

# Unisys

DATE: May 08, 1998 PPM-98-013  
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SUBJECT: Radiation Report on: **R29773 PROM (Fairchild/Raytheon) (LDC 9347)**  
PROJECT: GOES (ITT)

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A radiation evaluation was performed on **R29773 PROM (Fairchild/Raytheon)** to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. The total dose testing was performed using a Co<sup>60</sup> gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration) and two parts were used as control samples. The total dose radiation levels were 20.0, 40.0, 60.0, 80.0, 100.0, 150.0, and 200.0 kRads.<sup>1</sup> The dose rate was 1.200 kRads/hour (0.33 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 200.0 kRad irradiation, the parts were annealed under bias at 25°C and tested after 4, 24 and 168 hours.<sup>2</sup> After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits<sup>3</sup> listed in Table III. A brief summary is provided below, for detailed information, refer to Tables I through IV and Figure 1.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 473, 490, 501, 778, 781, 790, 846, and 853) were used as radiation samples while SN's 796 and 798 were used as control samples.

**All parts passed all tests through 200kRads. No significant change was noted in any parameter.**

After annealing the parts for 4, 24 and 168 hours at 25°C, parts showed no significant change in any parameter.

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.

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

<sup>2</sup> The temperature 25°C used in this document refers to room temperature.

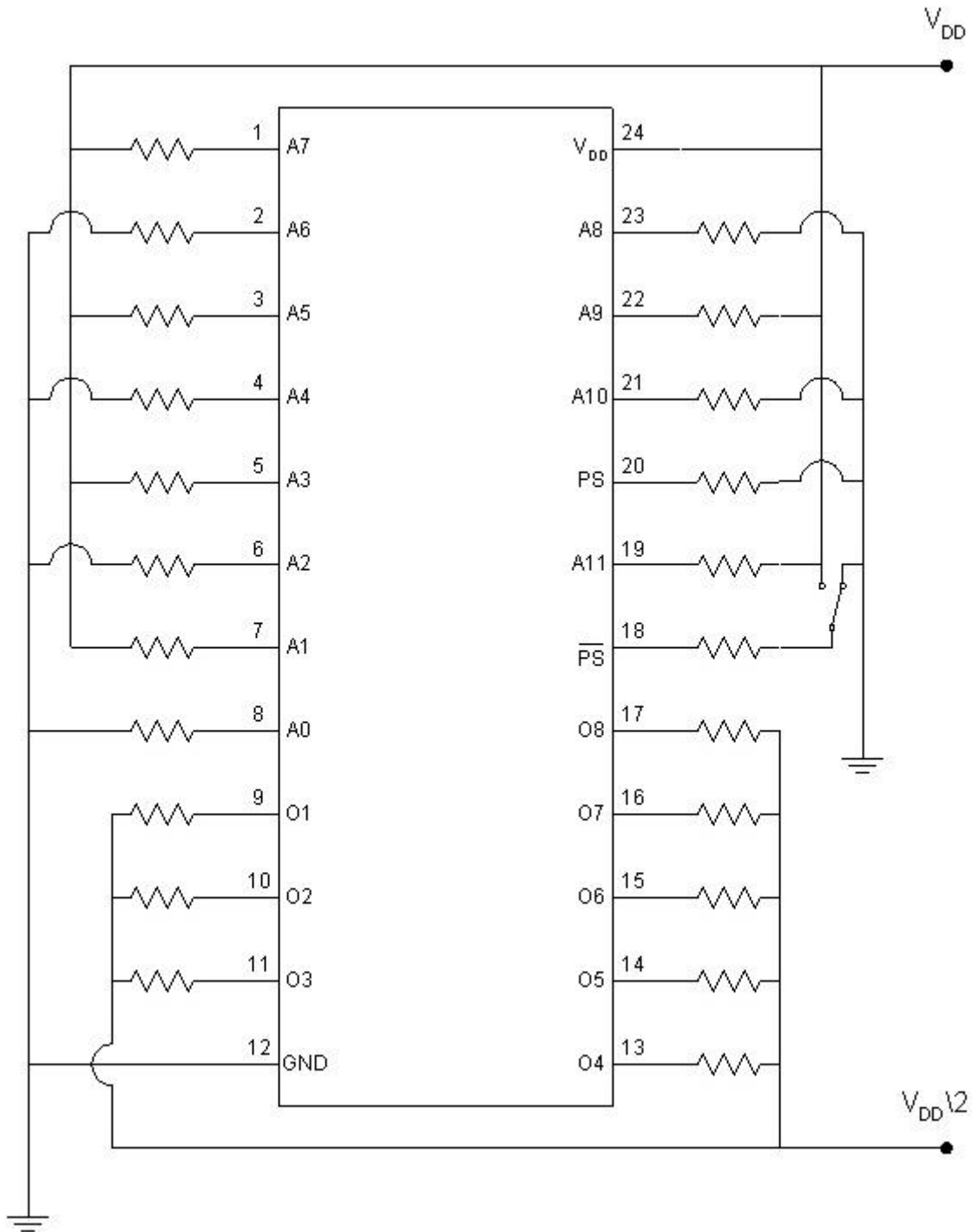
<sup>3</sup> These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for R29773 PROM



Notes:

1.  $R_L = 2k\Omega \pm 5\%$ ,  $\frac{1}{2}W$ .
2.  $V_{DD} = +5.0V \pm 0.5v$ ,  $V_{DD}/2 = +2.5V \pm 0.5V$ .
3. Pin 18 must be momentarily switched from GND to  $V_{DD}$  before each radiation exposure or annealing step.

TABLE I. Part Information

Generic Part Number:	R29773 PROM
GOES ITT Part Number	R29773 PROM
Charge Number:	C80709/C80825
Manufacturer:	Fairchild/Raytheon
Lot Date Code (LDC):	9347
Quantity Tested:	10
Serial Number of Control Samples:	796, 798
Serial Numbers of Radiation Samples:	473, 490, 501, 778, 781, 790, 846, and 853
Part Function:	2 x 8k PROM
Part Technology:	Bipolar
Package Style:	24 Pin DIP
Test Equipment:	A540
Test Engineer:	S. Archer-Davies

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

TABLE II. Radiation Schedule for R29773 PROM

EVENT .....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	04/10/98
2) 20.0 KRAD IRRADIATION (1.200 KRADS/HOUR) .....	04/13/98
POST-20.0 KRAD ELECTRICAL MEASUREMENT .....	04/14/98
3) 40.0 KRAD IRRADIATION (1.200 KRADS/HOUR) .....	04/14/98
POST-40.0 KRAD ELECTRICAL MEASUREMENT .....	04/15/98
4) 60.0 KRAD IRRADIATION (1.200 KRADS/HOUR) .....	04/15/98
POST-60.0 KRAD ELECTRICAL MEASUREMENT .....	04/16/98
5) 72 HOUR ANNEALING @25°C * .....	04/16/98
POST-72 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	04/20/98
6) 80.0 KRAD IRRADIATION (1.200 KRADS/HOUR) .....	04/20/98
POST-80.0 KRAD ELECTRICAL MEASUREMENT .....	04/21/98
7) 100.0 KRAD IRRADIATION (1.200 KRADS/HOUR) .....	04/21/98
POST-100.0 KRAD ELECTRICAL MEASUREMENT .....	04/22/98
8) 150.0 KRAD IRRADIATION (1.200 KRADS/HOUR) .....	04/22/98
POST-150.0 KRAD ELECTRICAL MEASUREMENT .....	04/24/98
9) 200.0 KRAD IRRADIATION (0.450 KRADS/HOUR) ** .....	04/24/98
POST-200.0 KRAD ELECTRICAL MEASUREMENT .....	04/27/98
10) 4 HOUR ANNEALING @25°C .....	04/27/98
POST-4 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	04/27/98
11) 24 HOUR ANNEALING @25°C .....	04/27/98
POST-24 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	04/28/98
12) 168 HOUR ANNEALING @25°C .....	04/27/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	05/04/98

Effective Dose Rate = 200,000 RADS/14 DAYS=595.2 RADS/HOUR=0.17 RADS/SEC

The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim-annealing step.

\* This 72 hour annealing step was added to maintain the prescribed dose rate due to the weekend.

\*\* The dose rate was adjusted to allow the parts to receive radiation dose over the weekend.

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

Table III. Electrical Characteristics of R29773 PROM /1

Test #	Parameter	Units	Test Conditions	Spec. min	Lim. max
100	functional test		/2		
200-207	VOH	V	$V_{CC} = 4.5V, I_{OH} = -2.0mA, V_{IN} = V_{IH} \text{ or } V_{IL}$	2.40	
300-307	VOL	mV	$V_{CC} = 4.5V, I_{OH} = 16mA, V_{IN} = V_{IH} \text{ or } V_{IL}$		500
400-413	IIH	$\mu A$	$V_{CC} = 5.5V, V_{IN} = 5.5V$	-40	40
500-513	IIL	$\mu A$	$V_{CC} = 5.5V, V_{IN} = 0.4V$	-100	100
600-607	IOS	mA	$V_{CC} = 5.5V, V_{OUT} = 0.2V$	-85	-15
700-711	VIC	V	$V_{CC} = 4.5V, I_{IN} = -18mA$	-1.20	0.00
800-807	IOZH	$\mu A$	$V_{CC} = 5.5V, \text{chip disabled}$	-40	40
900-907	IOZL	$\mu A$	$V_{CC} = 5.5V, \text{chip disabled}$	-40	40
950	IDD_CHIP_ENABLED	mA	$V_{CC} = 5.5V, PS_{10} = 0V, PS_2 = 5V$	0	195
951	IDD_CHIP_DISABLED	mA	$V_{CC} = 5.5V, PS_{10} = 5V, PS_2 = 0V$	0	55

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/ The parts were programmed with a random (4kx8) pattern using the 'C' compiler's **rand** algorithm before irradiation. A total of 4096 random numbers in the range 0 to 255 were generated and then converted into an 8-bit binary representation. This information was then written to the device for use in this test. The functional test consisted of verifying the test pattern after each radiation or annealing step.

**TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for R29773 PI**

Test #	Parameters	Unit	Spec. Lim. /2 min max		Total Dose Exposure (kRads Si)												Annealing											
					Initial		20.0		40.0		60.0		72 hours @25°C		80.0		100.0		150.0		200.0		4 hours @25°C		24 hours @25°C		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	mean	sd
100	functional test			0	P		P		P		P		P		P		P		P		P		P		P		P	
200-207	VOH	V	2.40		2.79	0.01	3.05	0.01	2.79	0.01	2.79	0.01	2.80	0.01	2.80	0.01	2.80	0.01	2.80	0.01	2.81	0.01	2.80	0.01	2.79	0.01	2.79	0.01
300-307	VOL	mV		500	370	5.2	416	4.9	369	5.6	369	5.4	370	5.4	370	6.1	370	5.4	371	5.4	372	6.8	371	5.0	371	6.9	374	5.6
400-413	IIH	?A	-40	40	1	0.1	2	0.1	3	0.1	3	0.1	1	0.4	1	0.3	1	0.3	1	0.3	0	0.3	0	0.3	0	0.3	0	0.3
500-513	IIL	?A	-100	100	-19	0.6	-22	0.7	-20	0.5	-20	0.5	-20	0.5	-20	0.5	-20	0.6	-20	0.6	-20	0.5	-20	0.5	-20	0	-20	0
600-607	IOS	mA	-85	-15	-35	1	-39	1	-35	1	-35	1	-35	1	-35	1	-35	1	-34	1	-35	1	-34	1	-34	1	-33	1
700-711	VIC	V	-1.20	0.00	-0.44	0	-0.48	0	-0.43	0	-0.43	0	-0.43	0	-0.42	0	-0.42	0	-0.42	0	-0.40	0	-0.42	0	-0.42	0	-0.42	0
800-807	IOZH	?A	-40	40	8	0.1	10	0.1	9	0.1	9	0.1	8	0.1	8	0.1	7	0.1	7	0.1	7	0.1	7	0.1	7	0.1	7	0
900-907	IOZL	?A	-40	40	2	0.1	2	0.1	2	0.1	2	0.1	2	0.1	2	0.1	2	0.1	2	0.1	1	0.2	2	0.1	2	0.1	2	0.1
950	IDD_CHIP_ENABL	mA	0	195	168	1.8	189	2.1	167	1.8	167	1.8	167	1.8	166	1.8	166	1.9	165	1.9	164	2.0	164	1.9	164	2.0	159	1.9
951	IDD_CHIP_DISABL	mA	0	55	49	0.5	55	0.7	49	0.5	48	0.5	48	0.5	48	0.5	48	0.5	48	0.6	48	0.6	48	0.5	48	0.6	48	0.6

- Notes:
- 1/ The mean and standard deviation values were calculated over the eight 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.

**Radiation sensitive parameters: None.**