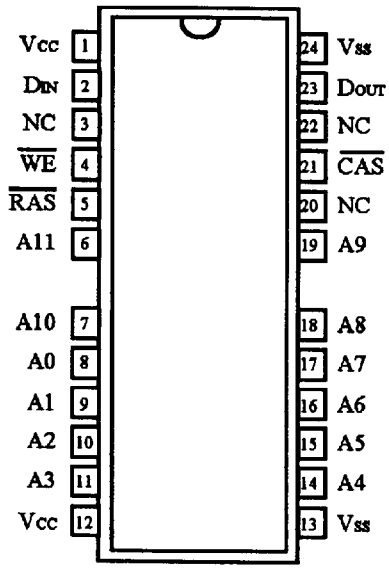
Description

The GM71C16100A is the new generation dynamic RAM organized 16,777,216 x 1 Bit. GM71C16100A has realized higher density, higher performance and various functions by utilizing advanced CMOS process technology. The GM71C16100A offers Fast Page Mode as a high speed access mode. Multiplexed address inputs permit the GM71C16100A to be packaged in a standard 300 mil 24 pin SOJ. The package size provides high system bit densities and is compatible with widely available automated testing and insertion equipment. System oriented features include sigle power supply 5V±10% tolerance, direct interfacing capability with high performance logic families such as Schottky TTL.

Pin Configuration

24 (26) SOJ



(Top View)

Features

- 16,777,216 Words x 1 Bit
- Fast Page Mode Capability
- Single Power Supply (5V ± 10%)
- Fast Access Time & Cycle Time

(Unit: ns)

	t_{RAC}	t_{CAC}	t_{RC}	t_{PC}
GM71C16100A-6	60	15	110	40
GM71C16100A-7	70	18	130	45
GM71C16100A-8	80	20	150	50

- Low Power
  Active : 440/385/358mW (MAX)
  Standby : 5.5mW (CMOS level : MAX)
- $\overline{RAS}$ Only Refresh, $\overline{CAS}$ before $\overline{RAS}$ Refresh, Hidden Refresh Capability
- All inputs and outputs TTL Compatible
- 4096 Refresh Cycles/64㎳
- Test function : 16-bit parallel test mode

Pin Description

Pin	Function	Pin	Function
A0-A11	Address Inputs	$\overline{WE}$	Read/Write Enable
A0-A11	Refresh Address Inputs	D_{OUT}	Data Output
D_{IN}	Data Input	V_{CC}	Power (+5V)
$\overline{RAS}$	Row Address Strobe	V_{SS}	Ground
$\overline{CAS}$	Column Address Strobe	NC	No Connection

Ordering Information

Type No.	Access Time	Package
GM71C16100AJ-6 GM71C16100AJ-7 GM71C16100AJ-8	60ns 70ns 80ns	300 Mil 24 (26) Pin Plastic SOJ
GM71C16100AT-6 GM71C16100AT-7 GM71C16100AT-8	60ns 70ns 80ns	300 Mil 24 (26) Pin Plastic TSOP II (Normal Type)
GM71C16100AR-6 GM71C16100AR-7 GM71C16100AR-8	60ns 70ns 80ns	300 Mil 24 (26) Pin Plastic TSOP II (Reverse Type)

Absolute Maximum Ratings*

Symbol	Parameter	Rating	Unit
T_A	Ambient Temperature under Bias	0 ~ 70	℃
T_{STG}	Storage Temperature (Plastic)	-55 ~ 125	℃
V_{IN}/V_{OUT}	Voltage on any Pin Relative to V_{SS}	-1.0 ~ 7.0	V
V_{CC}	Voltage on V_{CC} Relative to V_{SS}	-1.0 ~ 7.0	V
I_{OUT}	Short Circuit Output Current	50	mA
P_D	Power Dissipation	1.0	W

*Note: Operation at or above Absolute Maximum Ratings can adversely affect device reliability.

Recommended DC Operating Conditions (T_A = 0 ~ 70℃)

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

DC Electrical Characteristics (V_{CC} = 5V ± 10%, T_A = 0 ~ 70℃)

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 ($\overline{RAS}$, $\overline{CAS}$ Cycling: t_{RC} = t_{RC} min)	60ns	-	80	mA	1, 2
		70ns	-	70		
		80ns	-	65		
I_{CC2}	Standby Current (TTL) Power Supply Standby Current ($\overline{RAS}$, $\overline{CAS}$ = V_{IH}, D_{OUT} = High-Z)		-	2	mA	
I_{CC3}	$\overline{RAS}$-Only Refresh Current Average Power Supply Current $\overline{RAS}$-Only Refresh Mode ($\overline{RAS}$ Cycling, $\overline{CAS}$ = V_{IH}, t_{RC} = t_{RC} min)	60ns	-	80	mA	2
		70ns	-	70		
		80ns	-	65		
I_{CC4}	Fast Page Mode Current Average Power Supply Current Fast Page Mode ($\overline{RAS}$ = V_{IL}, $\overline{CAS}$, Address Cycling: t_{PC} = t_{PC} min)	60ns	-	70	mA	1, 3
		70ns	-	60		
		80ns	-	50		
I_{CC5}	Standby Current (CMOS) Power Supply Standby Current ($\overline{RAS}$, $\overline{CAS}$ ≥ V_{CC}-0.2V, D_{OUT} = High-Z)		-	1	mA	
I_{CC6}	$\overline{CAS}$-before-$\overline{RAS}$ Refresh Current (t_{RC} = t_{RC} min)	60ns	-	80	mA	
		70ns	-	70		
		80ns	-	65		
I_{CC7}	Standby Current $\overline{RAS}$ = V_{IH} $\overline{CAS}$ = V_{IL} D_{OUT} = Enable		-	5	mA	1
$I_{I(L)}$	Input Leakage Current Any Input (0V ≤ V_{IN} ≤ 7V)		-10	10	μA	
$I_{O(L)}$	Output Leakage Current (D_{OUT} is Disabled, 0V ≤ V_{OUT} ≤ 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 ($V_{CC} = 5V \pm 10\%$, $T_A = 25℃$)

Symbol	Parameter	Min	Max	Unit	Note
C_{I1}	Input Capacitance (Address)	-	5	pF	1
C_{I2}	Input Capacitance (Clocks)	-	7	pF	1
C_O	Output Capacitance (Data-Out)	-	7	pF	1, 2

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

AC Characteristics ($V_{CC} = 5V \pm 10\%$, $T_A = 0 \sim 70℃$, Notes 1, 2, 17)

Test Conditions

Input rise and fall times: 5ns
Input, output timing reference levels: 0.8V, 2.4V
Output load : 2 TTL gate + C_L (100pF) (Including scope and jig)

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

Symbol	Parameter	GM71C16100A-6		GM71C16100A-7		GM71C16100A-8		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RC}	Random Read or Write Cycle Time	110	-	130	-	150	-	ns	
t_{RP}	$\overline{RAS}$ Precharge Time	40	-	50	-	60	-	ns	
t_{CP}	$\overline{CAS}$ Precharge Time	10	-	10	-	10	-	ns	
t_{RAS}	$\overline{RAS}$ Pulse Width	60	10,000	70	10,000	80	10,000	ns	
t_{CAS}	$\overline{CAS}$ Pulse Width	15	10,000	18	10,000	20	10,000	ns	
t_{ASR}	Row Address Setup Time	0	-	0	-	0	-	ns	
t_{RAH}	Row Address Hold Time	10	-	10	-	10	-	ns	
t_{ASC}	Colimn Address Setup Time	0	-	0	-	0	-	ns	
t_{CAH}	Colimn Address Hold Time	10	-	15	-	15	-	ns	
t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	20	45	20	52	20	60	ns	3
t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	15	30	15	35	15	40	ns	4
t_{RSH}	$\overline{RAS}$ Hold Time	15	-	18	-	20	-	ns	
t_{CSH}	$\overline{CAS}$ Hold Time	60	-	70	-	80	-	ns	
t_{CRP}	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5	-	5	-	5	-	ns	
t_T	TransitionTime (Rise and Fall)	3	50	3	50	3	50	ns	5
t_{REF}	Refresh Period (4096 Cycles)	-	64	-	64	-	64	ms	

Read Cycle

Symbol	Parameter	GM71C16100A-6		GM71C16100A-7		GM71C16100A-8		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RAC}	Access Time from $\overline{RAS}$	-	60	-	70	-	80	ns	6,7,16
t_{CAC}	Access Time from $\overline{CAS}$	-	15	-	18	-	20	ns	7,8 15,16
t_{AA}	Access Time from Address	-	30	-	35	-	40	ns	7,8 15,16
t_{RCS}	Read Command Setup Time	0	-	0	-	0	-	ns	
t_{RCH}	Read Command Hold Time to $\overline{CAS}$	0	-	0	-	0	-	ns	10
t_{RRH}	Read Command Hold Time to $\overline{RAS}$	0	-	0	-	0	-	ns	10
t_{RAL}	Column Address to $\overline{RAS}$ Lead Time	30	-	35	-	40	-	ns	
t_{CAL}	Column Address to $\overline{CAS}$ Lead Time	30	-	35	-	40	-	ns	
t_{CLZ}	$\overline{CAS}$ to Output in low-Z	0	-	0	-	0	-	ns	
t_{OH}	Output Data Hold Time	3	-	3	-	3	-	ns	
t_{OFF}	Output Buffer Turn-off Time	-	15	-	15	-	15	ns	11

Write Cycle

Symbol	Parameter	GM71C16100A-6		GM71C16100A-7		GM71C16100A-8		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{WCS}	Write Command Setup Time	0	-	0	-	0	-	ns	12
t_{WCH}	Write Command Hold Time	10	-	15	-	15	-	ns	
t_{WP}	Write Command Pulse Width	10	-	10	-	10	-	ns	
t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	15	-	18	-	20	-	ns	
t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	15	-	18	-	20	-	ns	
t_{DS}	Data-in Setup Time	0	-	0	-	0	-	ns	13
t_{DH}	Data-in Hold Time	10	-	15	-	15	-	ns	13

Read- Modify-Write Cycle

Symbol	Parameter	GM71C16100A-6		GM71C16100A-7		GM71C16100A-8		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RWC}	Read-Modify-Write Cycle Time	130	-	153	-	175	-	ns	
t_{RWD}	$\overline{RAS}$ to $\overline{WE}$ Delay Time	60	-	70	-	80	-	ns	12
t_{CWD}	$\overline{CAS}$ to $\overline{WE}$ Delay Time	15	-	18	-	20	-	ns	12
t_{AWD}	Column Address to $\overline{WE}$ Delay Time	30	-	35	-	40	-	ns	12

Refresh Cycle

Symbol	Parameter	GM71C16100A-6		GM71C16100A-7		GM71C16100A-8		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{CSR}	$\overline{CAS}$ Set-up Time ($\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle)	5	-	5	-	5	-	ns	
t_{CHR}	$\overline{CAS}$ Hold Time ($\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle)	10	-	10	-	10	-	ns	
t_{RPC}	$\overline{RAS}$ Precharge to $\overline{CAS}$ Hold Time	0	-	0	-	0	-	ns	
t_{WRP}	$\overline{WE}$ Set-up Time ($\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle)	0	-	0	-	0	-	ns	
t_{WRH}	$\overline{WE}$ Hold Time ($\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle)	10	-	10	-	10	-	ns	

Fast Page Mode Cycle

Symbol	Parameter	GM71C16100A-6		GM71C16100A-7		GM71C16100A-8		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{PC}	Fast Page Mode Cycle Time	40	-	45	-	50	-	ns	
t_{RASC}	Fast Page Mode $\overline{RAS}$ Pulse Width	-	100,000	-	100,000	-	100,000	ns	14
t_{ACP}	Access Time from $\overline{CAS}$ Precharge	-	35	-	40	-	45	ns	7,15,16
t_{RHCP}	$\overline{RAS}$ Hold Time from $\overline{CAS}$ Precharge	35	-	40	-	45	-	ns	
t_{CPW}	$\overline{WE}$ Delay Time from $\overline{CAS}$ Precharge	35	-	40	-	45	-	ns	12
t_{PRWC}	Fast Page Mode Read-Modify-Write Cycle Time	60	-	68	-	75	-	ns	

Test Mode Cycle

Symbol	Parameter	GM71C16100A-6		GM71C16100A-7		GM71C16100A-8		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{WTS}	Test Mode $\overline{WE}$ Setup Time	0	-	0	-	0	-	ns	
t_{WTH}	Test Mode $\overline{WE}$ Hold Time	10	-	10	-	10	-	ns	

Counter Test Cycle

Symbol	Parameter	GM71C16100A-6		GM71C16100A-7		GM71C16100A-8		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{CPT}	$\overline{CAS}$ Precharge Time in Counter Test Cycle	20	-	30	-	30	-	ns	

Notes:

1. AC Measurements assume $t_T = 5$ns.
2. An initial pause of 200μs 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). If the internal refresh counter is used, a minimum of eight $\overline{CAS}$-before-$\overline{RAS}$ refresh cycles are required.
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. Assume 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.
7. Measured with a load circuit equivalent to 2 TTL loads and 100pF.
8. Assume that $t_{RCD} \geq t_{RCD}$(max) and $t_{RAD} \leq t_{RAD}$(max).
9. Assume that $t_{RCD} \leq t_{RCD}$(max) and $t_{RAD} \geq t_{RAD}$(max).
10. Either t_{RCH} or t_{RRH} must be satisfied for a read cycles.
11. t_{OFF}(max) and t_{OEZ}(max) define the time at which the outputs achieve the open circuit condition and are not referenced to output voltage levels.

12. 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 cyles is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle; if $t_{RWD} \geq t_{RWD}(min)$, the $t_{CWD} \geq t_{CWD}(min)$, 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.

13. These parameters are referenced to $\overline{CAS}$ leading edge in early write cycles and to $\overline{WE}$ leading edge in delayed write or read-modify-write cycles.

14. t_{RASC} defines $\overline{RAS}$ pulse width in fast page mode cycles.

15. Access time is determined by the longer of t_{AA} or t_{CAC} or t_{ACP}.

16. In a test mode read cycle, the value of t_{RAC}, t_{AA}, t_{CAC} and t_{ACP} is delayed by 2ns to 5ns for the specified value. These parameters should be specified in test mode cycles by adding the above value to the specified value in this data sheet.

17. The 16M DRAM offers a 16-bits time saving parallel test mode. Address CA0 and CA1 for the 16M x 1 are don't care during test mode. Test mode is set by performing a $\overline{WE}$-and-$\overline{CAS}$-before-$\overline{RAS}$ (WCBR) cycle. In 16-bits parallel test mode, data is written into 16 bits in parallel at D_{IN} and read out from D_{OUT}. resd out from each D_{OUT}. If 16 bits are equal (all 1s or 0s), data output pin is a high state during test mode read cycle, then the device has passed. If they are not equal, data output pin is a low state, then the device has failed. Refresh during test mode operation can be performed by normal read cycles or by WCBR refresh cycles. To get out of test mode and enter a normal operation mode, perform either a regular $\overline{CAS}$-before-$\overline{RAS}$ refresh cycle or $\overline{RAS}$-only refresh cycle.

Timing Waveforms

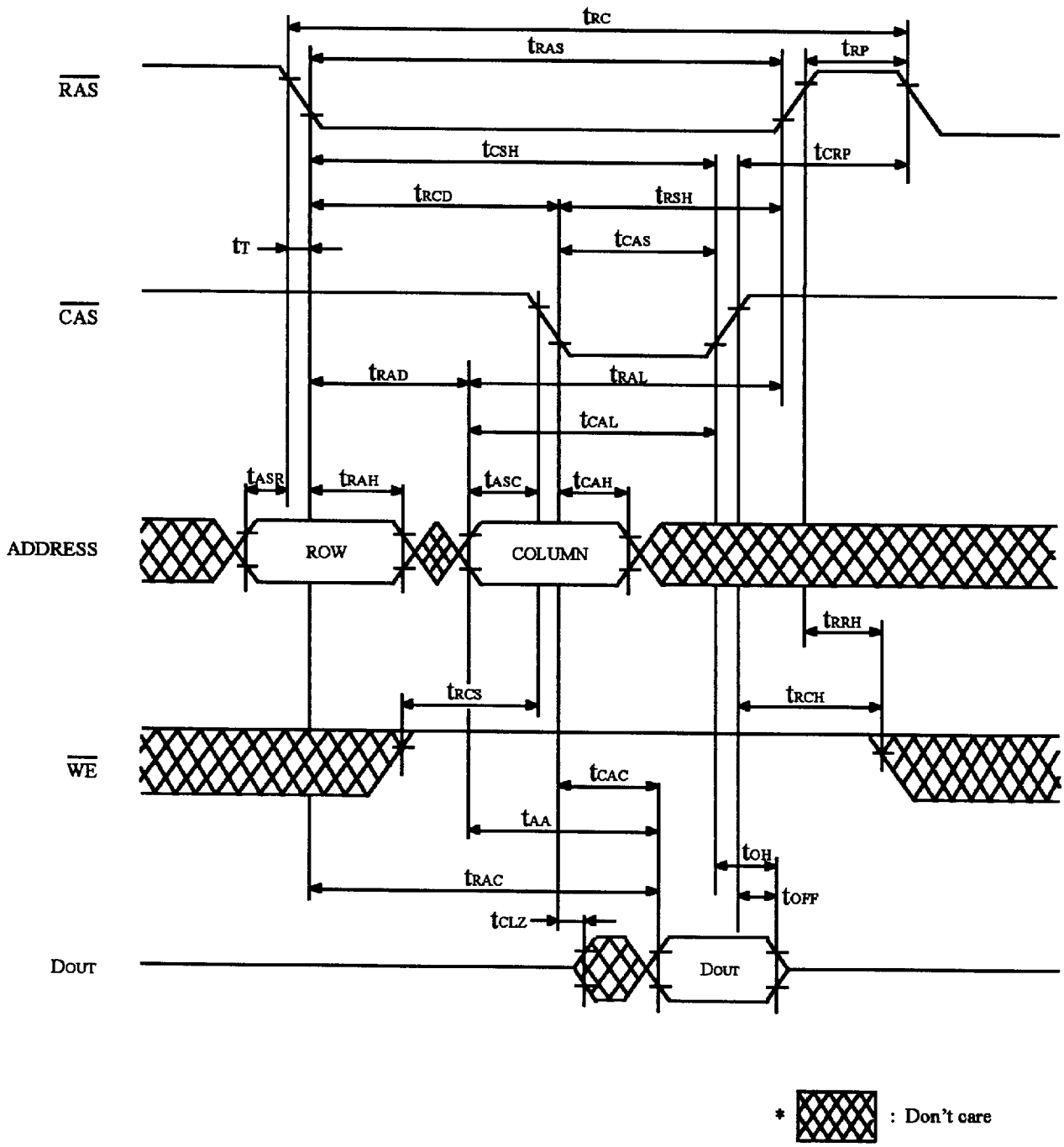


FIGURE 1. READ CYCLE

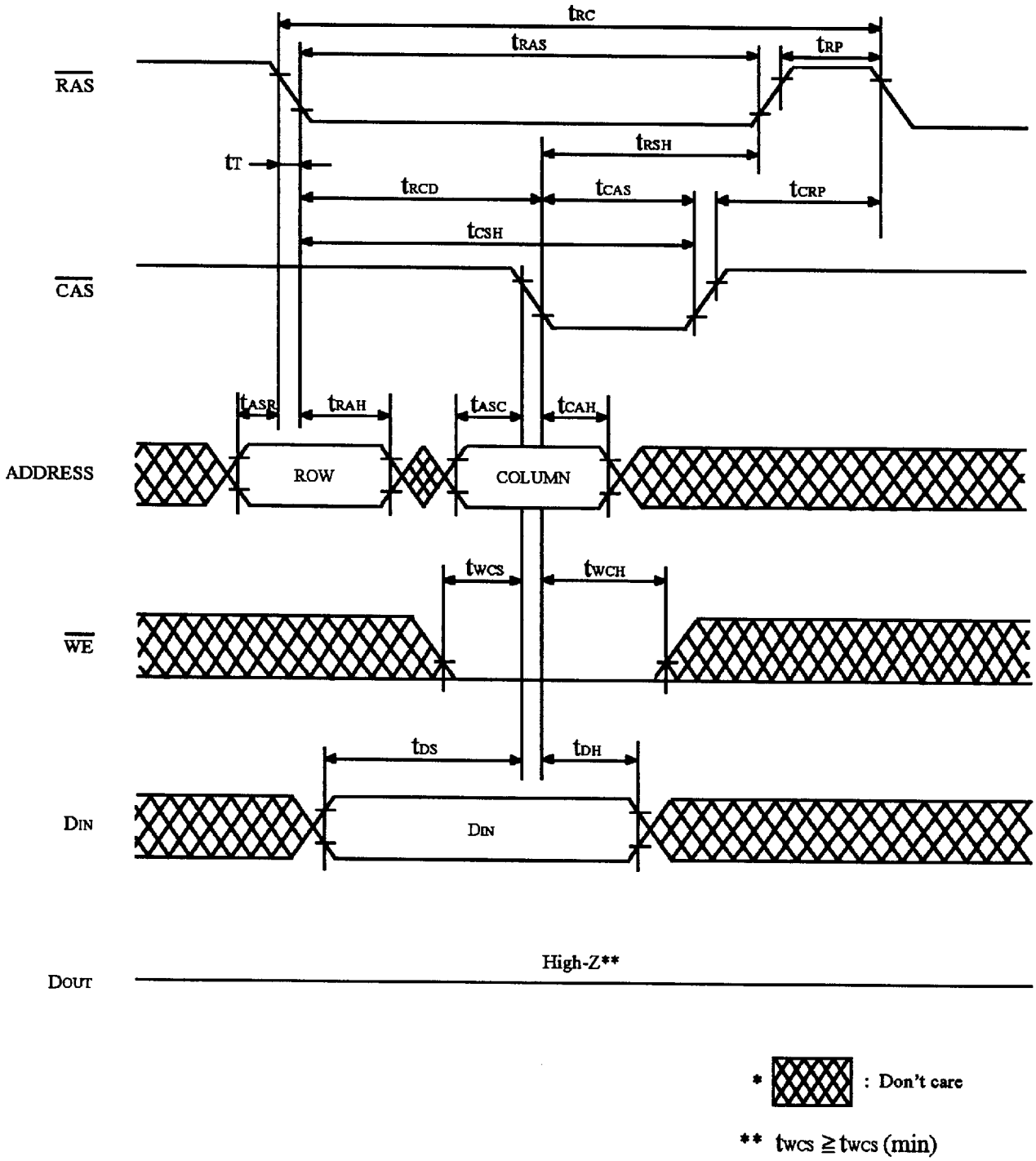


FIGURE 2. EARLY WRITE CYCLE

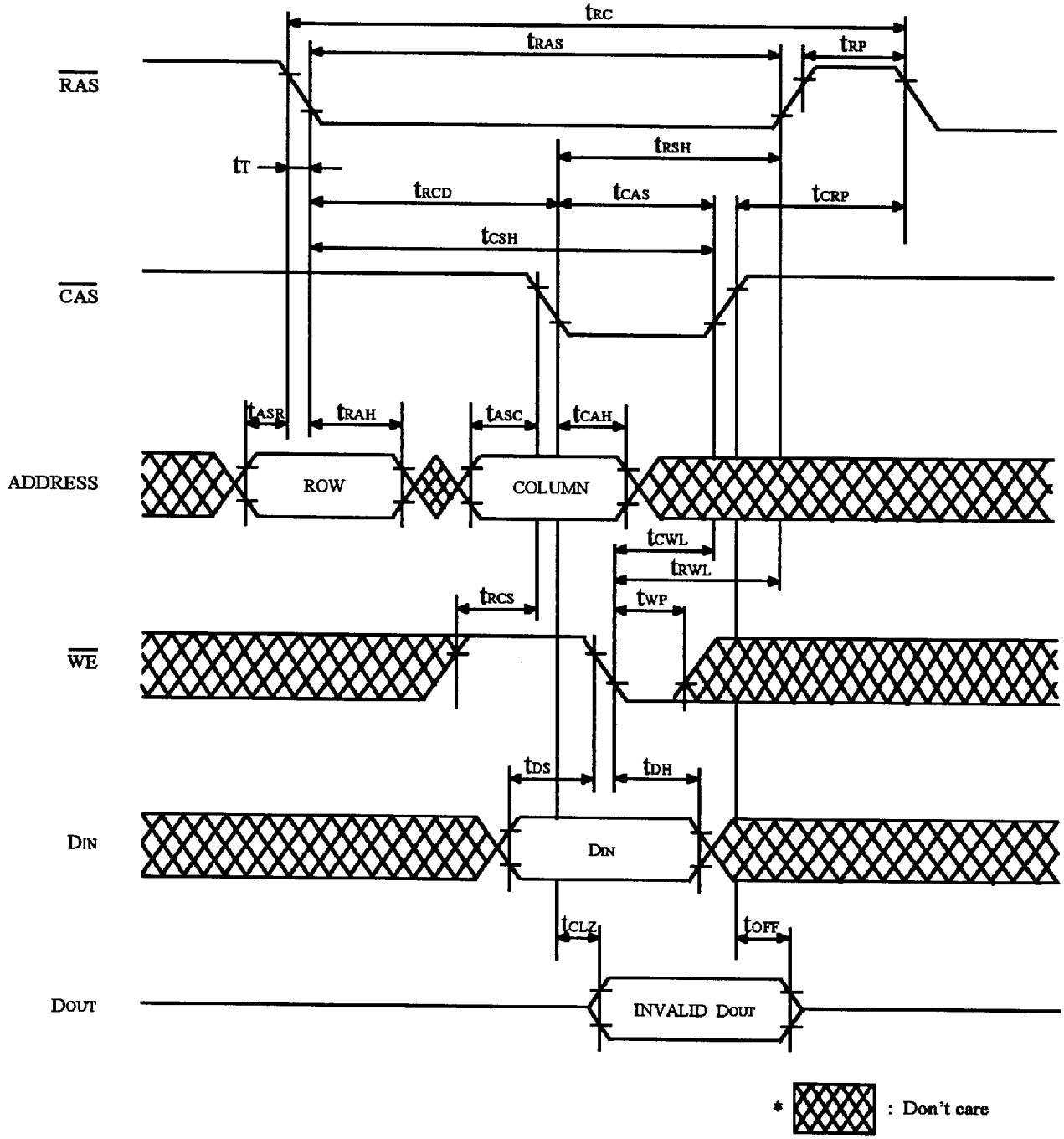


FIGURE 3. DELAYED WRITE CYCLE

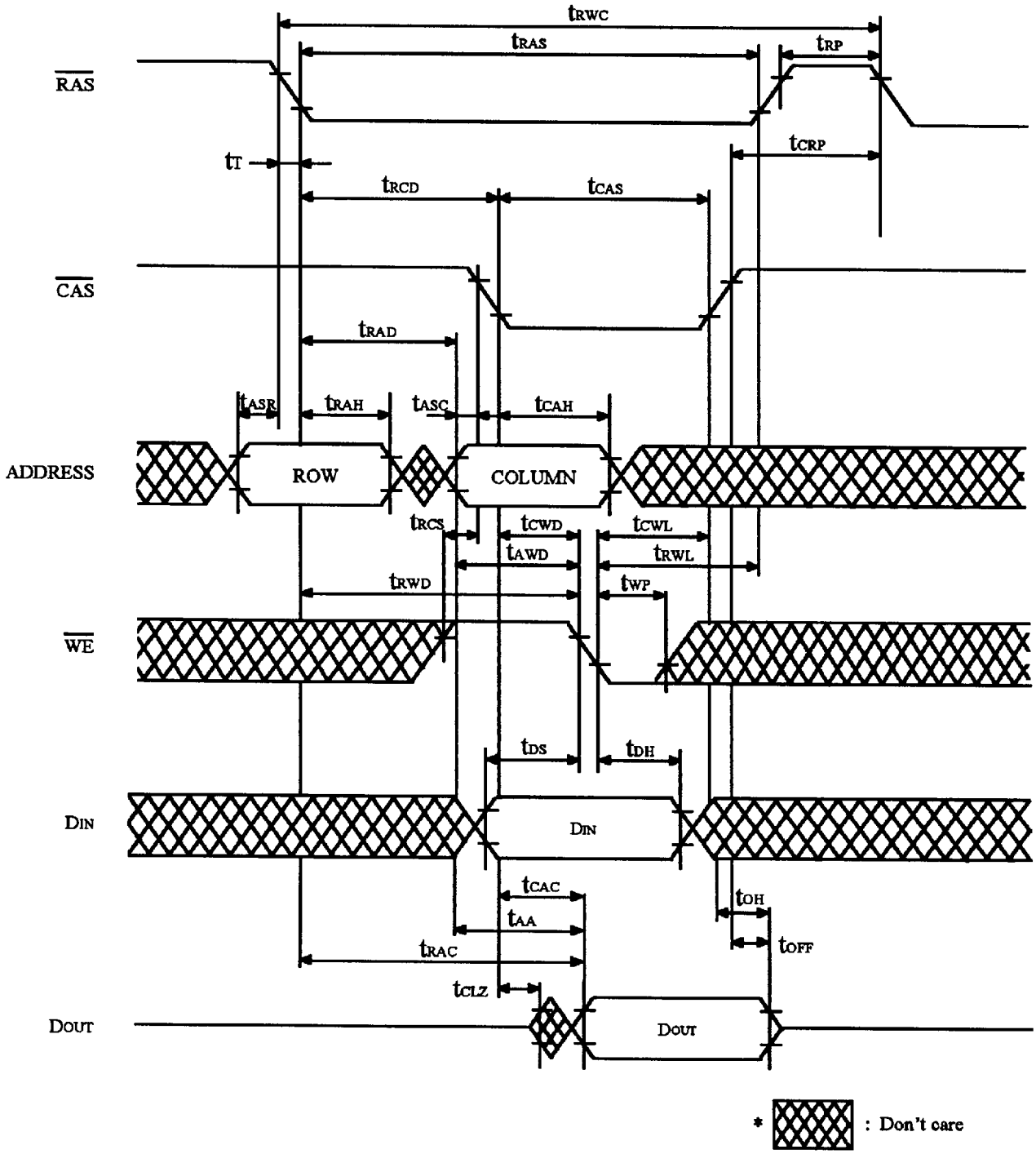
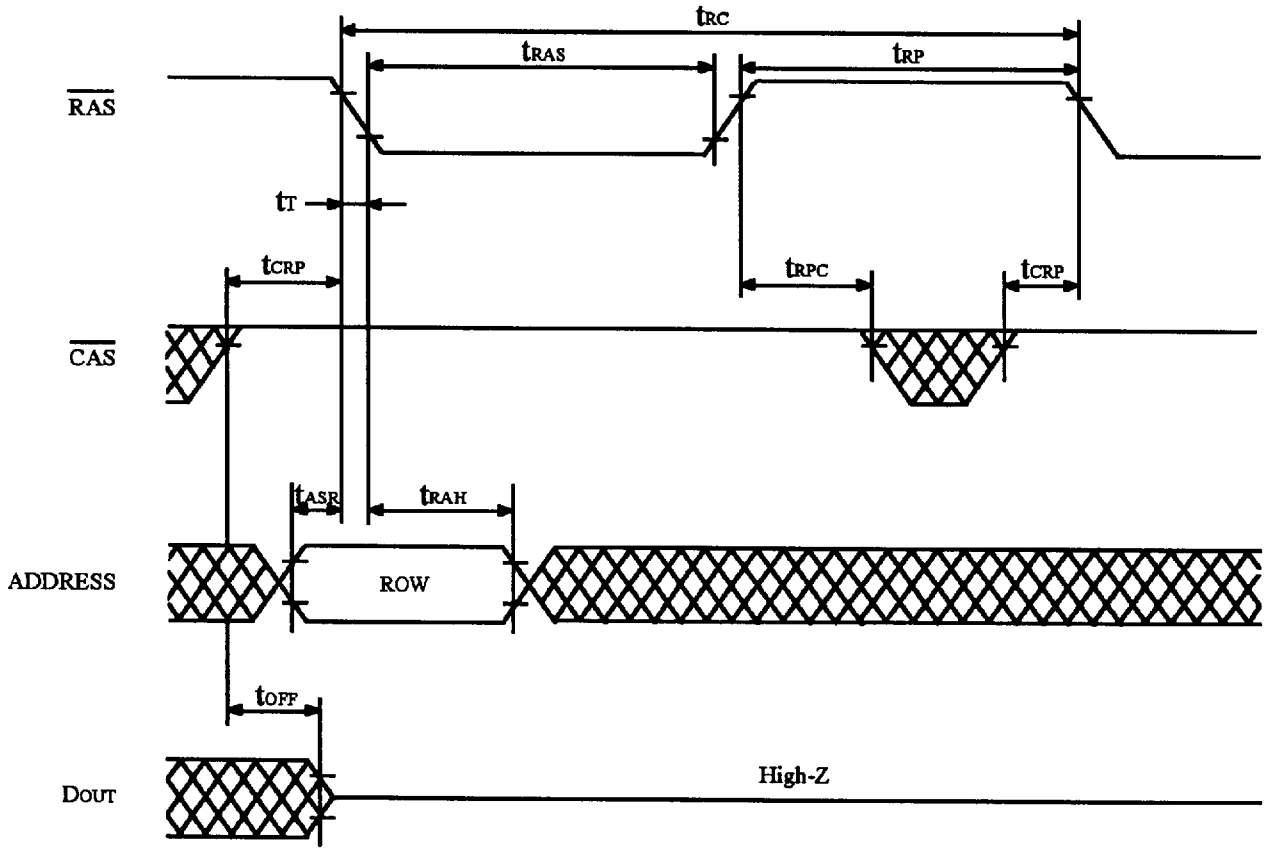


FIGURE 4. READ MODIFY WRITE CYCLE



* : Don't care

** $\overline{WE}$: Don't care

*** Refresh Address:
A0-A11 (RA0-RA11)

FIGURE 5. $\overline{RAS}$ ONLY REFRESH CYCLE

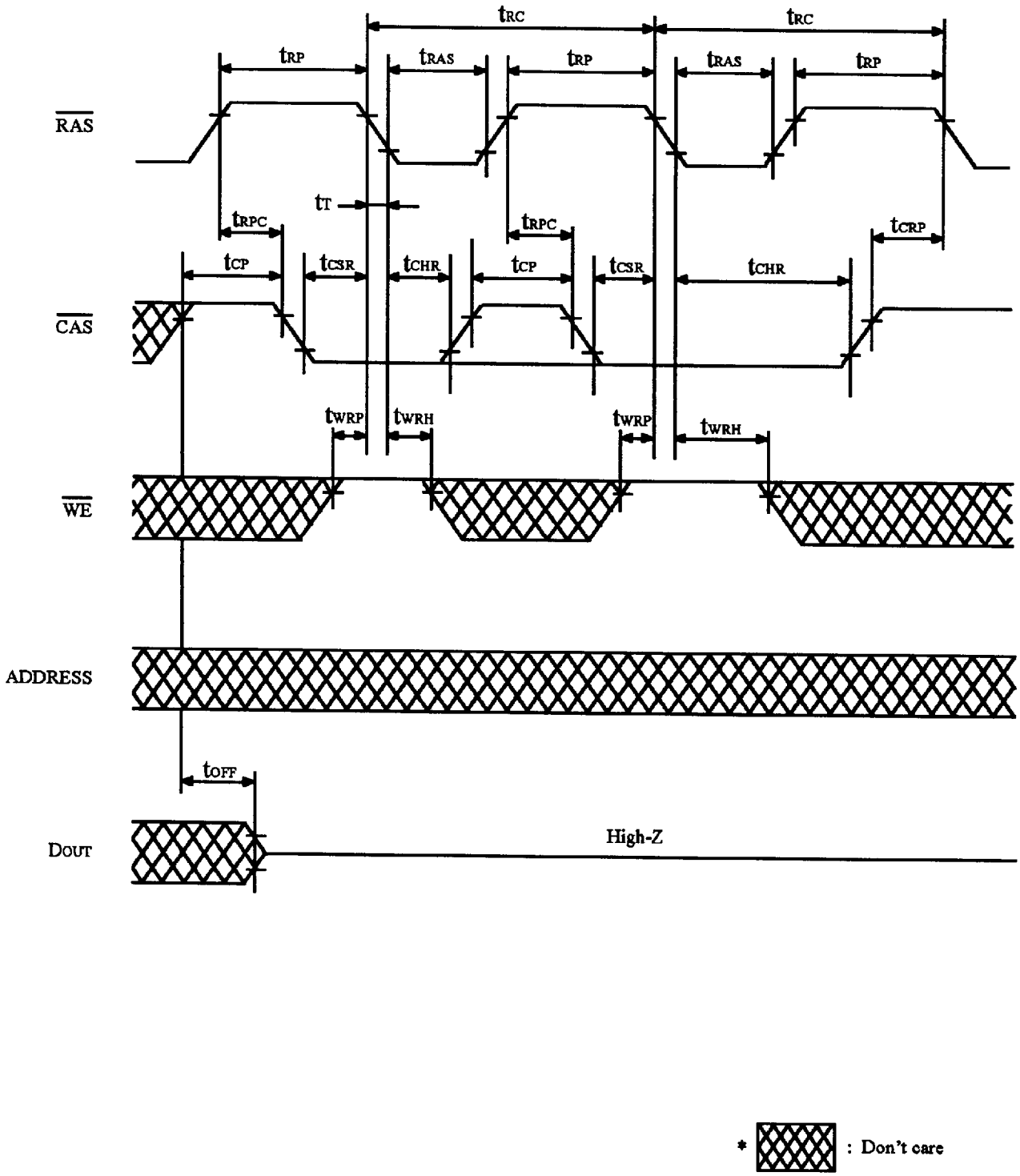


FIGURE 6. $\overline{\text{CAS}}$ BEFORE $\overline{\text{RAS}}$ REFRESH CYCLE

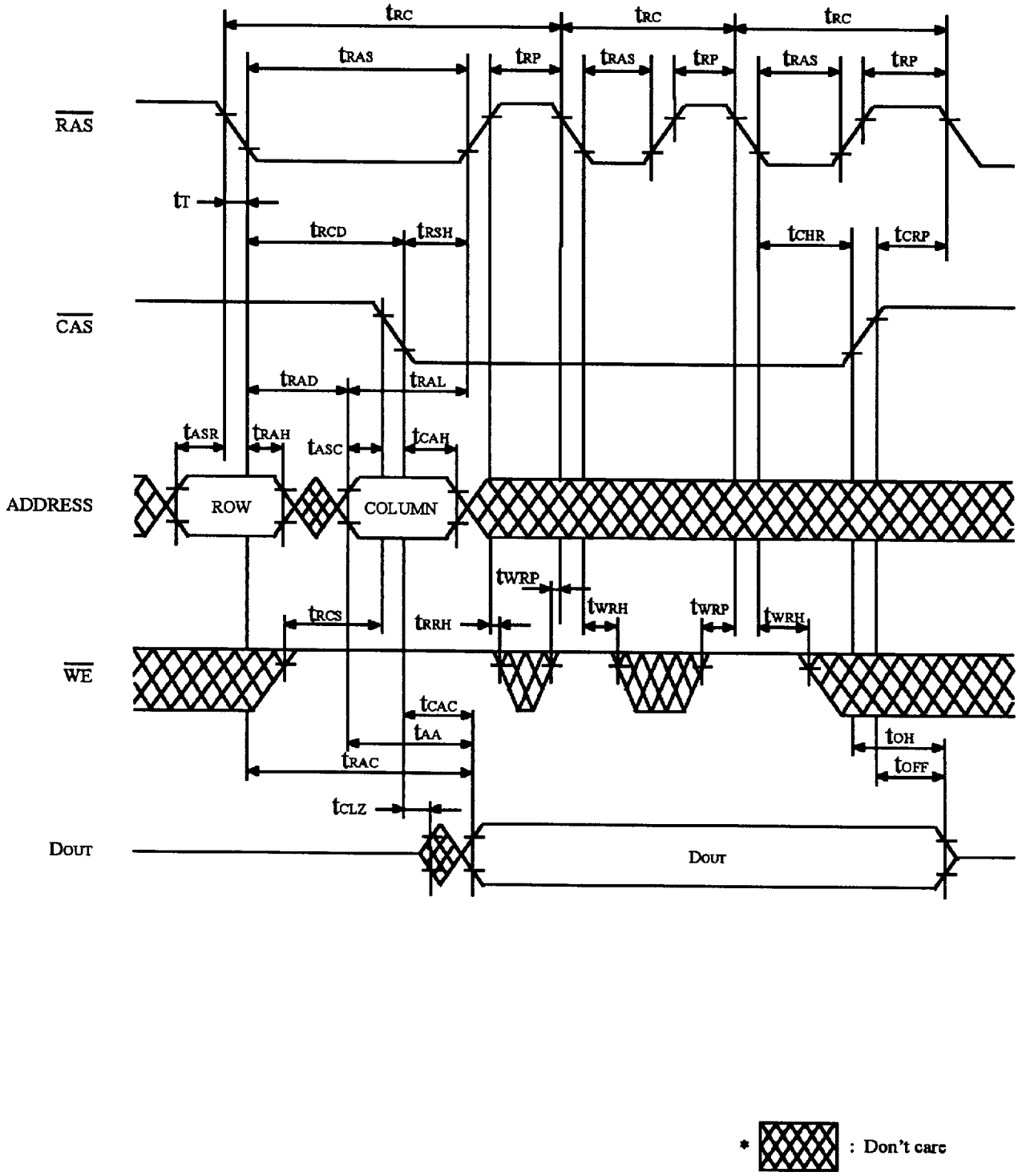


FIGURE 7. HIDDEN REFRESH CYCLE

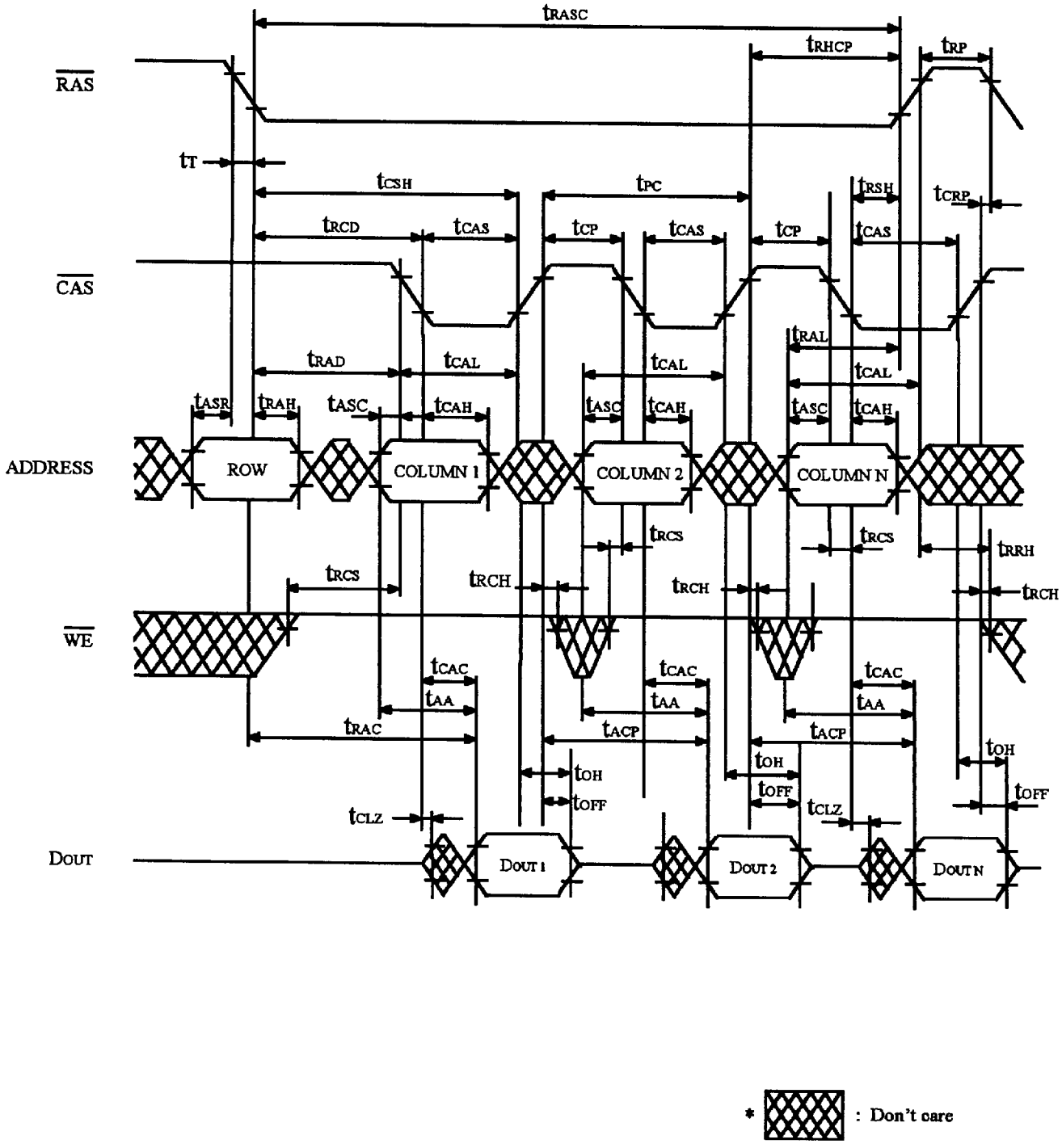


FIGURE 8. FAST PAGE MODE READ CYCLE

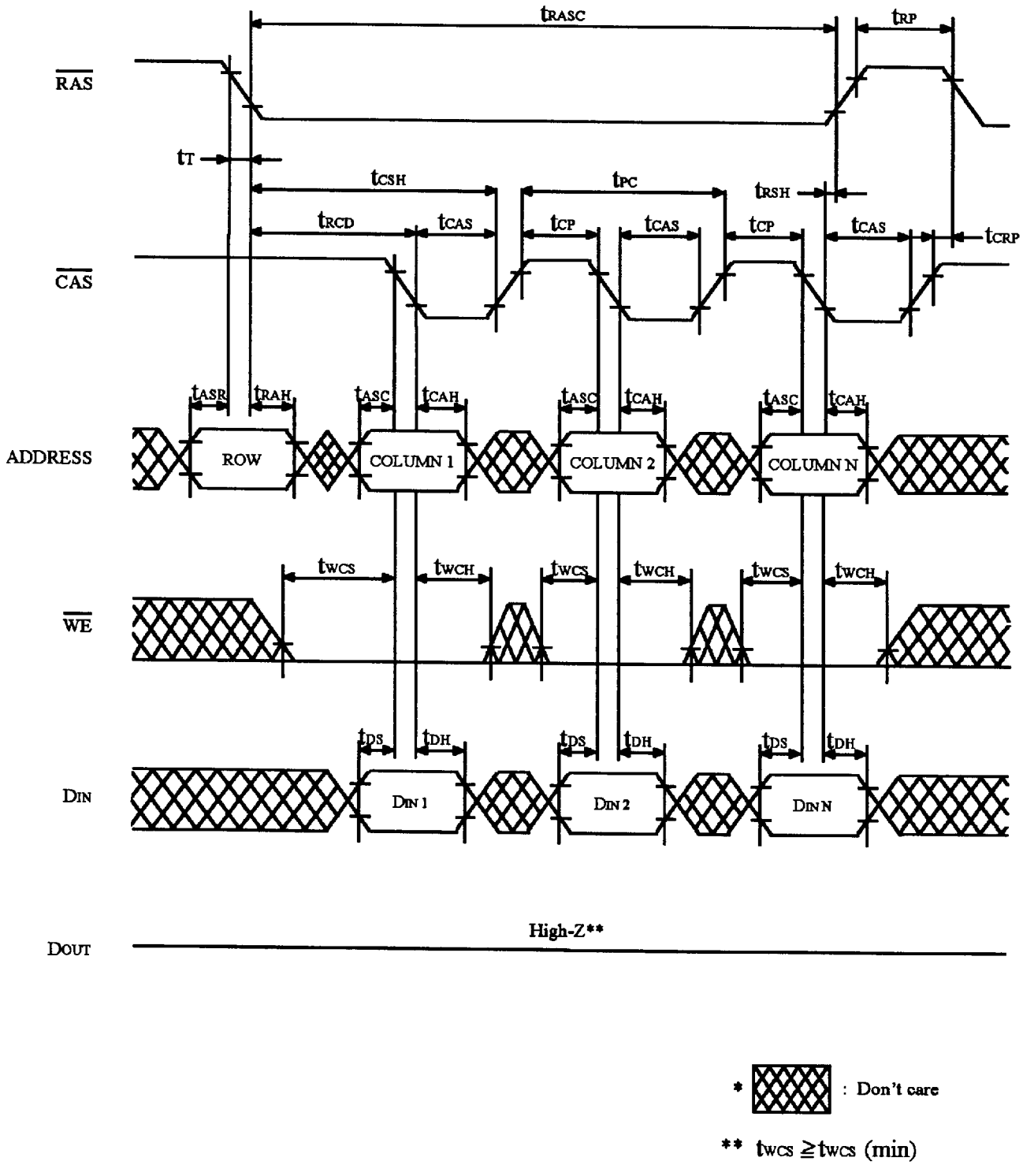


FIGURE 9. FAST PAGE MODE EARLY WRITE CYCLE

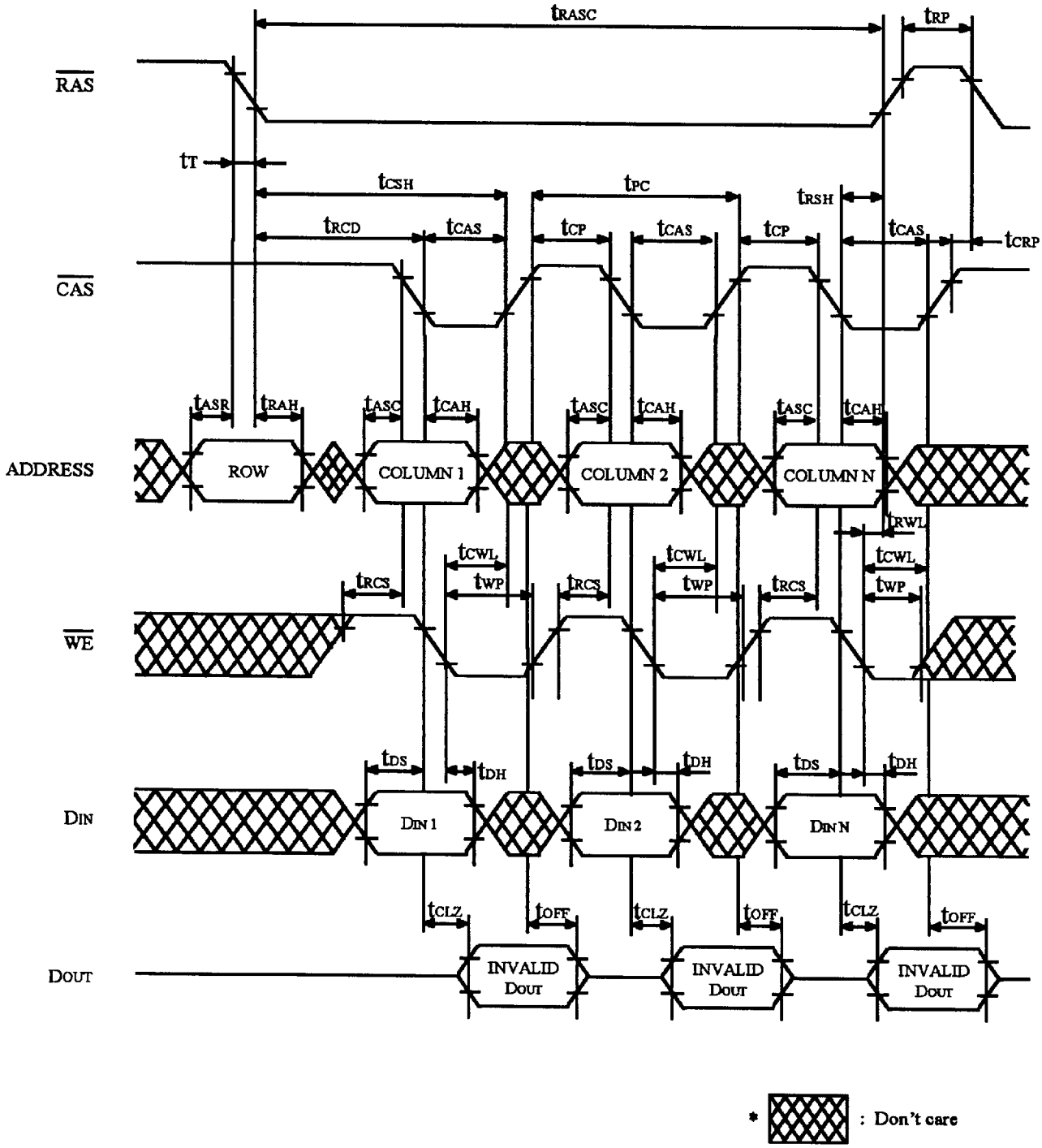


FIGURE 10. FAST PAGE MODE DELAYED WRITE CYCLE

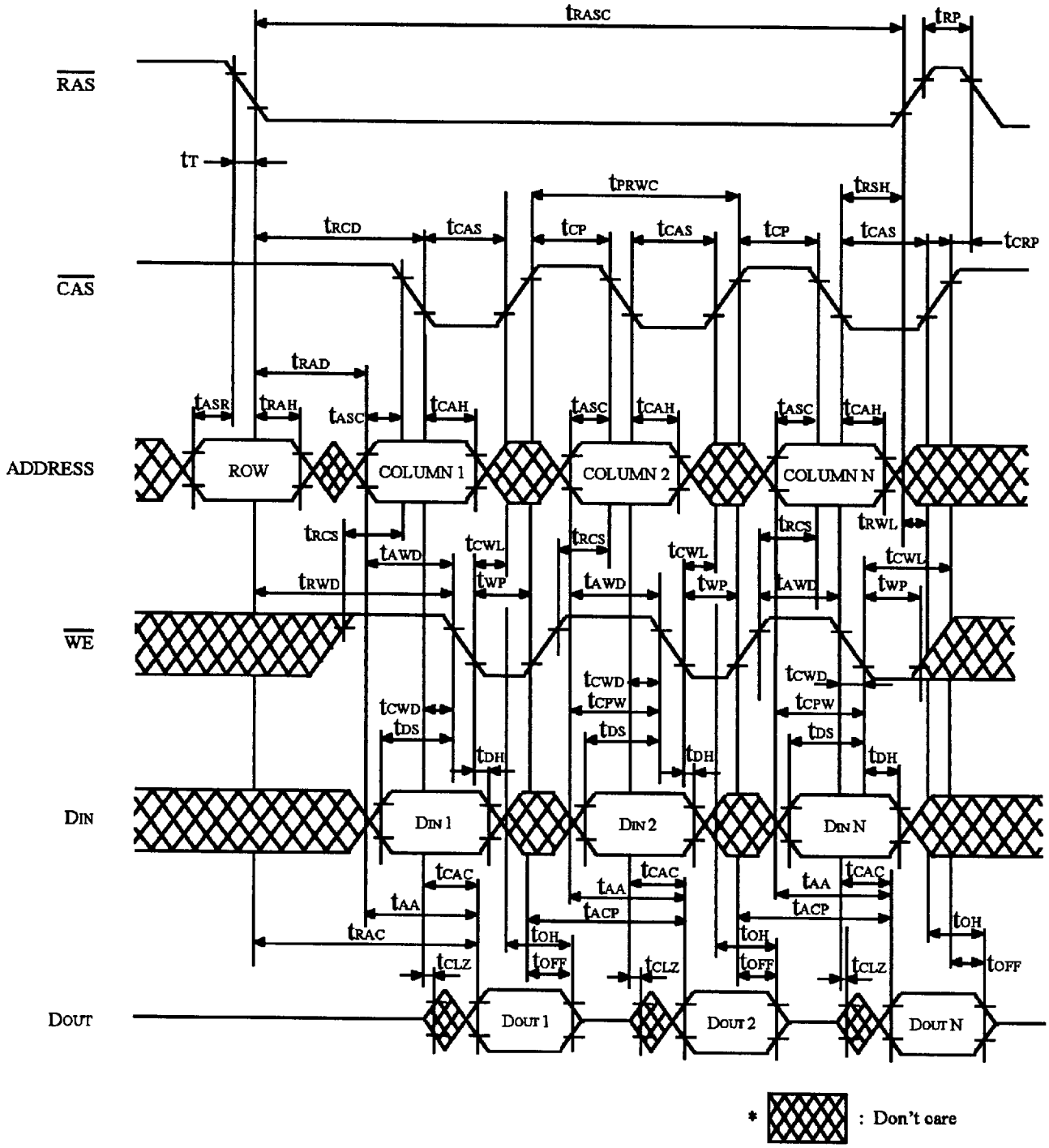


FIGURE 11. FAST PAGE MODE READ MODIFY WRITE CYCLE

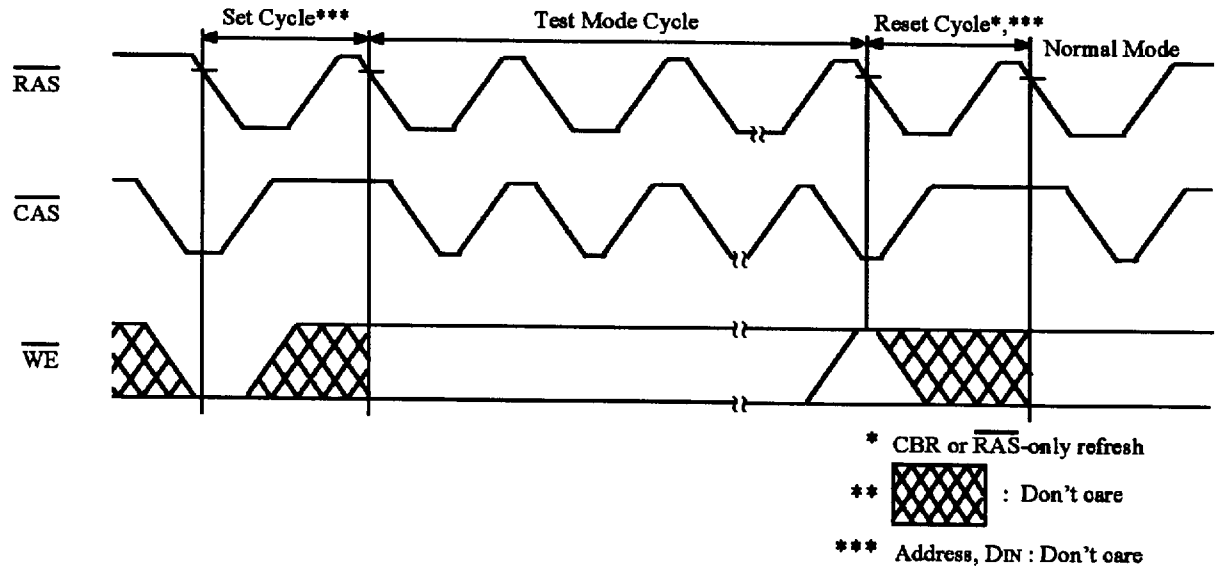


FIGURE 12. TEST MODE CYCLE

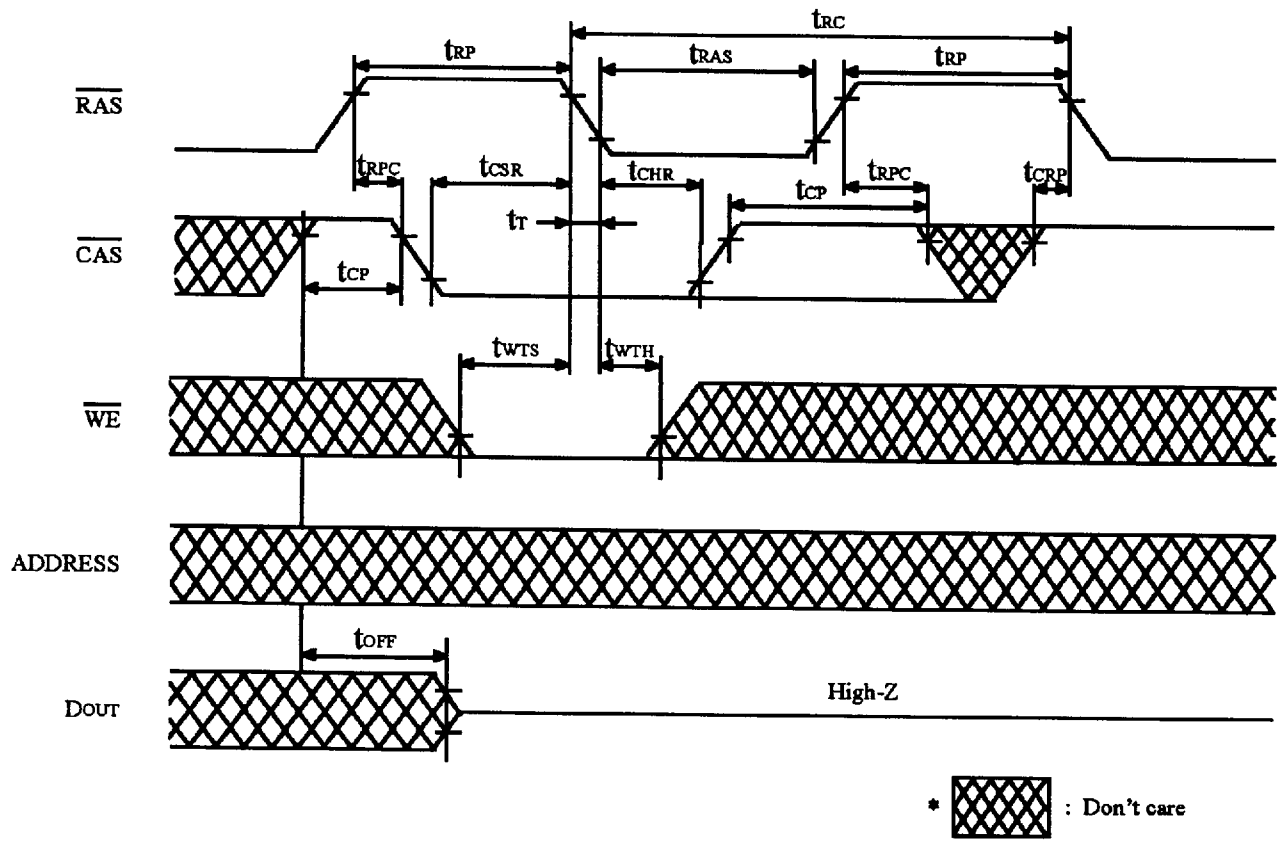


FIGURE 13. TEST MODE SET CYCLE

Test Mode Reset Cycle

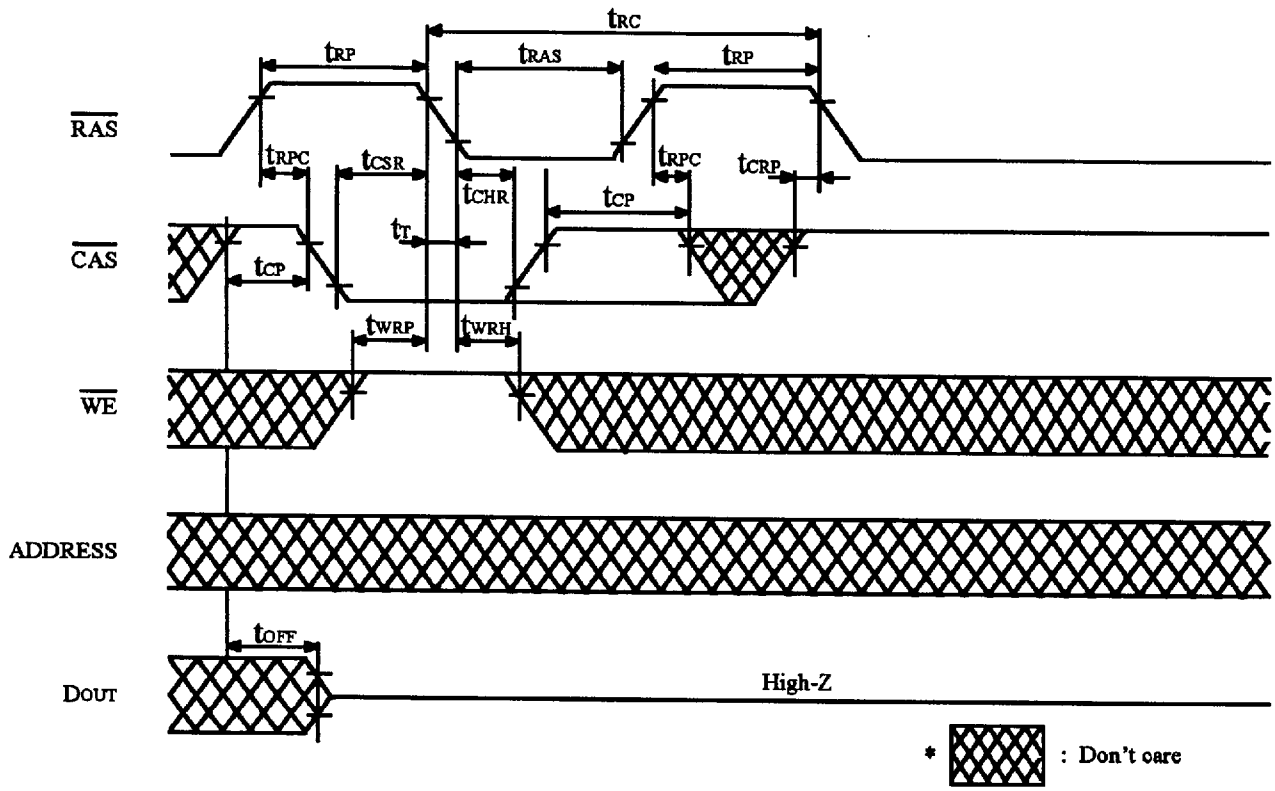


FIGURE 14. $\overline{\text{CAS}}$-BEFORE-$\overline{\text{RAS}}$ REFRESH CYCLE

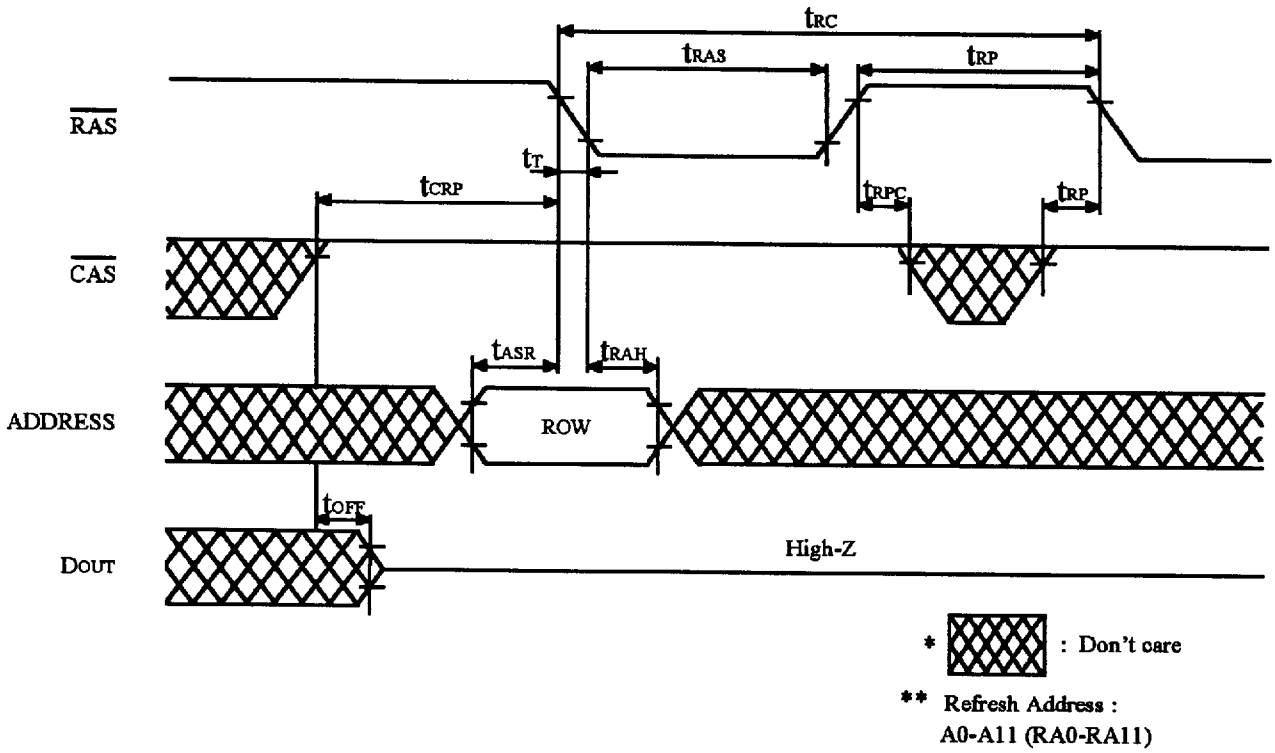


FIGURE 15. $\overline{\text{RAS}}$ ONLY REFRESH CYCLE

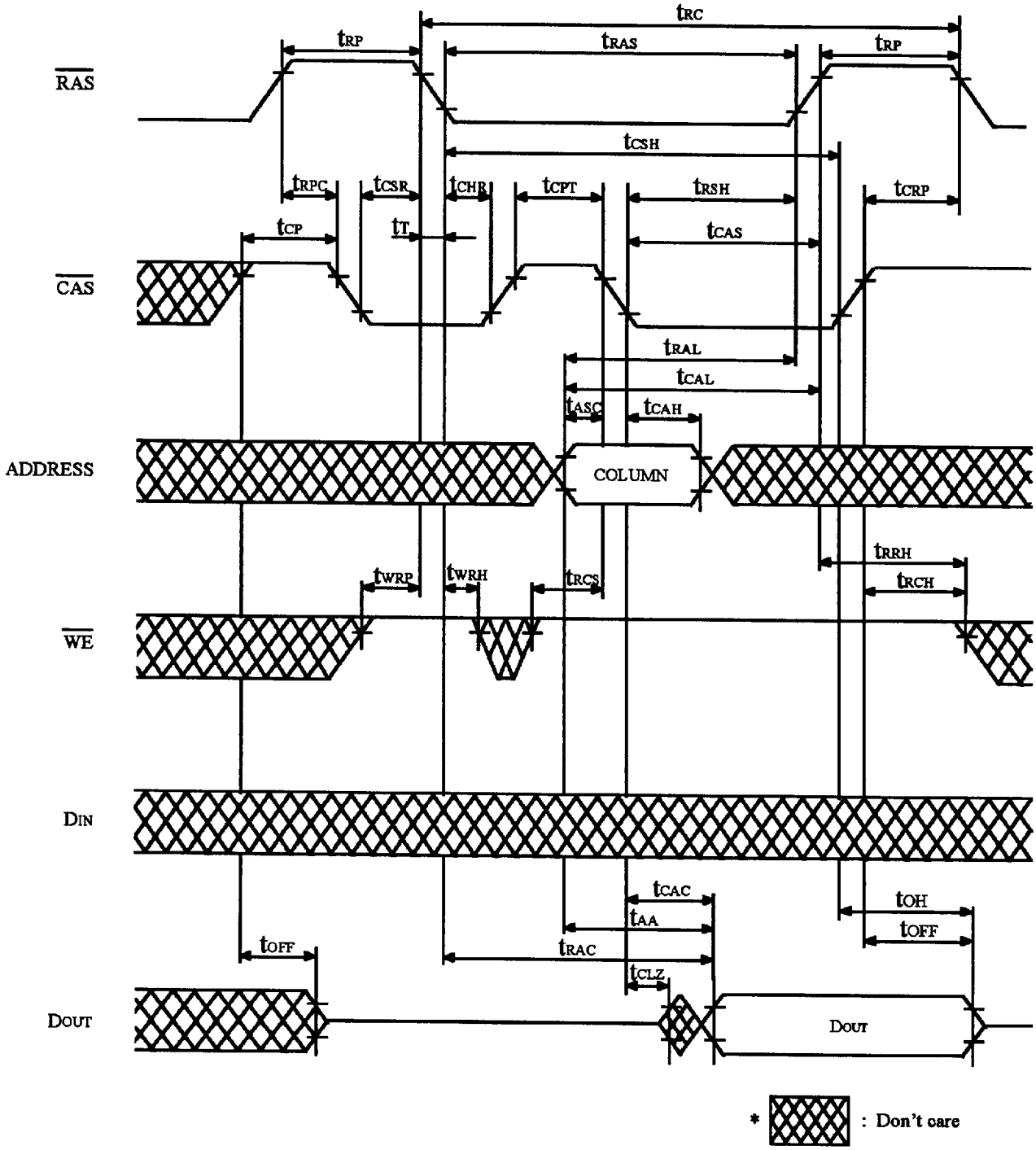


FIGURE 16. $\overline{CAS}$ BEFORE $\overline{RAS}$ REFRESH COUNTER CHECK CYCLE (READ)

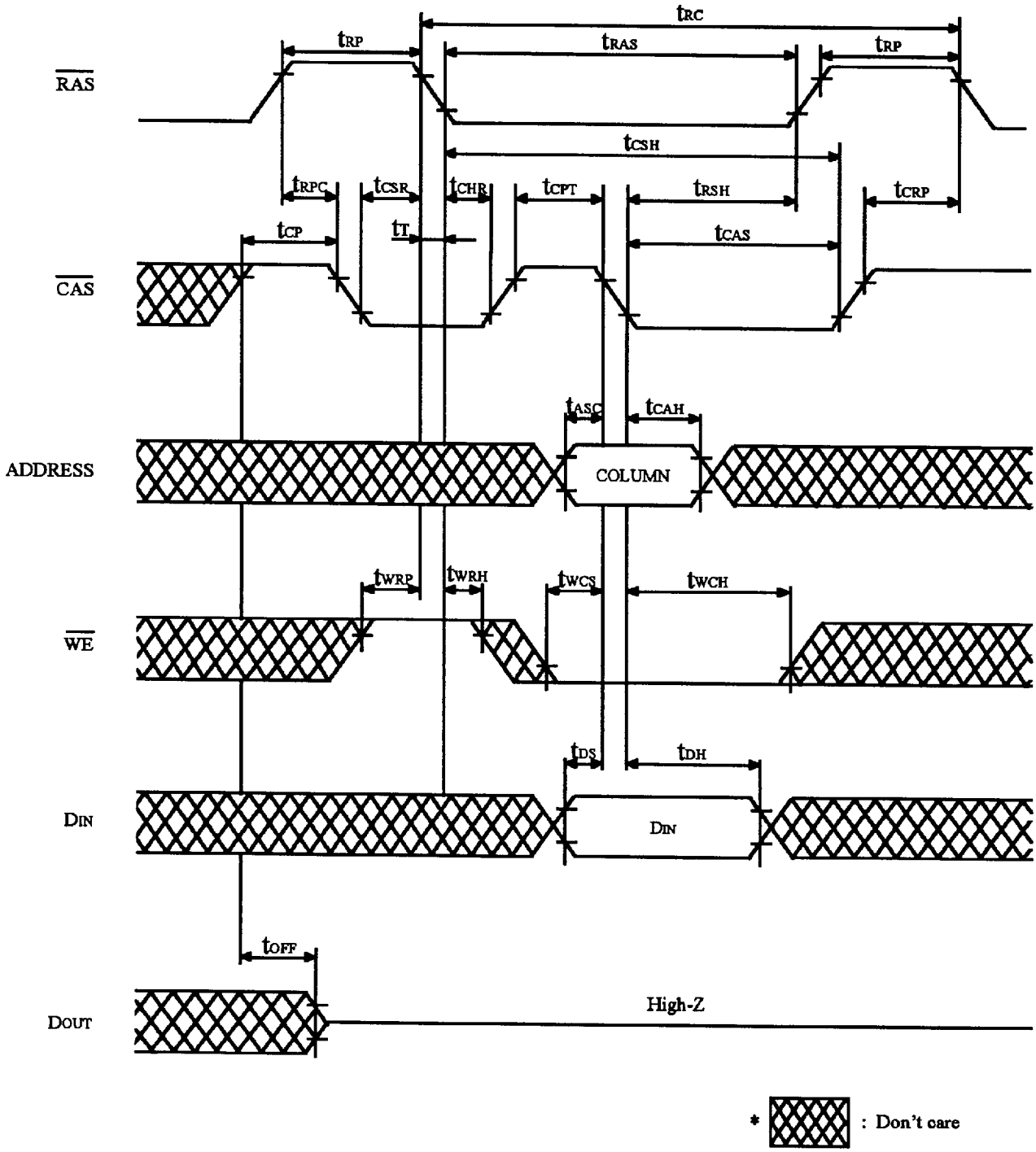
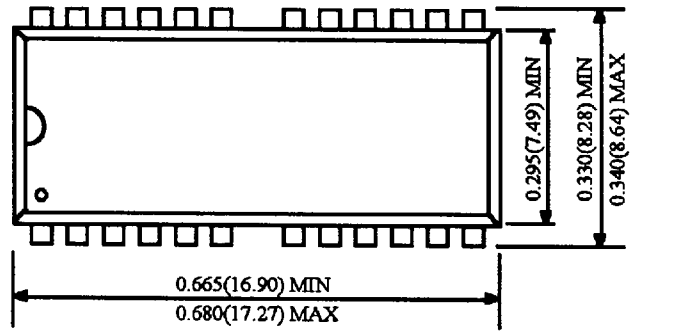


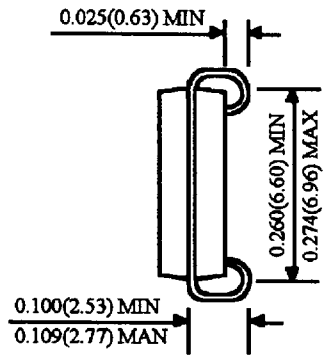
FIGURE 17. $\overline{CAS}$ BEFORE $\overline{RAS}$ REFRESH COUNTER CHECK CYCLE (WRITE)

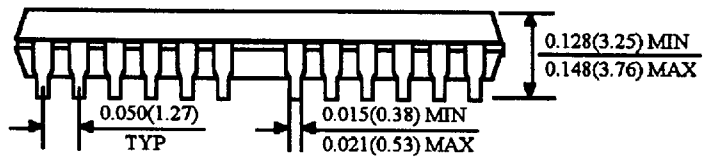
Package Dimension

Unit: Inches (mm)

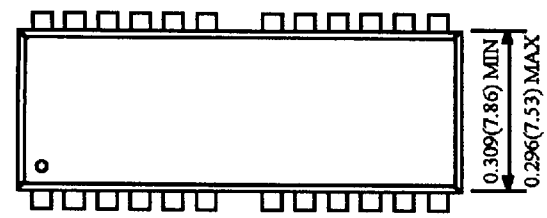
24 (26) SOJ



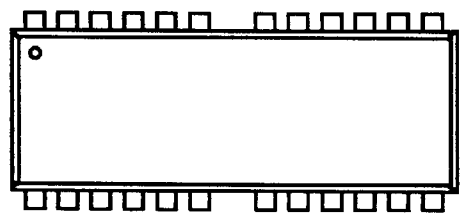




24 (26) TSOP(TYPE II)



NORMAL TYPE



REVERSE TYPE