

Unisys

DATE: July 16, 1998
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SUBJECT: Radiation Report on **28C256 (SEEQ/AMTEL) (LDC 9133)**
PROJECT: EOS PM Support

PPM-98-023

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A radiation evaluation was performed on **28C256 32k x 8 EEPROM (SEEQ/AMTEL)** to determine the total dose tolerance of these parts. The total dose testing was performed using a Co⁶⁰ 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 1.0, 2.0, 3.0, 4.5, 6.0, 10.0, 12.5, 15.0, and 25.0 kRads.¹ The dose rate was 0.048 kRads/hour (0.01 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 25.0 kRad irradiation, the parts were annealed under bias at 25°C and tested after 168 hours.² After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits³ listed in Table III. The functional tests used in this testing were Read Checkerboard, Write/Read Zeros, Write/Read Ones, and Write/Read Checkerboard. These tests are run before the parametric tests; also, following the parametric tests, Write/Read Checkerboard is repeated to leave the checkerboard pattern in memory during the radiation step.

An executive summary of the test results is provided below in bold, followed by a detailed summary of the test results after each radiation level and annealing step. For detailed information, refer to Tables I through IV and Figure 1.

All parts stayed within the specification limits for all tests through 20kRads. After 25kRads, one part failed the W/R All Ones Functional test. After annealing for 168 hours at 25°C the failing part recovered and all parts passed all functional and parametric tests.

Initial electrical measurements were made on 5 samples. Four samples (SN's 81, 82, 83, and 84) were used as radiation samples while SN 80 was used as a control sample. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 20 kRads.

After the 25.0 kRad irradiation, SN 84 failed W/R All Ones functional tests. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, SN 84 recovered and passed the W/R All One functional test.

Table IV provides a summary of the test results with 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 us at (301) 731-8954.

¹ The term Rads, as used in this document, means Rads (silicon). All radiation levels cited are cumulative.

² The temperature 25°C as used in this document implies room temperature.

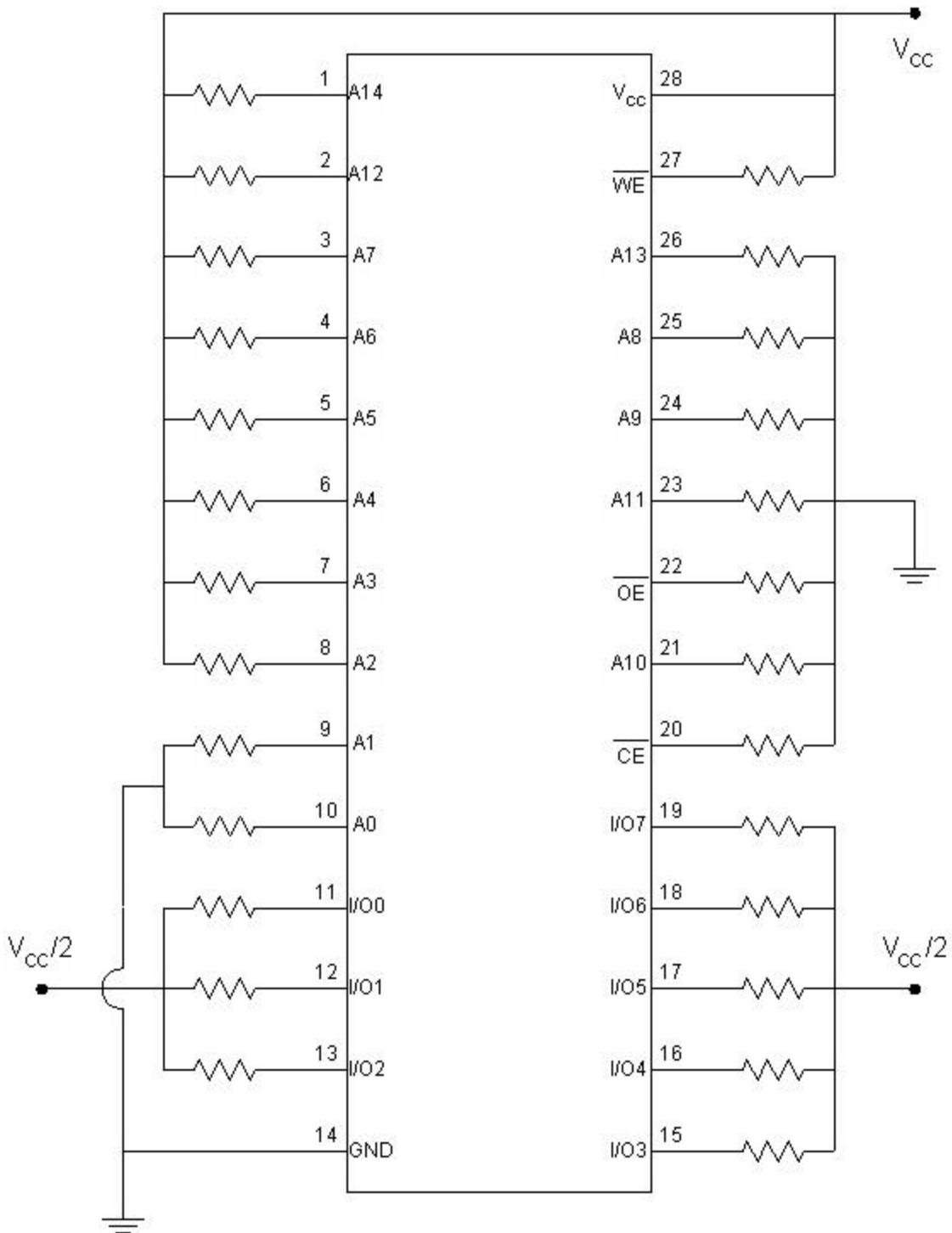
³ These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for 28C256



Notes:

1. $V_{CC} = +5.0V \pm 0.5V$.
2. $V_{CC}/2 = +2.5V \pm 0.25V$.
3. $R = 3.3k\Omega \pm 10\%$, $1/4W$.

TABLE I. Part Information

Generic Part Number:	28C256
EOS PM Support Part Number	28C256
Charge Number:	C80925
Manufacturer:	SEEQ/AMTEL
Lot Date Code (LDC):	9133
Quantity Tested:	5
Serial Number of Control Samples:	80
Serial Numbers of Radiation Samples:	81, 82, 83, and 84
Part Function:	32k X 8 EEPROM
Part Technology:	CMOS
Package Style:	28 Pin Flat Pack
Test Equipment:	A540
Test Engineer:	S. Archer-Davies/A. Duvalsaint

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for 28C256

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	06/25/98
2) 1.0 KRAD IRRADIATION (0.059 KRADS/HOUR)	06/25/98
POST-1.0 KRAD ELECTRICAL MEASUREMENT	06/26/98
3) 2.0 KRAD IRRADIATION (0.059 KRADS/HOUR)	06/26/98
POST-2.0 KRAD ELECTRICAL MEASUREMENT	06/29/98
4) 3.0 KRAD IRRADIATION (0.059 KRADS/HOUR)	06/29/98
POST-3.0 KRAD ELECTRICAL MEASUREMENT	06/30/98
5) 4.5 KRAD IRRADIATION (0.088 KRADS/HOUR)	06/30/98
POST-4.5 KRAD ELECTRICAL MEASUREMENT	07/01/98
6) 6.0 KRAD IRRADIATION (0.088 KRADS/HOUR)	07/01/98
POST-6.0 KRAD ELECTRICAL MEASUREMENT	07/02/98
7) 10.0 KRAD IRRADIATION (0.045 KRADS/HOUR)	07/02/98
POST-10.0 KRAD ELECTRICAL MEASUREMENT	07/06/98
8) 12.5 KRAD IRRADIATION (0.147 KRADS/HOUR)	07/06/98
POST-12.5 KRAD ELECTRICAL MEASUREMENT	07/07/98
9) 15.0 KRAD IRRADIATION (0.147 KRADS/HOUR)	07/07/98
POST-15.0 KRAD ELECTRICAL MEASUREMENT	07/08/98
10) 25.0 KRAD IRRADIATION (0.588 KRADS/HOUR).....	07/08/98
POST-25.0 KRAD ELECTRICAL MEASUREMENT	07/09/98
11) 168 HOUR ANNEALING @25°C	07/09/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	07/16/98

Effective Dose Rate = 25,000 RADS/14 DAYS=74.4 RADS/HOUR=0.02 RADS/SEC

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

Table III. Electrical Characteristics of 28C256 /1

Test #	Parameter /2	Units	Test Conditions	Spec. Lim.	
				min	max
10-40	Read Checkerboard	P/F	$V_{CC} = 5V, V_{IL} = 0V, V_{IH} = 3V, V_{OL} = V_{OH} = 1.5V$		
100-130	W/R All Ones	P/F	$V_{CC} = 5V, V_{IL} = 0V, V_{IH} = 3V, V_{OL} = V_{OH} = 1.5V$		
200-230	W/R All Zeros	P/F	$V_{CC} = 5V, V_{IL} = 0V, V_{IH} = 3V, V_{OL} = V_{OH} = 1.5V$		
300-330	W/R Checkerboard	P/F	$V_{CC} = 5V, V_{IL} = 0V, V_{IH} = 3V, V_{OL} = V_{OH} = 1.5V$		
340	Icc1	mA	$V_{CC} = 5.5V, CE = OE = 0V, WE = 5V, f = 5MHz$	0	80
350	Icc2	mA	$V_{CC} = 5.5V, CE = 2V, OE = 0.8V, WE = 5.2V$	0	3.0
400	Icc3	mA	$V_{CC} = 5.5V, CE = 5.2V, OE = WE = 5.2V$	0	350
500-517	IIH	mA	$V_{CC} = 5.5V, V_{IN} = 5.5V$	-10.0	10.0
600-617	IIIL	mA	$V_{CC} = 5.5V, V_{IN} = 0.1V$	-10.0	10.0
700-705	IOZH	mA	$V_{CC} = 5.5V, CE = 2V, V_{OUT} = 5.5V$	-10.0	10.0
800-805	IOZL	mA	$V_{CC} = 5.5V, CE = 2V, V_{OUT} = 0.1V$	-10.0	10.0
900-905	VOH	V	$V_{CC} = 4.5V, V_{IH} = 2V, V_{IL} = 0.8V, I_{OH} = -400mA$	2.40	
950-955	VOL	mV	$V_{CC} = 4.5V, V_{IH} = 2V, V_{IL} = 0.8V, I_{OL} = 2.1mA$		450
960-990	W/R Checkerboard	P/F	$V_{CC} = 5V, V_{IL} = 0V, V_{IH} = 3V, V_{OL} = V_{OH} = 1.5V$		

Notes:

1/ These are the manufacturer's non-irradiated data sheet specification limits. The manufacturer provided no post-irradiation limits at the time the tests were performed.

2/ For all tests, $+V_{IN} = 15V$, except where otherwise noted.

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

Test #	Parameters /3	Units	Spec. Lim. /2		Total Dose Exposure (kRads Si)																				Annealing	
					Initial		1.0		2.0		3.0		4.5		6.0		10.0		12.5		15.0		25.0		168 hours @25°C	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
10-40	Read Checkerboard	P/F			P		P		P		P		P		P		P		P		P		P		P	
100-130	W/R All Ones	P/F			P		P		P		P		P		P		P		P		P		3P/1F		P	
200-230	W/R All Zeros	P/F			P		P		P		P		P		P		P		P		P		P		P	
300-330	W/R Checkerboard	P/F			P		P		P		P		P		P		P		P		P		P		P	
340	Icc1	mA	0	80	6.3	0.2	6.3	0.2	6.3	0.2	6.2	0.1	6.4	0.2	6.5	0.2	6.7	0.2	6.9	0.2	7.0	0.2	7.3	0.2	7.3	0.2
350	Icc2	mA	0	3.0	1.2	0	1.2	0	1.2	0	1.2	0	1.2	0	1.1	0	1.1	0.1	1.1	0.1	1.1	0.1	1.0	0.1	1.0	0.1
400	Icc3	?A	0	350	47	10	49	11	50	6	40	6	43	4	52	12	43	13	47	10	46	9	43	10	53	16
500-517	IIH	?A	-10.0	10.0	1.7	0	1.7	0	1.7	0	1.6	0	1.1	0	1.1	0.1	1.1	0	1.2	0	1.0	0	1.4	0.1	1.0	0
600-617	III	?A	-10.0	10.0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0	-0.2	0	-0.2	0	-0.3	0	-0.3	0.2	0.2	0	-0.3	0
700-705	IOZH	?A	-10.0	10.0	2.3	0	2.1	0	1.9	0	1.8	0.1	1.4	0	1.3	0.1	1.3	0	1.4	0	1.1	0	1.6	0.1	1.1	0
800-805	IOZL	?A	-10.0	10.0	0.2	1.2	-1.2	0.5	-0.9	0	-0.6	0.4	0.7	0.5	0.5	0.6	-1.0	0.2	-1.0	0.5	-1.0	0.4	-0.6	0.4	0.9	0.5
900-905	VOH	V	2.4		3.1	0.3	3.2	0.3	3.2	0.3	3.3	0.1	3.4	0.1	3.7	0	3.6	0.1	3.7	0	3.7	0	3.7	0	3.7	0
950-955	VOL	mV		450	63	2	61	2	61	2	61	6	62	5	59	3	61	4	60	5	61	3	60	5	59	3
960-990	W/R Checkerboard	P/F			P		P		P		P		P		P		P		P		P		P		P	

- Notes:
- 1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing. The control samples remained constant throughout testing and are not included in this table.
 - 2/ 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.
 - 3/ "P" ("F") implies all parts passed (failed) this test at this level. nPmF implies that "n" parts passed and "m" parts failed this test at this level.

Radiation sensitive parameter: W/R All Ones.