

# MA6116 & MA6216

## RADIATION HARD 2048 x 8 BIT STATIC RAM

The MA6116 16K Static RAM is configured as 2048 x 8 bits and manufactured using CMOS-SOS high performance, radiation hard, 3µm technology. The MA6216 is manufactured using 2.5µm technology resulting in faster performance.

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.

### FEATURES

- 3µm CMOS-SOS Technology
- Latch-up Free
- Fast Access Time 110ns (MA6116) and 85ns (MA6216) Typical
- Total Dose 10<sup>6</sup> Rad(Si)
- Transient Upset >10<sup>10</sup> Rad(Si)/sec
- SEU <10<sup>-10</sup> Errors/bitday
- Single 5V Supply
- Three State Output
- Low Standby Current 100µA Typical
- -55°C to +125°C Operation
- TTL and CMOS Compatible Inputs
- Fully Static Operation

Operation Mode	$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	I/O	Power
Read	L	L	H	D OUT	ISB1
Write	L	H	L	D IN	
Write	L	L	L	D IN	
Standby	H	X	X	High Z	ISB2

Figure 1: Truth Table

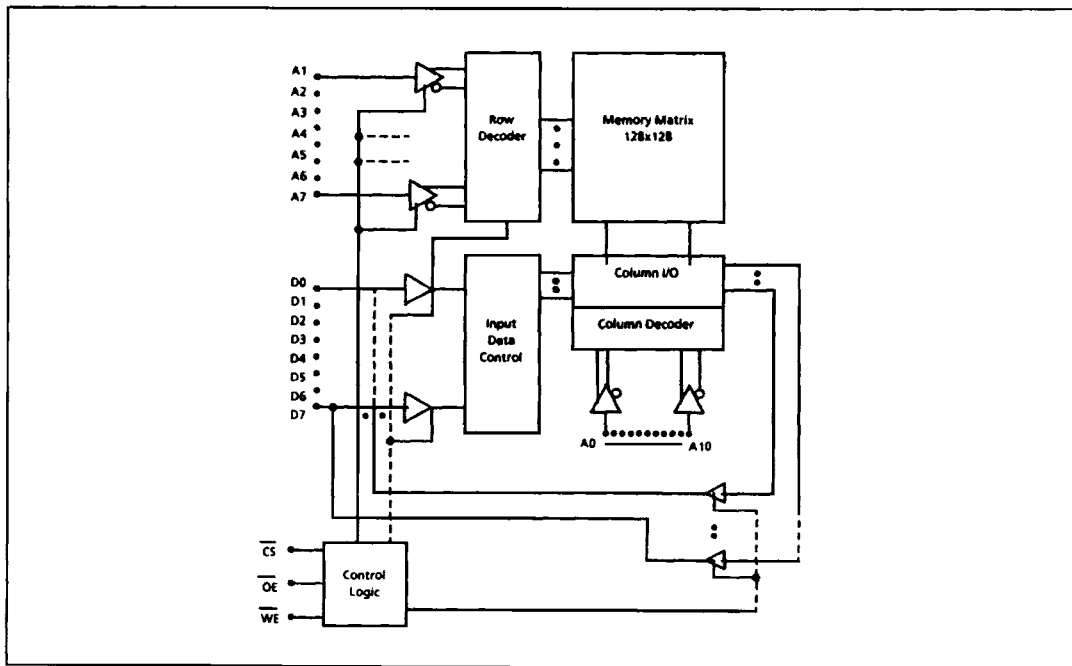


Figure 2: Block Diagram

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### CHARACTERISTICS AND RATINGS

Symbol	Parameter	Min.	Max.	Units
$V_{DD}$	Supply Voltage	-0.5	7	V
$V_I$	Input Voltage	-0.3	$V_{DD}+0.3$	V
$T_A$	Operating Temperature	-55	125	°C
$T_S$	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 maximum rating conditions for extended periods may affect device reliability.

Figure 3: Absolute Maximum Ratings

Notes for Tables 4 and 5:

1. Characteristics apply to pre radiation at  $T_A = -55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  with  $V_{DD} = 5\text{V} \pm 10\%$  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  $T_A = -55^{\circ}\text{C}$ .
3. GROUP A SUBGROUPS 1, 2, 3.

Symbol	Parameter	Conditions	Min.	Typ.	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	$I_{OH1} = -1\text{mA}$	2.4	-	-	V
$V_{OL}$	Output Low Voltage	$I_{OL} = 4\text{mA}$	-	-	0.4	V
$I_{LI}$	Input Leakage Current (note 2)	All inputs except $\overline{CS}$	-	-	$\pm 10$	$\mu\text{A}$
$I_{LO}$	Output Leakage Current (note 2)	Output disabled, $V_{OUT} = V_{SS}$ or $V_{DD}$	-	-	$\pm 20$	$\mu\text{A}$
$I_{DD}$	Power Supply Current	$f_{RC} = 1\text{MHz}$ , $\overline{CS} = 50\%$ mark:space	-	20	40	mA
$I_{SB1}$	Selected Supply Current	All inputs = $V_{DD}-0.2\text{V}$ except $\overline{CS} = V_{SS}+0.2\text{V}$	-	50	70	mA
$I_{SB2}$	Standby Supply Current	Chip disabled, $\overline{CS} = V_{DD}-0.2\text{V}$	-	0.1	5	mA

Figure 4: Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$V_{DR}$	$V_{CC}$ for Data Retention	$\overline{CS} = V_{DR}$	2.0	-	-	V
$I_{DDR}$	Data Retention Current	$\overline{CS} = V_{DR}$ , $V_{DR} = 2.0\text{V}$	-	50	3000	$\mu\text{A}$

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. Output load 1TTL gate and  $C_L = 60pF$ .
4. Transition is measured at  $\pm 500mV$  from steady state.
5. This parameter is sampled and not 100% tested.

Notes for Tables 6 and 7:

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

Symbol	Parameter	MA6116		MA6216		Units
		Min	Max	Min	Max	
$T_{AVAVR}$	Read Cycle Time	150	-	100	-	ns
$T_{AVOV}$	Address Access Time	-	130	-	95	ns
$T_{ELOV}$	Chip Select Access Time	-	140	-	100	ns
$T_{ELOX}(4,5)$	Chip Select to Output in Low Z	10	-	10	-	ns
$T_{GLOV}$	Output Enable to Output Valid	-	80	-	60	ns
$T_{GLOX}(4,5)$	Output Enable to Output in Low Z	10	-	10	-	ns
$T_{EHOZ}(4,5)$	Chip Deselect to Output in High Z	0	60	0	50	ns
$T_{GHOZ}(4,5)$	Chip Disable to Output in High Z	0	60	0	50	ns
$T_{AXOQ}$	Output Hold from Address Change	10	-	10	-	ns

Figure 6: Read Cycle AC Electrical Characteristics

Symbol	Parameter	MA6116		MA6216		Units
		Min	Max	Min	Max	
$T_{AVAVW}$	Write Cycle Time	150	-	100	-	ns
$T_{ELWH}$	Chip Selection to End of Write	85	-	75	-	ns
$T_{AVWH}$	Address Valid to End of Write	80	-	70	-	ns
$T_{AVWL}$	Address Set Up Time	20	-	10	-	ns
$T_{WLWH}$	Write Pulse Width	50	-	40	-	ns
$T_{WHAV}$	Write Recovery Time	5	-	5	-	ns
$T_{WLOZ}(4,5)$	Write to Output in High Z	0	60	0	50	ns
$T_{DVWH}$	Data to Write Time Overlap	30	-	25	-	ns
$T_{WHDX}$	Data Hold from Write Time	10	-	10	-	ns
$T_{WHOX}(4,5)$	Output Active from End to Write	5	-	5	-	ns
$T_{ELWL}$	Chip Selection to Write Low	25	-	25	-	ns

Figure 7: Write Cycle AC Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$C_{IN}$	Input Capacitance	$V_i = 0V$	-	6	10	pF
$C_{OUT}$	Output Capacitance	$V_o = 0V$	-	5	7	pF

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

Figure 8: Capacitance

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Symbol	Parameter	Conditions
$F_T$	Basic Functionality	$V_{DD} = 4.5V - 5.5V$ , FREQ = 1MHz $V_{IL} = V_{SS}$ , $V_{IH} = V_{DD}$ , $V_{OL} \leq 1.5V$ , $V_{OH} \geq 1.5V$ 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

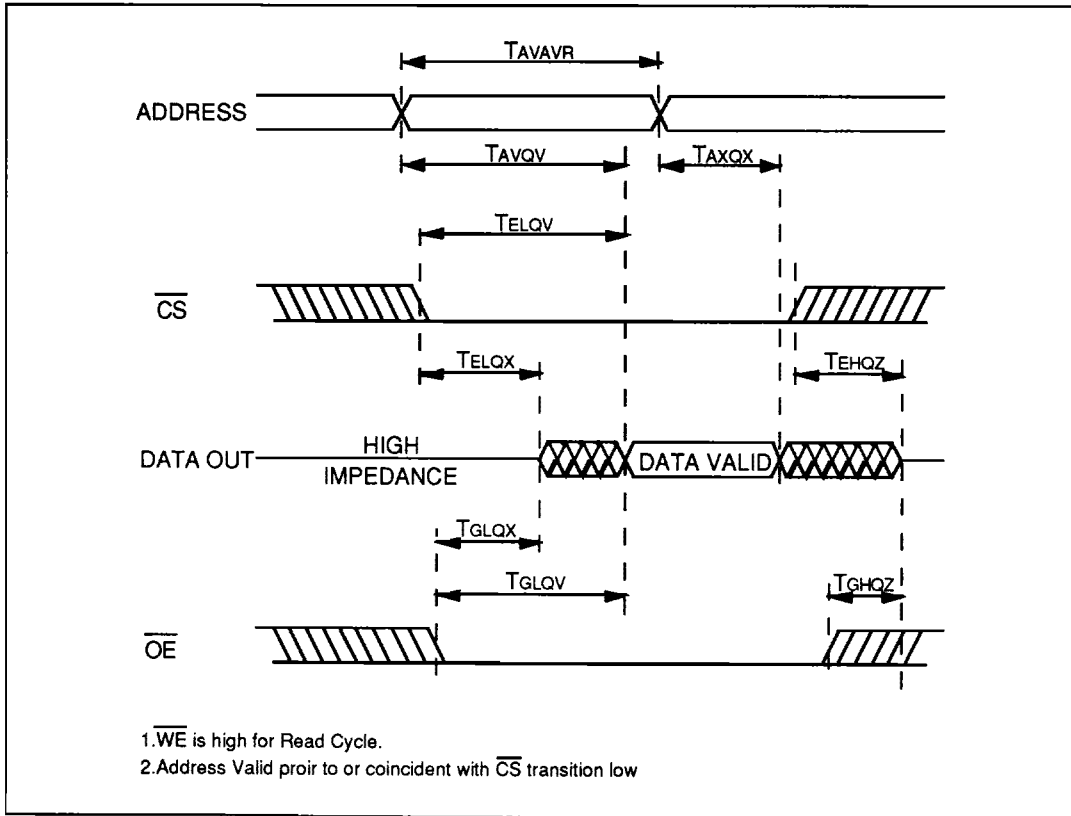


Figure 11a: Read Cycle 1

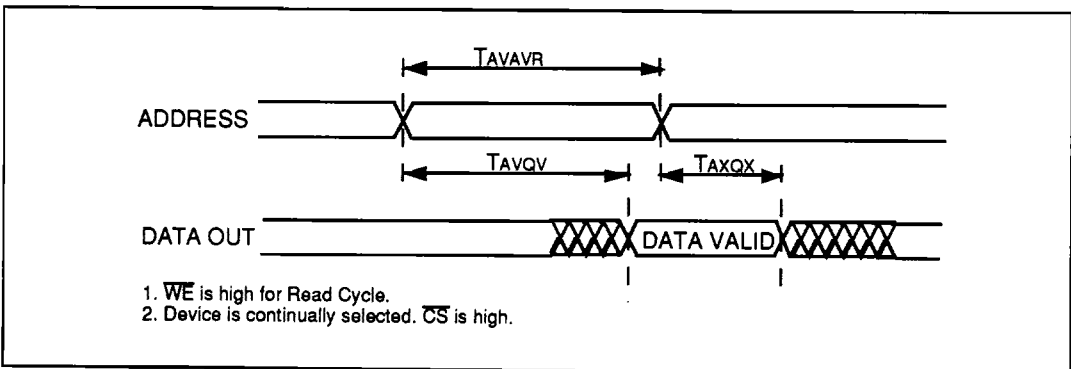
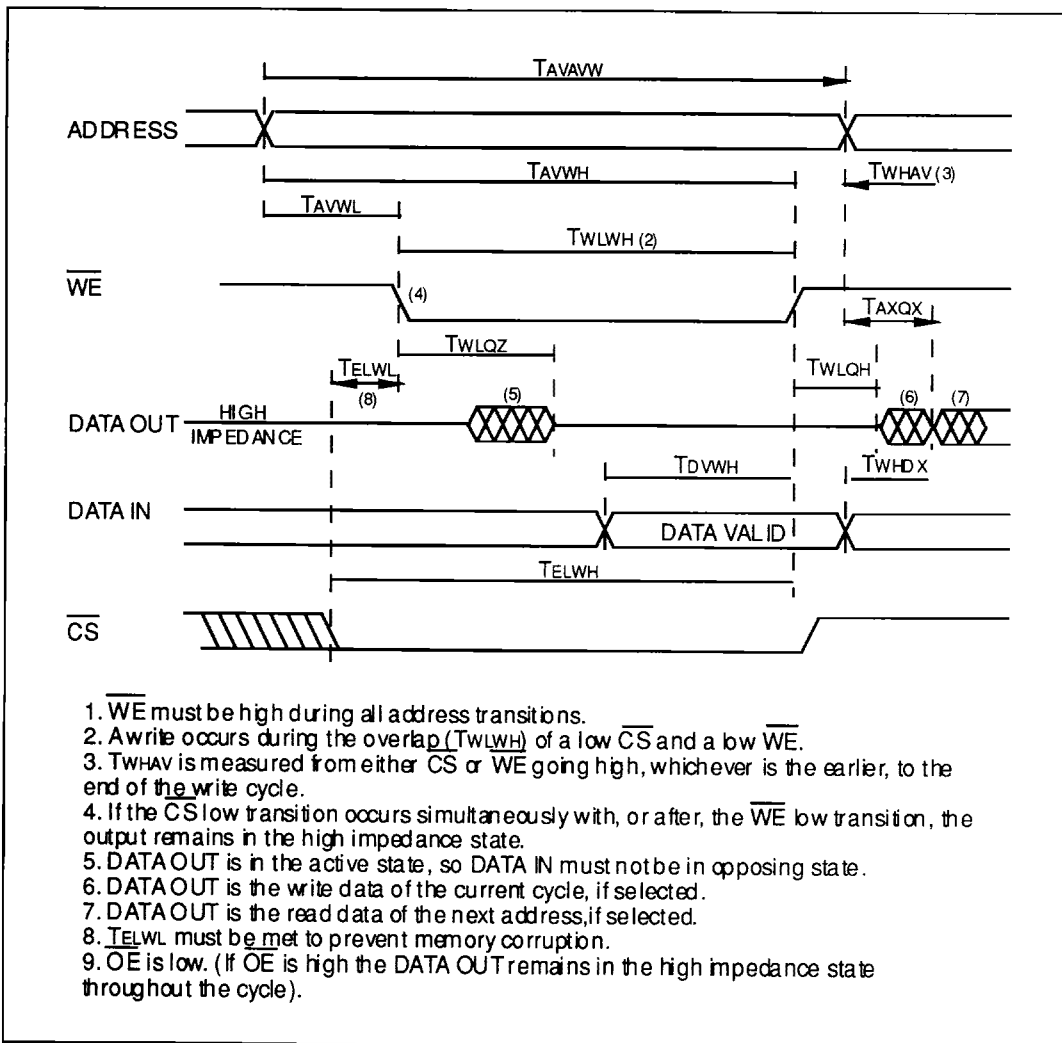


Figure 11b: Read Cycle 2



1.  $\overline{WE}$  must be high during all address transitions.
2. A write occurs during the overlap ( $T_{WLWH}$ ) of a low  $\overline{CS}$  and a low  $\overline{WE}$ .
3.  $T_{WHAV}$  is measured from either  $\overline{CS}$  or  $\overline{WE}$  going high, whichever is the earlier, to the end of the write cycle.
4. If the  $\overline{CS}$  low transition occurs simultaneously with, or after, the  $\overline{WE}$  low transition, the output remains in the high impedance state.
5. DATA OUT is in the active state, so DATA IN must not be in opposing state.
6. DATA OUT is the write data of the current cycle, if selected.
7. DATA OUT is the read data of the next address, if selected.
8.  $T_{ELWL}$  must be met to prevent memory corruption.
9. OE is low. (If OE is high the DATA OUT remains in the high impedance state throughout the cycle).

Figure 12: Write Cycle

OUTLINES AND PIN ASSIGNMENTS

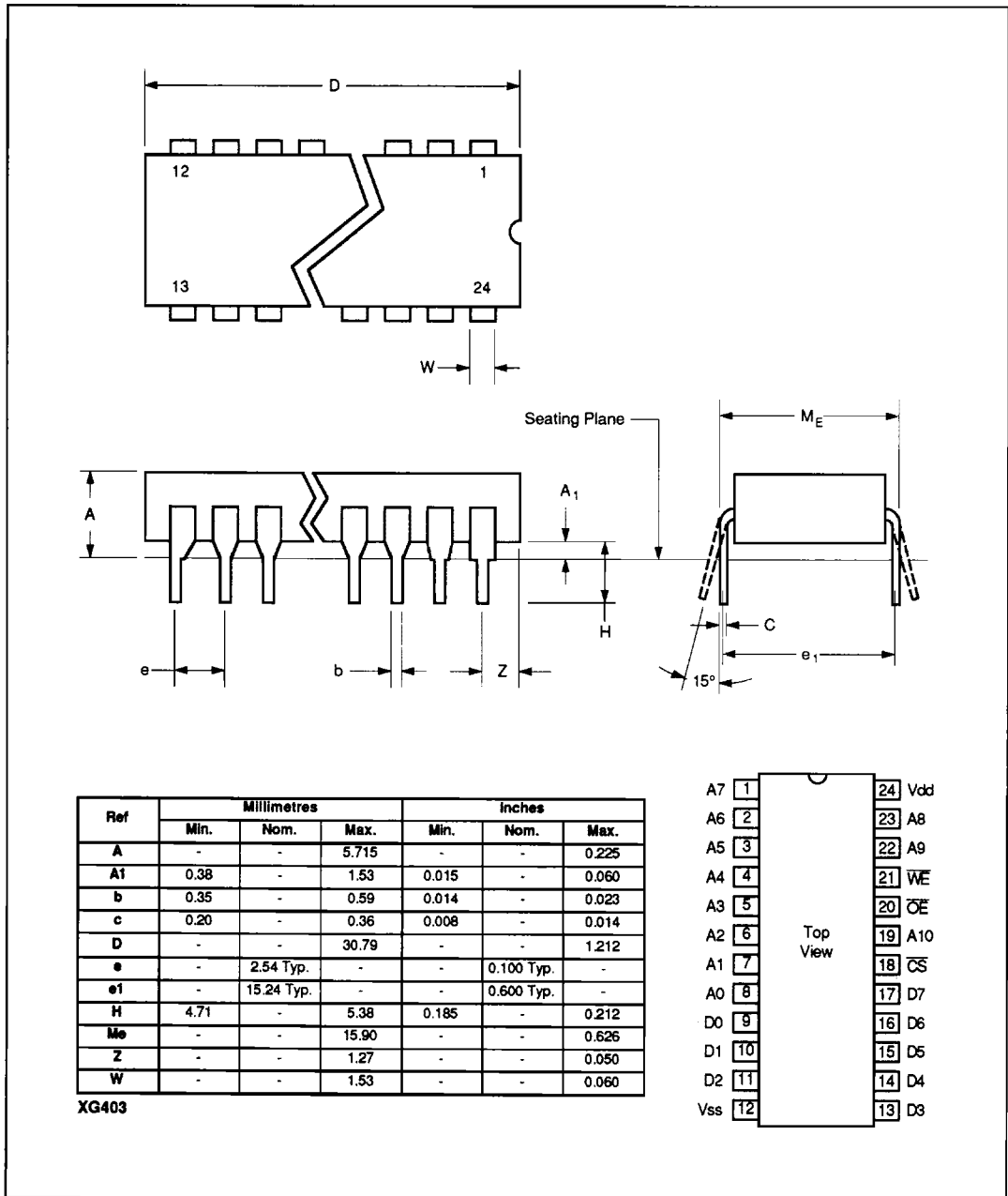
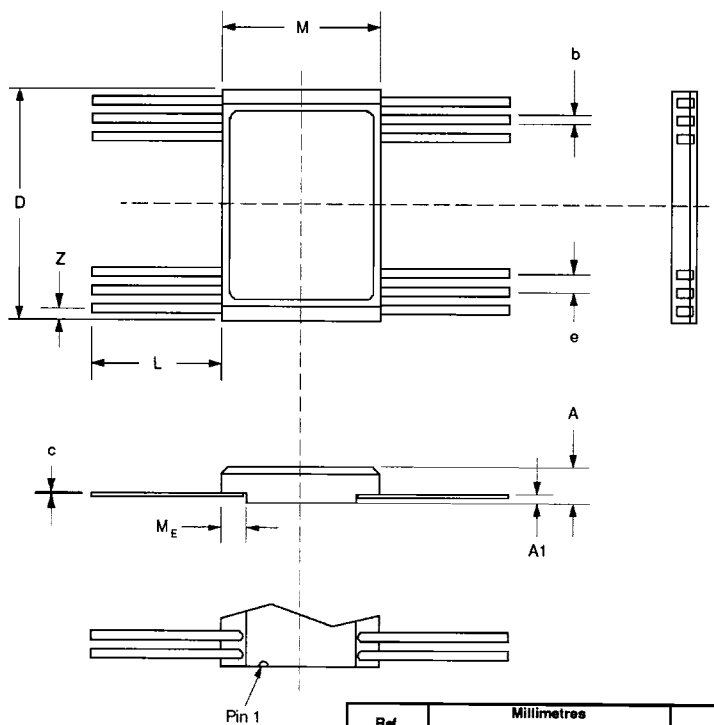


Figure 13: 24-Lead Ceramic DIL (Solder Seal) - Package Style C

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Ref	Millimetres			Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	3.07	-	-	0.121
A1	0.66	-	-	0.026	-	-
b	0.38	-	0.48	0.015	-	0.019
c	0.08	-	0.152	0.003	-	0.006
D	14.99	-	15.50	0.590	-	0.610
e	-	2.54	-	-	0.050	-
L	6.73	-	7.75	0.265	-	0.305
M	9.96	-	10.36	0.392	-	0.408
Me	7.6	-	-	0.30	-	-
Z	0.13	-	1.14	0.005	-	0.045

XG544

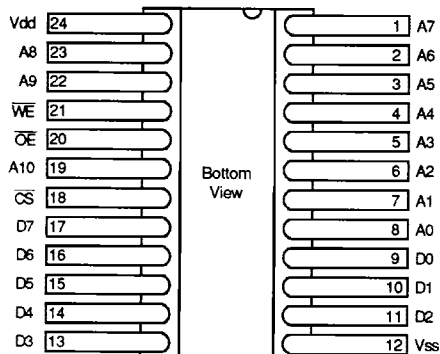


Figure 14: 24-Lead Ceramic Flatpack (Solder Seal) - Package Style F



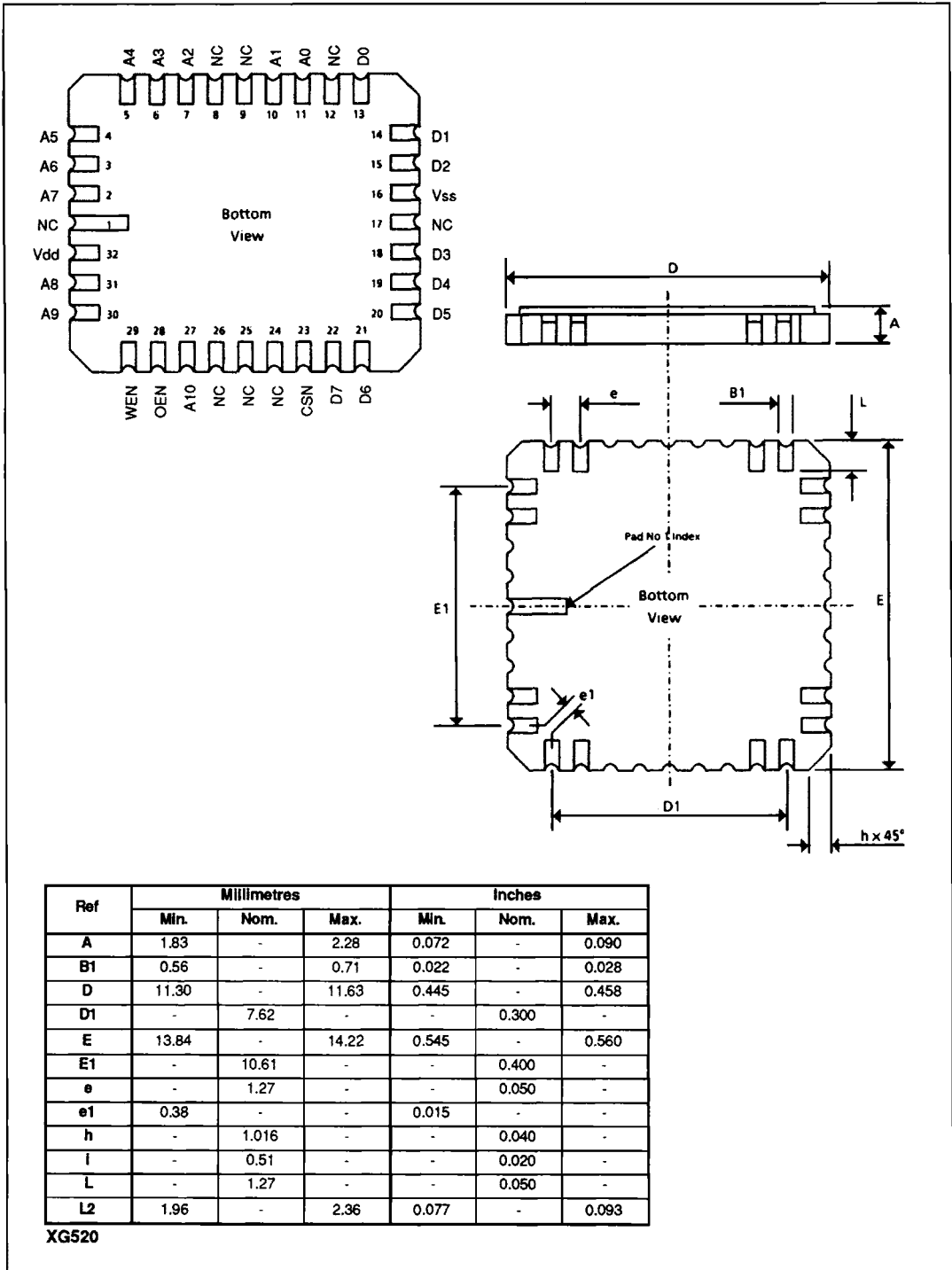


Figure 15: 32-Pad Leadless Chip Carrier - Package Style L

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Function	Package Options		Via	Burnin			Radiation
	L	C&F		Static1	Static 2	Dynamic	
A7	2	1	R	0V	5V	F7	5V
A6	3	2	R	0V	5V	F6	5V
A5	4	3	R	0V	5V	F5	5V
A4	5	4	R	0V	5V	F4	5V
A3	6	5	R	0V	5V	F3	5V
A2	7	6	R	0V	5V	F2	5V
A1	10	7	R	0V	5V	F1	5V
A0	11	8	R	0V	5V	F0	5V
D0	13	9	R	0V	5V	LOAD	5V
D1	14	10	R	0V	5V	LOAD	5V
D2	15	11	R	0V	5V	LOAD	5V
VSS	16	12	Direct	0V	0V	0V	0V
D3	18	13	R	0V	5V	LOAD	5V
D4	19	14	R	0V	5V	LOAD	5V
D5	20	15	R	0V	5V	LOAD	5V
D6	21	16	R	0V	5V	LOAD	5V
D7	22	17	R	0V	5V	LOAD	5V
CSB	23	18	R	0V	5V	0V	5V
A10	27	19	R	0V	5V	F10	5V
OEB	28	20	R	0V	5V	5V	5V
WEB	29	21	R	0V	5V	5V	5V
A9	30	22	R	0V	5V	F9	5V
A8	31	23	R	0V	5V	F8	5V
VDD	32	24	Direct	5V	5V	5V	5V

1. F0 = 150KHz, F0 = F0 /2, F2 = F0 /4, F3 = F0 /8 etc.
2. Burnin R = 1k
3. Radiation R = 10k

*Figure 16: Burnin and Radiation Configuration*

## 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 <sup>5</sup> Rad(Si)
Total Dose (Basic function)	1x10 <sup>6</sup> Rad(Si)
Transient Upset	>10 <sup>11</sup> Rad(Si)/sec
Neutron Hardness (Function to specification)	>10 <sup>15</sup> neutrons/cm <sup>2</sup>
Single Event Upset (Interplanetary/ Mi Alt)	3.4x10 <sup>-9</sup> errors/bitday
Latch-up	Not possible

Figure 17: Typical Radiation Hardness Parameters

## SINGLE EVENT UPSET CHARACTERISTICS

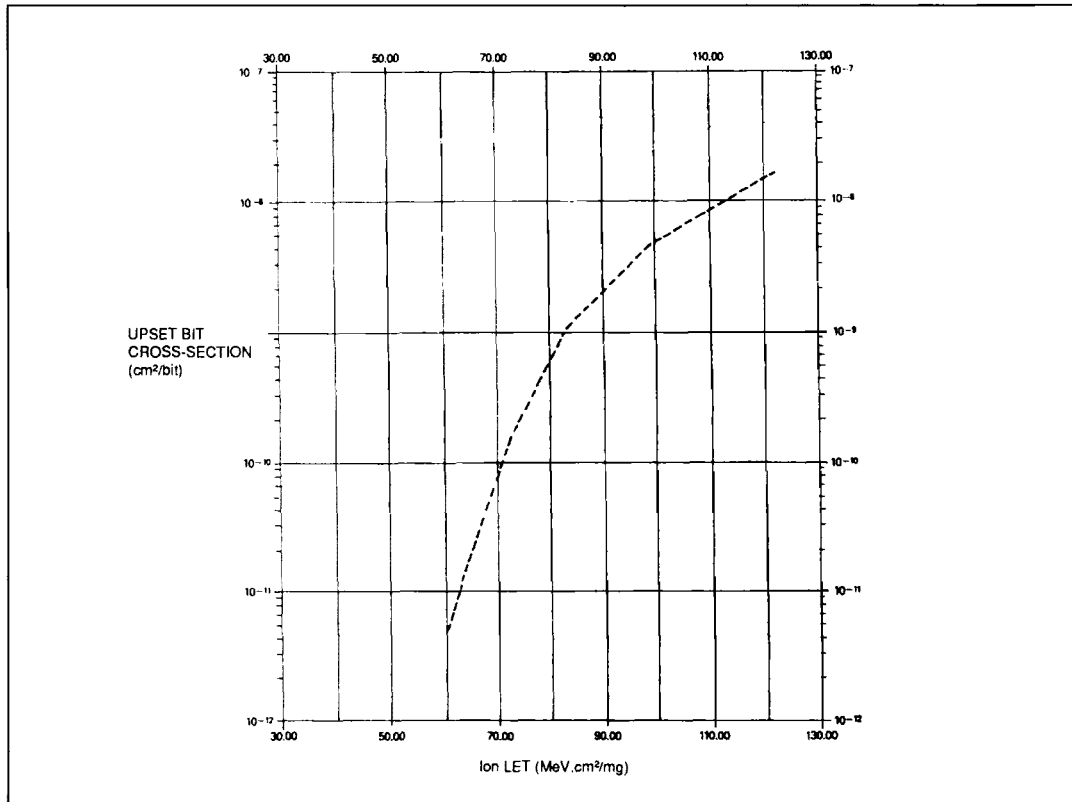


Figure 18: Typical Per-Bit Upset Cross-Section vs Ion LET

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## ORDERING INFORMATION

