

## **1M × 32-Bit Dynamic RAM Module (2M × 16-Bit Dynamic RAM Module)**

**HYM 321000S/GS-50/-60**

### **Advanced Information**

- 1 048 576 words by 32-bit organization  
(alternative 2 097 152 words by 16-bit)
- Fast access and cycle time  
50 ns access time  
90 ns cycle time (-50 version)  
60 ns access time  
110 ns cycle time (-60 version)
- Fast page mode capability with  
35 ns cycle time (-50 version)  
40 ns cycle time (-60 version)
- Single + 5 V (± 10 %) supply
- Low power dissipation  
max 2200 mW active (-50 version)  
max. 1980 mW active (-60 version)  
CMOS – 11 mW standby  
TTL – 22 mW standby
- $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh,  $\overline{\text{RAS}}$ -only-refresh, Hidden refresh
- 2 decoupling capacitors mounted on substrate
- All inputs, outputs and clock fully TTL compatible
- 72 pin Single in-Line Memory Module
- Utilizes two 1M × 16 -DRAMs in SOJ-42 packages
- 1024 refresh cycles/16 ms
- Optimized for use in byte-write non-parity applications
- Tin-Lead contact pads HYM 321000S
- Gold-Lead contact pads HYM 321000GS
- single sided module with 20.32 mm (800 mil) height



The HYM 321000S/GS-50/-60 is a 4 MByte DRAM module organized as 1 048 576 words by 32-bit in a 72-pin single-in-line package comprising two HYB 5118160BSJ 1M × 16 DRAMs in 400 mil wide SOJ-packages mounted together with two 0.2 µF ceramic decoupling capacitors on a PC board.

The HYM 321000S/GS-60/-70 can also be used as a 2 097 152 words by 16-bits dynamic RAM module by means of connecting DQ0 and DQ16, DQ1 and DQ17, DQ2 and DQ18, ..., DQ15 and DQ31, respectively.

Each HYB 5118160BSJ is described in the data sheet and is fully electrically tested and processed according to Siemens standard quality procedure prior to module assembly. After assembly onto the board, a further set of electrical tests is performed.

The speed of the module can be detected by the use of four presence detect pins.

The common I/O feature on the HYM 321000S/GS-50/-60 dictates the use of early write cycles.

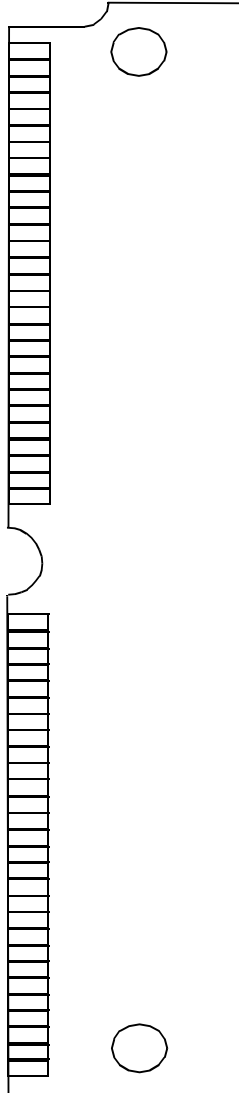
#### **Ordering Information**

<b>Type</b>	<b>Ordering Code</b>	<b>Package</b>	<b>Descriptions</b>
HYM 321000S-50	Q67100 - Q2051	L-SIM-72-10	DRAM module (access time 50 ns)
HYM 321000S-60	Q67100 - Q2056	L-SIM-72-10	DRAM module (access time 60 ns)
HYM 321000GS-50	Q67100 - Q2053	L-SIM-72-10	DRAM module (access time 50 ns)
HYM 321000GS-60	Q67100 - Q2058	L-SIM-72-10	DRAM module (access time 60 ns)



VSS 1 DQ0 2  
DQ16 3 DQ1 4  
DQ17 5 DQ2 6  
DQ18 7 DQ3 8  
DQ19 9 VCC 10  
N.C. 11 A0 12  
A1 13 A2 14  
A3 15 A4 16  
A5 17 A6 18  
N.C. 19 DQ4 20  
DQ20 21 DQ5 22  
DQ21 23 DQ6 24  
DQ22 25 DQ7 26  
DQ23 27 A7 28  
N.C. 29 VCC 30  
A8 31 A9 32  
N.C. 33 RAS2 34  
N.C. 35 N.C. 36

N.C. 37 N.C. 38  
VSS 39 CAS0 40  
CAS2 41 CAS3 42  
CAS1 43 RAS0 44  
N.C. 45 N.C. 46  
WE 47 N.C. 48  
DQ8 49 DQ24 50  
DQ9 51 DQ25 52  
DQ10 53 DQ26 54  
DQ11 55 DQ27 56  
DQ12 57 DQ28 58  
VCC 59 DQ29 60  
DQ13 61 DQ30 62  
DQ14 63 DQ31 64  
DQ15 65 N.C. 66  
PD0 67 PD1 68  
PD2 69 PD3 70  
N.C. 71 VSS 72



### Pin Names

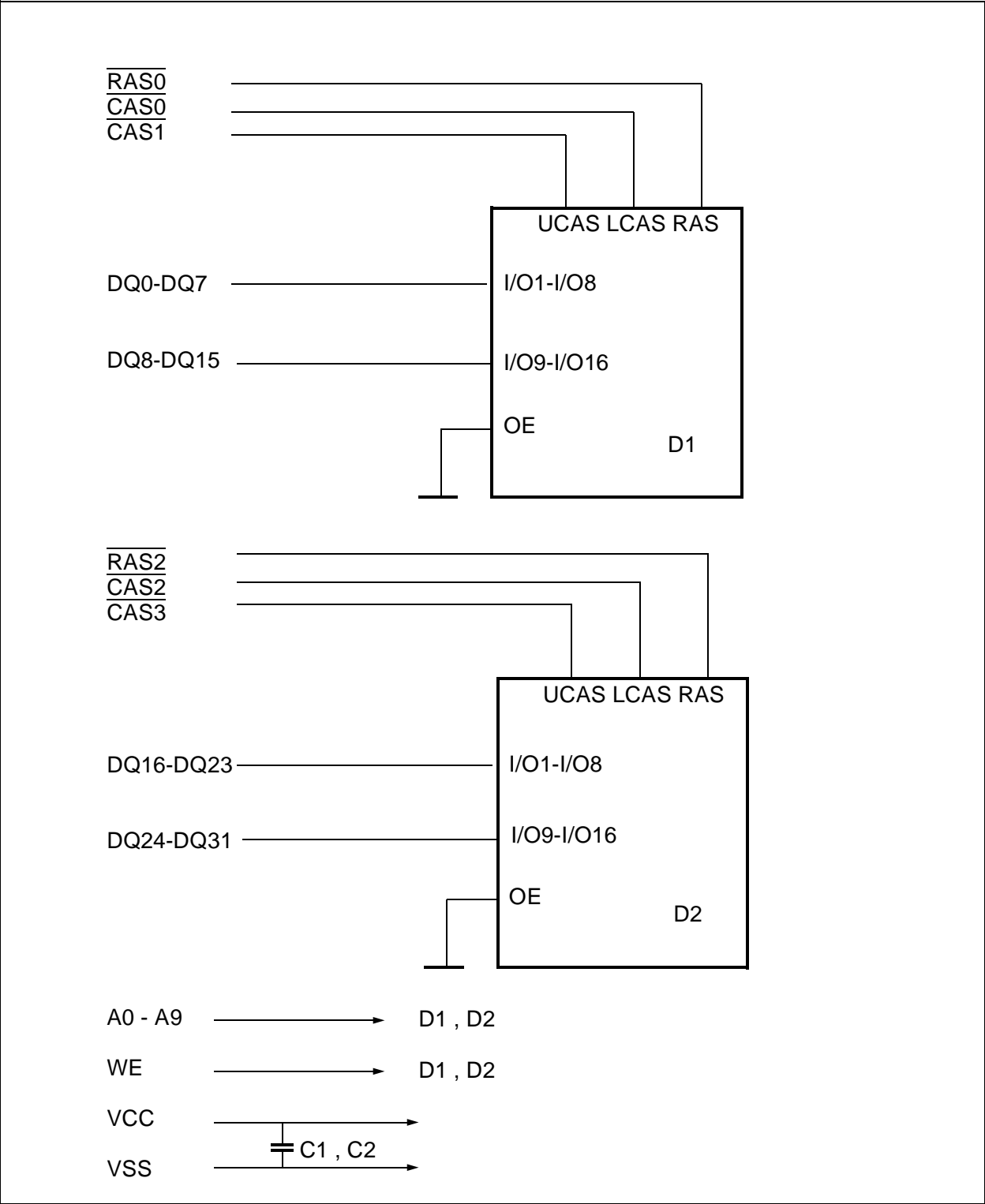
A0-A9	Address Inputs
DQ0-DQ31	Data Input/Output
CAS0 - CAS3	Column Address Strobe
RAS0, RAS2	Row Address Strobe
WE	Read/Write Input
V <sub>CC</sub>	Power (+ 5 V)
V <sub>SS</sub>	Ground
PD	Presence Detect Pin
N.C.	No Connection

### Presence Detect Pins

	-50	-60
PD0	V <sub>SS</sub>	V <sub>SS</sub>
PD1	V <sub>SS</sub>	V <sub>SS</sub>
PD2	V <sub>SS</sub>	N.C.
PD3	V <sub>SS</sub>	N.C.

### Pin Configuration





Block Diagram



#### Absolute Maximum Ratings

Operating temperature range ..... 0 to + 70 °C  
 Storage temperature range..... – 55 to + 125 °C  
 Input/output voltage ..... – 0.5 to min (V<sub>CC</sub> + 0.5, 7.0) V  
 Power supply voltage..... – 1 to + 7 V  
 Power dissipation..... 2.52 W  
 Data out current (short circuit) ..... 50 mA

**Note:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

#### DC Characteristics <sup>1)</sup>

T<sub>A</sub> = 0 to 70 °C; V<sub>CC</sub> = 5 V ± 10 %

Parameter	Symbol	Limit Values		Unit	Test Condition
		min.	max.		
Input high voltage	V <sub>IH</sub>	2.4	5.5	V	–
Input low voltage	V <sub>IL</sub>	– 1.0	0.8	V	–
Output high voltage (I <sub>OUT</sub> = – 5 mA)	V <sub>OH</sub>	2.4	–	V	–
Output low voltage (I <sub>OUT</sub> = 4.2 mA)	V <sub>OL</sub>	–	0.4	V	–
Input leakage current (0 V < V <sub>IN</sub> < 6.5 V, all other pins = 0 V)	I <sub>I(L)</sub>	– 10	10	μA	–
Output leakage current (DO is disabled, 0 V < V <sub>OUT</sub> < 5.5 V)	I <sub>O(L)</sub>	– 10	10	μA	–
Average V <sub>CC</sub> supply current: HYM 321000S/GS-50 HYM 321000S/GS-60  ( $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ , address cycling, t <sub>RC</sub> = t <sub>RC</sub> min.)	I <sub>CC1</sub>	– – –	400 360	mA mA	2), 3), 4)
Standby V <sub>CC</sub> supply current ( $\overline{\text{RAS}}$ = $\overline{\text{CAS}}$ = V <sub>IH</sub> )	I <sub>CC2</sub>	–	4	mA	–
Average V <sub>CC</sub> supply current during $\overline{\text{RAS}}$ only refresh cycles: HYM 321000S/GS-50 HYM 321000S/GS-60  ( $\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}}$ = V <sub>IH</sub> , t <sub>RC</sub> = t <sub>RC</sub> min.)	I <sub>CC3</sub>	– – –	400 360	mA mA	2), 4)



### DC Characteristics (cont'd) <sup>1)</sup>

Parameter	Symbol	Limit Values		Unit	Test Condition
		min.	max.		
Average $V_{CC}$ supply current during fast page mode: HYM 321000S/GS-50 HYM 321000S/GS-60  ( $\overline{RAS} = V_{IL}$ , $\overline{CAS}$ , address cycling $t_{PC} = t_{PC \text{ min.}}$ )	$I_{CC4}$	— — —	110 100	mA mA	2), 3), 4)
Standby $V_{CC}$ supply current ( $\overline{RAS} = \overline{CAS} = V_{CC} - 0.2 \text{ V}$ )	$I_{CC5}$	—	2	mA	—
Average $V_{CC}$ supply current during $\overline{CAS}$ -before- $\overline{RAS}$ refresh mode: HYM 321000S/GS-50 HYM 321000S/GS-60  ( $\overline{RAS}$ , $\overline{CAS}$ cycling, $t_{RC} = t_{RC \text{ min.}}$ )	$I_{CC6}$	— — —	400 360	mA mA	2), 4)

### Capacitance

$T_A = 0 \text{ to } 70 \text{ }^\circ\text{C}$ ;  $V_{CC} = 5 \text{ V} \pm 10 \%$ ;  $f = 1 \text{ MHz}$

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Input capacitance (A0 to A9)	$C_{I1}$	—	25	pF
Input capacitance ( $\overline{RAS0}$ , $\overline{RAS2}$ )	$C_{I2}$	—	20	pF
Input capacitance ( $\overline{CAS0}$ - $\overline{CAS3}$ )	$C_{I3}$	—	20	pF
Input capacitance ( $\overline{WE}$ )	$C_{I4}$	—	25	pF
I/O capacitance (DQ0-DQ31)	$C_{IO1}$	—	15	pF



### AC Characteristics <sup>5)6)</sup>

M16F

 $T_A = 0 \text{ to } 70 \text{ }^\circ\text{C}, V_{CC} = 5 \text{ V} \pm 10 \%, t_T = 5 \text{ ns}$ 

Parameter	Symbol	Limit Values				Unit	Note
		-50		-60			
		min.	max.	min.	max.		

#### common parameters

Random read or write cycle time	$t_{RC}$	90	—	110	—	ns	
$\overline{\text{RAS}}$ precharge time	$t_{RP}$	30	—	40	—	ns	
$\overline{\text{RAS}}$ pulse width	$t_{RAS}$	50	10k	60	10k	ns	
$\overline{\text{CAS}}$ pulse width	$t_{CAS}$	13	10k	15	10k	ns	
Row address setup time	$t_{ASR}$	0	—	0	—	ns	
Row address hold time	$t_{RAH}$	8	—	10	—	ns	
Column address setup time	$t_{ASC}$	0	—	0	—	ns	
Column address hold time	$t_{CAH}$	10	—	15	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ delay time	$t_{RCD}$	18	37	20	45		
$\overline{\text{RAS}}$ to column address delay time	$t_{RAD}$	13	25	15	30	ns	
$\overline{\text{RAS}}$ hold time	$t_{RSH}$	13		15	—	ns	
$\overline{\text{CAS}}$ hold time	$t_{CSH}$	50		60	—	ns	
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ precharge time	$t_{CRP}$	5	—	5	—	ns	
Transition time (rise and fall)	$t_T$	3	50	3	50	ns	7
Refresh period	$t_{REF}$	—	16	—	16	ms	

#### Read Cycle

Access time from $\overline{\text{RAS}}$	$t_{RAC}$	—	50	—	60	ns	8, 9
Access time from $\overline{\text{CAS}}$	$t_{CAC}$	—	13	—	15	ns	8, 9
Access time from column address	$t_{AA}$	—	25	—	30	ns	8,10
Column address to $\overline{\text{RAS}}$ lead time	$t_{RAL}$	25	—	30	—	ns	
Read command setup time	$t_{RCS}$	0	—	0	—	ns	
Read command hold time	$t_{RCH}$	0	—	0	—	ns	11
Read command hold time referenced to $\overline{\text{RAS}}$	$t_{RRH}$	0	—	0	—	ns	11
$\overline{\text{CAS}}$ to output in low-Z	$t_{CLZ}$	0	—	0	—	ns	8
Output buffer turn-off delay	$t_{OFF}$	0	13	0	15	ns	12



### AC Characteristics (cont'd) <sup>5)6)</sup>

M16F

 $T_A = 0 \text{ to } 70 \text{ }^\circ\text{C}, V_{CC} = 5 \text{ V} \pm 10 \%, t_T = 5 \text{ ns}$ 

Parameter	Symbol	Limit Values				Unit	Note
		-50		-60			
		min.	max.	min.	max.		

#### Early Write Cycle

Write command hold time	$t_{WCH}$	8	—	10	—	ns	
Write command pulse width	$t_{WP}$	8	—	10	—	ns	
Write command setup time	$t_{WCS}$	0	—	0	—	ns	13
Write command to $\overline{\text{RAS}}$ lead time	$t_{RWL}$	13	—	15	—	ns	
Write command to $\overline{\text{CAS}}$ lead time	$t_{CWL}$	13	—	15	—	ns	
Data setup time	$t_{DS}$	0	—	0	—	ns	14
Data hold time	$t_{DH}$	10	—	10	—	ns	14

#### Fast Page Mode Cycle

Fast page mode cycle time	$t_{PC}$	35	—	40	—	ns	
$\overline{\text{CAS}}$ precharge time	$t_{CP}$	10	—	10	—	ns	
Access time from $\overline{\text{CAS}}$ precharge	$t_{CPA}$	—	30	—	35	ns	7
$\overline{\text{RAS}}$ pulse width	$t_{RAS}$	50	200k	60	200k	ns	
$\overline{\text{CAS}}$ precharge to $\overline{\text{RAS}}$ Delay	$t_{RHCP}$	30	—	35	—	ns	

#### $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle

$\overline{\text{CAS}}$ setup time	$t_{CSR}$	10	—	10	—	ns	
$\overline{\text{CAS}}$ hold time	$t_{CHR}$	10	—	10	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ precharge time	$t_{RPC}$	5	—	5	—	ns	
Write to $\overline{\text{RAS}}$ precharge time	$t_{WRP}$	10	—	10	—	ns	
Write hold time referenced to $\overline{\text{RAS}}$	$t_{WRH}$	10	—	10	—	ns	

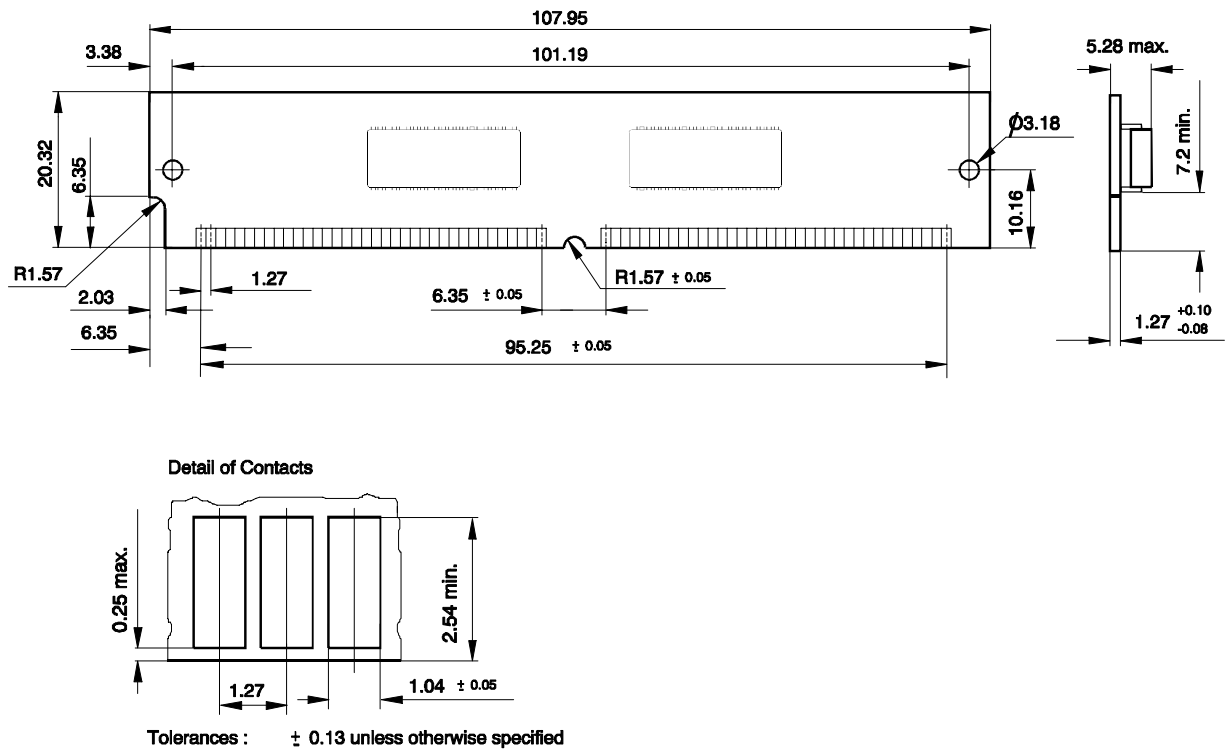


### Notes:

- 1) All voltages are referenced to VSS.
- 2) ICC1, ICC3, ICC4 and ICC6 depend on cycle rate.
- 3) ICC1 and ICC4 depend on output loading. Specified values are measured with the output open.
- 4) Address can be changed once or less while  $\overline{\text{RAS}} = \text{VIL}$ . In the case of ICC4 it can be changed once or less during a fast page mode cycle (tPC).
- 5) An initial pause of 200  $\mu\text{s}$  is required after power-up followed by 8  $\overline{\text{RAS}}$  cycles of which at least one cycle has to be a refresh cycle, before proper device operation is achieved. In case of using internal refresh counter, a minimum of 8  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  initialization cycles instead of 8  $\overline{\text{RAS}}$  cycles are required.
- 6) AC measurements assume  $t_T = 5 \text{ ns}$ .
- 7)  $\text{VIH}$  (min.) and  $\text{VIL}$  (max.) are reference levels for measuring timing of input signals. Transition times are also measured between  $\text{VIH}$  and  $\text{VIL}$ .
- 8) Measured with a load equivalent to 2 TTL loads and 100 pF.
- 9) Operation within the tRCD (max.) limit ensures 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 ensures 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.
- 11) Either tRCH or tRRH must be satisfied for a read cycle.
- 12) tOFF (max.) define the time at which the outputs achieve the open-circuit condition and are not referenced to output voltage levels.
- 13) tWCS is not a restrictive operating parameter. This is included in the data sheet as electrical characteristics only. If  $t\text{WCS} > t\text{WCS}(\text{min.})$ , the cycle is an early write cycle and the I/O pin will remain open-circuit (high impedance) through the entire cycle.
- 14) These parameters are referenced to the  $\overline{\text{CAS}}$  leading edge.



**L-SIM-72-10**  
Module package  
(single in-line memory module)



GLS05833