HY512260 Series

128K x 16-bit CMOS DRAM with 2CAS

DESCRIPTION

The HY512260 is the new generation and fast dynamic RAM organized 131,072 x 16-bit configuration employing advanced submicron CMOS process technology and advanced circuit design technique to achieve fast access time. Independant read and write of upper and lower byte is controlled by 2 separate $\overline{CAS}$ inputs.
Refresh control is provided through $\overline{RAS}$-only, $\overline{CAS}$-before-$\overline{RAS}$, hidden refresh and self refresh modes. Multiplexed address inputs permit the HY512260 to be packaged in a 400mil 40pin SOJ and 40/44pin TSOP-II and reverse TSOP-II packages.

FEATURES

- **Low power dissipation**
  Max. battery back-up 2.2mW (L-part)
  Max. CMOS standby 1.1mW (L-part)
  5.5mW
  Max. TTL standby 11.0mW
  Max. Self refresh 2.2mW(SL-part)
  Max. operating

Speed	Power
50	605.0mW
60	550.0mW
70	495.0mW

- **Single power supply of 5V±10%**
- **TTL compatible inputs and outputs**
- **Fast access and cycle time**

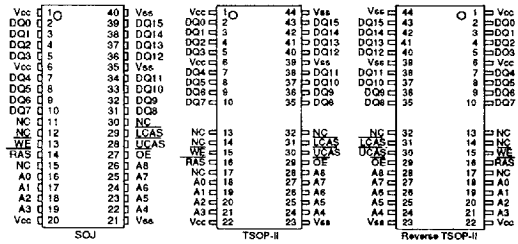
Speed	tRAC	tCAC	tPC
50	50ns	15ns	35ns
60	60ns	15ns	40ns
70	70ns	20ns	45ns

- **Fast page mode operation**
- **2 $\overline{CAS}$ inputs for upper and lower byte control**
- **Read-Modify-Write capability**
- **$\overline{CAS}$-before-$\overline{RAS}$, $\overline{RAS}$-only, Hidden refresh and Self refresh**
- **512 refresh cycles / 128ms (L-part)**
  512 refresh cycles / 8ms

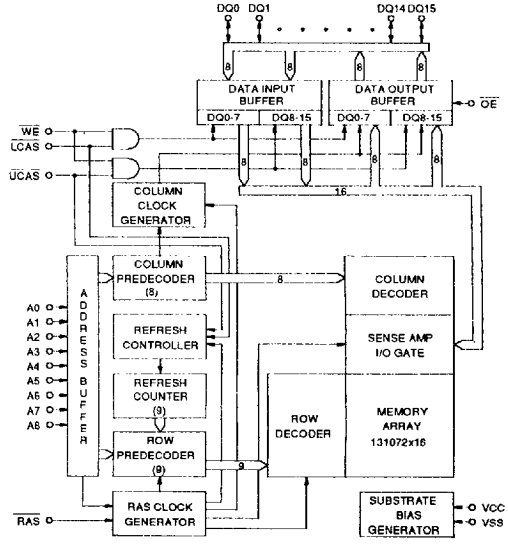
PIN DESCRIPTION

$\overline{RAS}$	Row Address Strobe
$\overline{LCAS}$, $\overline{UCAS}$	Column Address Strobe
$\overline{WE}$	Write Enable
$\overline{OE}$	Output Enable
A0-A8	Address Input
DQ0-DQ15	Data Input/Output
Vcc	Power (+5V)
Vss	Ground

PIN CONNECTION



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
T_A	Ambient Temperature	0 to 70	°C
T_{STG}	Storage Temperature	–55 to 150	°C
V_{IN}, V_{OUT}	Voltage on Any Pin Relative to V_{SS}	–1.0 to 7.0	V
V_{CC}	Voltage on V_{CC} Relative to V_{SS}	–1.0 to 7.0	V
I_{OS}	Short Circuit Output Current	50	mA
P_D	Power Dissipation	0.90	W
T_{SOLDER}	Soldering Temperature•Time	260•10	°C•sec

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

RECOMMENDED DC OPERATING CONDITIONS

(T_A=0°C to 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	-	V_{CC}+1.0	V
V_{IL}	Input Low Voltage	–1.0	-	0.8	V

NOTE : All voltages are referenced to V_{SS}.

DC CHARACTERISTICS

(T_A=0°C to 70°C, V_{CC}=5V±10%, V_{SS}=0V, unless otherwise noted.)

SYMBOL	PARAMETER	TEST CONDITIONS	SPEED/ POWER	MIN.	MAX.	UNIT	NOTE
I_{LI}	Input Leakage Current (Any Input Pins)	$V_{SS} \le V_{IN} \le 6.5V$, All other pins not under test=V_{SS}		-10	10	µA	
I_{LO}	Output Leakage Current (High Impedance State)	$V_{SS} \le V_{OUT} \le 5.5V$, $\overline{RAS}$ & $\overline{CAS}$ at V_{IH}		-10	10	µA	
I_{CC1}	V_{CC} Supply Current, Operating	$t_{RC}=t_{RC}$ (min.)	50 60 70	- - -	110 100 90	mA	1,2,3,7
I_{CC2}	V_{CC} Supply Current, TTL Standby	$\overline{RAS}$ & $\overline{CAS}$ at V_{IH}, other inputs≥V_{SS}		-	2	mA	
I_{CC3}	V_{CC} Supply Current, $\overline{RAS}$-only refresh	$t_{RC}=t_{RC}$ (min.)	50 60 70	- - -	110 100 90	mA	1,3,7
I_{CC4}	V_{CC} Supply Current, Fast Page mode	$t_{PC}=t_{PC}$ (min.)	50 60 70	- - -	80 70 60	mA	1,2,3,7
I_{CC5}	V_{CC} Supply Current, CMOS Standby	$\overline{RAS}$ & $\overline{CAS}$ ≥V_{CC}–0.2V	 L-part	- -	1 200	mA µA	 5
I_{CC6}	V_{CC} Supply Current, $\overline{CAS}$-before-$\overline{RAS}$ refresh	$t_{RC}=t_{RC}$ (min.)	50 60 70	- - -	100 100 90	mA	1,3,7
I_{CC7}	V_{CC} Supply Current, Battery Back Up (L-part only)	t_{RC}=125µs, $t_{RAS} \le$1µs $\overline{CAS}$=CBR cycling or 0.2V $\overline{OE}$ & $\overline{WE}$=V_{CC}–0.2V A0-A8=V_{CC}–0.2V or 0.2V DQ0-DQ15 =0.2V, V_{CC}-0.2V or open		-	400	µA	1,4,5
I_{CC8}	Vcc Supply Current, Self Refresh (SL-part only)	$\overline{RAS}$ & $\overline{CAS}$ ≤ 0.2V other pins same as I_{CC7}			400	µA	6
V_{OL}	Output Low Voltage	I_{OL}=4.2mA		-	0.4	V	
V_{OH}	Output High Voltage	I_{OH}=–5mA		2.4	-	V	

NOTE :

1. I_{CC1}, I_{CC3}, I_{CC4} and I_{CC6} depend on cycle rate.
2. I_{CC1}, I_{CC3}, I_{CC4} and I_{CC6} are dependent on output loading. Specified values are obtained with the output open.
3. I_{CC} is specified as average current. I_{CC1}, I_{CC3}, I_{CC6}, Address can be changed maximum two times while $\overline{RAS}$=V_{IL}. I_{CC4}, Address can be changed maximum once while $\overline{CAS}$=V_{IH}.
4. Only t_{RAS}(max.)=1µs is applied to refresh of battery backup but t_{RAS}(max.)=10µs is applied to normal functional operation.
5. I_{CC5}(max.)=200µA and I_{CC7} are applied to L-parts (HY512260LJ, HY512260LT, HY512260LR, HY512260SLJ, HY512260SLT, and HY512260SLR.)
6. I_{CC8} is applied to SL-parts only(HY512260SLJ, HY512260SLT and HY512260SLR).
7. Operating Condition for 50ns Part is V_{CC}=5V±5%, Cout=30pF.

AC CHARACTERISTICS

(T_A=0°C to 70°C, V_{CC}=5V±10%, V_{SS}=0V, unless otherwise noted.) NOTE : 1, 2, 3,13,18

#	SYMBOL	PARAMETER	HY512260J/T/R/LJ/LT/LR/SLJ/SLT/SLR						UNIT	NOTE
			-50		-60		-70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
1	tRC	Random Read or Write Cycle Time	90	-	110	-	130	-	ns	
2	tRWC	Read-Modify-Write Cycle Time	130	-	155	-	185	-	ns	
3	tPC	Fast Page Mode Cycle Time	35	-	40	-	45	-	ns	
4	tPRWC	Fast Page Mode Read-Modify-Write Cycle Time	75	-	80	-	95	-	ns	
5	tRAC	Access Time from $\overline{RAS}$	-	50	-	60	-	70	ns	4,9,10
6	tCAC	Access Time from $\overline{CAS}$	-	15	-	15	-	20	ns	4,9
7	tAA	Access Time from Column Address	-	25	-	30	-	35	ns	4,10
8	tCPA	Access Time from $\overline{CAS}$ Precharge	-	30	-	35	-	40	ns	4,15
9	tCLZ	$\overline{CAS}$ to Output Low Impedance	0	-	0	-	0	-	ns	4
10	tOFF	Output Buffer Turn-off Delay	0	15	0	15	0	20	ns	5
11	tT	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	3
12	tRP	$\overline{RAS}$ Precharge Time	30	-	40	-	50	-	ns	
13	tRAS	$\overline{RAS}$ Pulse Width	50	10K	60	10K	70	10K	ns	
14	tRASP	$\overline{RAS}$ Pulse Width (Fast Page Mode)	50	100K	60	100K	70	100K	ns	
15	tRSH	$\overline{RAS}$ Hold Time	15	-	15	-	20	-	ns	
16	tCSH	$\overline{CAS}$ Hold Time	50	-	60	-	70	-	ns	
17	tCAS	$\overline{CAS}$ Pulse Width	15	10K	15	10K	20	10K	ns	
18	tRCD	$\overline{RAS}$ to $\overline{CAS}$ Delay	15	35	20	45	20	50	ns	9
19	tRAD	$\overline{RAS}$ to Column Address Delay Time	10	25	15	30	15	35	ns	10
20	tCRP	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5	-	5	-	5	-	ns	15
21	tCP	$\overline{CAS}$ Precharge Time	10	-	10	-	10	-	ns	17
22	tASR	Row Address Set-up Time	0	-	0	-	0	-	ns	
23	tRAH	Row Address Hold Time	8	-	10	-	10	-	ns	
24	tASC	Column Address Set-up Time	0	-	0	-	0	-	ns	14
25	tCAH	Column Address Hold Time	15	-	15	-	15	-	ns	14
26	tAR	Column Address Hold Time from $\overline{RAS}$	40	-	50	-	55	-	ns	
27	tRAL	Column Address to $\overline{RAS}$ Lead Time	25	-	30	-	35	-	ns	
28	tRCS	Read Command Set-up Time	0	-	0	-	0	-	ns	14
29	tRCH	Read Command Hold Time Referenced to $\overline{CAS}$	0	-	0	-	0	-	ns	6,14
30	tRRH	Read Command Hold Time Referenced to $\overline{RAS}$	0	-	0	-	0	-	ns	6
31	tWCH	Write Command Hold Time	10	-	10	-	15	-	ns	14
32	tWCR	Write Command Hold Time from $\overline{RAS}$	40	-	45	-	55	-	ns	
33	tWP	Write Command Pulse Width	10	-	10	-	15	-	ns	
34	tRWL	Write Command to $\overline{RAS}$ Lead Time	15	-	15	-	20	-	ns	
35	tCWL	Write Command to $\overline{CAS}$ Lead Time	15	-	15	-	20	-	ns	16
36	tDS	Data-In Set-up Time	0	-	0	-	0	-	ns	7
37	tDH	Data-In Hold Time	15	-	15	-	15	-	ns	7
38	tDHR	Data-In Hold Time Referenced to $\overline{RAS}$	40	-	50	-	55	-	ns	
39	tREF	Refresh Period (512 cycles)	-	8	-	8	-	8	ms	12
		L-part	-	128	-	128	-	128		11
40	tWCS	Write Command Set-up Time	0	-	0	-	0	-	ns	8,14

AC CHARACTERISTICS

(continued)

#	SYMBOL	PARAMETER	HY512260J/T/R/LJ/LT/LR/SLJ/SLT/SLR						UNIT	NOTE
			-50		-60		-70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
41	tCWD	$\overline{CAS}$ to $\overline{WE}$ Delay Time	35	-	40	-	50	-	ns	8
42	tRWD	$\overline{RAS}$ to $\overline{WE}$ Delay Time	70	-	85	-	100	-	ns	8
43	tAWD	Column Address to $\overline{WE}$ Delay Time	45	-	55	-	65	-	ns	8
44	tCSR	$\overline{CAS}$ Set-up Time (CBR Cycle)	5	-	5	-	5	-	ns	14
45	tCHR	$\overline{CAS}$ Hold Time (CBR Cycle)	10	-	10	-	10	-	ns	15
46	tRPC	$\overline{RAS}$ to $\overline{CAS}$ Precharge Time	5	-	5	-	5	-	ns	14
47	tCPT	$\overline{CAS}$ Precharge Time (CBR Counter Test)	20	-	20	-	25	-	ns	17
48	tROH	$\overline{RAS}$ Hold Time Referenced to $\overline{OE}$	0	-	0	-	0	-	ns	
49	tOEA	$\overline{OE}$ Access Time	-	15	-	15	-	20	ns	
50	tOED	$\overline{OE}$ to Data Delay	15	-	15	-	20	-	ns	
51	tOEZ	Output Buffer Turn Off Delay Time from $\overline{OE}$	0	15	0	15	0	20	ns	5
52	tOEH	$\overline{OE}$ Command Hold Time	15	-	15	-	20	-	ns	
53	tCPWD	$\overline{WE}$ Delay Time from $\overline{CAS}$ Precharge	50	-	55	-	65	-	ns	8
54	tRHCP	$\overline{RAS}$ Hold Time from $\overline{CAS}$ Precharge	35	-	35	-	40	-	ns	
55	tRASS	$\overline{RAS}$ Pulse Width (Self Refresh)	100	-	100	-	100	-	ns	
56	tRPS	$\overline{RAS}$ Precharge Time (Self Refresh)	120	-	130	-	150	-	ns	
57	tCHS	$\overline{CAS}$ Hold Time from $\overline{RAS}$ (Self Refresh)	-50	-	-50	-	-50	-	ns	

NOTE :

1. An initial pause of 200μs is required after power-up followed by 8 $\overline{RAS}$ cycles before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8 $\overline{CAS}$-before-$\overline{RAS}$ initialization cycles instead of 8 $\overline{RAS}$-only refresh cycles are required.
2. If $\overline{RAS}$=Vss during power-up, the HY512260 could begin an active cycle. This condition results in higher current than necessary current which is demanded from the power supply during power-up. It is recommended that $\overline{RAS}$ and $\overline{CAS}$ track with Vcc during power-up or be held at a valid V_{IH} in order to minimize the power-up current.
3. V_{IH}(min.) and V_{IL}(max.) are reference levels for measuring timing of input signals. Transition times are measured between V_{IH}(min.) and V_{IL}(max.), and are assumed to be 5ns for all inputs.
4. Measured at V_{OH}=2.0V and V_{OL}=0.8V with a load equivalent to 2 TTL loads and 100pF for 60ns, 70ns part and measured at V_{OH}=2.0V and V_{OL}=0.8V with a load equivalent to 2TTL loads and 30pF for 50ns part..
5. t_{OFF}(max.) and t_{OEZ} define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
6. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
7. These parameters are referenced to $\overline{LCAS}$ or $\overline{UCAS}$ leading edge in early write cycles and to $\overline{WE}$ leading edge in Read-Modify-Write cycles.
8. t_{WCS}, t_{RWD}, t_{CWD}, t_{AWD} and t_{CPWD} 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 data out pin will remain open circuit (high impedance) through the entire cycle. If $t_{RWD} \geq t_{RWD}$(min.), $t_{CWD} \geq t_{CWD}$(min.), $t_{AWD} \geq t_{AWD}$(min.), and $t_{CPWD} \geq t_{CPWD}$(min.), the cycle is a Read-Modify-Write cycle and data out 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 indeterminated.
9. Operation within 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 by t_{CAC}.
10. Operation within 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 by t_{AA}.
11. t_{REF}(max.)=128ms is applied to L-parts (HY512260LJC, HY512260LTC, HY512260LRC, HY512260SLJC, HY512260SLTC and HY512260SLRC),
12. A burst of 512 $\overline{CAS}$-before-$\overline{RAS}$ refresh cycles must be executed within 8ms (128ms for L-part) after exiting self refresh.
13. When both $\overline{LCAS}$ and $\overline{UCAS}$ go low at the same time, all 16-bits data are written into the device. $\overline{LCAS}$ and $\overline{UCAS}$ must be transited simultaneously within a same read or write cycle.
14. These parameters are determined by the earlier falling edge of $\overline{LCAS}$ or $\overline{UCAS}$.
15. These parameters are determined by the later rising edge of $\overline{LCAS}$ or $\overline{UCAS}$.
16. t_{CWL} must be satisfied by both $\overline{LCAS}$ and $\overline{UCAS}$ for 16-bits access cycles.
17. t_{CP} and t_{CPT} are measured when both $\overline{LCAS}$ and $\overline{UCAS}$ are high state.
18. Operating Condition for 50ns Part is V_{CC}=5V±5%, Cout=30pF.

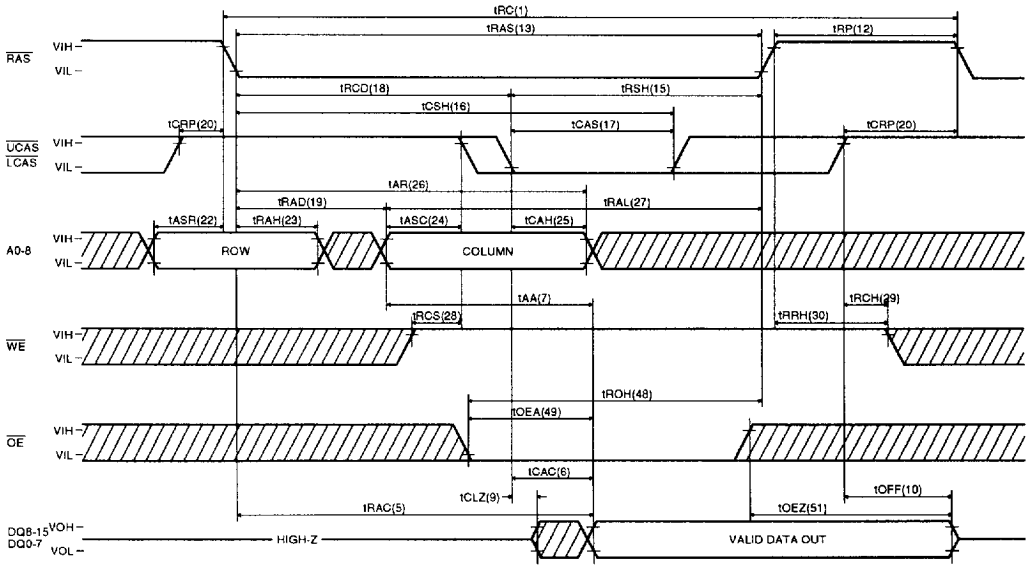
CAPACITANCE

(T_A=25°C, V_{CC}=5V±10%, V_{SS}=0V, f=1MHz, unless otherwise noted.)

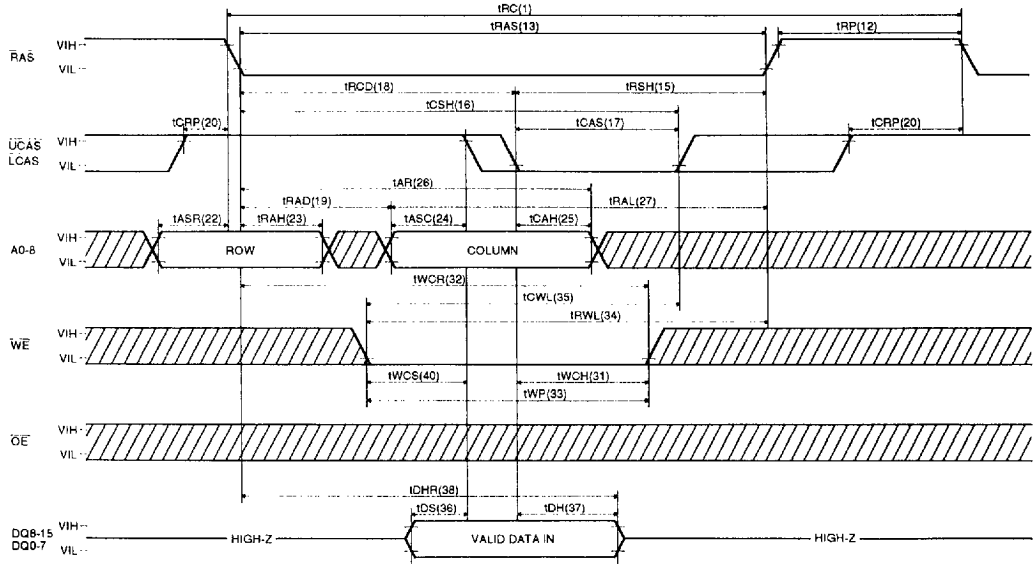
SYMBOL	PARAMETER	TYP.	MAX.	UNIT
C_{IN1}	Input Capacitance (A0-A8)	-	5	pF
C_{IN2}	Input Capacitance ($\overline{RAS}$, $\overline{LCAS}$, $\overline{UCAS}$, $\overline{WE}$, $\overline{OE}$)		7	pF
C_{DQ}	Data Input/Output Capacitance (DQ0-DQ15)	-	7	pF

TIMING DIAGRAM

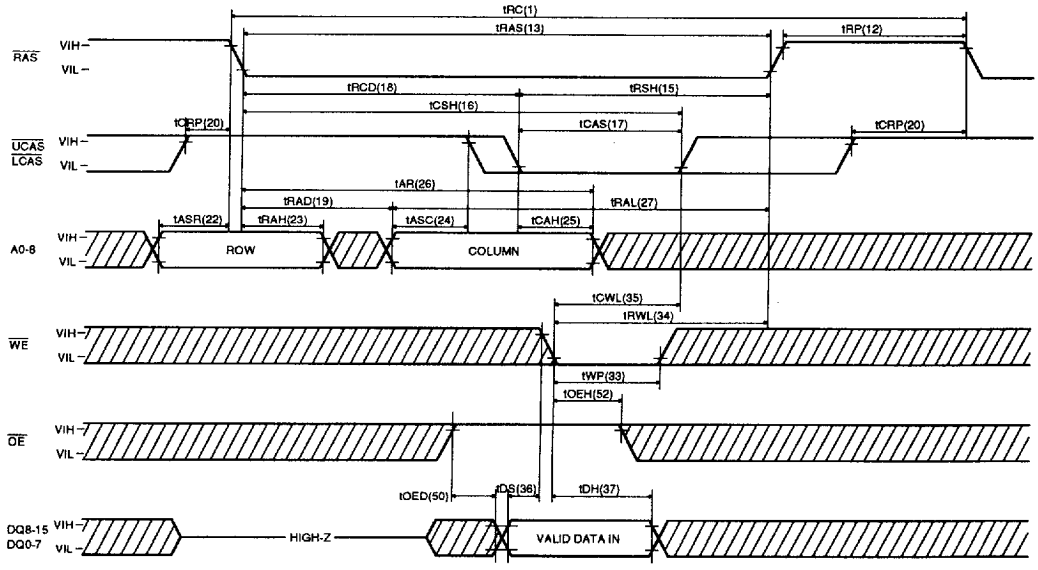
READ CYCLE



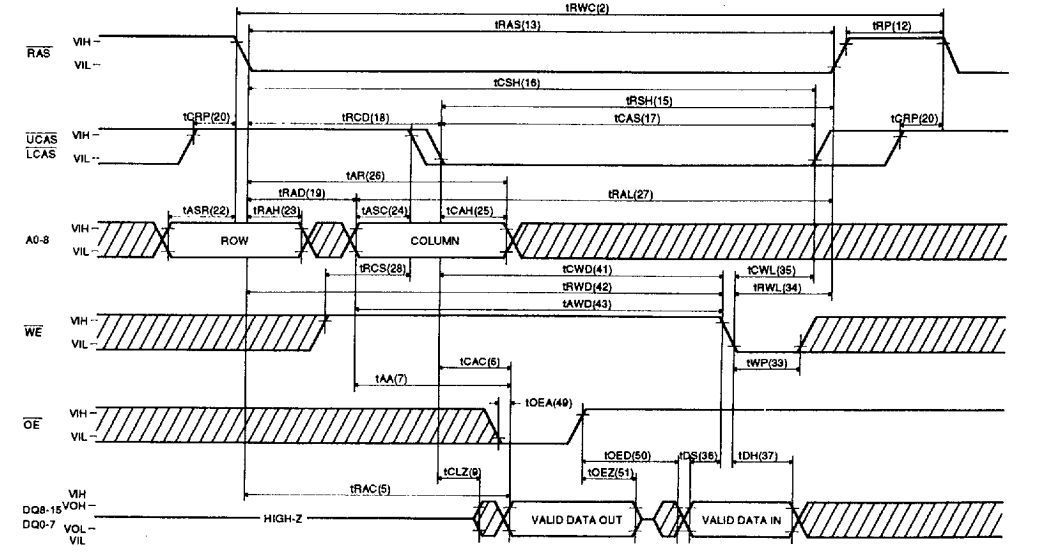
EARLY WRITE CYCLE



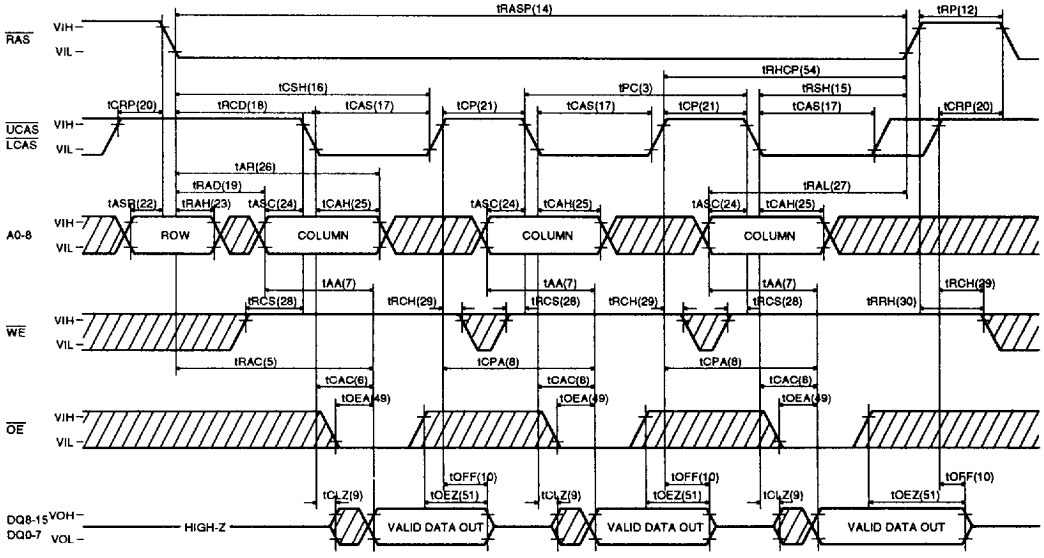
WRITE CYCLE ($\overline{OE}$ CONTROLLED WRITE)



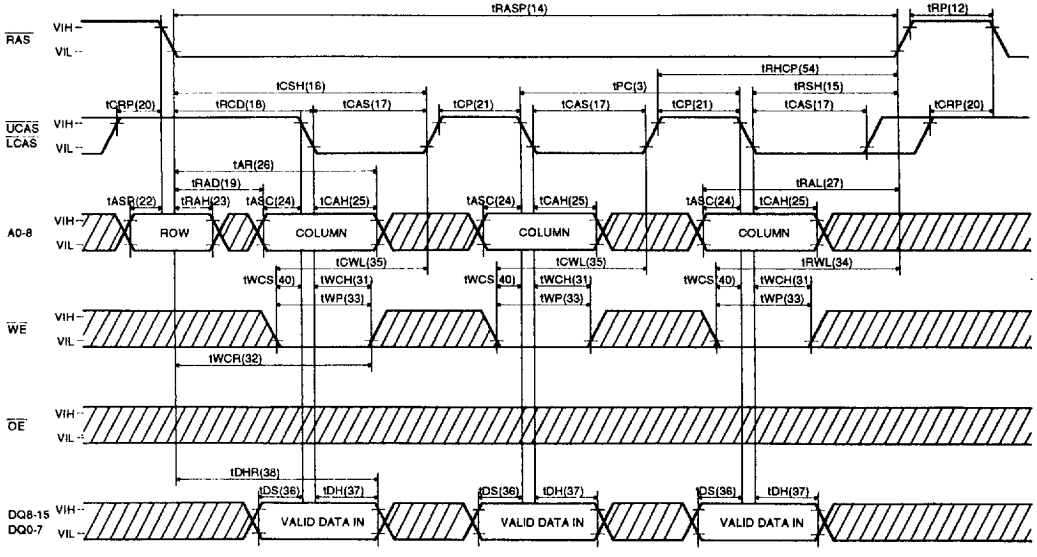
READ-MODIFY-WRITE CYCLE



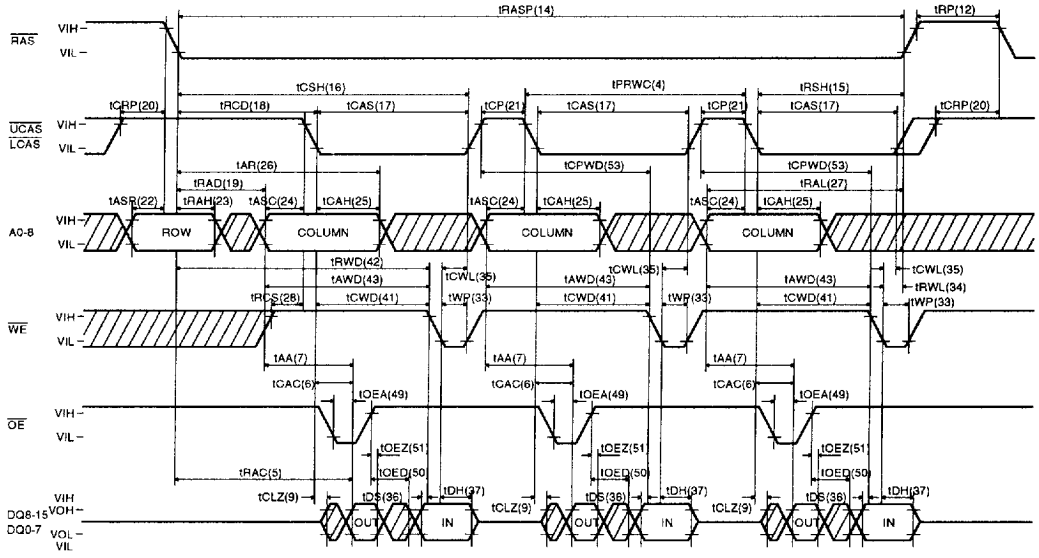
FAST PAGE MODE READ CYCLE



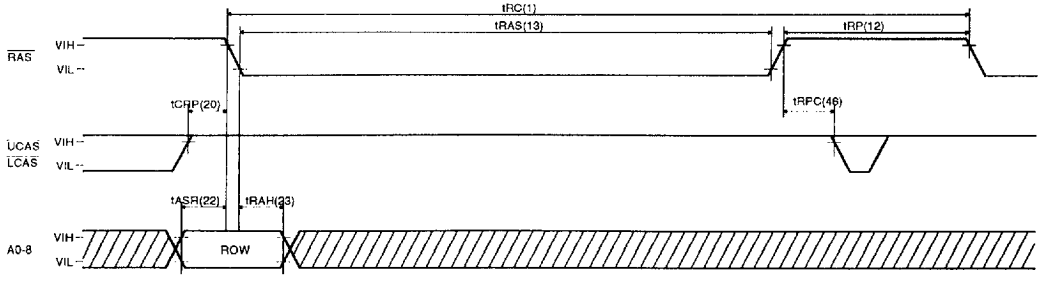
FAST PAGE MODE EARLY WRITE CYCLE



FAST PAGE MODE READ-MODIFY-WRITE CYCLE

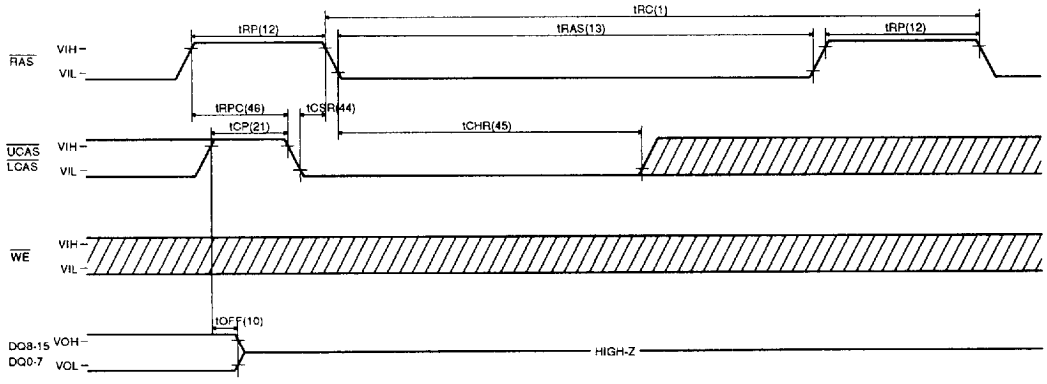


RAS-ONLY REFRESH CYCLE



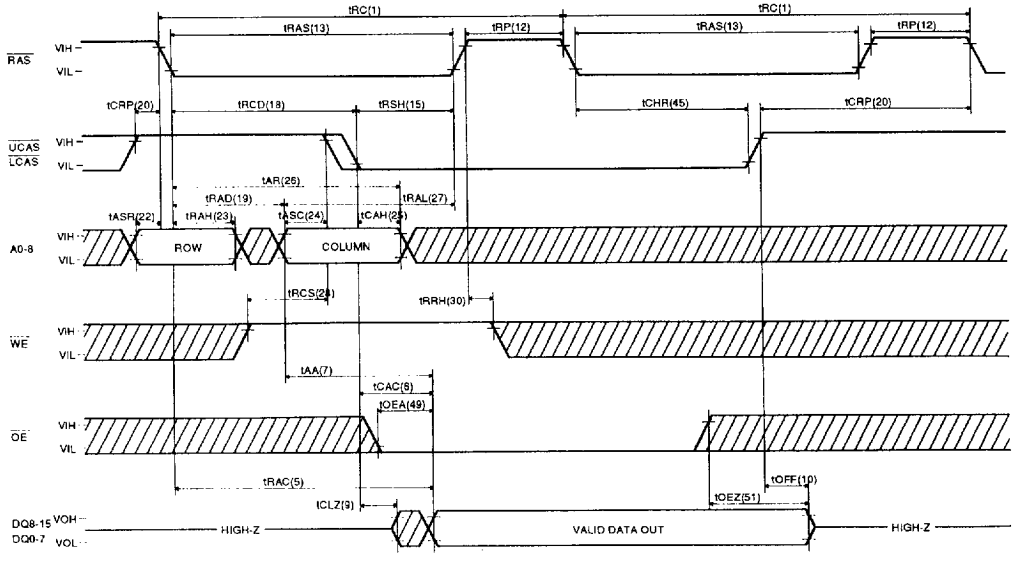
NOTE : $\overline{OE}$ and $\overline{WE}$ = "H" or "L"

CAS-BEFORE-RAS REFRESH CYCLE

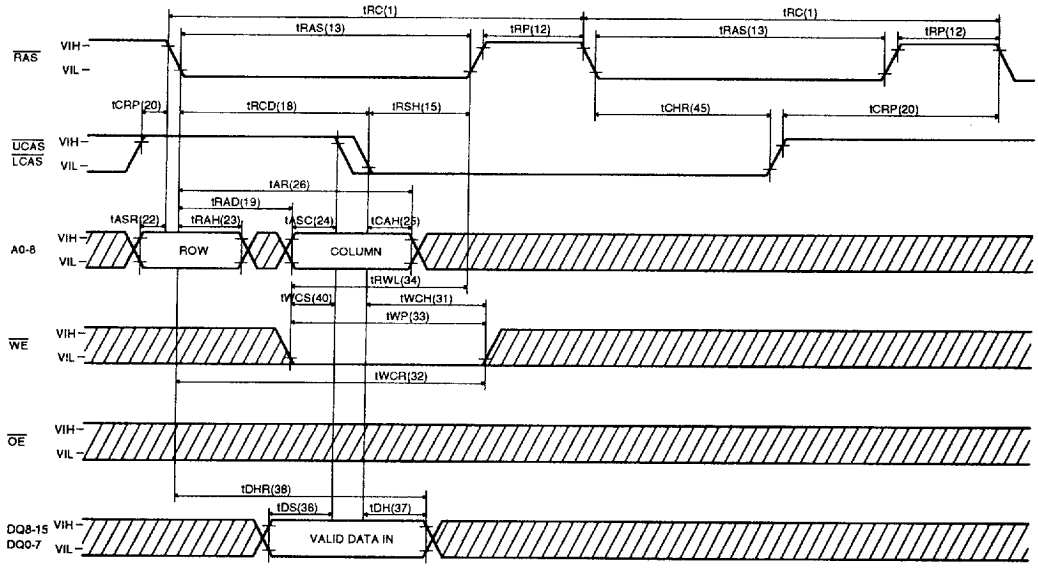


NOTE : A0-8 and $\overline{OE}$ = "H" or "L"

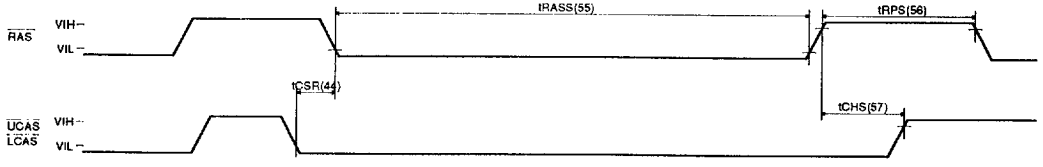
HIDDEN REFRESH CYCLE (READ)



HIDDEN REFRESH CYCLE (WRITE)

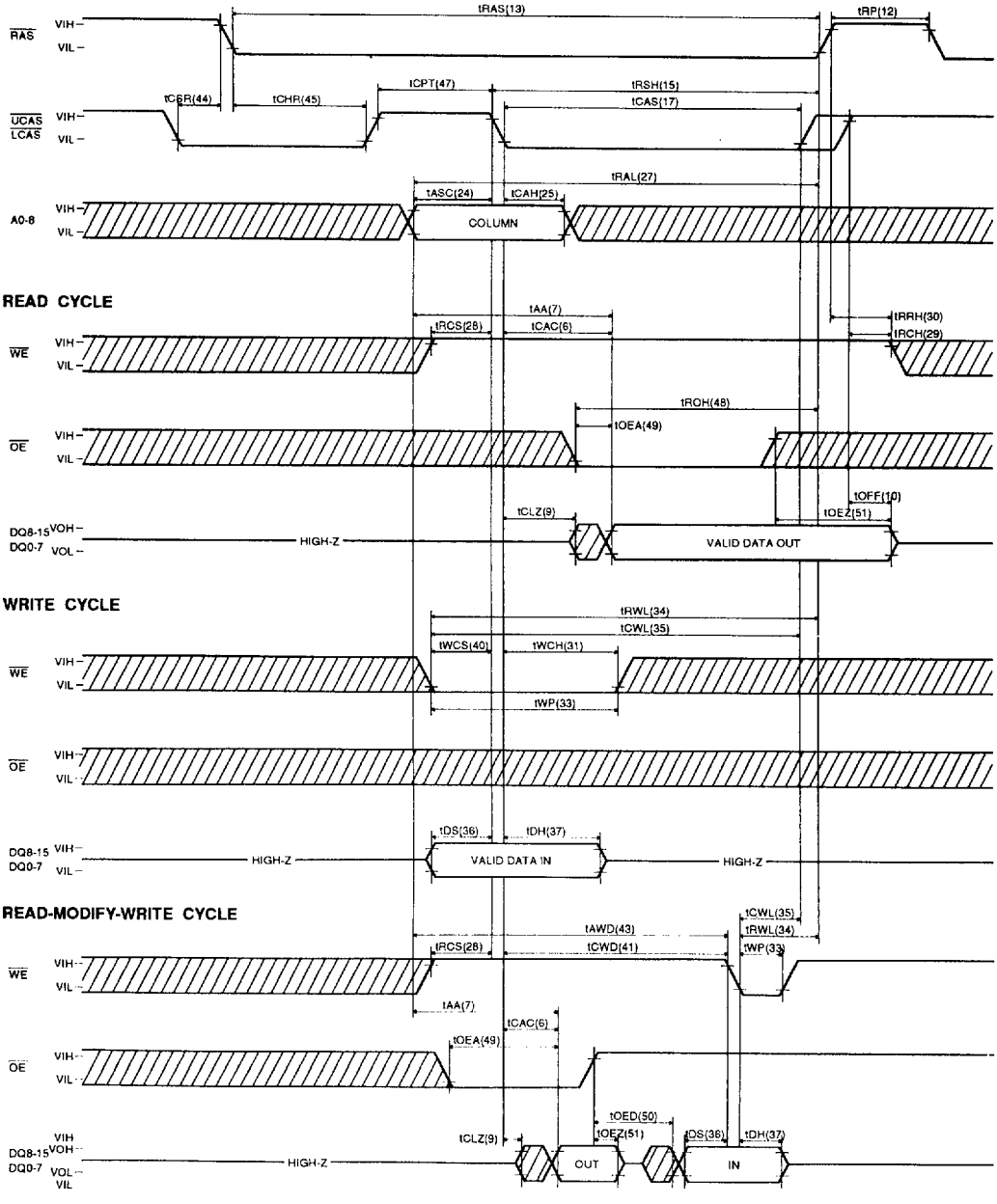


CAS-BEFORE-RAS SELF REFRESH CYCLE



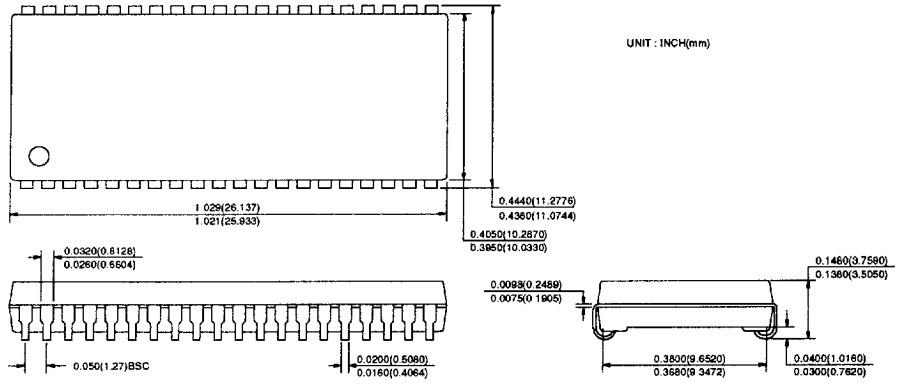
NOTE : A0-8, WE and OE = "H" or "L"

CAS-BEFORE-RAS REFRESH COUNTER TEST CYCLE

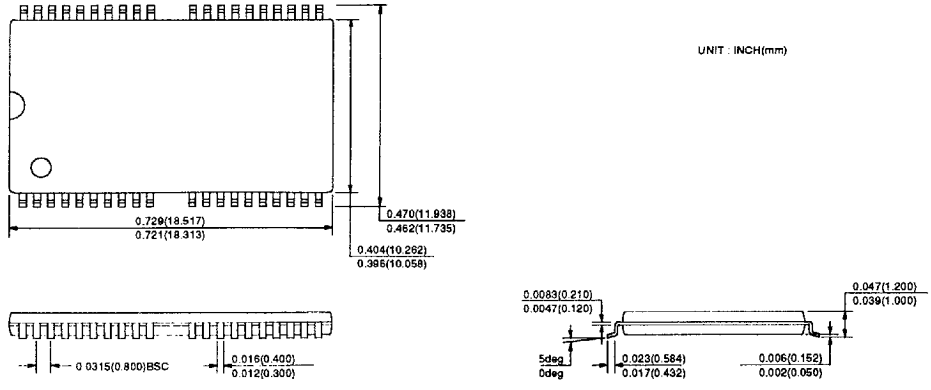


PACKAGE INFORMATION

400 mil 40 pin Small Outline J-form Package (JC)



400 mil 40/44 pin Thin Small Outline Package (TC) (RC)



ORDERING INFORMATION

PART NUMBER	SPEED	POWER	PACKAGE
HY512260JC	50/60/70		SOJ
HY512260LJC	50/60/70	L-part	SOJ
HY512260SLJC	50/60/70	SL-part	SOJ
HY512260TC	50/60/70		TSOP-II
HY512260LTC	50/60/70	L-part	TSOP-II
HY512260SLTC	50/60/70	SL-part	TSOP-II
HY512260RC	50/60/70		TSOP-II(R)
HY512260LRC	50/60/70	L-part	TSOP-II(R)
HY512260SLRC	50/60/70	SL-part	TSOP-II(R)