MSM511000H

1,048,576-Word × 1-Bit DYNAMIC RAM : FAST PAGE MODE TYPE

DESCRIPTION

The MSM511000H is a 1,048,576-word × 1-bit dynamic RAM fabricated in OKI's CMOS silicon gate technology. The MSM511000H achieves high integration, high-speed operation, and low-power consumption due to quadruple polysilicon single metal CMOS. The MSM511000H is available in a 18-pin plastic DIP, 26/20-pin plastic SOJ, or 20-pin plastic ZIP.

FEATURES

- 1,048,576-word × 1-bit configuration
- Single 5 V power supply, ±10% tolerance
- Input : TTL compatible, low input capacitance
- Output : TTL compatible, 3-state
- Refresh : 512 cycles/8 ms
- Fast page mode, read modify write capability
- $\overline{CAS}$ before $\overline{RAS}$ refresh, hidden refresh, $\overline{RAS}$-only refresh capability
- Package options:

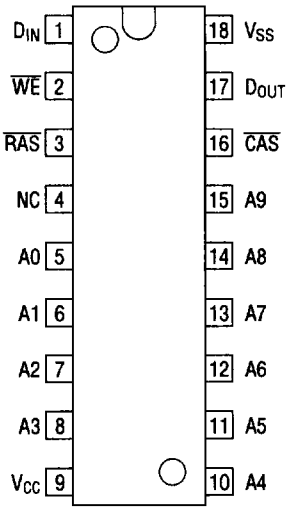
18-Pin 300 mil plastic DIP	(DIP18-P-300-W1)	(Product : MSM511000H-xxRS)
26/20-Pin 300 mil plastic SOJ	(SOJ26/20-P-300)	(Product : MSM511000H-xxJS)
20-Pin 400 mil plastic ZIP	(ZIP20-P-400)	(Product : MSM511000H-xxZS)

xx indicates speed rank.

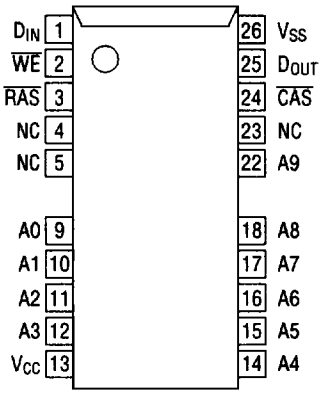
PRODUCT FAMILY

Family	Access Time (Max.)			Cycle Time (Min.)	Power Dissipation	
	t_{RAC}	t_{AA}	t_{CAC}		Operating (Max.)	Standby (Max.)
MSM511000H-45	45 ns	24 ns	14 ns	90 ns	550 mW	5.5 mW
MSM511000H-50	50 ns	26 ns	14 ns	100 ns	523 mW	
MSM511000H-60	60 ns	30 ns	15 ns	120 ns	468 mW	

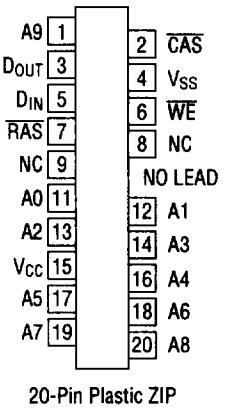
PIN CONFIGURATION (TOP VIEW)



18-Pin Plastic DIP



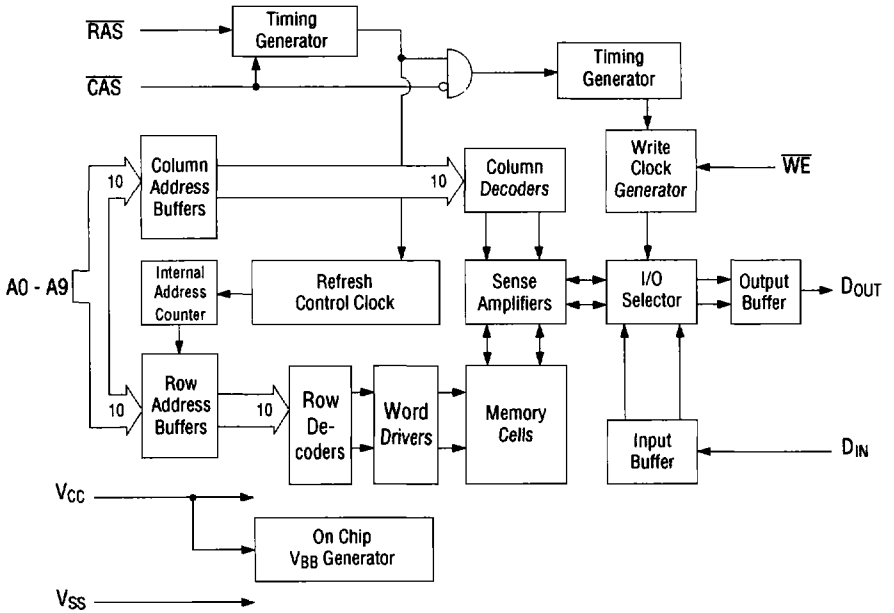
26/20-Pin Plastic SOJ



20-Pin Plastic ZIP

Pin Name	Function
A0 - A9	Address Input
$\overline{RAS}$	Row Address Strobe
$\overline{CAS}$	Column Address Strobe
D_{IN}	Data Input
D_{OUT}	Data Output
$\overline{WE}$	Write Enable
V_{CC}	Power Supply (5 V)
V_{SS}	Ground (0 V)
NC	No Connection

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Voltage on Any Pin Relative to V_{SS}	V_T	−1.0 to 7.0	V
Short Circuit Output Current	I_{OS}	50	mA
Power Dissipation	P_D*	1	W
Operating Temperature	T_{opr}	0 to 70	°C
Storage Temperature	T_{stg}	−55 to 150	°C

*: Ta = 25°C

Recommended Operating Conditions

(Ta = 0°C to 70°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{CC}	4.5	5.0	5.5	V
	V_{SS}	0	0	0	V
Input High Voltage	V_{IH}	2.6	—	6.5	V
Input Low Voltage	V_{IL}	−1.0	—	0.8	V

Capacitance

(V_{CC} = 5 V ±10%, Ta = 25°C, f = 1 MHz)

Parameter	Symbol	Typ.	Max.	Unit
Input Capacitance (A0 - A9, D_{IN})	C_{IN1}	—	5	pF
Input Capacitance ($\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$)	C_{IN2}	—	5	pF
Output Capacitance (D_{OUT})	C_{OUT}	—	7	pF

DC Characteristics

(V_{CC} = 5 V ±10%, Ta = 0°C to 70°C)

Parameter	Symbol	Condition	MSM511000 H-45		MSM511000 H-50		MSM511000 H-60		Unit	Note
			Min.	Max.	Min.	Max.	Min.	Max.		
Output High Voltage	V_{OH}	I_{OH} = −5.0 mA	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	V	
Output Low Voltage	V_{OL}	I_{OL} = 4.2 mA	0	0.4	0	0.4	0	0.4	V	
Input Leakage Current	I_{LI}	0 V ≤ V_I ≤ 6.5 V; All other pins not under test = 0 V	−10	10	−10	10	−10	10	µA	
Output Leakage Current	I_{LO}	D_{OUT} disable 0 V ≤ V_O ≤ 5.5 V	−10	10	−10	10	−10	10	µA	
Average Power Supply Current (Operating)	I_{CC1}	$\overline{RAS}$, $\overline{CAS}$ cycling, t_{RC} = Min.	—	100	—	95	—	85	mA	1, 2
Power Supply Current (Standby)	I_{CC2}	$\overline{RAS}$, $\overline{CAS}$ = V_{IH}	—	2	—	2	—	2	mA	1
		$\overline{RAS}$, $\overline{CAS}$ ≥ V_{CC} −0.2 V	—	1	—	1	—	1		
Average Power Supply Current ($\overline{RAS}$-only Refresh)	I_{CC3}	$\overline{RAS}$ cycling, $\overline{CAS}$ = V_{IH}, t_{RC} = Min.	—	100	—	95	—	85	mA	1, 2
Power Supply Current (Standby)	I_{CC5}	$\overline{RAS}$ = V_{IH}, $\overline{CAS}$ = V_{IL}, D_{OUT} = enable	—	5	—	5	—	5	mA	1
Average Power Supply Current ($\overline{CAS}$ before $\overline{RAS}$ Refresh)	I_{CC6}	$\overline{RAS}$ cycling, $\overline{CAS}$ before $\overline{RAS}$	—	100	—	95	—	85	mA	1, 2
Average Power Supply Current (Fast Page Mode)	I_{CC7}	$\overline{RAS}$ = V_{IL}, $\overline{CAS}$ cycling, t_{PC} = Min.	—	95	—	90	—	80	mA	1, 3

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

AC Characteristics (1/2)

(V_{CC} = 5 V ±10%, Ta = 0°C to 70°C, Input Pulse Levels 0 V to 3 V) Note 1, 2, 3

Parameter	Symbol	MSM511000 H-45		MSM511000 H-50		MSM511000 H-60		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Random Read or Write Cycle Time	t_{RC}	90	—	100	—	120	—	ns	
Read Modify Write Cycle Time	t_{RWC}	110	—	120	—	140	—	ns	
Fast Page Mode Cycle Time	t_{PC}	34	—	36	—	40	—	ns	
Fast Page Mode Read Modify Write Cycle Time	t_{PRWC}	54	—	56	—	60	—	ns	
Access Time from $\overline{RAS}$	t_{RAC}	—	45	—	50	—	60	ns	4, 5, 6
Access Time from $\overline{CAS}$	t_{CAC}	—	14	—	14	—	15	ns	4, 5
Access Time from Column Address	t_{AA}	—	24	—	26	—	30	ns	4, 6
Access Time from $\overline{CAS}$ Precharge	t_{CPA}	—	28	—	30	—	34	ns	4
Output Low Impedance Time from $\overline{CAS}$	t_{CLZ}	0	—	0	—	0	—	ns	4
$\overline{CAS}$ to Data Output Buffer Turn-off Delay Time	t_{OFF}	0	10	0	10	0	10	ns	7
Transition Time	t_T	3	50	3	50	3	50	ns	3
Refresh Period	t_{REF}	—	8	—	8	—	8	ms	
$\overline{RAS}$ Precharge Time	t_{RP}	35	—	40	—	50	—	ns	
$\overline{RAS}$ Pulse Width	t_{RAS}	45	10,000	50	10,000	60	10,000	ns	
$\overline{RAS}$ Pulse Width (Fast Page Mode)	t_{RASP}	45	100,000	50	100,000	60	100,000	ns	
$\overline{RAS}$ Hold Time	t_{RSH}	12	—	13	—	15	—	ns	
$\overline{CAS}$ Precharge Time (Fast Page Mode)	t_{CP}	10	—	10	—	10	—	ns	
$\overline{CAS}$ Pulse Width	t_{CAS}	14	10,000	14	10,000	15	10,000	ns	
$\overline{CAS}$ Hold Time	t_{CSH}	45	—	50	—	60	—	ns	
$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	t_{CRP}	5	—	5	—	5	—	ns	
$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	t_{RHCP}	28	—	30	—	34	—	ns	
$\overline{RAS}$ to $\overline{CAS}$ Delay Time	t_{RCD}	17	31	18	36	20	45	ns	5
$\overline{RAS}$ to Column Address Delay Time	t_{RAD}	12	21	13	24	15	30	ns	6
Row Address Set-up Time	t_{ASR}	0	—	0	—	0	—	ns	
Row Address Hold Time	t_{RAH}	7	—	8	—	10	—	ns	
Column Address Set-up Time	t_{ASC}	0	—	0	—	0	—	ns	
Column Address Hold Time	t_{CAH}	12	—	13	—	15	—	ns	
Column Address Hold Time from $\overline{RAS}$	t_{AR}	35	—	40	—	50	—	ns	
Column Address to $\overline{RAS}$ Lead Time	t_{RAL}	24	—	26	—	30	—	ns	

AC Characteristics (2/2)

(V_{CC} = 5 V ±10%, Ta = 0°C to 70°C, Input Pulse Levels 0 V to 3 V) Note 1, 2, 3

Parameter	Symbol	MSM511000 H-45		MSM511000 H-50		MSM511000 H-60		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Read Command Set-up Time	t_{RCS}	0	—	0	—	0	—	ns	
Read Command Hold Time	t_{RCH}	0	—	0	—	0	—	ns	8
Read Command Hold Time referenced to $\overline{RAS}$	t_{RRH}	0	—	0	—	0	—	ns	8
Write Command Set-up Time	t_{WCS}	0	—	0	—	0	—	ns	9
Write Command Hold Time	t_{WCH}	12	—	13	—	15	—	ns	
Write Command Hold Time from $\overline{RAS}$	t_{WCR}	50	—	55	—	60	—	ns	
Write Command Pulse Width	t_{WP}	10	—	10	—	10	—	ns	
Write Command to $\overline{RAS}$ Lead Time	t_{RWL}	14	—	14	—	15	—	ns	
Write Command to $\overline{CAS}$ Lead Time	t_{CWL}	14	—	14	—	15	—	ns	
Data-in Set-up Time	t_{DS}	0	—	0	—	0	—	ns	10
Data-in Hold Time	t_{DH}	12	—	13	—	15	—	ns	10
Data-in Hold Time from $\overline{RAS}$	t_{DHR}	35	—	40	—	50	—	ns	
$\overline{CAS}$ to $\overline{WE}$ Delay Time	t_{CWD}	14	—	14	—	15	—	ns	9
Column Address to $\overline{WE}$ Delay Time	t_{AWD}	24	—	26	—	30	—	ns	9
$\overline{RAS}$ to $\overline{WE}$ Delay Time	t_{RWD}	45	—	50	—	60	—	ns	9
$\overline{CAS}$ Precharge $\overline{WE}$ Delay Time	t_{CPWD}	28	—	30	—	34	—	ns	9
$\overline{CAS}$ Active Delay Time from $\overline{RAS}$ Precharge	t_{RPC}	0	—	0	—	0	—	ns	
$\overline{RAS}$ to $\overline{CAS}$ Set-up Time ($\overline{CAS}$ before $\overline{RAS}$)	t_{CSR}	10	—	10	—	10	—	ns	
$\overline{RAS}$ to $\overline{CAS}$ Hold Time ($\overline{CAS}$ before $\overline{RAS}$)	t_{CHR}	25	—	25	—	25	—	ns	

Notes:

1. A start-up delay of 100 μs is required after power-up, followed by a minimum of eight initialization cycles ($\overline{RAS}$-only refresh or $\overline{CAS}$ before $\overline{RAS}$ refresh) before proper device operation is achieved.

2. The AC characteristics assume $t_T = 5$ ns.

3. V_{IH} (Min.) and V_{IL} (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 100 pF.

5. 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, access time is controlled by t_{CAC}.

6. 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, access time is controlled by t_{AA}.

7. t_{OFF} (Max.) defines 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. t_{WCS}, t_{CWD}, t_{RWD}, t_{AWD} and t_{CPWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only. If $t_{WCS} \geq t_{WCS}$ (Min.), the cycle is an early write cycle and the data out will remain open circuit (high impedance) throughout the entire cycle. If $t_{CWD} \geq t_{CWD}$ (Min.), $t_{RWD} \geq t_{RWD}$ (Min.), $t_{AWD} \geq t_{AWD}$ (Min.) and $t_{CPWD} \geq t_{CPWD}$ (Min.), the cycle is a read modify write cycle and data out will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indeterminate.

10. These parameters are referenced to $\overline{CAS}$ leading edge in an early write cycle, and to $\overline{WE}$ leading edge in a read modify write cycle.

See ADDENDUM B for AC Timing Waveforms