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DS3580-3.2

MA5104

RADIATION HARD 4096 x 1 BIT STATIC RAM

The MA5104 4k Static RAM is configured as 4096 x 1 bits and manufactured using CMOS-SOS high performance, radiation hard, $3\mu m$ technology.

The device has separate input and output terminals controlled by Chip Select and Write Enable. The design uses a 6 transistor cell and has full static operation with no clock or timing strobe required. Address input buffers are deselected when Chip Select is in the HIGH state.

Operation Mode	<u>cs</u>	S WE I/O		Power
Read	L	Н	D OUT	ISB1
Write	L	L	D IN	
Standby	Н	Х	High Z	ISB2

Figure 1: Truth Table

FEATURES

- 3µm CMOS-SOS Technology
- Latch-up Free
- Fast Access Time 90ns Typical
- Total Dose 10⁶ Rad(Si)
- Transient Upset >1010 Rad(Si)/sec
- SEU <10⁻¹⁰ Errors/bitday
- Single 5V Supply
- Three State Output
- Low Standby Current 10µA Typical
- -55°C to +125°C Operation
- All Inputs and Outputs Fully TTL or CMOS Compatible
- Fully Static Operation

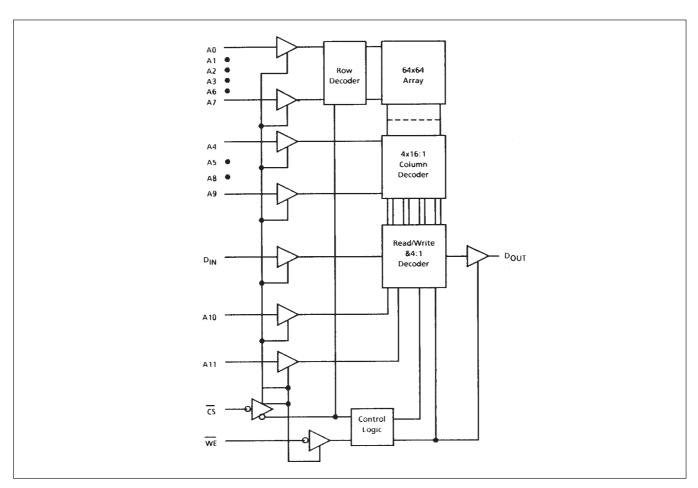


Figure 2: Block Diagram

CHARACTERISTICS AND RATINGS

Symbol	Parameter	Min.	Max.	Units
V _{CC}	Supply Voltage	-0.5	7	V
VI	Input Voltage	-0.3	V _{DD} +0.3	V
T _A	Operating Temperature	-55	125	°C
Ts	Storage Temperature	-65	150	°C

Stresses above those listed may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions, or at any other condition above those indicated in the operations section of this specification, is not Implied Exposure to absolute maxlmum rating conditions for extended perlods may affect device reliability.

Figure 3: Absolute Maximum Ratings

Notes for Tables 4 and 5:

- 1. Characteristics apply to pre radiation at T_A = -55°C to +125°C with V_{DD} = 5V $\pm 10\%$ and to post 100k Rad(Si) total dose radiation at $T_A = 25^{\circ}\text{C}$ with $V_{DD} = 5\text{V} \pm 10\%$ (characteristics at higher radiation levels available on request). 2. Worst case at $T_A = +125^{\circ}\text{C}$, guaranteed but not tested at $T_A = -55^{\circ}\text{C}$.
- GROUP A SUBGROUPS 1, 2, 3.

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Units
V _{DD}	Supply voltage	-	4.5	5.0	5.5	V
V _{IH}	Input High Voltage	-	V _{DD} /2	-	V _{DD}	V
V _{IL}	Input Low Voltage	-	V _{SS}	-	0.8	V
V _{OH}	Output High Voltage	I _{OH1} = -1mA	2.4	-	-	V
V _{OL}	Output Low Voltage	I _{OL} = 2mA	-	-	0.4	V
ILI	Input Leakage Current (note 2)	All inputs except <u>CS</u>	-	-	±10	μΑ
I _{LO}	Output Leakage Current (note 2)	Output disabled, $V_{OUT} = V_{SS}$ or V_{DD}	-	-	±20	μΑ
I _{PUI}	Input Pull-Up Current	$V_{IN} = V_{SS}$ on <u>CS</u> input only	-	-	-100	μΑ
I _{PDI}	Input Leakage Current	$V_{IN} = V_{SS}$ on <u>CS</u> input only	-	-	5	μΑ
I _{DD}	Power Supply Current	f _{RC} = 1MHz, <u>CS</u> = 50% mark:space	-	12	16	mA
I _{SB1}	Selected Supply Current	<u>CS</u> = V _{SS}	-	25	35	mA
I _{SB2}	Standby Supply Current	Chip disabled	-	50	3000	μΑ

Figure 4: Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Units
V_{DR}	V _{CC} for Data Retention	$\underline{CS} = V_{DR}$	2.0	-	-	V
I _{DDR}	Data Retention Current	$\underline{CS} = V_{DR}, V_{DR} = 2.0V$	-	30	2000	μΑ

Figure 5: Data Retention Characteristics

AC CHARACTERISTICS

Conditions of Test for Tables 5 and 6:

- 1. Input pulse = V_{ss} to 3.0V. 2. Times measurement reference level = 1.5V.
- 3. Transition is measured at $\pm 500 \text{mV}$ from steady state.
- 4. This parameter is sampled and not 100% tested.

Notes for Tables 6 and 7:

Characteristics apply to pre-radiation at T_A = -55°C to +125°C with V_{DD} = 5V±10% and to post 100k Rad(Si) total dose radiation at T_A = 25°C with V_{DD} = 5V ±10%. GROUP A SUBGROUPS 9, 10, 11.

Symbol	Parameter		Max	Units
T _{AVAVR}	Read Cycle Time	135	-	ns
T _{AVQV}	Address Access Time		135	ns
T _{ELQV}	Chip Select to Output Valid		135	ns
T _{ELQX} (4)	Chip Select to Output Active		-	ns
T _{ELQZ} (4)	Chip Select to Output Tri State		50	ns
T _{AXQX}	Output Hold from Address Change	10	-	ns

Figure 6: Read Cycle AC Electrical Characteristics

Symbol	Parameter		Max	Units
T _{AVAVW}	Write Cycle Time	135	-	ns
T _{AVWL}	Address Set Up Time	10	-	ns
T _{wtwh}	Write Pulse Width	50	-	ns
T _{whav}	Write Recovery Time	5	-	ns
T _{DVWH}	Data Set Up Time		-	ns
T _{NHDX}	Data Hold Time		-	ns
T _{WLQZ} (4)	Write Enable to Output Tri State	10	50	ns
T _{ELWL}	Chip Selection to Write Low	25	-	ns
T _{ELWH}	Chip Selection to End of Write		-	ns
T _{AVWH}	Address Valid to End of Write		-	ns
T _{WHQX} (4)	Output Active from End to Write	5	-	ns

Figure 7: Write Cycle AC Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Units
C _{IN}	Input Capacitance	V ₁ = 0V	-	6	10	pF
C _{OUT}	Output Capacitance	V ₀ = 0V	-	8	12	pF

Note: $T_A = 25$ °C and f = 1MHz. Data obtained by characterisation or analysis; not routinely measured.

Figure 8: Capacitance

arameter	Conditions
asic Functionality	$V_{DD} = 4.5V - 5.5V$, FREQ = 1MHz
	$V_{_{ L}} = V_{_{SS}}, \ V_{_{ H}} = V_{_{DD}}, \ V_{_{OL}} \le 1.5 V, \ V_{_{OH}} \ge 1.5 V$
	TEMP = -55°C to +125°C, GPS PATTERN SET
	GROUP A SUBGROUPS 7, 8A, 8B
_	

Figure 9: Functionality

Subgroup	Definition				
1	Static characteristics specified in Tables 4 and 5 at +25°C				
2	Static characteristics specified in Tables 4 and 5 at +125°C				
3	Static characteristics specified in Tables 4 and 5 at -55°C				
7	Functional characteristics specified in Table 9 at +25°C				
8A	Functional characteristics specified in Table 9 at +125°C				
8B	Functional characteristics specified in Table 9 at -55°C				
9	Switching characteristics specified in Tables 6 and 7 at +25°C				
10	switching characteristics specified in Tables 6 and 7 at +125°C				
11	Switching characteristics specified in Tables 6 and 7 at -55°C				

Figure 10: Definition of Subgroups

TIMING DIAGRAMS

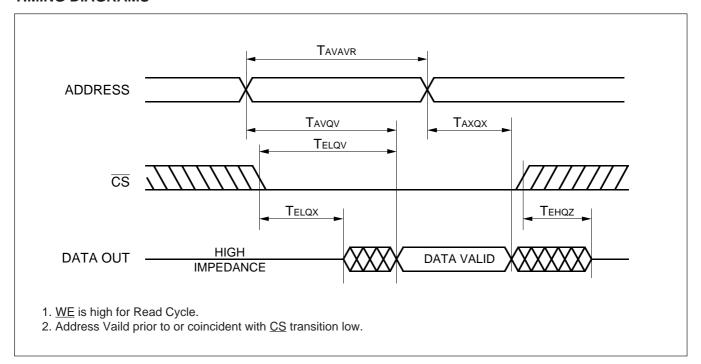


Figure 11a: Read Cycle 1

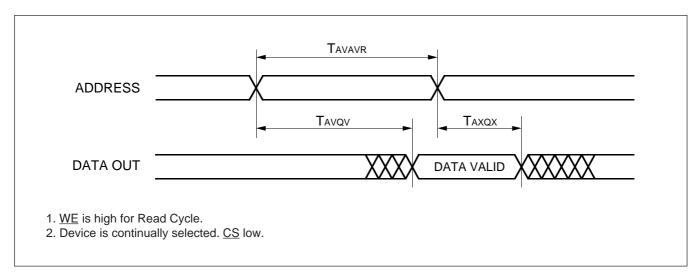
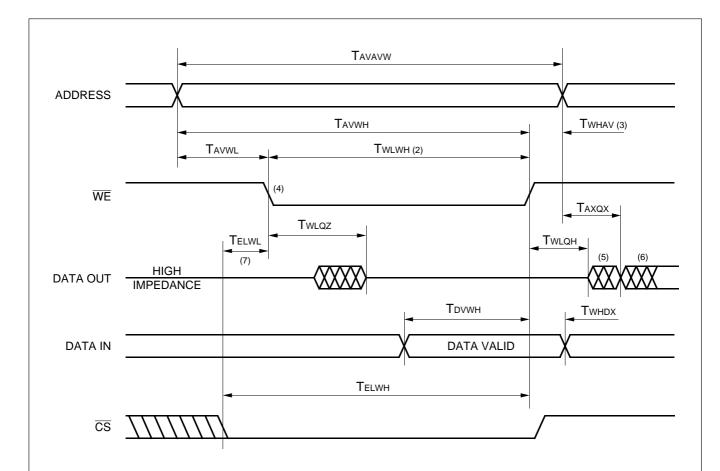


Figure 11b: Read Cycle 2



- 1. WE must be high during all address transitions.
- 2. A write occurs during the overlap (T $_{WLWH}$) of a low \underline{CS} , a high CE and a low \underline{WE} .
- 3. T_{WHAV} is measured from either \underline{CS} or \underline{WE} going high or CE going low, whichever is the earlier, to the end of the write cycle.
- 4. If the \underline{CS} low transition occurs simultaneously with, or after, the \underline{WE} low transition, the output remains in the high impedance state.
- 5. DATA OUT is the write data of the current cycle, if selected.
- 6. DATA OUT is the read data of the next address, if selected.
- 7. T_{ELWL} must be met to prevent memory corruption.

Figure 12: Write Cycle

OUTLINES AND PIN ASSIGNMENTS

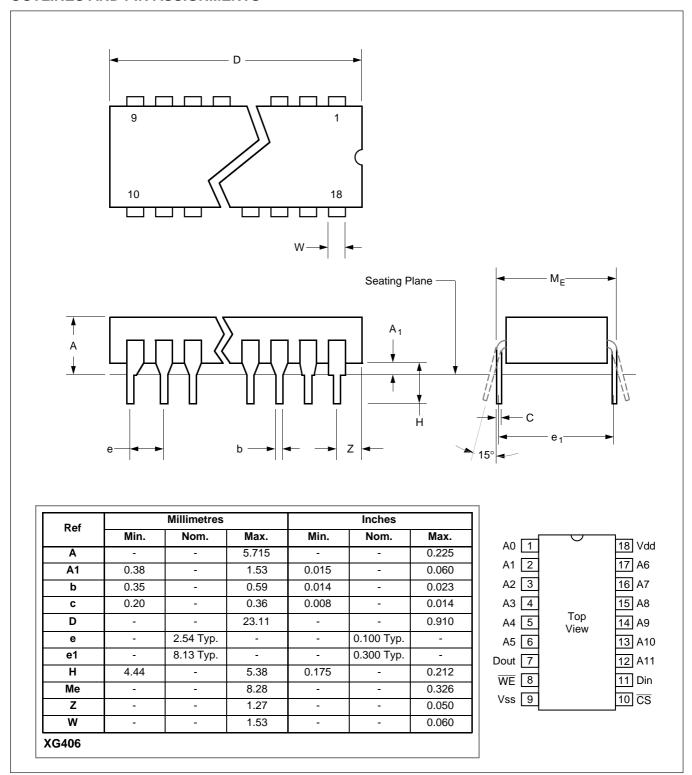


Figure 13: 18-Lead Ceramic DIL (Solder Seal) - Package Style C

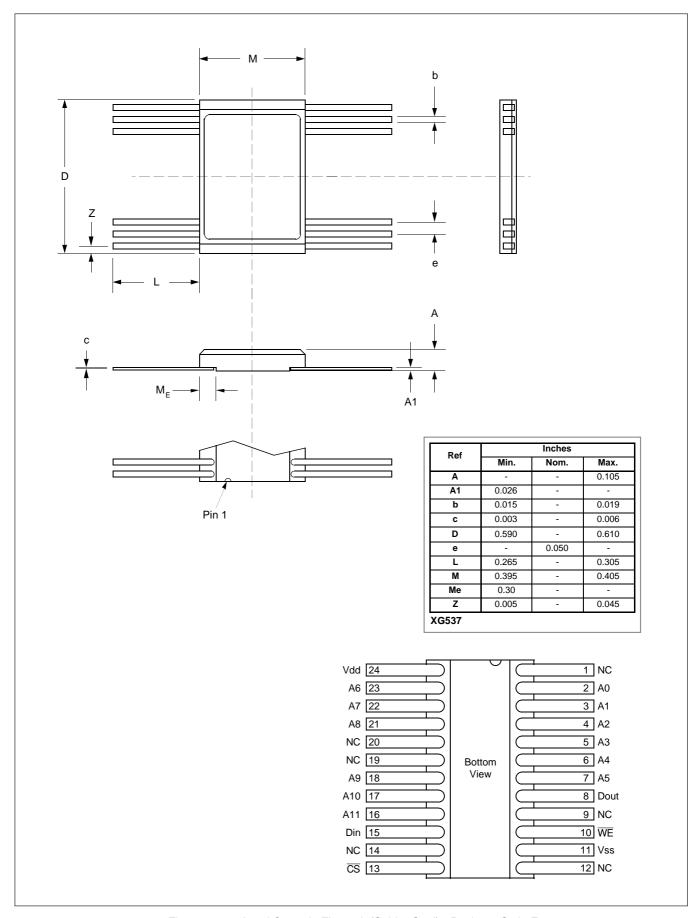


Figure 14: 24-Lead Ceramic Flatpack (Solder Seal) - Package Style F

	Packag	e Option		Burnin			
Function	F	С	Via	Static 1	Static 2	Dynamic	Radiation
A0	2	1	R	0V	5V	F0	5V
A1	3	2	R	0V	5V	F1	5V
A2	4	3	R	٥V	5V	F2	5V
A3	5	4	R	0V	5V	F3	5V
A4	6	5	R	0V	5V	F4	5V
A5	7	6	R	0V	5V	F5	5V
DOUT	8	7	R	0V	5V	LOAD	5V
WEB	10	8	R	0V	5V	F12	5V
VSS	11	9	Direct	0V	0V	0V	0V
CSB	13	10	R	0V	5V	0V	5V
DIN	15	11	R	0V	5V	F13	5V
A11	16	12	R	0V	5V	F11	5V
A10	17	13	R	0V	5V	F10	5V
A9	18	14	R	0V	5V	F9	5V
A8	21	15	R	0V	5V	F8	5V
A7	22	16	R	0V	5V	F7	5V
A6	23	17	R	0V	5V	F6	5V
VDD	24	18	Direct	5V	5V	5V	5V

^{1.} F0=150KHz, F1=F0/2, F2=F0/4, F3=F0/8 etc.

Figure 15: Burnin and Radiation Configuration

^{2.} Burnin R=1k

^{3.} Radiation R=10k

RADIATION TOLERANCE

Total Dose Radiation Testing

For product procured to guaranteed total dose radiation levels, each wafer lot will be approved when all sample devices from each lot pass the total dose radiation test.

The sample devices will be subjected to the total dose radiation level (Cobalt-60 Source), defined by the ordering code, and must continue to meet the electrical parameters specified in the data sheet. Electrical tests, pre and post irradiation, will be read and recorded.

GEC Plessey Semiconductors can provide radiation testing compliant with MIL-STD-883 test method 1019, Ionizing Radiation (Total Dose).

Total Dose (Function to specification)*	1x10 ⁵ Rad(Si)
Transient Upset (Stored data loss)	5x10 ¹⁰ Rad(Si)/sec
Transient Upset (Survivability)	>1x10 ¹² Rad(Si)/sec
Neutron Hardness (Function to specification)	>1x10 ¹⁵ n/cm ²
Single Event Upset**	3.4x10 ⁻⁹ Errors/bit day
Latch Up	Not possible

^{*} Other total dose radiation levels available on request

Figure 16: Radiation Hardness Parameters

SINGLE EVENT UPSET CHARACTERISTICS

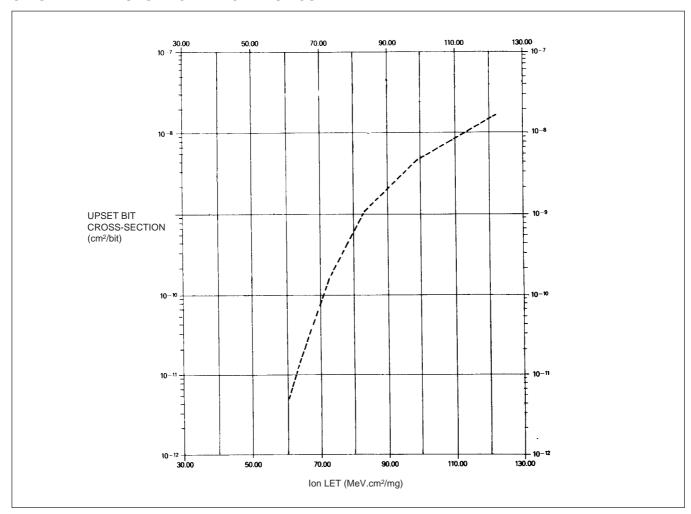
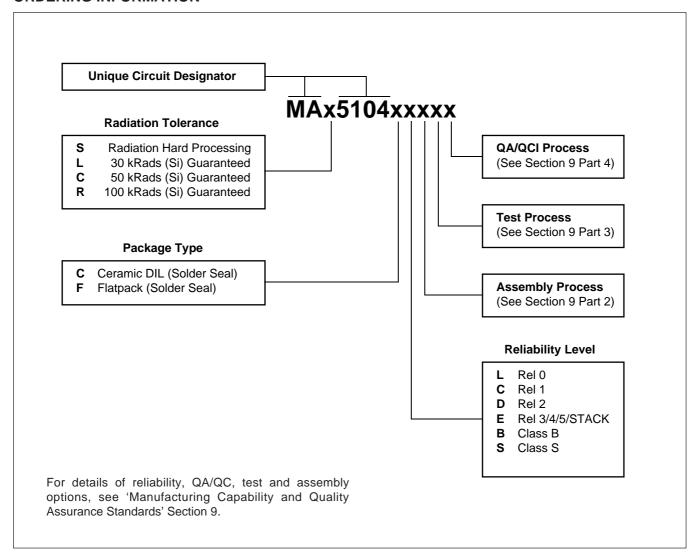


Figure 17: Typical Per-Bit Upset Cross-Section vs Ion LET

^{**} Worst case galactic cosmic ray upset - interplanetary/high altitude orbit

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