t_{\text{CAC}}$ (max) $\leq t_{\text{RAD}} + t_{\text{AA}}$ (max).
 10. Either t_{RCH} or t_{RRH} must be satisfied for a read cycles.
 11. t_{OFF} (max) defines the time at which the outputs achieve the open circuit condition and are not referred to output voltage levels.
 12. Early write cycle only ($t_{\text{WCS}} \geq t_{\text{WCS}}$ (min)).
 13. These parameters are referred to $\overline{\text{CAS}}$ leading edge in early write cycles.
 14. t_{RASP} defines $\overline{\text{RAS}}$ pulse width in Fast page mode cycles.
 15. Access time is determined by the longest among t_{AA} , t_{CAC} and t_{CPA} .
 16. 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 $V_{\text{CC}} / V_{\text{SS}}$ line noise, which causes to degrade V_{IH} min./ V_{IL} max level.
 17. All the V_{CC} and V_{SS} pins shall be supplied with the same voltages.

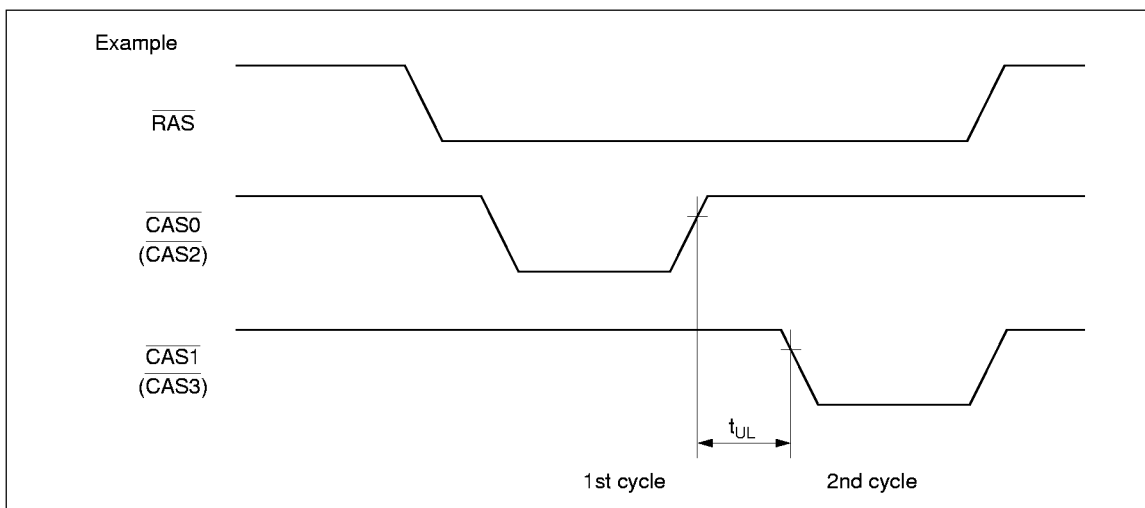
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Notes concerning $2\overline{\text{CAS}}$ control

- (1) In one memory cycle, active both of $2\overline{\text{CAS}}$ s ($\overline{\text{CAS0}}$ and $\overline{\text{CAS1}}$ (or $\overline{\text{CAS2}}$ and $\overline{\text{CAS3}}$) or only one of them or neither of them.
- (2) To activate both of $2\overline{\text{CAS}}$ s in an early write cycle or a page mode early write cycle, please keep t_{SKW} (skew between $\overline{\text{CAS0}}$ and $\overline{\text{CAS1}}$ (or $\overline{\text{CAS2}}$ and $\overline{\text{CAS3}}$)) 5 ns or less.

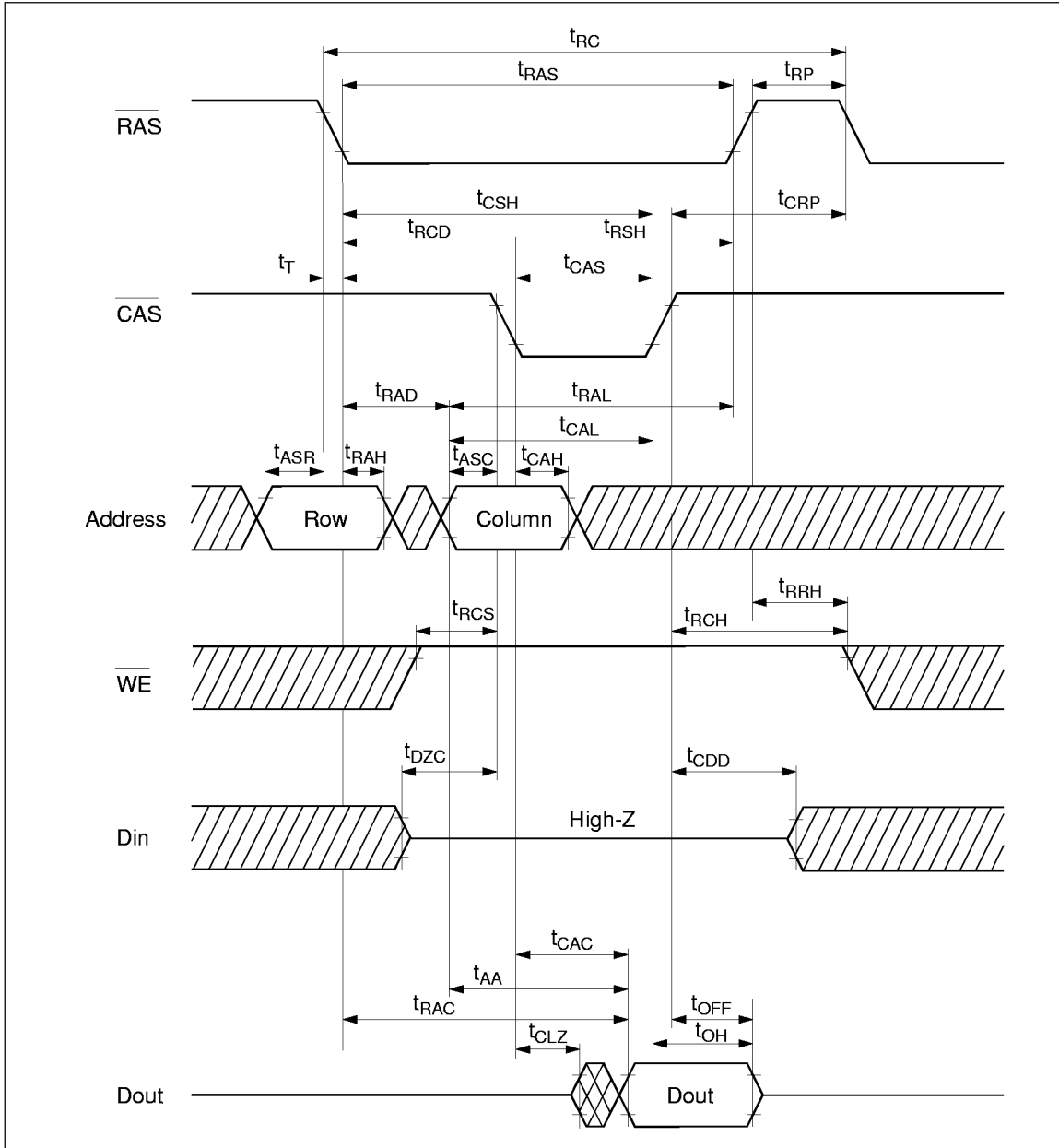


- (3) If the different $\overline{\text{CAS}}$ s are activated in the consecutive page cycles, t_{UL} the period that both $\overline{\text{CAS}}$ s are high, should be keep t_{CP} spec ($t_{\text{CP min}} \leq t_{\text{UL}}$).



Timing Waveforms

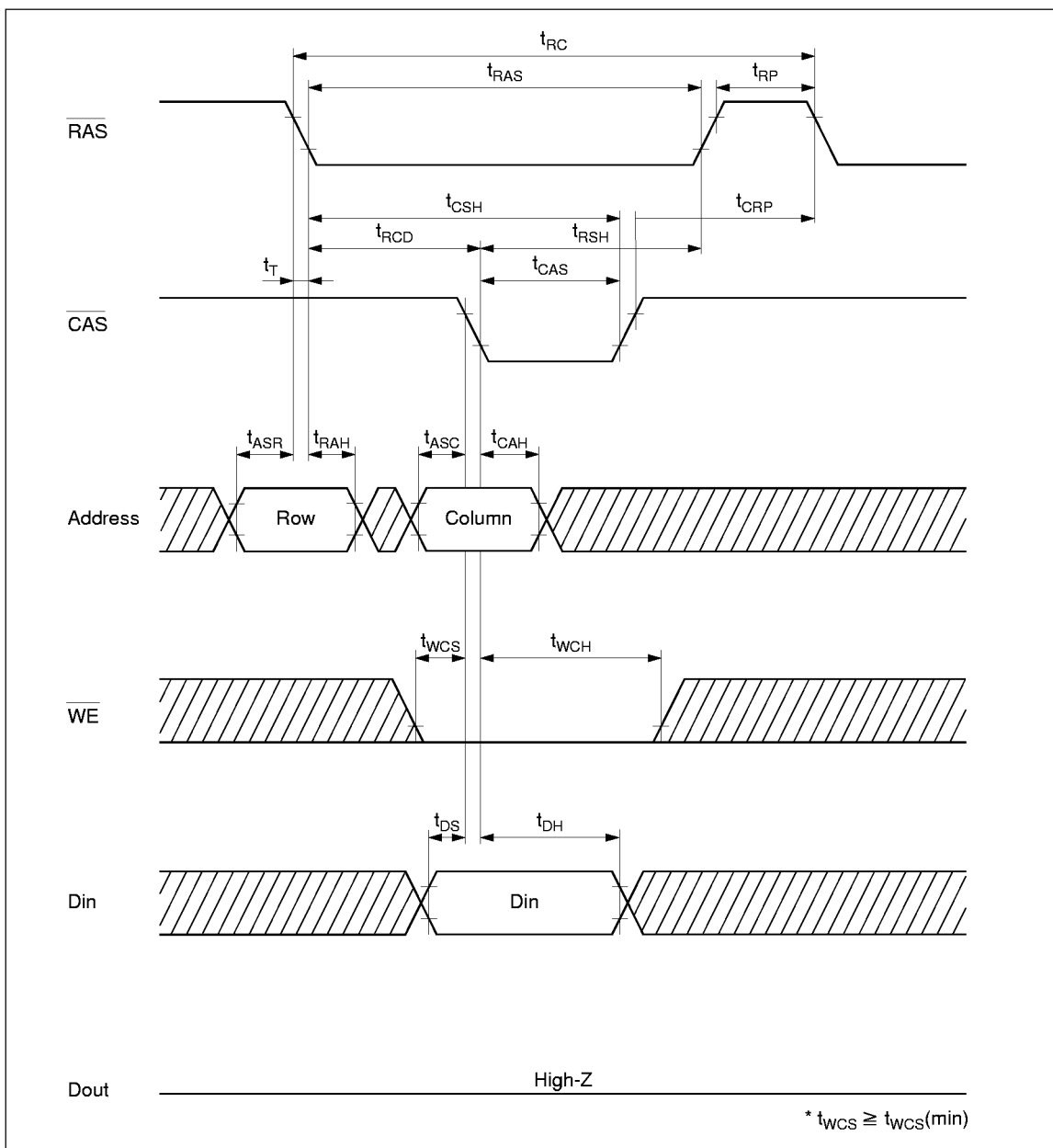
Read Cycle



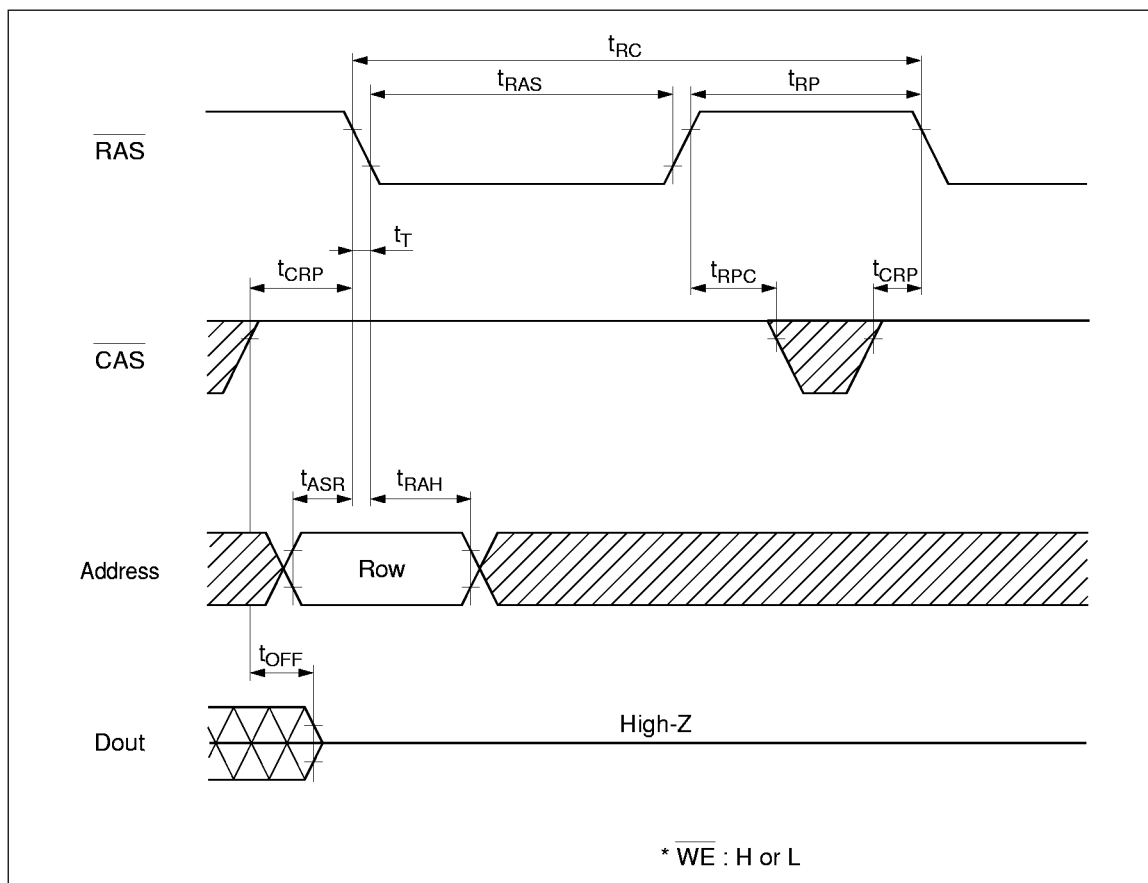
Note : V_{IH} (min) $\leq V_{IN} \leq V_{IH}$ (max), L: V_{IL} (min) $\leq V_{IN} \leq V_{IL}$ (max))
 "XXXX" Invalid Dout

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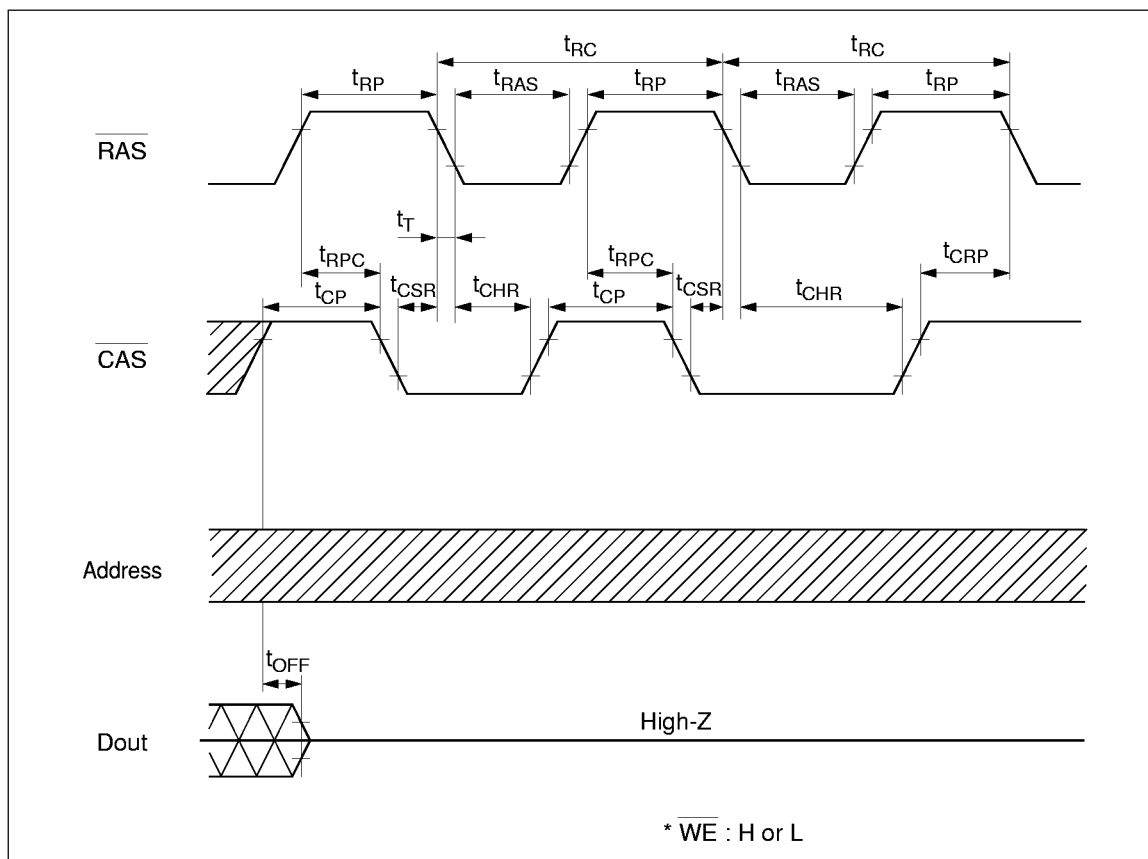
Early Write Cycle



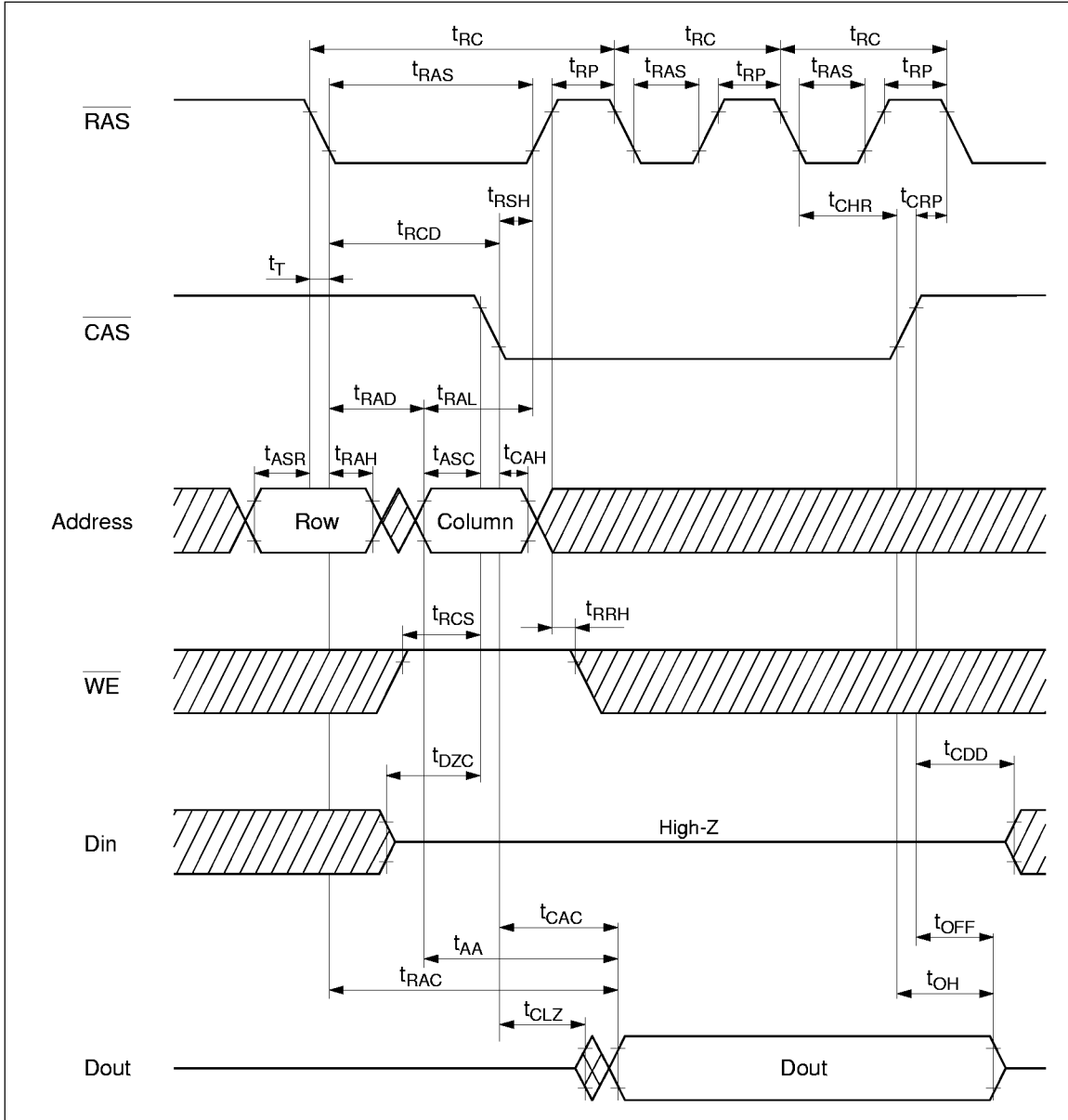
$\overline{\text{RAS}}$ -Only Refresh Cycle



CAS-Before-RAS Refresh Cycle

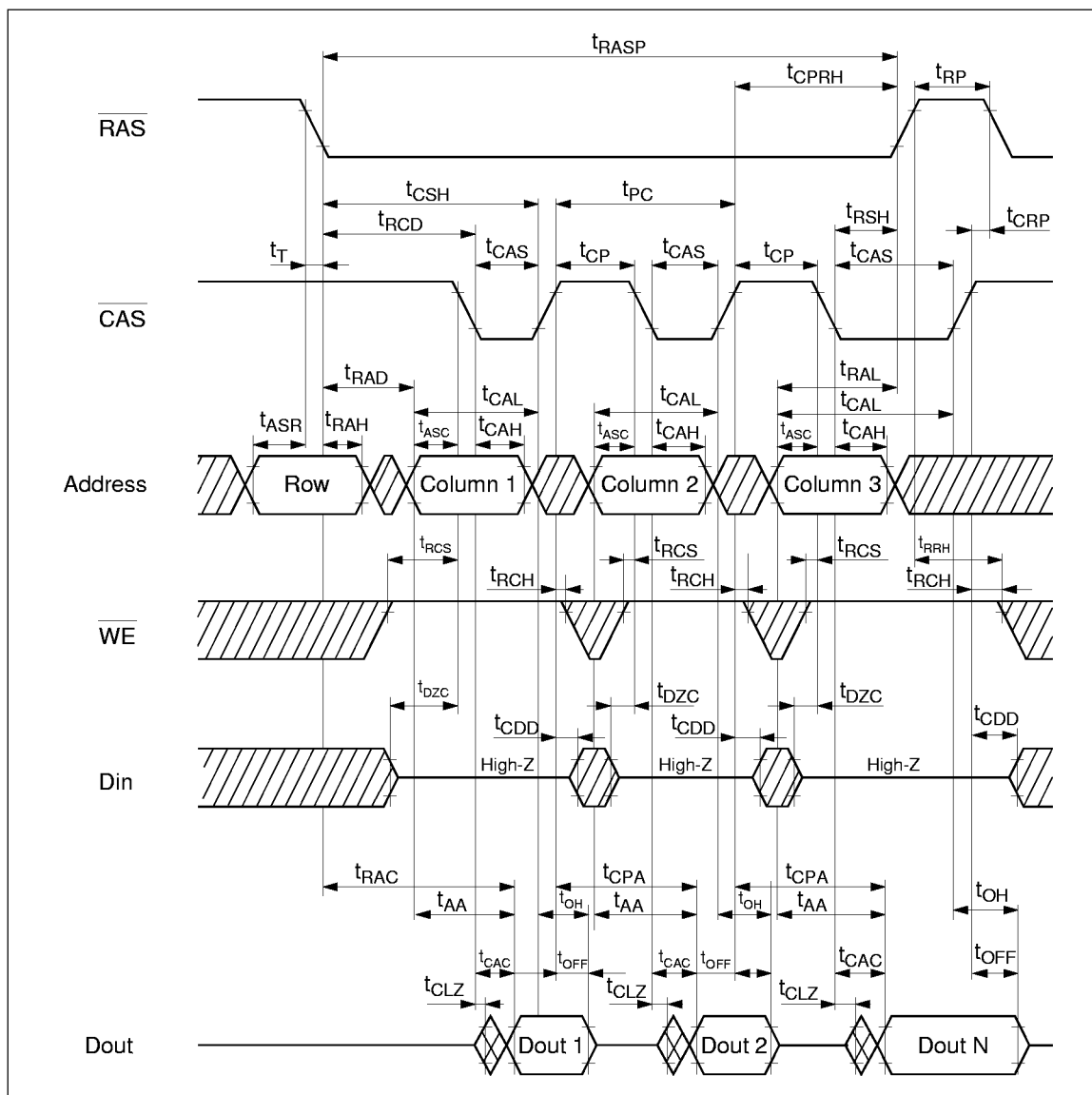


Hidden Refresh Cycle

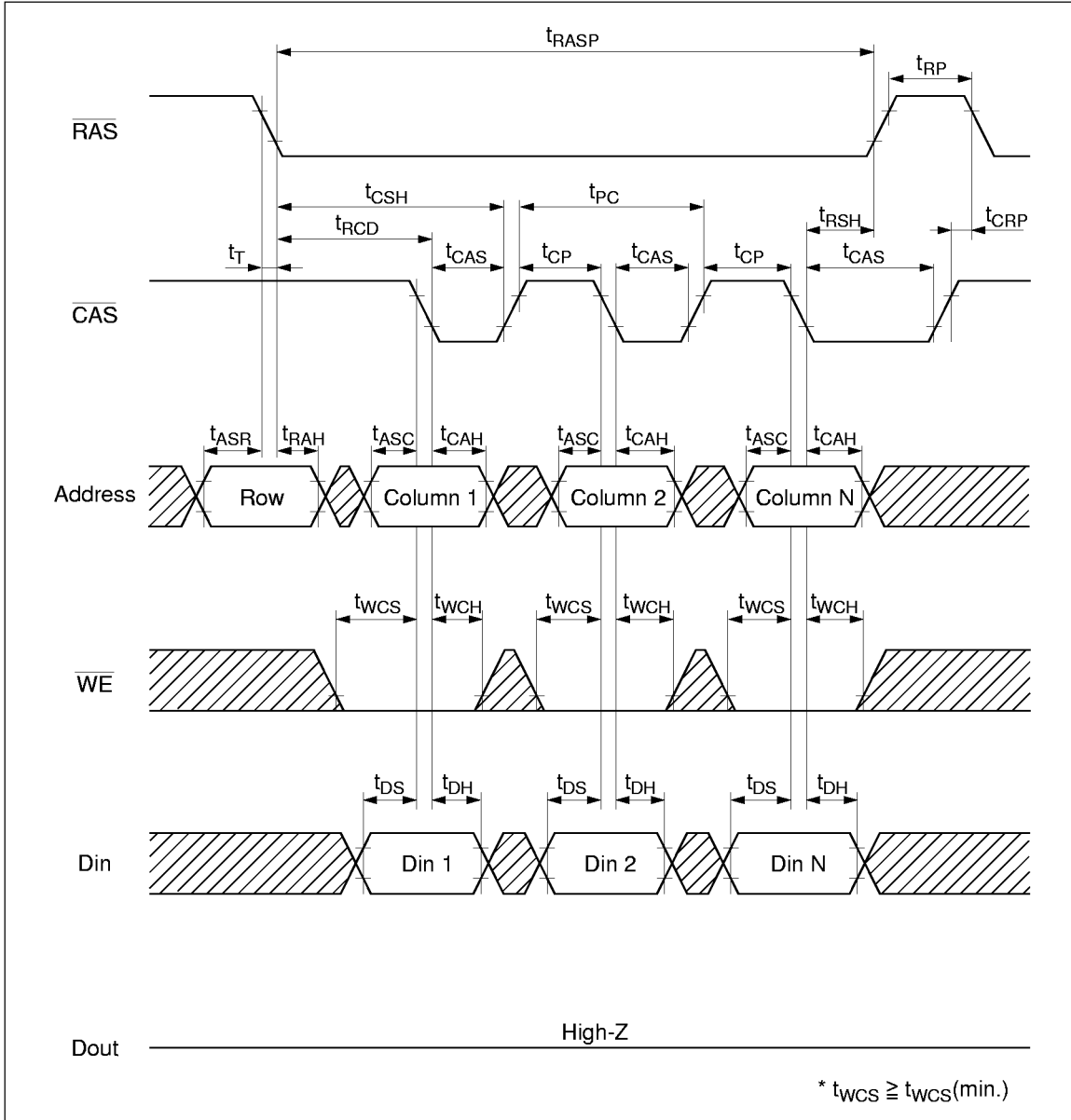


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Fast Page Mode Read Cycle



Fast Page Mode Early Write Cycle



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Physical Outline

Unit: mm/inch

