MCM6943

Product Preview
256K x 16 Bit 3.3 V Asynchronous Fast Static RAM

The MCM6943 is a 4,194,304 bit static random access memory organized as 262,144 words of 16 bits. Static design eliminates the need for external clocks or timing strobes.

The MCM6943 is equipped with chip enable ($\overline{E}$), write enable ($\overline{W}$), and output enable ($\overline{G}$) pins, allowing for greater system flexibility and eliminating bus contention problems. Separate byte enable controls ($\overline{LB}$ and $\overline{UB}$) allow individual bytes to be written and read. $\overline{LB}$ controls the lower bits DQ0 to DQ7, while $\overline{UB}$ controls the upper bits DQ8 to DQ15.

The MCM6943 is available in a 400 mil, 44–lead small–outline SOJ package and a 44–lead TSOP Type II package.

- Single 3.3 V ± 0.3 V Power Supply
- Fast Access Time: 8/10/12/15 ns
- Equal Address and Chip Enable Access Time
- All Inputs and Outputs are TTL Compatible
- Data Byte Control
- Fully Static Operation
- Power Operation: 265/250/240/230 mA Maximum, Active AC
- Standard Industrial Temperature Option: – 40 to + 85°C
- Part Numbers (Standard Industrial Power): SCM6943YJ8A
  SCM6943YJ10A
  SCM6943YJ12A
  SCM6943YJ15A
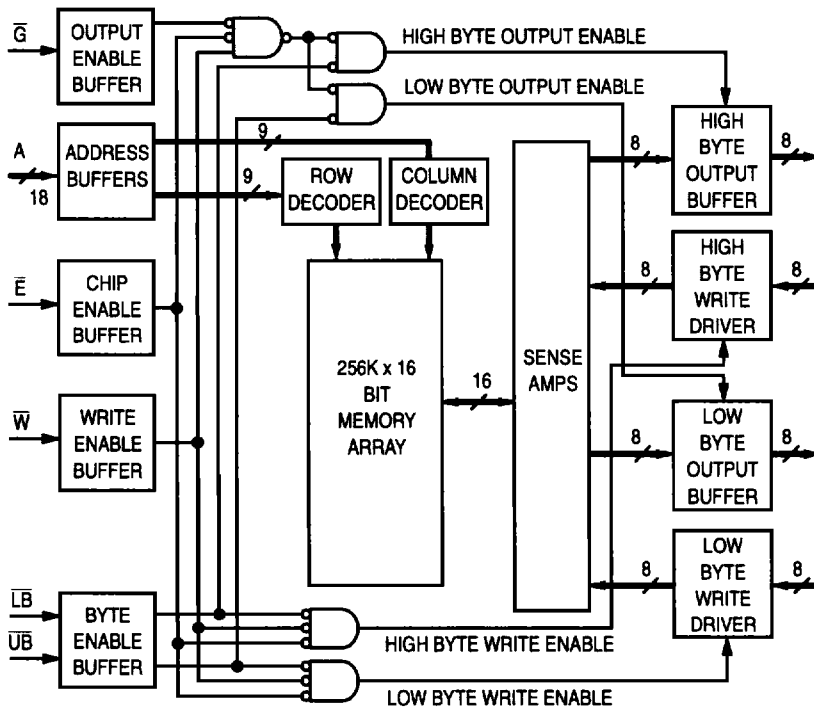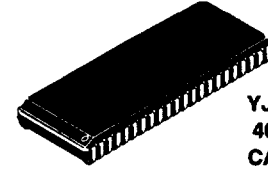
**YJ PACKAGE
400 MIL SOJ
CASE 919–01**

**TS PACKAGE
TSOP TYPE II
CASE 924A–01**

PIN ASSIGNMENT

A	1 ●	44	A
A	2	43	A
A	3	42	A
A	4	41	$\overline{G}$
A	5	40	$\overline{UB}$
$\overline{E}$	6	39	$\overline{LB}$
DQ0	7	38	DQ15
DQ1	8	37	DQ14
DQ2	9	36	DQ13
DQ3	10	35	DQ12
V_{DD}	11	34	V_{SS}
V_{SS}	12	33	V_{DD}
DQ4	13	32	DQ11
DQ5	14	31	DQ10
DQ6	15	30	DQ9
DQ7	16	29	DQ8
$\overline{W}$	17	28	NC
A	18	27	A
A	19	26	A
A	20	25	A
A	21	24	A
A	22	23	A

PIN NAMES

A0 – A17	Address Input
$\overline{E}$	Chip Enable
$\overline{W}$	Write Enable
$\overline{G}$	Output Enable
$\overline{UB}$	Upper Byte
$\overline{LB}$	Lower Byte
DQ0 – DQ15	Data Input/Output
V_{DD}	+ 3.3 V Power Supply
V_{SS}	Ground
NC	No Connection

BLOCK DIAGRAM

12/18/96

Ⓜ **MOTOROLA**

TRUTH TABLE (X = Don't Care)

$\overline{E}$	$\overline{G}$	$\overline{W}$	$\overline{LB}$	$\overline{UB}$	Mode	V_{DD} Current	DQ0 – DQ7	DQ8 – DQ15
H	X	X	X	X	Not Selected	I_{SB1}, I_{SB2}	High–Z	High–Z
L	H	H	X	X	Output Disabled	I_{DDA}	High–Z	High–Z
L	X	X	H	H	Output Disabled	I_{DDA}	High–Z	High–Z
L	L	H	L	H	Low Byte Read	I_{DDA}	D_{out}	High–Z
L	L	H	H	L	High Byte Read	I_{DDA}	High–Z	D_{out}
L	L	H	L	L	Word Read	I_{DDA}	D_{out}	D_{out}
L	X	L	L	H	Low Byte Write	I_{DDA}	D_{in}	High–Z
L	X	L	H	L	High Byte Write	I_{DDA}	High–Z	D_{in}
L	X	L	L	L	Word Write	I_{DDA}	D_{in}	D_{in}

ABSOLUTE MAXIMUM RATINGS (See Notes)

Rating	Symbol	Value	Unit
Supply Voltage	V_{DD}	– 0.5 to + 4.6	V
Voltage on Any Pin	V_{in}	– 0.5 to V_{DD} + 0.5	V
Output Current per Pin	I_{out}	± 20	mA
Package Power Dissipation	P_D	TBD	W
Temperature Under Bias Commercial Industrial	T_{bias}	– 10 to + 85 – 45 to + 90	°C
Operating Temperature Commercial Industrial	T_A	0 to + 70 – 45 to + 85	°C
Storage Temperature	T_{stg}	– 55 to + 150	°C

NOTES:
1. Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to RECOMMENDED OPERATING CONDITIONS. Exposure to higher than recommended voltages for extended periods of time could affect device reliability.
2. All voltages are referenced to V_{SS}.
3. Power dissipation capability will be dependent upon package characteristics and use environment.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to these high impedance circuits.

This BiCMOS memory circuit has been designed to meet the dc and ac specifications shown in the tables, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse air flow of at least 500 linear feet per minute is maintained.

DC OPERATING CONDITIONS AND CHARACTERISTICS

($V_{DD} = 3.3$ V ± 0.3 V, $T_A = 0$ to 70°C, Unless Otherwise Noted)
($T_A = -40$ to + 85°C for Industrial Temperature Offering)

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V_{DD}	3.0	3.3	3.6	V
Input High Voltage	V_{IH}	2.2	—	$V_{DD} + 0.3$**	V
Input Low Voltage	V_{IL}	-0.5*	—	0.8	V

* V_{IL} (min) = -0.5 V dc; V_{IL} (min) = -2.0 V ac (pulse width ≤ 20 ns) for I ≤ 20.0 mA.
** V_{IH} (max) = $V_{DD} + 0.3$ V dc; V_{IH} (max) = $V_{DD} + 2.0$ V ac (pulse width ≤ 20 ns) for I ≤ 20.0 mA.

DC CHARACTERISTICS

Parameter		Symbol	Min	Max	Unit
Input Leakage Current (All Inputs, V_{in} = 0 to V_{DD})		$I_{lkg(I)}$	—	± 1.0	µA
Output Leakage Current ($\overline{E} = V_{IH}$, V_{out} = 0 to V_{DD})		$I_{lkg(O)}$	—	± 1.0	µA
Output Low Voltage	(I_{OL} = + 4.0 mA) (I_{OL} = + 100 µA)	V_{OL}	—	0.4 $V_{SS} + 0.2$	V
Output High Voltage	(I_{OH} = – 4.0 mA) (I_{OH} = – 100 µA)	V_{OH}	2.4 $V_{DD} - 0.2$	—	V

POWER SUPPLY CURRENTS

Parameter		Symbol	0 to 70°C	– 40 to + 85°C	Unit
AC Active Supply Current (I_{out} = 0 mA, V_{CC} = max)	MCM6943– 8: t_{AVAV} = 8 ns MCM6943–10: t_{AVAV} = 10 ns MCM6943–12: t_{AVAV} = 12 ns MCM6943–15: t_{AVAV} = 15 ns	I_{CC}	265 250 240 230	275 260 250 240	mA
AC Standby Current (V_{CC} = max, $\overline{E} = V_{IH}$, No other restrictions on other inputs)	MCM6943– 8: t_{AVAV} = 8 ns MCM6943–10: t_{AVAV} = 10 ns MCM6943–12: t_{AVAV} = 12 ns MCM6943–15: t_{AVAV} = 15 ns	I_{SB1}	55 50 50 45	60 55 55 50	mA
CMOS Standby Current ($\overline{E} \geq V_{CC} - 0.2$ V, $V_{in} \leq V_{SS} + 0.2$ V or $\geq V_{CC} - 0.2$ V) (V_{CC} = max, f = 0 MHz)		I_{SB2}	5	5	mA

CAPACITANCE (f = 1.0 MHz, dV = 3.0 V, $T_A = 25$°C, Periodically Sampled Rather Than 100% Tested)

Parameter	Symbol	Typ	Max	Unit
Address Input Capacitance	C_{in}	—	6	pF
Control Input Capacitance	C_{in}	—	6	pF
Input/Output Capacitance	$C_{I/O}$	—	8	pF

AC OPERATING CONDITIONS AND CHARACTERISTICS

(V$_{CC}$ = 3.3 V ± 0.3 V, T$_A$ = 0 to + 70°C, Unless Otherwise Noted)

(T$_A$ = − 40 to + 85°C for Industrial Temperature Offering)

Logic Input Timing Measurement Reference Level .... 1.50 V
Logic Input Pulse Levels .... 0 to 3.0 V
Input Rise/Fall Time .... 2 ns

Output Timing Reference Level .... 1.50 V
Output Load .... See Figure 1a

READ CYCLE TIMING (See Notes 1 and 2)

Parameter	Symbol	MCM6943–8 Min	MCM6943–8 Max	MCM6943–10 Min	MCM6943–10 Max	MCM6943–12 Min	MCM6943–12 Max	MCM6943–15 Min	MCM6943–15 Max	Unit	Notes
Read Cycle Time	t$_{AVAV}$	8	—	10	—	12	—	15	—	ns	3
Address Access Time	t$_{AVQV}$	—	8	—	10	—	12	—	15	ns	
Enable Access Time	t$_{ELQV}$	—	8	—	10	—	12	—	15	ns	4
Output Enable Access Time	t$_{GLQV}$	—	4	—	5	—	6	—	7	ns	
Output Hold from Address Change	t$_{AXQX}$	3	—	3	—	3	—	3	—	ns	
Enable Low to Output Active	t$_{ELQX}$	3	—	3	—	3	—	3	—	ns	5, 6, 7
Output Enable Low to Output Active	t$_{GLQX}$	0	—	0	—	0	—	0	—	ns	5, 6, 7
Enable High to Output High–Z	t$_{EHQZ}$	0	4	0	5	0	6	0	7	ns	5, 6, 7
Output Enable High to Output High–Z	t$_{GHQZ}$	0	4	0	5	0	6	0	7	ns	5, 6, 7
Byte Enable Access Time	t$_{BLQV}$	—	4	—	5	—	6	—	7	ns	
Byte Enable Low to Output Active	t$_{BLQX}$	0	—	0	—	0	—	0	—	ns	5, 6, 7
Byte High to Output High–Z	t$_{BHQZ}$	0	4	0	5	0	6	0	7	ns	5, 6, 7

NOTES:
1. $\overline{W}$ is high for read cycle.
2. Product sensitivities to noise require proper grounding and decoupling of power supplies as well as minimization or elimination of bus contention conditions during read and write cycles.
3. All read cycle timings are referenced from the last valid address to the first transitioning address.
4. Addresses valid prior to or coincident with $\overline{E}$ going low.
5. At any given voltage and temperature, t$_{EHQZ}$ max < t$_{ELQX}$ min, and t$_{GHQZ}$ max < t$_{GLQX}$ min, both for a given device and from device to device.
6. Transition is measured ± 200 mV from steady–state voltage with load of Figure 1b.
7. This parameter is sampled and not 100% tested.
8. Device is continuously selected ($\overline{E} \leq$ V$_{IL}$, $\overline{G} \leq$ V$_{IL}$).
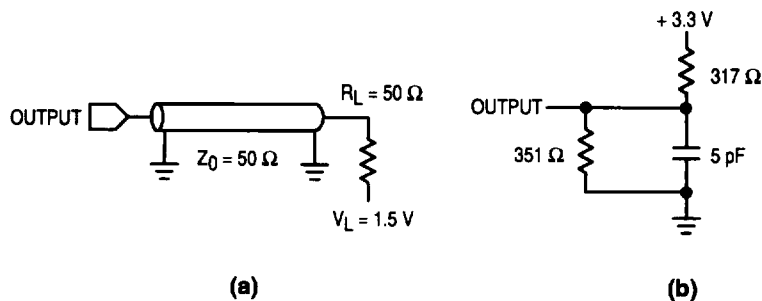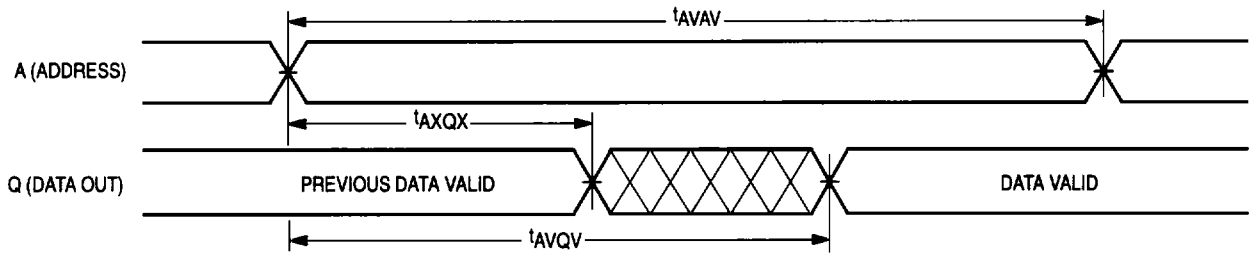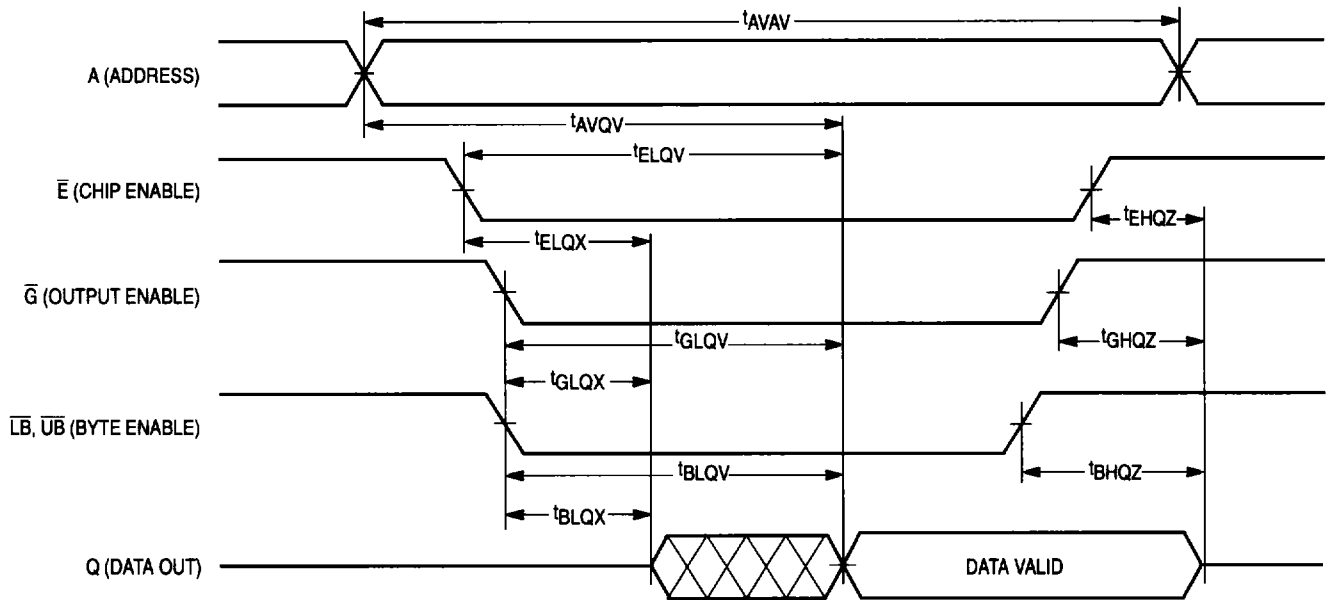
TIMING LIMITS

The table of timing values shows either a minimum or a maximum limit for each parameter. Input requirements are specified from the external system point of view. Thus, address setup time is shown as a minimum since the system must supply at least that much time. On the other hand, responses from the memory are specified from the device point of view. Thus, the access time is shown as a maximum since the device never provides data later than that time.

Figure 1. AC Test Loads

READ CYCLE 1 (See Note 8)

A (ADDRESS)

t_{AVAV}

t_{AXQX}

Q (DATA OUT)   PREVIOUS DATA VALID   DATA VALID

t_{AVQV}

READ CYCLE 2 (See Note 4)

A (ADDRESS)

t_{AVAV}

t_{AVQV}

$\overline{E}$ (CHIP ENABLE)

t_{ELQV}

t_{EHQZ}

$\overline{G}$ (OUTPUT ENABLE)

t_{ELQX}

t_{GLQV}

t_{GHQZ}

$\overline{LB}, \overline{UB}$ (BYTE ENABLE)

t_{GLQX}

t_{BLQV}

t_{BHQZ}

t_{BLQX}

Q (DATA OUT)   DATA VALID

WRITE CYCLE 1 ($\overline{W}$ Controlled; See Notes 1, 2, and 3)

Parameter	Symbol	MCM6943–8 Min	MCM6943–8 Max	MCM6943–10 Min	MCM6943–10 Max	MCM6943–12 Min	MCM6943–12 Max	MCM6943–15 Min	MCM6943–15 Max	Unit	Notes
Write Cycle Time	t_{AVAV}	8	—	10	—	12	—	15	—	ns	4
Address Setup Time	t_{AVWL}	0	—	0	—	0	—	0	—	ns	
Address Valid to End of Write	t_{AVWH}	8	—	9	—	10	—	12	—	ns	
Address Valid to End of Write, $\overline{G}$ High	t_{AVWH}	7	—	8	—	9	—	10	—	ns	
Write Pulse Width	t_{WLWH} t_{WLEH}	8	—	9	—	10	—	12	—	ns	
Write Pulse Width, $\overline{G}$ High	t_{WLWH} t_{WLEH}	7	—	8	—	9	—	10	—	ns	
Data Valid to End of Write	t_{DVWH}	4	—	5	—	6	—	7	—	ns	
Data Hold Time	t_{WHDX}	0	—	0	—	0	—	0	—	ns	
Write Low to Data High–Z	t_{WLQZ}	0	4	0	5	0	6	0	7	ns	5, 6, 7
Write High to Output Active	t_{WHQX}	3	—	3	—	3	—	3	—	ns	5, 6, 7
Write Recovery Time	t_{WHAX}	0	—	0	—	0	—	0	—	ns	

NOTES:
1. A write occurs during the overlap of $\overline{E}$ low and $\overline{W}$ low.
2. Product sensitivities to noise require proper grounding and decoupling of power supplies as well as minimization or elimination of bus contention conditions during read and write cycles.
3. If $\overline{G}$ goes low coincident with or after $\overline{W}$ goes low, the output will remain in a high–impedance state.
4. All write cycle timings are referenced from the last valid address to the first transitioning address.
5. Transition is measured ± 200 mV from steady–state voltage with load of Figure 1b.
6. This parameter is sampled and not 100% tested.
7. At any given voltage and temperature, t_{WLQZ} max < t_{WHQX} min both for a given device and from device to device.

WRITE CYCLE 1
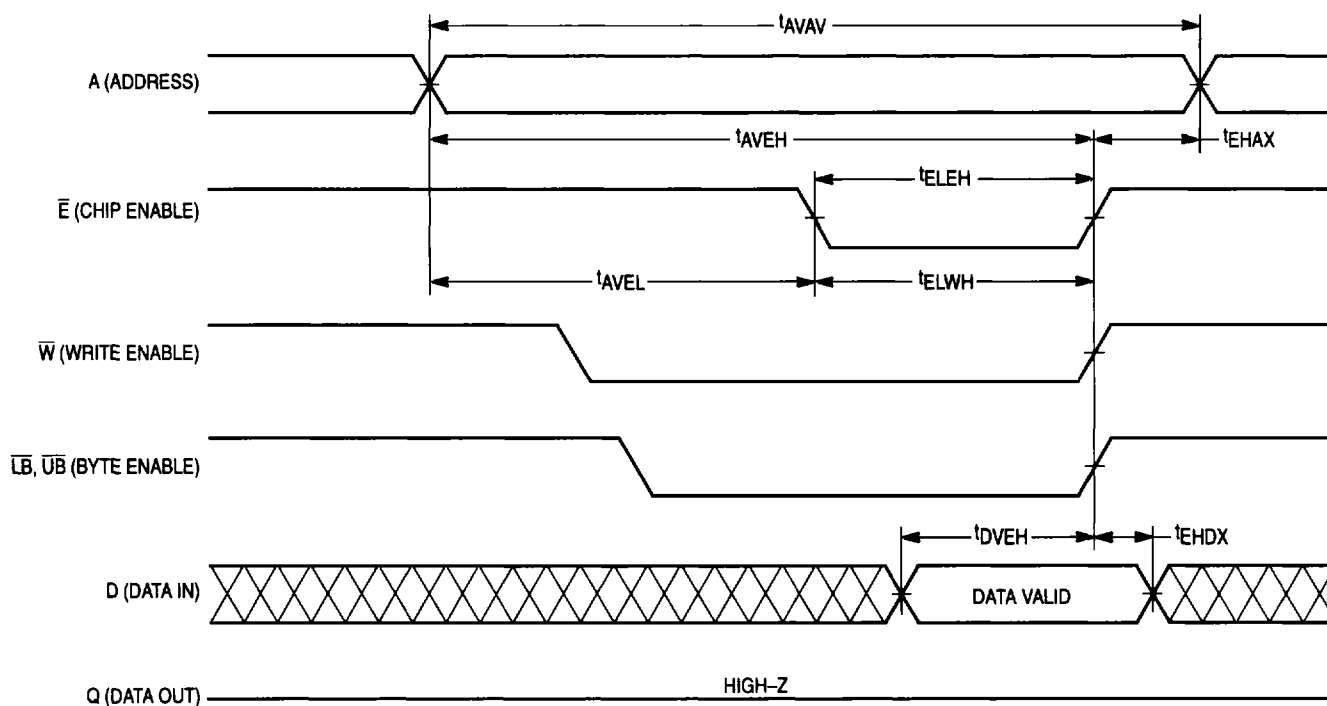
($\overline{W}$ Controlled; See Notes 1, 2, and 3)
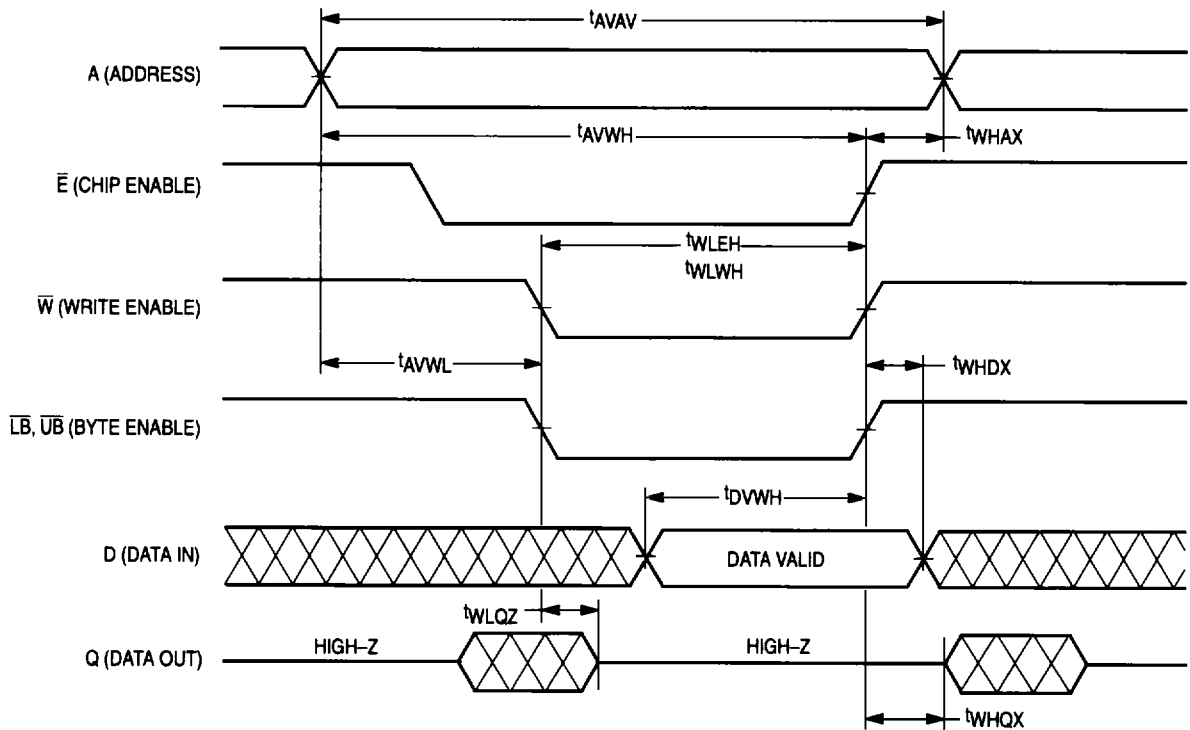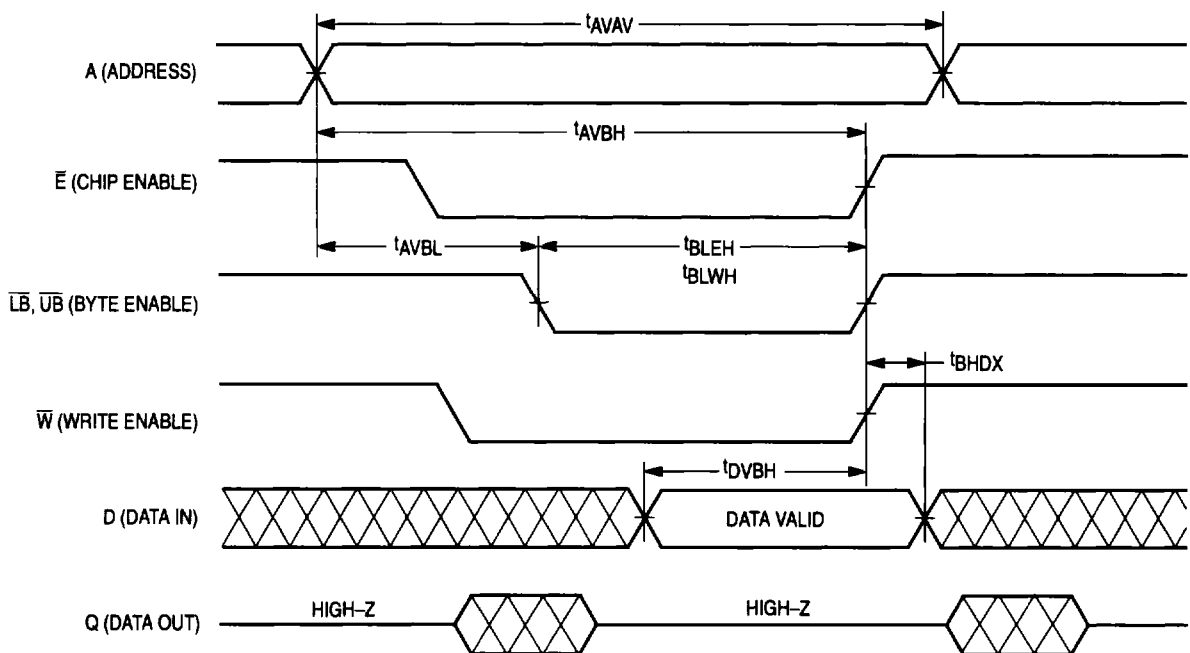
WRITE CYCLE 2 (E̅ Controlled; See Notes 1, 2, and 3)

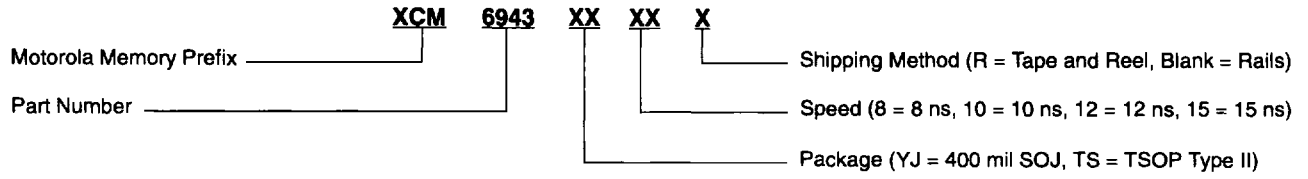| Parameter	Symbol	MCM6943–8		MCM6943–10		MCM6943–12		MCM6943–15		Unit	Notes
		Min	Max	Min	Max	Min	Max	Min	Max		
Write Cycle Time	t$_{AVAV}$	8	—	10	—	12	—	15	—	ns	4
Address Setup Time	t$_{AVEL}$	0	—	0	—	0	—	0	—	ns	
Address Valid to End of Write	t$_{AVEH}$	7	—	8	—	9	—	10	—	ns	
Enable to End of Write	t$_{ELEH}$, t$_{ELWH}$	7	—	8	—	9	—	10	—	ns	5, 6
Data Valid to End of Write	t$_{DVEH}$	4	—	5	—	6	—	7	—	ns	
Data Hold Time	t$_{EHDX}$	0	—	0	—	0	—	0	—	ns	
Write Recovery Time	t$_{EHAX}$	0	—	0	—	0	—	0	—	ns	

NOTES:
1. A write occurs during the overlap of E̅ low and W̅ low.
2. Product sensitivities to noise require proper grounding and decoupling of power supplies as well as minimization or elimination of bus contention conditions during read and write cycles.
3. If G̅ goes low coincident with or after W̅ goes low, the output will remain in a high–impedance state.
4. All write cycle timing is referenced from the last valid address to the first transitioning address.
5. If E̅ goes low coincident with or after W̅ goes low, the output will remain in a high impedance condition.
6. If E̅ goes high coincident with or before W̅ goes high, the output will remain in a high impedance condition.

WRITE CYCLE 2

(E̅ Controlled; See Notes 1, 2, and 3)

WRITE CYCLE 3 ($\overline{E}$ Controlled; See Notes 1, 2, and 3)

Parameter	Symbol	MCM6943-8 Min	MCM6943-8 Max	MCM6943-10 Min	MCM6943-10 Max	MCM6943-12 Min	MCM6943-12 Max	MCM6943-15 Min	MCM6943-15 Max	Unit	Notes
Write Cycle Time	t_{AVAV}	8	—	10	—	12	—	15	—	ns	4
Address Setup Time	t_{AVBL}	0	—	0	—	0	—	0	—	ns	
Address Valid to End of Write	t_{AVBH}	8	—	9	—	10	—	12	—	ns	
Address Valid to End of Write, $\overline{G}$ High	t_{AVBH}	7	—	8	—	9	—	10	—	ns	
Byte Pulse Width	t_{BLWH} t_{BLEH}	8	—	9	—	10	—	12	—	ns	
Byte Pulse Width, $\overline{G}$ High	t_{BLWH} t_{BLEH}	7	—	8	—	9	—	10	—	ns	
Data Valid to End of Write	t_{DVBH}	4	—	5	—	6	—	7	—	ns	
Data Hold Time	t_{BHDX}	0	—	0	—	0	—	0	—	ns	

NOTES:
1. A write occurs during the overlap of $\overline{E}$ low and $\overline{W}$ low.
2. Product sensitivities to noise require proper grounding and decoupling of power supplies as well as minimization or elimination of bus contention conditions during read and write cycles.
3. If $\overline{G}$ goes low coincident with or after $\overline{W}$ goes low, the output will remain in a high–impedance state.
4. All write cycle timings are referenced from the last valid address to the first transitioning address.

WRITE CYCLE 3
($\overline{E}$ Controlled; See Notes 1, 2, and 3)

## ORDERING INFORMATION
(Order by Full Part Number)

<u>XCM</u>   <u>6943</u>   <u>XX</u>   <u>XX</u>   <u>X</u>

Motorola Memory Prefix ————————┘   ————— Shipping Method (R = Tape and Reel, Blank = Rails)

Part Number ————————————┘   ————— Speed (8 = 8 ns, 10 = 10 ns, 12 = 12 ns, 15 = 15 ns)

                                                      ————— Package (YJ = 400 mil SOJ, TS = TSOP Type II)

Full Commercial Part Numbers —	MCM6943YJ8	MCM6943YJ8R	MCM6943TS8
	MCM6943YJ10	MCM6943YJ10R	MCM6943TS10
	MCM6943YJ12	MCM6943YJ12R	MCM6943TS12
	MCM6943YJ15	MCM6943YJ15R	MCM6943TS15
Full Industrial Part Numbers —	SCM6943YJ8A	SCM6943YJ8AR	SCM6943TS8A*
	SCM6943YJ10A	SCM6943YJ10AR	SCM6943TS10A*
	SCM6943YJ12A	SCM6943YJ12AR	SCM6943TS12A*
	SCM6943YJ15A	SCM6943YJ15AR	SCM6943TS15A*

* Not available in Tape and Reel.

MOTOROLA FAST SRAM

PACKAGE DIMENSIONS

YJ PACKAGE
44–LEAD
400 MIL SOJ
CASE 919–01
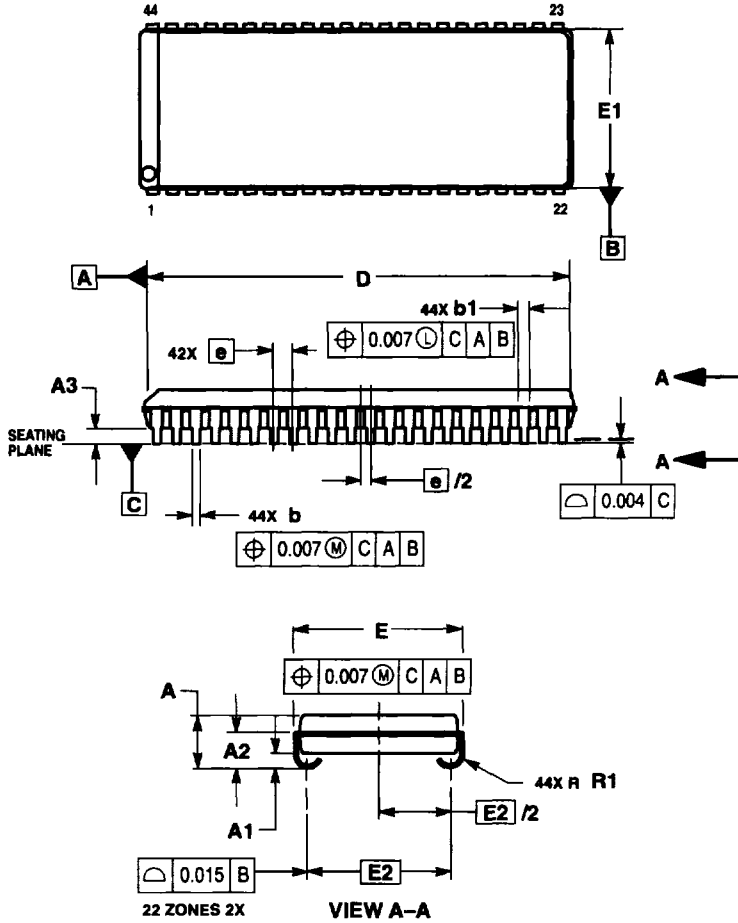
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION D DOES NOT INCLUDE MOLD FLASH, TIE BAR BURRS AND GATE BURRS. MOLD FLASH, TIE BAR BURRS AND GATE BURRS SHALL NOT EXCEED 0.006 PER END. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010 PER SIDE.
4. THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM. DIMENSIONS D AND E1 AND, HENCE, DATUMS A AND B, ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
5. DIMENSION b1 DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE SHOULDER WIDTH TO EXCEED b1 MAX BY MORE THAN 0.005. THE DAMBAR INTRUSION(S) SHALL NOT REDUCE THE SHOULDER WIDTH TO LESS THAN 0.001 BELOW b1 MIN.

DIM	INCHES MIN	INCHES MAX
A	0.128	0.148
A1	0.025	—
A2	0.082	—
A3	0.035	0.045
b	0.015	0.020
b1	0.026	0.032
D	1.120	1.130
E	0.435	0.445
E1	0.395	0.405
E2	0.370 BSC	
e	0.050 BSC	
R1	0.030	0.040

VIEW A–A

TS PACKAGE
44–LEAD
TSOP TYPE II
CASE 924A–01

VIEW A

DETAIL A
ROTATED 90° CLOCKWISE

| ⊕ | 0.008 (0.2) Ⓜ | C | A |

BASE METAL

| ⊕ | 0.008 (0.2) Ⓜ | T | Z |

SECTION A–A
40 PLACES

SEATING PLANE
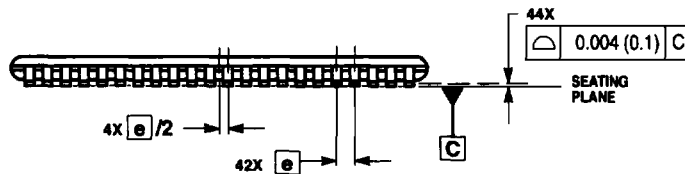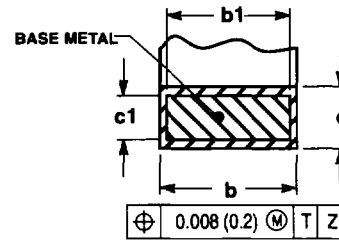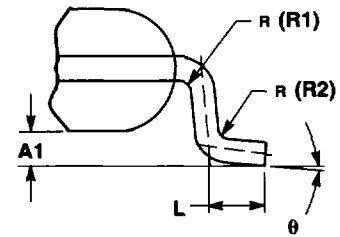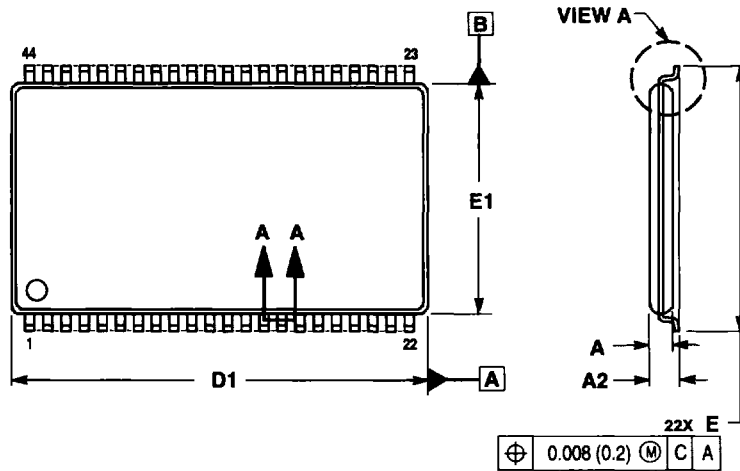
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION IS 0.006 (0.015) PER SIDE.
4. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSIONS. DAMBAR PROTRUSIONS SHALL NOT ALLOW THE b DIMENSION TO EXCEED 0.023 (0.58).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	—	0.050	—	1.270
A1	0.002	0.006	0.051	0.152
A2	0.038	0.042	0.965	1.067
b	0.012	0.018	0.305	0.457
b1	0.012	0.016	0.305	0.406
c	0.005	0.008	0.127	0.203
c1	0.004	0.006	0.101	0.152
D1	0.721	0.729	18.313	18.517
e	0.0315 BSC		0.800 BSC	
E	0.456	0.470	11.582	11.938
E1	0.396	0.404	10.058	10.262
L	0.016	0.023	0.406	0.584
R1	0.004 REF		0.100 REF	
R2	0.004 REF		0.100 REF	
θ	0°	5°	0°	5°

MOTOROLA