

# OKI Semiconductor

## MSM514800A/ASL

524,288-Word × 8-Bit DYNAMIC RAM : FAST PAGE MODE TYPE

### DESCRIPTION

The MSM514800A/ASL is a 524,288-word × 8-bit dynamic RAM fabricated in OKI's CMOS silicon gate technology. The MSM514800A/ASL achieves high integration, high-speed operation, and low-power consumption due to quadruple polysilicon single metal CMOS. The MSM514800A/ASL is available in a 28-pin plastic SOJ or 28-pin plastic TSOP. The MSM514800ASL (the self-refresh version) is specially designed for lower-power applications.

### FEATURES

- 524,288-word × 8-bit configuration
- Single 5 V power supply, ±10% tolerance
- Input : TTL compatible, low input capacitance
- Output : TTL compatible, 3-state
- Refresh : 1024 cycles/16 ms, 1024 cycles/128 ms (SL version)
- Fast page mode, read modify write capability
- $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  refresh, hidden refresh,  $\overline{\text{RAS}}$ -only refresh capability
- $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  self-refresh capability (SL version)
- Package options:
 

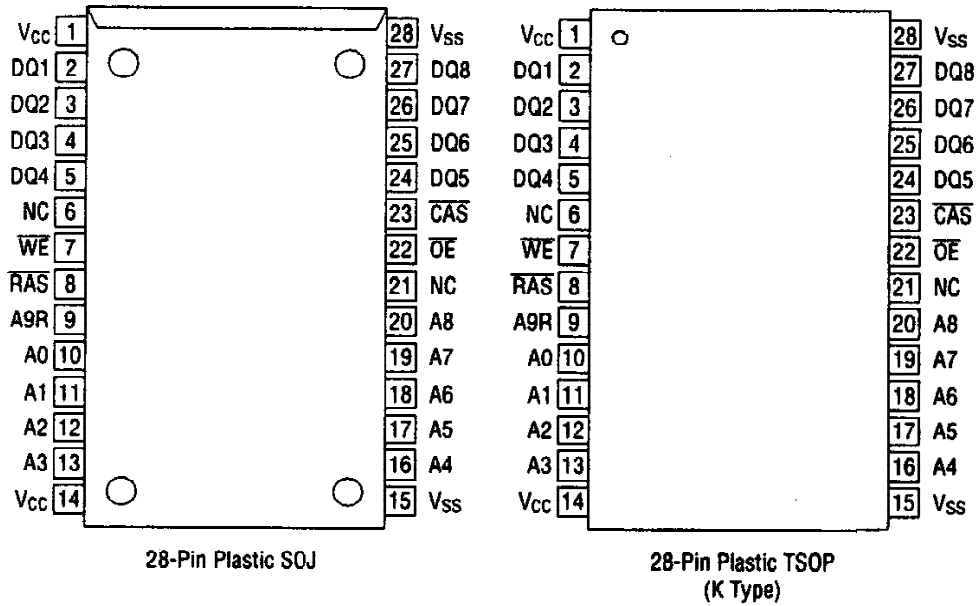
28-Pin 400 mil plastic SOJ	(SOJ28-P-400)	(Product : MSM514800A/ASL-xxJS)
28-Pin 400 mil plastic TSOP	(TSOP28-P-400-K)	(Product : MSM514800A/ASL-xxTS-K)

 xx indicates speed rank.

### PRODUCT FAMILY

Family	Access Time (Max.)				Cycle Time (Min.)	Power Dissipation	
	t <sub>RAC</sub>	t <sub>AA</sub>	t <sub>CAC</sub>	t <sub>OEA</sub>		Operating (Max.)	Standby (Max.)
MSM514800A/ASL-70	70 ns	35 ns	20 ns	20 ns	130 ns	605 mW	5.5 mW/ 1.1 mW (SL version)
MSM514800A/ASL-80	80 ns	40 ns	20 ns	20 ns	150 ns	550 mW	
MSM514800A/ASL-10	100 ns	50 ns	25 ns	25 ns	180 ns	495 mW	

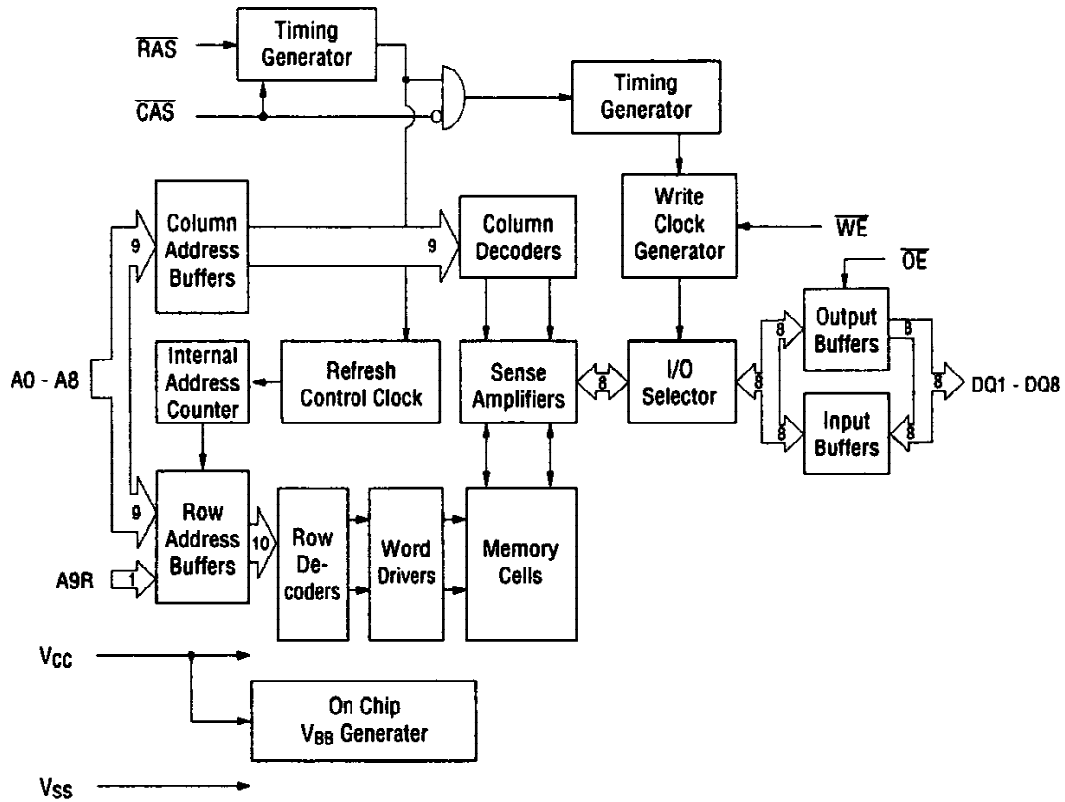
**PIN CONFIGURATION (TOP VIEW)**



Pin Name	Function
A0 - A8, A9R	Address Input
RAS	Row Address Strobe
CAS	Column Address Strobe
DQ1 - DQ8	Data Input / Data Output
OE	Output Enable
WE	Write Enable
V <sub>CC</sub>	Power Supply (5 V)
V <sub>SS</sub>	Ground (0 V)
NC	No Connection

Note: The same power supply voltage must be provided to every V<sub>CC</sub> pin, and the same GND voltage level must be provided to every V<sub>SS</sub> pin.

**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

\*:  $T_a = 25^\circ\text{C}$ **Recommended Operating Conditions** $(T_a = 0^\circ\text{C to } 70^\circ\text{C})$ 

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	$V_{IH}$	2.4	—	6.5	V
Input Low Voltage	$V_{IL}$	-1.0	—	0.8	V

**Capacitance** $(V_{CC} = 5\text{ V} \pm 10\%, T_a = 25^\circ\text{C}, f = 1\text{ MHz})$ 

Parameter	Symbol	Typ.	Max.	Unit
Input Capacitance (A0 - A8, A9R)	$C_{IN1}$	—	7	pF
Input Capacitance ( $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ , $\overline{\text{WE}}$ , $\overline{\text{OE}}$ )	$C_{IN2}$	—	7	pF
Output Capacitance (DQ1 - DQ8)	$C_{I/O}$	—	8	pF

DC Characteristics

(V<sub>CC</sub> = 5 V ±10%, T<sub>a</sub> = 0°C to 70°C)

Parameter	Symbol	Condition	MSM514800 A/ASL-70		MSM514800 A/ASL-80		MSM514800 A/ASL-10		Unit	Note
			Min.	Max.	Min.	Max.	Min.	Max.		
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -5.0 mA	2.4	V <sub>CC</sub>	2.4	V <sub>CC</sub>	2.4	V <sub>CC</sub>	V	
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 4.2 mA	0	0.4	0	0.4	0	0.4	V	
Input Leakage Current	I <sub>LI</sub>	0 V ≤ V <sub>i</sub> ≤ 6.5 V; All other pins not under test = 0 V	-10	10	-10	10	-10	10	μA	
Output Leakage Current	I <sub>LO</sub>	DQ disable 0 V ≤ V <sub>O</sub> ≤ 5.5 V	-10	10	-10	10	-10	10	μA	
Average Power Supply Current (Operating)	I <sub>CC1</sub>	$\overline{\text{RAS}}, \overline{\text{CAS}}$ cycling, t <sub>RC</sub> = Min.	—	110	—	100	—	90	mA	1, 2
Power Supply Current (Standby)	I <sub>CC2</sub>	$\overline{\text{RAS}}, \overline{\text{CAS}} = V_{IH}$	—	2	—	2	—	2	mA	1
		$\overline{\text{RAS}}, \overline{\text{CAS}} \geq V_{CC} - 0.2 \text{ V}$	—	1	—	1	—	1	μA	1, 5
Average Power Supply Current (RAS-only Refresh)	I <sub>CC3</sub>	$\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}} = V_{IH}$ , t <sub>RC</sub> = Min.	—	110	—	100	—	90	mA	1, 2
Power Supply Current (Standby)	I <sub>CC5</sub>	$\overline{\text{RAS}} = V_{IH}$ , $\overline{\text{CAS}} = V_{IL}$ , DQ = enable	—	5	—	5	—	5	mA	1
Average Power Supply Current ( $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Refresh)	I <sub>CC6</sub>	$\overline{\text{RAS}}$ cycling, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$	—	110	—	100	—	90	mA	1, 2
Average Power Supply Current (Fast Page Mode)	I <sub>CC7</sub>	$\overline{\text{RAS}} = V_{IL}$ , $\overline{\text{CAS}}$ cycling, t <sub>PC</sub> = Min.	—	100	—	90	—	80	mA	1, 3
Average Power Supply Current (Battery Backup)	I <sub>CC10</sub>	t <sub>RC</sub> = 125 μs, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ , t <sub>RAS</sub> ≤ 1 μs	—	300	—	300	—	300	μA	1, 4, 5
Average Power Supply Current ( $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Self-Refresh)	I <sub>CC8</sub>	$\overline{\text{RAS}} \leq 0.2 \text{ V}$ , $\overline{\text{CAS}} \leq 0.2 \text{ V}$	—	300	—	300	—	300	μA	1, 5

- Notes:
1. I<sub>CC</sub> Max. is specified as I<sub>CC</sub> for the output open condition.
  2. Address can be changed once or less while  $\overline{\text{RAS}} = V_{IL}$ .
  3. Address can be changed once or less while  $\overline{\text{CAS}} = V_{IH}$ .
  4. V<sub>CC</sub> - 0.2 V ≤ V<sub>IH</sub> ≤ 6.5 V, -1.0 V ≤ V<sub>IL</sub> ≤ 0.2 V.
  5. SL version.

## AC Characteristics (1/2)

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

Parameter	Symbol	MSM514800 A/ASL-70		MSM514800 A/ASL-80		MSM514800 A/ASL-10		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Random Read or Write Cycle Time	t <sub>RC</sub>	130	—	150	—	180	—	ns	
Read Modify Write Cycle Time	t <sub>RWC</sub>	185	—	205	—	245	—	ns	
Fast Page Mode Cycle Time	t <sub>PC</sub>	45	—	50	—	60	—	ns	
Fast Page Mode Read Modify Write Cycle Time	t <sub>PRWC</sub>	100	—	105	—	125	—	ns	
Access Time from $\overline{\text{RAS}}$	t <sub>RAC</sub>	—	70	—	80	—	100	ns	4, 5, 6
Access Time from $\overline{\text{CAS}}$	t <sub>CAC</sub>	—	20	—	20	—	25	ns	4, 5
Access Time from Column Address	t <sub>AA</sub>	—	35	—	40	—	50	ns	4, 6
Access Time from $\overline{\text{CAS}}$ Precharge	t <sub>CPA</sub>	—	40	—	45	—	55	ns	4
Access Time from $\overline{\text{OE}}$	t <sub>OEa</sub>	—	20	—	20	—	25	ns	4
Output Low Impedance Time from $\overline{\text{CAS}}$	t <sub>CLZ</sub>	0	—	0	—	0	—	ns	4
$\overline{\text{CAS}}$ to Data Output Buffer Turn-off Delay Time	t <sub>OFF</sub>	0	20	0	20	0	25	ns	7
$\overline{\text{OE}}$ to Data Output Buffer Turn-off Delay Time	t <sub>OEZ</sub>	0	20	0	20	0	25	ns	7
Transition Time	t <sub>T</sub>	3	50	3	50	3	50	ns	3
Refresh Period	t <sub>REF</sub>	—	16	—	16	—	16	ms	
Refresh Period (SL version)	t <sub>REF</sub>	—	128	—	128	—	128	ms	11
$\overline{\text{RAS}}$ Precharge Time	t <sub>RP</sub>	50	—	60	—	70	—	ns	
$\overline{\text{RAS}}$ Pulse Width	t <sub>RAS</sub>	70	10,000	80	10,000	100	10,000	ns	
$\overline{\text{RAS}}$ Pulse Width (Fast Page Mode)	t <sub>RASP</sub>	70	100,000	80	100,000	100	100,000	ns	
$\overline{\text{RAS}}$ Hold Time	t <sub>RSH</sub>	20	—	20	—	25	—	ns	
$\overline{\text{RAS}}$ Hold Time referenced to $\overline{\text{OE}}$	t <sub>ROH</sub>	20	—	20	—	25	—	ns	
$\overline{\text{CAS}}$ Precharge Time (Fast Page Mode)	t <sub>CP</sub>	10	—	10	—	10	—	ns	
$\overline{\text{CAS}}$ Pulse Width	t <sub>CAS</sub>	20	10,000	20	10,000	25	10,000	ns	
$\overline{\text{CAS}}$ Hold Time	t <sub>CSH</sub>	70	—	80	—	100	—	ns	
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ Precharge Time	t <sub>CRP</sub>	10	—	10	—	10	—	ns	
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ Precharge Time	t <sub>RHCP</sub>	40	—	45	—	55	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Delay Time	t <sub>RCD</sub>	20	50	20	60	25	75	ns	5
$\overline{\text{RAS}}$ to Column Address Delay Time	t <sub>RAD</sub>	15	35	15	40	20	50	ns	6
Row Address Set-up Time	t <sub>ASR</sub>	0	—	0	—	0	—	ns	
Row Address Hold Time	t <sub>RAH</sub>	10	—	10	—	15	—	ns	
Column Address Set-up Time	t <sub>ASC</sub>	0	—	0	—	0	—	ns	
Column Address Hold Time	t <sub>CAH</sub>	15	—	15	—	20	—	ns	
Column Address Hold Time from $\overline{\text{RAS}}$	t <sub>AR</sub>	55	—	60	—	75	—	ns	
Column Address to $\overline{\text{RAS}}$ Lead Time	t <sub>RAL</sub>	35	—	40	—	50	—	ns	
Read Command Set-up Time	t <sub>RCS</sub>	0	—	0	—	0	—	ns	
Read Command Hold Time	t <sub>RCH</sub>	0	—	0	—	0	—	ns	8
Read Command Hold Time referenced to $\overline{\text{RAS}}$	t <sub>RRH</sub>	0	—	0	—	0	—	ns	8

AC Characteristics (2/2)

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

Parameter	Symbol	MSM514800 A/ASL-70		MSM514800 A/ASL-80		MSM514800 A/ASL-10		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Write Command Set-up Time	t <sub>WCS</sub>	0	—	0	—	0	—	ns	9
Write Command Hold Time	t <sub>WCH</sub>	15	—	15	—	20	—	ns	
Write Command Hold Time from $\overline{\text{RAS}}$	t <sub>WCR</sub>	55	—	60	—	75	—	ns	
Write Command Pulse Width	t <sub>WCP</sub>	15	—	15	—	20	—	ns	
OE Command Hold Time	t <sub>OEH</sub>	20	—	20	—	25	—	ns	
Write Command to $\overline{\text{RAS}}$ Lead Time	t <sub>RWL</sub>	20	—	20	—	25	—	ns	
Write Command to $\overline{\text{CAS}}$ Lead Time	t <sub>CWL</sub>	20	—	20	—	25	—	ns	
Data-in Set-up Time	t <sub>DS</sub>	0	—	0	—	0	—	ns	10
Data-in Hold Time	t <sub>DH</sub>	15	—	15	—	20	—	ns	10
Data-in Hold Time from $\overline{\text{RAS}}$	t <sub>DHR</sub>	55	—	60	—	75	—	ns	
OE to Data-in Delay Time	t <sub>OED</sub>	20	—	20	—	25	—	ns	
$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ Delay Time	t <sub>CWD</sub>	50	—	50	—	60	—	ns	9
Column Address to $\overline{\text{WE}}$ Delay Time	t <sub>AWD</sub>	65	—	70	—	85	—	ns	9
$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ Delay Time	t <sub>RWD</sub>	100	—	110	—	135	—	ns	9
$\overline{\text{CAS}}$ Precharge $\overline{\text{WE}}$ Delay Time	t <sub>CPWD</sub>	70	—	75	—	90	—	ns	9
$\overline{\text{CAS}}$ Active Delay Time from $\overline{\text{RAS}}$ Precharge	t <sub>RPC</sub>	10	—	10	—	10	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Set-up Time ( $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ )	t <sub>CSR</sub>	10	—	10	—	10	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Hold Time ( $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ )	t <sub>CHR</sub>	15	—	15	—	20	—	ns	
$\overline{\text{CAS}}$ Precharge Time (Refresh Counter Test)	t <sub>CPT</sub>	40	—	40	—	50	—	ns	
$\overline{\text{RAS}}$ Pulse Width ( $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Self-Refresh)	t <sub>RASS</sub>	100	—	100	—	100	—	μs	11
$\overline{\text{RAS}}$ Precharge Time ( $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Self-Refresh)	t <sub>RPS</sub>	130	—	150	—	180	—	ns	11
$\overline{\text{CAS}}$ Hold Time ( $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Self-Refresh)	t <sub>CHS</sub>	-50	—	-60	—	-70	—	ns	11

- Notes:
1. A start-up delay of 200  $\mu$ s is required after power-up, followed by a minimum of eight initialization cycles ( $\overline{\text{RAS}}$ -only refresh or  $\overline{\text{CAS}}$  before  $\overline{\text{RAS}}$  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.) and  $t_{OEZ}$  (Max.) define the time at which the output achieves the open circuit condition and are 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  $\overline{\text{CAS}}$  leading edge in an early write cycle, and to  $\overline{\text{WE}}$  leading edge in an  $\overline{\text{OE}}$  control write cycle or a read modify write cycle.
  11. Only SL version.

**See ADDENDUM I for AC Timing Waveforms**