Federal Systems

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DATE: January 16, 1996

PPM-95-187

TO: G. Kramer/311

FROM: K. Sahu/300.1 KS

SUBJECT: Radiation Report on: 28C256

Project: AXAF/Gulton
Control #: 14509
Job #: ER61108
Project part #: 28C256EFY-25

cc: T. Canales/Gulton
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A radiation evaluation was performed on 28C256 (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, five 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 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 krads*. The dose rate was between 0.50 and 0.59 krads/hour (see Table II for radiation schedule). 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 six initial (pre-rad) functional tests at 10 MHz: These functional tests were WRITE/READ ZEROES, WRITE/READ ONES and WRITE/READ CHECKERBOARD with Vcc = 4.5 V, Vil = 0.0 V and Vih = 4.5 V and the same three tests with Vcc = 5.5 V, Vil = 0.0 V and Vih = 5.5 V. After the first (1 krad) irradiation, six additional functional tests were added. These were WRITE/READ ZEROES, WRITE/READ ONES and WRITE/READ CHECKERBOARD with Vcc = 5.0 V, Vil = 0.0 V and Vih = 5.0 V, and Three READ CHECKERBOARD tests, one with Vcc = 4.5 V, Vil = 0.0 V and Vih = 4.5 V, one with Vcc = 5.0 V, Vil = 0.0 V and Vih = 5.0 V and one with Vcc = 5.5 V, vil = 0.0 V and Vih = 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 7 krad irradiation level.

After the 8 krad irradiation, S/N 61 failed Functional Test # 1 (READ CHECKERBOARD @ Vcc = 4.5 V), #2 (READ CHECKERBOARD @ Vcc = 5.0 V) and #3 (READ CHECKERBOARD @ Vcc = 5.5 V). This indicates that the checkerboard pattern written into the part before the 8 krad irradiation was corrupted during the irradiation. In addition,.SN 61, 63 and 64 failed Functional Test # 6 (WRITE/READ CHKBD @ Vcc = 4.5 V), #9 (WRITE/READ CHKBD @ Vcc = 5.0 V) and #12 (WRITE/READ CHKBD @ Vcc = 5.5 V). These results, i.e., failures in the WRITE/READ CHKBD test, but not in the WRITE/READ ZEROES or WRITE/READ ONES tests, indicate that the functional failures are pattern-sensitive. The same parts also failed the VOL test.

After annealing for 24 hours at 25°C, no recovery was observed. In addition, after this annealing, S/N 63 and 64 also failed Functional Tests # 1, 2 and 3.

* 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 annealing for an additional 144 hours at 25°C, for a cumulative total of 168 hours, no recovery was observed.

After annealing for an additional 144 hours, for a cumulative total of 336 hours at 25°C, no recovery was observed.

After the 9 krad irradiation, the same failures in VOL and the same functional failures continued to be observed. In addition, S/N 63 and 64 failed Functional Tests # 1, 2 and 3, and S/N 62, 63, 64 and 65 failed Functional Test # 5 (WRITE/READ ONES).

After the 10 krad irradiation, the same failures in VOL and the same functional failures continued to be observed. In addition, all irradiated parts failed Functional Test # 5, 6, 8 (WRITE/READ ONES) and 9, S/N 64 failed Functional Test #4 (WRITE/READ ZEROES), S/N 62 failed Functional Test # 4 and S/N 62, 63, 64 and 65 failed Functional Test # 11 (WRITE/READ ONES). S/N 62 failed the VOL test and S/N 64 exceeded the maximum specification limit of 350 μA for both ICCL3 and ICCH3, with readings of 574 μA for both parameters.

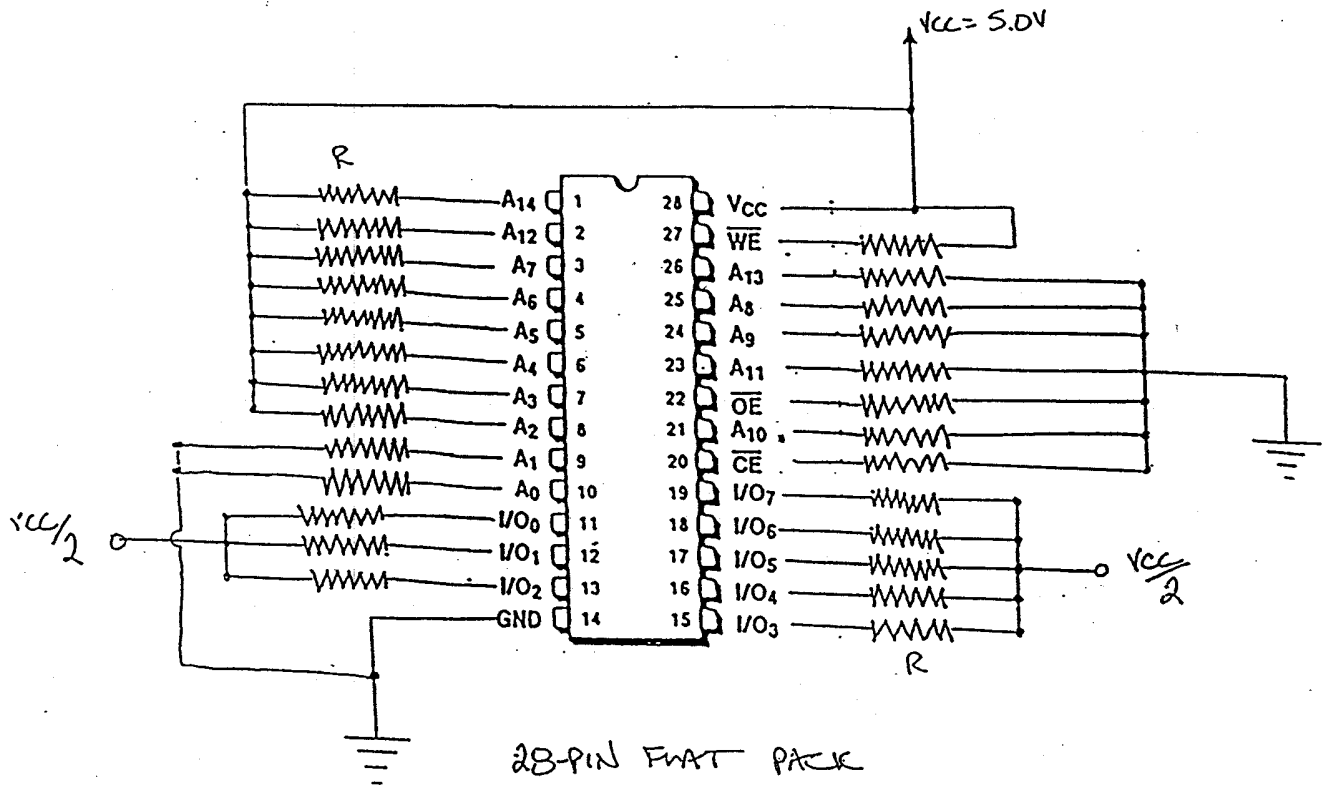
After annealing for 312 hours at 25°C, the following changes in the functional test results were observed: S/N 61 passed Functional Test # 8, S/N 62 failed Functional Tests # 1, 2, 3, 7 and 10, S/N 63 showed no change, S/N 64 failed FunctionalTest # 4 and S/N 65 passed FunctionalTest # 9. No recovery was observed in any of the parametric tests.

After annealing for 168 hours at 100°C, S/N 62 and 64 failed Functional Tests # 1, 2, 3, 6, 9 and 12. All other irradiated parts passed all functional tests. No rebound effects were 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.

Figure 1. Radiation Bias Circuit for 28C256



1) Vcc = +5.0 VDC ± 0.5 VDC, Vcc/2 = 2.5 VDC ± 0.25 VDC

2) All resistors R = ~~2.0K~~ 3.3K Ohms ± 10%, 1/4 W

TABLE I. Part Information

Generic Part Number:	28C256*
AXAF/Gulton Part Number	28C256EFY-25
AXAF/Gulton Control Number:	14509
Charge Number:	ER61108
Manufacturer:	SEI
Lot Date Code (LDC):	9543
Quantity Tested:	6
Serial Number of Control Samples:	60
Serial Numbers of Radiation Samples:	61, 62, 63, 64, 65
Part Function:	EEPROM
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 28C256

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	11/16/95
2) 1 KRAD IRRADIATION (0.59 KRADS/HOUR)	11/16/95
POST-1 KRAD ELECTRICAL MEASUREMENT	11/17/95
3) 2 KRAD IRRADIATION (0.59 KRADS/HOUR)	11/17/95
POST-2 KRAD ELECTRICAL MEASUREMENT	11/21/95
4) 3 KRAD IRRADIATION (0.59 KRADS/HOUR)	11/21/95
POST-3 KRAD ELECTRICAL MEASUREMENT	11/22/95
5)4 KRAD IRRADIATION (0.59 KRADS/HOUR)	11/27/95
POST-4 KRAD ELECTRICAL MEASUREMENT	11/28/95
6) 5 KRAD IRRADIATION (0.59 KRADS/HOUR)	11/28/95
POST-5 KRAD ELECTRICAL MEASUREMENT	11/29/95
7) 6 KRAD IRRADIATION (0.59 KRADS/HOUR)	11/29/95
POST-6 KRAD ELECTRICAL MEASUREMENT	11/30/95
8) 7 KRAD IRRADIATION (0.59 KRADS/HOUR)	11/30/95
POST-7 KRAD ELECTRICAL MEASUREMENT	12/01/95
9) 8 KRAD IRRADIATION (0.59 KRADS/HOUR)	12/03/95
POST-8 KRAD ELECTRICAL MEASUREMENT	12/04/95
10) 24-HOUR ANNEALING @25°C	12/04/95
POST-24 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/05/95
11) 168-HOUR ANNEALING @25°C	12/05/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/11/95
12) 336-HOUR ANNEALING @25°C	12/11/95
POST-336 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/18/95
13) 9 KRAD IRRADIATION (0.59 KRADS/HOUR)	12/18/95
POST-9 KRAD ELECTRICAL MEASUREMENT	12/19/95
14) 10 KRAD IRRADIATION (0.50 KRADS/HOUR)	12/19/95
POST-10 KRAD ELECTRICAL MEASUREMENT	12/20/95
15) 312-HOUR ANNEALING @25°C	12/21/95
POST-312 HOUR ANNEAL ELECTRICAL MEASUREMENT	01/02/96
16) 192-HOUR ANNEALING @ 100°C	01/03/96
POST-192-HOUR ANNEAL ELECTRICAL MEASUREMENT	01/11/96

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

Table III. Electrical Characteristics of 28C256

PVT OR INITIAL EM'S FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	PATTERN	CONDITIONS	PINS	LIMITS
FUNCT # 1	4.5V	0.0V	4.5V	WR/RD ZEROS	FREQ=0.5 MHZ	I/O'S	VOL<1.0V , VOH>2.0V
FUNCT # 2	4.5V	0.0V	4.5V	WR/RD ONES	FREQ=0.5 MHZ	I/O'S	VOL<1.0V , VOH>2.0V
FUNCT # 3	4.5V	0.0V	4.5V	WR/RD CHKBD	FREQ=0.5 MHZ	I/O'S	VOL<1.0V , VOH>2.0V
FUNCT # 4	5.5V	0.0V	5.5V	WR/RD ZEROS	FREQ=0.5 MHZ	I/O'S	VOL<1.0V , VOH>2.0V
FUNCT # 5	5.5V	0.0V	5.5V	WR/RD ONES	FREQ=0.5 MHZ	I/O'S	VOL<1.0V , VOH>2.0V
FUNCT # 6	5.5V	0.0V	5.5V	WR/RD CHKBD	FREQ=0.5 MHZ	I/O'S	VOL<1.0V , VOH>2.0V

POST RADIATION/ANNEALING EM'S FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	PATTERN	CONDITIONS	PINS	LIMITS
FUNCT # 1	4.5V	0.0V	4.5V	READ CHKBD	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT # 2	5.0V	0.0V	5.0V	READ CHKBD	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT # 3	5.5V	0.0V	5.5V	READ CHKBD	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT # 4	4.5V	0.0V	4.5V	WR/RD ZEROS	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT # 5	4.5V	0.0V	4.5V	WR/RD ONES	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT # 6	4.5V	0.0V	4.5V	WR/RD CHKBD	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT # 7	5.0V	0.0V	5.0V	WR/RD ZEROS	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT # 8	5.0V	0.0V	5.0V	WR/RD ONES	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT # 9	5.0V	0.0V	5.0V	WR/RD CHKBD	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT #10	5.5V	0.0V	5.5V	WR/RD ZEROS	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT #11	5.5V	0.0V	5.5V	WR/RD ONES	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V
FUNCT #12	5.5V	0.0V	5.5V	WR/RD CHKBD	FREQ=0.5 MHZ	I/O'S	VOL<1.0V, VOH>2.0V

DC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
VOL	4.5V	0.8V	2.0V	LOAD = +2.1MA	OUTS	> 0.0V , < 0.45V
VOH	4.5V	0.8V	2.0V	LOAD = -400UA	OUTS	> 2.4V , < 4.5V
IIL	5.5V	0.1V	5.5V	TSTV = +0.1V	INS	>-100NA , <+100NA
IIH	5.5V	0.0V	5.5V	TSTV = +5.5V	INS	>-100NA , <+100NA
IOZL	5.5V	0.1V	5.5V	TSTV = +0.1V	OUTS	>-500NA , <+500NA
IOZH	5.5V	0.0V	5.5V	TSTV = +5.5V	OUTS	>-500NA , <+500NA
IOE	5.5V	0.0V	5.5V	TSTV = +13.0V	OE	>-10UA , <+100UA
ICC1	5.5V	0.0V	5.5V	FREQ = 5.0MHZ	VCC	> 0MA , < 80MA
ICCL2	5.5V	0.8V	2.0V	CE=VIH, VI&OE=VIL	VCC	> 0MA , < 3MA
ICCH2	5.5V	0.8V	2.0V	VI&CE=VIH, OE=VIL	VCC	> 0MA , < 3MA
ICCL3	5.5V	0.0V	5.2V	CE=VIH, VI=VIL	VCC	> 0UA , < 350UA
ICCH3	5.5V	0.0V	5.2V	CE=VIH, VI=VIH	VCC	> 0UA , < 350UA

SPECIAL COMMENTS AND EXCEPTIONS

(1) VIL & VIH TESTS PERFORMED WITHIN VOL & VOH TEST GO/NOGO.
(2) TEST NOT PERFORMED : CIN & COUT DYNAMIC CAPACITANCE TESTS.

TABLE IV: Summary of Functional Measurements after Total Dose Exposures and Annealing for 28C256 /1

#	Functional Tests /2	Pattern	Initial	
1	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD 0's	P	
2	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD 1's	P	
3	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD CHKBD	P	
4	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD 0's	P	
5	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD 1's	P	
6	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD CHKBD	P	

#	Functional Tests /3, 4	Pattern	Total Dose Exposure (TDE) (krads) 1		2		3		4		5	
1	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	READ CHKBD	P		P		P		P		P	
2	Vcc=5.0V,Vil=0.0V,Vih=5.0V,Freq.=0.5MHz	READ CHKBD	P		P		P		P		P	
3	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	READ CHKBD	P		P		P		P		P	
4	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD 0's	P		P		P		P		P	
5	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD 1's	P		P		P		P		P	
6	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD CHKBD	P		P		P		P		P	
7	Vcc=5.0V,Vil=0.0V,Vih=5.0V,Freq.=0.5MHz	WR/RD 0's	P		P		P		P		P	
8	Vcc=5.0V,Vil=0.0V,Vih=5.0V,Freq.=0.5MHz	WR/RD 1's	P		P		P		P		P	
9	Vcc=5.0V,Vil=0.0V,Vih=5.0V,Freq.=0.5MHz	WR/RD CHKBD	P		P		P		P		P	
10	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD 0's	P		P		P		P		P	
11	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD 1's	P		P		P		P		P	
12	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD CHKBD	P		P		P		P		P	

Notes:

1/ The mean and standard deviation values were calculated over the five 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/ After the first (1 krad) irradiation, a modified set of functional tests was used (see text).

5/ 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.

TABLE IV(Cont'd.): Summary of Functional Measurements after Total Dose Exposures and Annealing for 28C256 /1

#	Functional Tests /3, 4	Pattern	TDE (krads) 6	7	8	Annealing 24 hrs. @ 25°C	168 hrs. @ 25°C	336 hrs. @ 25°C	TDE (krads) 9	10	Annealing 312 hrs. @ 25°C	192 hrs. @ 100°C
1	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	READ CHKBD	P	P	4P1F	2P3F	2P3F	2P3F	2P3F	2P3F	1P4F	3P2F
2	Vcc=5.0V,Vil=0.0V,Vih=5.0V,Freq.=0.5MHz	READ CHKBD	P	P	4P1F	2P3F	2P3F	2P3F	2P3F	2P3F	1P4F	3P2F
3	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	READ CHKBD	P	P	4P1F	2P3F	2P3F	2P3F	2P3F	2P3F	1P4F	3P2F
4	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD 0's	P	P	P	P	P	P	P	4P1F	P	P
5	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD 1's	P	P	P	P	P	P	1P4F	F	F	P
6	Vcc=4.5V,Vil=0.0V,Vih=4.5V,Freq.=0.5MHz	WR/RD CHKBD	P	P	2P3F	2P3F	2P3F	2P3F	2P3F	F	F	3P2F
7	Vcc=5.0V,Vil=0.0V,Vih=5.0V,Freq.=0.5MHz	WR/RD 0's	P	P	P	P	P	P	P	P	4P1F	P
8	Vcc=5.0V,Vil=0.0V,Vih=5.0V,Freq.=0.5MHz	WR/RD 1's	P	P	P	P	P	P	4P1F	F	1P4F	P
9	Vcc=5.0V,Vil=0.0V,Vih=5.0V,Freq.=0.5MHz	WR/RD CHKBD	P	P	2P3F	2P3F	2P3F	2P3F	2P3F	F	1P4F	3P2F
10	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD 0's	P	P	P	P	P	P	P	P	4P1F	P
11	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD 1's	P	P	P	P	P	P	P	1P4F	1P4F	P
12	Vcc=5.5V,Vil=0.0V,Vih=5.5V,Freq.=0.5MHz	WR/RD CHKBD	P	P	2P3F	2P3F	2P3F	2P3F	2P3F	1P4F	1P4F	3P2F

Notes:

1/ The mean and standard deviation values were calculated over the five 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/ After the first (1 krad) irradiation, a modified set of functional tests was used (see text).

5/ 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.

TABLE IV(Cont'd.): Summary of Parametric Measurements after Total Dose Exposures and Annealing for 28C256 /1

					Total Dose Exposure (TDE) (krads)																	
			Spec. Lim./2, 5		Initial		1		2		3		4		5		6		7		8	
#	Parameters	Units	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	VOL/2	mV	0	450	84.0	1.2	83.8	1.5	84.0	1.5	84.2	1.6	84.4	1.7	84.0	2.2	84.1	1.9	84.2	1.5	3P3F	
2	VOH	V	2.4	4.5	3.66	.02	3.66	.02	3.66	.02	3.67	.02	3.67	.02	3.67	.01	3.67	.02	3.68	.02	3.68	.02
3	IIL	µA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	IIH	µA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	IOZL	µA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	IOZH	µA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	IOE	µA	-10	100	7.90	.30	8.03	.30	8.10	.30	8.15	.30	8.17	.29	8.25	.30	8.31	.30	8.38	.30	8.44	.27
8	ICC1	mA	0	80	7.44	.22	7.60	.19	7.57	.22	7.65	.23	7.66	.19	7.72	.24	7.79	.19	7.87	.18	7.29	.74
9	ICCL2	mA	0	3	1.78	.07	1.74	.06	1.73	.07	1.70	.07	1.67	.06	1.66	.07	1.64	.06	1.64	.08	1.65	.09
10	ICCH2	mA	0	3	1.78	.07	1.74	.07	1.73	.07	1.71	.07	1.68	.06	1.67	.06	1.65	.06	1.63	.07	1.64	.10
11	ICCL3	µA	0	350	33.6	4.9	35.2	7.7	40.4	7.1	37.2	4.0	38.8	6.0	42.0	7.5	31.8	4.0	52.8	27	77.2	72
12	ICCH3	µA	0	350	40.4	7.1	37.2	4.0	30.0	0	35.4	4.9	40.2	9.3	33.4	9.9	40.6	9.4	56.2	30	79.0	71

Notes:

1/ The mean and standard deviation values were calculated over the five 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/ After the first (1 krad) irradiation, a modified set of functional tests was used (see text).

5/ 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.

TABLE IV(Cont'd.): Summary of Parametric Measurements after Total Dose Exposures and Annealing for 28C256 /1

			Spec. Lim./2, 5		Annealing						TDE (krads)				Annealing			
					24 hrs. @ 25°C		168 hrs. @ 25°C		336 hrs. @ 25°C		9		10		312 hrs. @ 25°C		192 hrs. @ 100°C	
#	Parameters	Units	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	VOL	mV	0	450	3P3F		3P3F		3P3F		3P3F		2P4F		1P4F		3P2F	
2	VOH	V	2.4	4.5	3.68	.02	3.68	.02	3.68	.02	3.67	.02	3.68	.02	3.67	.02	3.58	.04
3	IIL	µA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	IIH	µA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	IOZL	µA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	IOZH	µA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	IOE	µA	-10	100	8.45	.29	8.45	.29	8.45	.29	8.42	.26	8.51	.26	8.45	.25	8.10	.24
8	ICC1	mA	0	80	7.28	.76	7.28	.76	7.28	.76	6.19	2.7	7.26	.54	7.20	.53	7.23	.69
9	ICCL2	mA	0	3	1.64	.10	1.64	.10	1.64	.10	1.65	.14	1.71	.23	1.68	.21	1.57	.09
10	ICCH2	mA	0	3	1.65	.10	1.65	.10	1.65	.10	1.65	.15	1.72	.24	1.67	.21	1.57	.08
11	ICCL3	µA	0	350	77.2	73	77.2	73	77.2	73	107	131	185	227	148	194	53.6	27
12	ICCH3	µA	0	350	78.8	72	78.8	72	78.8	72	109	121	189	225	152	193	43.2	23

Notes:

1/ The mean and standard deviation values were calculated over the five 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/ After the first (1 krad) irradiation, a modified set of functional tests was used (see text).

5/ 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.