

### DESCRIPTION

The HYM591000 is a 1M x 9-bit Fast page mode CMOS DRAM module consisting of nine HY531000 in 20/26 pin SOJ on a 30 pin glass-epoxy printed circuit board. 0.22 $\mu$ F decoupling capacitor is mounted for each DRAM. The HYM591000M is a Tin-Lead plated socket type Single In-line Memory Module suitable for easy interchange and addition of 1M byte memory.

### FEATURES

- Low power dissipation  
Max. CMOS standby 49.5mW  
Max. TTL standby 99.0mW  
Max. operating

Speed	Power
60	4.21W
70	3.71W
80	3.22W

- Single power supply of 5V  $\pm$  10%
- TTL compatible inputs and outputs
- Fast access time

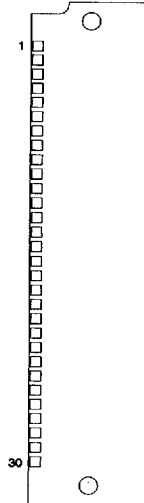
Speed	tRAC	tCAC	tpc
60	60ns	20ns	40ns
70	70ns	20ns	40ns
80	80ns	20ns	45ns

- Fast page mode operation
- CAS-before-RAS, RAS-only, Hidden refresh
- 512 refresh cycles / 8ms

### PIN DESCRIPTION

RAS	Row Address Strobe
CAS	Column Address Strobe
PCAS	CAS for Parity
WE	Write Enable
A0-A9	Address Input
DQ0-DQ7	Data Input/Output
PD	Data In for Parity
PQ	Data Out for Parity
Vcc	Power (+5V)
Vss	Ground

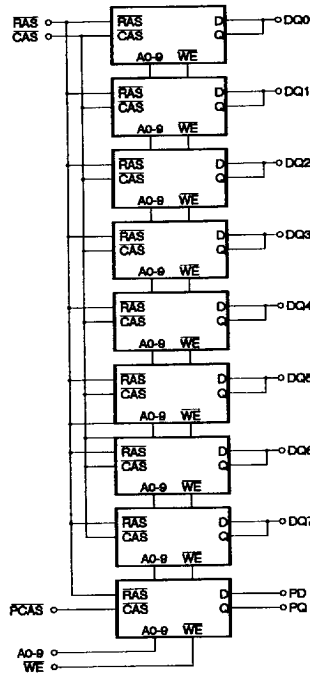
### PIN CONNECTION



**PIN NAME**

#	NAME
1	VCC
2	CAS
3	DQ0
4	A0
5	A1
6	DQ1
7	A2
8	A3
9	VSS
10	DQ2
11	A4
12	A5
13	DQ3
14	A6
15	A7
16	DQ4
17	A8
18	A9
19	NC
20	DQ5
21	WE
22	VSS
23	DQ6
24	NC
25	DQ7
26	PQ
27	RAS
28	PCAS
29	PD
30	VCC

**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	5.4	W

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	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
ILI	Input Leakage Current (Any Input Pin)	VSS ≤ VIN ≤ VCC + 1.0, All other pins not under test = VSS		-90	90	μA	
ILO	Output Leakage Current (High Impedance State)	VSS ≤ VOUT ≤ VCC, RAS & CAS at VIH		-10	10	μA	
ICC1	VCC Supply Current, Operating	trC = trC (min.)	60 70 80	-	765 675 585	mA	1,2,3
ICC2	VCC Supply Current, TTL Standby	RAS & CAS at VIH, other inputs ≥ VSS		-	18	mA	
ICC3	VCC Supply Current, RAS-only refresh	trC = trC (min.)	60 70 80	-	765 675 585	mA	1,3
ICC4	VCC Supply Current, Fast Page mode	tPC = tPC (min.)	60 70 80	-	585 495 405	mA	1,2,3
ICC5	VCC Supply Current, CMOS Standby	RAS & CAS ≥ VCC - 0.2V		-	9	mA	
ICC6	VCC Supply Current, CAS-before-RAS refresh	trC = trC (min.)	60 70 80	-	765 675 585	mA	1,3
VOL	Output Low Voltage	IOL = 4.2mA		-	0.4	V	
VOH	Output High Voltage	IOH = -5mA		2.4	-	V	

**NOTE :**

1. ICC1, ICC3, ICC4 and ICC6 depend on cycle rate.
2. ICC1 and ICC4 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 RAS = VIH and CAS = VIH.

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**AC CHARACTERISTICS**

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

#	SYMBOL	PARAMETER	HYM591000M						UNIT	NOTE
			-60		-70		-80			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
1	trc	Random Read or Write Cycle Time	120	-	130	-	150	-	ns	
2	trpc	RAS to CAS Precharge Time	0	-	0	-	0	-	ns	
3	tpc	Fast Page Mode Cycle Time	40	-	40	-	45	-	ns	
4	trhpc	RAS Hold Time from CAS Precharge	30	-	35	-	35	-	ns	
5	trac	Access Time from RAS	-	60	-	70	-	80	ns	4,9,10
6	tcac	Access Time from CAS	-	20	-	20	-	20	ns	4,9
7	tAA	Access Time from Column Address	-	30	-	35	-	40	ns	4,10
8	tCPA	Access Time from CAS Precharge	-	35	-	35	-	40	ns	4
9	tCLZ	CAS to Output Low Impedance	0	-	0	-	0	-	ns	4
10	tOFF	Output Buffer Turn-off Delay	0	20	0	20	0	20	ns	5
11	tr	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	3
12	trp	RAS Precharge Time	50	-	50	-	60	-	ns	
13	trAS	RAS Pulse Width	60	10K	70	10K	80	10K	ns	
14	trASP	RAS Pulse Width (Fast Page Mode)	60	100K	70	100K	80	100K	ns	
15	trSH	RAS Hold Time	20	-	20	-	20	-	ns	
16	tCSH	CAS Hold Time	60	-	70	-	80	-	ns	
17	tcAS	CAS Pulse Width	20	10K	20	10K	20	10K	ns	
18	trCD	RAS to CAS Delay	20	40	20	50	20	60	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	10	-	10	-	10	-	ns	
22	tASR	Row Address Set-up Time	0	-	0	-	0	-	ns	
23	trAH	Row Address Hold Time	10	-	10	-	10	-	ns	
24	tASC	Column Address Set-up Time	0	-	0	-	0	-	ns	
25	tCAH	Column Address Hold Time	15	-	15	-	15	-	ns	
26	tAR	Column Address Hold Time from RAS	50	-	55	-	60	-	ns	
27	trAL	Column Address to RAS Lead Time	30	-	35	-	40	-	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	15	-	15	-	15	-	ns	
32	twCR	Write Command Hold Time from RAS	50	-	55	-	60	-	ns	
33	tWP	Write Command Pulse Width	15	-	15	-	15	-	ns	
34	trWL	Write Command to RAS Lead Time	20	-	20	-	20	-	ns	
35	tcWL	Write Command to CAS Lead Time	20	-	20	-	20	-	ns	
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 RAS	50	-	55	-	60	-	ns	
39	tREF	Refresh Period (512 cycles)	-	8	-	8	-	8	ms	
40	twCS	Write Command Set-up Time	0	-	0	-	0	-	ns	8

**AC CHARACTERISTICS**

(continued)

#	SYMBOL	PARAMETER	HYM591000M						UNIT	NOTE
			-60		-70		-80			
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
41	tCSR	CAS Set-up Time (CBR Cycle)	5	-	5	-	5	-	ns	
42	tCHR	CAS Hold Time (CBR Cycle)	15	-	15	-	15	-	ns	
43	tCPT	CAS Precharge Time (CBR Counter Test)	40	-	40	-	40	-	ns	

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**NOTE :**

1. An initial pause of 200 $\mu$ s is required after power-up followed by 8 RAS cycles before proper device operation is achieved. In case of using Internal refresh counter, a minimum initialization cycles of 8 CAS-before-RAS instead of 8 RAS cycles are required.
2. VIH(min.) and VIL(max.) are reference levels for measuring timing of input signals. Transition time is measured between VIH and VIL and assumed to be 5ns for all inputs.
3. Refer to the HY531000 data sheet for detailed information.
4. Measured with a load equivalent to 2 TTL loads and 100pF.
5. tOFF(max.) defines the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
6. Either tRCH or tRRH must be satisfied for a read cycle.
7. These parameters are referenced to CAS leading edge in early write cycles.
8. twCS is not a restrictive operating parameter. It is included in the data sheet as electrical characteristics only. If twCS  $\geq$  twCS(min.), the cycle is an early write cycle and data out pin will remain open circuit (high impedance) through the entire cycle.
9. Operation within the tRCD(max.) limit insures that tRAC(max.) can be met. tRCD(max.) is specified as a reference point only. If tRCD is greater than the specified tRCD(max.) limit, then access time is controlled by tCAC.
10. Operation within the tRAD(max.) limit insures that tRAC(max.) can be met. tRAD(max.) is specified as a reference point only. If tRAD is greater than the specified tRAD(max.) limit, then access time is controlled by tAA.

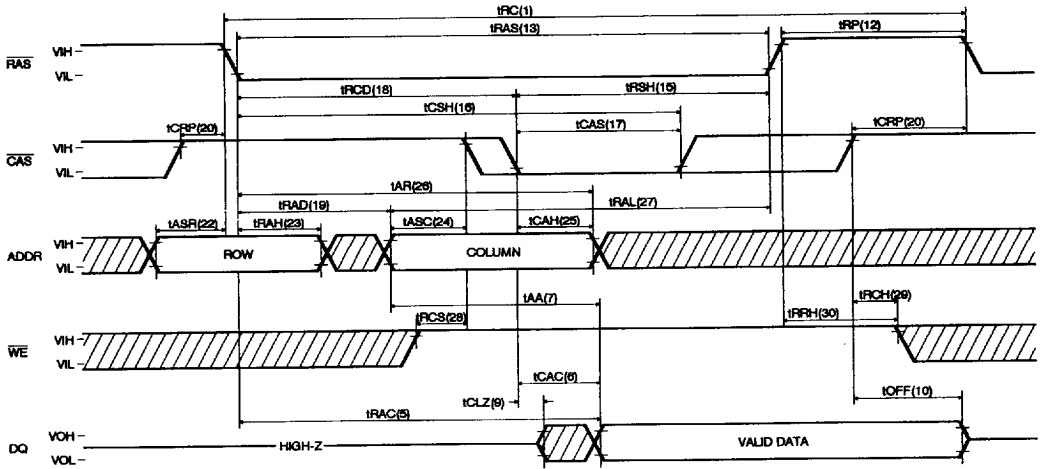
**CAPACITANCE**

(TA=25°C, VCC=5V $\pm$ 10%, VSS=0V, f=1MHz, unless otherwise noted.)

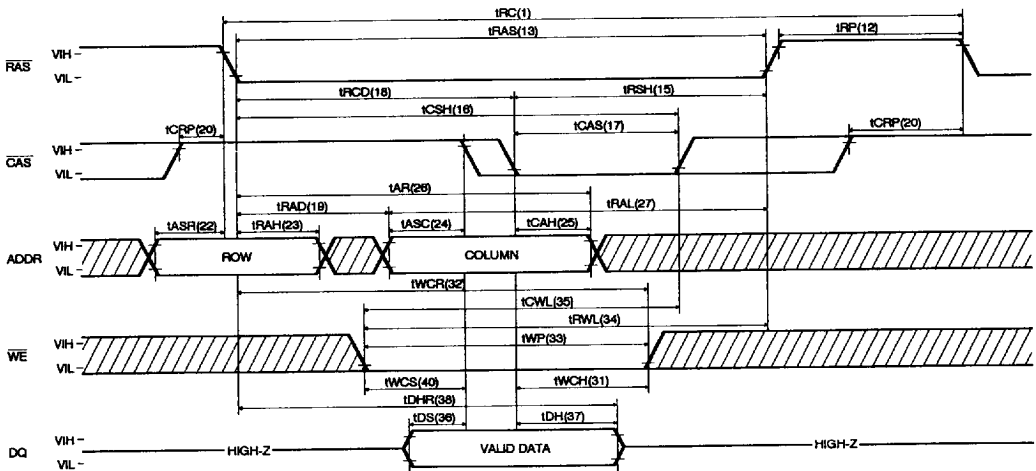
SYMBOL	PARAMETER	TYP.	MAX.	UNIT
CIN1	Input Capacitance (A0-A10, WE, CAS, RAS)	-	60	pF
CIN2	Input Capacitance (PD, PCAS)	-	10	pF
CdQ	I/O Capacitance (DQ0-DQ7)	-	15	pF
CPQ	Output Capacitance (PQ)	-	10	pF

**TIMING DIAGRAM**

**READ CYCLE**



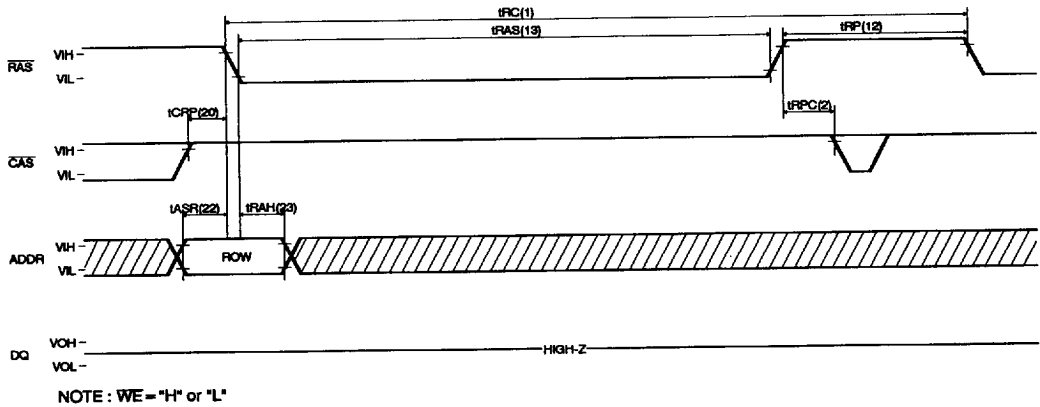
**EARLY WRITE CYCLE**



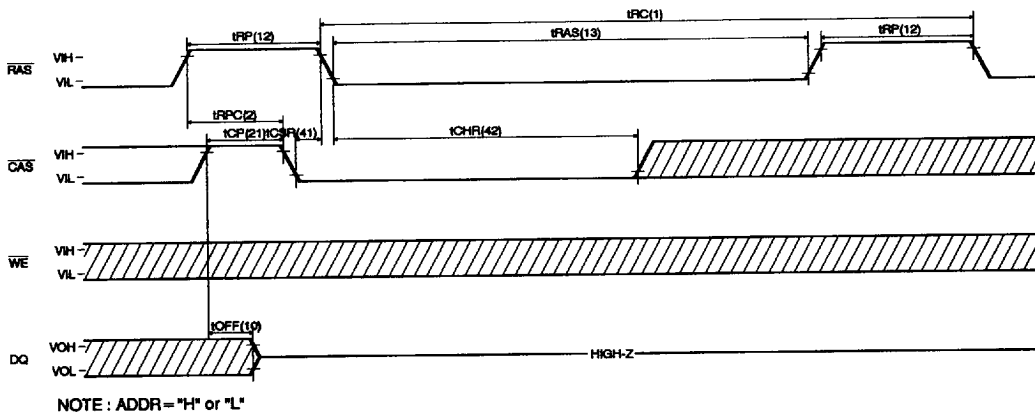




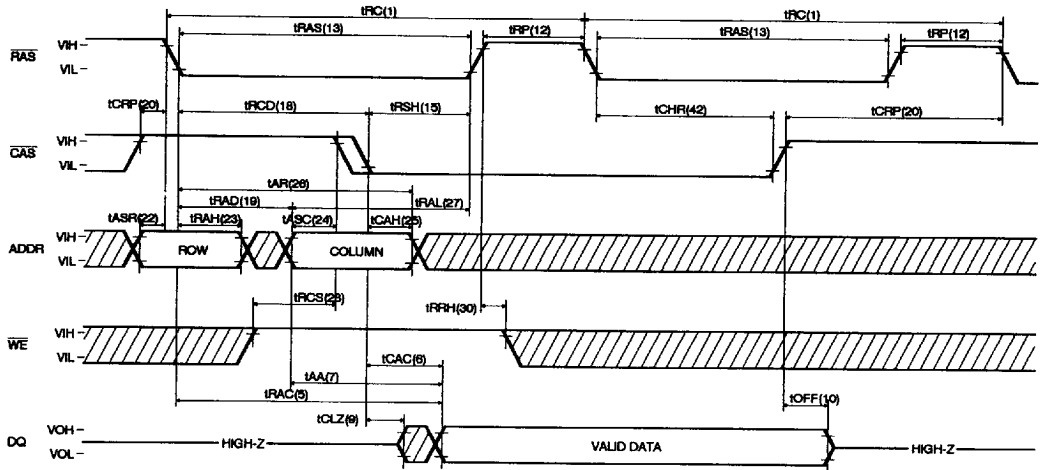
**RAS-ONLY REFRESH CYCLE**



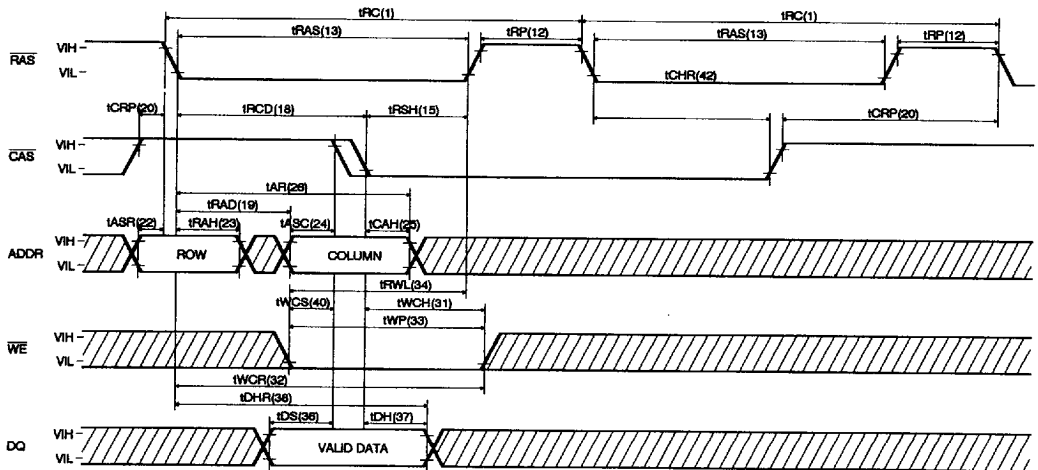
**CAS-BEFORE-RAS REFRESH CYCLE**



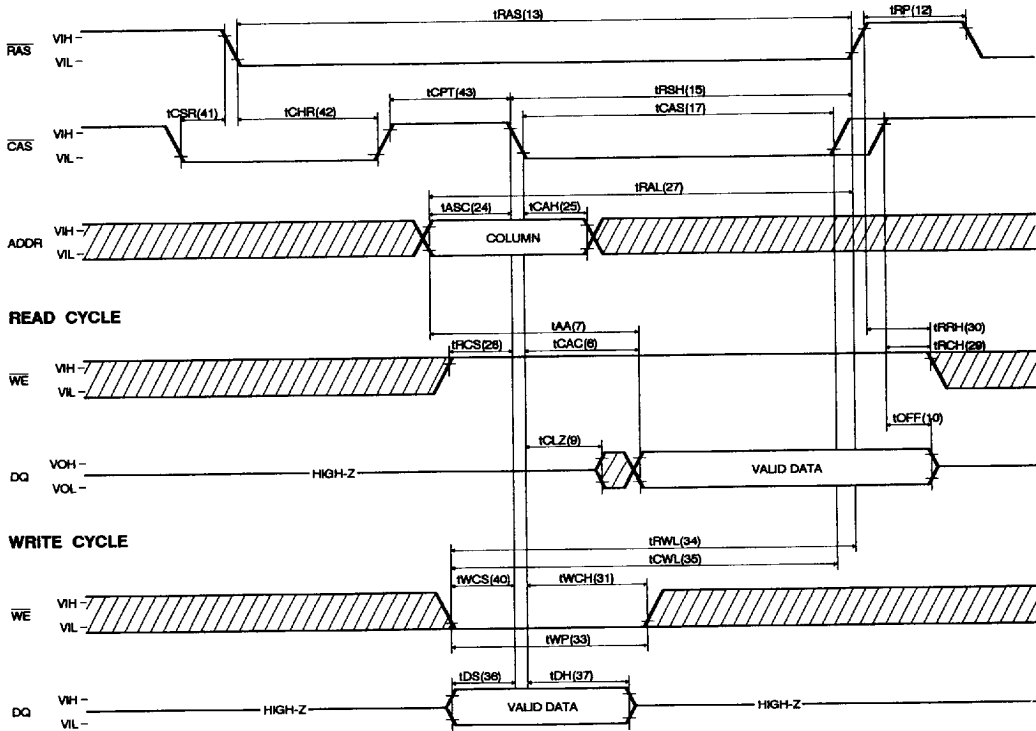
HIDDEN REFRESH CYCLE (READ)



HIDDEN REFRESH CYCLE (WRITE)



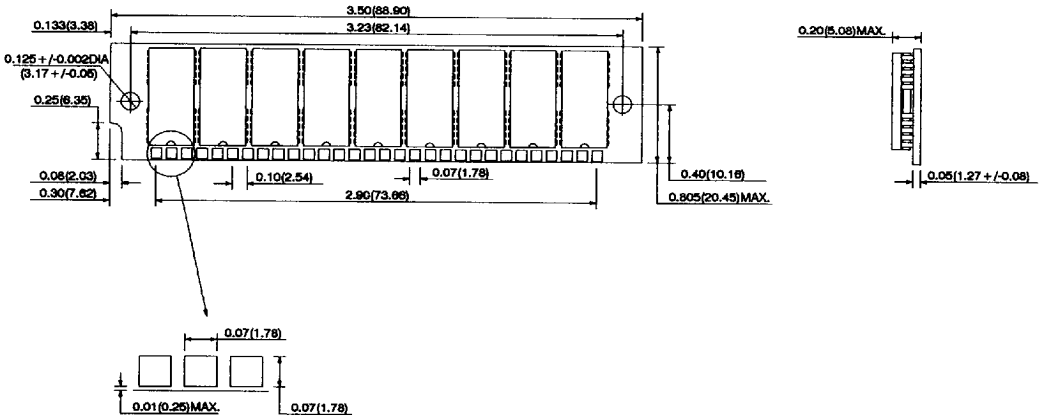
CAS-BEFORE-RAS REFRESH COUNTER TEST CYCLE



**PACKAGE INFORMATION**

**30 pin Single In-line Memory Module (M ; Tin-Lead plated)**

UNIT : INCH(mm)  
TOLERANCE : +/-0.005(0.13)



**ORDERING INFORMATION**

PART NUMBER	SPEED	POWER	PACKAGE	PLATING
HYM591000M	60/70/80		SIMM	Tin-Lead