

MITSUBISHI LSIs M5M44266BP, J, L-7, -8, -10

FAST PAGE MODE 1048576-BIT(262144-WORD BY 4-BIT)DYNAMIC RAM

DESCRIPTION

This is a family of 262144-word by 4-bit dynamic RAMs, fabricated with the high performance CMOS process, and is ideal for large-capacity memory systems where high speed, low power dissipation, and low costs are essential. The use of triple-layer polysilicon process combined with silicide technology and a single-transistor dynamic storage cell provide high circuit density at reduced costs, and the use of dynamic circuitry including sense amplifiers assures low power dissipation. Multiplexed address inputs permit both a reduction in pins and an increase in system densities.

In addition to the $\overline{\text{RAS}}$ -only refresh mode, the hidden refresh mode and $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh mode are available.

FEATURES

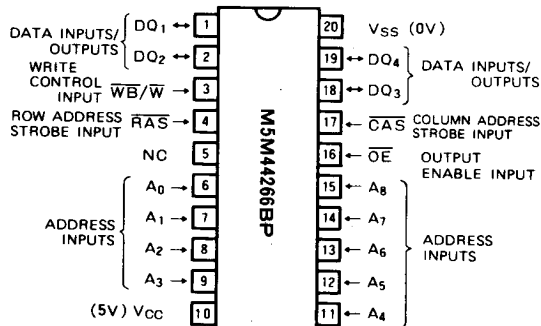
Type name	$\overline{\text{RAS}}$ access time (max. ns)	$\overline{\text{CAS}}$ access time (max. ns)	Address access time (max. ns)	$\overline{\text{OE}}$ access time (max. ns)	Cycle time (min. ns)	Power dissipation (typ.mW)
M5M44266BJ-7 P L	70	20	35	20	140	230
M5M44266BJ-8 P L	80	20	40	20	160	200
M5M44266BJ-10 P L	100	25	50	25	190	175

- High performance CMOS technology
- Standard 20 pin DIP, 26 pin SOJ, 20 pin ZIP
- Single $5\text{V} \pm 10\%$ supply
- Low standby power dissipation
2.75mW (Max) CMOS Input level
- Low operating power dissipation
M5M44266BP, J, L-7 440mW (max)
M5M44266BP, J, L-8 385mW (max)
M5M44266BP, J, L-10 330mW (max)
- All inputs, outputs TTL compatible and low capacitance
- Tri-state unlatched output
- 512 refresh cycles/8ms
- Early write mode and $\overline{\text{OE}}$ control output buffer impedance
- Write per bit mode capability
- Read-Modify-write, $\overline{\text{RAS}}$ -only refresh, Fast-page mode capabilities
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh mode capability
- $\overline{\text{CAS}}$ controlled output allows hidden refresh
- Wide $\overline{\text{RAS}}$ low pulse width for
Fast page mode 50 μs (max)

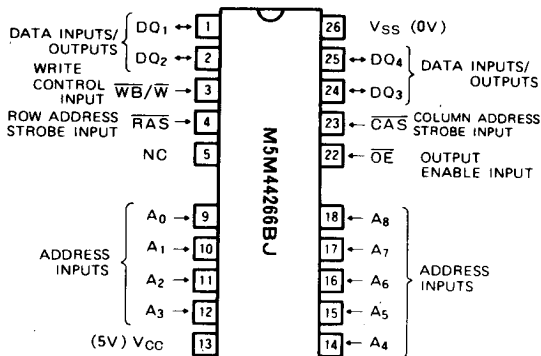
APPLICATION

Main memory unit for computers, Microcomputer memory,
Refresh memory for CRT

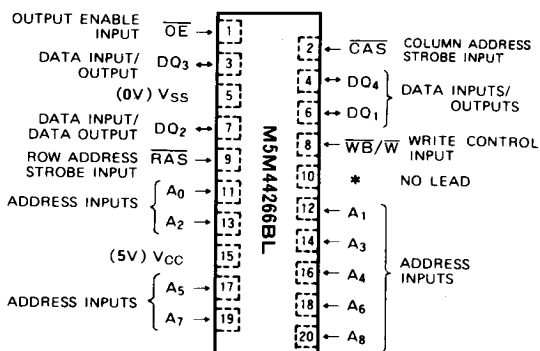
PIN CONFIGURATION (TOP VIEW)



Outline 20P4Y (DIP)



Outline 26P0J (SOJ)



Outline 20P5L-A(ZIP)

NC: NO CONNECTION

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FUNCTION

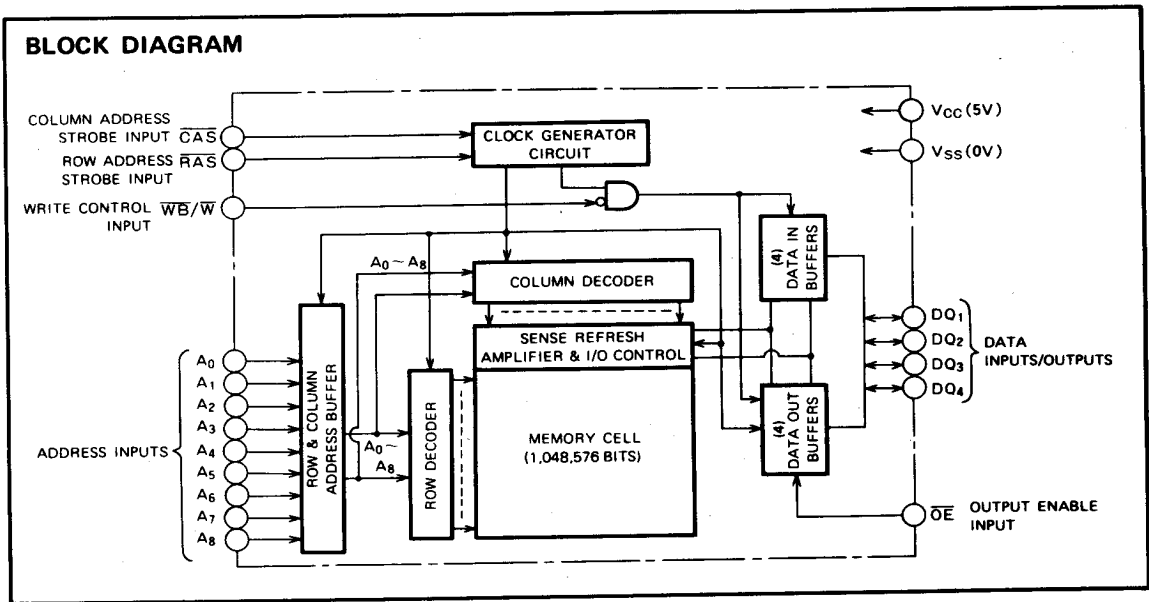
The M5M44266BP, J, L provide, in addition to normal read, write, and read-modify-write operations, a number of other functions, e.g., write per bit mode, fast page mode, $\overline{\text{RAS}}$ -only refresh, and delayed-write. The input conditions for each are shown in Table 1.

Table 1 Input conditions for each mode

Operation	Inputs						Input/Output		Refresh	Remark
	$\overline{\text{RAS}}$	$\overline{\text{CAS}}$	$\overline{\text{W}}$	$\overline{\text{OE}}$	Row address	Column address	Input	Output		
Read	ACT	ACT	NAC	ACT	APD	APD	OPN	VLD	YES	Fast page mode identical
Write (Early write)	ACT	ACT	ACT	DNC	APD	APD	VLD	OPN	YES	
Read-Modify-write	ACT	ACT	ACT	ACT	APD	APD	VLD	VLD	YES	
$\overline{\text{RAS}}$ -only refresh	ACT	NAC	DNC	DNC	APD	DNC	DNC	OPN	YES	
Hidden refresh	ACT	ACT	DNC	ACT	APD	DNC	OPN	VLD	YES	
$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh	ACT	ACT	DNC	DNC	DNC	DNC	DNC	OPN	YES	
Standby	NAC	DNC	DNC	DNC	DNC	DNC	DNC	OPN	NO	

Note ACT: active, NAC: nonactive, DNC: don't care, VLD: valid, APD: applied, OPN: open

BLOCK DIAGRAM



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ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage	With respect to V_{SS}	-1 ~ 7	V
V_I	Input voltage		-1 ~ 7	V
V_O	Output voltage		-1 ~ 7	V
I_O	Output current		50	mA
P_d	Power dissipation	$T_a = 25^\circ\text{C}$	1000	mW
T_{opr}	Operating temperature		0 ~ 70	$^\circ\text{C}$
T_{stg}	Storage temperature		-65 ~ 150	$^\circ\text{C}$

RECOMMENDED OPERATING CONDITIONS ($T_a = 0 \sim 70^\circ\text{C}$, unless otherwise noted) (Note 1)

Symbol	Parameter	Limits			Unit
		Min	Nom	Max	
V_{CC}	Supply voltage	4.5	5	5.5	V
V_{SS}	Supply voltage	0	0	0	V
V_{IH}	High-level input voltage, all inputs	2.4		6.5	V
V_{IL}	Low-level input voltage, all inputs	-1.0		0.8	V

Note 1: All voltage values are with respect to V_{SS} .

ELECTRICAL CHARACTERISTICS ($T_a = 0 \sim 70^\circ\text{C}$, $V_{CC} = 5V \pm 10\%$, $V_{SS} = 0V$, unless otherwise noted) (Note 2)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V_{OH}	High-level output voltage	$I_{OH} = -5\text{mA}$	2.4		V_{CC}	V
V_{OL}	Low-level output voltage	$I_{OL} = 4.2\text{mA}$	0		0.4	V
I_{OZ}	Off-state output current	Q floating $0V \leq V_{OUT} \leq 5.5V$	-10		10	μA
I_I	Input current	$0V \leq V_{IN} \leq 6.5V$ Other inputs pins = 0V	-10		10	μA
$I_{CC1(AV)}$	Average supply current from V_{CC} , operating (Note 3, 4)	$\overline{RAS}$, $\overline{CAS}$ cycling			80	mA
		$t_{RC} = t_{WC} = \text{min}$, output open			70	
					60	
I_{CC2}	Supply current from V_{CC} , standby	$RAS = CAS = V_{IH}$, output open			2	mA
		$RAS = CAS - OE \geq V_{CC} - 0.5$, output open			0.5	
$I_{CC3(AV)}$	Average supply current from V_{CC} , refreshing (Note 3)	$\overline{RAS}$ cycling, $\overline{CAS} = V_{IH}$			80	mA
		$t_{RC} = \text{min}$, output open			70	
					60	
$I_{CC4(AV)}$	Average supply current from V_{CC} , Fast-Page-Mode (Note 3, 4)	$\overline{RAS} = V_{IL}$, $\overline{CAS}$ cycling			70	mA
		$t_{PC} = \text{min}$, output open			60	
					50	
$I_{CC6(AV)}$	Average supply current from V_{CC} , $\overline{CAS}$ before $\overline{RAS}$ refresh mode (Note 3)	$\overline{CAS}$ before $\overline{RAS}$ refresh cycling			80	mA
		$t_{RC} = \text{min}$, output open			70	
					60	

Note 2: Current flowing into an IC is positive, out is negative.

3: $I_{CC1(AV)}$, $I_{CC3(AV)}$ and $I_{CC4(AV)}$ are dependent on cycle rate. Maximum current is measured at the fastest cycle rate.

4: $I_{CC1(AV)}$ and $I_{CC4(AV)}$ are dependent on output loading. Specified values are obtained with the output open.

CAPACITANCE ($T_a = 0 \sim 70^\circ\text{C}$, $V_{CC} = 5V \pm 10\%$, $V_{SS} = 0V$, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$C_{I(A)}$	Input capacitance, address inputs (Note 5)	$V_I = V_{SS}$ $f = 1\text{MHz}$ $V_I = 25\text{mVrms}$			5	pF
$C_{I(OE)}$	Input capacitance, $\overline{OE}$ input				7	pF
$C_{I(W)}$	Input capacitance, write control input				7	pF
$C_{I(RAS)}$	Input capacitance, $\overline{RAS}$ input				7	pF
$C_{I(CAS)}$	Input capacitance, $\overline{CAS}$ input				7	pF
$C_{I/O}$	Input/Output capacitance, data ports				7	pF

Note 5: $C_{I(A)}$ of Z1P is 6pF (max).

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SWITCHING CHARACTERISTICS ($T_a = 0 \sim 70^\circ\text{C}$, $V_{CC} = 5\text{V} \pm 10\%$, $V_{SS} = 0\text{V}$, unless otherwise noted) (Note 6)

Symbol	Parameter	Limits						Unit
		M5M44266B-7		M5M44266B-8		M5M44266B-10		
		Min	Max	Min	Max	Min	Max	
t _{CAC}	Access time from $\overline{\text{CAS}}$ (Note 7, 8)		20		20		25	ns
t _{RAC}	Access time from $\overline{\text{RAS}}$ (Note 7, 9)		70		80		100	ns
t _{CAA}	Column Address access time (Note 7, 10)		35		40		50	ns
t _{CPA}	Access time from $\overline{\text{CAS}}$ precharge (Note 7, 11)		40		45		55	ns
t _{OEA}	Access time from $\overline{\text{OE}}$ (Note 7)		20		20		25	ns
t _{CLZ}	Output low impedance time from $\overline{\text{CAS}}$ low (Note 7)	5		5		5		ns
t _{OFF}	Output disable time after $\overline{\text{CAS}}$ high (Note 12)	0	20	0	20	0	25	ns
t _{dis(OE)}	Output disable time after $\overline{\text{OE}}$ high (Note 12)	0	20	0	20	0	25	ns

Note 6: An initial pause of 500 μ s is required after power-up followed by any 8 $\overline{\text{RAS}}$ or $\overline{\text{RAS}}/\overline{\text{CAS}}$ cycles before proper device operation is achieved.

Note that $\overline{\text{RAS}}$ may be cycled during the initial pause. And any 8 $\overline{\text{RAS}}$ or $\overline{\text{RAS}}/\overline{\text{CAS}}$ cycles are required after prolonged periods of $\overline{\text{RAS}}$ inactivity before proper device operation is achieved.

7: Measured with a load circuit equivalent to 2TTL loads and 100pF.

8: Assume that $t_{PCD}(\text{max}) \leq t_{RCD}$ and $t_{ASC}(\text{max}) \leq t_{ASC}$.

9: Assumes that $t_{RCD} \leq t_{RCD}(\text{max})$ and $t_{RAD} \leq t_{RAD}(\text{max})$. If t_{RCD} or t_{RAD} is greater than the maximum recommended value shown in this table, t_{RAC} will increase by amount that t_{RCD} or t_{RAD} exceeds the value shown.

10: Assume that $t_{RAD}(\text{max}) \leq t_{RAD}$ and $t_{ASC} \leq t_{ASC}(\text{max})$.

11: Assume that $t_{CP} \leq t_{CP}(\text{max})$ and $t_{ASC} \geq t_{ASC}(\text{max})$.

12: $t_{OFF}(\text{max})$ and $t_{dis}(\text{OE})$ define the time at which the output achieves the high impedance state ($I_{OUT} \leq \pm 10\mu\text{A}$) and are not reference to $V_{OH}(\text{min})$ or $V_{OL}(\text{max})$.

TIMING REQUIREMENTS (For Read, Write, Read-Modify-Write, Refresh, and Fast Page Cycles)

($T_a = 0 \sim 70^\circ\text{C}$, $V_{CC} = 5\text{V} \pm 10\%$, $V_{SS} = 0\text{V}$, unless otherwise noted, See notes 13, 14)

Symbol	Parameter	Limits						Unit
		M5M44266B-7		M5M44266B-8		M5M44266B-10		
		Min	Max	Min	Max	Min	Max	
t _{REF}	Refresh cycle time		8		8		8	ms
t _{RP}	RAS high pulse width	60		70		80		ns
t _{RCD}	Delay time, RAS low to CAS low (Note 15)	20	50	25	60	25	75	ns
t _{CRP}	Delay time, CAS high to RAS low (Note 16)	10		10		10		ns
t _{CPN}	CAS high pulse width	10		10		10		ns
t _{RAD}	Column address delay time from RAS low (Note 17)	15	35	20	40	20	50	ns
t _{ASR}	Row address setup time before RAS low	0		0		0		ns
t _{ASC}	Column address setup time before CAS low (Note 18)	0	10	0	15	0	20	ns
t _{RAH}	Row address hold time after RAS low	10		15		15		ns
t _{CAH}	Column address hold time after CAS low or W low	15		20		20		ns
t _τ	Transition time (Note 19)	3	50	3	50	3	50	ns

Note 13: The timing requirements are assumed $t_T = 5\text{ns}$.

14: $V_{IH}(\text{min})$ and $V_{IL}(\text{max})$ are reference levels for measuring timing of input signals.

15: $t_{RCD}(\text{max})$ is specified as a reference point only. If t_{RCD} is less than $t_{RCD}(\text{max})$, access time is t_{RAC} . If t_{RCD} is greater than $t_{RCD}(\text{max})$, access time is defined as t_{CAC} and t_{CAA} as shown in notes 8, 10.

16: t_{CRP} requirement is applicable for all $\overline{\text{RAS}}/\overline{\text{CAS}}$ cycles.

17: $t_{RAD}(\text{max})$ is specified as a reference point only. If $t_{RAD} \geq t_{RAD}(\text{max})$ and $t_{ASC} \leq t_{ASC}(\text{max})$, access time is controlled exclusively by t_{CAA} .

18: $t_{ASC}(\text{max})$ is specified as a reference point only. If $t_{RCD} \geq t_{RCD}(\text{max})$ and $t_{ASC} \geq t_{ASC}(\text{max})$, access time is controlled exclusively by t_{CAC} .

19: t_T is measured between $V_{IH}(\text{min})$ and $V_{IL}(\text{max})$.

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Read and Refresh Cycles

Symbol	Parameter	Limits						Unit
		M5M44266B-7		M5M44266B-8		M5M44266B-10		
		Min	Max	Min	Max	Min	Max	
t _{RC}	Read cycle time	140		160		190		ns
t _{RAS}	RAS low pulse width	70	10000	80	10000	100	10000	ns
t _{CAS}	CAS low pulse width	20	10000	20	10000	25	10000	ns
t _{CSH}	CAS hold time after RAS low	70		80		100		ns
t _{RSH}	RAS hold time after CAS low	20		20		25		ns
t _{RCS}	Read Setup time before CAS low	0		0		0		ns
t _{RCH}	Read hold time after CAS high (Note 20)	0		0		0		ns
t _{RRH}	Read hold time after RAS high (Note 20)	10		10		10		ns
t _{RAL}	Column address to RAS setup time	35		40		50		ns
t _{RPC}	Precharge to CAS active time	0		0		0		ns
t _{h(CLOE)}	OE hold time after CAS low	20		20		25		ns
t _{h(RLOE)}	OE hold time after RAS low	70		80		100		ns
t _{DOEL}	Delay time, Data to OE low	0		0		0		ns
t _{OEHD}	Delay time, OE high to Data	15		15		20		ns
t _{h(OECH)}	CAS hold time after OE low	20		20		25		ns
t _{h(OERH)}	RAS hold time after OE low	20		20		25		ns

Note 20: Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.

Write Cycle (Early Write and Delayed Write)

Symbol	Parameter	Limits						Unit
		M5M44266B-7		M5M44266B-8		M5M44266B-10		
		Min	Max	Min	Max	Min	Max	
t _{WC}	Write cycle time	140		160		190		ns
t _{RAS}	RAS low pulse width	70	10000	80	10000	100	10000	ns
t _{CAS}	CAS low pulse width	20	10000	20	10000	25	10000	ns
t _{CSH}	CAS hold time after RAS low	70		80		100		ns
t _{RSH}	RAS hold time after CAS low	20		20		25		ns
t _{WCS}	Write setup time before CAS low (Note 22)	0		0		0		ns
t _{WCH}	Write hold time after CAS low	15		15		20		ns
t _{CWL}	CAS hold time after write low	20		20		25		ns
t _{RWL}	RAS hold time after write low	20		20		25		ns
t _{WP}	Write pulse width	15		15		20		ns
t _{DS}	Data setup time	0		0		0		ns
t _{DH}	Data hold time after CAS low	15		15		20		ns
t _{OEHD}	Delay time, OE high to data	15		15		20		ns
t _{h(WOE)}	OE hold time after write low	15		15		20		ns
t _{WBS}	WB setup time before RAS low	0		0		0		ns
t _{WBH}	WB hold time after RAS low	10		15		15		ns
t _{WDS}	WPB selection setup time	0		0		0		ns
t _{WDH}	WPB selection hold time	10		15		15		ns

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Read-Write and Read-Modify-Write Cycles

Symbol	Parameter	Limits						Unit
		M5M44266B-7		M5M44266B-8		M5M44266B-10		
		Min	Max	Min	Max	Min	Max	
t _{RWC}	Read write/read modify write cycle time (Note 21)	185		205		245		ns
t _{RAS}	RAS low pulse width	115	10000	125	10000	155	10000	ns
t _{CAS}	CAS low pulse width	65	10000	65	10000	80	10000	ns
t _{CSH}	CAS hold time after RAS low	115		125		155		ns
t _{RSH}	RAS hold time after CAS low	65		65		80		ns
t _{RCS}	Read setup time before CAS low	0		0		0		ns
t _{CWD}	Delay time, CAS low to write low (Note 22)	40		40		50		ns
t _{RWD}	Delay time, RAS low to write low (Note 22)	90		100		125		ns
t _{CWL}	CAS hold time after write low	20		20		25		ns
t _{RWL}	RAS hold time after write low	20		20		25		ns
t _{WP}	Write pulse width	15		15		20		ns
t _{DS}	Data setup time	0		0		0		ns
t _{DH}	Data hold time after write low	15		15		20		ns
t _{AWD}	Delay time, address to write low (Note 22)	55		60		75		ns
t _{h(CLOE)}	OE hold time after CAS low	20		20		25		ns
t _{h(RLOE)}	OE hold time after RAS low	70		80		100		ns
t _{DOEL}	Delay time, Data to OE low	0		0		0		ns
t _{OEHD}	Delay time, OE high to Data	15		15		20		ns
t _{h(WOE)}	OE hold time after write low	15		15		20		ns
t _{WBS}	WB setup time before RAS low	0		0		0		ns
t _{WBH}	WB hold time after RAS low	10		15		15		ns
t _{WDS}	WPB selection setup time	0		0		0		ns
t _{WDH}	WPB selection hold time	10		15		15		ns

Note 21: t_{RWC} is specified as t_{RWC(min)} = t_{RAC(max)} + t_{OEHD(min)} + t_{RWL(min)} + t_{RP(min)} + 4t_t.

22: t_{WCS}, t_{CWD}, t_{RWD} and t_{AWD} are specified as reference points only. If t_{WCS} ≥ t_{WCS(min)} the cycle is an early write cycle and the DQ pins will remain high impedance throughout the entire cycle. If t_{CWD} ≥ t_{CWD(min)}, t_{RWD} ≥ t_{RWD(min)} and t_{AWD} ≥ t_{AWD(min)}, the cycle is a read-modify-write cycle and the DQ will contain the data read from the selected address. If neither of the above conditions is satisfied, the condition of the DQ (at access time and until CAS or OE goes back to V_{DD}) is indeterminate.

Fast-Page Mode Cycle (Read, Early Write, Read-Write, Read-Modify-Write Cycle)

Symbol	Parameter	Limits						Unit
		M5M44266B-7		M5M44266B-8		M5M44266B-10		
		Min	Max	Min	Max	Min	Max	
t _{PC}	Read, Write cycle time	45		50		60		ns
t _{RWPC}	Read write/read modify write cycle time	95		100		115		ns
t _{RAS}	RAS low pulse width for Read, write cycle	115	50000	135	50000	160	50000	ns
t _{CAS}	CAS low pulse width for read cycle	20	10000	20	10000	25	10000	ns
t _{CP}	CAS high pulse width (Note 23)	10	25	10	25	10	25	ns
t _{RSH}	RAS hold time after CAS low	20		20		25		ns

Note 23: t_{CP(max)} is specified as a reference point only. If t_{CP(max)} ≤ t_{CP}, access time is assumed by t_{CAC}.

CAS before RAS Refresh Cycle (Note 24)

Symbol	Parameter	Limits						Unit
		M5M44266B-7		M5M44266B-8		M5M44266B-10		
		Min	Max	Min	Max	Min	Max	
t _{CSR}	CAS setup time for CAS before RAS refresh	10		10		10		ns
t _{CHR}	CAS hold time for CAS before RAS refresh	15		15		20		ns
t _{RPC}	Precharge to CAS active time	0		0		0		ns

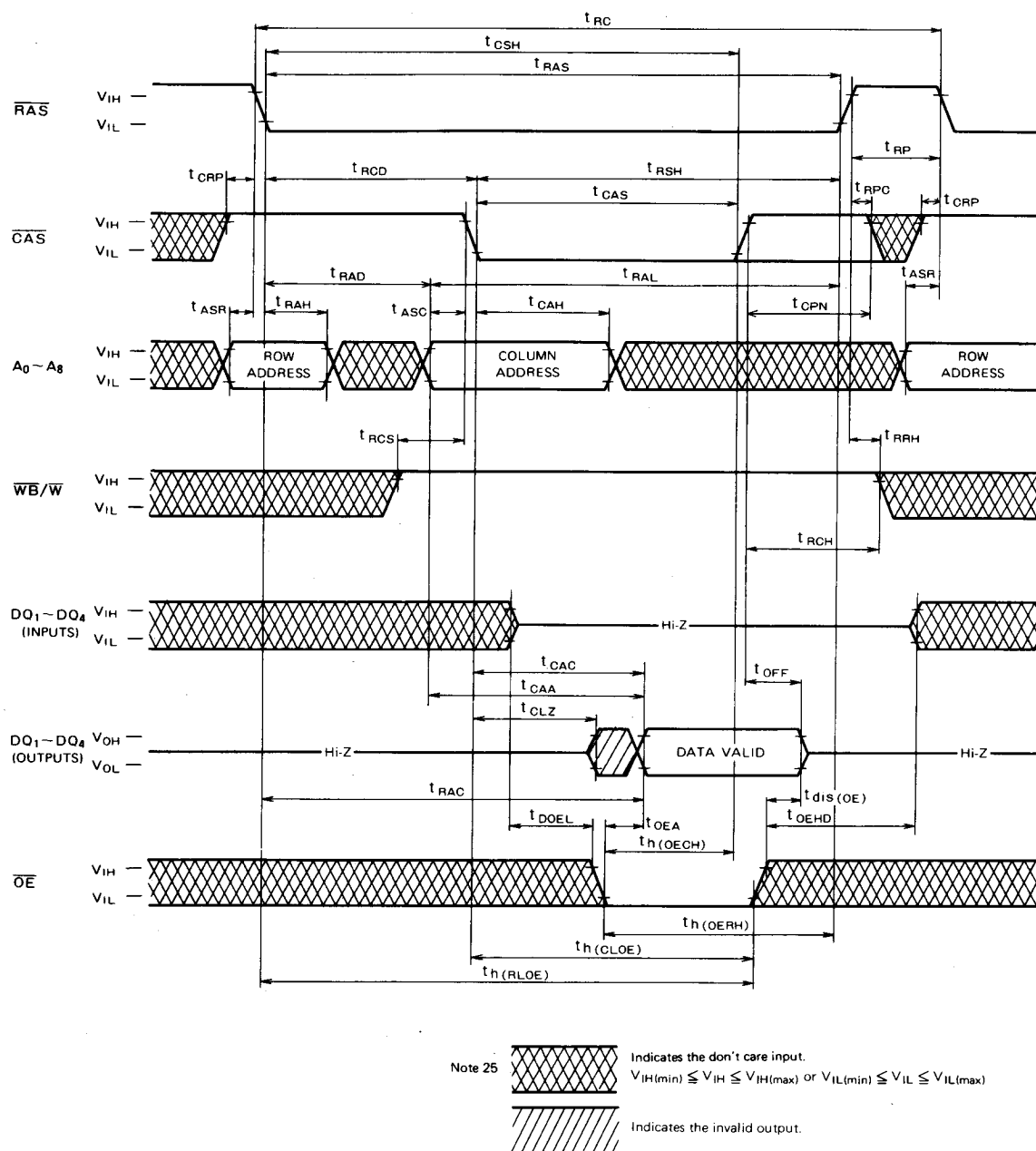
Note 24: Eight or more CAS before RAS cycles instead of eight RAS cycles are necessary for proper operation of CAS before RAS refresh mode.



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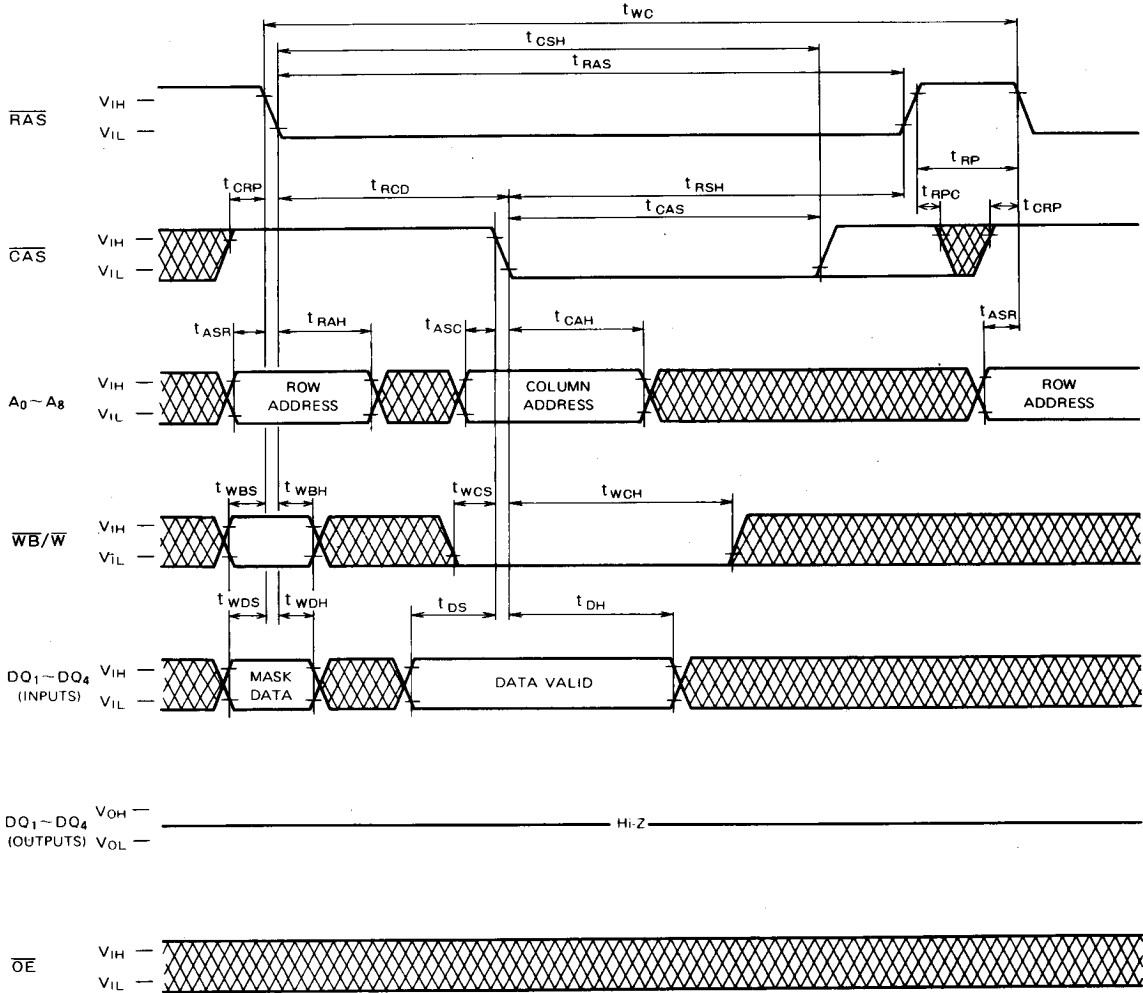
Timing Diagrams (Note 25)

Read Cycle



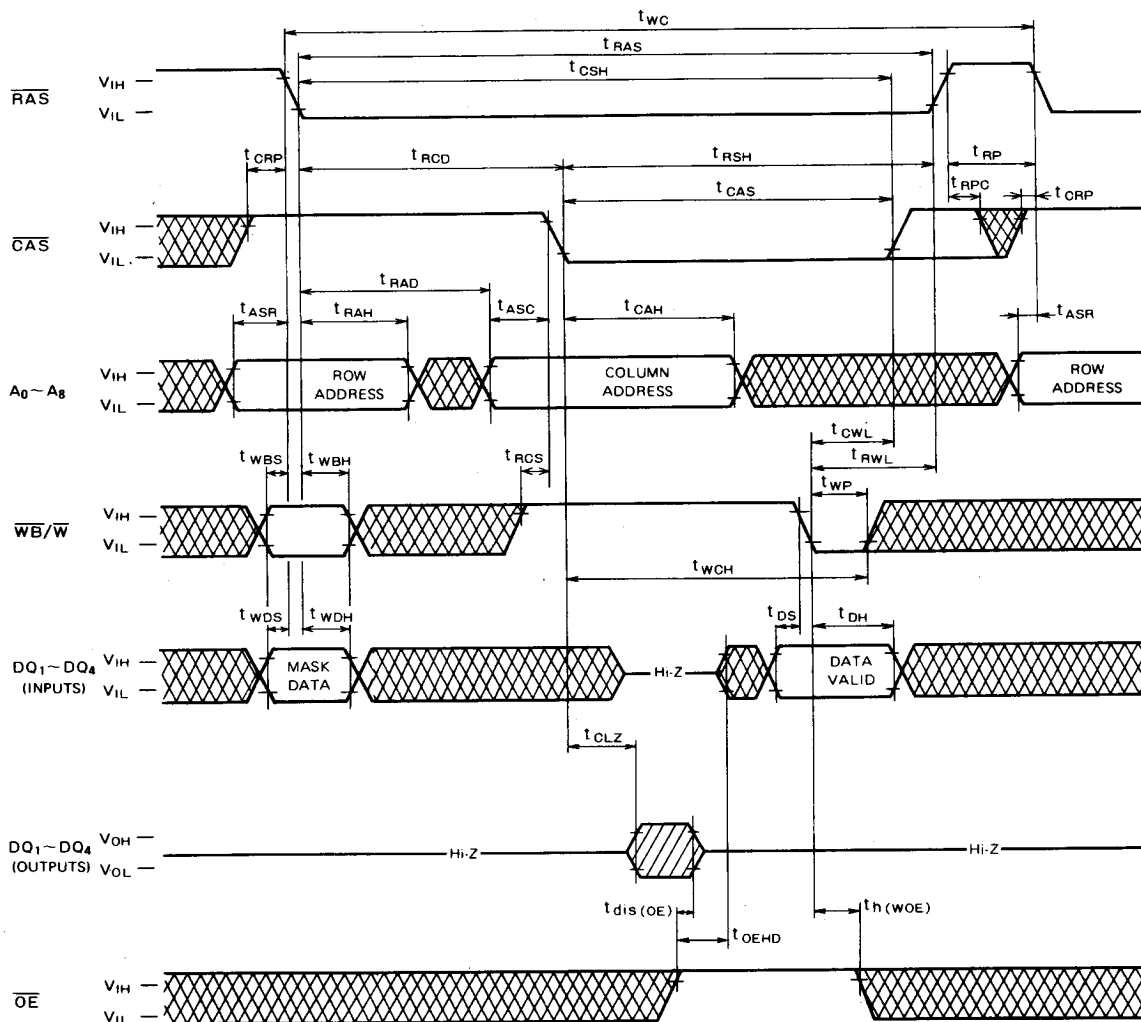
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Write Cycle (Early write)



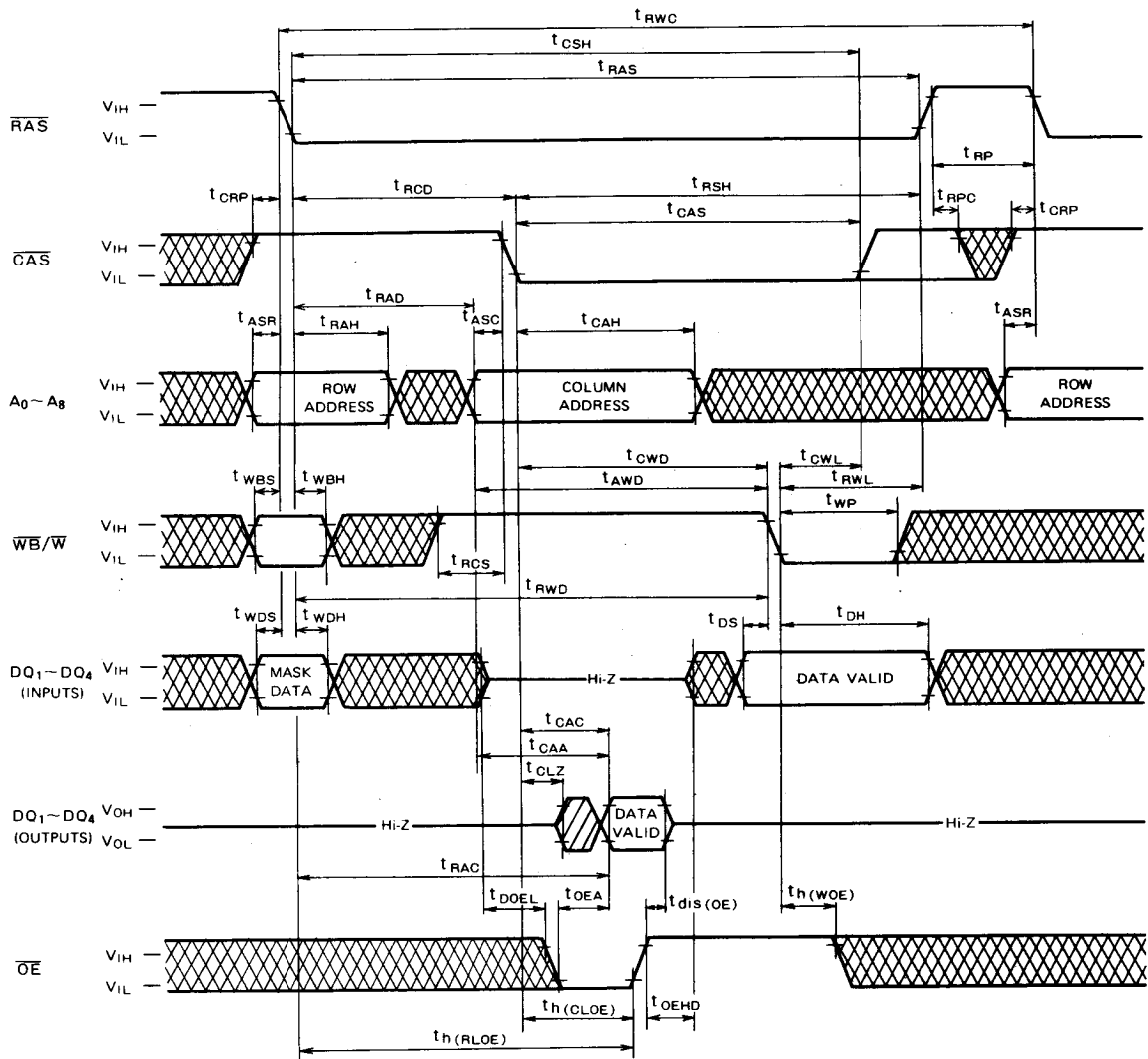
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Write Cycle (Delayed Write)



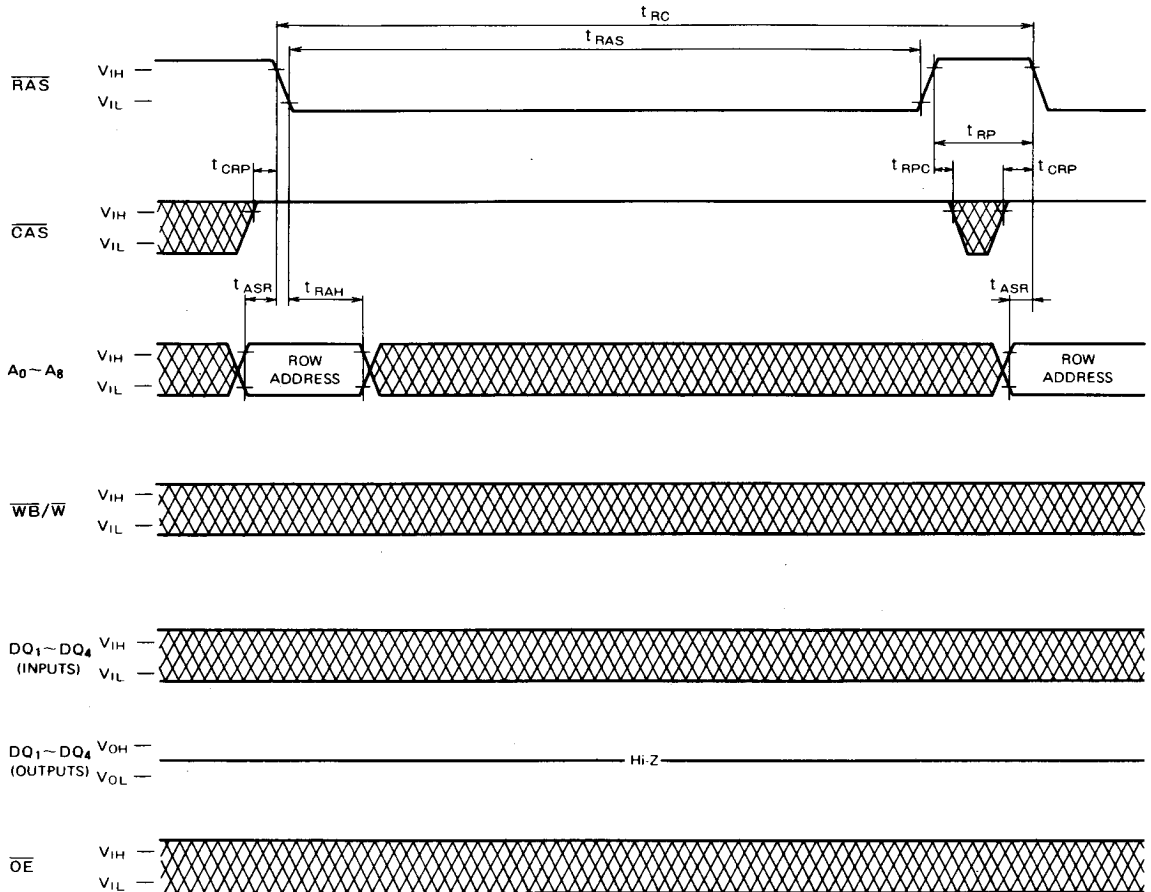
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Read-Write, Read-Modify-Write Cycle



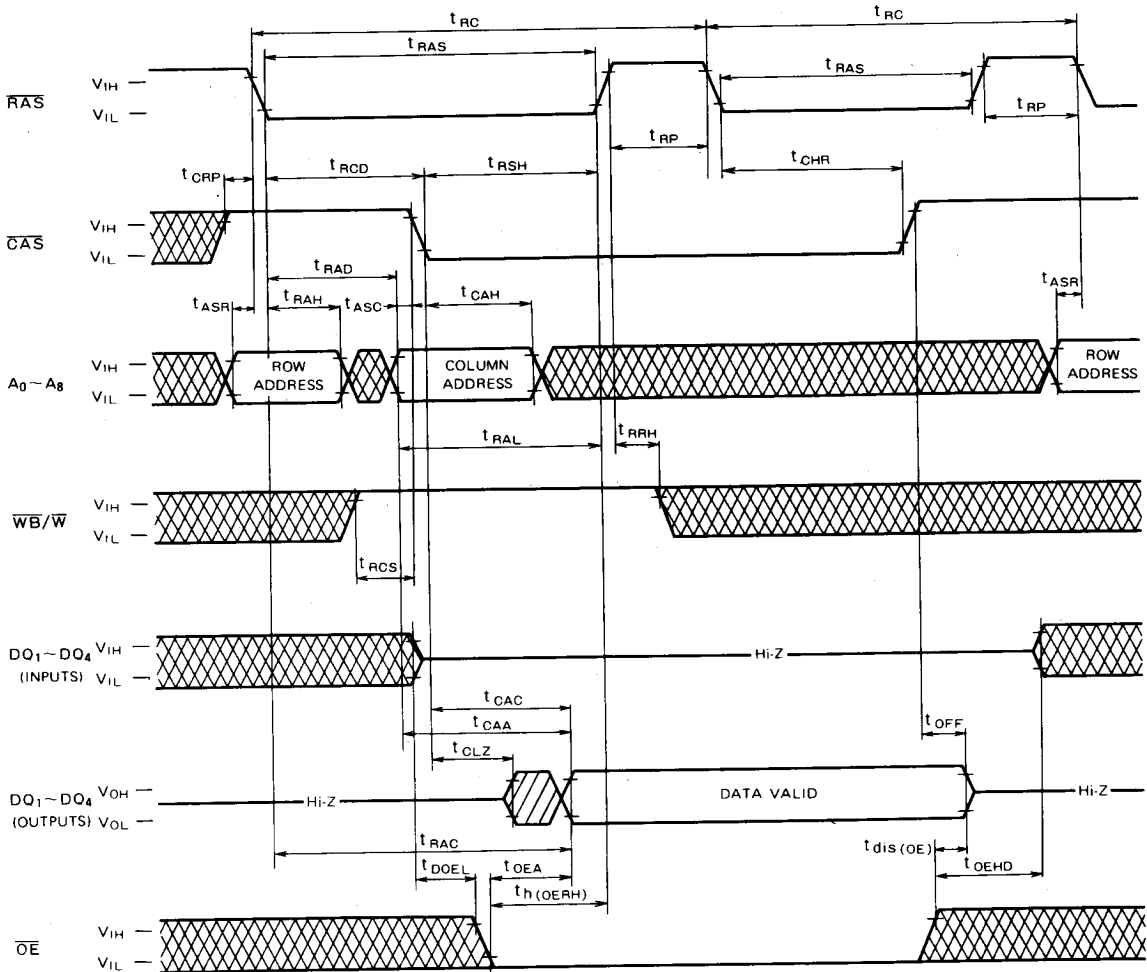
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RAS-only Refresh Cycle



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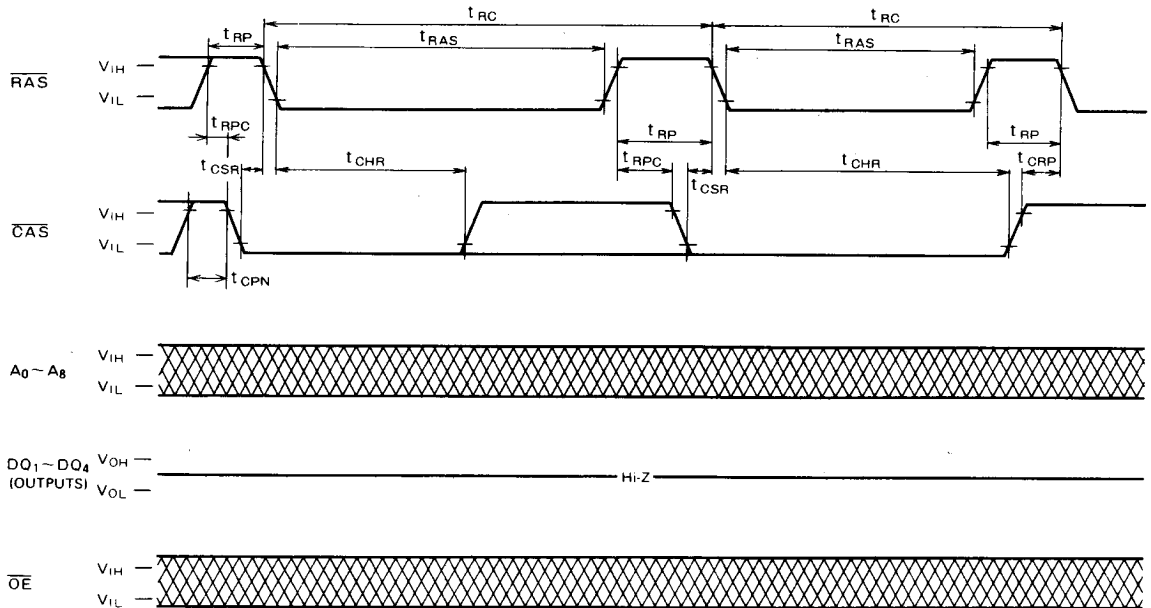
Hidden Refresh Cycle (Read) (Note 26)



Note 26: Early write, delayed write, read-write or read-modify-write cycle is applicable instead of read cycle.
 Timing requirements and output state are the same as that of each cycle shown before.

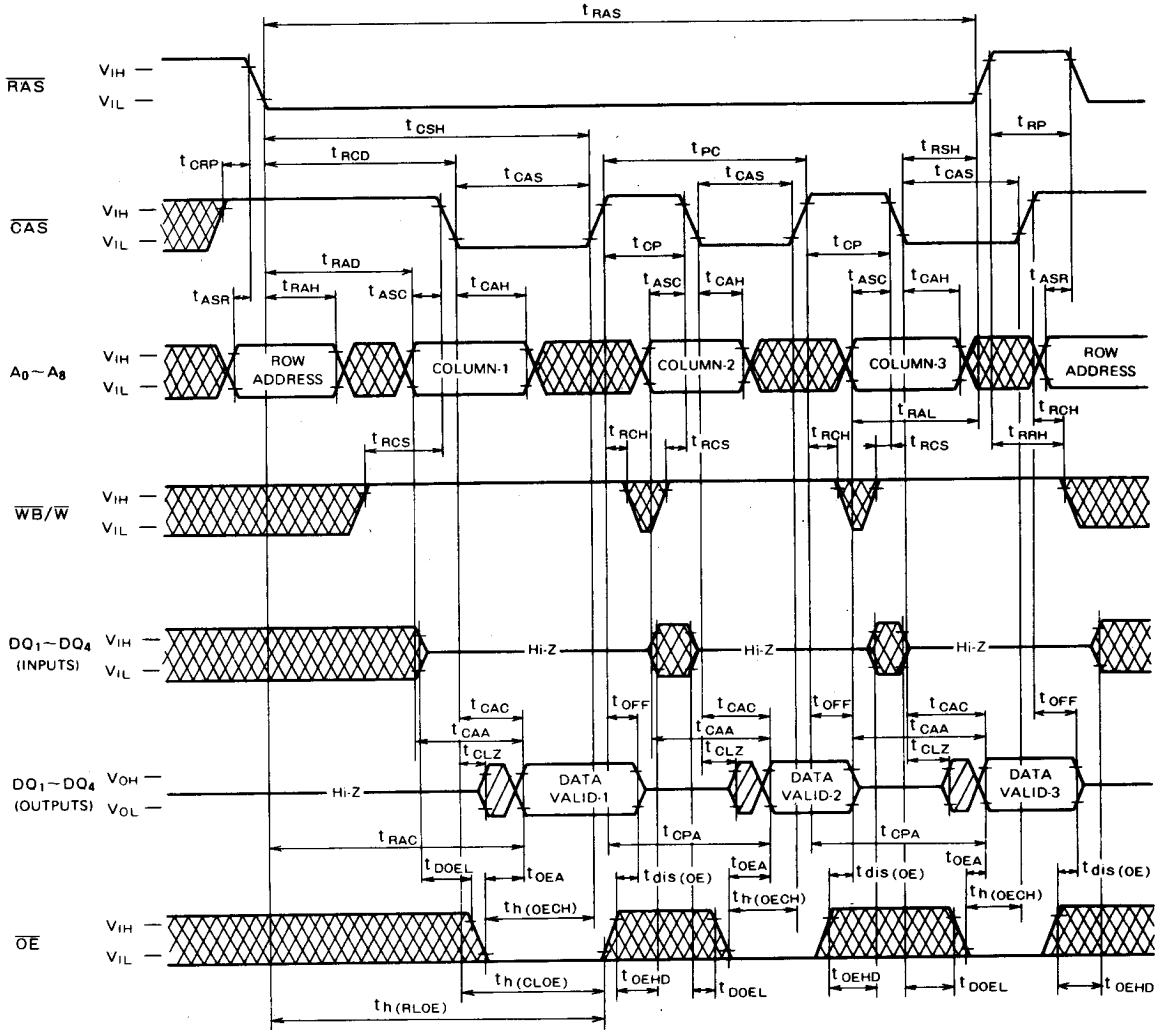
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$\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Refresh Cycle



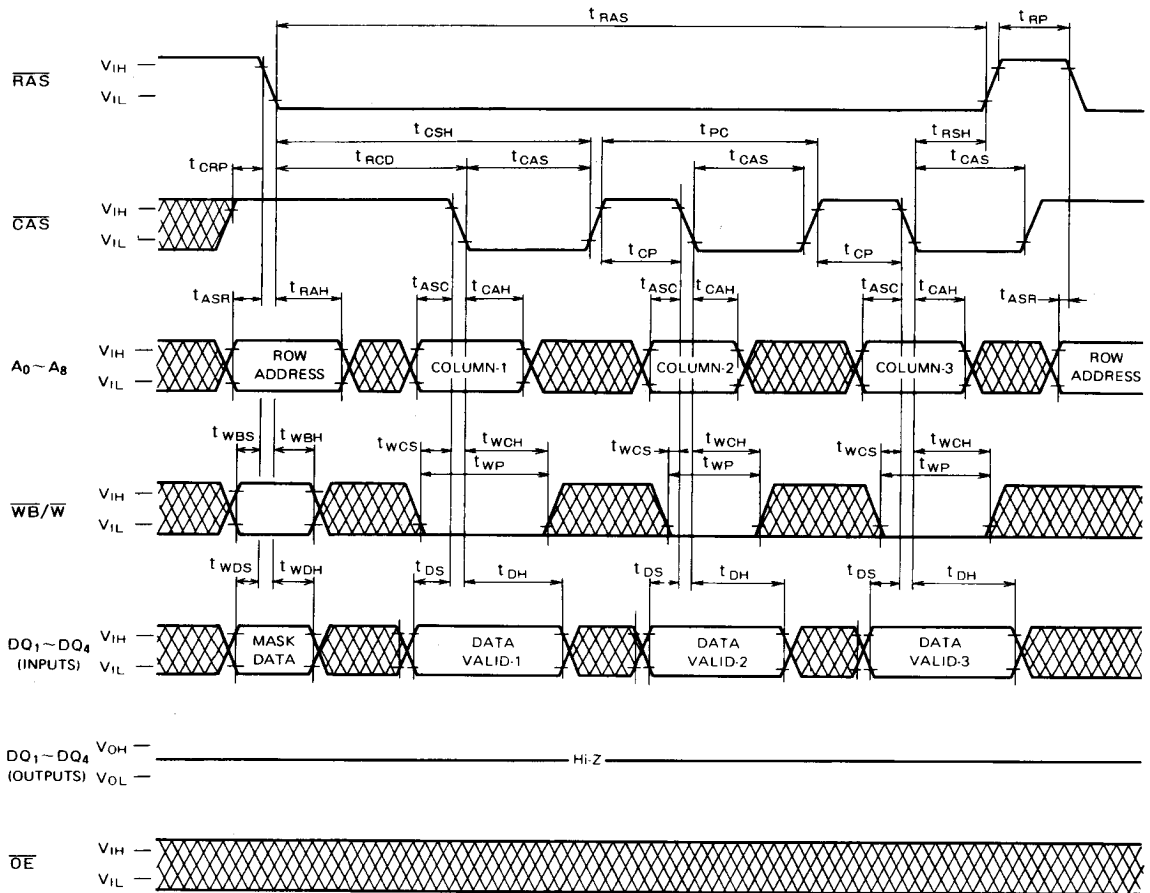
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Fast Page Mode Read Cycle



FAST PAGE MODE 1048576-BIT(262144-WORD BY 4-BIT)DYNAMIC RAM

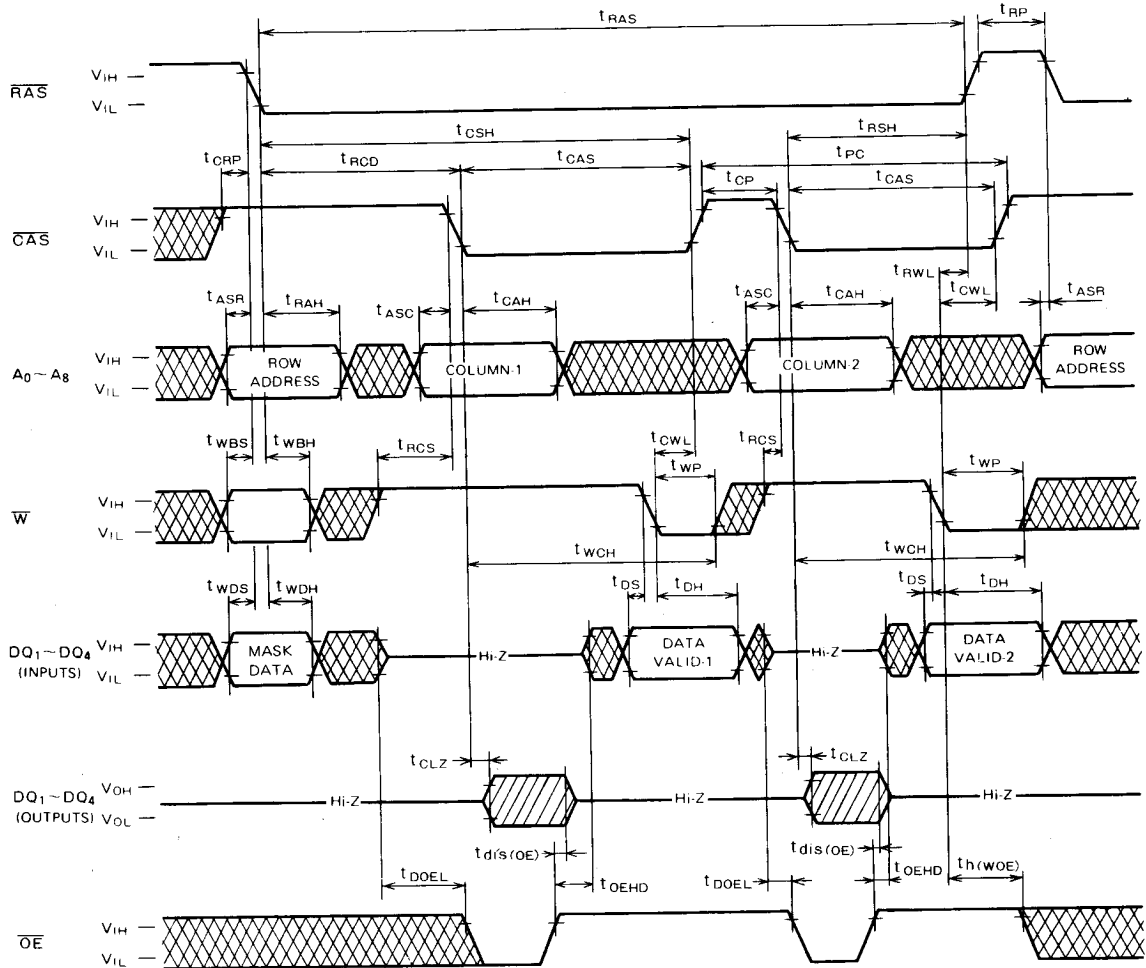
Fast Page Mode Early Write Cycle (Note 27)



Note 27: It is impossible to change the selected bits of write per bit mode during page mode cycle.

FAST PAGE MODE 1048576-BIT (262144-WORD BY 4-BIT) DYNAMIC RAM

Fast Page Mode Delayed Write Cycle (Note 27)



FAST PAGE MODE 1048576-BIT(262144-WORD BY 4-BIT)DYNAMIC RAM

Fast Page Mode Read-Write, Read-Modify-Write Cycle (Note 27)

