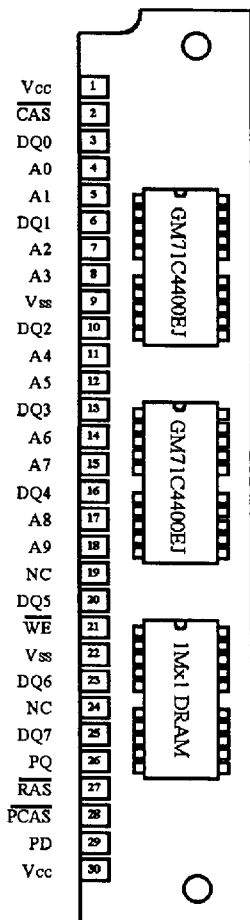


Description

The GMM791000ENS is an 1M x 9 bits Dynamic RAM Module which is assembled 2 pieces of 4M bit DRAM (GM71C4400EJ, 1M x4) sealed in 20 pin SOJ package and 1Mx1 DRAM in 20 pin SOJ package. The GMM791000ENS is a socket type memory module, suitable for easy change or addition of module. The GMM791000ENS provides common data inputs and outputs, and also provides separate I/O on parity bit for parity check. It's module board has decoupling capacitors mounted for each DRAM.

• **GMM791000ENS (Single Side)**



Features

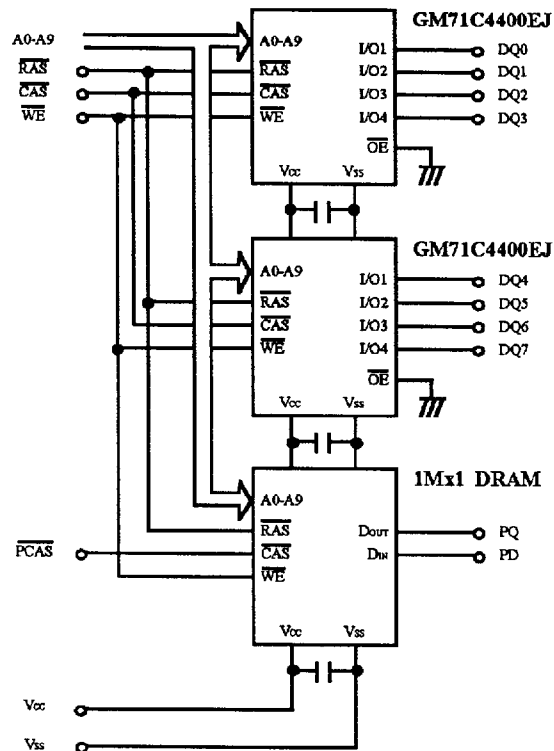
- High Density Standard 30 pin mounting 2 pcs of 4M DRAM and an 1M DRAM
- Fast Page Mode Capability
- Single Power Supply
- Fast Access Time & Cycle Time

(Unit: ns)

	t _{TRAC}	t _{CAC}	t _{RC}	t _{PC}
GMM791000ENS-60	60	20	120	45
GMM791000ENS-70	70	20	130	50
GMM791000ENS-80	80	25	160	55

- Low Power
Active : 1,705/1,540/1,375mW (MAX)
Standby : 16.5mW (CMOS level : MAX)
- RAS Only Refresh, CAS before RAS Refresh, Hidden Refresh Capability
- All inputs and outputs TTL Compatible
- 1024 Refresh Cycles/16ms

Block Diagram



Pin Description

Pin	Function	Pin	Function
A0-A9	Address Inputs	\overline{WE}	Read/Write Enable
DQ0-DQ7	Data Input/Output	PD	Data in for Parity
\overline{RAS}	Row Address Strobe	PQ	Data out for Parity
\overline{CAS}	Column Address Strobe	Vcc	Power (+5V)
\overline{PCAS}	\overline{CAS} for Parity	Vss	Ground
NC	No Connection		

- *Note: 1. Common CAS controls for eight common data-in and data-out lines.
 2. The common controls for one separate pair of data-in and data-out lines.
 3. The common I/O feature dictates the use of only early write operations to prevent contention on data-in and data-out.

Absolute Maximum Ratings*

Symbol	Parameter	Rating	Unit
T _A	Ambient Temperature under Bias	0 ~ 70	°C
T _{STG}	Storage Temperature (Plastic)	-55 ~ 125	°C
V _{IN} /V _{OUT}	Voltage on any Pin Relative to V _{SS}	-1.0 ~ 7.0	V
V _{CC}	Power Supply Voltage	-1.0 ~ 7.0	V
I _{OUT}	Short Circuit Output Current	50	mA
P _D	Power Dissipation	3.0	W

- *Note: 1. Stress greater than above "Absolute Maximum Ratings" may cause permanent damage to the device.

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

Symbol	Parameter	Min	Typ	Max	Unit	Note
V _{CC}	Supply Voltage	4.5	5.0	5.5	V	1
V _{IH}	Input High Voltage	2.4	-	6.5	V	1
V _{IL}	Input Low Voltage	-1.0	-	0.8	V	1

- *Note: 1. All voltages referenced to V_{SS}.

DC Electrical Characteristics ($V_{CC} = 5V \pm 10\%$, $T_A = 0 \sim 70^\circ C$)

Symbol	Parameter	Min	Max	Unit	Note	
V_{OH}	Output Level Output "H" Level Voltage ($I_{OUT} = -5mA$)	2.4	V_{CC}	V		
V_{OL}	Output Level Output "L" Level Voltage ($I_{OUT} = 4.2mA$)	0	0.4	V		
I_{CC1}	Operating Current Average Power Supply Operating Current (\overline{RAS} , \overline{CAS} , Address Cycling: $t_{RC} = t_{RC\ min}$)	60 ns	-	310	mA	1, 2
		70 ns	-	280		
		80 ns	-	250		
I_{CC2}	Standby Current (TTL) Power Supply Standby Current (\overline{RAS} , $\overline{CAS} = V_{IH}$)	-	6	mA		
I_{CC3}	\overline{RAS} Only Refresh Current Average Power Supply Current \overline{RAS} Only Mode (\overline{RAS} Cycling, $\overline{CAS} = V_{IH}$, $t_{RC} = t_{RC\ min}$)	60 ns	-	310	mA	2
		70 ns	-	280		
		80 ns	-	240		
I_{CC4}	Fast Page Mode Current Average Power Supply Current Fast Page Mode ($\overline{RAS} = V_{IL}$, \overline{CAS} , Address Cycling : $t_{RC} = t_{RC\ min}$)	60 ns	-	300	mA	1, 3
		70 ns	-	270		
		80 ns	-	230		
I_{CC5}	Standby Current (CMOS) Power Supply Standby Current (\overline{RAS} , $\overline{CAS} \geq V_{CC} - 0.2V$)	-	3	mA		
I_{CC6}	\overline{CAS} before \overline{RAS} Refresh Current ($t_{RC} = t_{RC\ min}$)	60 ns	-	300	mA	
		70 ns	-	270		
		80 ns	-	240		
I_{CC7}	Standby Current $\overline{RAS} = V_{IH}$ $\overline{CAS} = V_{IL}$ $D_{OUT} = \text{Enable}$	-	15	mA	1	
I_{IL}	Input Leakage Current Any Input ($0V \leq V_{IN} \leq 7V$) All Other Pins Not Under Test = 0V	PD, \overline{PCAS}	-10	10	μA	
		ADDR, \overline{RAS} , \overline{CAS} , \overline{WE}	-30	30		
I_{OL}	Output Leakage Current (D_{OUT} is Disabled, $0V \leq V_{OUT} \leq 7V$)	-10	10	μA		

Note: 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 ($V_{CC} = 5V \pm 10\%$, $T_A = 25^\circ C$, $f = 1MHz$)

Symbol	Parameter	Min	Max	Unit	Note
C_{I1}	Input Capacitance (Address)	-	25	pF	1
C_{I2}	Input Capacitance (Clocks)	-	25	pF	1, 2
C_{I3}	Input Capacitance (PD)	-	10	pF	1
$C_{I/O}$	I/O Capacitance (DQ0~DQ7)	-	15	pF	1, 2
C_O	Output Capacitance (PQ)	-	10	pF	1, 2

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

AC Electrical Characteristics ($V_{CC} = 5V \pm 10\%$, $T_A = 0 \sim 70^\circ C$, Notes 1, 14)

The GMM791000ENS writes data only in early write cycle ($twcs \geq twcs(\min)$).
 Delayed write cycle is not available because of I/O common.

Read, Write and Refresh Cycle (Common Parameters)

Symbol	Parameter	GMM791000 ENS-60		GMM791000 ENS-70		GMM791000 ENS-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RC}	Random Read or Write Cycle Time	120	-	130	-	160	-	ns	
t_{RP}	\overline{RAS} Precharge Time	50	-	50	-	70	-	ns	
t_{RAS}	\overline{RAS} Pulse Width	60	10,000	70	10,000	80	10,000	ns	
t_{CAS}	\overline{CAS} Pulse Width	20	10,000	20	10,000	25	10,000	ns	
t_{ASR}	Row Address Setup Time	0	-	0	-	0	-	ns	
t_{RAH}	Row Address Hold Time	10	-	10	-	12	-	ns	
t_{ASC}	Column Address Setup Time	0	-	0	-	0	-	ns	
t_{CAH}	Column Address Hold Time	15	-	15	-	20	-	ns	
t_{RCD}	\overline{RAS} to \overline{CAS} Delay Time	20	40	20	50	22	55	ns	8
t_{RAD}	\overline{RAS} to Column Address Delay Time	15	30	15	35	17	40	ns	9
t_{RSH}	\overline{RAS} Hold Time	20	-	20	-	25	-	ns	
t_{CSH}	\overline{CAS} Hold Time	60	-	70	-	80	-	ns	
t_{CRP}	\overline{CAS} to \overline{RAS} Precharge Time	10	-	10	-	10	-	ns	
t_T	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	7
t_{REF}	Refresh Period (1024 Cycles)	-	16	-	16	-	16	ms	

Read Cycle

Symbol	Parameter	GMM791000 ENS-60		GMM791000 ENS-70		GMM791000 ENS-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{RAC}	Access Time from $\overline{\text{RAS}}$	-	60	-	70	-	80	ns	2, 3
t _{CAC}	Access Time from $\overline{\text{CAS}}$	-	20	-	20	-	25	ns	3, 4
t _{AA}	Access Time from Column Address	-	30	-	35	-	40	ns	3, 5
t _{RCS}	Read Command Setup Time	0	-	0	-	0	-	ns	
t _{RCH}	Read Command Hold Time to $\overline{\text{CAS}}$	0	-	0	-	0	-	ns	
t _{RRH}	Read Command Hold Time to $\overline{\text{RAS}}$	10	-	10	-	10	-	ns	
t _{RAL}	Column Address to $\overline{\text{RAS}}$ Lead Time	30	-	35	-	40	-	ns	
t _{OFF}	Output Buffer Turn-off Time	0	20	0	20	0	20	ns	6

Write Cycle

Symbol	Parameter	GMM791000 ENS-60		GMM791000 ENS-70		GMM791000 ENS-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{WCS}	Write Command Setup Time	0	-	0	-	0	-	ns	10
t _{WCH}	Write Command Hold Time	15	-	15	-	20	-	ns	
t _{WP}	Write Command Pulse Width	10	-	10	-	10	-	ns	
t _{RWL}	Write Command to $\overline{\text{RAS}}$ Lead Time	20	-	20	-	25	-	ns	
t _{CWL}	Write Command to $\overline{\text{CAS}}$ Lead Time	20	-	20	-	25	-	ns	
t _{DS}	Data-in Setup Time	0	-	0	-	0	-	ns	11
t _{DH}	Data-in Hold Time	15	-	15	-	20	-	ns	11

Refresh Cycle

Symbol	Parameter	GMM791000 ENS-60		GMM791000 ENS-70		GMM791000 ENS-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{CSR}	$\overline{\text{CAS}}$ Setup Time ($\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle)	10	-	10	-	10	-	ns	
t _{CHR}	$\overline{\text{CAS}}$ Hold Time ($\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle)	15	-	15	-	20	-	ns	
t _{RPC}	$\overline{\text{RAS}}$ Precharge to $\overline{\text{CAS}}$ Hold Time	10	-	10	-	10	-	ns	
t _{CPN}	$\overline{\text{CAS}}$ Precharge Time in Normal Mode	10	-	10	-	10	-	ns	

Fast Page Mode Cycle

Symbol	Parameter	GMM791000 ENS-60		GMM791000 ENS-70		GMM791000 ENS-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{PC}	Fast Page Mode Cycle Time	45	-	50	-	55	-	ns	
t _{CP}	Fast Page Mode $\overline{\text{CAS}}$ Precharge Time	10	-	10	-	10	-	ns	
t _{RASP}	Fast Page Mode $\overline{\text{RAS}}$ Pulse Width	-	100,000	-	100,000	-	100,000	ns	12
t _{ACP}	Access Time from $\overline{\text{CAS}}$ Precharge	-	40	-	45	-	50	ns	13
t _{RHCP}	$\overline{\text{RAS}}$ Hold Time from $\overline{\text{CAS}}$ Precharge	40	-	45	-	50	-	ns	

Notes:

1. AC measurements assume $t_r = 5 \text{ ns}$.
2. Assumes that $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$ and $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$. If t_{RCD} or t_{RAD} is greater than the maximum recommended value shown in this table, t_{RAC} exceeds the value shown.
3. Measured with a load circuit equivalent to 2TTL loads and 100pF.
4. Assumes that $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{max})$ and $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$.
5. Assumes that $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$ and $t_{\text{RAD}} \geq t_{\text{RAD}}(\text{max})$.
6. $t_{\text{OFF}}(\text{max})$ defines the time at which the outputs achieve the open circuit condition and is not referenced to output voltage levels.
7. $V_{\text{IH}}(\text{min})$ and $V_{\text{IL}}(\text{max})$ are reference levels for measuring timing of input signals. Also, transition times are measured between V_{IH} and V_{IL} .
8. Operation with the $t_{\text{RCD}}(\text{max})$ limit insures that $t_{\text{RAC}}(\text{max})$ can be met, $t_{\text{RCD}}(\text{max})$ is specified as a reference point only, if t_{RCD} is greater than the specified $t_{\text{RCD}}(\text{max})$ limit, then access time is controlled exclusively by t_{CAC} .
9. Operation with the $t_{\text{RAD}}(\text{max})$ limit insures that $t_{\text{RAC}}(\text{max})$ can be met, $t_{\text{RAD}}(\text{max})$ is specified as a reference point only, if t_{RAD} is greater than the specified $t_{\text{RAD}}(\text{max})$ limit, then access time is controlled exclusively by t_{AA} .
10. t_{WCS} is not restrictive operating parameter. It is included in the data sheet as electrical characteristics only. If $t_{\text{WCS}} \geq t_{\text{WCS}}(\text{min})$, the cycle is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle.
11. These parameters are referenced to $\overline{\text{CAS}}$ leading edge in early write cycles.
12. t_{RASP} is defines $\overline{\text{RAS}}$ pulse width in Fast Page Mode cycles.
13. Access time is determined by the longer of t_{AA} or t_{CAC} or t_{ACP} .
14. An initial pause of 100 μs is required after power up followed by a minimum of eight initialization cycles (any combination of cycles containing $\overline{\text{RAS}}$ clock such as $\overline{\text{RAS}}$ only refresh). If the internal refresh counter is used, a minimum of eight $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycles are required.

Timing Waveforms

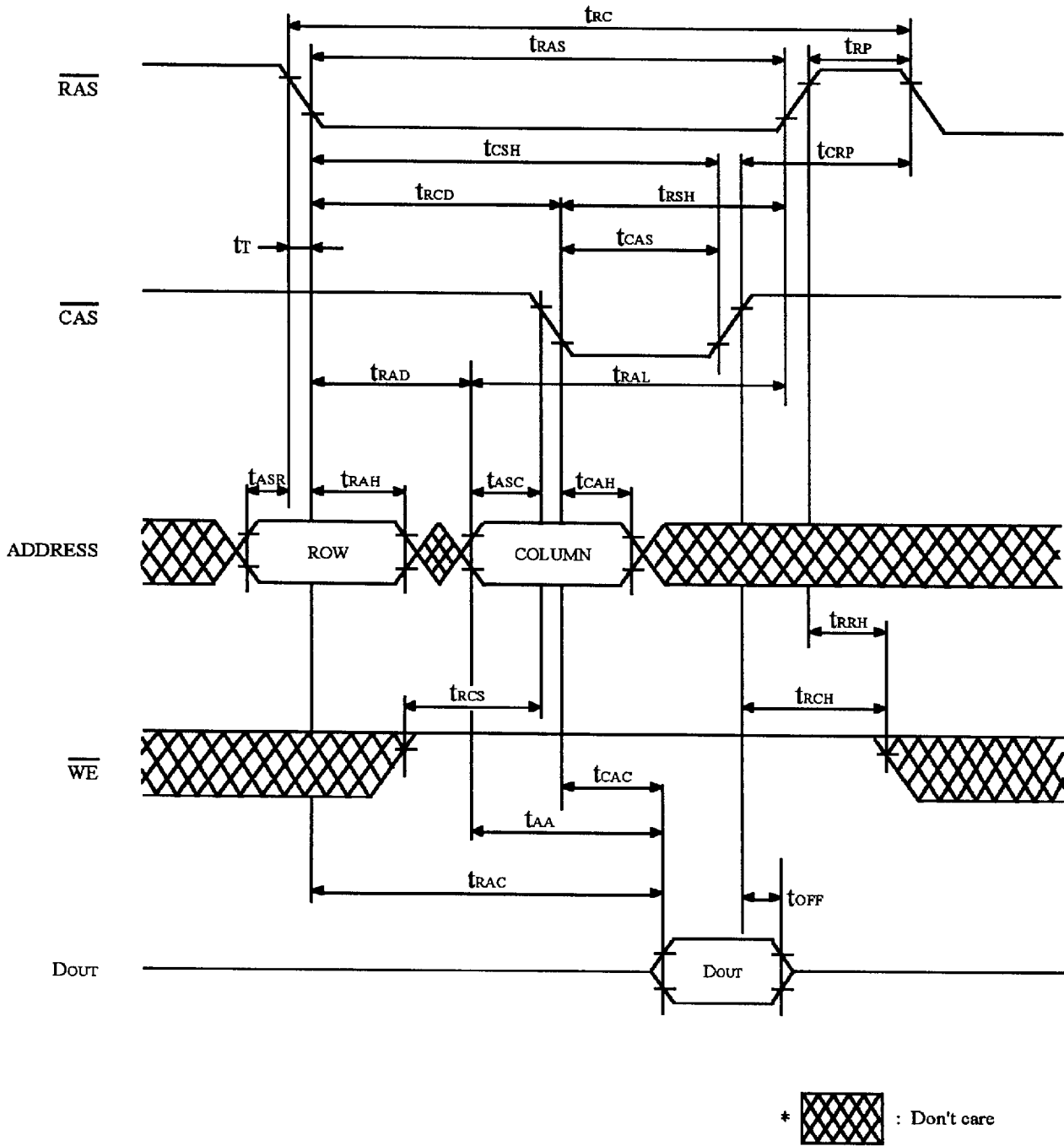
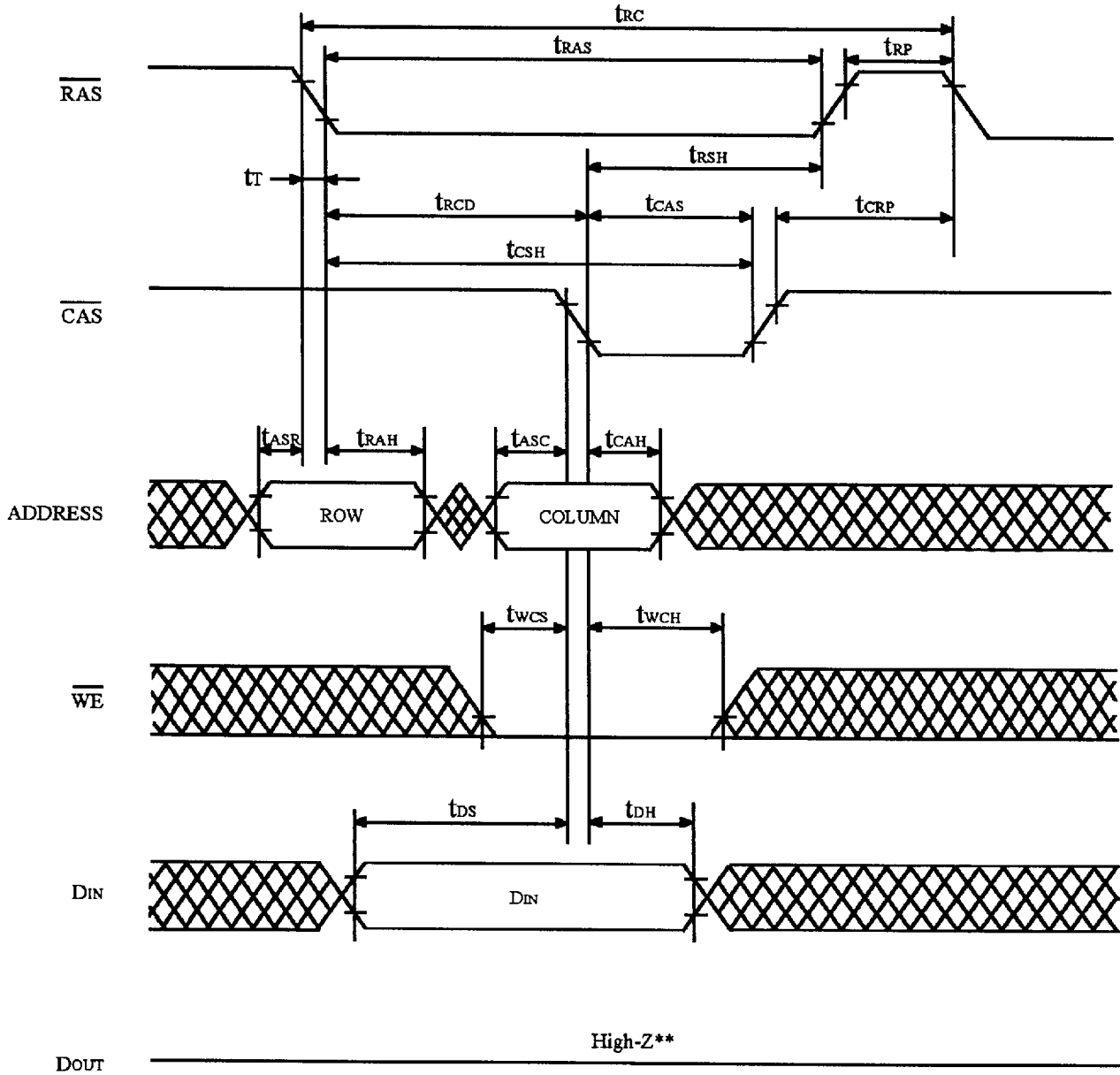



FIGURE 1. READ CYCLE



*  : Don't care

** $t_{wcs} \geq t_{wcs}(\text{min})$

FIGURE 2. EARLY WRITE CYCLE

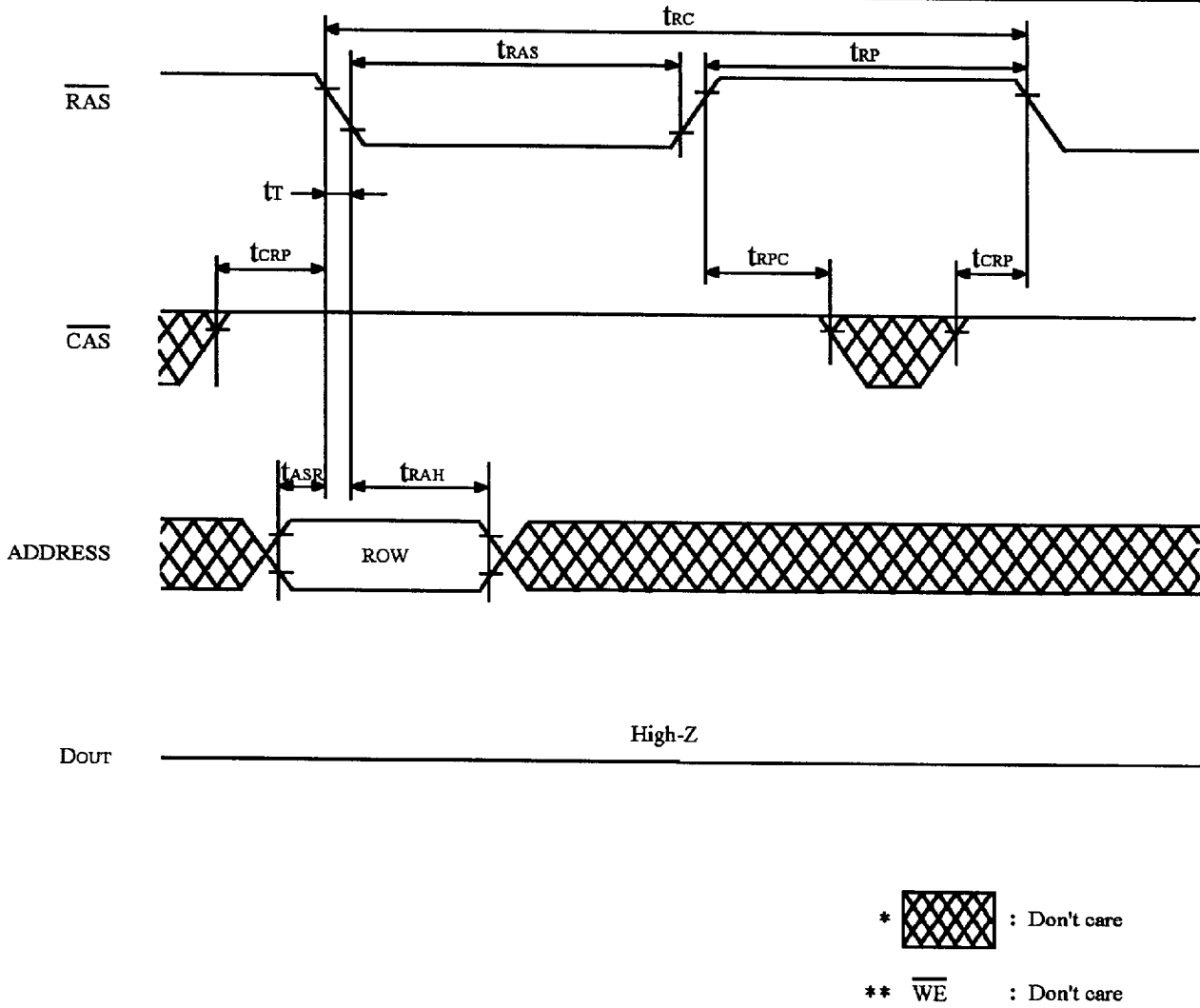
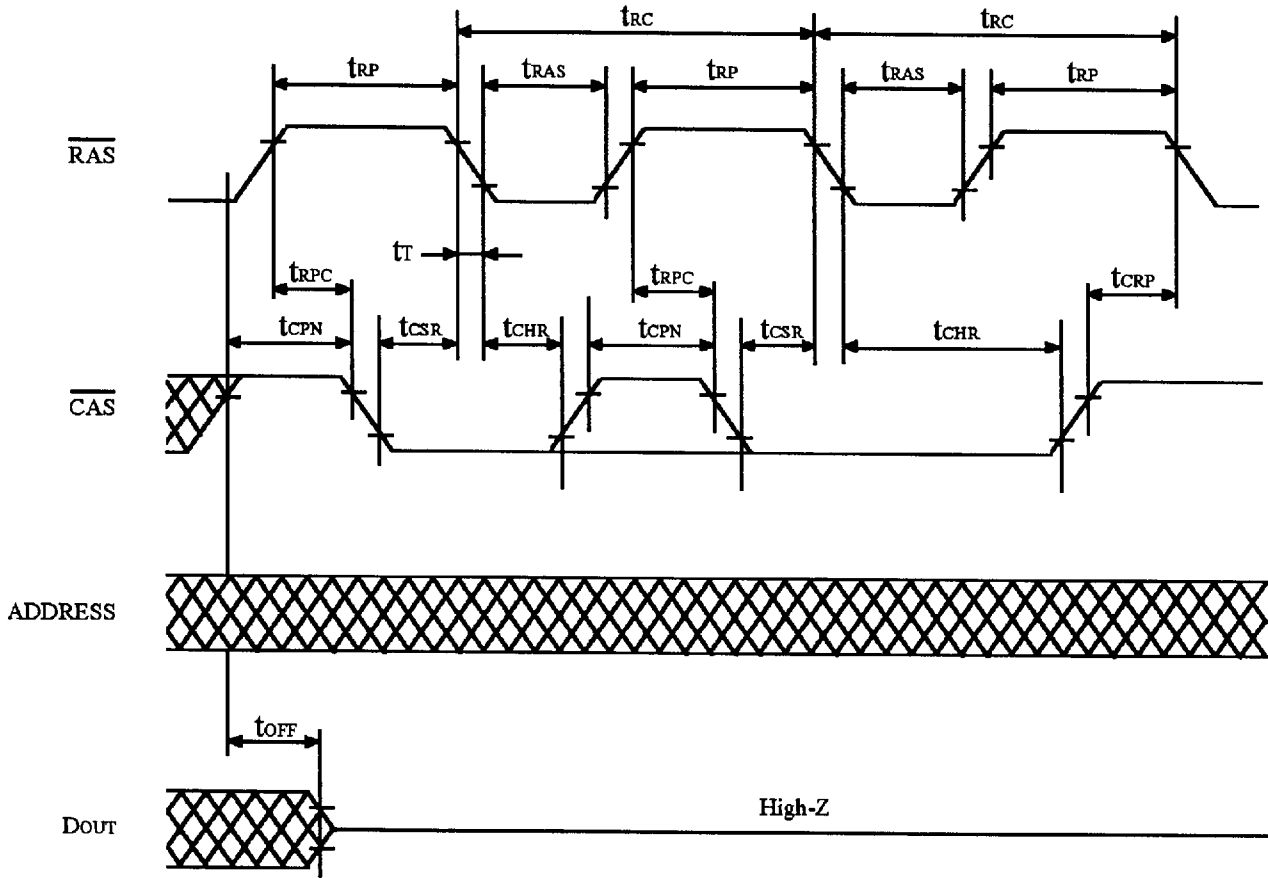



FIGURE 3. $\overline{\text{RAS}}$ ONLY REFRESH CYCLE



*  : Don't care

* * \overline{WE} : V_{IH}

FIGURE 4. \overline{CAS} BEFORE \overline{RAS} REFRESH CYCLE

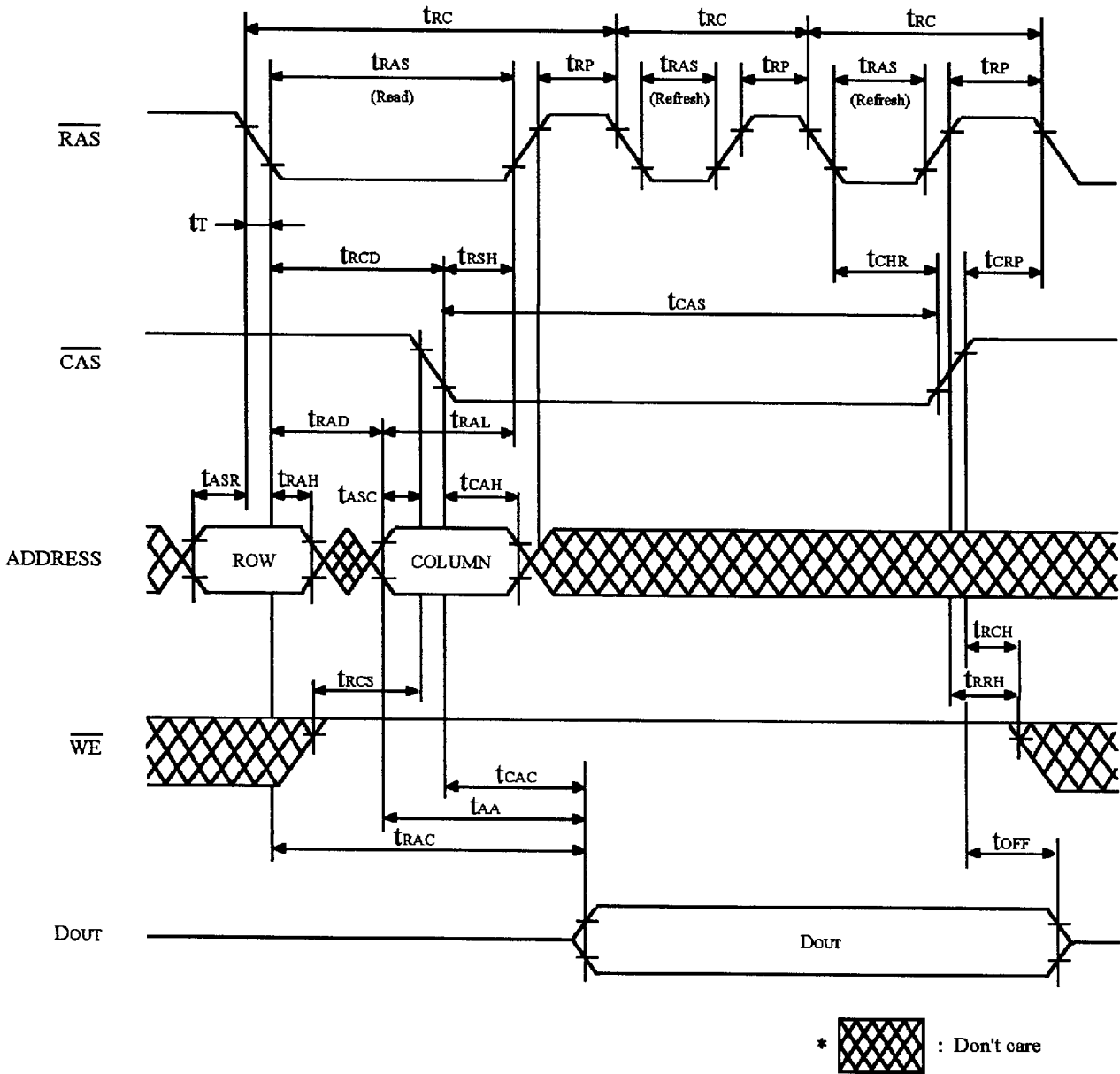


FIGURE 5. HIDDEN REFRESH CYCLE

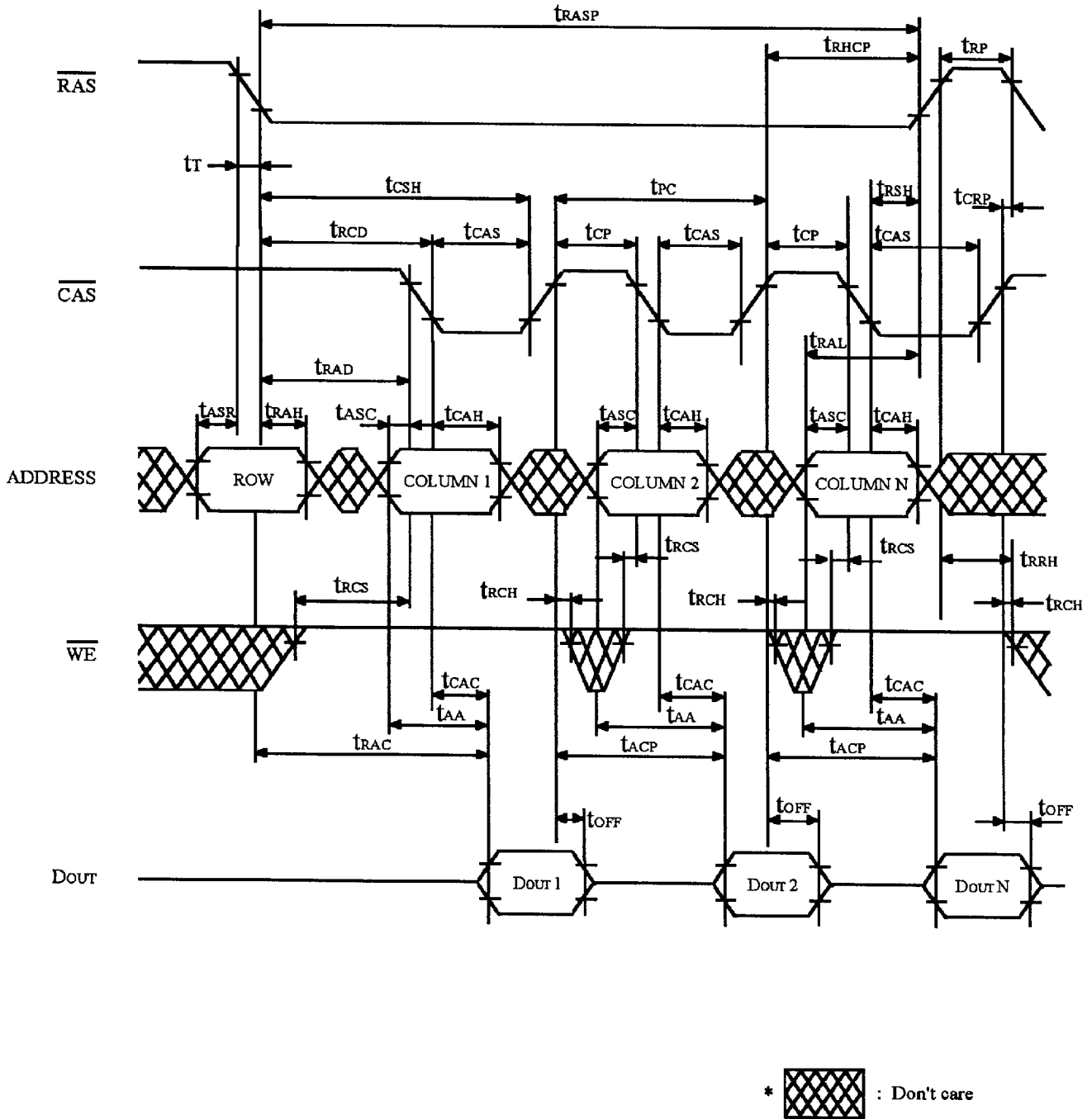


FIGURE 6. FAST PAGE MODE READ CYCLE

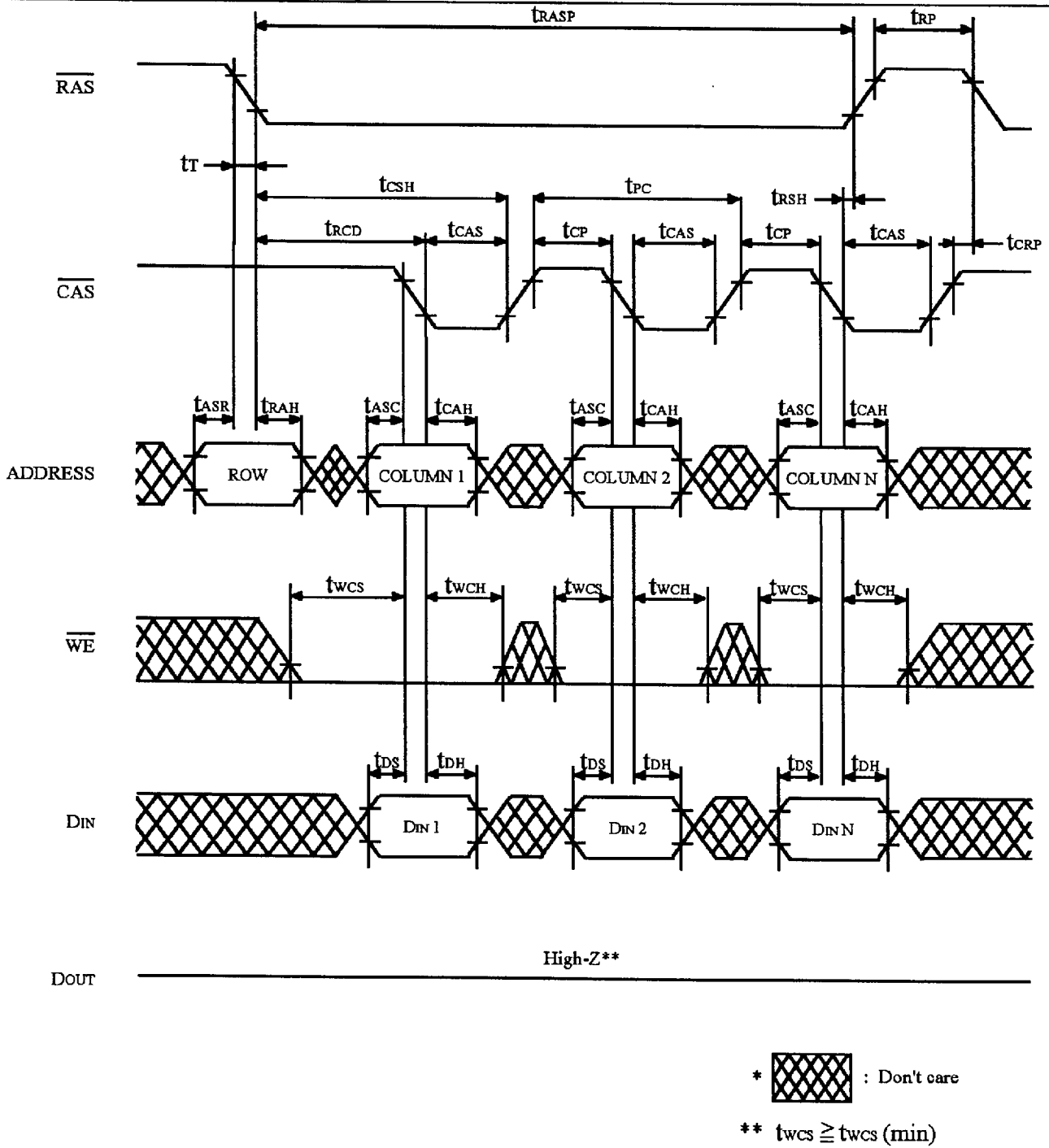


FIGURE 7. FAST PAGE MODE EARLY WRITE CYCLE

Package Dimension

Unit: inches (mm)

