

OKI Semiconductor

MSM511664A/AL

65,536-Word × 16-Bit DYNAMIC RAM : FAST PAGE MODE TYPE (BYTE WRITE)

DESCRIPTION

The MSM511664A/AL is a 65,536-word × 16-bit dynamic RAM fabricated in OKI's CMOS silicon gate technology. The MSM511664A/AL achieves high integration, high-speed operation, and low-power consumption due to quadruple polysilicon single metal CMOS. The MSM511664A/AL is available in a 40-pin plastic SOJ or 44/40-pin plastic TSOP. The MSM511664AL (the low-power version) is specially designed for lower-power applications.

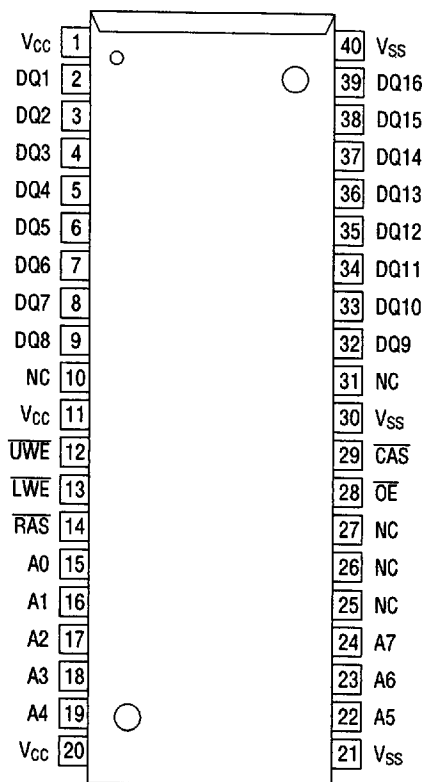
FEATURES

- 65,536-word × 16-bit configuration
- Single 5 V power supply, ±10% tolerance
- Input : TTL compatible, low input capacitance
- Output : TTL compatible, 3-state
- Refresh : 256 cycles/4 ms, 256 cycles/32 ms (L-version)
- Byte write and fast page mode, read modify write capability
- $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, hidden refresh, $\overline{\text{RAS}}$ -only refresh capability
- Package options:
 - 40-Pin 400 mil plastic SOJ (SOJ40-P-400) (Product : MSM511664A/AL-xxJS)
 - 44/40-Pin 400 mil plastic TSOP (TSOP44/40-P-400/0.8-K) (Product : MSM511664A/AL-xxTS-K)xx indicates speed rank.

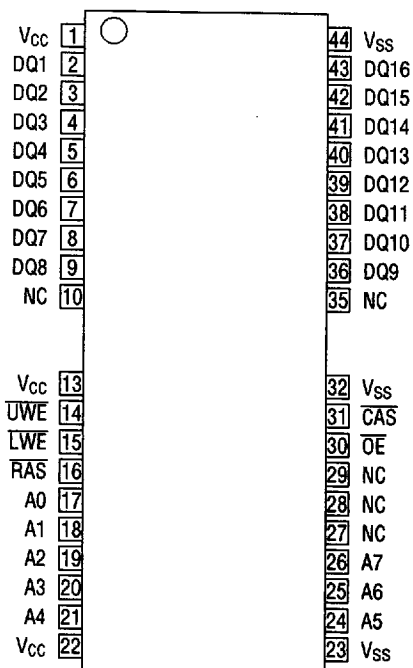
PRODUCT FAMILY

Family	Access Time (Max.)				Cycle Time (Min.)	Power Dissipation	
	t _{RAC}	t _{AA}	t _{CAC}	t _{OEA}		Operating (Max.)	Standby (Max.)
MSM511664A/AL-70	70 ns	40 ns	25 ns	25 ns	120 ns	715 mW	5.5 mW/ 1.1 mW (L-version)
MSM511664A/AL-80	80 ns	45 ns	30 ns	30 ns	135 ns	633 mW	
MSM511664A/AL-10	100 ns	55 ns	40 ns	40 ns	170 ns	495 mW	

PIN CONFIGURATION (TOP VIEW)



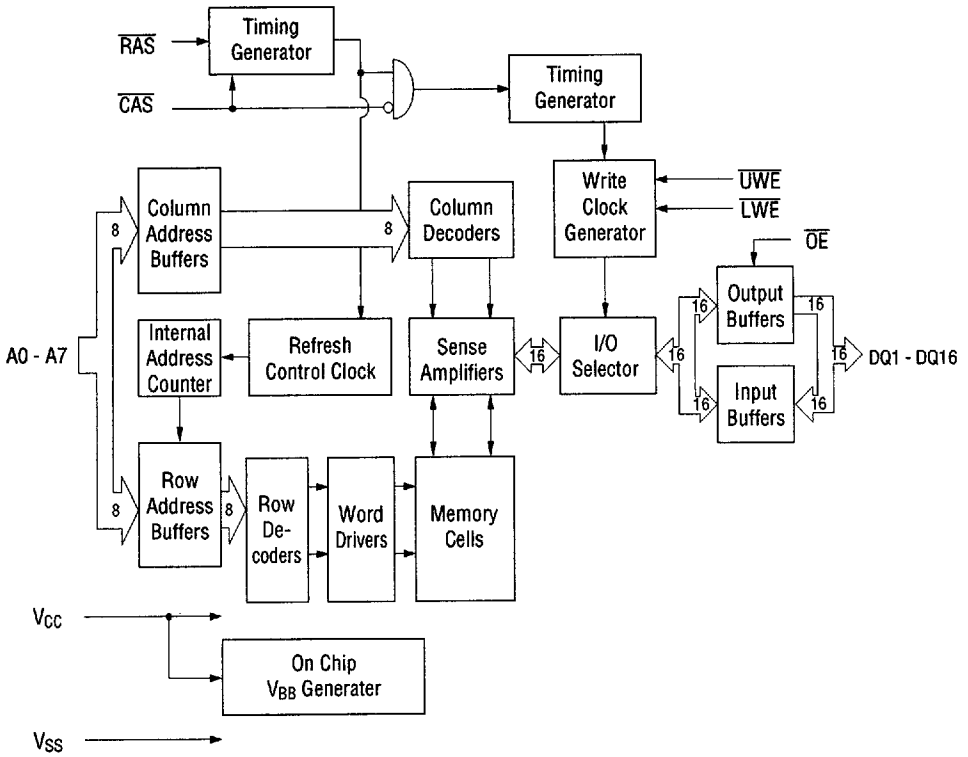
40-Pin Plastic SOJ

44/40-Pin Plastic TSOP
(K Type)

Pin Name	Function
A0 - A7	Address Input
RAS	Row Address Strobe
CAS	Column Address Strobe
DQ1 - DQ16	Data Input/Data Output
OE	Output Enable
LWE	Lower Byte Write Enable
UWE	Upper Byte Write Enable
V _{CC}	Power Supply (5 V)
V _{SS}	Ground (0 V)
NC	No Connection

Note : The same power supply voltage must be provided to every V_{CC} pin, and the same GND voltage level must be provided to every V_{SS} pin.

BLOCK DIAGRAM



FUNCTION TABLE

Input Pin					DQ Pin		Function Mode
RAS	CAS	LWE	UWE	OE	DQ1 - DQ8	DQ9 - DQ16	
H	*	*	*	*	High-Z	High-Z	Standby
L	H	*	*	*	High-Z	High-Z	Refresh
L	L	H	H	L	D _{OUT}	D _{OUT}	Word Read
L	L	L	H	H	D _{IN}	Don't Care	Lower Byte Write
L	L	H	L	H	Don't Care	D _{IN}	Upper Byte Write
L	L	L	L	H	D _{IN}	D _{IN}	Word Write
L	L	H	H	H	High-Z	High-Z	—

*: "H" or "L"

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 - A7)	C_{IN1}	—	7	pF
Input Capacitance ($\overline{\text{RAS}}$, $\overline{\text{CAS}}$, $\overline{\text{UWE}}$, $\overline{\text{LWE}}$, $\overline{\text{OE}}$)	C_{IN2}	—	7	pF
Output Capacitance (DQ1 - DQ16)	$C_{I/O}$	—	7	pF

DC Characteristics

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

Parameter	Symbol	Condition	MSM511664 A/AL-70		MSM511664 A/AL-80		MSM511664 A/AL-10		Unit	Note
			Min.	Max.	Min.	Max.	Min.	Max.		
Output High Voltage	V_{OH}	$I_{OH} = -2.5 \text{ mA}$	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	V	
Output Low Voltage	V_{OL}	$I_{OL} = 2.1 \text{ mA}$	0	0.4	0	0.4	0	0.4	V	
Input Leakage Current	I_{LI}	$0V \leq V_i \leq 6.5V$; All other pins not under test = $0V$	-10	10	-10	10	-10	10	μA	
Output Leakage Current	I_{LO}	DQ disable $0V \leq V_o \leq 5.5V$	-10	10	-10	10	-10	10	μA	
Average Power Supply Current (Operating)	I_{CC1}	\overline{RAS} , \overline{CAS} cycling, $t_{RC} = \text{Min.}$	—	130	—	115	—	90	mA	1, 2
Power Supply Current (Standby)	I_{CC2}	\overline{RAS} , $\overline{CAS} = V_{IH}$	—	2	—	2	—	2	mA	1
		\overline{RAS} , \overline{CAS} $\geq V_{CC} - 0.2V$	—	1	—	1	—	1	μA	1, 5
			—	200	—	200	—	200	μA	1, 5
Average Power Supply Current (\overline{RAS} -only Refresh)	I_{CC3}	\overline{RAS} cycling, $\overline{CAS} = V_{IH}$, $t_{RC} = \text{Min.}$	—	130	—	115	—	90	mA	1, 2
Power Supply Current (Standby)	I_{CC5}	$\overline{RAS} = V_{IH}$, $\overline{CAS} = V_{IL}$, DQ = 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}	—	130	—	115	—	90	mA	1, 2
Average Power Supply Current (Fast Page Mode)	I_{CC7}	$\overline{RAS} = V_{IL}$, \overline{CAS} cycling, $t_{PC} = \text{Min.}$	—	110	—	90	—	70	mA	1, 3
Average Power Supply Current (Battery Backup)	I_{CC10}	$t_{RC} = 125 \mu s$, \overline{CAS} before \overline{RAS} , $t_{RAS} \leq 1 \mu s$	—	300	—	300	—	300	μA	1, 4, 5

- 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 $\overline{CAS} = V_{IH}$.
 4. $V_{CC} - 0.2V \leq V_{IH} \leq 6.5V$, $-1.0V \leq V_{IL} \leq 0.2V$.
 5. L-version.

AC Characteristics (1/2)

 $(V_{CC} = 5\text{ V} \pm 10\%, T_a = 0^\circ\text{C to } 70^\circ\text{C})$ Note 1, 2, 3

Parameter	Symbol	MSM511664 A/AL-70		MSM511664 A/AL-80		MSM511664 A/AL-10		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Random Read or Write Cycle Time	t_{RC}	120	—	135	—	170	—	ns	
Read Modify Write Cycle Time	t_{RWC}	170	—	185	—	225	—	ns	
Fast Page Mode Cycle Time	t_{PC}	50	—	55	—	65	—	ns	
Fast Page Mode Read Modify Write Cycle Time	t_{PRWC}	95	—	100	—	120	—	ns	
Access Time from $\overline{\text{RAS}}$	t_{RAC}	—	70	—	80	—	100	ns	4, 5, 6
Access Time from $\overline{\text{CAS}}$	t_{CAC}	—	25	—	30	—	40	ns	4, 5
Access Time from Column Address	t_{AA}	—	40	—	45	—	55	ns	4, 6
Access Time from $\overline{\text{CAS}}$ Precharge	t_{CPA}	—	45	—	50	—	60	ns	4
Access Time from $\overline{\text{OE}}$	t_{OEA}	—	25	—	30	—	40	ns	4
Output Low Impedance Time from $\overline{\text{CAS}}$	t_{CLZ}	0	—	0	—	0	—	ns	4
$\overline{\text{CAS}}$ to Data Output Buffer Turn-off Delay Time	t_{OFF}	0	20	0	20	0	20	ns	7
$\overline{\text{OE}}$ to Data Output Buffer Turn-off Delay Time	t_{OEZ}	0	15	0	15	0	20	ns	7
Transition Time	t_T	3	50	3	50	3	50	ns	3
Refresh Period	t_{REF}	—	4	—	4	—	4	ms	
Refresh Period (L-version)	t_{REF}	—	32	—	32	—	32	ms	
$\overline{\text{RAS}}$ Precharge Time	t_{RP}	40	—	45	—	60	—	ns	
$\overline{\text{RAS}}$ Pulse Width	t_{RAS}	70	10,000	80	10,000	100	10,000	ns	
$\overline{\text{RAS}}$ Pulse Width (Fast Page Mode)	t_{RASP}	70	100,000	80	100,000	100	100,000	ns	
$\overline{\text{RAS}}$ Hold Time	t_{RSH}	25	—	30	—	40	—	ns	
$\overline{\text{RAS}}$ Hold Time referenced to $\overline{\text{OE}}$	t_{ROH}	15	—	15	—	20	—	ns	
$\overline{\text{CAS}}$ Precharge Time (Fast Page Mode)	t_{CP}	10	—	10	—	10	—	ns	
$\overline{\text{CAS}}$ Pulse Width	t_{CAS}	25	10,000	30	10,000	40	10,000	ns	
$\overline{\text{CAS}}$ Hold Time	t_{CSH}	70	—	80	—	100	—	ns	
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ Precharge Time	t_{CRP}	5	—	5	—	5	—	ns	
$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ Precharge Time	t_{RHCP}	45	—	50	—	60	—	ns	
$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Delay Time	t_{RAD}	20	45	22	50	25	60	ns	5
$\overline{\text{RAS}}$ to Column Address Delay Time	t_{RAD}	15	30	17	35	20	45	ns	6
Row Address Set-up Time	t_{ASR}	0	—	0	—	0	—	ns	
Row Address Hold Time	t_{RAH}	10	—	12	—	15	—	ns	
Column Address Set-up Time	t_{ASC}	0	—	0	—	0	—	ns	
Column Address Hold Time	t_{CAH}	10	—	15	—	15	—	ns	
Column Address Hold Time from $\overline{\text{RAS}}$	t_{AR}	45	—	55	—	65	—	ns	
Column Address to $\overline{\text{RAS}}$ Lead Time	t_{RAL}	40	—	45	—	55	—	ns	
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 $\overline{\text{RAS}}$	t_{RRH}	0	—	0	—	0	—	ns	8

AC Characteristics (2/2)

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

Parameter	Symbol	MSM511664 A/AL-70		MSM511664 A/AL-80		MSM511664 A/AL-10		Unit	Note
		Min.	Max.	Min.	Max.	Min.	Max.		
Write Command Set-up Time	t _{WCS}	0	—	0	—	0	—	ns	9
Write Command Hold Time	t _{WCH}	10	—	15	—	15	—	ns	
Write Command Hold Time from RAS	t _{WCR}	45	—	55	—	65	—	ns	
Write Command Pulse Width	t _{WP}	10	—	15	—	15	—	ns	
OE Command Hold Time	t _{OEH}	10	—	10	—	20	—	ns	
Write Command to RAS Lead Time	t _{RWL}	20	—	20	—	20	—	ns	
Write Command to CAS Lead Time	t _{CWL}	20	—	20	—	20	—	ns	
Data-in Set-up Time	t _{DS}	0	—	0	—	0	—	ns	10
Data-in Hold Time	t _{DH}	10	—	15	—	15	—	ns	10
Data-in Hold Time from RAS	t _{DHR}	45	—	55	—	65	—	ns	
OE to Data-in Delay Time	t _{OED}	15	—	15	—	20	—	ns	
CAS to WE Delay Time	t _{CWD}	50	—	55	—	70	—	ns	9
Column Address to WE Delay Time	t _{AWD}	60	—	70	—	85	—	ns	9
RAS to WE Delay Time	t _{RWD}	95	—	105	—	130	—	ns	9
CAS Precharge WE Delay Time	t _{CPWD}	70	—	75	—	90	—	ns	9
CAS Active Delay Time from RAS Precharge	t _{RPC}	0	—	0	—	0	—	ns	
RAS to CAS Set-up Time (CAS before RAS)	t _{CSR}	5	—	5	—	5	—	ns	
RAS to CAS Hold Time (CAS before RAS)	t _{CHR}	10	—	10	—	10	—	ns	
CAS Precharge Time	t _{CPN}	10	—	10	—	15	—	ns	
CAS Precharge Time (Refresh Counter Test)	t _{CPT}	40	—	40	—	50	—	ns	

- Notes:
1. A start-up delay of 100 μ 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 1 TTL load and 50 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.

See ADDENDUM F for AC Timing Waveforms