Federal Systems

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DATE: November 29, 1995
TO: G. Kramer/311
FROM: K. Sahu/300.1 KS
SUBJECT: Radiation Report on: MT5C1008
Project: AXAF/Gulton
Control #: 13743
Job #: EE61737
Project part #: 5962-8959817MTA

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A radiation evaluation was performed on MT5C1008 (CMOS SRAM) to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Tables I through IV and Figure 1.

The total dose testing was performed using a Co^{60} gamma ray source. During the radiation testing, four parts were irradiated under bias (see Figure 1 for bias configuration) and one part was used as a control sample. The total dose radiation levels were 2.5, 5, 7.5, 10 and 15 krads*. The dose rate was between 0.15 and 0.29 krads/hour (see Table II for radiation schedule). After the 15 krad exposure, the parts were annealed for 24 hours at 25°C after which electrical measurements were made. After this, the parts were annealed for an additional 72 hours at 25°C, for a cumulative total of 96 hours annealing, after which electrical measurements were again made. After each radiation exposure, parts were electrically tested according to the test conditions and the specification limits** listed in Table III. The electrical measurements included four functional tests at 10 MHz: one with Vcc = 4.5 V, two with Vcc = 5.0 V and one with Vcc = 5.5 V.

All parts passed all initial electrical parametric and functional tests.

All irradiated parts passed all electrical parametric and functional tests up to and including the 10 krad irradiation level.

After the 15 krad irradiation, all four irradiated parts failed all four functional tests. All irradiated parts continued to pass all other electrical parametric tests.

After annealing for 24 hours at 25°C, all irradiated parts continued to fail all four functional tests, while continuing to pass all electrical parametric tests. After annealing for a total of 96 hours at 25°C, no recovery was observed.

Table IV provides a summary of the functional test results and the mean and standard deviation values for each parameter after each irradiation exposure and annealing step.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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* The term rads, as used in this document, means rads(silicon). All consecutive annealing times at the same temperature and all radiation levels cited are cumulative.

** These are manufacturer's pre-irradiation data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for MT5C1008

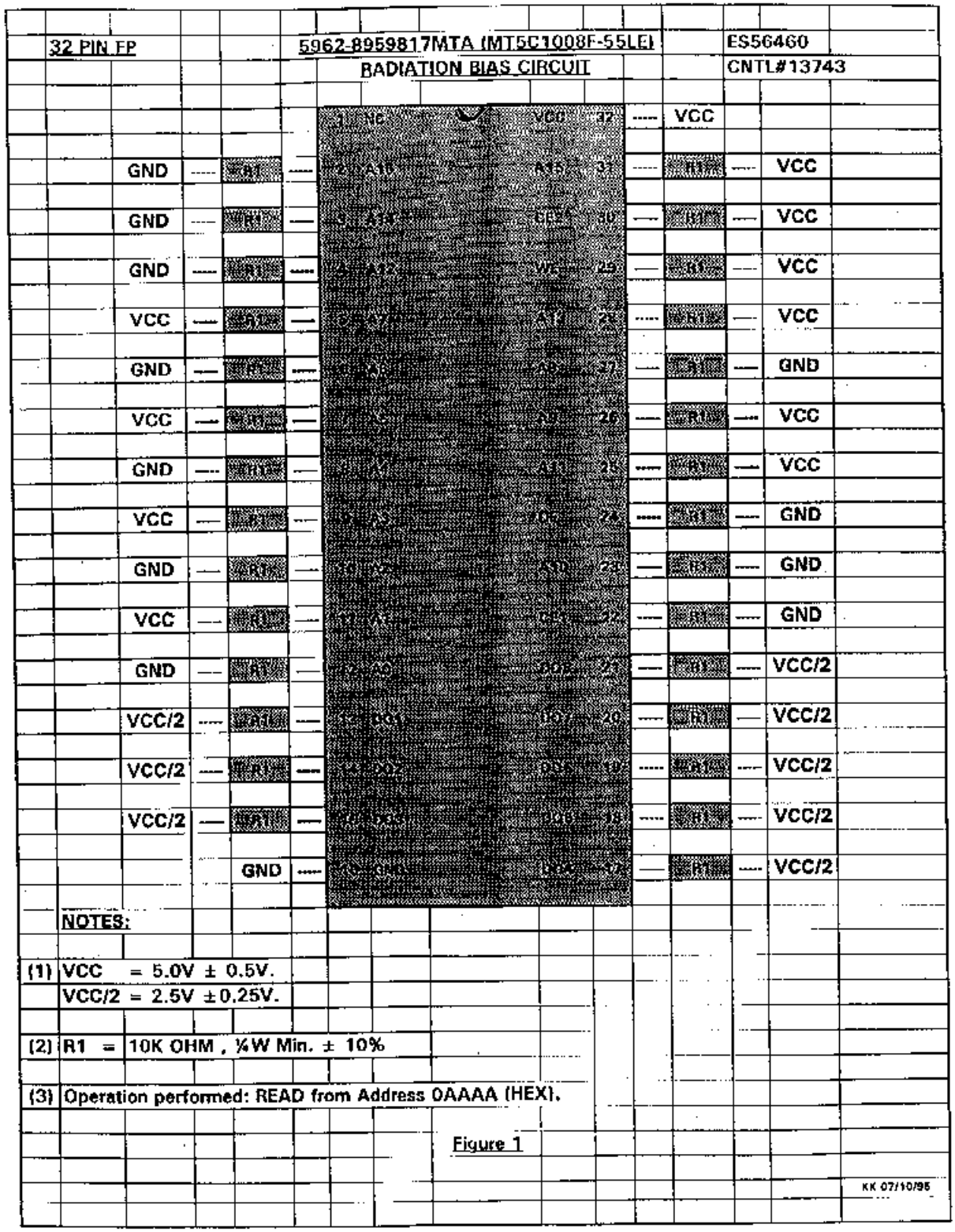

TABLE I. Part Information

Generic Part Number:	MT5C1008*
AXAF/Gulton Part Number	5962-8959817MTA
AXAF/Gulton Control Number:	13743
Charge Number:	EE61737
Manufacturer:	Micron Technology
Lot Date Code (LDC):	9421, 9515
Quantity Tested:	5
Serial Number of Control Samples:	1
Serial Numbers of Radiation Samples:	150, 151, 152, 153
Part Function:	CMOS SRAM
Part Technology:	CMOS
Package Style:	32-pin Flatpack
Test Equipment:	S-50
Engineer:	K. Kim

* No radiation tolerance/hardness was guaranteed by the manufacturer for this part.

TABLE II. Radiation Schedule for MT5C1008

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	08/03/95
2) 2.5 KRAD IRRADIATION (0.15 KRADS/HOUR)	08/17/95
POST-2.5 KRAD ELECTRICAL MEASUREMENT	08/18/95
3) 5 KRAD IRRADIATION (0.18 KRADS/HOUR)	08/20/95
POST-5 KRAD ELECTRICAL MEASUREMENT	08/21/95
4) 7.5 KRAD IRRADIATION (0.15 KRADS/HOUR)	08/21/95
POST-7.5 KRAD ELECTRICAL MEASUREMENT	08/22/95
5)10 KRAD IRRADIATION (0.16 KRADS/HOUR)	08/22/95
POST-10 KRAD ELECTRICAL MEASUREMENT	08/23/95
6) 15 KRAD IRRADIATION (0.29 KRADS/HOUR)	08/23/95
POST-15 KRAD ELECTRICAL MEASUREMENT	08/24/95
7) 24-HOUR ANNEALING @25°C	08/24/95
POST-24 HOUR ANNEAL ELECTRICAL MEASUREMENT	08/25/95
8) 96-HOUR ANNEALING @25°C	08/25/95
POST-96 HOUR ANNEAL ELECTRICAL MEASUREMENT	08/28/95

PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

Table III. Electrical Characteristics of MT5C1008

FUNCTIONAL TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C
FUNCT # 1	5.5V	0.0V	5.5V	FREQ = 10 MHZ	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 2	5.0V	0.0V	5.0V	FREQ = 10 MHZ	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 3	4.5V	0.0V	4.5V	FREQ = 10 MHZ	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 4	5.0V	0.0V	5.0V	FREQ = 10 MHZ	ALL I/O	VOL<1.5V , VOH>1.5V

DC PARAMETRIC TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C
VIH	5.5V	0.0V	0.8V	FREQ= 1MHZ	INS	> 0.0V , <+2.2V
VIL	4.5V	2.2V	4.5V	FREQ= 1MHZ	INS	>+0.8V , <+2.5V
VOH	4.5V	0.8V	2.2V	LOAD= -4MA	OUTS	>+2.4V , <+4.5V
VOL	4.5V	0.8V	2.2V	LOAD= +8MA	OUTS	> 0.0V , <+0.4V
IIH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	> 0.0UA , <+10UA
IIL	5.5V	0.0V	5.5V	VIN = 0.0V	INS	>-10UA , < 0.0UA
IOZH	5.5V	0.0V	5.0V	VOUT= 5.5V OE =5.5V	OUTS	>0.0UA , <+10UA
IOZL	5.5V	0.0V	5.0V	VOUT= 0.0V OE =5.5V	OUTS	>-10UA , <0.0UA
ICC1	5.5V	0.8V CE1=0.8V; OE ,WE ,CE2 = 2.2V	2.2V	FRQ=20MHZ	VCC	> 0.0MA , <+115MA
ICC2	5.5V	0.8V	2.2V CE1=2.2V; CE2=0.8V	FRQ= 0MHZ	VCC	> 0.0MA , <+25MA
ICC3	5.5V	0.8V	5.5V CE1=5.3V; OTHER INPUTS=0.8V	FRQ= 0MHZ	VCC	> 0.0MA , <+10MA
ICC4 (DATA RETENTION CURRENT)	2.0V	0.2V	2.0V CE1=1.8V; OTHER INPUTS=0.2V	FRQ= 0MHZ	VCC	> 0.0MA , <+10MA

AC PARAMETRIC TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C
TAVQVH	4.5V	0.0V	3.0V	F=1.0MHZ,VCMP=1.5V	OUTPUTS	> 100PS , < 55NS
TAVQVL	4.5V	0.0V	3.0V	F=1.0MHZ,VCMP=1.5V	OUTPUTS	> 100PS , < 55NS

COMMENTS/EXCEPTIONS

(1) FUNCTIONAL TESTS CONSISTS OF THE FOLLOWING PATTERNS :
1 - ALL ONES
2 - ALL ZEROS
3 - CHECKERBOARD
4 - 10N MARCH
5 - ROW ADDRESS
6 - COLUMN ADDRESS
7 - SLIDE DIAGONAL
8 - PING PONG
9 - SURROUND
10 - ROW GALPAT
11 - COLUMN GALPAT

(2) VIL & VIH WERE TESTED DYNAMICALLY @ 1MHZ FUNCTIONAL AND GO/NOGO DURING VOL & VOH DC TESTS. THE DYNAMIC TEST CONSISTS OF WRITING AND READING AA TO/FROM ADDRESS 00 AND 55 TO/FROM ADDRESS 1FFFF. THE INPUT THRESHOLDS ON ALL INPUTS ARE VARIED UNTIL THE FUNCTIONAL TEST PASSES. THESE TESTS ARE PERFORMED FOR INFORMATION PURPOSES ONLY AND IS NOT BEING TESTED AS A PASS/FAIL CRITERIA.

(3) TESTS NOT PERFORMED :
- CIN , CCLKL & COUT TEST.
- ONLY ADDRESS ACCESS TIME PROP. DELAYS WERE PERFORMED (TAVQV TESTS).
- ALL OTHER AC TESTS ARE NOT PERFORMED.

(4) DATA RETENTION TEST IS PERFORMED DURING FUNCTIONAL TEST #4.

(5) THIS PROGRAM TESTS FOR CONTINUITY AND ORIENTATION TESTS. ALSO THIS PROGRAM WILL PERFORM AN OPPOSITE STATE VOL & VOH TEST.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for MT5C1008 /1

Test/2 #	Parameter	Unit	Spec. Lim./3 min	Spec. Lim./3 max	Total Dose Exposure (krads) Initial mean	Initial sd	2.5 mean	2.5 sd	5 mean	5 sd	7.5 mean	7.5 sd	10 mean	10 sd	15 mean	15 sd	Annealing 24 hrs @25°C mean	24 hrs @25°C sd	96 hrs @25°C mean	96 hrs @25°C sd
1	VIH	V	0.0	2.2	1.67	.01	1.67	.01	1.67	.01	1.66	0	1.66	0	1.68	.01	1.66	.02	1.67	.01
2	VIL	V	0.8	2.5	1.45	.01	1.45	.02	1.44	.01	1.47	.02	1.43	.01	1.46	.01	1.44	.01	1.44	.01
3	VOH	V	2.4	4.5	3.01	.01	3.01	0	3.01	.01	3.02	0	3.01	.01	3.01	0	3.01	0	3.01	0
4	VOL	mV	0.0	400	115	1.8	114	1.7	115	2.7	116	1.8	113	1.6	113	1.9	114	1.6	114	1.8
5	IIH	uA	0.0	10	0.03	.05	0	.01	0	.01	0.03	.01	0	0	0	0	0.01	0	0	0
6	IIL	uA	-10	0.0	-0.02	.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	IOZH	uA	0.0	10	0.05	.09	0	.01	0	0	0.01	0	0	9	0	0	0	0	0	0
8	IOZL	uA	-10	0.0	-0.06	.10	0	.01	0	0	0	0	0	0	0	0	0	0	0	0
9	ICC1	mA	0.0	115	67.9	.75	68.4	.75	68.4	.83	70.1	.72	69.0	.62	69.1	.75	68.8	.75	68.9	.75
10	ICC2	mA	0.0	25	2.49	.03	2.49	.03	2.50	.03	2.55	.03	2.52	.03	2.66	.02	2.65	.04	2.64	.03
11	ICC3	mA	0.0	10	1.77	.02	1.78	.02	1.77	.03	1.89	.04	1.81	.04	1.96	.03	1.95	.03	1.90	.04
12	ICC4	mA	0.0	10	0.10	.06	0.04	.07	0.09	.07	0.15	.07	0	0	0.39	.03	0.37	.03	0.35	.03
13	TAVQVH	ns	0.1	55	16.4	.46	16.3	.42	16.3	.42	17.1	.45	16.3	.41	16.2	.38	16.0	.42	16.0	.41
14	TAVQVL	ns	0.1	55	15.8	.95	15.7	.93	15.7	.94	17.2	.94	15.6	.92	15.6	.92	15.1	.68	15.1	.70
15	FUNC1, Vcc=5.5V, Vil=0.0V, Vih=5.5V, 10MHz				P		P		P		P		P		F		F		F	
16	FUNC2, Vcc=5.0V, Vil=0.0V, Vih=5.0V, 10MHz				P		P		P		P		P		F		F		F	
17	FUNC3, Vcc=4.5V, Vil=0.0V, Vih=4.5V, 10MHz				P		P		P		P		P		F		F		F	
18	FUNC4, Vcc=5.0V, Vil=0.0V, Vih=5.0V, 10MHz				P		P		P		P		P		F		F		F	

Notes:

1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing. The control sample remained constant throughout the testing and is not included in this table.

2/ In the Functional Tests, "P" means that all parts passed this test at this irradiation or annealing level, "F" means that all parts failed this test at this irradiation or annealing level, and "nPmF" means that n parts passed this test and m parts failed this test at this irradiation or annealing level.

3/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

Radiation-sensitive parameters: FUNC1, FUNC2, FUNC3, FUNC4