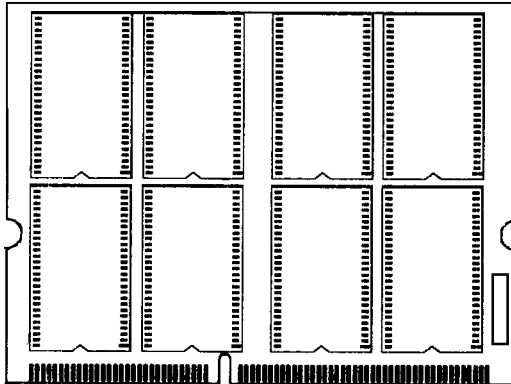
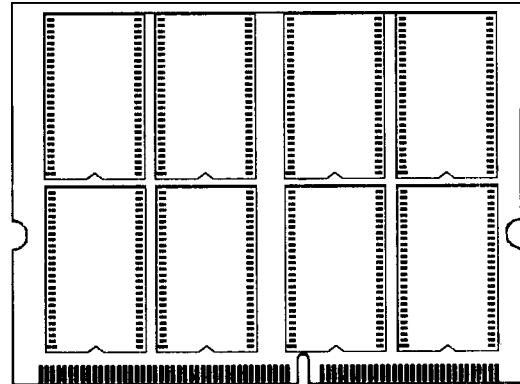


FRONT VIEW



BACK VIEW



GENERAL DESCRIPTION

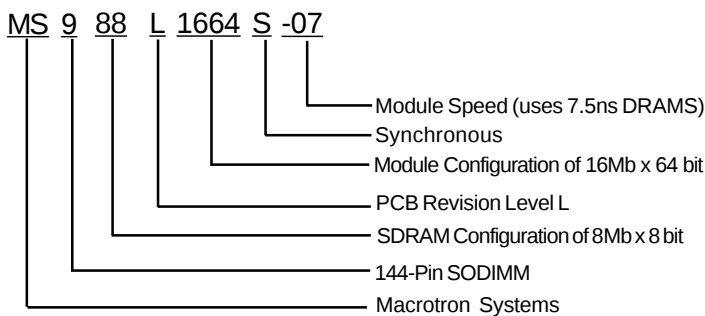
The Macrotron MS988L1664S-07 is a PC133 Compliant 16M bit x 64 bit Synchronous Dynamic RAM high density memory module. It consists of sixteen CMOS 8M x 8 bit with Synchronous DRAMs in TSOP packages and a 2K EEPROM in 8-pin TSOP package on a 144-pin glass-epoxy substrate. Decoupling capacitors are mounted on the printed circuit board in parallel for each SDRAM. The product is a Small Outline Dual In-line Memory Module and is intended for mounting into 144-pin edge connector sockets.

Synchronous design allows precise cycle controls with the use of system clock. I/O transactions are possible on every clock cycle. Range of operating frequencies and programmable latencies allow the same device to be useful for a variety of high bandwidth, high performance memory system applications.

FEATURES

- 16 Megabit by 64 bit (128 Megabyte) Synchronous DRAM Module PC 133 Compliant
- JEDEC-standard 144-pin small outline, dual in-line memory module (SODIMM)
- Utilizes 7.5ns SDRAM components
- Nonbuffered
- Single +3.3V $\pm$ 0.3V power supply
- Fully synchronous; all signals registered on positive edge system clock
- Internal pipeline operation; column address can be changed every clock cycle
- Dual internal banks for hiding row access/precharge
- Programmable burst lengths: 1,2,4, 8 or full page
- Auto Precharged and Auto Refresh Modes
- LVTTTL compatible inputs and outputs
- Serial Presence Detect (SPD)

PART NUMBER DESIGNATOR



KEY TIMING PARAMETERS

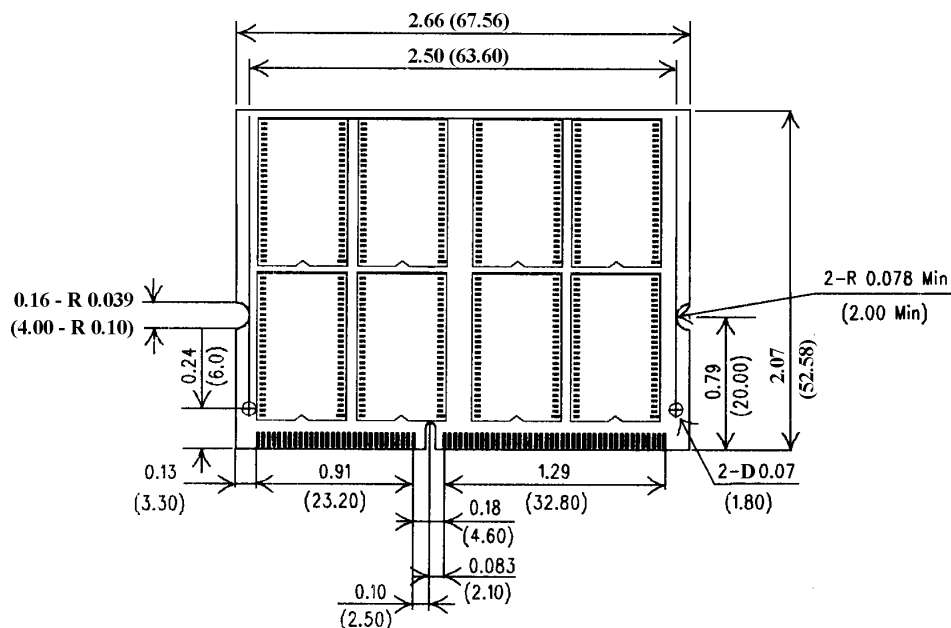
PARAMETER	VALUE	UNIT
Module Bus Speed	133	MHz
Module Speed	7.5	ns
SDRAM Speed	133	MHz
CAS Latency	2/3	CLOCK
SDRAM Access Time	5.4	ns
SDRAM Setup Time	1.5	ns
SDRAM Hold Time	0.8	ns

PIN CONFIGURATIONS

PIN	FRONT	PIN	BACK	PIN	FRONT	PIN	BACK	PIN	FRONT	PIN	BACK
1	V _{SS}	2	V _{SS}	51	DQ14	52	DQ46	101	V _{DD}	102	V _{DD}
3	DQ0	4	DQ32	53	DQ15	54	DQ47	103	A6	104	A7
5	DQ1	6	DQ33	55	V _{SS}	56	V _{SS}	105	A8	106	BA0
7	DQ2	8	DQ34	57	NC	58	NC	107	V _{SS}	108	V _{SS}
9	DQ3	10	DQ35	59	NC	60	NC	109	A9	110	BA1
11	V _{DD}	12	V _{DD}	61	CLK0	62	CKE0	111	A10/AP	112	A11
13	DQ4	14	DQ36	63	V _{DD}	64	V _{DD}	113	V _{DD}	114	V _{DD}
15	DQ5	16	DQ37	65	RAS	66	CAS	115	DQM2	116	DQM6
17	DQ6	18	DQ38	67	WE	68	CKE1	117	DQM3	118	DQM7
19	DQ7	20	DQ39	69	CS0	70	*A12	119	V _{SS}	120	V _{SS}
21	V _{SS}	22	V _{SS}	71	CS1	72	*A13	121	DQ24	122	DQ56
23	DQM0	24	DQM4	73	DU	74	CLK1	123	DQ25	124	DQ57
25	DQM1	26	DQM5	75	V _{SS}	76	V _{SS}	125	DQ26	126	DQ58
27	V _{DD}	28	V _{DD}	77	NC	78	NC	127	DQ27	128	DQ59
29	A0	30	A3	79	NC	80	NC	129	V _{DD}	130	V _{DD}
31	A1	32	A4	81	V _{DD}	82	V _{DD}	131	DQ28	132	DQ60
33	A2	34	A5	83	DQ16	84	DQ48	133	DQ29	134	DQ61
35	V _{SS}	36	V _{SS}	85	DQ17	86	DQ49	135	DQ30	136	DQ62
37	DQ8	38	DQ40	87	DQ18	88	DQ50	137	DQ31	138	DQ63
39	DQ9	40	DQ41	89	DQ19	90	DQ51	139	V _{SS}	140	V _{SS}
41	DQ10	42	DQ42	91	V _{SS}	92	V _{SS}	141	**SDA	142	**SCL
43	DQ11	44	DQ43	93	DQ20	94	DQ52	143	V _{DD}	144	V _{DD}
45	V _{DD}	46	V _{DD}	95	DQ21	96	DQ53	* These pins are not used in this module. ** These pins should be NC in the system which does not support SPD			
47	DQ12	48	DQ44	97	DQ22	98	DQ54				
49	DQ13	50	DQ45	99	DQ23	100	DQ55				

PIN NAMES

PIN NAME	FUNCTION
A0~A13	Address Input (multiplexed)
BA0~BA1	Select Bank
DQ0~DQ63	Data Input / Data Output
CLK0~CLK1	Clock Input
CKE0	Clock Enable Input
CS0	Chip Select Input
RAS	Row Address Strobe
CAS	Column Address Strobe
WE	Write Enable
DQM0~7	DQM
V _{DD}	Power Supply (3.3V)
V _{SS}	Ground
SDA	Serial Data I/O
SCL	Serial Clock
DU	Don't Use
NC	No Connection



ABSOLUTE MAXIMUM RATINGS

PARAMETERS	SYMBOL	VALUE	UNIT
Voltage on any pin relative to V_{SS}	V_{IN}, V_{OUT}	-1.0 ~ 4.6	V
Voltage on V_{DD} supply relative to V_{SS}	V_{DD}, V_{DDQ}	-1.0 ~ 4.6	V
Storage Temperature	T_{STG}	-55 ~ +150	C
Power Dissipation	PD	8	W
Short Circuit Current	I_{OS}	50	mA

DC OPERATING CONDITIONS AND CHARACTERISTICS

PARAMETERS		SYMBOL	MIN	MAX	UNIT	NOTES
Supply Voltage		V_{DD}	3.0	3.6	V	
Input High Voltage (Logic 1), All Inputs		V_{IH}	2.0	$V_{DD} + 0.3$	V	
Input low Voltage (Logic 0), All Inputs		V_{IL}	-0.3	0.8	V	
INPUT LEAKAGE CURRENT Any input $0V \leq V_{IN} \leq V_{DD}$ (All other pins not under test = 0V)	DQM0~7	I_{I1}	-10	10	μA	
	CK0~3, S0~3#	I_{I2}	-20	20	μA	
	CKE0~1	I_{I3}	-40	40	μA	
	RAS, CAS, A0~10, BA0, WE	I_{I4}	-80	80	μA	
OUTPUT LEAKAGE CURRENT (DQs are disabled; $0V \leq V_{OUT} \leq V_{DD}$)	DQ0~63	I_{OZ}	-10	10	μA	
OUTPUT LEVELS						
Output High Voltage		V_{OH}	2.4			$I_{OH} = -2mA$
Output low Voltage		V_{OL}		0.4	V	$I_{OL} = 2mA$

CAPACITANCE ($V_{DD} = 3.3V$, $T_A = 23C$, $F = 1MHz$, $V_{REF} = 1.4V$)

PARAMETERS	SYMBOL	MAX	UNIT
Input Capacitance ($A_0 \sim A_n$, BA0, RAS, CAS, WE)	C_{I1}	60	pF
Input Capacitance (S0~3)	C_{I2}	16	pF
Input Capacitance (CKE0~1)	C_{I3}	30	pF
Input Capacitance (DQMB0~7)	C_{I4}	9	pF
Input Capacitance (SCL, SA0~2)	C_{I5}	6	pF
Data Input/Output Capacitance (DQ0~63, SDA)	C_{I0}	14	pF
Input Capacitance (CK0~3)	C_{I6}	18	pF

OPERATING CONDITIONS AND MAXIMUM LIMITS

PARAMETER/CONDITION	SYMBOL	MAX	UNITS
OPERATING CURRENT: Active Mode, Burst =2 READ or WRITE, $t_{RC} \geq t_{RC} \text{ (MIN)}$, CAS Latency = 3	ICC1	1280	mA
STANDBY CURRENT: Power-Down Mode, $t_{CK} = 7.5\text{ns}$, $CKE \leq V_{IL} \text{ (MAX)}$, All banks idle	ICC2	16	mA
STANDBY CURRENT: $CS \geq V_{IH} \text{ (MIN)}$, $t_{CK} = 7.5\text{ns}$, $CKE \geq V_{IH} \text{ (MAX)}$, All banks idle	ICC3	48	mA
STANDBY CURRENT: $CS \geq V_{IH} \text{ (MIN)}$ $t_{CK} = 7.5\text{ns}$, $CKE \geq V_{IH} \text{ (MIN)}$, all banks active after t_{RCD} met, No accesses in progress	ICC4	720	mA
OPERATING CURRENT: Burst Mode, Continuous burst, READ or WRITE, $t_{CK} = 7.5\text{ns}$, all banks active, Addresses transition once per clock cycle, CAS Latency = 3	ICC5	1480	mA
AUTO REFRESH CURRENT: $t_{RC} > t_{RC} \text{ (MIN)}$, CAS Latency = 3	ICC6	2040	mA
SELF REFRESH CURRENT: $CKE < 0.2V$	ICC7	16	mA

AC FUNCTIONAL CHARACTERISTICS

PARAMETERS		SYMBOL		UNITS
READ/WRITE command to READ/WRITE command		tCCD	1	tCK
CKE to clock disable or power-down entry mode		tCKED	1	tCK
CKE to clock enable or power-down exit mode		tPED	1	tCK
DQM to input data delay		tDQD	0	tCK
DQM to data mask during WRITES		tDQM	0	tCK
DQM to data high-impedance during READS		tDQZ	2	tCK
WRITE command to input data delay		tDWD	0	tCK
Data-in to PRECHARGE command		tDAL	2	tCK
Data-in to ACTIVE command		tDPL	5	tCK
Last data-in to PRECHARGE command		tRDL	2	tCK
Last data-in to burst STOP command		tBDL	1	tCK
Last data-in to new READ/WRITE command		tCDL	1	tCK
LOAD MODE REGISTER command to command		tMRD	2	tCK
Data-out to high-impedance from PRECHARGE command	CAS latency=3	tROH	3	tCK
	CAS latency=2	tROH	2	tCK

FUNCTIONAL BLOCK DIAGRAM

