

# OKI Semiconductor

## MSC23832D-xxBS16/DS16

8,388,608-word x 32-bit DYNAMIC RAM MODULE : FAST PAGE MODE TYPE

### DESCRIPTION

The MSC23832D-xxBS16/DS16 is an 8,388,608-word x 32-bit CMOS dynamic random access memory module which is composed of sixteen 16Mb DRAMs (4Mx4) in SOJ packages mounted with sixteen decoupling capacitors. This is a 72-pin single in-line memory module. This module supports any application where high density and large capacity of storage memory are required.

### FEATURES

- 8,388,608-word x 32-bit organization
- 72-pin Single In-Line Memory Module  
     MSC23832D-xxBS16 : Gold tab  
     MSC23832D-xxDS16 : Solder tab
- Single 5V power supply,  $\pm 10\%$  tolerance
- Input : TTL compatible
- Output : TTL compatible, 3-state
- Refresh : 2048cycles/32ms
- Fast page mode capability
- /CAS before /RAS refresh, hidden refresh, /RAS only refresh capability
- Multi-bit test mode capability

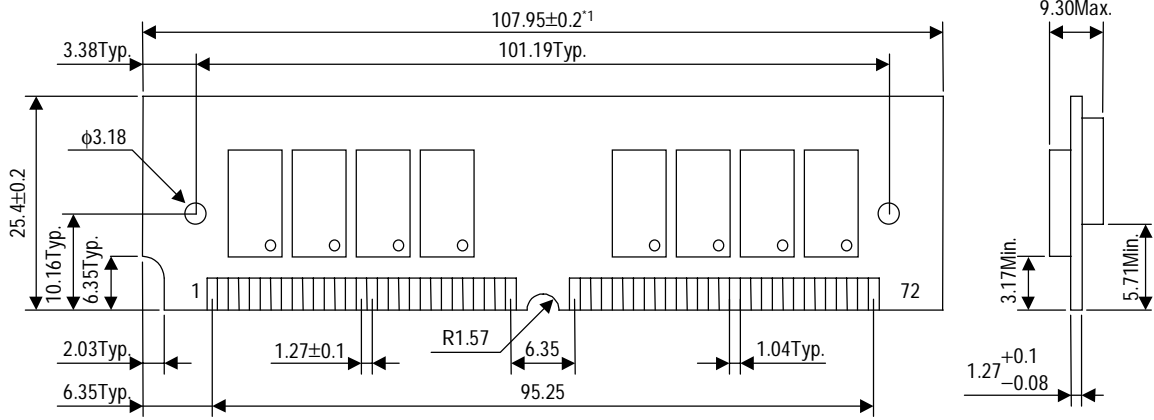
### PRODUCT FAMILY

Family	Access Time (Max.)			Cycle Time (Min.)	Power Dissipation (Max.)	
	t <sub>RAC</sub>	t <sub>AA</sub>	t <sub>CAC</sub>		Operating	Standby
MSC23832D-60BS16/DS16	60ns	30ns	15ns	110ns	4180mW	88mW
MSC23832D-70BS16/DS16	70ns	35ns	20ns	130ns	3960mW	

MODULE OUTLINE

MSC23832D-xxBS16/DS16

(Unit : mm)



Note:

- 1. Tolerance over 12.5mm from board edge is  $\pm 0.5$ .

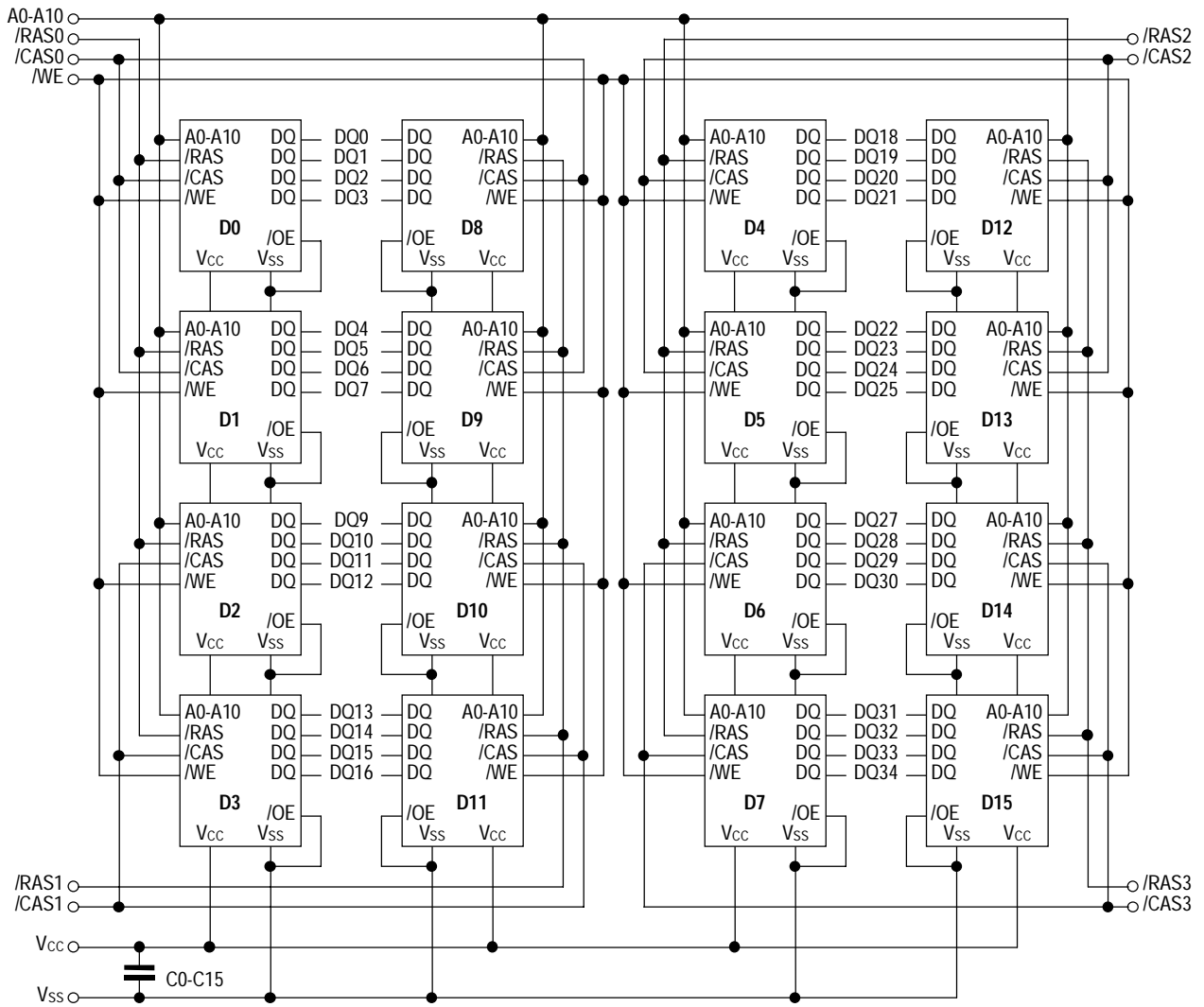
**PIN CONFIGURATION**

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	V <sub>SS</sub>	19	A10	37	NC	55	DQ12
2	DQ0	20	DQ4	38	NC	56	DQ30
3	DQ18	21	DQ22	39	V <sub>SS</sub>	57	DQ13
4	DQ1	22	DQ5	40	/CAS0	58	DQ31
5	DQ19	23	DQ23	41	/CAS2	59	V <sub>CC</sub>
6	DQ2	24	DQ6	42	/CAS3	60	DQ32
7	DQ20	25	DQ24	43	/CAS1	61	DQ14
8	DQ3	26	DQ7	44	/RAS0	62	DQ33
9	DQ21	27	DQ25	45	/RAS1	63	DQ15
10	V <sub>CC</sub>	28	A7	46	NC	64	DQ34
11	NC	29	NC	47	/WE	65	DQ16
12	A0	30	V <sub>CC</sub>	48	NC	66	NC
13	A1	31	A8	49	DQ9	67	PD1
14	A2	32	A9	50	DQ27	68	PD2
15	A3	33	/RAS3	51	DQ10	69	PD3
16	A4	34	/RAS2	52	DQ28	70	PD4
17	A5	35	NC	53	DQ11	71	NC
18	A6	36	NC	54	DQ29	72	V <sub>SS</sub>

**Presence Detect Pins**

Pin No.	Pin Name	-60	-70
67	PD1	NC	NC
68	PD2	V <sub>SS</sub>	V <sub>SS</sub>
69	PD3	NC	V <sub>SS</sub>
70	PD4	NC	NC

**BLOCK DIAGRAM**



## ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Voltage on Any Pin Relative to V <sub>SS</sub>	V <sub>T</sub>	-0.5 to 7.0	V
Short Circuit Output Current	I <sub>OS</sub>	50	mA
Power Dissipation	P <sub>D</sub> *	16	W
Operating Temperature	T <sub>OPR</sub>	0 to 70	°C
Storage Temperature	T <sub>STG</sub>	-40 to 125	°C

\*: Ta = 25°C

### Recommended Operating Conditions

(Ta = 0°C to 70°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
	V <sub>SS</sub>	0	0	0	V
Input High Voltage	V <sub>IH</sub>	2.4	—	V <sub>CC</sub> + 0.5	V
Input Low Voltage	V <sub>IL</sub>	-0.5	—	0.8	V

### Capacitance

(V<sub>CC</sub> = 5V ± 10%, Ta = 25°C, f = 1 MHz)

Parameter	Symbol	Typ.	Max.	Unit
Input Capacitance (A0 - A10)	C <sub>IN1</sub>	—	109	pF
Input Capacitance (/WE)	C <sub>IN2</sub>	—	125	pF
Input Capacitance (/RAS0 - /RAS3)	C <sub>IN3</sub>	—	35	pF
Input Capacitance (/CAS0 - /CAS3)	C <sub>IN4</sub>	—	35	pF
I/O Capacitance (DQ0 - DQ7, DQ9 - DQ16, DQ18 - DQ25, DQ27 - DQ34)	C <sub>I/O</sub>	—	26	pF

DC Characteristics

( $V_{CC} = 5V \pm 10\%$ ,  $T_a = 0^\circ C$  to  $70^\circ C$ )

Parameter	Symbol	Condition	-60		-70		Unit	Note
			Min.	Max.	Min.	Max.		
Output High Voltage	$V_{OH}$	$I_{OH} = -5.0mA$	2.4	$V_{CC}$	2.4	$V_{CC}$	V	
Output Low Voltage	$V_{OL}$	$I_{OL} = 4.2mA$	0	0.4	0	0.4	V	
Input Leakage Current	$I_{LI}$	$0V \leq V_{IN} \leq 6.5V$ ; All other pins not under test = 0V	-160	160	-160	160	$\mu A$	
Output Leakage Current	$I_{LO}$	DQ disable $0V \leq V_{OUT} \leq V_{CC}$	-20	20	-20	20	$\mu A$	
Average Power Supply Current (Operating)	$I_{CC1}$	/RAS, /CAS cycling, $t_{RC} = \text{Min.}$	—	760	—	720	mA	1, 2
Power supply current (Standby)	$I_{CC2}$	/RAS, /CAS = $V_{IH}$	—	32	—	32	mA	1
		/RAS, /CAS $\geq V_{CC} - 0.2V$	—	16	—	16		
Average Power Supply Current (/RAS only refresh)	$I_{CC3}$	/RAS cycling, /CAS = $V_{IH}$ , $t_{RC} = \text{Min.}$	—	760	—	720	mA	1, 2
Average Power Supply Current (/CAS before /RAS refresh)	$I_{CC6}$	/RAS cycling, /CAS before /RAS	—	760	—	720	mA	1, 2
Average Power Supply Current (Fast Page Mode)	$I_{CC7}$	/RAS = $V_{IL}$ , /CAS cycling, $t_{PC} = \text{Min.}$	—	600	—	560	mA	1, 3

- Notes: 1.  $I_{CC}$  Max. is specified as  $I_{CC}$  for output open condition.  
 2. The address can be changed once or less while /RAS =  $V_{IL}$ .  
 3. The address can be changed once or less while /CAS =  $V_{IH}$ .

**AC Characteristics (1/2)**

(V<sub>CC</sub> = 5V ±10%, Ta = 0°C to 70°C) Note: 1, 2, 3, 9, 10

Parameter	Symbol	-60		-70		Unit	Note
		Min.	Max.	Min.	Max.		
Random Read or Write Cycle Time	t <sub>RC</sub>	110	—	130	—	ns	
Fast Page Mode Cycle Time	t <sub>PC</sub>	40	—	45	—	ns	
Access Time from /RAS	t <sub>RAC</sub>	—	60	—	70	ns	4, 5, 6
Access Time from /CAS	t <sub>CAC</sub>	—	15	—	20	ns	4, 5
Access Time from Column Address	t <sub>AA</sub>	—	30	—	35	ns	4, 6
Access Time from /CAS Precharge	t <sub>CPA</sub>	—	35	—	40	ns	4
Output Low Impedance Time from /CAS	t <sub>CLZ</sub>	0	—	0	—	ns	4
/CAS to Data Output Buffer Turn-off Delay Time	t <sub>OFF</sub>	0	15	0	20	ns	7
Transition Time	t <sub>T</sub>	3	50	3	50	ns	3
Refresh Period	t <sub>REF</sub>	—	32	—	32	ms	
/RAS Precharge Time	t <sub>RP</sub>	40	—	50	—	ns	
/RAS Pulse Width	t <sub>RAS</sub>	60	10K	70	10K	ns	
/RAS Pulse Width (Fast Page Mode)	t <sub>RASP</sub>	60	100K	70	100K	ns	
/RAS Hold Time	t <sub>RSH</sub>	15	—	20	—	ns	
/CAS Precharge Time (Fast Page Mode)	t <sub>CP</sub>	10	—	10	—	ns	
/CAS Pulse Width	t <sub>CAS</sub>	15	10K	20	10K	ns	
/CAS Hold Time	t <sub>CSH</sub>	60	—	70	—	ns	
/CAS to /RAS Precharge Time	t <sub>CRP</sub>	5	—	5	—	ns	
/RAS Hold Time from /CAS Precharge	t <sub>RHCP</sub>	35	—	40	—	ns	
/RAS to /CAS Delay Time	t <sub>RCD</sub>	20	45	20	50	ns	5
/RAS to Column Address Delay Time	t <sub>RAD</sub>	15	30	15	35	ns	6
Row Address Set-up Time	t <sub>ASR</sub>	0	—	0	—	ns	
Row Address Hold Time	t <sub>RAH</sub>	10	—	10	—	ns	
Column Address Set-up Time	t <sub>ASC</sub>	0	—	0	—	ns	
Column Address Hold Time	t <sub>CAH</sub>	10	—	15	—	ns	
Column Address to /RAS Lead Time	t <sub>RAL</sub>	30	—	35	—	ns	
Read Command Set-up Time	t <sub>RCS</sub>	0	—	0	—	ns	
Read Command Hold Time	t <sub>RCH</sub>	0	—	0	—	ns	8
Read Command Hold Time referenced to /RAS	t <sub>RRH</sub>	0	—	0	—	ns	8

**AC Characteristics (2/2)**

(V<sub>CC</sub> = 5V ±10%, Ta = 0°C to 70°C) Note: 1, 2, 3, 9, 10

Parameter	Symbol	-60		-70		Unit	Note
		Min.	Max.	Min.	Max.		
Write Command Set-up Time	t <sub>WCS</sub>	0	—	0	—	ns	
Write Command Hold Time	t <sub>WCH</sub>	10	—	10	—	ns	
Write Command Pulse Width	t <sub>WP</sub>	10	—	10	—	ns	
Write Command to /RAS Lead Time	t <sub>RWL</sub>	15	—	20	—	ns	
Write Command to /CAS Lead Time	t <sub>CWL</sub>	15	—	20	—	ns	
Data-in Set-up Time	t <sub>DS</sub>	0	—	0	—	ns	
Data-in Hold Time	t <sub>DH</sub>	10	—	15	—	ns	
/CAS Active Delay Time from /RAS Precharge	t <sub>RPC</sub>	5	—	5	—	ns	
/RAS to /CAS Set-up Time (/CAS before /RAS)	t <sub>CSR</sub>	10	—	10	—	ns	
/RAS to /CAS Hold Time (/CAS before /RAS)	t <sub>CHR</sub>	10	—	10	—	ns	
/WE to /RAS Precharge Time (/CAS before /RAS)	t <sub>WRP</sub>	10	—	10	—	ns	
/WE Hold Time from /RAS (/CAS before /RAS)	t <sub>WRH</sub>	10	—	10	—	ns	
/RAS to /WE Set-up Time (Test Mode)	t <sub>WTS</sub>	10	—	10	—	ns	
/RAS to /WE Hold Time (Test Mode)	t <sub>WTH</sub>	10	—	10	—	ns	



- Notes:
1. A start-up delay of 200 $\mu$ s is required after power-up, followed by a minimum of eight initialization cycles (/RAS only refresh or /CAS before /RAS refresh) before proper device operation is achieved.
  2. The AC characteristics assumes  $t_T = 5$ ns.
  3.  $V_{IH}(\text{Min.})$  and  $V_{IL}(\text{Max.})$  are reference levels for measuring input timing signals. Transition times ( $t_T$ ) are measured between  $V_{IH}$  and  $V_{IL}$ .
  4. This parameter is measured with a load circuit equivalent to 2 TTL loads and 100pF.
  5. Operation within the  $t_{RCD}(\text{Max.})$  limit ensures that  $t_{RAC}(\text{Max.})$  can be met.  $t_{RCD}(\text{Max.})$  is specified as a reference point only. If  $t_{RCD}$  is greater than the specified  $t_{RCD}(\text{Max.})$  limit, then the access time is controlled by  $t_{CAC}$ .
  6. Operation within the  $t_{RAD}(\text{Max.})$  limit ensures that  $t_{RAC}(\text{Max.})$  can be met.  $t_{RAD}(\text{Max.})$  is specified as a reference point only. If  $t_{RAD}$  is greater than the specified  $t_{RAD}(\text{Max.})$  limit, then the access time is controlled by  $t_{AA}$ .
  7.  $t_{OFF}(\text{Max.})$  define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
  8.  $t_{RCH}$  or  $t_{RRH}$  must be satisfied for a read cycle.
  9. The test mode is initiated by performing a /WE and /CAS before /RAS refresh cycle. This mode is latched and remains in effect until the exit cycle is generated. The test mode specified in this data sheet is a 4-bit parallel test function. CA0 and CA1 are not used. In a read cycle, if all internal bits are equal, the DQ pin will indicate a high level. If any internal bits are not equal, the DQ pin will indicate a low level. The test mode is cleared and the memory device returned to its normal operating state by a /RAS only refresh or /CAS before /RAS refresh cycle.
  10. In a test mode read cycle, the value of access time parameters is delayed for 5ns for the specified value. These parameters should be specified in test mode cycle by adding the above value to the specified value in this data sheet.