HM51W4260C Series

262,144-word × 16-bit Dynamic Random Access Memory

HITACHI

ADE-203-292C (Z)
Rev. 3.0
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Description

The Hitachi HM51W4260C is CMOS dynamic RAM organized as 262,144-word × 16-bit. HM51W4260C has realized higher density, higher performance and various functions by employing 0.8 µm CMOS process technology and some new CMOS circuit design technologies. The HM51W4260C offers Fast Page Mode as a high speed access mode. It is packaged in standard 44-pin plastic TSOPII.

Features

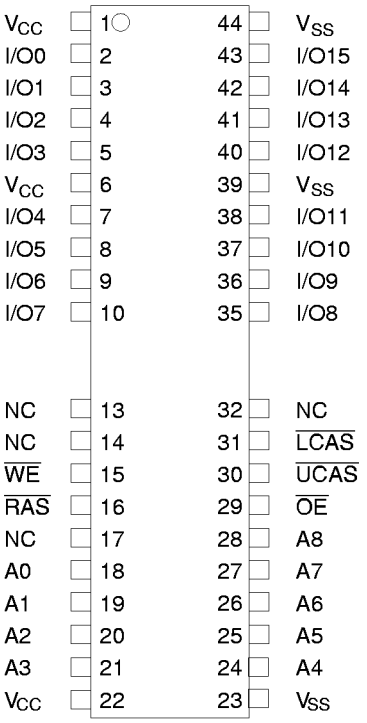
- Single 3.3 V supply: 3.3 V ±0.15 V (HM51W4260C-6R)
  3.3 V ±0.3 V (HM51W4260C-7/8)
- Access time: 60 ns/70 ns/80 ns (max)
- Power dissipation
  - — Active mode: 449 mW/396 mW/342 mW (max)
  - — Standby mode: 6.9 mW (max) (HM51W4260C-6R)
    7.2 mW (max) (HM51W4260C-7/8)
    0.35 mW (max) (L-version) (HM51W4260CL-6R)
    0.36 mW (max) (L-version) (HM51W4260CL-7/8)
- Fast page mode capability
- Refresh cycles
  - — 512 refresh cycles: 8 ms
    128 ms (L-version)
- 2 $\overline{\text{CAS}}$-byte control
- 3 variations of refresh
  - — $\overline{\text{RAS}}$-only refresh
  - — $\overline{\text{CAS}}$-before-$\overline{\text{RAS}}$ refresh
  - — Self refresh
- Battery back up operation (L-version)

Ordering Information

Type No.	Access time	Package
HM51W4260CTT-6R	60 ns	400-mill 44-pin plastic TSOP II (TTP-44/40DB)
HM51W4260CTT-7	70 ns	
HM51W4260CTT-8	80 ns	
HM51W4260CLTT-6R	60 ns	
HM51W4260CLTT-7	70 ns	
HM51W4260CLTT-8	80 ns	

Pin Arrangement

HM51W4260CTT/CLTTSeries

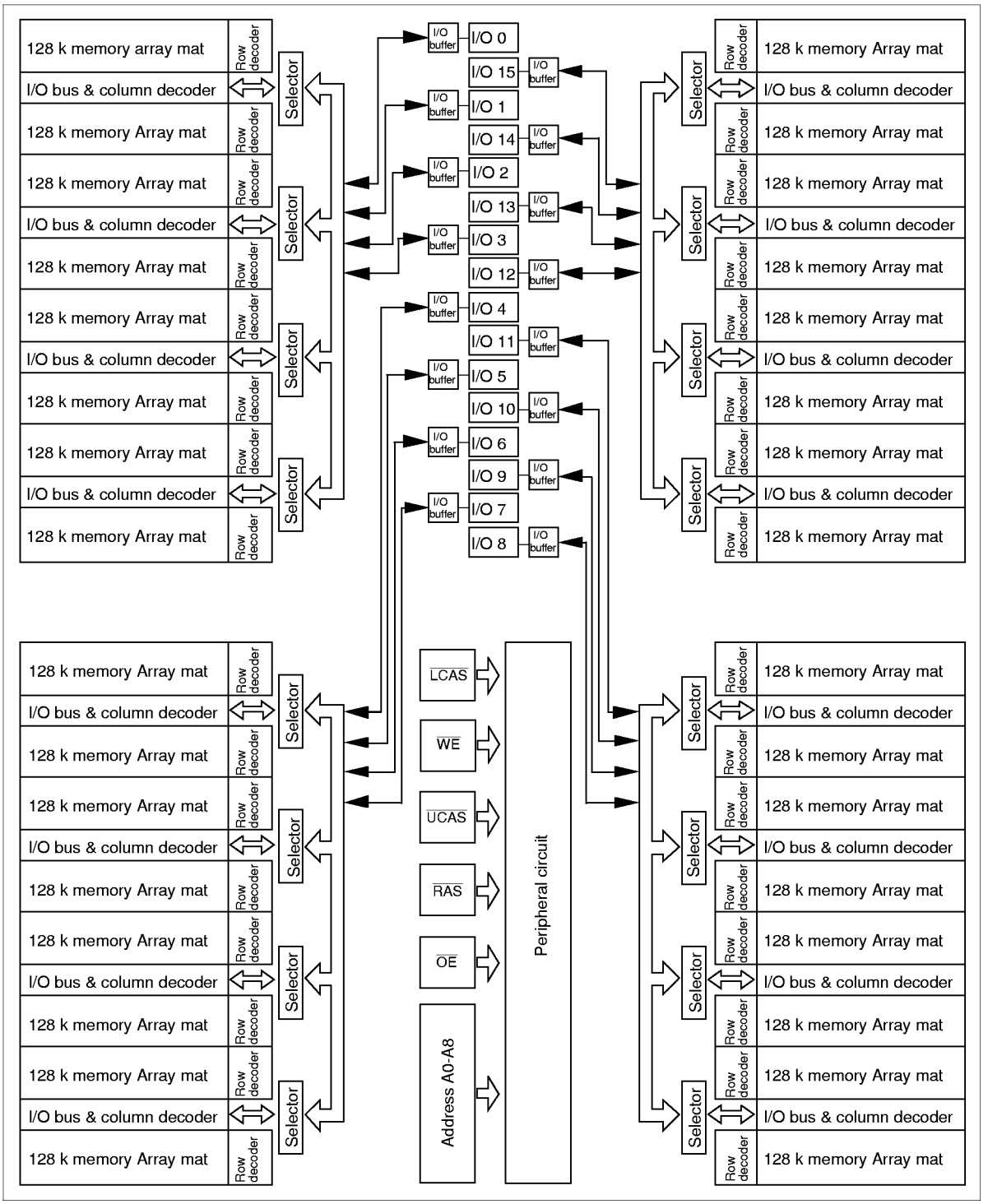


(Top view)

Pin Description

Pin name	Function
A0 to A8	Address input – Row address A0 to A8 – Column address A0 to A8 – Refresh address A0 to A8
I/O0 to I/O15	Data input/output
$\overline{RAS}$	Row address strobe
$\overline{UCAS}$, $\overline{LCAS}$	Column address strobe
$\overline{WE}$	Read/write enable
$\overline{OE}$	Output enable
V_{CC}	Power supply
V_{SS}	Ground
NC	No connection

Block Diagram



Operation Table

The HM51W4260C series has the following 11 operation modes.

1. Read cycle
2. Early write cycle
3. Delayed write cycle
4. Read-modify-write cycle
5. $\overline{\text{RAS}}$-only refresh cycle
6. $\overline{\text{CAS}}$-before-$\overline{\text{RAS}}$ refresh cycle
7. Self refresh cycle
8. Fast page mode read cycle
9. Fast page mode early write cycle
10. Fast page mode delayed write cycle
11. Fast page mode read-modify-write cycle

Inputs

$\overline{RAS}$	$\overline{LCAS}$	$\overline{UCAS}$	$\overline{WE}$	$\overline{OE}$	Output	Operation
H	H	H	D	D	Open	Standby
H	L	L	H	L	Valid	Standby
L	L	L	H	L	Valid	Read cycle
L	L	L	L*2	D	Open	Early write cycle
L	L	L	L*2	H	Undefined	Delayed write cycle
L	L	L	H to L	L to H	Valid	Read-modify-write cycle
L	H	H	D	D	Open	$\overline{RAS}$-only refresh cycle
H to L	H	L	D	D	Open	$\overline{CAS}$-before-$\overline{RAS}$ refresh cycle
	L	H				Self refresh cycle
	L	L				
L	H to L	H to L	H	L	Valid	Fast page mode read cycle
L	H to L	H to L	L*2	D	Open	Fast page mode early write cycle
L	H to L	H to L	L*2	H	Undefined	Fast page mode delayed write cycle
L	H to L	H to L	H to L	L to H	Valid	Fast page mode read-modify-write cycle
L	L	L	H	H	Open	Read cycle (Output disabled)

Notes: 1. H: High(inactive) L: Low(active) D: H or L (H: V_{IH} (min) ≤ V_{IN} ≤ V_{IH} (max), L: V_{IL} (min) ≤ V_{IN} ≤ V_{IL} (max))

2. $t_{WCS} \geq 0$ ns: Early write cycle
   $t_{WCS} < 0$ ns: Delayed write cycle
3. Mode is determined by the OR function of the $\overline{UCAS}$ and $\overline{LCAS}$. (Mode is set by the earliest of $\overline{UCAS}$ and $\overline{LCAS}$ active edge and reset by the latest of $\overline{UCAS}$ and $\overline{LCAS}$ inactive edge.) However write operation and output High-Z control are done independently by each $\overline{UCAS}$, $\overline{LCAS}$.
   ex. if $\overline{RAS}$ = H to L, $\overline{LCAS}$ = L, $\overline{UCAS}$ = H, then $\overline{CAS}$-before-$\overline{RAS}$ refresh cycle is selected.

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Voltage on any pin relative to V_{SS}	V_T	–0.5 to +4.6	V
Supply voltage relative to V_{SS}	V_{CC}	–0.5 to +4.6	V
Short circuit output current	Iout	50	mA
Power dissipation	P_T	1.0	W
Operating temperature	Topr	0 to +70	°C
Storage temperature	Tstg	–55 to +125	°C

Recommended DC Operating Conditions (Ta = 0 to +70°C)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Supply voltage	V_{SS}	0	0	0	V	2
	V_{CC} (HM51W4260C-6R)	3.15	3.3	3.45	V	1, 2
	V_{CC} (HM51W4260C-7/8)	3.0	3.3	3.6	V	1, 2
Input high voltage	V_{IH}	2.0	—	V_{CC} + 0.3	V	1
Input low voltage	V_{IL}	–0.3	—	0.8	V	1

Notes: 1. All voltage referred to V_{SS}
2. The supply voltage with all V_{CC} pins must be on the same level.
The supply voltage with all V_{SS} pins must be on the same level.

DC Characteristics

(Ta = 0 to 70°C, V_{CC} = 3.3 V ± 0.15 V, V_{SS} = 0 V) (HM51W4260C-6R)*5
(Ta = 0 to 70°C, V_{CC} = 3.3 V ± 0.3 V, V_{SS} = 0 V) (HM51W4260C-7/8) *5

		HM51W4260C							
		-6R		-7		-8			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Test conditions**
Operating current*1, *2	I_{CC1}	—	130	—	110	—	95	mA	$\overline{RAS}$, $\overline{UCAS}$, $\overline{LCAS}$ cycling t_{RC} = min
Standby current	I_{CC2}	—	2	—	2	—	2	mA	TTL interface $\overline{RAS}$, $\overline{UCAS}$, $\overline{LCAS}$ = V_{IH} Dout = High-Z
		—	1	—	1	—	1	mA	CMOS interface $\overline{RAS}$, $\overline{UCAS}$, $\overline{LCAS}$, $\overline{WE}$, $\overline{OE}$ ≥ V_{CC} – 0.2 V Dout = High-Z
Standby current (L-version)		—	100	—	100	—	100	µA	CMOS interface $\overline{RAS}$, $\overline{UCAS}$, $\overline{LCAS}$, $\overline{OE}$, $\overline{WE}$ ≥ V_{CC} – 0.2 V Dout = High-Z
$\overline{RAS}$-only refresh current*2	I_{CC3}	—	125	—	105	—	92	mA	t_{RC} = min
Standby current*1	I_{CC5}	—	5	—	5	—	5	mA	$\overline{RAS}$ = V_{IH}, $\overline{UCAS}$, $\overline{LCAS}$ = V_{IL} Dout = enable
$\overline{CAS}$-before-$\overline{RAS}$ refresh current*2	I_{CC6}	—	125	—	105	—	92	mA	t_{RC} = min
Fast page mode current*1, *3	I_{CC7}	—	115	—	95	—	80	mA	t_{PC} = min
Battery back up current*4 (Standby with CBR refresh) (L-version)	I_{CC10}	—	100	—	100	—	100	µA	Standby: CMOS interface Dout = High-Z CBR refresh: t_{RC} = 250 µs t_{RAS} ≤ 1 µs, $\overline{UCAS}$, $\overline{LCAS}$ = V_{IL} $\overline{WE}$, $\overline{OE}$ = V_{IH}
Self-refresh mode current (HM51W4260C)	I_{CC11}	—	1	—	1	—	1	mA	CMOS interface $\overline{RAS}$, $\overline{UCAS}$, $\overline{LCAS}$ ≤ 0.2 V, Dout = High-Z
Self-refresh mode current (HM51W4260CL)		—	100	—	100	—	100	µA	CMOS interface $\overline{RAS}$, $\overline{UCAS}$, $\overline{LCAS}$ ≤ 0.2 V, Dout = High-Z
Input leakage current	I_{LI}	–10	10	–10	10	–10	10	µA	0 V ≤ Vin ≤ 4.6 V
Output leakage current	I_{LO}	–10	10	–10	10	–10	10	µA	0 V ≤ Vout ≤ 4.6 V, Dout = disable
Output high voltage	V_{OH}	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	V	High Iout = –2 mA
Output low voltage	V_{OL}	0	0.4	0	0.4	0	0.4	V	Low Iout = 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 $\overline{RAS}$ = V_{IL}.
3. Address can be changed once or less while $\overline{UCAS}$ and $\overline{LCAS}$ = V_{IH}.
4. $V_{IH} \geq V_{CC} - 0.2$ V, $0 \leq V_{IL} \leq 0.2$ V, Address can be changed once or less while $\overline{RAS}$ = V_{IL}
5. All the V_{CC} pins shall be supplied with the same voltage. And all the V_{SS} pins shall be supplied with the same voltage.

Capacitance (Ta = +25°C, V_{CC} = 3.3 V ± 0.15 V) (HM51W4260C-6R)
(Ta = +25°C, V_{CC} = 3.3 V ± 0.3 V) (HM51W4260C-7/8)

Parameter	Symbol	Typ	Max	Unit	Notes
Input capacitance (Address)	C_{I1}	—	5	pF	1
Input capacitance (Clocks)	C_{I2}	—	7	pF	1
Output capacitance (Data-in, Data-out)	$C_{I/O}$	—	10	pF	1, 2

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

AC Characteristics

(Ta = 0 to 70°C, V_{CC} = 3.3 V ± 0.15 V, V_{SS} = 0 V) (HM51W4260C-6R)*1, *14, *15, *17, *18
(Ta = 0 to 70°C, V_{CC} = 3.3 V ±0.3 V, V_{SS} = 0 V) (HM51W4260C-7/8) *1, *14, *15, *17, *18

Test Conditions

- Input rise and fall time: 5 ns
- Input levels: V_{IL} = 0 V, V_{IH} = 3 V
- Input timing reference levels: 0.8 V, 2.0 V
- Output load: 1 TTL gate + C_L (50 pF) (HM51W4260C-6R) (Including scope and jig)
  1 TTL gate + C_L (100 pF) (HM51W4260-7/8) (Including scope and jig)

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

		HM51W4260C							
		-6		-7		-8			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Random read or write cycle time	t_{RC}	110	—	130	—	150	—	ns	
$\overline{RAS}$ precharge time	t_{RP}	40	—	50	—	60	—	ns	
$\overline{RAS}$ pulse width	t_{RAS}	60	10000	70	10000	80	10000	ns	
$\overline{CAS}$ pulse width	t_{CAS}	15	10000	20	10000	20	10000	ns	23
Row address setup time	t_{ASR}	0	—	0	—	0	—	ns	
Row address hold time	t_{RAH}	10	—	10	—	10	—	ns	
Column address setup time	t_{ASC}	0	—	0	—	0	—	ns	19
Column address hold time	t_{CAH}	15	—	15	—	15	—	ns	19
$\overline{RAS}$ to $\overline{CAS}$ delay time	t_{RCD}	20	45	20	50	20	60	ns	8
$\overline{RAS}$ to column address delay time	t_{RAD}	15	30	15	35	15	40	ns	9
$\overline{RAS}$ hold time	t_{RSH}	15	—	20	—	20	—	ns	
$\overline{CAS}$ hold time	t_{CSH}	60	—	70	—	80	—	ns	
$\overline{CAS}$ to $\overline{RAS}$ precharge time	t_{CRP}	10	—	15	—	15	—	ns	20
$\overline{OE}$ to Din delay time	t_{ODD}	15	—	20	—	20	—	ns	
$\overline{OE}$ delay time from Din	t_{DZO}	0	—	0	—	0	—	ns	
$\overline{CAS}$ setup time from Din	t_{DZC}	0	—	0	—	0	—	ns	
Transition time (rise and fall)	t_T	3	50	3	50	3	50	ns	7
Refresh period	t_{REF}	—	8	—	8	—	8	ms	
Refresh period (L-version)	t_{REF}	—	128	—	128	—	128	ms	

Read Cycle

		HM51W4260C							
		-6		-7		-8			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Access time from $\overline{RAS}$	t_{RAC}	—	60	—	70	—	80	ns	2, 3
Access time from $\overline{CAS}$	t_{CAC}	—	15	—	20	—	20	ns	3, 4, 13
Access time from address	t_{AA}	—	30	—	35	—	40	ns	3, 5, 13
Access time from $\overline{OE}$	t_{OAC}	—	15	—	20	—	20	ns	3, 23
Read command setup time	t_{RCS}	0	—	0	—	0	—	ns	19
Read command hold time to $\overline{CAS}$	t_{RCH}	0	—	0	—	0	—	ns	16, 20
Read command hold time to $\overline{RAS}$	t_{RRH}	0	—	0	—	0	—	ns	16
Column address to $\overline{RAS}$ lead time	t_{RAL}	30	—	35	—	40	—	ns	
Output buffer turn-off time	t_{OFF1}	0	15	0	15	0	15	ns	6
Output buffer turn-off to $\overline{OE}$	t_{OFF2}	0	15	0	15	0	15	ns	6
$\overline{CAS}$ to Din delay time	t_{CDD}	15	—	15	—	15	—	ns	

Write Cycle

		HM51W4260C							
		-6R		-7		-8			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Write command setup time	t_{WCS}	0	—	0	—	0	—	ns	10, 19
Write command hold time	t_{WCH}	15	—	15	—	15	—	ns	19
Write command pulse width	t_{WP}	10	—	10	—	10	—	ns	
Write command to $\overline{RAS}$ lead time	t_{RWL}	15	—	20	—	20	—	ns	
Write command to $\overline{CAS}$ lead time	t_{CWL}	15	—	20	—	20	—	ns	21
Data-in setup time	t_{DS}	0	—	0	—	0	—	ns	11, 21
Data-in hold time	t_{DH}	15	—	15	—	15	—	ns	11, 21
$\overline{CAS}$ to $\overline{OE}$ delay time	t_{COD}	—	0	—	0	—	0	ns	19, 23

Read-Modify-Write Cycle

		HM51W4260C							
		-6R		-7		-8			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Read-modify-write cycle time	t_{RWC}	150	—	180	—	200	—	ns	
$\overline{RAS}$ to $\overline{WE}$ delay time	t_{RWD}	80	—	95	—	105	—	ns	10
$\overline{CAS}$ to $\overline{WE}$ delay time	t_{CWD}	35	—	45	—	45	—	ns	10
Column address to $\overline{WE}$ delay time	t_{AWD}	50	—	60	—	65	—	ns	10
$\overline{OE}$ hold time from $\overline{WE}$	t_{OEH}	15	—	20	—	20	—	ns	

Refresh Cycle

		HM51W4260C							
		-6R		-7		-8			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
$\overline{CAS}$ setup time (CBR refresh cycle)	t_{CSR}	10	—	10	—	10	—	ns	19
$\overline{CAS}$ hold time (CBR refresh cycle)	t_{CHR}	10	—	10	—	10	—	ns	20
$\overline{RAS}$ precharge to $\overline{CAS}$ hold time	t_{RPC}	10	—	10	—	10	—	ns	19
$\overline{CAS}$ precharge time in normal mode	t_{CPN}	10	—	10	—	10	—	ns	22

Fast Page Mode Cycle

		HM51W4260C							
		-6R		-7		-8			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Notes**
Fast page mode cycle time	t_{PC}	40	—	45	—	50	—	ns	
Fast page mode $\overline{CAS}$ precharge time	t_{CP}	10	—	10	—	10	—	ns	22
Fast page mode $\overline{RAS}$ pulse width	t_{RASC}	—	100000	—	100000	—	100000	ns	12
Access time from $\overline{CAS}$ precharge	t_{ACP}	—	35	—	40	—	45	ns	3, 13, 20
$\overline{RAS}$ hold time from $\overline{CAS}$ precharge	t_{RHCP}	35	—	40	—	45	—	ns	

Fast Page Mode Read-Modify-Write Cycle

		HM51W4260C							
		-6R		-7		-8			
Parameter	Symbol	Min	Max	Min	Max	Min	Max	Unit	Notes
Fast page mode read-modify-write cycle $\overline{CAS}$ precharge to $\overline{WE}$ delay time	t_{CPW}	55	—	65	—	70	—	ns	10, 20
Fast page mode read-modify-write cycle time	t_{PCM}	80	—	95	—	100	—	ns	

Self Refresh Mode

		HM51W4260C							
		-6R		-7		-8			
Parameter	Symbol	Min	Max	Min	Max	Min	Max	Unit	Notes
$\overline{RAS}$ pulse width (self-refresh)	t_{RASS}	100	—	100	—	100	—	µs	24, 25, 26, 27
$\overline{RAS}$ precharge time (self-refresh)	t_{RPS}	110	—	130	—	150	—	ns	
$\overline{CAS}$ hold time (self-refresh)	t_{CHS}	–50	—	–50	—	–50	—	ns	21

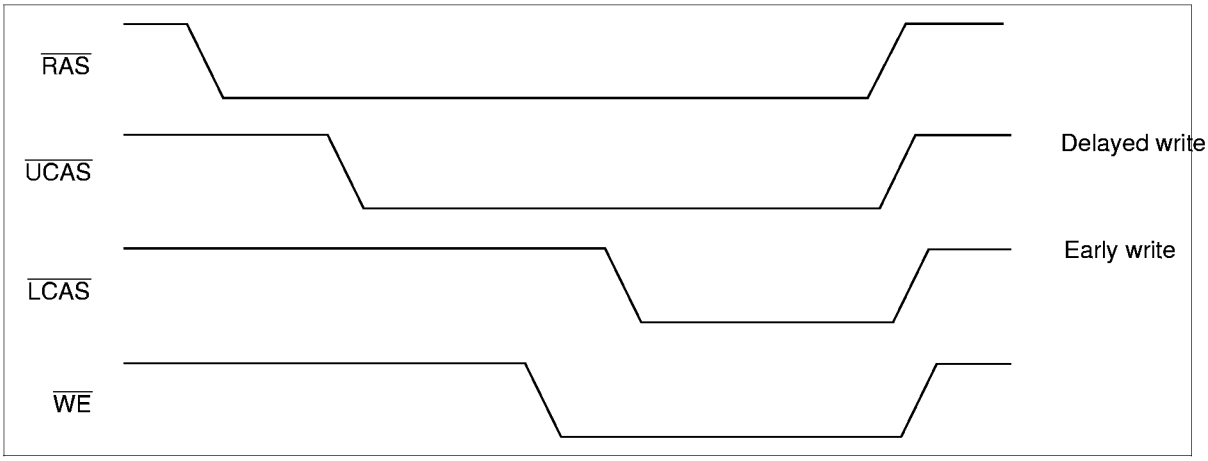
Notes:
1. AC measurements assume t_T = 5 ns.
2. Assumes that $t_{RCD} \leq t_{RCD}$ (max) and $t_{RAD} \leq t_{RAD}$ (max). If t_{RCD} or t_{RAD} is greater than the maximum recommended value shown in this table, t_{RAC} exceeds the value shown.
3. Measured with a load circuit equivalent to 1 TTL load and 50 pF (HM51W4260C-6R), 1 TTL load and 100 pF (HM51W4260C-7/8) (V_{OH} = 2.0 V, V_{OL} = 0.8 V).
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 referred 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} and t_{AWD} 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 referred to $\overline{CAS}$ leading edge in an early write cycle and to $\overline{WE}$ leading edge in a 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 longest among t_{AA}, t_{CAC} and 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. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
17. When both $\overline{UCAS}$ and $\overline{LCAS}$ go low at the same time, all 16-bit data are written into the device. $\overline{UCAS}$ and $\overline{LCAS}$ cannot be staggered within the same write/read cycles.
18. All the V_{CC} and V_{SS} pins shall be supplied with the same voltages.
19. t_{ASC}, t_{CAH}, t_{RCS}, t_{WCS}, t_{WCH}, t_{CSR}, t_{RPC} and t_{COD} are determined by the earlier falling edge of $\overline{UCAS}$ or $\overline{LCAS}$.
20. t_{CRP}, t_{CHR}, t_{ACP}, t_{RCH} and t_{CPW} are determined by the later rising edge of $\overline{UCAS}$ or $\overline{LCAS}$.
21. t_{CWL}, t_{DH}, t_{DS} and t_{CHS} should be satisfied by both $\overline{UCAS}$ and $\overline{LCAS}$.

22. t_{CPN} and t_{CP} are determined by the time that both $\overline{UCAS}$ and $\overline{LCAS}$ are high.
23. 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_{CC}/V_{SS} line noise, which causes to degrade V_{IH} min/V_{IL} max level.
24. Please do not use t_{RASS} timing, 10 μs ≤ t_{RASS} ≤ 100 μs. During this period, the device is in transition state from normal operation mode to self refresh mode. If t_{RASS} ≥ 100 μs, then $\overline{RAS}$ precharge time should use t_{RPS} instead of t_{RP}.
25. If you use distributed CBR refresh mode with 15.6 μs interval in normal read/write cycle, CBR refresh should be executed within 15.6 μs immediately after exiting from and before entering into self refresh mode.
26. If you use $\overline{RAS}$ only refresh or CBR burst refresh mode in normal read/write cycle, 512 cycles of distributed CBR refresh with 15.6 μs interval should be executed within 8 ms immediately after exiting from and before entering into the self refresh mode.
27. Repetitive self refresh mode without refreshing all memory is not allowed. Once you exit from self refresh mode, all memory cells need to be refreshed before re-entering the self refresh mode again.
28. XXX: H or L (H: V_{IH} (min) ≤ V_{IN} ≤ V_{IH} (max), L: V_{IL} (min) ≤ V_{IN} ≤ V_{IL} (max))
    ///////: Invalid Dout
    When the address, clock and input pins are not described on timing waveforms, their pins must be applied V_{IH} or V_{IL}.

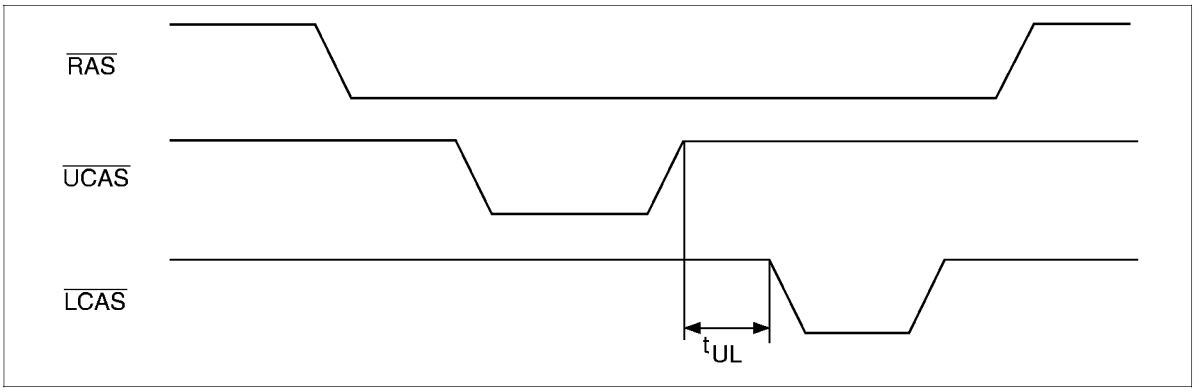
Notes concerning 2$\overline{CAS}$ control

Please do not separate the $\overline{UCAS}$/$\overline{LCAS}$ operation timing intentionally. However skew between $\overline{UCAS}$/$\overline{LCAS}$ are allowed under the following conditions.

1. Each of the $\overline{UCAS}$/$\overline{LCAS}$ should satisfy the timing specifications individually.
2. Different operation mode for upper/lower byte is not allowed; such as following.



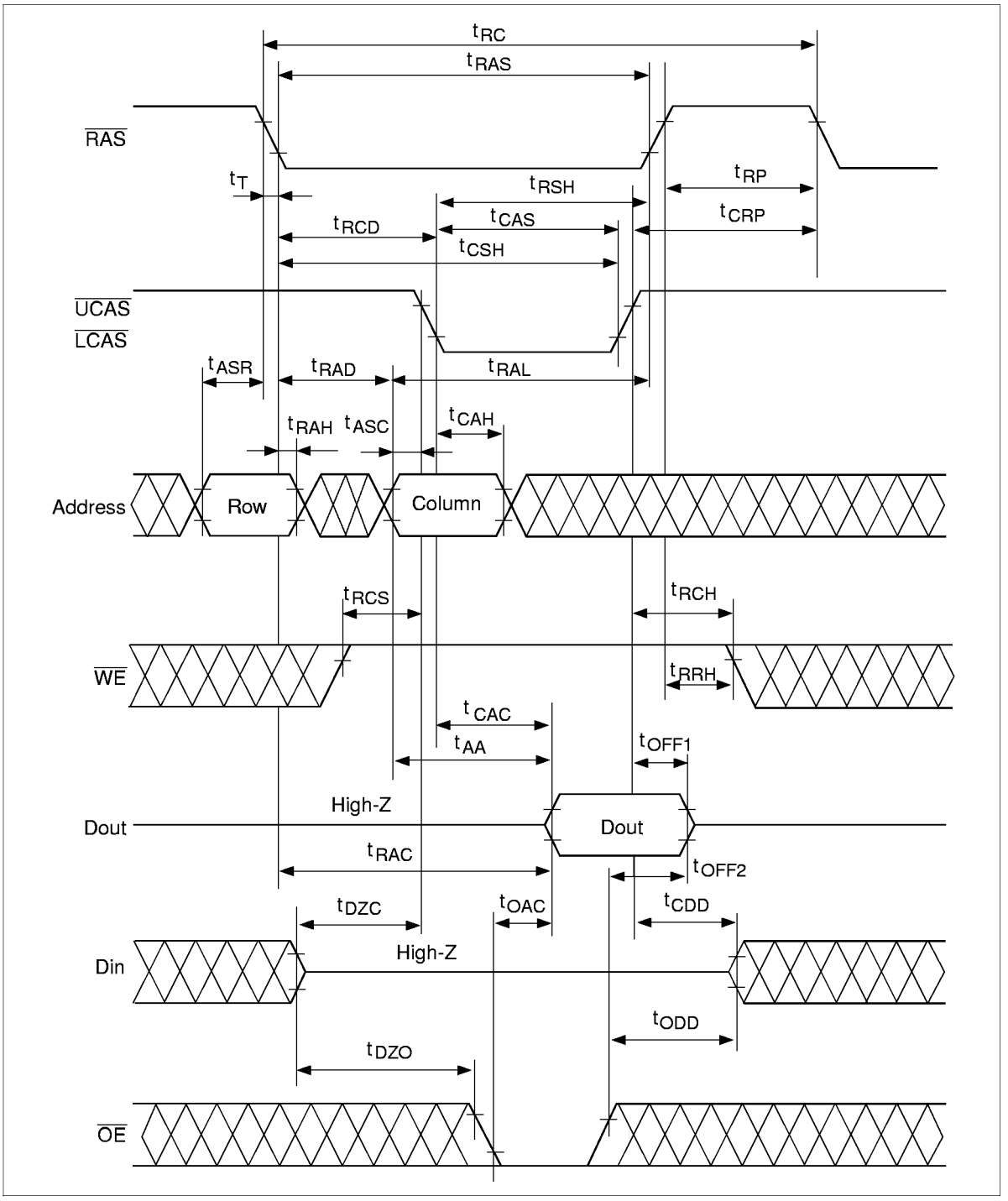
3. Closely separated upper/lower byte control is not allowed. However when the condition ($t_{CP} \leq t_{UL}$) is satisfied, fast page mode can be performed.



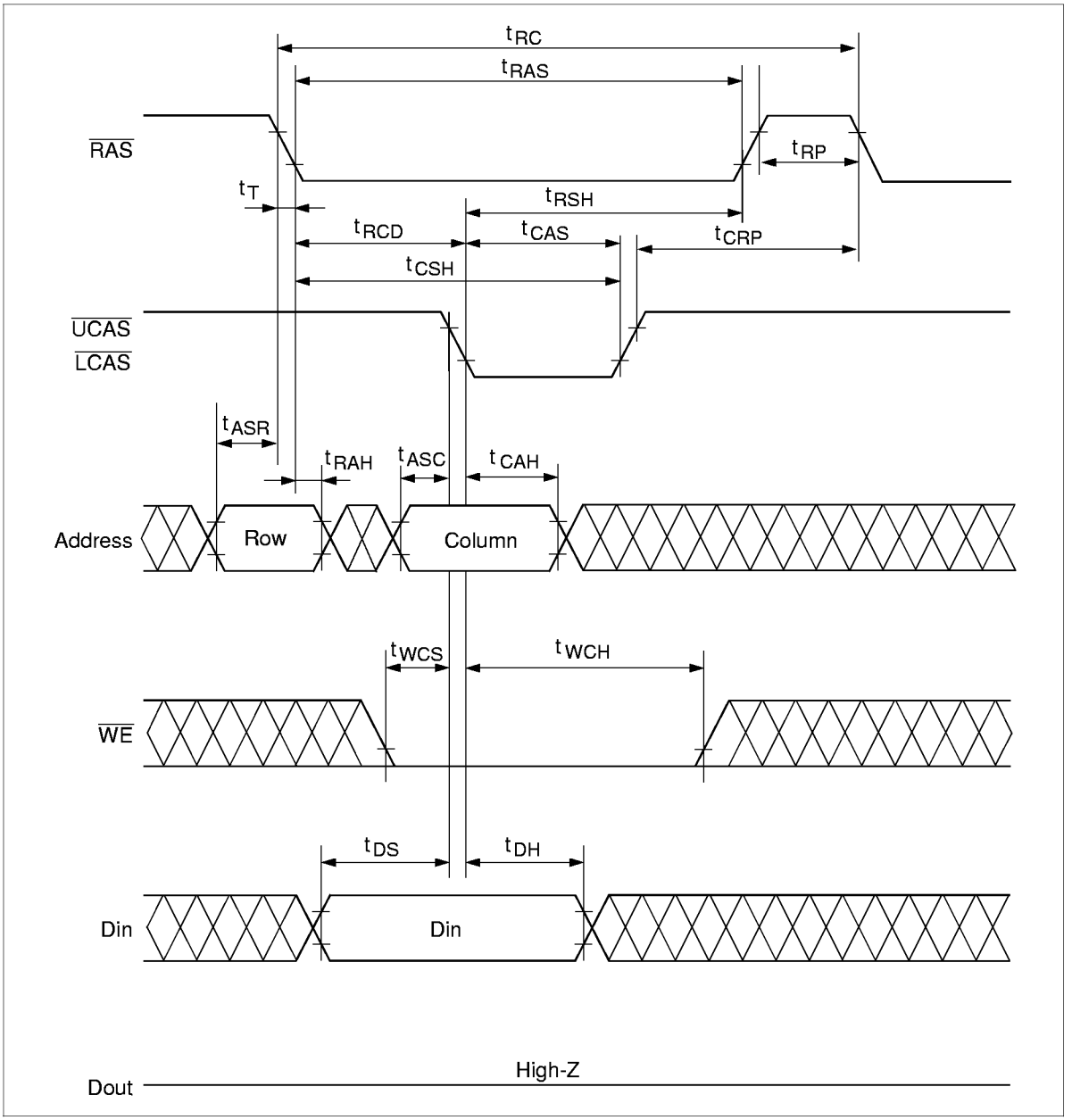
4. Byte control operation by remaining $\overline{UCAS}$ or $\overline{LCAS}$ high is guaranteed.

Timing Waveforms*[28]

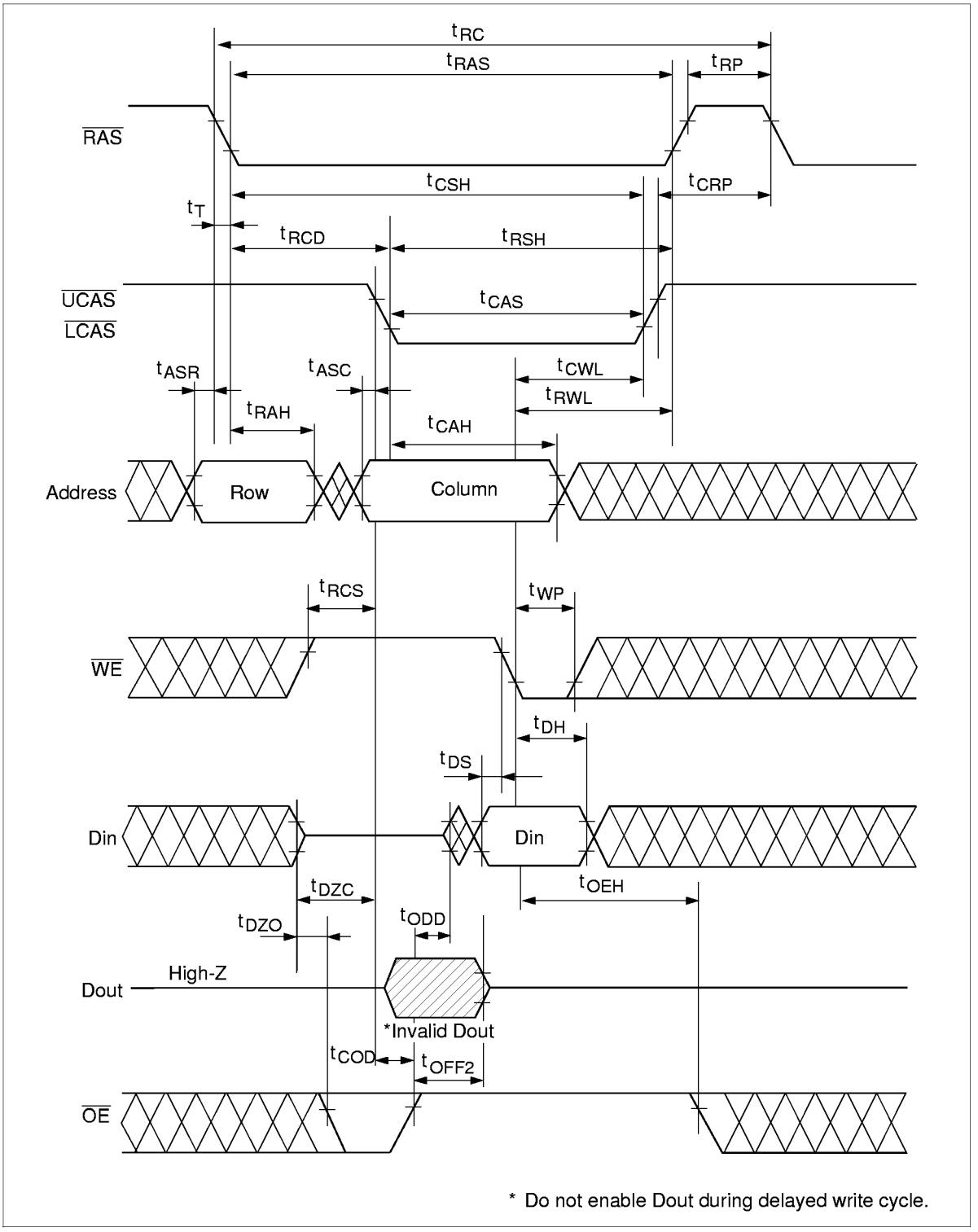
Read Cycle



Early Write Cycle

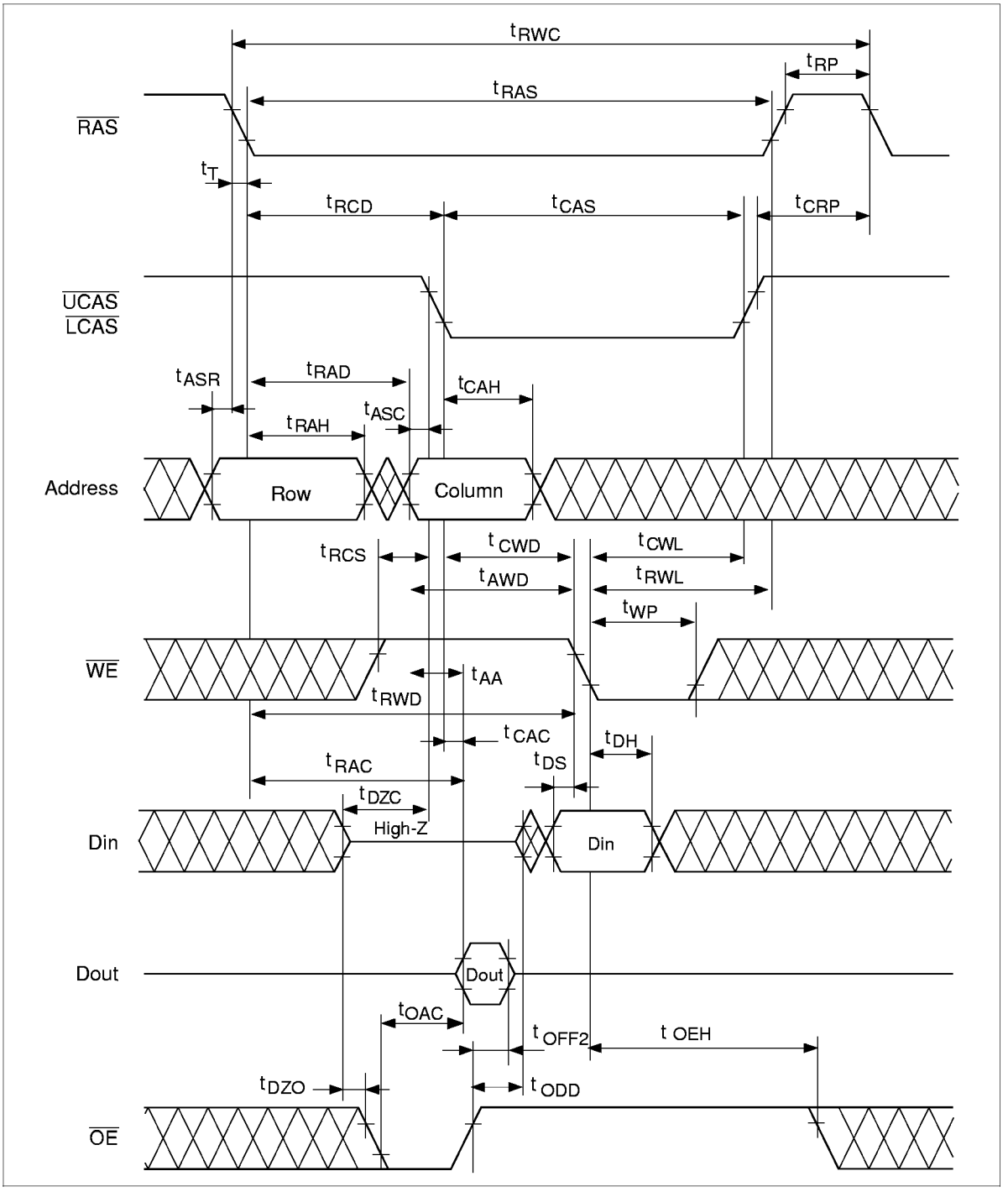


Delayed Write Cycle

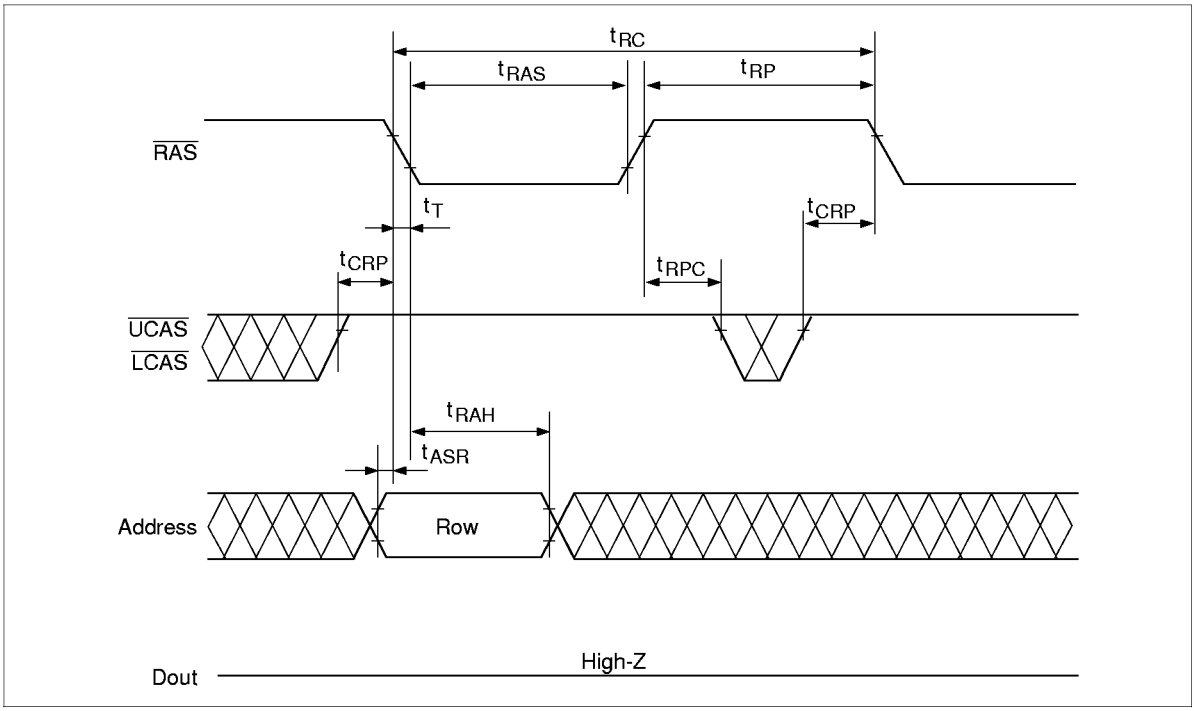


* Do not enable Dout during delayed write cycle.

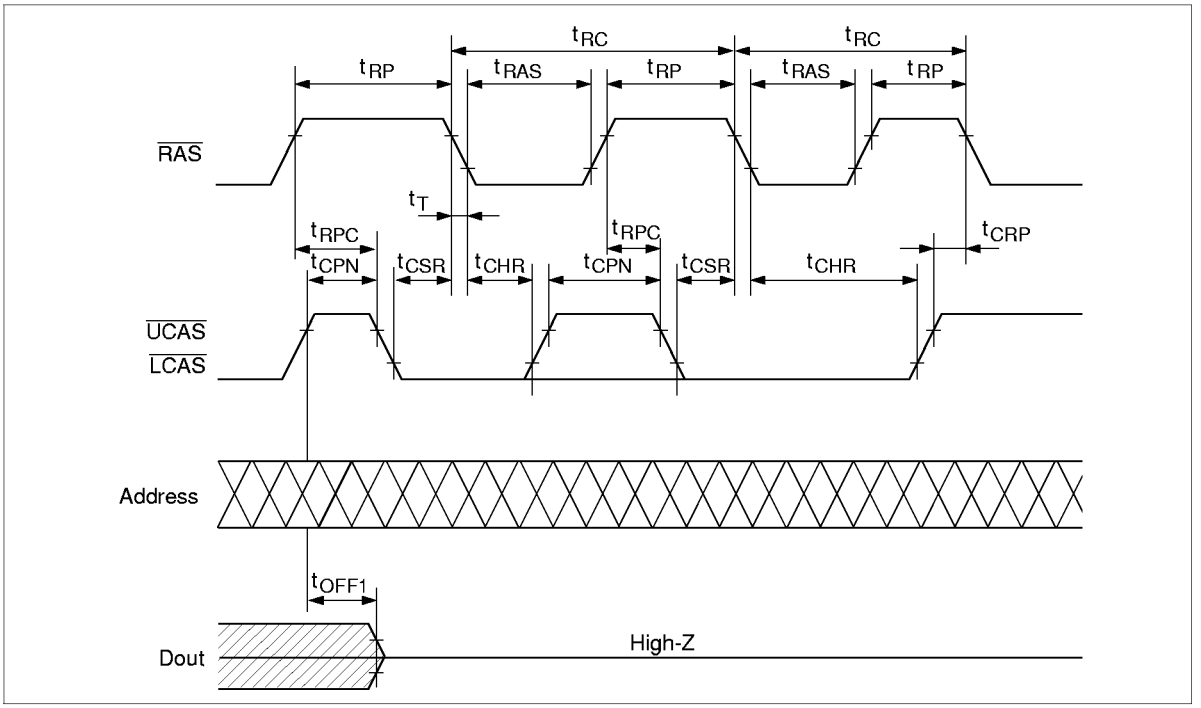
Read-Modify-Write Cycle



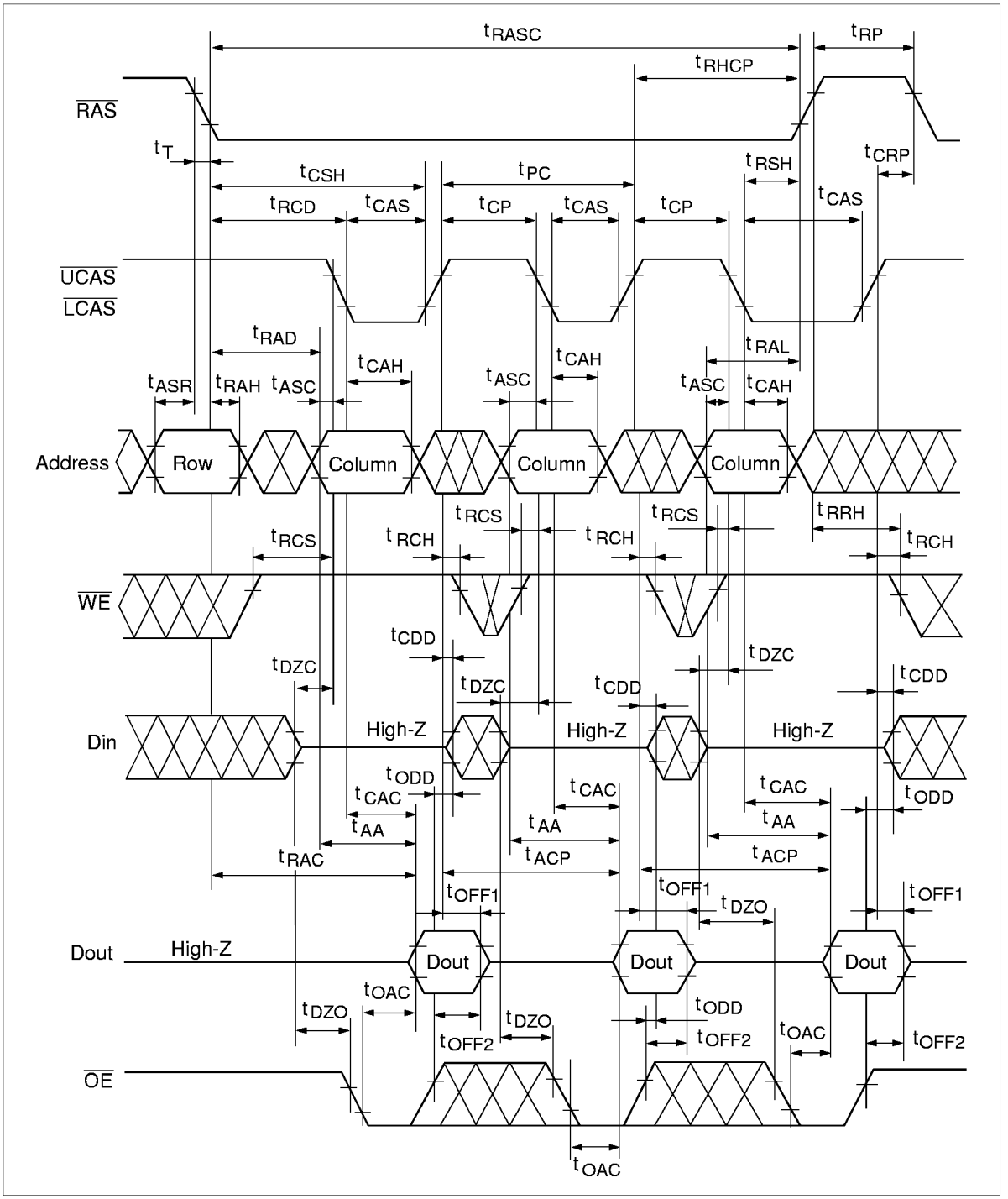
$\overline{\text{RAS}}$-Only Refresh Cycle



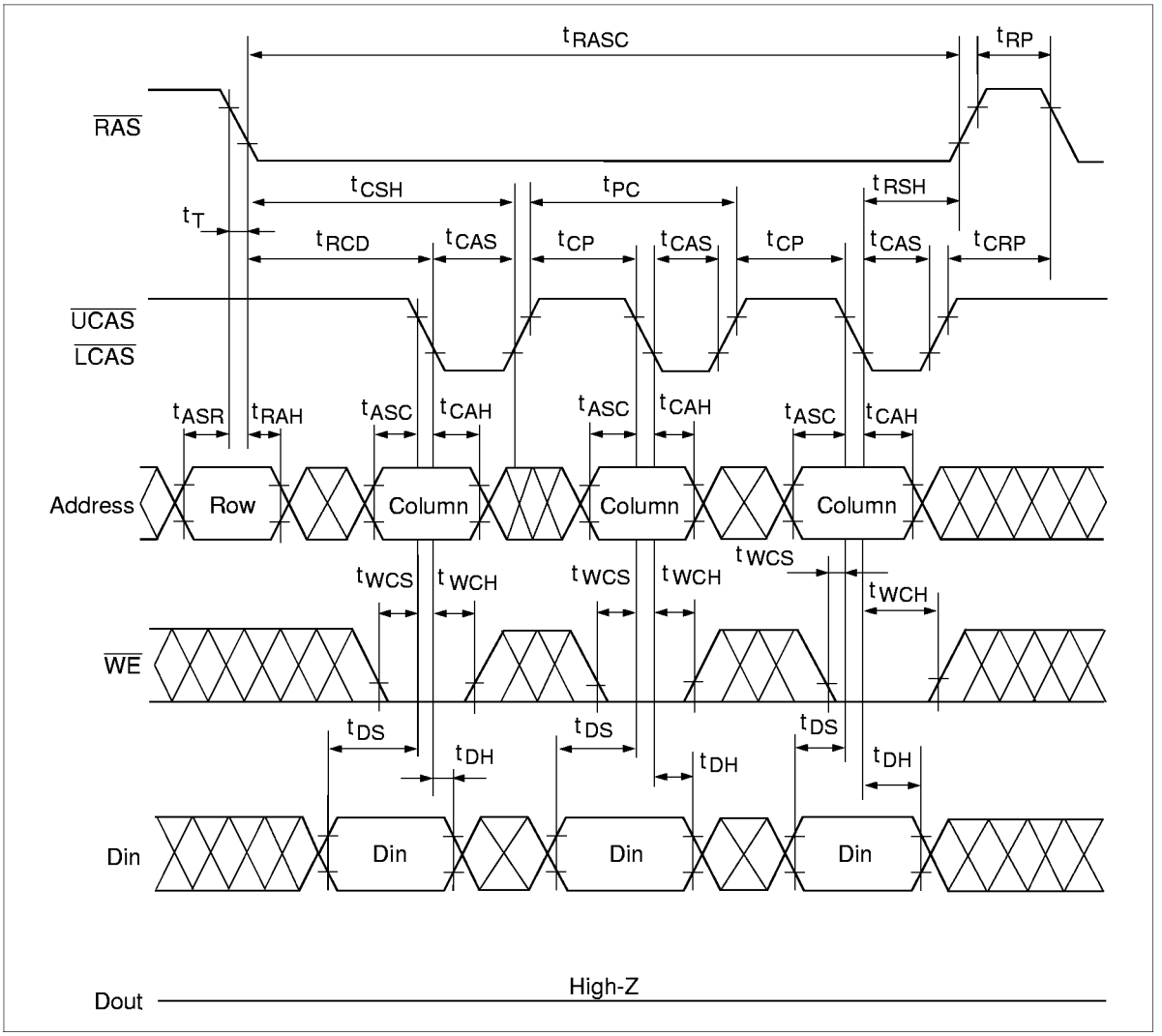
$\overline{\text{CAS}}$-Before-$\overline{\text{RAS}}$ Refresh Cycle



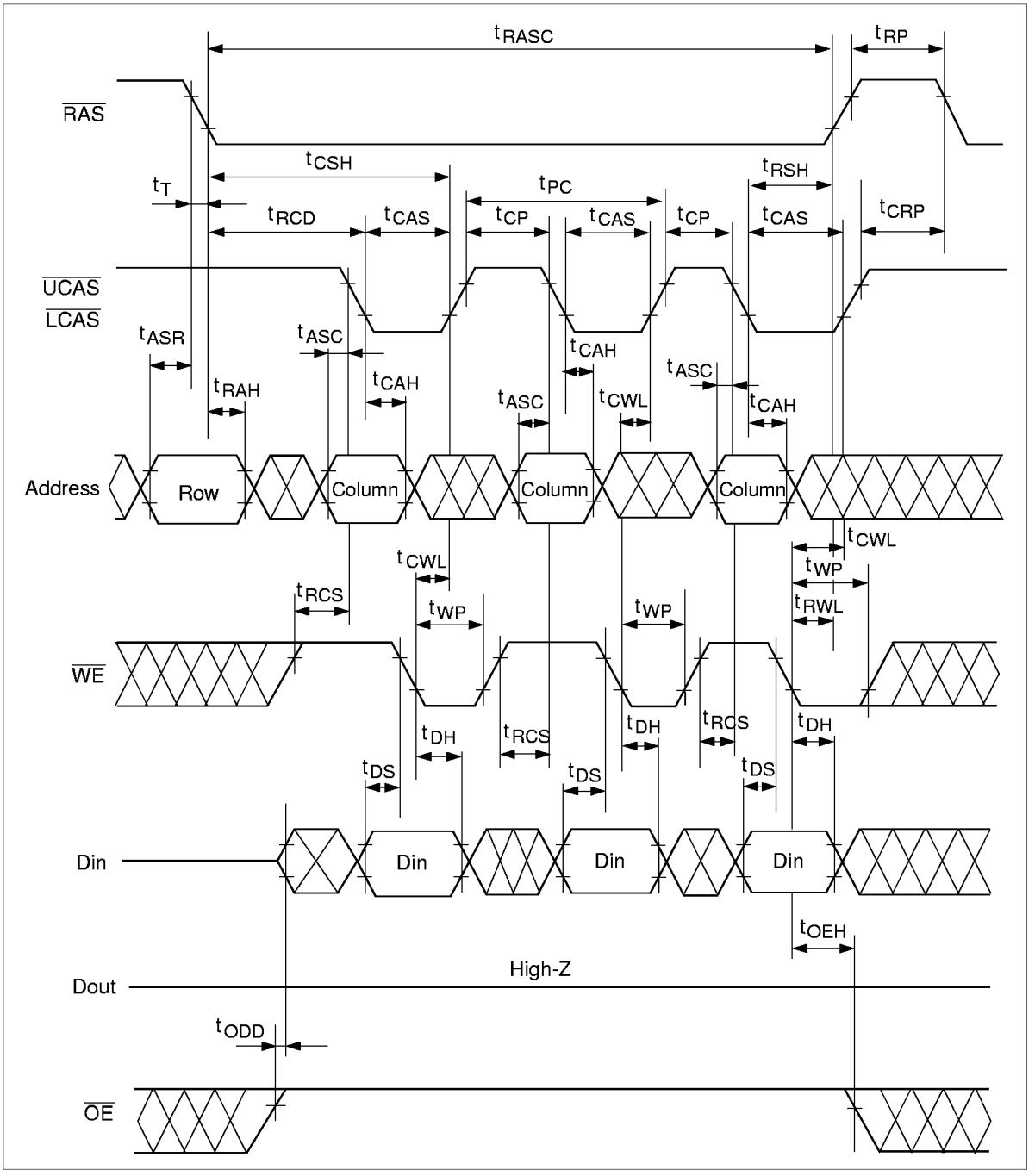
Fast Page Mode Read Cycle



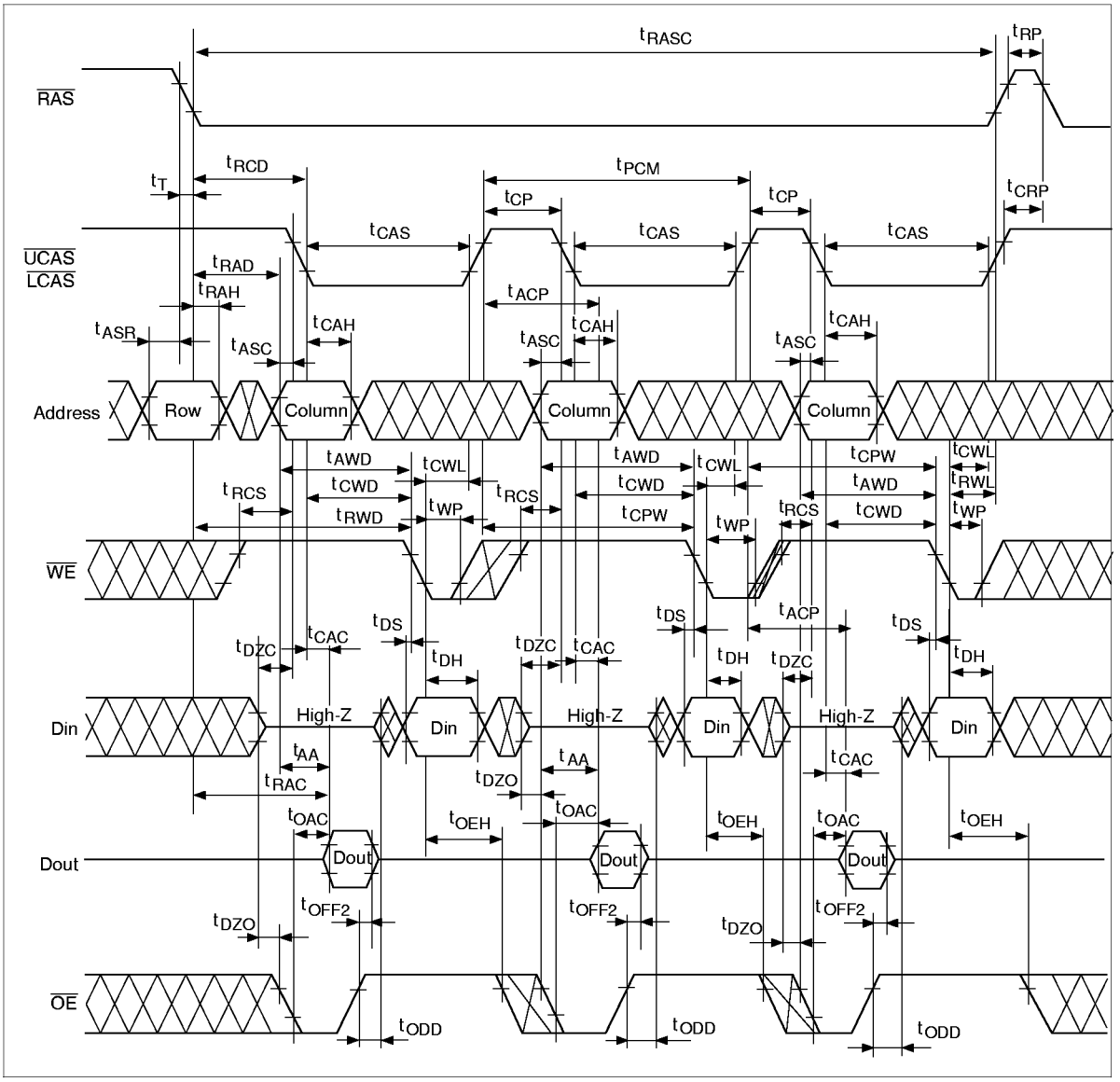
Fast Page Mode Early Write Cycle



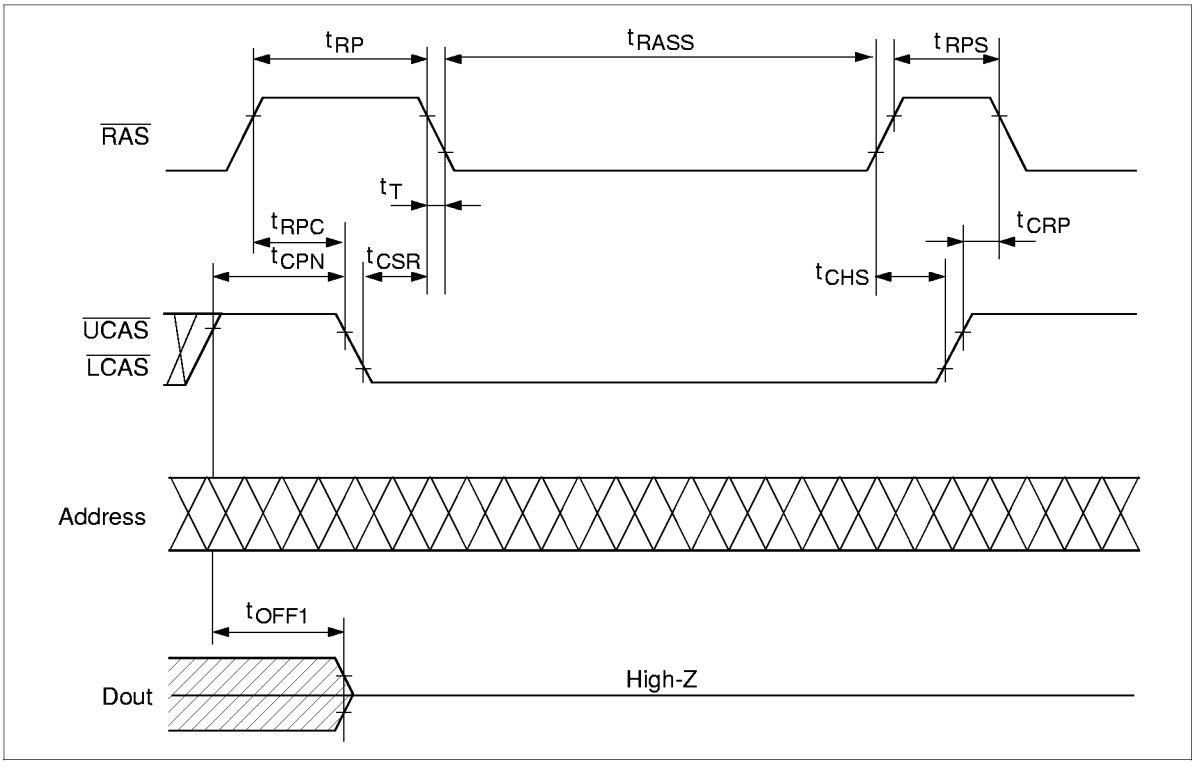
Fast Page Mode Delayed Write Cycle



Fast Page Mode Read-Modify-Write Cycle

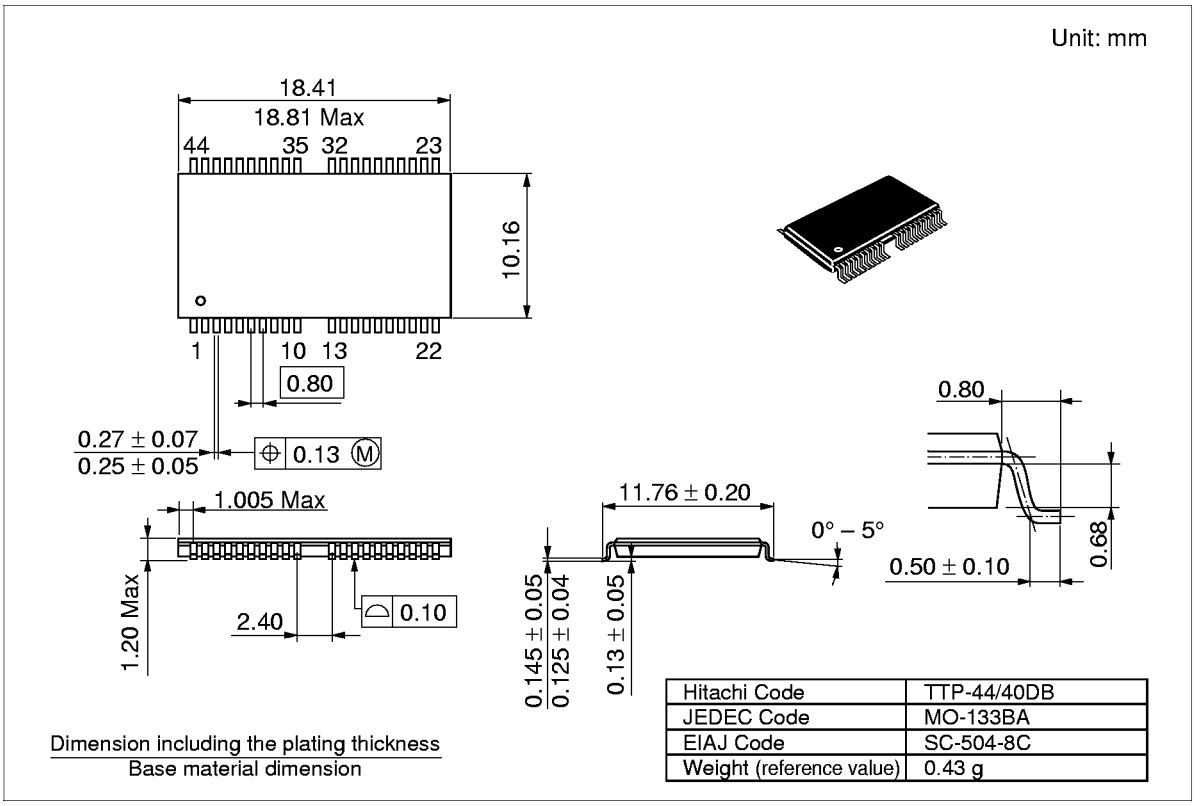


Self Refresh Cycle*[24, 25, 26, 27]



Package Dimensions

HM51W4260CTT/CLTT Series (TTP44/40DB)



Hitachi Code	TTP-44/40DB
JEDEC Code	MO-133BA
EIAJ Code	SC-504-8C
Weight (reference value)	0.43 g

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Revision Record

Rev.	Date	Contents of Modification	Drawn by	Approved by
0.0	Sep. 7, 1994	Initial issue	S. Hatano	M. Yamamura
1.0	Feb. 2, 1995	Recommended DC Operating conditions V_{IH} min: 2.4 V to 2.0 V	A. Kumata	J. Kitano
2.0	Jul. 18, 1996	Addition of HM51W4260C-6R Series AC Characteristics Deletion of note 27: Measured with a load circuit equivalent to 1 TTL load and 100 pF Change of note 3 Addition of note 24 Change of note 28 Note concerning 2$\overline{CAS}$ control Addition of note 4 Timing waveforms Deletion of notes about undefined pins Change waveforms Read-modify-write cycle Fast page mode read cycle $\overline{CAS}$-before-$\overline{RAS}$ refresh cycle Fast page mode read-modify-write cycle Self refresh cycle	A. Kumata	S. Suzuki
3.0	Jul. 10, 1997	Correct errors DC Characteristics Test condition of I_{CC1}, I_{CC5}: $\overline{UCAS}$ or ..... to $\overline{UCAS}$, ... AC Characteristics Correct note numbers on tables Timing waveforms Read-modify-write cycle, Fast page mode read-modify-write cycle		