

### DESCRIPTION

The HY5117410A is the new generation and fast dynamic RAM organized 4,194,304 x 4-bit. The HY5117410A utilizes Hyundai's CMOS silicon gate process technology as well as advanced circuit techniques to provide wide operating margins to the users. Multiplexed address inputs permit the HY5117410A to be packaged in standard 24/26 pin plastic SOJ, TSOP-II and Reverse TSOP-II.

The package size provides high system bit densities and is compatible with widely available automated testing and insertion equipments. System oriented feature includes single power supply of 5V±10% tolerance and direct interfacing capability with high performance logic families such as Schottky TTL.

### FEATURES

- **Low power dissipation**  
**Max. battery back-up 2.75mW (SL-part)**  
**Max. CMOS standby 2.2mW (SL-part)**  
**5.5mW**  
**Max. TTL standby 11.0mW**  
**Max. operating**

Speed	Power
50	798mW
60	660mW
70	550mW

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

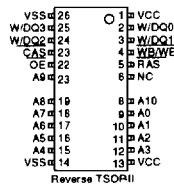
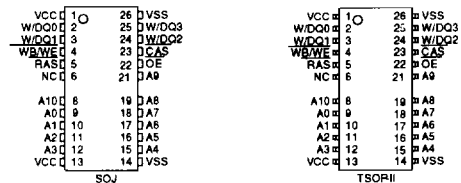
Speed	t <sub>RAC</sub>	t <sub>CAC</sub>	t <sub>PC</sub>
50	50ns	13ns	35ns
60	60ns	15ns	40ns
70	70ns	18ns	45ns

- **Fast page mode operation**
- **Write-Per-Bit and Multi-bit test capability**
- **Read-Modify-Write capability**
- **CAS-before-RAS, RAS-only, Hidden refresh and Self Refresh**
- **2048 refresh cycles / 256ms (SL-part)**  
**2048 refresh cycles / 32ms**

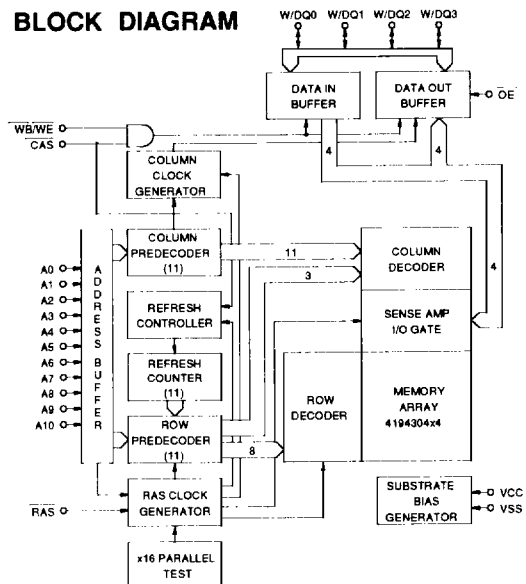
### PIN DESCRIPTION

RAS	Row Address Strobe
CAS	Column Address Strobe
WB/WE	Write-Per-Bit / Write Enable
OE	Output Enable
A0-A10	Address Input
W/DQ0-DQ3	Write mask / Data IO
VCC	Power (+5V)
VSS	Ground

### PIN CONNECTION



### BLOCK DIAGRAM



**ABSOLUTE MAXIMUM RATINGS**

SYMBOL	PARAMETER	RATING	UNIT
TA	Ambient Temperature	0 to 70	°C
TSTG	Storage Temperature	-55 to 150	°C
VIN, VOUT	Voltage on Any Pin Relative to VSS	-1.0 to 7.0	V
VCC	Voltage on VCC Relative to VSS	-1.0 to 7.0	V
IOS	Short Circuit Output Current	50	mA
PD	Power Dissipation	1.02	W
TSOLDER	Soldering Temperature•Time	260•10	°C•sec

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

**RECOMMENDED DC OPERATING CONDITIONS**

(TA= 0°C to 70°C)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
VCC	Power Supply Voltage	4.5	5.0	5.5	V
VIH	Input High Voltage	2.4	-	VCC+ 1.0	V
VIL	Input Low Voltage	-1.0	-	0.8	V

NOTE : All voltages are referenced to VSS.

**DC CHARACTERISTICS**

(TA= 0°C to 70°C, VCC= 5V± 10%, VSS= 0V, unless otherwise noted.)

SYMBOL	PARAMETER	TEST CONDITIONS	SPEED	MIN.	MAX.	UNIT	NOTE
I <sub>LI</sub>	Input Leakage Current (Any Input Pins)	V <sub>SS</sub> ≤ V <sub>IN</sub> ≤ V <sub>CC</sub> + 1.0, All other pins not under test= V <sub>SS</sub>		-10	10	μA	
I <sub>LO</sub>	Output Leakage Current (High Impedance State)	V <sub>SS</sub> ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub> , R <sub>AS</sub> & C <sub>AS</sub> at V <sub>IH</sub>		-10	10	μA	
I <sub>CC1</sub>	V <sub>CC</sub> Supply Current, Operating	t <sub>RC</sub> = t <sub>RC</sub> (min.)	50	-	145	mA	1,2,3
			60	-	120		
			70	-	100		
I <sub>CC2</sub>	V <sub>CC</sub> Supply Current, TTL Standby	R <sub>AS</sub> & C <sub>AS</sub> at V <sub>IH</sub> (min.), other inputs ≥ V <sub>SS</sub>		-	2	mA	
I <sub>CC3</sub>	V <sub>CC</sub> Supply Current, R <sub>AS</sub> -only refresh	t <sub>RC</sub> = t <sub>RC</sub> (min.),	50	-	145	mA	1,3
			60	-	120		
			70	-	100		
I <sub>CC4</sub>	V <sub>CC</sub> Supply Current, Fast Page mode	t <sub>PC</sub> = t <sub>PC</sub> (min.),	50	-	90	mA	1,2,3
			60	-	80		
			70	-	70		
I <sub>CC5</sub>	V <sub>CC</sub> Supply Current, CMOS Standby	R <sub>AS</sub> & C <sub>AS</sub> ≥ V <sub>CC</sub> - 0.2V	SL-part	-	1 0.4	mA	5
I <sub>CC6</sub>	V <sub>CC</sub> Supply Current, C <sub>AS</sub> -before-R <sub>AS</sub> refresh	t <sub>RC</sub> = t <sub>RC</sub> (min.),	50	-	145	mA	1,3
			60	-	120		
			70	-	100		
I <sub>CC7</sub>	V <sub>CC</sub> Supply Current, Battery Back Up (SL-part only)	t <sub>RC</sub> = 125μs, C <sub>AS</sub> = CBR cycling or 0.2V, OE & WB/WE= V <sub>CC</sub> -0.2V, A0-A10= V <sub>CC</sub> -0.2V or 0.2V, W/DQ0-W/DQ3= V <sub>CC</sub> - 0.2V, 0.2V or open.	t <sub>RAS</sub> ≤ 300ns	-	300	μA	1,4,5
			t <sub>RAS</sub> ≤ 1μs	-	500		
I <sub>CC8</sub>	V <sub>CC</sub> Supply Current Self Refresh (SL-part only)	R <sub>AS</sub> & C <sub>AS</sub> ≤ 0.2V OE & WB/WE & A0-A10= V <sub>CC</sub> -0.2V or 0.2V, W/DQ0-W/DQ3= V <sub>CC</sub> - 0.2V, 0.2V or open			300	μA	5
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 4.2mA		-	0.4	V	
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -5mA		2.4	-	V	

**NOTE :**

1. I<sub>CC1</sub>, I<sub>CC3</sub>, I<sub>CC4</sub>, I<sub>CC6</sub> and I<sub>CC7</sub> depend on cycle rate.
2. I<sub>CC1</sub> and I<sub>CC4</sub> depend on output loading. Specified values are obtained with the output open.
3. It depends on user whether column address is changed or not at least once while R<sub>AS</sub>= V<sub>IL</sub> and C<sub>AS</sub>= V<sub>IH</sub>.
4. t<sub>RAS</sub>(max.)= 1μs is only applied to refresh of battery backup but t<sub>RAS</sub>(max.)= 10μs is applied to normal functional operating.
5. I<sub>CC5</sub>(max.)= 0.4mA and I<sub>CC7</sub> and I<sub>CC8</sub> are applied to SL-part only (HY5117410ASLJ, HY5117410ASLT and HY5117410ASLR).

**AC CHARACTERISTICS**

(TA=0°C to 70°C, Vcc=5V±10%, Vss = 0V, unless otherwise noted.) NOTE : 1, 2, 3

#	SYMBOL	PARAMETER	HY5117410AJ/T/R/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	140	-	160	-	180	-	ns		
3	tPC	Fast Page Mode Cycle Time	35	-	40	-	45	-	ns		
4	tPRWC	Fast Page Mode Read-Modify-Write Cycle Time	80	-	85	-	90	-	ns		
5	tRAC	Access Time from RAS	-	50	-	60	-	70	ns	4,9,10	
6	tCAC	Access Time from CAS	-	13	-	15	-	18	ns	4,9	
7	tAA	Access Time from Column Address	-	25	-	30	-	35	ns	4,10	
8	tCPA	Access Time from CAS Precharge	-	30	-	35	-	40	ns	4	
9	tCLZ	CAS to Output Low Impedance	0	-	0	-	0	-	ns	4	
10	tOFF	Output Buffer Turn-off Delay	0	10	0	13	0	15	ns		
11	tT	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	3	
12	tRP	RAS Precharge Time	30	-	40	-	50	-	ns		
13	tRAS	RAS Pulse Width	50	10K	60	10K	70	10K	ns		
14	tRASP	RAS Pulse Width (Fast Page Mode)	50	200K	60	200K	70	200K	ns		
15	tRSH	RAS Hold Time	13	-	15	-	18	-	ns		
16	tCSH	CAS Hold Time	50	-	60	-	70	-	ns		
17	tCAS	CAS Pulse Width	13	10K	15	10K	18	10K	ns		
18	tRCD	RAS to CAS Delay	18	37	20	45	20	52	ns	9	
19	tRAD	RAS to Column Address Delay Time	15	30	15	35	15	40	ns	10	
20	tCRP	CAS to RAS Precharge Time	5	-	5	-	5	-	ns		
21	tCP	CAS Precharge Time	8	-	10	-	10	-	ns		
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		
25	tCAH	Column Address Hold Time	10	-	10	-	10	-	ns		
26	tAR	Column Address Hold Time from RAS	50	-	50	-	55	-	ns		
27	tRAL	Column Address to RAS Lead Time	25	-	30	-	35	-	ns		
28	tRCS	Read Command Set-up Time	0	-	0	-	0	-	ns		
29	tRCH	Read Command Hold Time Referenced to CAS	0	-	0	-	0	-	ns	6	
30	tRRH	Read Command Hold Time Referenced to RAS	0	-	0	-	0	-	ns	6	
31	tWCH	Write Command Hold Time	8	-	10	-	10	-	ns		
32	tWCR	Write Command Hold Time from RAS	45	-	55	-	60	-	ns		
33	tWP	Write Command Pulse Width	8	-	10	-	10	-	ns		
34	tRWL	Write Command to RAS Lead Time	13	-	15	-	18	-	ns		
35	tCWL	Write Command to CAS Lead Time	13	-	15	-	18	-	ns		
36	tDS	Data-In Set-up Time	0	-	0	-	0	-	ns	7	
37	tDH	Data-In Hold Time	10	-	10	-	10	-	ns	7	
38	tDHR	Data-In Hold Time Referenced to RAS	50	-	50	-	55	-	ns		
39	tREF	Refresh Period (2048 cycles)		-	32	-	32	-	32	ms	12
			SL-part	-	256	-	256	-	256		11
40	tWCS	Write Command Set-up Time	0	-	0	-	0	-	ns	8	

**AC CHARACTERISTICS**

(continued)

#	SYMBOL	PARAMETER	HY51V17410AJ/T/R/SLJ/SLT/SLR						UNIT	NOTE
			-60		-70		-80			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
41	tCWD	CAS to WE Delay Time	38	-	43	-	45	-	ns	8
42	tRWD	RAS to WE Delay Time	83	-	95	-	105	-	ns	8
43	tAWD	Column Address to WE Delay Time	53	-	60	-	65	-	ns	8
44	tCSR	CAS Set-up Time (CBR Cycle)	5	-	5	-	5	-	ns	
45	tCHR	CAS Hold Time (CBR Cycle)	10	-	10	-	10	-	ns	
46	tRPC	RAS to CAS Precharge Time	0	-	0	-	0	-	ns	
47	tCPT	CAS Precharge Time (CBR Counter Test)	20	-	25	-	25	-	ns	
48	tROH	RAS Hold Time Reference to OE	0	-	0	-	0	-	ns	
49	tOEA	OE Access Time	-	15	-	18	-	20	ns	
50	tOED	OE to Data Delay	15	-	15	-	15	-	ns	
51	tOEZ	Output Buffer Turn Off Delay Time	0	13	0	15	0	15	ns	
52	tOEH	OE Command Hold Time	10	-	10	-	10	-	ns	
53	tCPWD	WE Delay Time from CAS Precharge	35	-	40	-	45	-	ns	8
54	tRHCP	RAS Hold Time from CAS Precharge	35	-	40	-	45	-	ns	
55	tWRP	WE to RAS Precharge Time (CBR Cycle)	10	-	10	-	10	-	ns	
56	tWRH	WE to RAS Hold Time (CBR Cycle)	10	-	10	-	10	-	ns	
57	tWTS	Write Command Set-up Time (Test Mode In)	10	-	10	-	10	-	ns	
58	tWTH	Write Command Hold Time (Test Mode In)	10	-	10	-	10	-	ns	
59	twBS	Write-Per-Bit Set-up Time (Test Mode In)	0		0		0		ns	
60	twBH	Write-Per-Bit Hold Time (Test Mode In)	10		10		10		ns	
61	twDS	Write-Per-Bit Selection Set-up Time (Test Mode In)	0		0		0		ns	
62	twDH	Write-Per-Bit Selection Hold Time (Test Mode In)	10		10		10		ns	
63	tRASS	RAS Pulse Width (Self Refresh Cycle)	100	-	100	-	100	-	μs	
64	tRPS	RAS Precharge Time (Self Refresh Cycle)	90	-	110	-	130	-	ns	
65	tCHS	CAS Hold Time (Self Refresh Cycle)	-50	-	-50	-	-50	-	ns	

**AC CHARACTERISTICS IN TEST MODE** NOTE 13

#	SYMBOL	PARAMETER	HY5117410AJ/T/R/SLJ/SLT/SLR/						UNIT	NOTE
			-50		-60		-70			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
1	tRC	Random Read or Write Cycle Time	95	-	115	-	135	-	ns	
2	tRWC	Read-Modify-Write Cycle Time	115	-	135	-	160	-	ns	
3	tPC	Fast Page Mode Cycle Time	40	-	45	-	50	-	ns	
4	tPRWC	Fast Page Mode Read-Modify-Write Cycle Time	60	-	65	-	75	-	ns	
5	tRAC	Access Time from RAS	-	55	-	65	-	75	ns	4,9,10
6	tCAC	Access Time from CAS	-	18	-	20	-	23	ns	4,9
7	tAA	Access Time from Column Address	-	30	-	35	-	40	ns	4,10
8	tCPA	Access Time from CAS Precharge	-	35	-	40	-	45	ns	4
13	tRAS	RAS Pulse Width	55	10K	65	10K	75	10K	ns	
14	tRASP	RAS Pulse Width (Fast Page Mode)	55	200K	65	200K	75	200K	ns	
15	tRSH	RAS Hold Time	18	-	20	-	23	-	ns	
16	tCSH	CAS Hold Time	55	-	65	-	75	-	ns	
17	tCAS	CAS Pulse Width	18	10K	20	10K	23	10K	ns	
27	tRAL	Column Address to RAS Lead Time	30	-	35	-	40	-	ns	
41	tCWD	CAS to WE Delay Time	18	-	20	-	23	-	ns	8
42	tRWD	RAS to WE Delay Time	55	-	65	-	75	-	ns	8
43	tAWD	Column Address to WE Delay Time	30	-	35	-	40	-	ns	8
49	tOEA	OE Access Time	-	20	-	20	-	25	ns	
50	tOED	OE to Data Delay	20	-	20	-	25	-	ns	
52	tOEH	OE Command Hold Time	20	-	20	-	25	-	ns	

**NOTE :**

1. An initial pause of 200 $\mu$ s is required after power-up followed by any 8  $\overline{\text{RAS}}$  only or  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh cycle before proper device operation is achieved.
2. If  $\overline{\text{RAS}}=\text{Vss}$  during power-up, the HY5117410A could begin an active cycle. These condition results in higher current than necessary which is demanded from the power supply during power-up. It is recommended that  $\overline{\text{RAS}}$  and  $\overline{\text{CAS}}$  track with  $\text{Vcc}$  during power-up or be held at a valid  $\text{VIH}$  in order to minimize the power-up current
3.  $\text{VIH}(\text{min.})$  and  $\text{VIL}(\text{max.})$  are reference levels for measuring timing of input signals. Also, transition times are measured between  $\text{VIH}(\text{min.})$  and  $\text{VIL}(\text{max.})$ , and are assumed to be 5ns for all inputs.
4. Measured at  $\text{VOH}=2.4\text{V}$  and  $\text{VOL}=0.4\text{V}$  with a load equivalent to 2 TTL loads and 100pF.
5.  $\text{tOFF}(\text{max.})$  and  $\text{tOEZ}$  define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
6. Either  $\text{trCH}$  or  $\text{trRH}$  must be satisfied for a read cycle.
7. These parameters are referenced to  $\overline{\text{CAS}}$  leading edge in early write cycles and to  $\overline{\text{WB/WE}}$  leading edge in Read-Modify-Write cycles.
8.  $\text{twCS}$ ,  $\text{trWD}$ ,  $\text{tcWD}$ ,  $\text{tAWD}$  and  $\text{tcpWD}$  are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If  $\text{twCS}(\text{min.})$ , the cycle is an early write cycle and data out pin will remain open circuit (high impedance) through the entire cycle. If  $\text{trWD}(\text{min.})$ ,  $\text{tcWD}(\text{min.})$ ,  $\text{tAWD}(\text{min.})$ , and  $\text{tcpWD}(\text{min.})$ , 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 indetermined.
9. Operation within the  $\text{trCD}(\text{max.})$  limit insures that  $\text{trAC}(\text{max.})$  can be met.  $\text{trCD}(\text{max.})$  is specified as a reference point only. If  $\text{trCD}$  is greater than the specified  $\text{trCD}(\text{max.})$  limit, then access time is controlled by  $\text{tCAC}$ .
10. Operation within the  $\text{trAD}(\text{max.})$  limit insures that  $\text{trAC}(\text{max.})$  can be met.  $\text{trAD}(\text{max.})$  is specified as a reference point only. If  $\text{trAD}$  is greater than the specified  $\text{trAD}(\text{max.})$  limit, then access time is controlled by  $\text{tAA}$ .
11.  $\text{tREF}(\text{max.})=256\text{ms}$  is applied to SL-Parts (HY5117410ASLJ, HY5117410ASLT and HY5117410ASLR).
12. A burst of 2048  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh cycles must be executed within 64ms(256ms for SL-part) after exiting self refresh.
13. These specifications are applied to the test Mode.

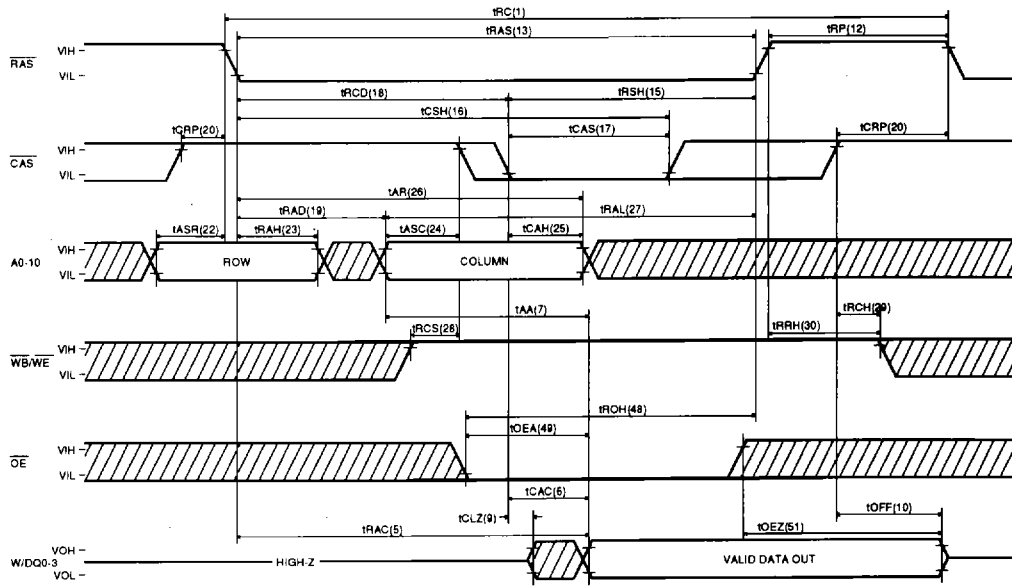
**CAPACITANCE**

( $\text{TA}=25^\circ\text{C}$ ,  $\text{Vcc}=5\text{V}$  10%,  $\text{Vss}=0\text{V}$ ,  $f=1\text{MHz}$ , unless otherwise noted.)

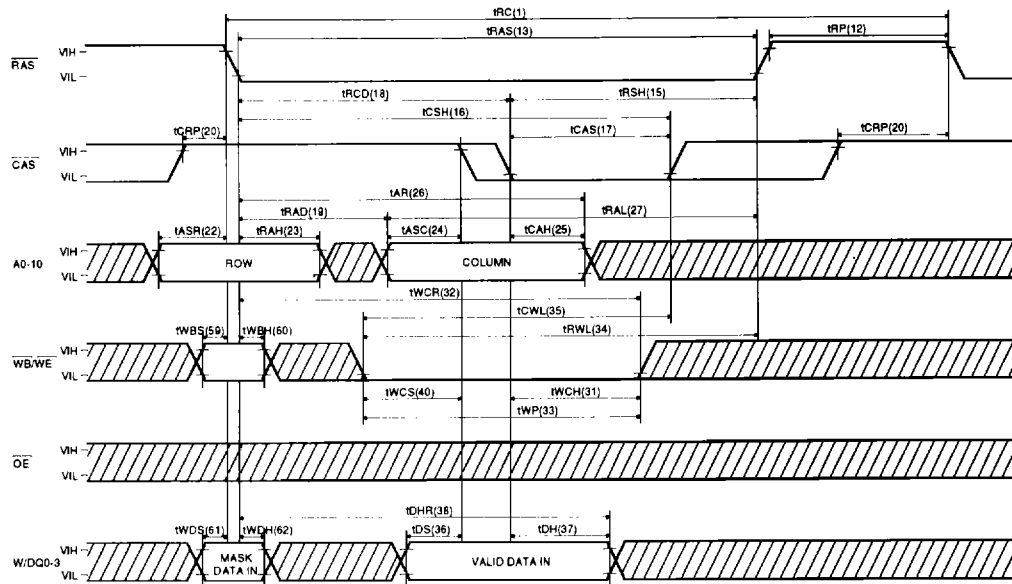
SYMBOL	PARAMETER	TYP.	MAX.	UNIT
CIN1	Input Capacitance (A0-A10)	-	5	pF
CIN2	Input Capacitance ( $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ , $\overline{\text{WB/WE}}$ , $\overline{\text{OE}}$ )	-	7	pF
CDQ	Write Mask / Data I/O Capacitance (W/DQ0-W/DQ3)	-	7	pF

**TIMING DIAGRAM**

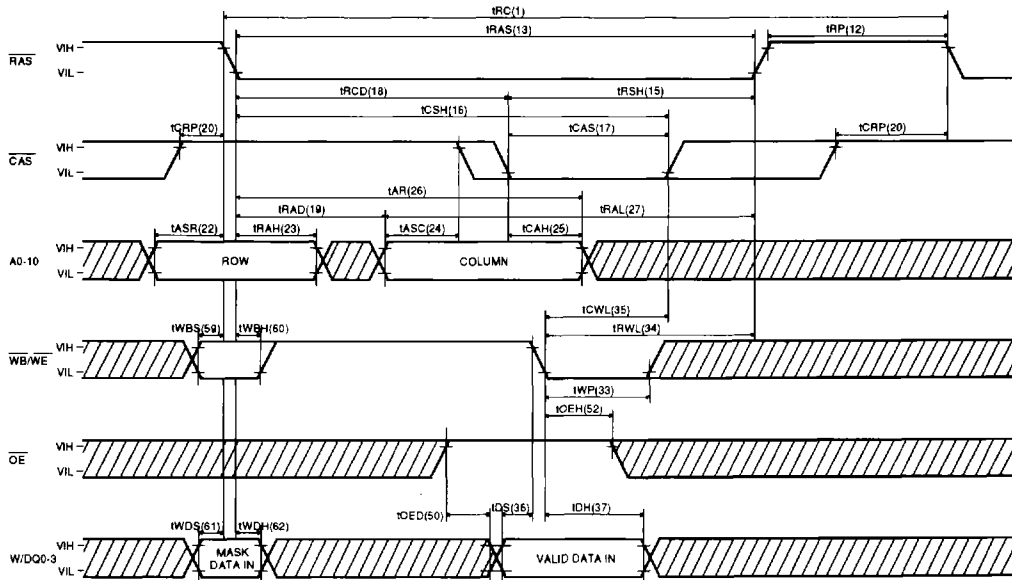
**READ CYCLE**



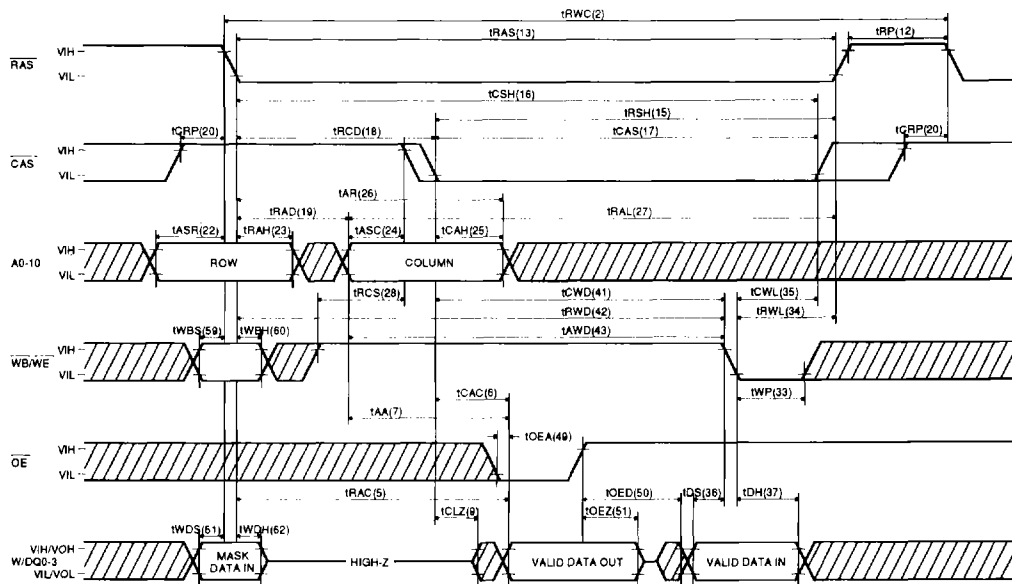
**EARLY WRITE CYCLE**



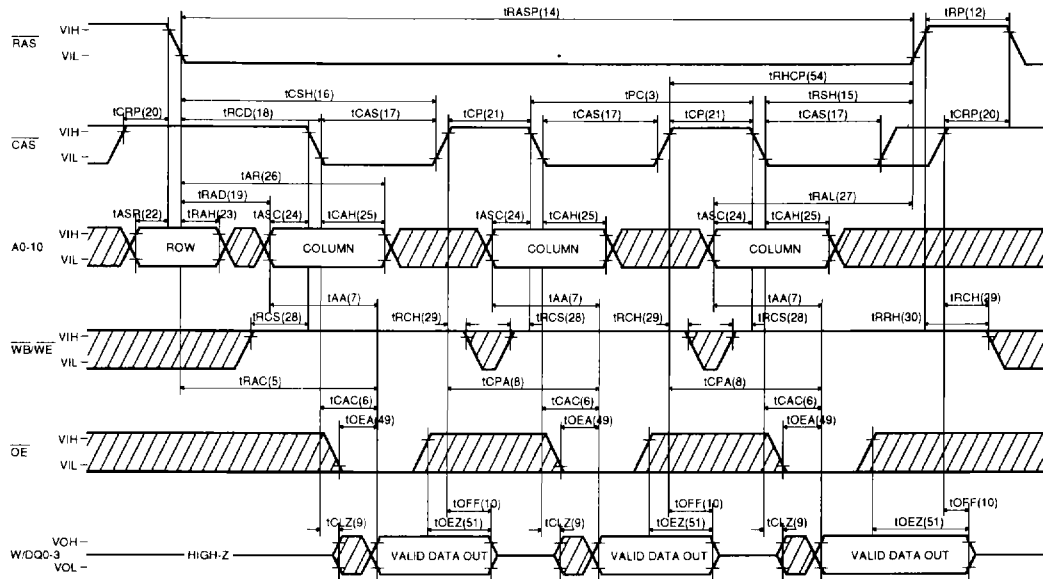
WRITE CYCLE ( $\overline{OE}$  CONTROLLED WRITE)



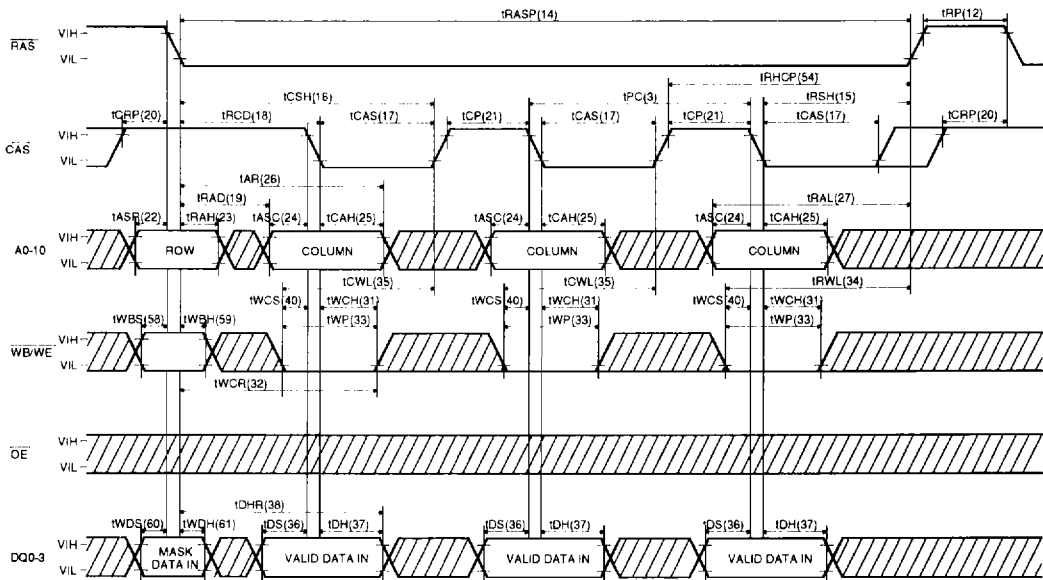
READ-MODIFY-WRITE CYCLE



**FAST PAGE MODE READ CYCLE**



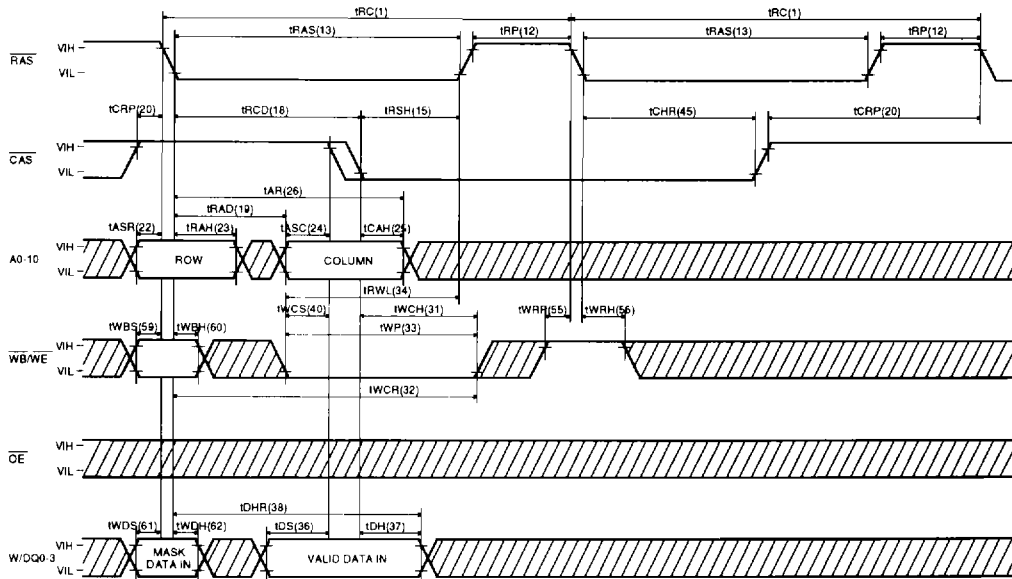
**FAST PAGE MODE EARLY WRITE CYCLE**



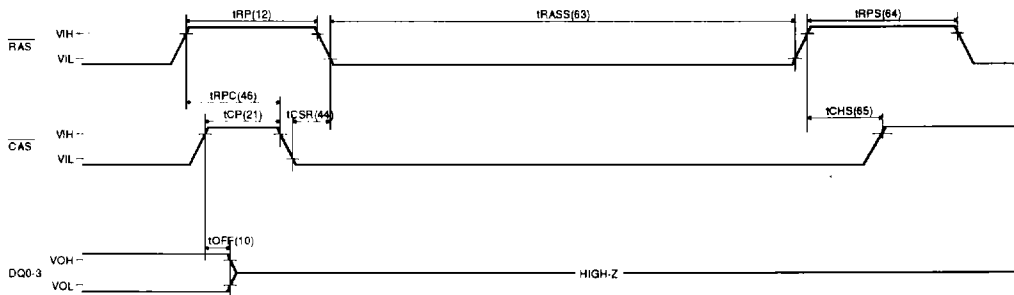




**HIDDEN REFRESH CYCLE (WRITE)**

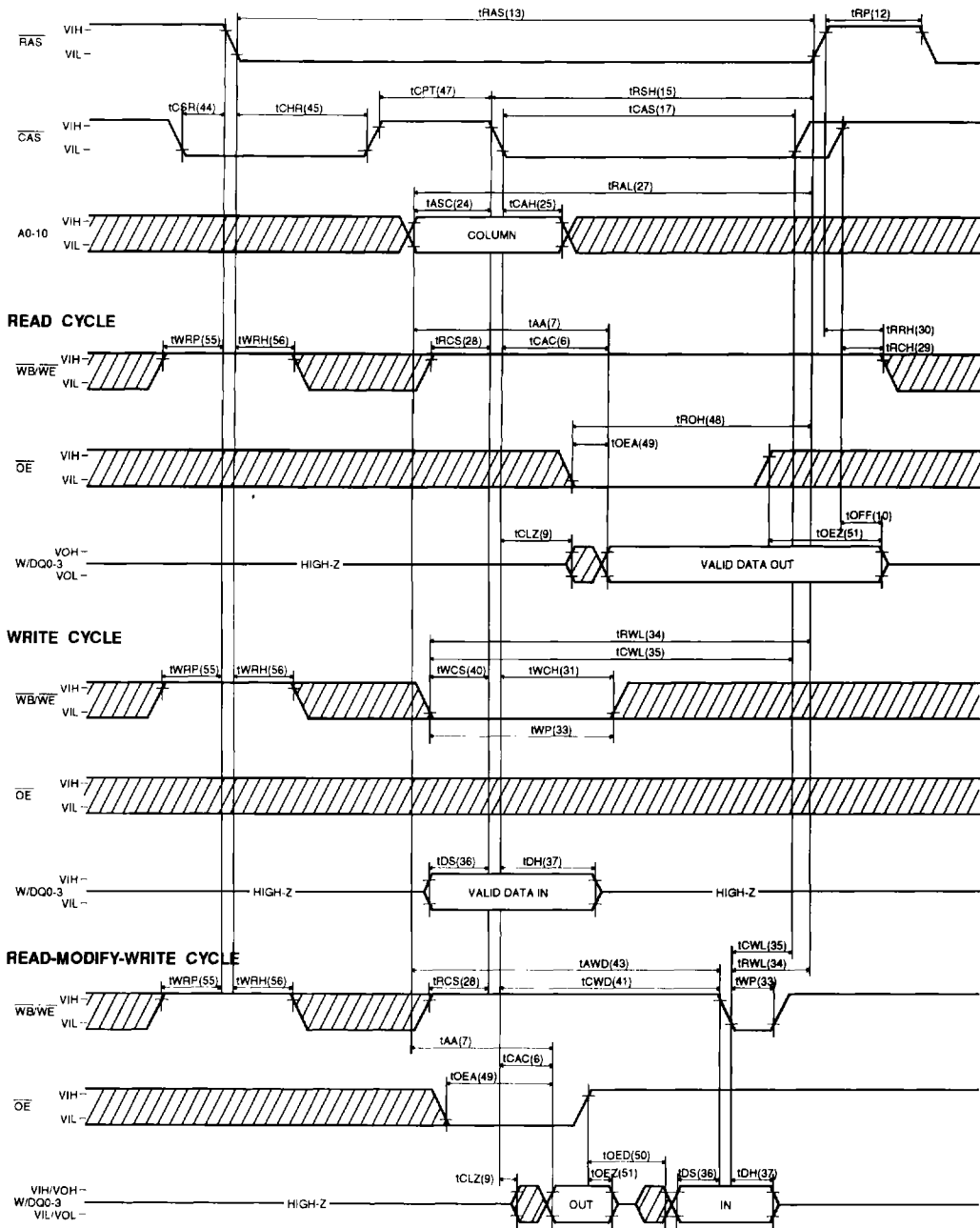


**CAS-BEFORE-RAS SELF REFRESH CYCLE**



NOTE A0-10, OE and WE = "H" or "L"

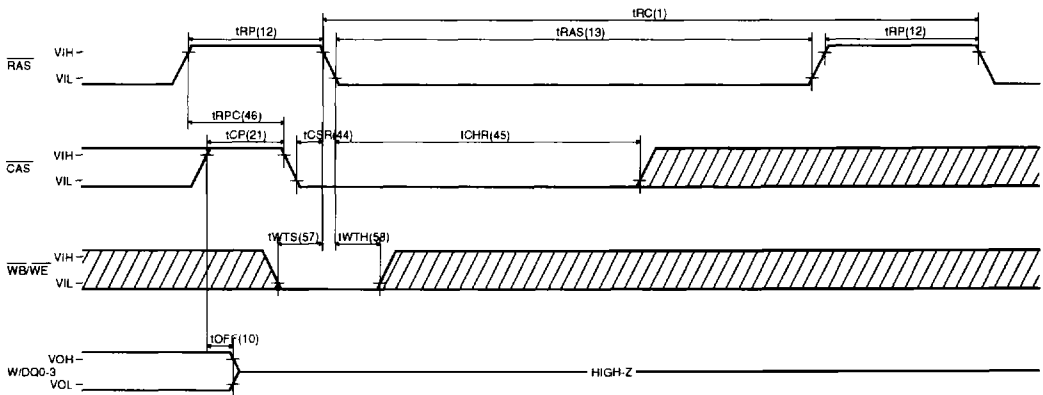
**CAS-BEFORE-RAS REFRESH COUNTER TEST CYCLE**



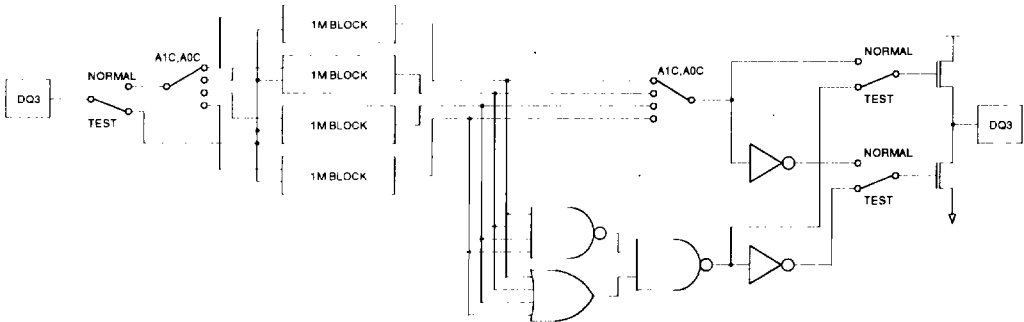
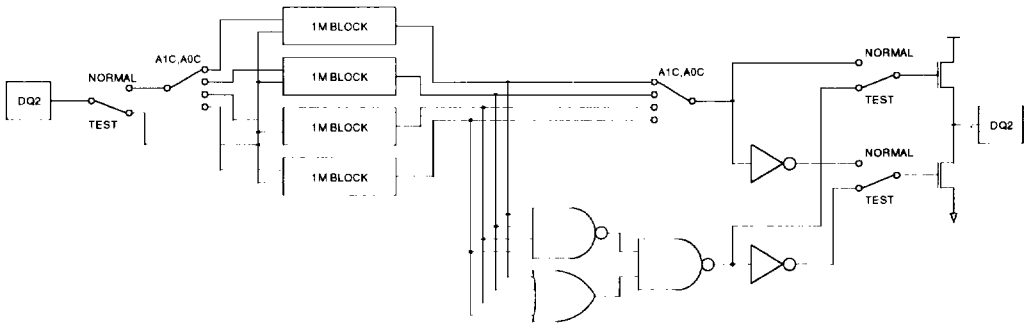
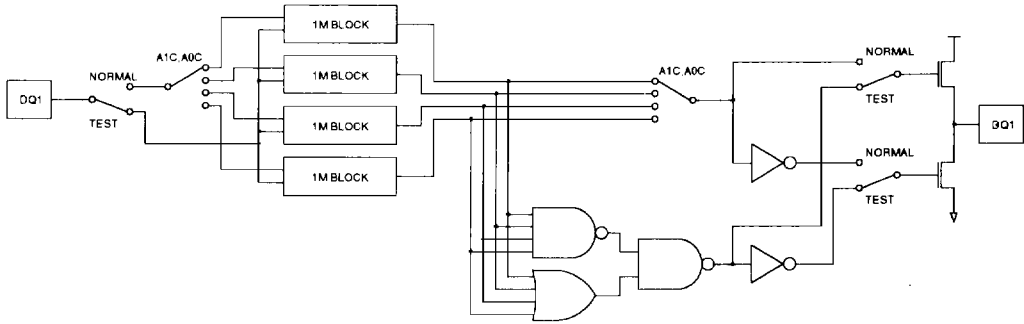
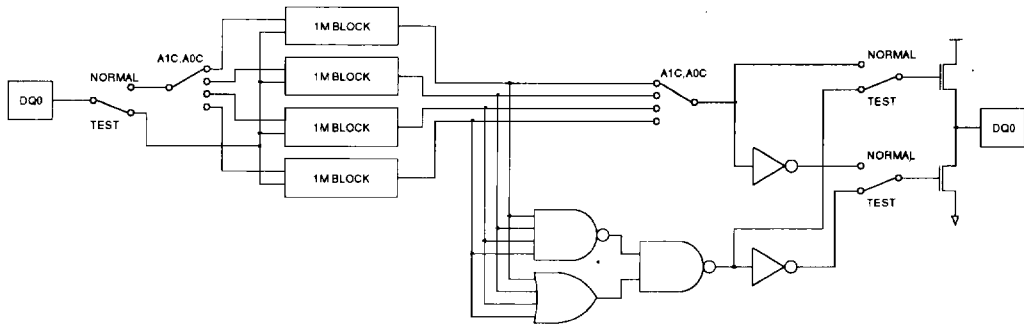
**TEST MODE**

The HY5117410A is a DRAM organized 4,194,304 x 4-bit. It is internally organized 1,048,576 x 16-bit. In Test Mode, data are written into 16 sectors (Each is composed of 1M bits) in parallel and retrieved the same way. Column address A0 and A1 are not used. If, upon reading, 4-bit data from 4 sectors connected to one DQ pin are equal (all "1"s or "0"s), the DQ pin indicates a "1". If they are not equal, the DQ pin indicates a "0". Belowing shows the timing diagram of the HY5117410A to enter Test Mode. In Test Mode, the 4Mx4 DRAM can be tested as if it were a 1Mx4 DRAM. WE, CAS-before-RAS cycle (Test Mode In Cycle) puts the HY5117410A into Test Mode and CAS-before-RAS or RAS-only refresh cycle puts it back into Normal Mode. In Test Mode, WE, CAS-before-RAS cycle shall be used for the refresh operation. The Test Mode function reduces test time (1/4 in case of N test pattern).

**TEST MODE IN CYCLE**

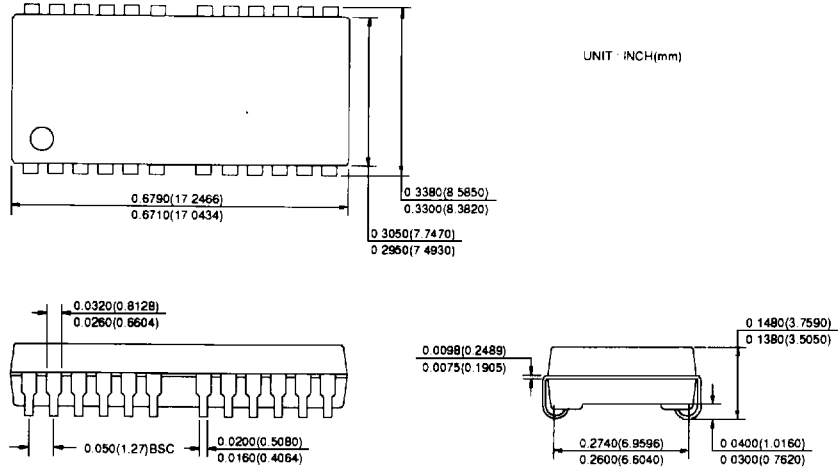


BLOCK DIAGRAM IN TEST MODE

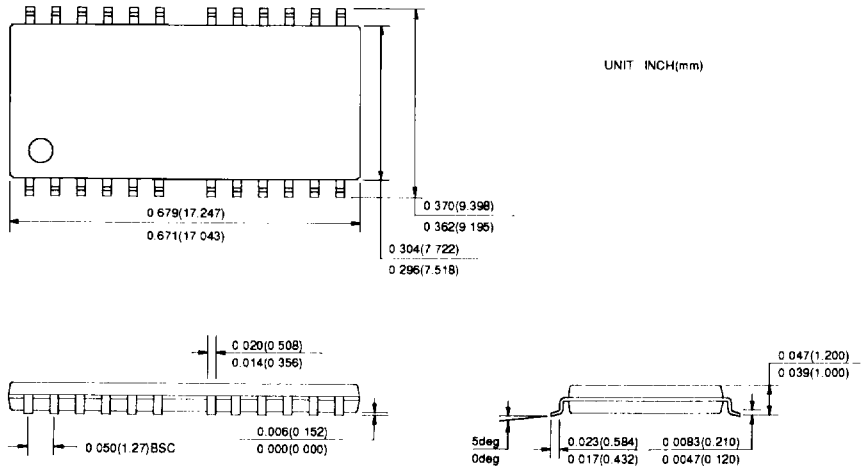


**PACKAGE INFORMATION**

**300 mil 24/26 pin Small Outline J-form Package (J)**



**300 mil 24/26 pin Thin Small Outline Package (T) (R)**



**ORDERING INFORMATION**

<b>PART NO</b>	<b>SPEED</b>	<b>POWER</b>	<b>PACKAGE</b>
HY5117410AJ	50/60/70		SOJ
HY5117410ASLJ	50/60/70	SL-part	SOJ
HY5117410AT	50/60/70		TSOP-II
HY5117410ASLT	50/60/70	SL-part	TSOP-II
HY5117410AR	50/60/70		TSOP-II(R)
HY5117410ASLR	50/60/70	SL-part	TSOP-II(R)