Federal Systems

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UNISYS

DATE: May 6, 1996
TO: A. Sharma/311
FROM: K. Sahu/300.1 KS
SUBJECT: Radiation Report on: 58C1001
Project: GPEP/PPL
Control #: 14973
Job #: EE61876
Project part #: 58C1001F

PPM-96-003

cc: G. Kramer/311
R. Chinnapongse/311
OFA Library/300.1

A radiation evaluation was performed on 58C1001 (125K x 8 Rad-Hard EEPROM) 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, three 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, 10, 15, 20, 25, 30, 50, 75 and 100 krads*. The dose rate was between 0.08 and 1.47 krads/hour (see Table II for radiation schedule). After each radiation exposure and annealing step, parts were electrically tested according to the test conditions and the specification limits** listed in Table III The electrical measurements included nine initial (pre-rad) functional tests at 1.0 MHz: These functional tests were WRITE/READ ZEROES, WRITE/READ ONES and WRITE/READ CHECKERBOARD with Vcc = 4.75 V, Vil = 0.0 V and Vih = 4.75 V, the same three tests with Vcc = 5.00 V, Vil = 0.0 V and Vih = 5.00 V, and the same three tests with Vcc = 5.25 V, Vil = 0.0 V and Vih = 5.25 V. After the first (2.5 krad) irradiation, three additional functional tests were added. These were READ CHECKERBOARD tests, for the purpose of determining if the checkerboard pattern read into the parts before irradiation could still be read after irradiation. These tests were performed with Vcc = 4.75 V, Vil = 0.0 V and Vih = 4.75 V, with Vcc = 5.00 V, Vil = 0.0 V and Vih = 5.00 V and with Vcc = 5.25 V, Vil = 0.0 V and Vih = 5.25 V.

Initial functional and electrical parametric tests were performed at -55°C, -30°C, +25°C (room temperature) and +125°C. At -55°C, S/N 23 and 24 failed Functional Test # 9 (WR/RD CHKBD). All other parts passed all initial functional and electrical parametric tests at all temperatures. During initial electrical parametric measurements, the value of IIL as measured on pin # 30 read between -20.0 and -30.0 μA for all parts against a minimum specification limit of -2.00 μA. This pin continued to read approximately the same values throughout all irradiation and annealing steps; consequently, this reading has been attributed to test equipment malfunction and has been ignored in the statistical calculations.

All irradiated parts passed all electrical parametric and functional tests up to and including the 20 krad irradiation level.

After the 25 krad irradiation, S/N 24 failed Functional Tests #1, 2 and 3 (READ CHKBD) and Functional Test #4 (WR/RD 0's). All other irradiated parts continued to pass all functional and parametric tests at this level.

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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.

After the 25 krad irradiation, the parts were annealed for 168 hours at 25°C. After this annealing, S/N 24 continued to fail Functional Tests #1, 2 and 3, but passed Functional Test #4: however, S/N 25 fell below the minimum specification limit of 0.00 for ICC1, with a reading of -12.0 μA.

After the 30 krad irradiation, all irradiated parts passed all functional tests; however, S/N 24 fell below the minimum specification limit for ICC1, with a reading of -12.0 μA. All other irradiated parts continued to pass all functional and parametric tests at this level.

After the 50 krad irradiation, all irradiated parts passed all functional tests; however, S/N 23, 24 and 25 fell below the minimum specification limit of -2.00 μA for IIL, with readings of -4.12, -5.75 and -4.81 μA, respectively. All parts continued to pass all other functional and parametric tests at this level.

After the 75 krad irradiation, S/N 24 failed Functional Tests # 1, 2 and 3. In addition, S/N 24 failed Functional Tests # 11 and 12 (WR/RD CHKBD). Increasing degradation was also seen in IIL for all three irradiated parts, with readings of -8.68, -12.86 and -11.34 μA, respectively.

After the 100 krad irradiation, S/N 24 passed all functional tests: however, S/N 23 and 25 failed Functional Tests # 1, 2 and 3. In addition, S/N 25 also failed Functional Test # 12. All irradiated parts also continued to exceed specification limits for IIL, with readings of -8.35, -14.23 and -13.11 μA, respectively. At this level, S/N 23 and 24 exceeded the maximum specification limit of 20.00 μA for ICC1, with readings of 32.00 and 23.00 μA.

After annealing for 384 hours at 25°C, S/N 24 again failed Functional Tests #1, 2 and 3. Both other irradiated parts passed all functional tests. The degradation in all three irradiated parts continued in IIL, with readings ranging from -3.67 to -5.27 μA. In addition, S/N 24 continued to exceed specification limits for ICC1, with a reading of -12.00 μA.

After annealing for 240 hours at 100°C, no rebound effects were observed.

Tables IVa-IVf provide 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.

(d) The information should not be construed as a representation of product performance by either GSFC or the manufacturer;

(e) Neither the United States government nor any person acting on behalf of the United States government assumes any liability resulting from the application or use of the information.

Figure 1. Radiation Bias Circuit for 58C1001

32 PIN FP

58C1001
~~28C010TRPFE~~

RADIATION BIAS CIRCUIT

EE 61876
~~ES56499~~
CNTL#~~13958~~ 14973

VCC/2	R1	1	RDY/BUSY	VCC	32	VCC						
GND	R1	2	A16	A15	31	R1	VCC					
GND	R1	3	A14	RES	30	R1	VCC					
GND	R1	4	A12	WE	29	R1	VCC					
VCC	R1	5	A7	A13	28	R1	VCC					
GND	R1	6	A6	A8	27	R1	GND					
VCC	R1	7	A5	A9	26	R1	VCC					
GND	R1	8	A4	A11	25	R1	VCC					
VCC	R1	9	A3	OE	24	R1	GND					
GND	R1	10	A2	A10	23	R1	GND					
VCC	R1	11	A1	CE	22	R1	GND					
GND	R1	12	A0	DQ8	21	R1	VCC/2					
VCC/2	R1	13	DQ1	DQ7	20	R1	VCC/2					
VCC/2	R1	14	DQ2	DQ6	19	R1	VCC/2					
VCC/2	R1	15	DQ3	DQ5	18	R1	VCC/2					
	GND	16	GND	DQ4	17	R1	VCC/2					

NOTES:

(1) VCC = 5.0V ± 0.5V.
VCC/2 = 2.5V ± 0.25V.

(2) R1 = 10K OHM , ¼W Min. ± 10%

(3) Read Operation : Address = 0AAAA, Output = 55.

Figure 1

KK 09/01/95

TABLE I. Part Information

Generic Part Number:	58C1001*
GPEP/PPL Part Number	58C1001F
GPEP/PPL Control Number:	14973
Charge Number:	EE61876
Manufacturer:	Hitachi die, packaged by Austin
Lot Date Code (LDC):	unknown
Quantity Tested:	4
Serial Number of Control Samples:	22
Serial Numbers of Radiation Samples:	23, 24, 25
Part Function:	125K x 8 Rad-Hard EEPROM
Part Technology:	CMOS
Package Style:	32-pin Flatpack
Test Equipment:	S-50
Engineer:	A. Duvalsaint

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

TABLE II. Radiation Schedule for 58C1001

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	03/06/96
2) 2.5 KRAD IRRADIATION (0.15 KRADS/HOUR)	03/06/96
POST-2.5 KRAD ELECTRICAL MEASUREMENT	03/07/96
3) 5 KRAD IRRADIATION (0.15 KRADS/HOUR)	03/07/96
POST-5 KRAD ELECTRICAL MEASUREMENT	03/08/96
4) 10 KRAD IRRADIATION (0.08 KRADS/HOUR)	03/08/96
POST-10 KRAD ELECTRICAL MEASUREMENT	03/11/96
5) 15 KRAD IRRADIATION (0.29 KRADS/HOUR)	03/11/96
POST-15 KRAD ELECTRICAL MEASUREMENT	03/12/96
6) 20 KRAD IRRADIATION (0.29 KRADS/HOUR)	03/12/96
POST20 KRAD ELECTRICAL MEASUREMENT	03/13/96
7) 25 KRAD IRRADIATION (0.29 KRADS/HOUR)	03/13/96
POST-25 KRAD ELECTRICAL MEASUREMENT	03/14/96
8) 168-HOUR ANNEALING @25°C	03/14/96
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	03/21/96
9) 30 KRAD IRRADIATION (0.29 KRADS/HOUR)	03/21/96
POST-30 KRAD ELECTRICAL MEASUREMENT	03/22/96
10) 50 KRAD IRRADIATION (0.30 KRADS/HOUR)	03/22/96
POST-50 KRAD ELECTRICAL MEASUREMENT	03/25/96
11) 75 KRAD IRRADIATION (1.47 KRADS/HOUR)	03/25/96
POST-75 KRAD ELECTRICAL MEASUREMENT	03/26/96
12) 100 KRAD IRRADIATION (1.47 KRADS/HOUR)	03/26/96
POST-100 KRAD ELECTRICAL MEASUREMENT	03/27/96
13) 384-HOUR ANNEALING @25°C	03/27/96
POST-384 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/12/96
14) 240-HOUR ANNEALING @ 100°C	04/12/96
POST-240-HOUR ANNEAL ELECTRICAL MEASUREMENT	04/25/96

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

Table III. Electrical Characteristics of 58C1001

PART NUMBER : AS58C1001F
DESCRIPTION : 1 MEG (128K X 8) RAD HARD EEPROM (32-LEAD FLAT PACK)
SPECS : AUSTIN SEMICONDUCTOR, INC DATA SHEET
PCN : SI10761A
LOCATION : [LIBRARY.761]

INITIAL EM'S FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	PATTERN	CONDITIONS	PINS	LIMITS	
FUNCT # 1	4.75V	0.0V	4.75V	WR/RD ZEROS	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V
FUNCT # 2	5.00V	0.0V	5.00V	WR/RD ZEROS	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V
FUNCT # 3	5.25V	0.0V	5.25V	WR/RD ZEROS	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V
FUNCT # 4	4.75V	0.0V	4.75V	WR/RD ONES	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V
FUNCT # 5	5.00V	0.0V	5.00V	WR/RD ONES	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V
FUNCT # 6	5.25V	0.0V	5.25V	WR/RD ONES	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V
FUNCT # 7	4.75V	0.0V	4.75V	WR/RD CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V
FUNCT # 8	5.00V	0.0V	5.00V	WR/RD CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V
FUNCT # 9	5.25V	0.0V	5.25V	WR/RD CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V,	VOH>1.5V

POST RADIATION/ANNEALING EM'S FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	PATTERN	CONDITIONS	PINS	LIMITS	
FUNCT # 1	4.75V	0.0V	4.75V	READ CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT # 2	5.00V	0.0V	5.00V	READ CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT # 3	5.25V	0.0V	5.25V	READ CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT # 4	4.75V	0.0V	4.75V	WR/RD ZEROS	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT # 5	5.00V	0.0V	5.00V	WR/RD ZEROS	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT # 6	5.25V	0.0V	5.25V	WR/RD ZEROS	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT # 7	4.75V	0.0V	4.75V	WR/RD ONES	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT # 8	5.00V	0.0V	5.00V	WR/RD ONES	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT # 9	5.25V	0.0V	5.25V	WR/RD ONES	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT #10	4.75V	0.0V	4.75V	WR/RD CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT #11	5.00V	0.0V	5.00V	WR/RD CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V
FUNCT #12	5.25V	0.0V	5.25V	WR/RD CHKBD	FREQ=1.0MHZ	I/O'S	VOL<1.5V ,	VOH>1.5V

DC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C	
VOL	4.75V	0.4V	2.8V	LOAD = +2.1MA	OUTS	> 0.0V ,	< 0.40V
VOH1	4.75V	0.4V	2.8V	LOAD = -400UA	OUTS	> 2.4V ,	< 4.75V
IIL	5.25V	0.0V	5.25V	TSTV = +0.0V	INS	> -2UA ,	< +2UA
IIL(RES_)	5.25V	0.0V	5.25V	TSTV = +0.0V	INS	> -100UA,	< +100UA
IIH	5.25V	0.0V	5.25V	TSTV = +5.25V	INS	> -2UA ,	< +2UA
IIH(RES_)	5.25V	0.0V	5.25V	TSTV = +5.25V	INS	> -100UA,	< +100UA
IOZL	5.25V	0.0V	5.25V	TSTV = +0.40V	OUTS	> -2UA ,	< +2UA
IOZH	5.25V	0.0V	5.25V	TSTV = +5.25V	OUTS	> -2UA ,	< +2UA
ICC1	5.25V	0.0V	5.25V	CE = 5.25V	VCC	> 0A ,	< 20UA
ICC2	5.25V	0.0V	5.25V	CE = 2.8V	VCC	> 0A ,	< 1MA
ICC3	5.25V	0.0V	5.25V	FREQ = 1.0MHZ	VCC	> 0A ,	< 15MA
ICC4	5.25V	0.0V	5.25V	FREQ = 5.0MHZ	VCC	> 0A ,	< 40MA

AC PARAMETRIC TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C	
TACCLH	5.00V	0.4V	2.8V	VCOMP = 2.0V	A->Q	>0NS ,	<150NS
TACCHL	5.00V	0.4V	2.8V	VCOMP = 0.8V	A->Q	>0NS ,	<150NS

TABLE IVa: Summary of Initial (Pre-Rad) Functional Tests at -55°C, -30°C and +125°C for 58C1001 /1

#	Functional Tests /2, /3	Pattern	Initial							
			-55°C		-30°C		+25°C		+125°C	
1	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P	
2	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P	
3	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P	
4	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD 1's	P		P		P		P	
5	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD 1's	P		P		P		P	
6	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD 1's	P		P		P		P	
7	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD CHKBD	P		P		P		P	
8	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD CHKBD	P		P		P		P	
9	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD CHKBD	1P2F		P		P		P	

Notes:

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

2/ "P" indicates that all parts passed this test at this irradiation or annealing level.
"F" indicates that all parts failed this test at this irradiation or annealing level.
"nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing level.

3/ Prior to the first irradiation, a checkerboard pattern was written into the parts to be irradiated. After the start of irradiation, the test program was modified to include additional tests (see Table III).

TABLE IVb: Summary of Initial (Pre-Rad) Electrical Measurements at -55°C, -30°C and +125°C for 58C1001 /1

	Electrical		Spec. Lim./4		Initial							
					-55°C		-30°C		+25°C		+125°C	
#	Parameters	Units	min	max	mean	sd	mean	sd	mean	sd	mean	sd
1	VOL	mV	0	400	52.92	1.5	53.33	1.5	76.75	1.9	114	2.4
2	VOH	V	2.4	5	4.66	0	4.66	0	4.64	0	4.62	2.0
3	IIL /5	µA	-2	2	-0.94	5.0	-0.95	.01	-1.03	5.4	-1.15	5.9
4	IIH	µA	-2	2	0.01	.04	0.01	0	0	0	0.01	.01
5	IOZL	µA	-2	2	0	0	0	0	0	0	0	0
6	IOZH	µA	-2	2	0	.01	0	0	0	0	0.14	.54
7	ICC1	µA	0	20	-4.00	5.7	9.33	6.6	0	0	0	0
8	ICC2	µA	0	1000	152	4.2	140	18	114	4.2	87.33	11
9	ICC3	mA	0	15	5.33	.28	5.08	.46	4.37	.17	3.72	.11
10	ICC4	mA	0	40	29.16	.50	28.30	1.3	27.19	.33	26.28	.34
11	TACCLH	ns	0	150			53.40	8.2	60.40	4.7	76.10	5.2
12	TACCHL	ns	0	150			50.98	5.5	57.11	1.6	73.53	5.7

Notes:

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

2/ "P" indicates that all parts passed this test at this irradiation or annealing level.
"F" indicates that all parts failed this test at this irradiation or annealing level.
"nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing level.

3/ Prior to the first irradiation, a checkerboard pattern was written into the parts to be irradiated. After the start of irradiation, the test program was modified to include additional tests (see Table III).

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

5/ The reading for IIL on pin # 30 was unreliable and is not included in the statistical calculations.

TABLE IVc: Summary of Functional Tests after Total Dose Exposures and Annealing for 58C1001 /1

#	Functional Tests /2, /3	Pattern	Initial +25°C	
1	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD 0's	P	
2	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD 0's	P	
3	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD 0's	P	
4	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD 1's	P	
5	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD 1's	P	
6	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD 1's	P	
7	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD CHKBD	P	
8	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD CHKBD	P	
9	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD CHKBD	P	

#	Functional Tests /2, /3	Pattern	Total Dose Exposure (TDE) (krads) 2.5		5		10		15	
1	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	READ CHKBD	P		P		P		P	
2	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	READ CHKBD	P		P		P		P	
3	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	READ CHKBD	P		P		P		P	
4	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P	
5	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P	
6	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P	
7	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD 1's	P		P		P		P	
8	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD 1's	P		P		P		P	
9	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD 1's	P		P		P		P	
10	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD CHKBD	P		P		P		P	
11	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD CHKBD	P		P		P		P	
12	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD CHKBD	P		P		P		P	

Notes:

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

2/ "P" indicates that all parts passed this test at this irradiation or annealing level.
"F" indicates that all parts failed this test at this irradiation or annealing level.
"nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing level.

3/ Prior to the first irradiation, a checkerboard pattern was written into the parts to be irradiated. After the start of irradiation, the test program was modified to include additional tests (see Table III).

TABLE IVd: Summary of Functional Tests after Total Dose Exposures and Annealing for 58C1001 /1

#	Functional Tests /2, /3	Pattern	TDE (krads) 20		TDE (krads) 25		Annealing 168 hrs. @ 25°C		Total Dose Exposure (TDE) (krads) 30		50		75		100		Annealing 384 hrs. @ 25°C	
1	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	READ CHKBD	P		2P1F		2P1F		P		P		2P1F		1P2F		2P1F	
2	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	READ CHKBD	P		2P1F		2P1F		P		P		2P1F		1P2F		2P1F	
3	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	READ CHKBD	P		2P1F		2P1F		P		P		2P1F		1P2F		2P1F	
4	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P		P		P		P		P	
5	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P		P		P		P		P	
6	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD 0's	P		P		P		P		P		P		P		P	
7	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD 1's	P		2P1F		P		P		P		P		P		P	
8	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD 1's	P		P		P		P		P		P		P		P	
9	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD 1's	P		P		P		P		P		P		P		P	
10	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0MHz	WR/RD CHKBD	P		P		P		P		P		P		P		P	
11	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0MHz	WR/RD CHKBD	P		P		P		P		P		2P1F		P		P	
12	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0MHz	WR/RD CHKBD	P		P		P		P		P		2P1F		2P1F		P	

#	Functional Tests /2, /3	Pattern	Annealing 240 hrs. @ 100°C	
1	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0M	WR/RD 0's	P	
2	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0M	WR/RD 0's	P	
3	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0M	WR/RD 0's	P	
4	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0M	WR/RD 1's	P	
5	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0M	WR/RD 1's	P	
6	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0M	WR/RD 1's	P	
7	Vcc=4.75V,Vil=0.0V,Vih=4.75V,Freq.=1.0M	WR/RD CHKBD	P	
8	Vcc=5.00V,Vil=0.0V,Vih=5.00V,Freq.=1.0M	WR/RD CHKBD	P	
9	Vcc=5.25V,Vil=0.0V,Vih=5.25V,Freq.=1.0M	WR/RD CHKBD	F	

Notes:

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

2/ "P" indicates that all parts passed this test at this irradiation or annealing level.
"F" indicates that all parts failed this test at this irradiation or annealing level.
"nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing level.

3/ Prior to the first irradiation, a checkerboard pattern was written into the parts to be irradiated. After the start of irradiation, the test program was modified to include additional tests (see Table III).

TABLE IVe: Summary of Electrical Measurements after Total Dose Exposures and Annealing for 58C1001 /1

					Initial		Total Dose Exposure (TDE) (krads)							
	Electrical		Spec. Lim./4		+25°C		2.5		5		10		15	
#	Parameters	Units	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	VOL	mV	0	400	76.75	1.9	76.83	2.0	77.13	1.9	76.67	1.7	77.38	1.8
2	VOH	V	2.4	5	4.64	0	4.64	0	4.64	0	4.64	0	4.64	0
3	IIL /5	µA	-2	2	-1.03	5.4	-1.03	5.4	-1.03	5.4	-1.03	5.4	-1.03	5.5
4	IIH	µA	-2	2	0	0	0	0	0	0	0	0	0	0
5	IOZL	µA	-2	2	0	0	0	0	0	0	0	0	0	0
6	IOZH	µA	-2	2	0	0	0	0	0	0	0	0	0	0
7	ICC1	µA	0	20	0	0	0	0	-4.00	5.7	0	0	0	0
8	ICC2	µA	0	1000	114	4.2	102	0	105	4.2	111	7.3	111	7.3
9	ICC3	mA	0	15	4.37	.17	4.37	.13	4.34	.22	4.38	.11	4.28	.15
10	ICC4	mA	0	40	27.19	.33	27.25	.42	27.19	.38	27.04	.48	26.93	.52
11	TACCLH	ns	0	150	60.40	4.7	60.70	4.6	61.20	4.2	4.2E4	2.0E4	4.2E4	2.0E5
12	TACCHL	ns	0	150	57.11	1.6	56.99	1.7	56.98	1.6	56.61	1.6	56.98	1.6

Notes:

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

2/ "P" indicates that all parts passed this test at this irradiation or annealing level.
"F" indicates that all parts failed this test at this irradiation or annealing level.
"nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing

3/ Prior to the first irradiation, a checkerboard pattern was written into the parts to be irradiated.
After the start of irradiation, the test program was modified to include additional tests (see Ta

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

5/ The reading for IIL on pin # 30 was unreliable and is not included in the statistical calculation

TABLE IVf: Summary of Electrical Measurements after Total Dose Exposures and Annealing for 58C1001 /1

					TDE (krads)				Annealing		Total Dose Exposure (TDE) (krads)								Annealing			
	Electrical		Spec. Lim./4		20		25		168 hrs. @ 25°C		30		50		75		100		384 hrs. @ 25°C		240 hrs. @ 100°C	
#	Parameters	Units	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	VOL	mV	0	400	76.83	1.9	76.83	1.9	78.38	1.8	78.38	2.0	79.42	2.2	78.38	1.9	79.13	1.9	78.83	1.9	79.96	1.8
2	VOH	V	2.4	5	4.64	0	4.64	2.0	4.64	0	4.64	0	4.64	0	4.64	0	4.64	0	4.64	0	4.64	0
3	IIL /5	µA	-2	2	-1.03	5.4	-1.05	5.4	-1.04	5.4	-1.16	5.5	-2.04	5.9	-3.24	6.8	-3.31	6.7	-2.02	5.91	-1.03	5.4
4	IIH	µA	-2	2	0	0	0	0	0	0	0	0	0.01	0	0.05	.05	0.13	.16	0.01	.01	0	0
5	IOZL	µA	-2	2	0	0	0	0	0	0	0	0	0	0	0	.01	0.01	0	-0.01	.01	0	0
6	IOZH	µA	-2	2	0	0	0	0	0	0	0	0	0	0	0.03	.02	0.07	.05	0.01	.01	0	0
7	ICC1	µA	0	20	4.67	6.6	-4.00	5.7	-8.00	5.7	5.33	12	4.67	6.6	0	0	18.33	13	-4.00	5.7	-8.00	5.7
8	ICC2	µA	0	1000	105	4.2	105	11	105	8.5	114	8.5	134	4.2	160	3.8	175	4.2	123	3.8	102	7.3
9	ICC3	mA	0	15	4.34	.15	4.30	.13	4.31	.15	4.27	.15	4.25	.18	4.22	.22	4.17	.19	4.10	.18	4.04	.19
10	ICC4	mA	0	40	26.98	.52	27.09	.36	26.94	.66	27.00	.45	26.69	.45	26.65	.51	26.35	.33	26.40	.47	26.46	.29
11	TACCLH	ns	0	150	61.28	4.1	61.30	4.1	61.31	4.2	61.46	4.1	62.50	3.6	63.17	3.6	63.69	3.6	64.38	3.1	63.88	3.4
12	TACCHL	ns	0	150	56.60	1.6	56.64	1.7	56.67	1.6	56.79	1.6	57.13	1.6	57.50	1.7	57.84	1.8	57.29	1.9	57.55	1.7

Notes:

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

2/ "P" indicates that all parts passed this test at this irradiation or annealing level.
"F" indicates that all parts failed this test at this irradiation or annealing level.
le "nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing level.

3/ Prior to the first irradiation, a checkerboard pattern was written into the parts to be irradiated.
le After the start of irradiation, the test program was modified to include additional tests (see Table III).

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

5/ The reading for IIL on pin # 30 was unreliable and is not included in the statistical calculations.