GoldStar
GOLDSTAR ELECTRON CO., LTD.

GM71C4400B/BL

1,048,576 WORDS×4 BIT
CMOS DYNAMIC RAM

Description

The GM71C4400B/BL is the new generation dynamic RAM organized 1,048,576×4 Bit. GM71C4400B/BL has realized higher density, higher performance and various functions by utilizing advanced CMOS process technology. The GM71C4400B/BL offers Fast Page Mode as a high speed access Mode. Multiplexed address inputs permit the GM71C4400B/BL to be packaged in a standard 300 mil 20 pin plastic SOJ, standard 400 mil 20 pin plastic ZIP, and standard 300 mil 20 pin plastic TSOP II. The package size provides high system bit densities and is compatible with widely available automated testing and insertion equipment. System oriented features include single power supply of 5V ± 10% tolerance, direct interfacing capability with high performance logic families such as Schottky TTL.

Features

- 1,048,576×4 Bit Organization
- Fast Page Mode Capability
- Single Power Supply
- Fast Access Time & Cycle Time

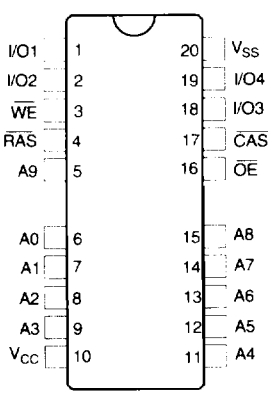
(Unit: ns)

	t_{RAC}	t_{CAC}	t_{RC}	t_{PC}
GM71C4400B/BL-60	60	15	110	40
GM71C4400B/BL-70	70	20	130	45
GM71C4400B/BL-80	80	20	150	50

- Low Power
  Active: 605/550/495 mW (MAX)
  Standby: 5.5mW (CMOS level: MAX)
  1.1mW (L-series)
- $\overline{RAS}$ Only Refresh, $\overline{CAS}$ before $\overline{RAS}$ Refresh, Hidden Refresh Capability
- All inputs and outputs TTL Compatible
- 1024 Refresh Cycles/16ms
- 1024 Refresh Cycles/128ms (L-series)
- Battery Back Up Operation (L-series)

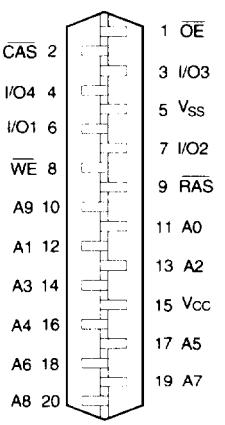
Pin Configuration

20 (26) SOJ



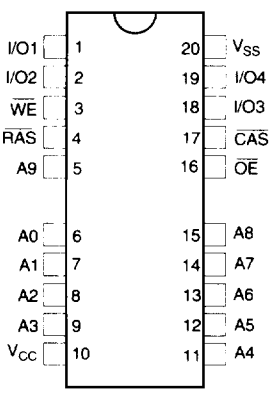
(TOP VIEW)

20 ZIP

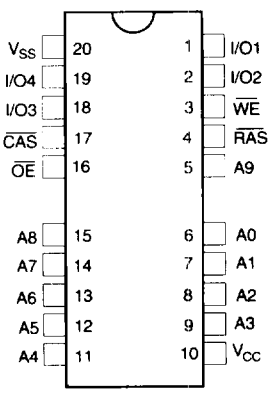


(BOTTOM VIEW)

20 (26) TSOP II



GM71C4400BT/BLT



GM71C4400BR/BLR

(TOP VIEW)

Pin Description

Pin	Function	Pin	Function
A0 ~ A9	Address Input	$\overline{WE}$	Read/Write Enable
A0 ~ A9	Refresh Address Inputs	$\overline{OE}$	Output Enable
I/O1-I/O4	Data-in/Data-out	V_{CC}	Power (+5V)
$\overline{RAS}$	Row Address Strobe	V_{SS}	Ground
$\overline{CAS}$	Column Address Strobe		

Ordering Information

Type No.	Access Time	PKG
GM71C4400BJ/BLJ-60 GM71C4400BJ/BLJ-70 GM71C4400BJ/BLJ-80	60ns 70ns 80ns	300 Mil 20 (26) Pin Plastic SOJ
GM71C4400BZ/BLZ-60 GM71C4400BZ/BLZ-70 GM71C4400BZ/BLZ-80	60ns 70ns 80ns	400 Mil 20 Pin Plastic ZIP
GM71C4400BT/BLT-60 GM71C4400BT/BLT-70 GM71C4400BT/BLT-80	60ns 70ns 80ns	300 Mil 20 (26) Pin Plastic TSOP II (Normal Type)
GM71C4400BR/BLR-60 GM71C4400BR/BLR-70 GM71C4400BR/BLR-80	60ns 70ns 80ns	300 Mil 20 (26) Pin Plastic TSOP II (Reverse Type)

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}	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 Operating Condition (T_A = 0°C ~ 70°C)

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 (I/O Pin)	-1.0	—	0.8	V
V_{IL}	Input Low Voltage (Other)	-2.0	—	0.8	V

DC Electrical Characteristics: (V_{CC} = 5V ± 10%, T_A = 0 ~ 70°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 ($\overline{RAS}$, $\overline{CAS}$ Cycling: t_{RC} = t_{RC} min)	60ns	—	110	mA	1,2
		70ns	—	100		
		80ns	—	90		
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	—	110	mA	2
		70ns	—	100		
		80ns	—	90		
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	—	110	mA	1,3
		70ns	—	100		
		80ns	—	90		
I_{CC5}	Standby Current (CMOS) Power Supply Standby Current ($\overline{RAS}$, $\overline{CAS}$ = V_{IH} $\overline{WE}$, $\overline{OE}$, Address, D_{IN} = V_{IH} or V_{IL}, D_{OUT} = High-Z)		— —	1 200	mA μA	 4,5
I_{CC6}	$\overline{CAS}$-before-$\overline{RAS}$ Refresh Current (t_{RC} = t_{RC} min)	60ns	—	110	mA	
		70ns	—	100		
		80ns	—	90		
I_{CC7}	Battery Back Up Current (Standby with CBR Refresh) (t_{RC} = 125μs, t_{RAS} ≤ 1μs, $\overline{WE}$ = V_{IH}, $\overline{CAS}$ = V_{IL}, $\overline{OE}$, Addres and D_{IN} = V_{IH} or V_{IL}, D_{OUT} = High-Z)		—	300	μA	4,5
I_{CC8}	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 loading 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}.
4. L Series.
5. V_{CC} − 0.2V ≤ V_{IH} ≤ 6.5V, 0V ≤ V_{IL} ≤ 0.2V.

Capacitance (V_{CC} = 5V ± 10%, T_A = 25°C)

Symbol	Parameter	Min	Max	Unit	Note
C_{I1}	Input Capacitance (Address)	–	5	pF	1
C_{I2}	Input Capacitance (Clocks)	–	7	pF	1
$C_{I/O}$	Output Capacitance (Data-In/Out)	–	10	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 ± 10%, T_A = 0 ~ 70°C, Notes 1, 14, 15, 16)

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

Symbol	Parameter	GM71C4400B/BL-60		GM71C4400B/BL-70		GM71C4400B/BL-80		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_{RAS}	$\overline{RAS}$ Pulse Width	60	10,000	70	10,000	80	10,000	ns	
t_{CAS}	$\overline{CAS}$ Pulse Width	15	10,000	20	10,000	20	10,000	ns	
t_{ASR}	Row Address Set-up Time	0	–	0	–	0	–	ns	
t_{RAH}	Row Address Hold Time	10	–	10	–	10	–	ns	
t_{ASC}	Column Address Set-up Time	0	–	0	–	0	–	ns	
t_{CAH}	Column Address Hold Time	15	–	15	–	15	–	ns	
t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	20	45	20	50	20	60	ns	8
t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	15	30	15	35	15	40	ns	9
t_{RSH}	$\overline{RAS}$ Hold Time	15	–	20	–	20	–	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_{ODD}	$\overline{OE}$ to D_{IN} Delay Time	15	–	20	–	20	–	ns	
t_{DZO}	$\overline{OE}$ Delay Time from D_{IN}	0	–	0	–	0	–	ns	
t_{DZC}	$\overline{CAS}$ Set-up Time from D_{IN}	0	–	0	–	0	–	ns	
t_T	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	7
t_{REF}	Refresh Period	–	16	–	16	–	16	ms	
	Refresh Period (L-Series)	–	128	–	128	–	128	ms	

Read Cycle

Symbol	Parameter	GM71C4400B/BL-60		GM71C4400B/BL-70		GM71C4400B/BL-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RAC}	Access Time from $\overline{RAS}$	–	60	–	70	–	80	ns	2,3,17
t_{CAC}	Access Time from $\overline{CAS}$	–	15	–	20	–	20	ns	3,4,13, 17
t_{AA}	Access Time from Address	–	30	–	35	–	40	ns	3,5,13, 17
t_{OAC}	Access Time from $\overline{OE}$	–	15	–	20	–	20	ns	3,17
t_{RCS}	Read Command Set-up Time	0	–	0	–	0	–	ns	
t_{RCH}	Read Command Hold Time to $\overline{CAS}$	0	–	0	–	0	–	ns	18
t_{RRH}	Read Command Hold Time to $\overline{RAS}$	0	–	0	–	0	–	ns	18
t_{RAL}	Column Address to $\overline{RAS}$ Lead Time	30	–	35	–	40	–	ns	
t_{OFF1}	Output Buffer Turn-off Time	0	15	0	20	0	20	ns	6
t_{OFF2}	Output Buffer Turn-off Time from $\overline{OE}$	0	15	0	20	0	20	ns	6
t_{CDD}	$\overline{CAS}$ to D_{IN} Delay Time	15	–	20	–	20	–	ns	

Write Cycle

Symbol	Parameter	GM71C4400B/BL-60		GM71C4400B/BL-70		GM71C4400B/BL-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{WCS}	Write Command Set-up Time	0	–	0	–	0	–	ns	10
t_{WCH}	Write Command Hold Time	15	–	15	–	15	–	ns	
t_{WP}	Write Command Pulse Width	10	–	10	–	10	–	ns	
t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	15	–	20	–	20	–	ns	
t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	15	–	20	–	20	–	ns	
t_{DS}	Data-in Set-up Time	0	–	0	–	0	–	ns	11
t_{DH}	Data-in Hold Time	15	–	15	–	15	–	ns	11

Read-Modify-Write Cycle

Symbol	Parameter	GM71C4400B/BL-60		GM71C4400B/BL-70		GM71C4400B/BL-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RWC}	Read-Modify-Write Cycle Time	150	—	180	—	200	—	ns	
t_{RWD}	$\overline{RAS}$ to $\overline{WE}$ Delay Time	80	—	95	—	105	—	ns	10
t_{CWD}	$\overline{CAS}$ to $\overline{WE}$ Delay Time	35	—	45	—	45	—	ns	10
t_{AWD}	Column Address to $\overline{WE}$ Delay Time	50	—	60	—	65	—	ns	10
t_{OEH}	$\overline{OE}$ Hold Time from $\overline{WE}$	15	—	20	—	20	—	ns	

Refresh Cycle

Symbol	Parameter	GM71C4400B/BL-60		GM71C4400B/BL-70		GM71C4400B/BL-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{CSR}	$\overline{CAS}$ Set-up Time ($\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle)	10	—	10	—	10	—	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	10	—	10	—	10	—	ns	
t_{CPN}	$\overline{CAS}$ Precharge Time in Normal Mode	10	—	10	—	10	—	ns	

Fast Page Mode Cycle

Symbol	Parameter	GM71C4400B/BL-60		GM71C4400B/BL-70		GM71C4400B/BL-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{PC}	Fast Page Mode Cycle Time	40	—	45	—	50	—	ns	
t_{CP}	Fast Page Mode $\overline{CAS}$ Precharge Time	10	—	10	—	10	—	ns	
t_{RASC}	Fast Page Mode $\overline{RAS}$ Pulse Width	—	100,000	—	100,000	—	100,000	ns	12
t_{ACP}	Access Time from $\overline{CAS}$ Precharge	—	35	—	40	—	45	ns	3,13,17
t_{RHCP}	$\overline{RAS}$ Hold Time from $\overline{CAS}$ Precharge	35	—	40	—	45	—	ns	
t_{CPW}	Fast Page Mode Read-Modify-Write Cycle $\overline{CAS}$ Precharge to $\overline{WE}$ Delay Time	55	—	65	—	70	—	ns	
t_{PCM}	Fast Page Mode Read-Modify-Write Cycle Time	80	—	95	—	100	—	ns	

Test Mode Cycle

Symbol	Parameter	GM71C4400B/BL-60		GM71C4400B/BL-70		GM71C4400B/BL-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{WS}	Test Mode $\overline{WE}$ Set-up Time	0	—	0	—	0	—	ns	
t_{WH}	Test Mode $\overline{WE}$ Hold Time	10	—	10	—	10	—	ns	

Counter Test Cycle

Symbol	Parameter	GM71C4400B/BL-60		GM71C4400B/BL-70		GM71C4400B/BL-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{CPT}	$\overline{CAS}$ Precharge Time in Counter Test Cycle	40	—	40	—	40	—	ns	

Notes:

1. AC measurements assume $t_T = 5ns$.
2. 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.
3. Measured with a load circuit equivalent to 2TTL loads and 100pF.
4. Assumes that $t_{RCD} \geq t_{RCD}$ (max) and $t_{RAD} \leq t_{RAD}$ (max).
5. Assumes that $t_{RCD} \leq t_{RCD}$ (max) and $t_{RAD} \geq t_{RAD}$ (max).
6. t_{OFF} (max) defines the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
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} and V_{IL}.
8. 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}.
9. 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}.
10. t_{WCS}, t_{RWD}, t_{CWD}, t_{AWD} and 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) $t_{AWD} \geq t_{AWD}$ (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.
11. These parameters are referenced to $\overline{CAS}$ leading edge in early write cycles and to $\overline{WE}$ lading edge in delayed write or a read modify write cycle.
12. t_{RASC} defines $\overline{RAS}$ 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 ($\overline{RAS}$ only refresh cycle or $\overline{CAS}$ before $\overline{RAS}$ refresh cycle). If the internal refresh counter is used, a minimum of eight $\overline{CAS}$ before $\overline{RAS}$ refresh cycles is required.
15. In delayed write or read modify write cycles, $\overline{OE}$ must disable output buffer prior to applying data to the device.
16. Test mode operation specified in this data sheet is 2 bit test function controlled by control address bits ... CA0. This test mode operation can be performed by $\overline{WE}$ and $\overline{CAS}$ before $\overline{RAS}$ (WCBR) refresh cycle. Refresh during test mode operation will be performed by normal read cycles or by WCBR refresh cycles. When the state of two test bits accord each other, the condition of the output data is high level. When the state of test bits do not accord, the condition of the output data is low level. In order to end this test mode operation perform a $\overline{RAS}$ only refresh cycle or a $\overline{CAS}$ before $\overline{RAS}$ refresh cycle.
17. In a test mode read cycle, the value of t_{RAC}, t_{AA}, t_{CAC},t_{OAC} and t_{ACP} is delayed for 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.

TIMING WAVEFORMS

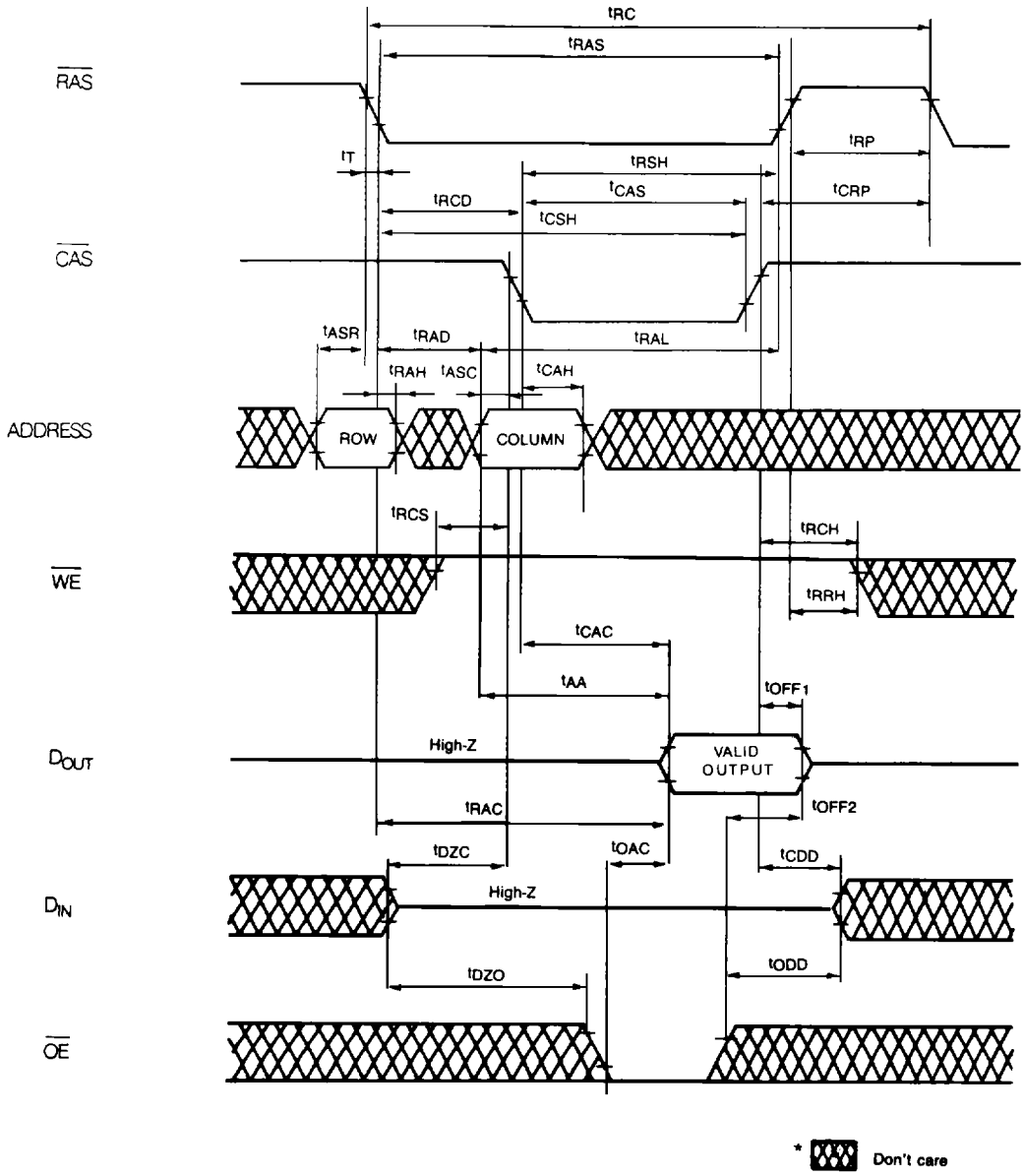


FIGURE 1. READ CYCLE

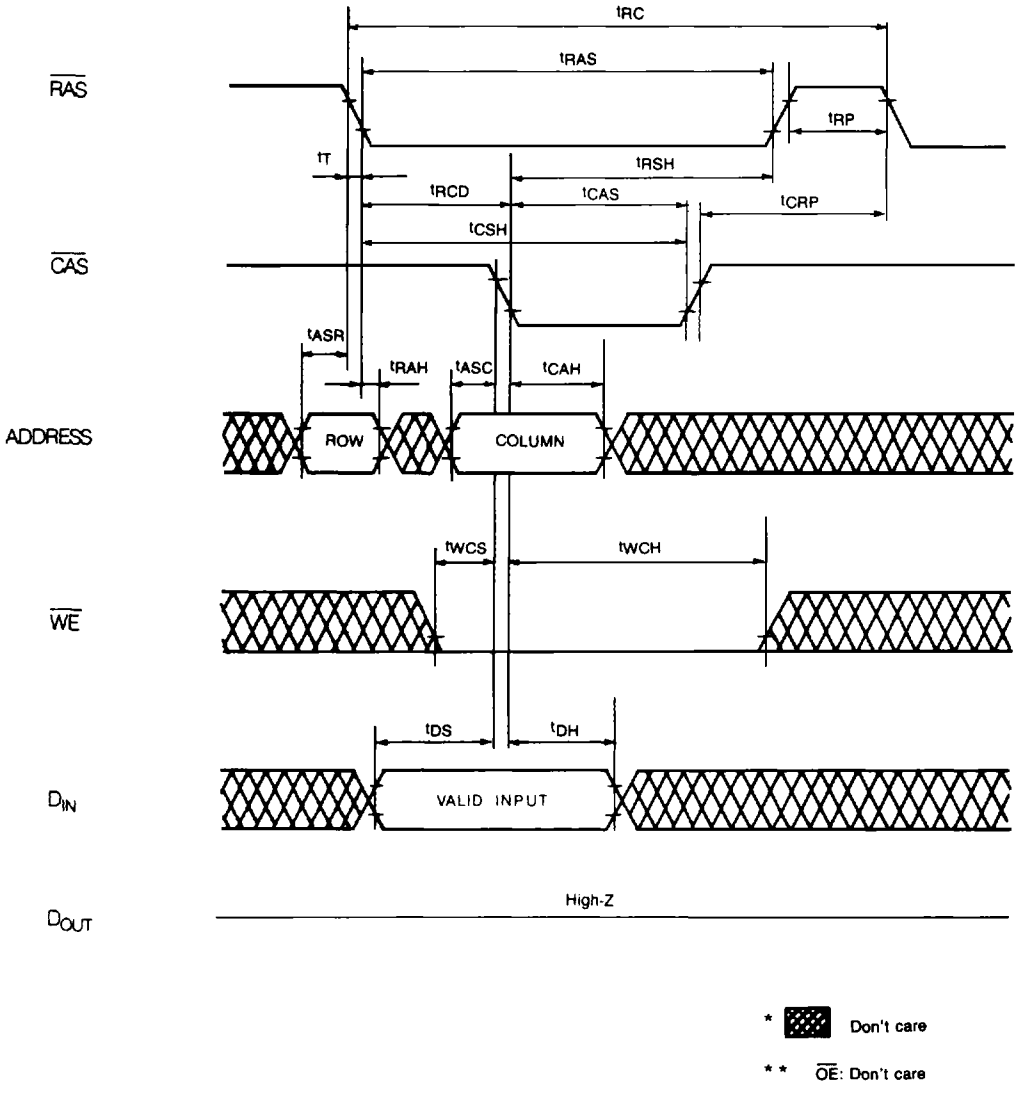


FIGURE 2. EARLY WRITE CYCLE

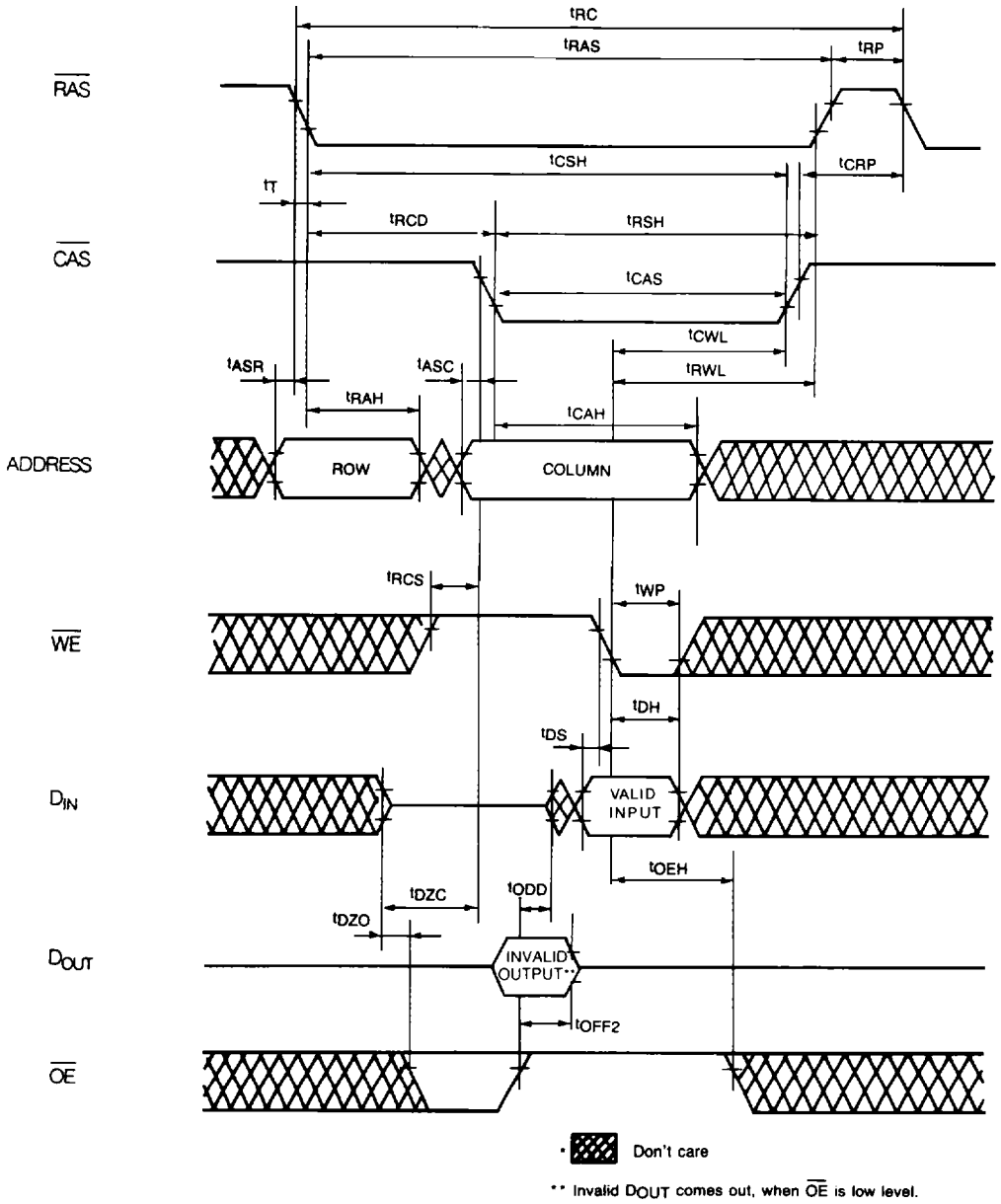


FIGURE 3. DELAYED WRITE CYCLE

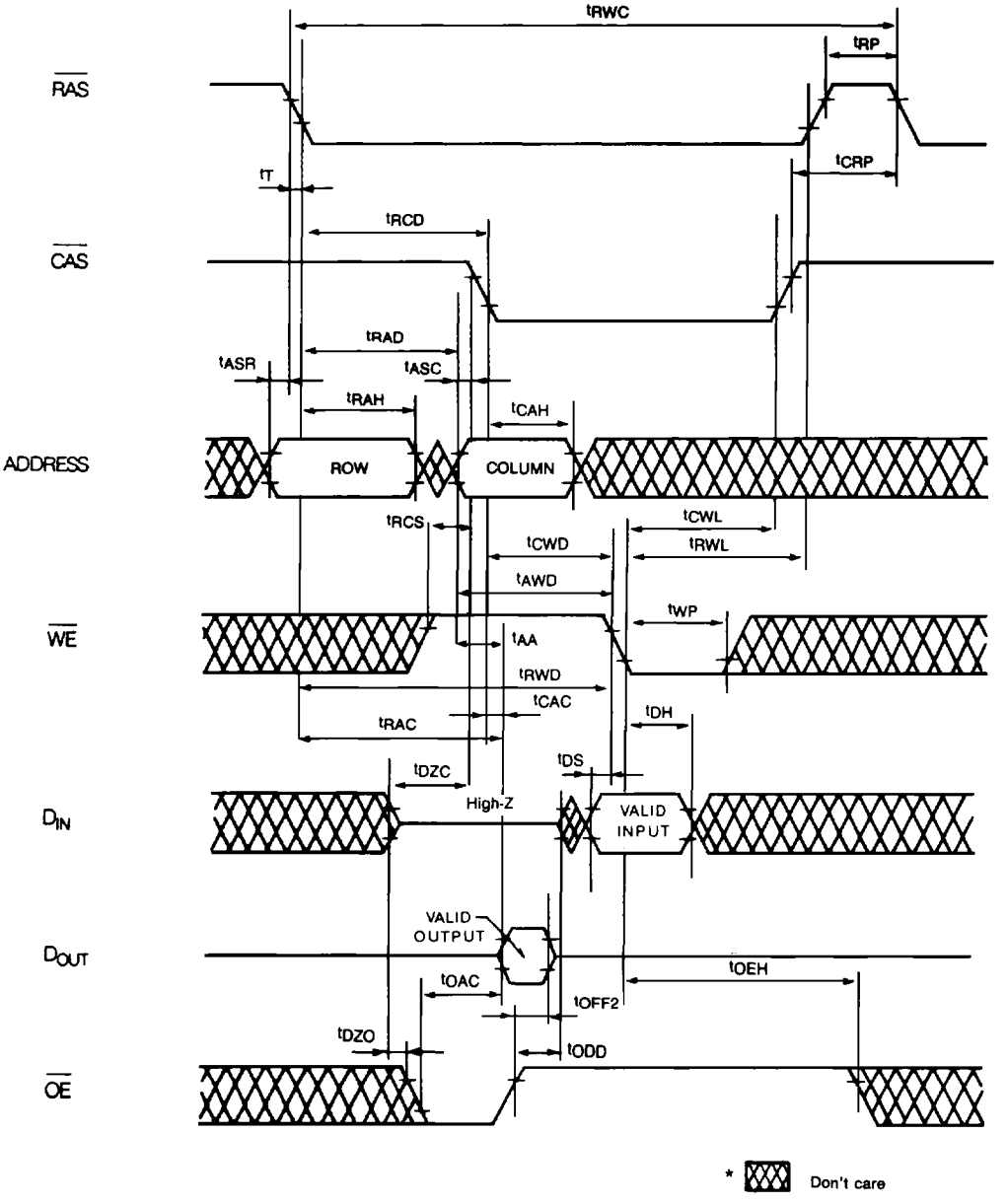


FIGURE 4. READ-MODIFY-WRITE CYCLE

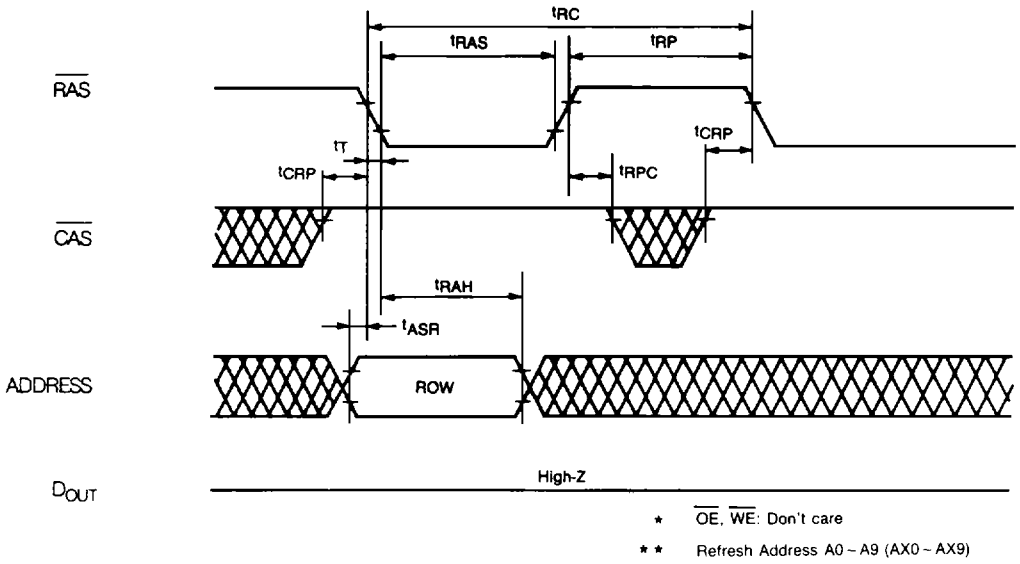


FIGURE 5. RAS-ONLY REFRESH CYCLE

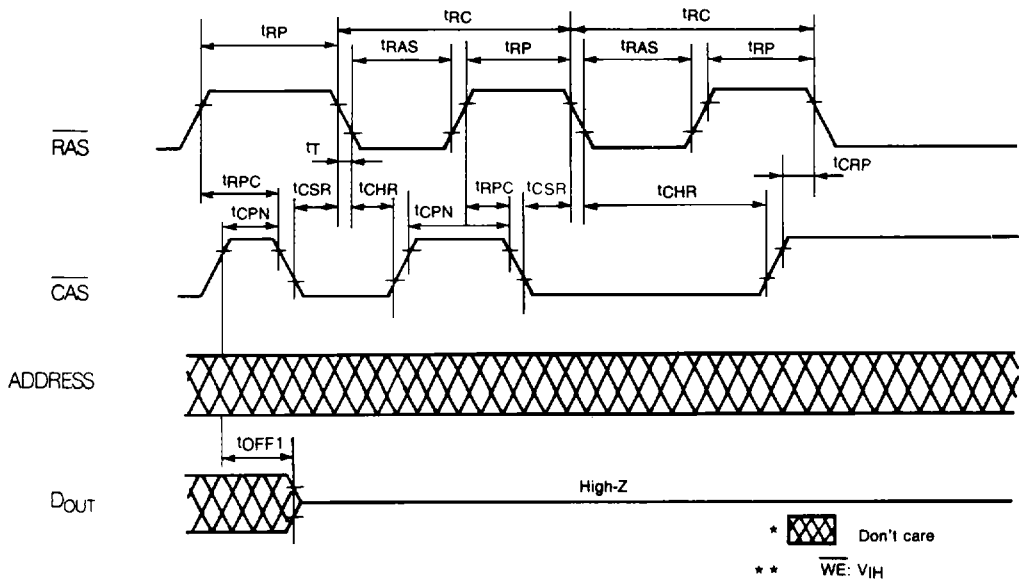


FIGURE 6. CAS-BEFORE-RAS REFRESH CYCLE

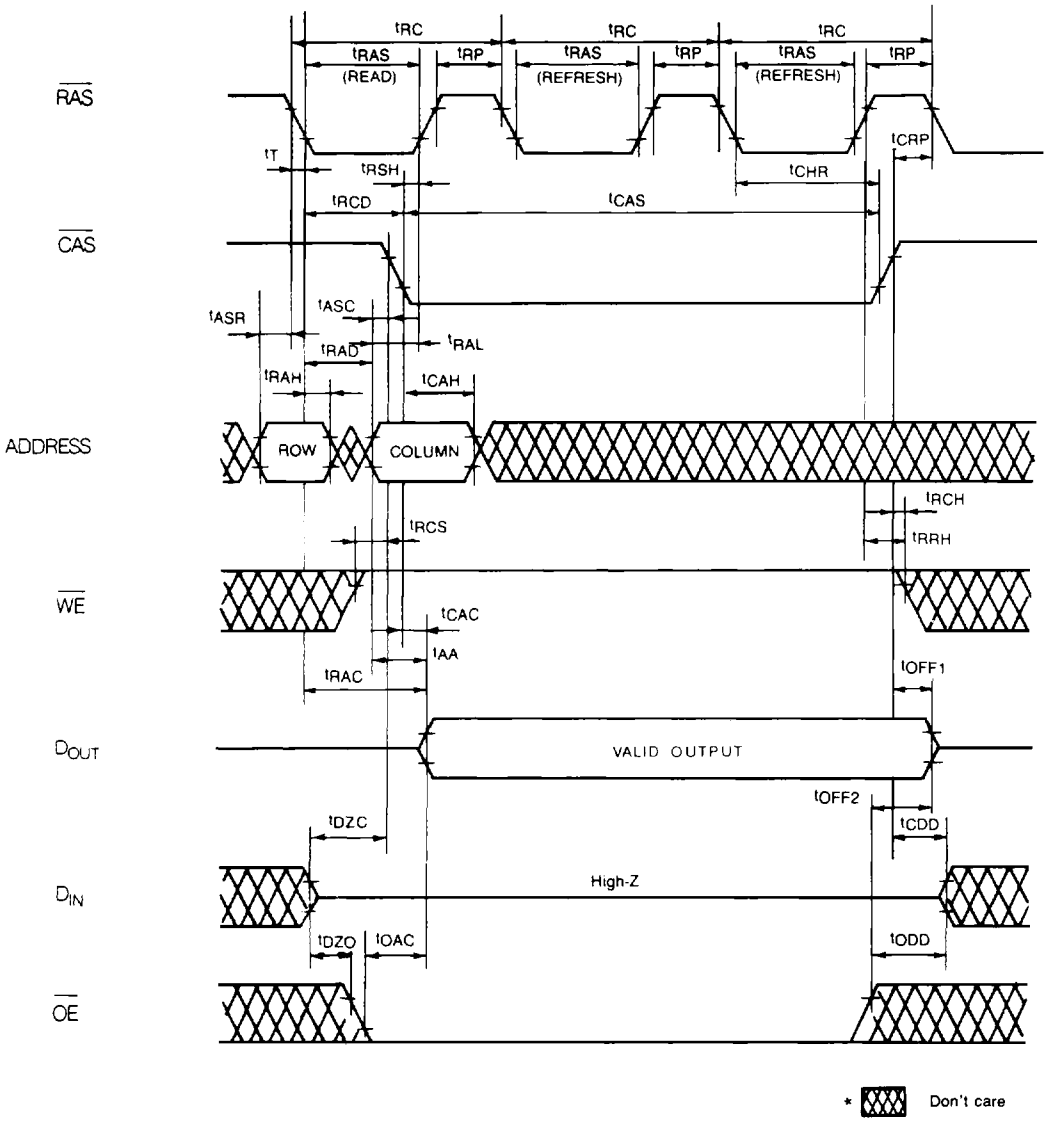


FIGURE 7. HIDDEN REFRESH CYCLE

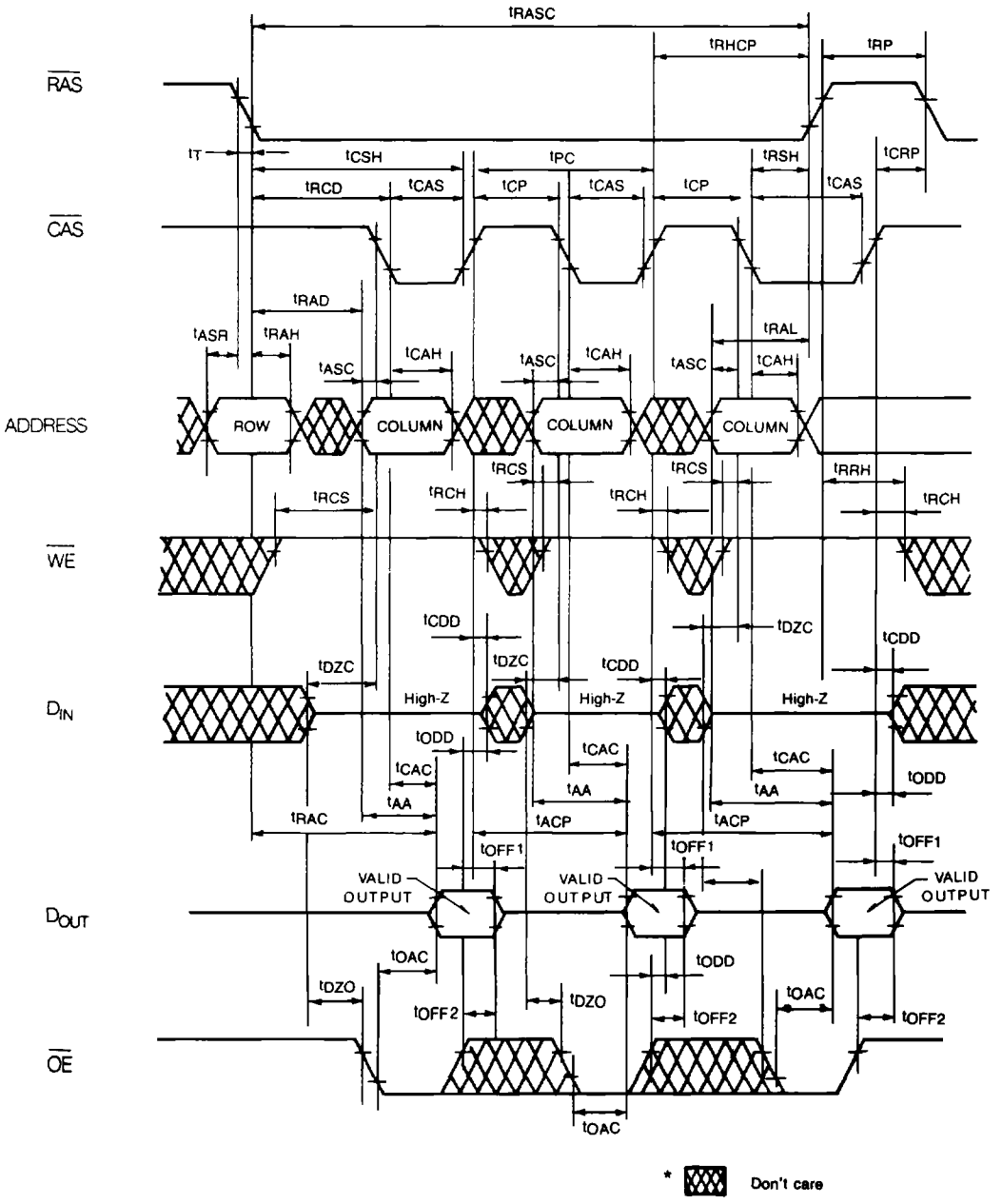


FIGURE 8. FAST PAGE MODE READ CYCLE

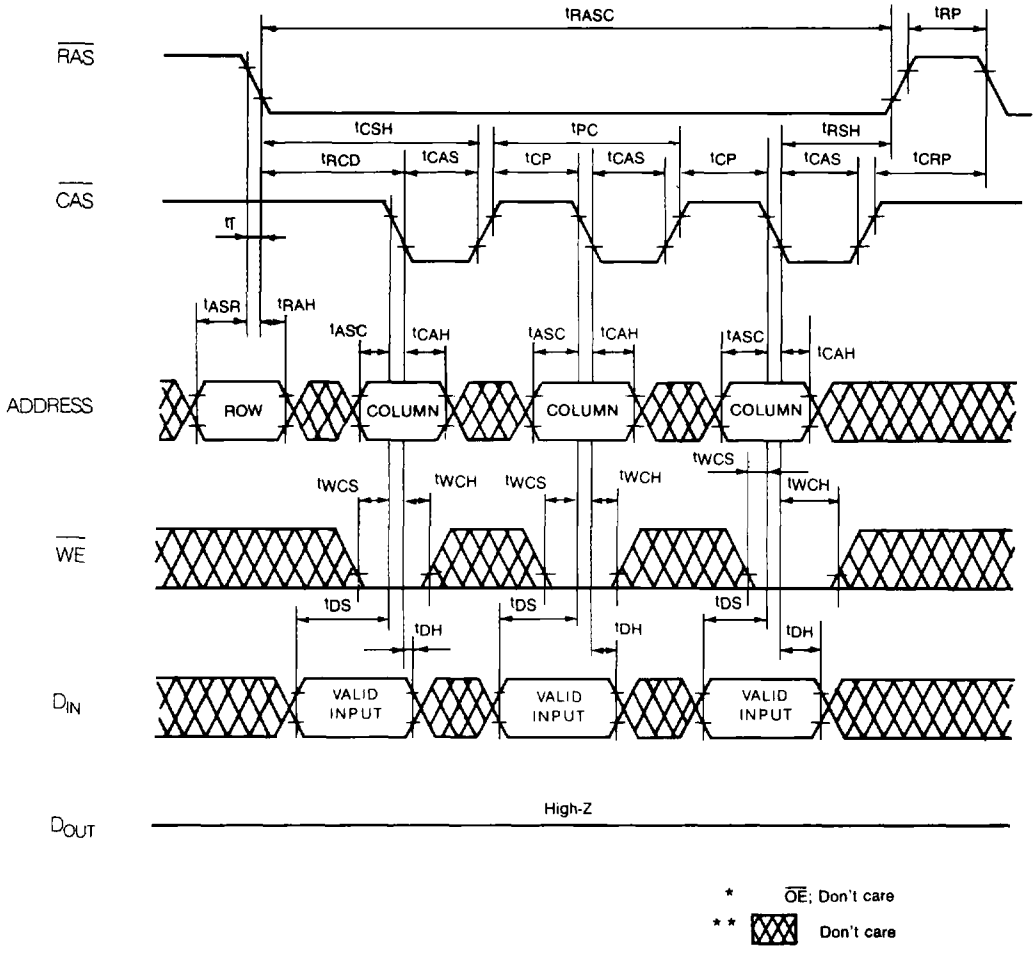


FIGURE 9. FAST PAGE MODE EARLY WRITE CYCLE

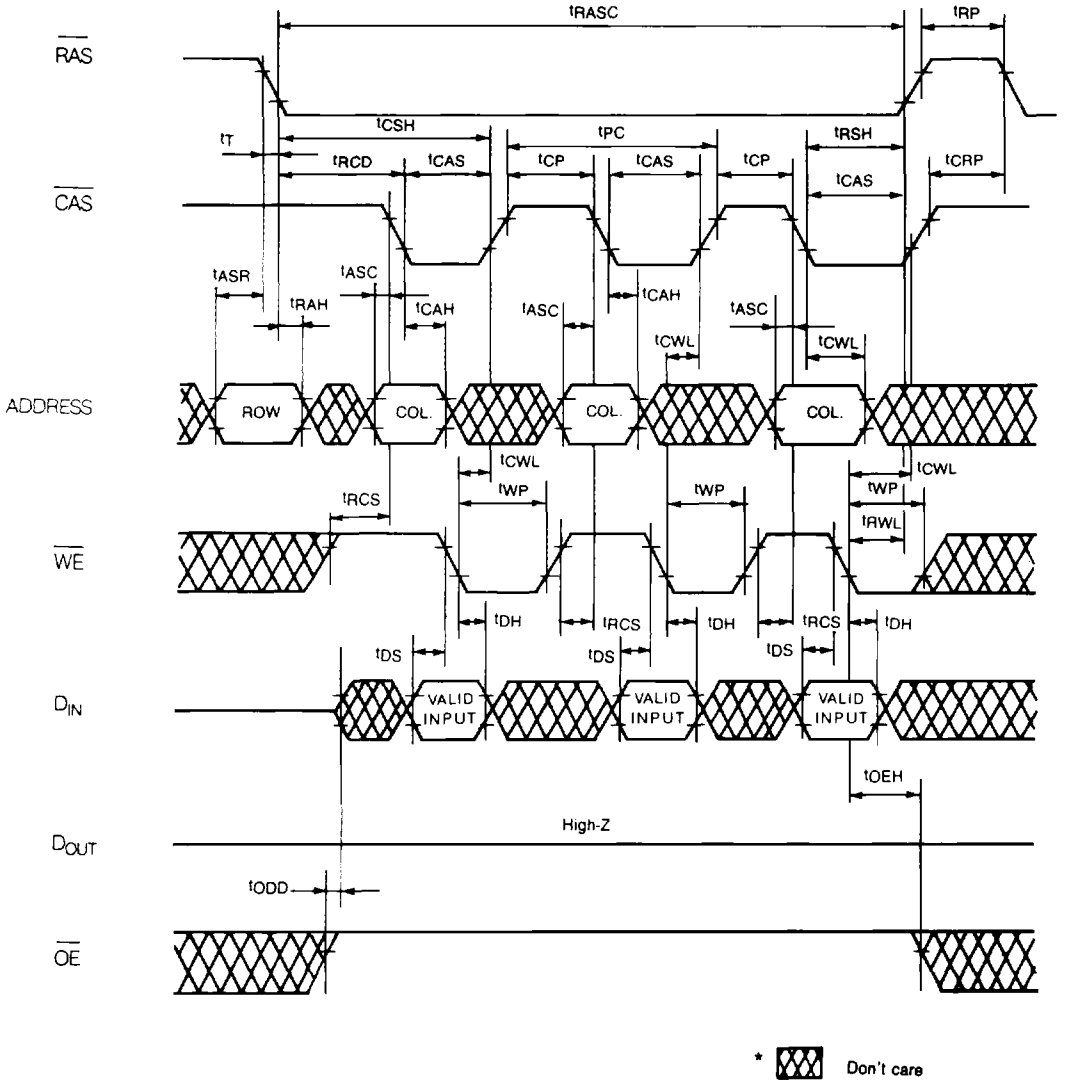


FIGURE 10. FAST PAGE MODE DELAYED WRITE CYCLE

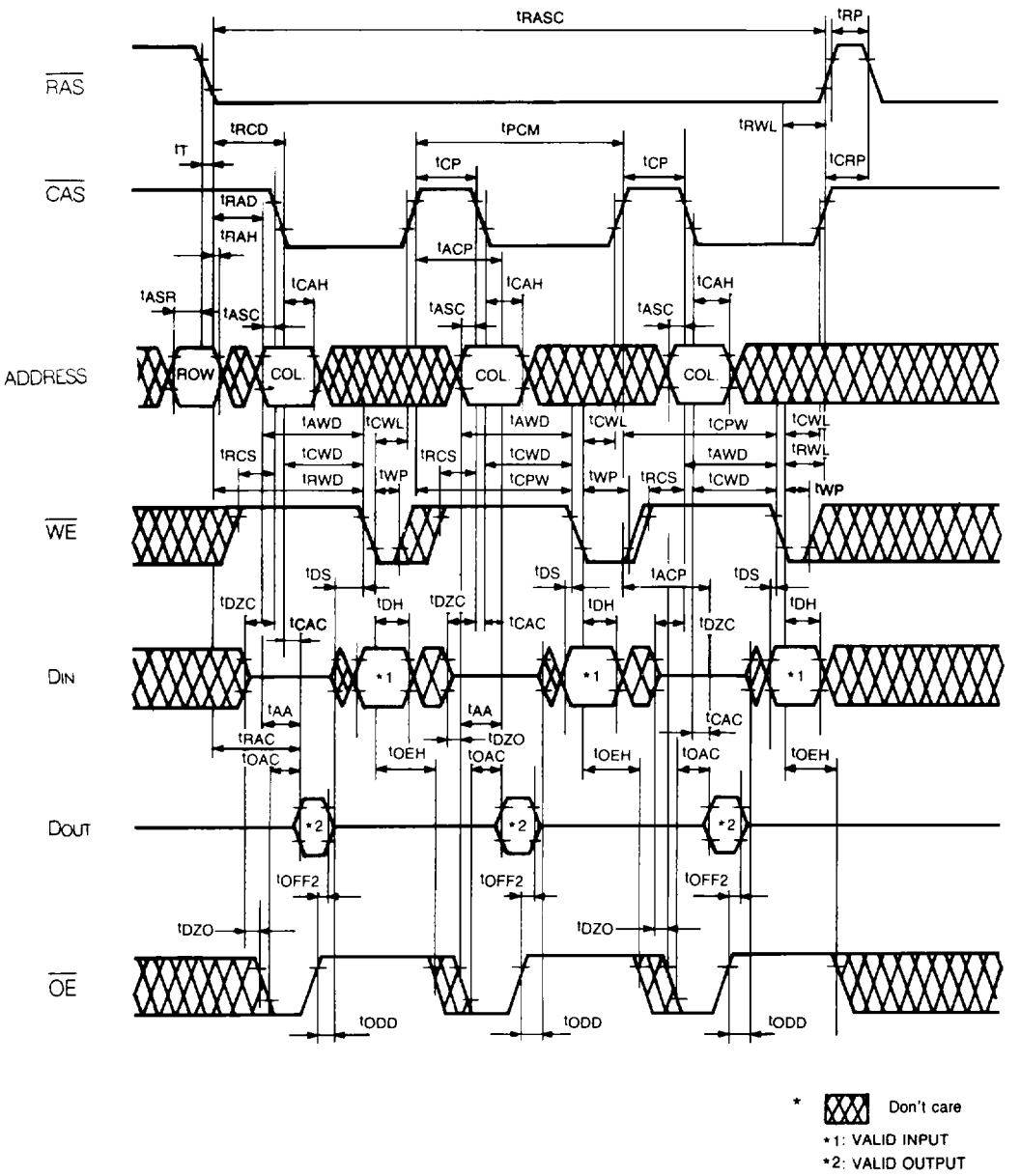


FIGURE 11. FAST PAGE MODE READ-MODIFY-WRITE CYCLE

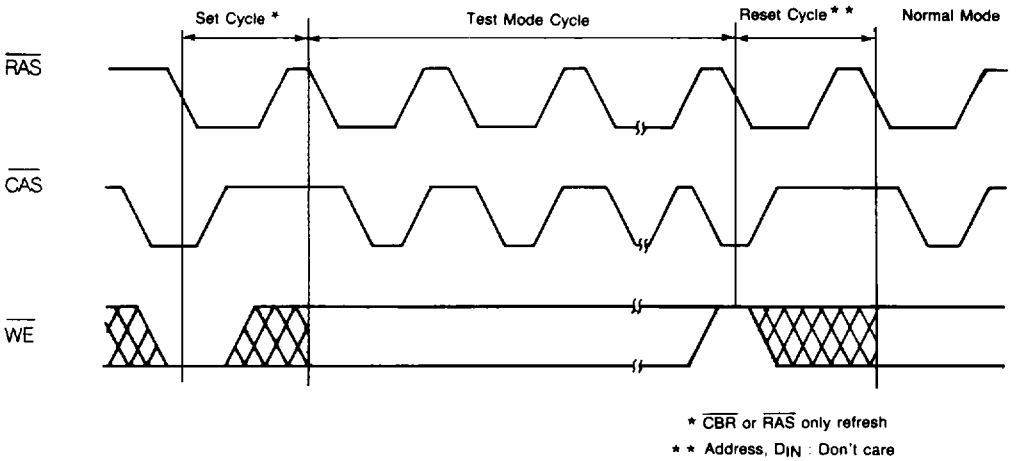


FIGURE 12. TEST MODE CYCLE

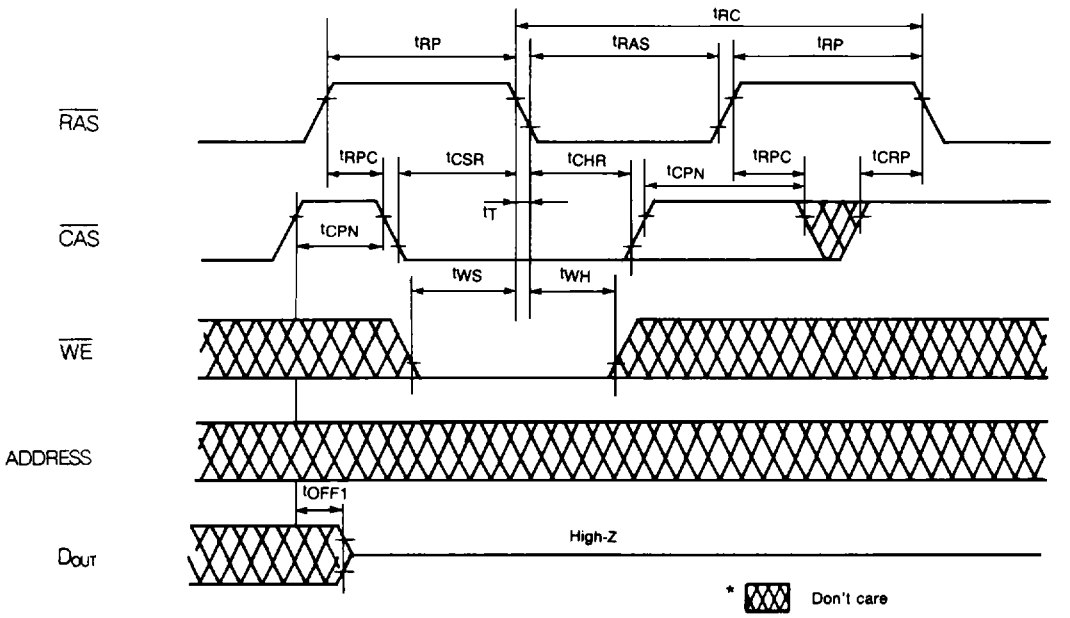


FIGURE 13. TEST MODE SET CYCLE

TEST MODE RESET CYCLE

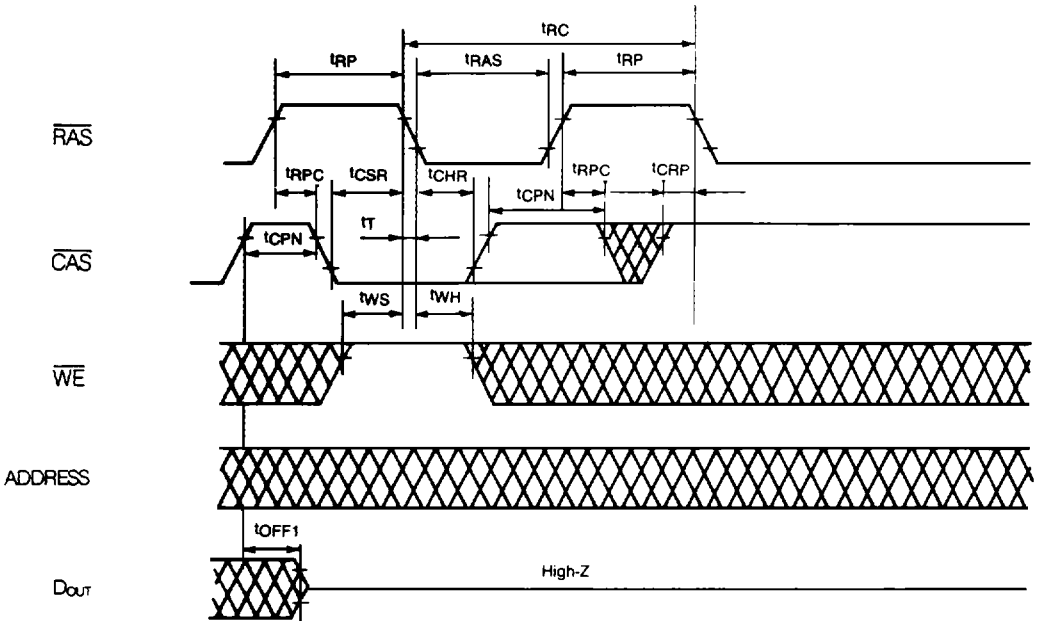


FIGURE 14. CAS-BEFORE-RAS REFRESH CYCLE

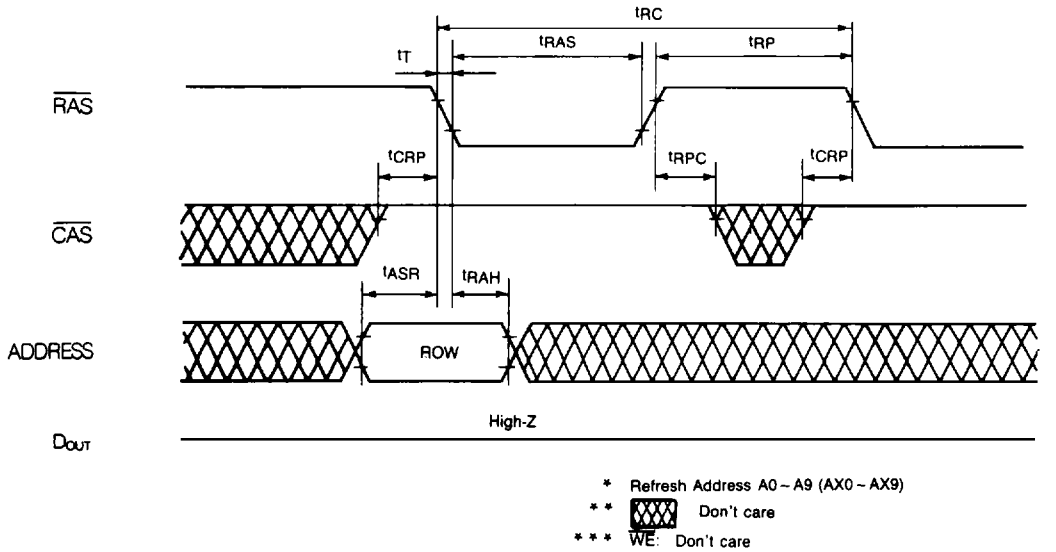


FIGURE 15. RAS-ONLY REFRESH CYCLE

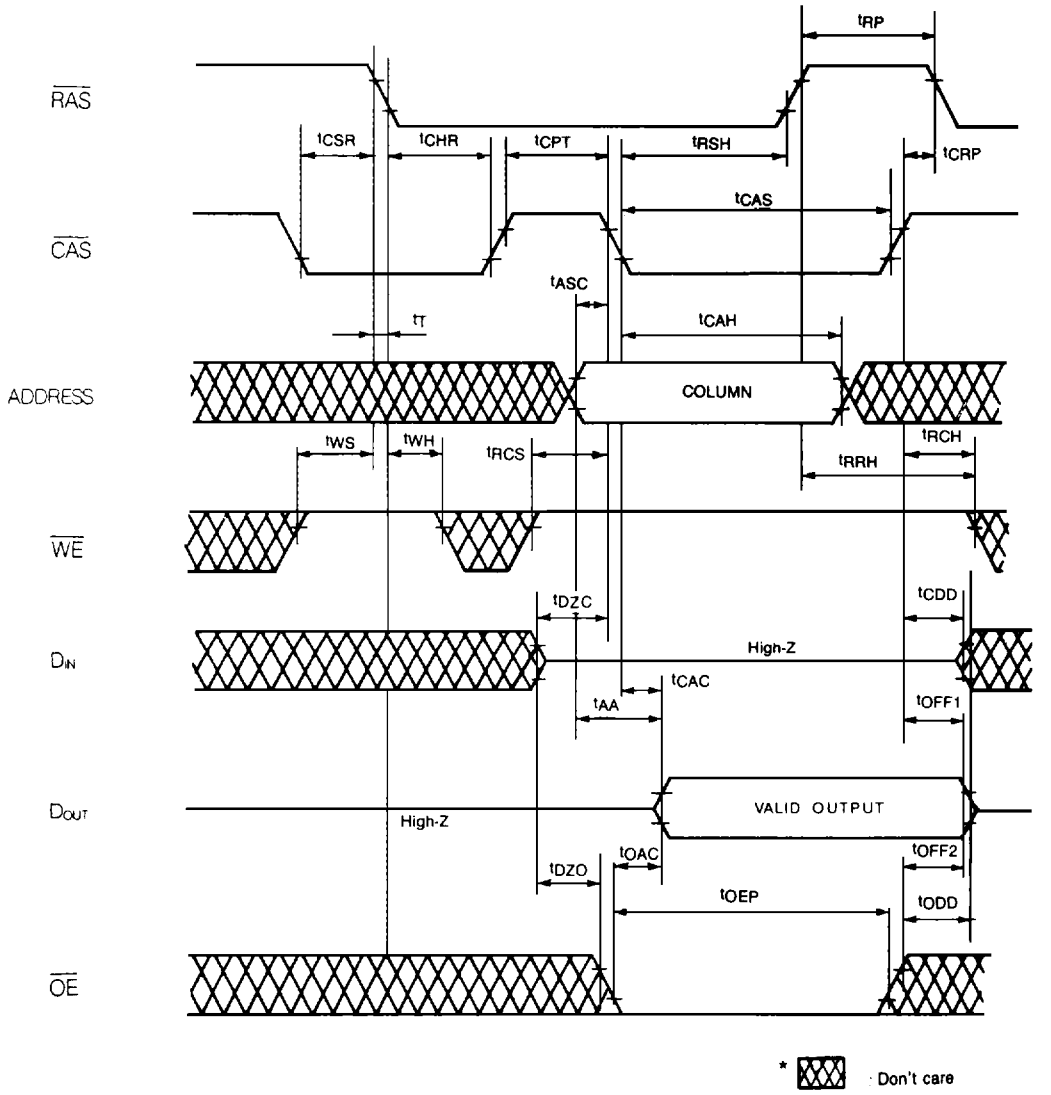


FIGURE 16. $\overline{\text{CAS}}$-BEFORE-$\overline{\text{RAS}}$ REFRESH COUNTER CHECK CYCLE (READ)

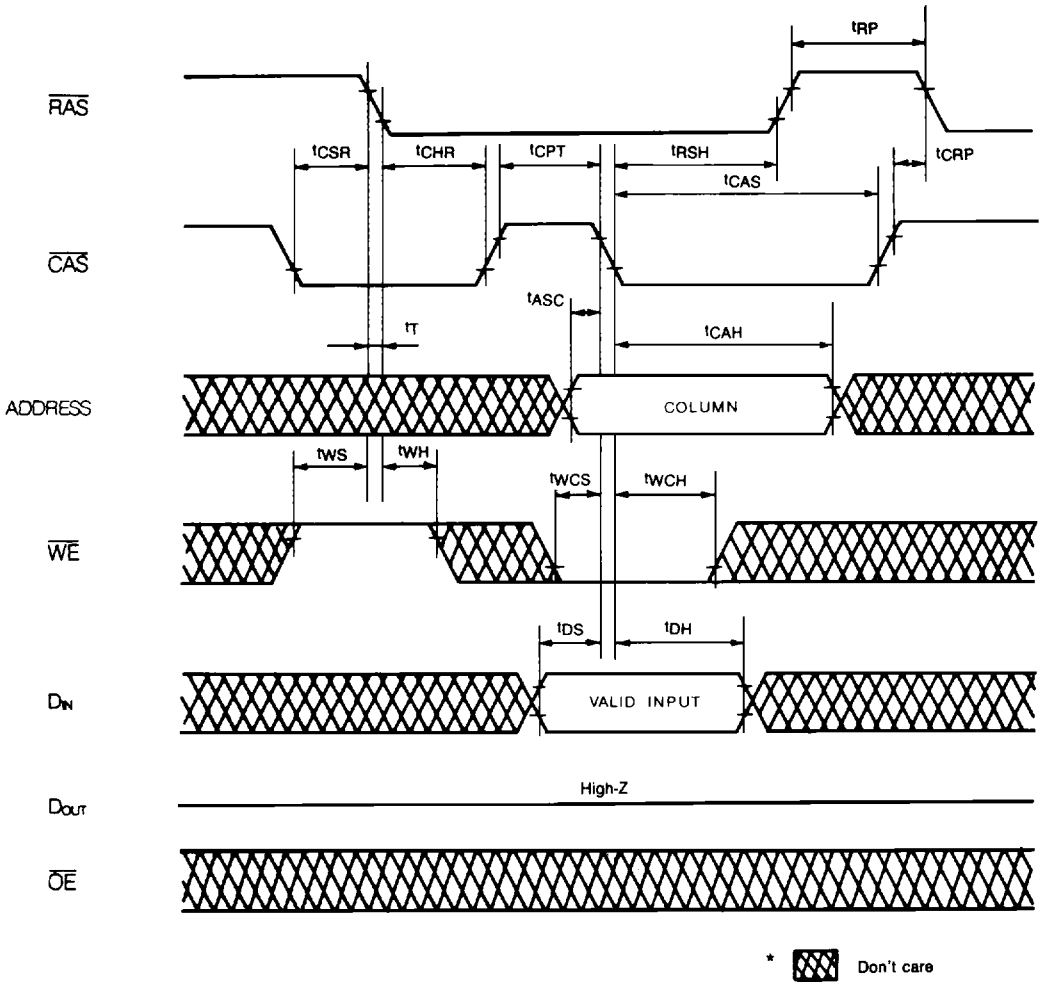
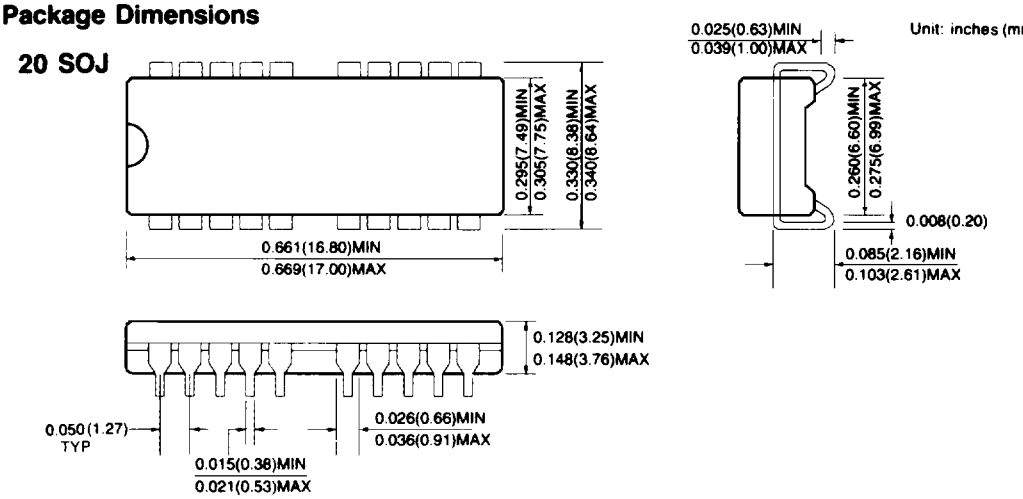


FIGURE 17. $\overline{\text{CAS}}$-BEFORE-$\overline{\text{RAS}}$ REFRESH COUNTER CHECK CYCLE (WRITE)

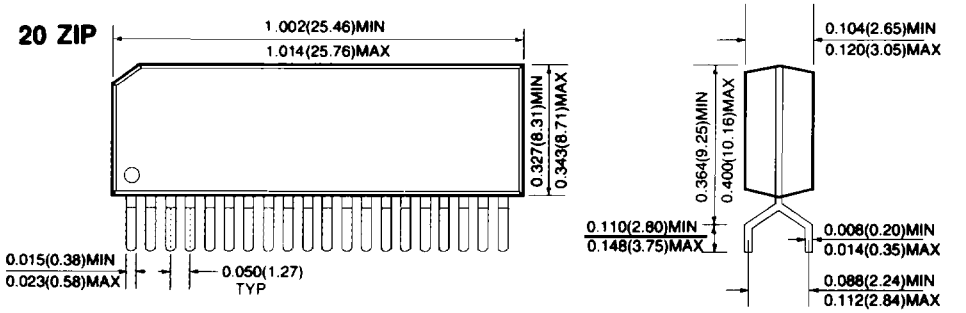
Package Dimensions

Unit: inches (mm)

20 SOJ



20 ZIP



20(26) TSOP (TYPE II)