SIEMENS

3.3V DRAM Modules HYM64Vx005GCD(L)-60

144 pin SO-DIMM EDO-DRAM Modules
8MB , 16MB, 32MB & 64MB density

- 144 Pin JEDEC Standard, 8 Byte Small Outline Dual In-line Memory Modules with 8 Byte busses for PC notebook applications
- Chip-on Board (COB) Assembly Technique
- One bank 1M x 64, 2M x 64, 4M x 64 and 8M x 64 non-parity module organisations
- Performance:

		-60
tRAC	RAS Access Time	60 ns
tCAC	CAS Access Time	15 ns
tAA	Access Time from Address	30 ns
tRC	Cycle Time	104 ns
tHPC	EDO Mode Cycle Time	25 ns

- Single +3.3V(± 0.3V) power supply
- $\overline{\text{CAS}}$-before-$\overline{\text{RAS}}$ refresh, $\overline{\text{RAS}}$-only-refresh
- L-versions use low power DRAMs and support Self Refresh („sleep mode")
- Decoupling capacitors mounted on substrate
- All inputs, outputs are LVTTL compatible
- Optional serial presence detect
- Gold contact pad

These SIEMENS modules are industry standard 144-pin 8-byte EDO-DRAM Small Outline Dual In-line Memory Modules (SO-DIMM) which are organised as x 64 high speed memory arrays designed for use in non-parity applications. These SO-DIMMs are assemble in Chip-On-Board (COB) assembly technique. L-versions support low power DRAMs with Self Refresh („sleep mode")

These modules use serial presence detects implemented via a serial E ^{2}PROM using the two pin I^{2}C protocol. This communication protocol uses CLOCK (SCL) and DATA I/O (SDA) lines to synchronously clock data between the master and the slave E^{2}PROM device. The device address for the E^{2}PROM is set to zero at the module. The first 128 bytes are utilized by the SODIMM manufacturer and the second 128 bytes are available to the end user.

All SIEMENS 144-pin SO-DIMMs provide a high performance, flexible 8-byte interface in a 67,5 mm long footprint with 25,4 mm height.

Product Spectrum:

Standard versions:

		DRAMs used	Rows	Columns	Refresh	Period
1M x 64	HYM64V1005GCD-60	4 1Mx16	10	10	1k	16 ms
2M x 64	HYM64V2005GCD-60	8 2Mx8	11	10	2k	32 ms
4M x 64	HYM64V4005GCD-60	4 4Mx16	12	10	4k	64 ms
8M x 64	HYM64V8005GCD-60	8 8Mx8	12	11	4k	64 ms

Low Power Versions with Self Refresh:

		DRAMs used	Rows	Columns	Refresh	Period
1M x 64	HYM64V1005GCDL-50/-60	4 1Mx16	10	10	1k	128 ms
2M x 64	HYM64V2005GCDL-50/-60	8 2Mx8	11	10	2k	128 ms
4M x 64	HYM64V4005GCDL-50/-60	4 4Mx16	12	10	4k	128 ms
8M x 64	HYM64V8005GCDL-50/-60	8 8Mx8	12	11	4k	128 ms

Card Dimensions:

Organisation	PCB-Board	L x H x T [mm]
1M x 64	L-DIM-144-C1	67.60 x 25.40 x 3.80
2M x 64	L-DIM-144-C2	67.60 x 25.40 x 3.80
4M x 64	L-DIM-144-C3	67.60 x 25.40 x 3.80
8M x 64	L-DIM-144-C4	67.60 x 25.40 x 3.80

Pin Names

A0-Ax	Address Inputs
DQ0 - DQ63	Data Inout/Output
$\overline{RAS0}$	Row Address Strobe
$\overline{CAS0}$ - $\overline{CAS7}$	Column Address Strobe
$\overline{WE}$	Read / Write Input
$\overline{OE}$	Output Enable
Vcc	Power (+3.3 Volt)
Vss	Ground
SCL	Clock for Presence Detect
SDA	Serial Data Out for Presence Detect
N.C.	No Connection

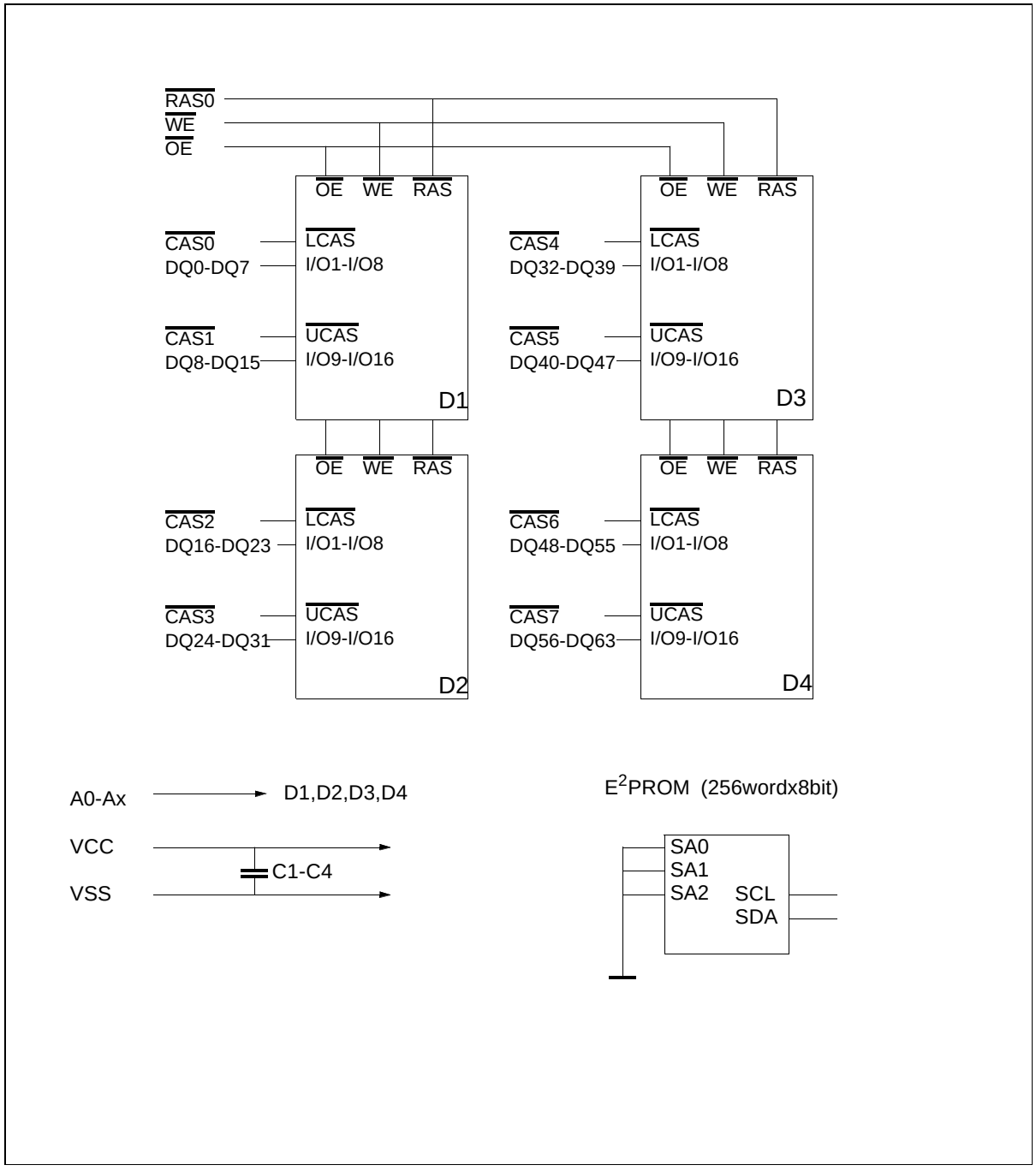
Capacitance

T_A = 0 to 70 °C; V_{CC} = 3.3 V ± 0.3 V; f = 1 MHz

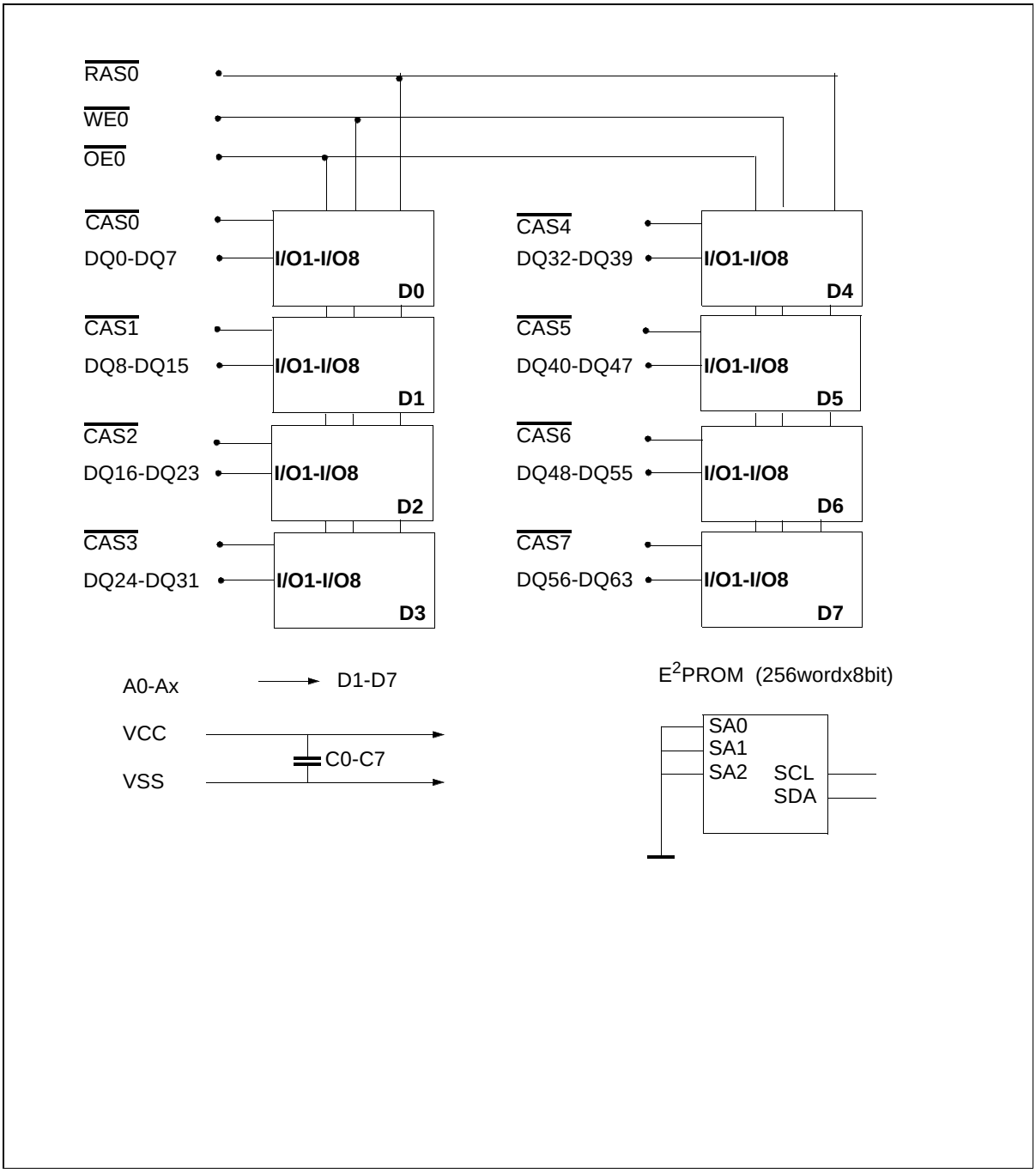
Parameter	Symbol	Limit Values		Unit
		2M x 64	4Mx64	
Input capacitance (Addresses)	C_{I1}	32	25	pF
Input capacitance ($\overline{RAS0}$)	C_{I2}	32	22	pF
Input capacitance ($\overline{CAS0}$-$\overline{CAS7}$)	C_{I3}	10	8	pF
Input capacitance ($\overline{WE}$, $\overline{OE}$)	C_{I4}	32	20	pF
I/O capacitance (DQ0-DQ63)	C_{IO1}	8	9	pF
Input Capacitance ($\overline{SCL}$)	C_{scl}	8	8	pF
Input/Output capacitance (SDA)	C_{sda}	10	10	pF

Pin Configuration

PIN #	Front Side	PIN #	Back Side		PIN #	Front Side	PIN #	Back Side
1	VSS	2	VSS		73	$\overline{OE}$	74	NC
3	DQ0	4	DQ32		75	Vss	76	Vss
5	DQ1	6	DQ33		77	NC	78	NC
7	DQ2	8	DQ34		79	NC	80	NC
9	DQ3	10	DQ35		81	Vcc	82	Vcc
11	VCC	12	Vcc		83	DQ16	84	DQ48
13	DQ4	14	DQ36		85	DQ17	86	DQ49
15	DQ5	16	DQ37		87	DQ18	88	DQ50
17	DQ6	18	DQ38		89	DQ19	90	DQ51
19	DQ7	20	DQ39		91	Vss	92	Vss
21	Vss	22	Vss		93	DQ20	94	DQ52
23	$\overline{CAS0}$	24	$\overline{CAS4}$		95	DQ21	96	DQ53
25	$\overline{CAS1}$	26	$\overline{CAS5}$		97	DQ22	98	DQ54
27	Vcc	28	Vcc		99	DQ23	100	DQ55
29	A0	30	A3		101	Vcc	102	Vcc
31	A1	32	A4		103	A6	104	A7
33	A2	34	A5		105	A8	106	A11
35	Vss	36	Vss		107	Vss	108	Vss
37	DQ8	38	DQ40		109	A9	110	(A12)
39	DQ9	40	DQ41		111	A10	112	(A13)
41	DQ10	42	DQ42		113	Vcc	114	Vcc
43	DQ11	44	DQ43		115	$\overline{CAS2}$	116	$\overline{CAS6}$
45	Vcc	46	Vcc		117	$\overline{CAS3}$	118	$\overline{CAS7}$
47	DQ12	48	DQ44		119	Vss	120	Vss
49	DQ13	50	DQ45		121	DQ24	122	DQ56
51	DQ14	52	DQ46		123	DQ25	124	DQ57
53	DQ15	54	DQ47		125	DQ26	126	DQ58
55	Vss	56	Vss		127	DQ27	128	DQ59
57	NC	58	NC		129	Vcc	130	Vcc
59	NC	60	NC		131	DQ28	132	DQ60
61	DU	62	DU		133	DQ29	134	DQ61
63	Vcc	64	Vcc		135	DQ30	136	DQ62
65	DU	66	DU		137	DQ31	138	DQ63
67	$\overline{WE}$	68	NC		139	Vss	140	Vss
69	$\overline{RAS0}$	70	NC		141	SDA	142	SCL
71	NC	72	NC		143	Vcc	144	Vcc



Block Diagram for 1M x 64 and 4M x 64 SODIMM modules



Block Diagram for 2M x 64 and 8M x 64 SODIMM modules

TRUTH TABLE

FUNCTION		$\overline{RAS}$	$\overline{CAS}$	$\overline{WRITE}$	$\overline{OE}$	ROW ADDR	COL ADDR	DQ0-DQ63
Standby		H	X	X	X	X	X	High Impedance
Read		L	L	H	L	ROW	COL	Data Out
Early-Write		L	L	L	X	ROW	COL	Data In
Late-Write		L	L	H - L	H	ROW	COL	Data In
Read-Modify-Write (RMW)		L	L	H - L	L - H	ROW	COL	Data Out, Data In
EDO Page Mode Read	1st Cycle	L	H - L	H	L	ROW	COL	Data Out
	2nd Cycle	L	H - L	H	L	n/a	COL	Data Out
EDO Page Mode Write	1st Cycle	L	H - L	L	X	ROW	COL	Data In
	2nd Cycle	L	H - L	L	X	n/a	COL	Data In
EDO Page Mode RMW	1st Cycle	L	H - L	H - L	L - H	ROW	COL	Data Out, Data In
	2st Cycle	L	H - L	H - L	L - H	n/a	COL	Data Out, Data In
$\overline{RAS}$ only refresh		L	H	X	X	ROW	n/a	High Impedance
$\overline{CAS}$-before-$\overline{RAS}$ refresh		H - L	L	H	X	X	n/a	High Impedance
Hidden Refresh	READ	L-H-L	L	H	L	ROW	COL	Data Out
	WRITE	L-H-L	L	L	X	ROW	COL	Data In
Self Refresh		H - L	L	H	X	X	X	High Impedance

Absolute Maximum Ratings

Operating temperature range ..... 0 to + 70 ℃
Storage temperature range..... – 55 to + 125 ℃
Input/output voltage ..... –0.5 to min (Vcc+0.5, 4.6) V
Power supply voltage..... –0.5 to 4.6 V
Power dissipation..... 3.68 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

T_A = 0 to 70 °C, V_{SS} = 0 V, V_{CC} = 3.3 V ± 0.3 V

Parameter	Symbol	Limit Values		Unit	Note
		min.	max.		
Input high voltage	V_{IH}	2.0	Vcc+0.3	V	1)
Input low voltage	V_{IL}	– 0.3	0.8	V	1)
Output high voltage (LVTTL) Output „H“level voltage (Iout = -2mA)	V_{OH}	2.4	–	V	
Output low voltage (LVTTL) Output „L“level voltage (Iout = +2mA)	V_{OL}	–	0.4	V	
Output high voltage (LVCMOS) Output „H“level voltage (Iout = -100uA)	V_{OH}	Vcc-0.2	-	V	
Ouput low voltage (LVCMOS) Output „L“level voltage (Iout = +100uA)	V_{OL}	-	0.2	V	
Input leakage current,any input (0 V < Vin < Vcc , all other pins = 0 V	$I_{I(L)}$	–10	10	µA	
Output leakage current (DO is disabled, 0 V < Vout < Vcc)	$I_{O(L)}$	– 10	10	µA	

AC Characteristics 5)6) 16E

T_A = 0 to 70 °C, V_{CC} = 3.3 V ± 0.3V , t_T = 2 ns

Parameter	Symbol	Limit Values		Unit	Note
		-60			
		min.	max.		
common parameters					
Random read or write cycle time	t_{RC}	104	–	ns	
$\overline{RAS}$ precharge time	t_{RP}	40	–	ns	
$\overline{RAS}$ pulse width	t_{RAS}	60	10k	ns	
$\overline{CAS}$ pulse width	t_{CAS}	10	10k	ns	
Row address setup time	t_{ASR}	0	–	ns	
Row address hold time	t_{RAH}	10	–	ns	
Column address setup time	t_{ASC}	0	–	ns	
Column address hold time	t_{CAH}	10	–	ns	
$\overline{RAS}$ to $\overline{CAS}$ delay time	t_{RCD}	14	45	ns	
$\overline{RAS}$ to column address delay	t_{RAD}	12	30	ns	
$\overline{RAS}$ hold time	t_{RSH}	15	–	ns	
$\overline{CAS}$ hold time	t_{CSH}	50	–	ns	
$\overline{CAS}$ to $\overline{RAS}$ precharge time	t_{CRP}	5	–	ns	
Transition time (rise and fall)	t_T	1	50	ns	7
Read Cycle					
Access time from $\overline{RAS}$	t_{RAC}	–	60	ns	8, 9
Access time from $\overline{CAS}$	t_{CAC}	–	15	ns	8, 9
Access time from column address	t_{AA}	–	30	ns	8,10
$\overline{OE}$ access time	t_{OEA}	–	15	ns	
Column address to $\overline{RAS}$ lead time	t_{RAL}	30	–	ns	
Read command setup time	t_{RCS}	0	–	ns	
Read command hold time	t_{RCH}	0	–	ns	11
Read command hold time referenced to $\overline{RAS}$	t_{RRH}	0	–	ns	11
$\overline{CAS}$ to output in low-Z	t_{CLZ}	0	–	ns	8
Output buffer turn-off delay	t_{OFF}	0	15	ns	12
Output turn-off delay from $\overline{OE}$	t_{OEZ}	0	15	ns	12
Data to $\overline{CAS}$ low delay	t_{DZC}	0	–	ns	13

AC Characteristics (cont'd) [5)6)] 16E

T_A = 0 to 70 °C, V_{CC} = 3.3 V ± 0.3V , t_T = 2 ns

Parameter	Symbol	Limit Values		Unit	Note
		-60			
		min.	max.		
Data to $\overline{OE}$ low delay	t_{DZO}	0	–	ns	13
$\overline{CAS}$ high to data delay	t_{CDD}	13	–	ns	14
$\overline{OE}$ high to data delay	t_{ODD}	13	–	ns	14
Write Cycle					
Write command hold time	t_{WCH}	10	–	ns	
Write command pulse width	t_{WP}	10	–	ns	
Write command setup time	t_{WCS}	0	–	ns	15
Write command to $\overline{RAS}$ lead time	t_{RWL}	15	–	ns	
Write command to $\overline{CAS}$ lead time	t_{CWL}	15	–	ns	
Data setup time	t_{DS}	0	–	ns	16
Data hold time	t_{DH}	10	–	ns	16
Read-modify-Write Cycle					
Read-write cycle time	t_{RWC}	138	–	ns	
$\overline{RAS}$ to WE delay time	t_{RWD}	77	–	ns	15
$\overline{CAS}$ to $\overline{WE}$ delay time	t_{CWD}	32	–	ns	15
Column address to $\overline{WE}$ delay time	t_{AWD}	47	–	ns	15
$\overline{OE}$ command hold time	t_{OEH}	13	–	ns	
Hyper Page Mode (EDO) Cycle					
Hyper page mode (EDO) cycle time	t_{HPC}	25	–	ns	
$\overline{CAS}$ precharge time	t_{CP}	10	–	ns	
Access time from $\overline{CAS}$ precharge	t_{CPA}	–	32	ns	7
Output data hold time	t_{COH}	3	–	ns	
$\overline{RAS}$ pulse width in EDO mode	t_{RAS}	60	200k	ns	
$\overline{CAS}$ precharge to $\overline{RAS}$ Delay	t_{RHCP}	32	–	ns	
$\overline{OE}$ setup time prior to $\overline{CAS}$	t_{OES}	5	–	5	–

AC Characteristics (cont'd) [5)6)] 16E

T_A = 0 to 70 °C, V_{CC} = 3.3 V ± 0.3V , t_T = 2 ns

Parameter	Symbol	Limit Values		Unit	Note
		-60			
		min.	max.		
Hyper Page Mode (EDO) Read-modify-Write Cycle					
Hyper page mode (EDO) read-write cycle time	t_{PRWC}	68	–	ns	
$\overline{CAS}$ precharge to $\overline{WE}$	t_{CPWD}	49	–	ns	
$\overline{CAS}$-before-$\overline{RAS}$ refresh cycle					
$\overline{CAS}$ setup time	t_{CSR}	10	–	ns	
$\overline{CAS}$ hold time	t_{CHR}	10	–	ns	
$\overline{RAS}$ to $\overline{CAS}$ precharge time	t_{RPC}	5	–	ns	
Write to $\overline{RAS}$ precharge time	t_{WRP}	10	–	ns	
Write hold time referenced to $\overline{RAS}$	t_{WRH}	10	–	ns	
$\overline{CAS}$-before-$\overline{RAS}$ counter test cycle					
$\overline{CAS}$ precharge time	t_{CPT}	40	–	ns	
Self Refresh Cycle (L-versions only)					
$\overline{RAS}$ pulse width	t_{RASS}	100k	_	ns	17
$\overline{RAS}$ precharge	t_{RPS}	110	_	ns	17
$\overline{CAS}$ hold time	t_{CHS}	-50	_	ns	17

Notes:

1) All voltages are referenced to V_{SS}.
2) I_{CC1}, I_{CC3}, I_{CC4} and I_{CC6} depend on cycle rate.
3) I_{CC1} and I_{CC4} depend on output loading. Specified values are obtained with the output open.
4) Address can be changed once or less while RAS = Vil. In case of ICC4 it can be changed once or less during a hyper page mode (EDO) cycle
5) An initial pause of 200 µs is required after power-up followed by 8 $\overline{RAS}$ cycles of which at least one cycle has to be a refresh cycle, before proper device operation is achieved. In case of using the internal refresh counter, a minimum of 8 $\overline{CAS}$-before-$\overline{RAS}$ initialization cycles instead of 8 $\overline{RAS}$ cycles are required.
6) AC measurements assume t_T = 2 ns.
7) $V_{IH\ (min.)}$ and $V_{IL\ (max.)}$ are reference levels for measuring timing of input signals. Transition times are also measured between V_{IH} and V_{IL}.
8) Measured with a load equivalent to 1 TTL loads and 100 pF, (Vol = 0.8 V and Voh = 2.0 V).
9) Operation within the $t_{RCD\ (max.)}$ limit ensures 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 ensures 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) Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
12) $t_{OFF\ (max.)}$, $t_{OEZ\ (max.)}$ define the time at which the output achieves the open-circuit conditions and are not referenced to output voltage levels. t_{OFF} is referenced from the rising edge of $\overline{RAS}$ or $\overline{CAS}$, whichever occurs last.
13) Either t_{DZC} or t_{DZO} must be satisfied.
14) Either t_{CDD} or t_{ODD} must be satisfied.
15) 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 $t_{WCS} > t_{WCS\ (min.)}$, the cycle is an early write cycle and data out pin will remain open-circuit (high impedance) through the entire cycle; if $t_{RWD} > t_{RWD\ (min.)}$, $t_{CWD} > t_{CWD\ (min.)}$ and $t_{AWD} > t_{AWD\ (min.)}$, the cycle is a read-write cycle and I/O will contain data read from the selected cells. If neither of the above sets of conditions is satisfied, the condition of I/O (at access time) is indeterminate.
16) These parameters are referenced to the $\overline{CAS}$ leading edge in early write cycles and to the $\overline{WE}$ leading edge in read-write cycles.
17) When using Self Refresh mode, the following refresh operations must be performed to ensure proper DRAM operation:
    If row addresses are being refreshed on an evenly distributed manner over the refresh interval using CBR refresh cycles, then only one CBR cycle must be performed immediately after exit from Self Refresh.
    If row addresses are being refreshed in any other manner (ROR - Distributed/Burst; or CBR-Burst) over the refresh interval, then a full set of row refreshes must be performed immediately before entry to and immediately after exit from Self Refresh

Serial Presence Detects:

A serial presence detect storage device -- E^2PROM is assembled on to the module. Information about the modul confuguration, speed, etc. is written into the EEPROM device during module production using a serial presence detect protocol (I^2C synchronous 2-wire bus).

Standard Version (without Self Refresh & Low Power)

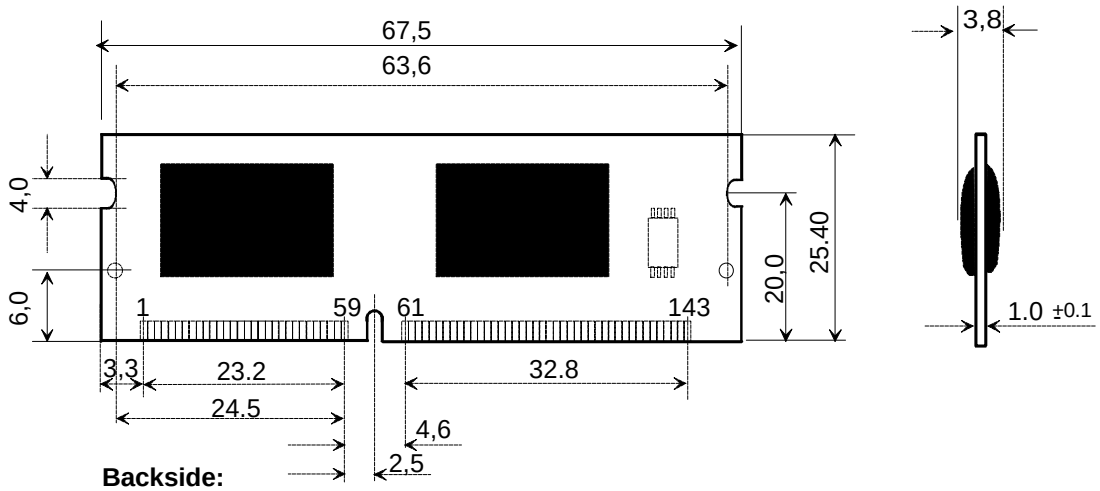
Byte# Description SPD Entry Value			Hex HYM			
			64 V1005 GC-60	64 V2005 GC-60	64 V4005 GC-60	64 V8005 GC-60
0	Number of SPD bytes	128	80	80	80	80
1	Total bytes in Serial PD	256	08	08	08	08
2	Memory Type	EDO	02	02	02	02
3	Number of Row Addresses		0A	0B	0C	0C
4	Number of Column Addresses		0A	0A	0A	0B
5	Number of DIMM Banks	1	01	01	01	01
6	Module Data Width	x64	40	40	40	40
7	Module Data Width (cont'd)	0	00	00	00	00
8	Module Interface Levels	LVTTL	01	01	01	01
9	RAS access time	60 ns	3C	3C	3C	3C
10	CAS access time	15 ns	0F	0F	0F	0F
11	Dimm Config (Error Det/Corr.)	none	00	00	02	02
12	Refresh Rate/Type	normal 15.6µs	00	00	00	00
13	Primary DRAM data width		10	08	10	08
14	Error checking DRAM data width	none	00	00	00	00
15-31	reserved for future offerings		FF	FF	FF	FF
32	Superset Memory Type	NA	FF	FF	FF	FF
33-61	Superset information (may be used in future)	NA	FF	FF	FF	FF
62	SPD Revision Designator	Rev. 1.0	01	01	01	01
63	Checksum for bytes 0-62			06	0F	
64-127	Manufacturer Information (optional)		FF	FF	FF	FF
128-255	Unused Storage Locations		FF	FF	FF	FF

Low Power Version with Self Refresh:

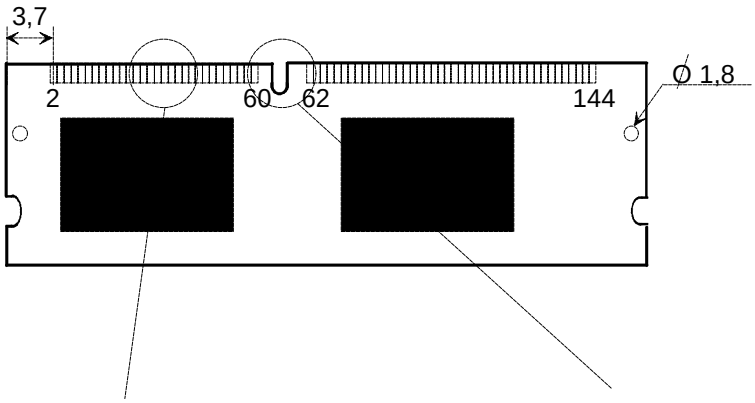
Byte# Description SPD Entry Value			Hex HYM			
			64 V1005 GCL-60	64 V2005 GCL-60	64 V4005 GCL-60	64 V8005 GCL-60
0	Number of SPD bytes	128	80	80	80	80
1	Total bytes in Serial PD	256	08	08	08	08
2	Memory Type	EDO	02	02	02	02
3	Number of Row Addresses		0A	0B	0C	0C
4	Number of Column Addresses		0A	0A	0A	0B
5	Number of DIMM Banks	1	01	01	01	01
6	Module Data Width	x64	40	40	40	40
7	Module Data Width (cont'd)	0	00	00	00	00
8	Module Interface Levels	LVTTL	01	01	01	01
9	RAS access time	60 ns	3C	3C	3C	3C
10	CAS access time	15 ns	0F	0F	0F	0F
11	Dimm Config (Error Det/Corr.)	none	00	00	02	02
12	Refresh Rate/Type	self refresh	85	84	83	83
13	Primary DRAM data width		10	08	10	08
14	Error checking DRAM data width	none	00	00	00	00
15-31	reserved for future offerings		FF	FF	FF	FF
32	Superset Memory Type	NA	FF	FF	FF	FF
33-61	Superset information (may be used in future)	NA	FF	FF	FF	FF
62	SPD Revision Designator	Rev. 1.0	01	01	01	01
63	Checksum for bytes 0-62					
64-127	Manufacturer Information (optional)		FF	FF	FF	FF
128-255	Unused Storage Locations		FF	FF	FF	FF

L-DIM-144-C1 to L-DIM-144-C4
SO-DIMM Module package
(144 pin, dual read-out, single in-line COB memory module)

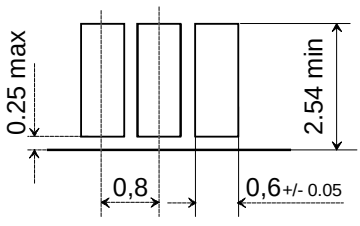
Front Side:



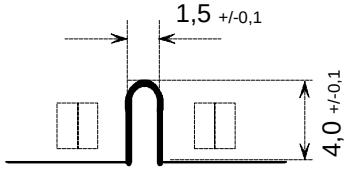
Backside:



Detail of Contacts:



Details of Notch :



2Mx64 COB-SC
DM144-2.WMF

preliminary drawing