Federal Systems

C:\RDREP300\315.DOC

Unisys Corporation
4700 Boston Way
Lanham MD 20706

Telephone
301 731 8600

UNISYS

DATE: May 5, 1997

PPM-97-019

TO: J.Lohr/311

FROM: K. Sahu/300.1 KS

SUBJECT: Radiation Report on: OP27
Project: SMEX-LITE
Job #: EV78111
Project part #: OP27 (M38510/13503BGA)

cc: M. Delmont/303
A. Reyes/OSC
A. Sharma/311
OFA Library/300.1

A radiation evaluation was performed on OP27 (M38510/13503BGA) 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, 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 2.5, 5.0, 10.0, 15.0, 20.0, 30.0, and 50.0 kRads.* The dose rate was between 0.06 and 0.50 kRads/hour (see Table II for radiation schedule). After the 50.0 kRad exposure, the parts were annealed for 168 hours at 25°C. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits** listed in Table III.

Initial electrical measurements were made on 8 samples. Six samples (SN's 182, 183, 184, 185, 186, and 187) were used as radiation samples while SN's 180 and 181 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests upon irradiation to 20.0 kRads.

After 30.0 kRads, all parts except SN185 exceeded the specification limits for both P_IIB and N_IIB. Readings were in the range of 38.3 to 55.6nA for P_IIB and 36.7 to 54.4nA for N_IIB, against a specification limit of 40.0nA. All parts passed all other tests at this level.

After 50.0 kRads, all parts failed both P_IIB and N_IIB with readings in the range of 112 to 147nA and 110 to 144nA respectively. All parts passed all other tests.

After annealing the parts for 168 hours at 25°C, the parts showed some recovery in P_IIB and N_IIB, but still failed to meet the specifications for both parameters. Readings were in the range of 57 to 72nA for P_IIB and 55 to 69nA for N_IIB. All parts passed all other tests.

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 me at (301) 731-8954.

---

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

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

ADVISORY ON THE USE OF THIS DOCUMENT

The information contained in this document has been developed solely for the purpose of providing general guidance to employees of the Goddard Space Flight Center (GSFC). This document may be distributed outside GSFC only as a courtesy to other government agencies and contractors. Any distribution of this document, or application or use of the information contained herein, is expressly conditional upon, and is subject to, the following understandings and limitations:

(a) The information was developed for general guidance only and is subject to change at any time;

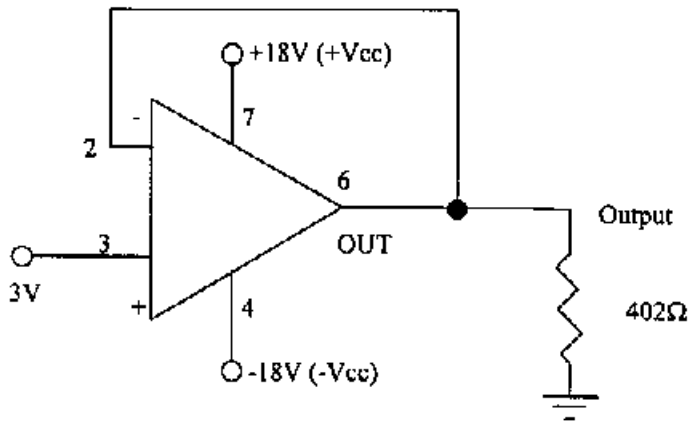
(b) The information was developed under unique GSFC laboratory conditions which may differ substantially from outside conditions;

(c) GSFC does not warrant the accuracy of the information when applied or used under other than unique GSFC laboratory conditions;

(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 OP27



Note: Resistor is 402Ω ±5%, ½ W.

TABLE I. Part Information

Generic Part Number:	OP27
MIDEX/MAP Part Number	M38510/13503BGA
Charge Number:	EV78111
Manufacturer:	Analog Devices
Lot Date Code (LDC):	9648A
Quantity Tested:	8
Serial Number of Control Samples:	180, 181
Serial Numbers of Radiation Samples:	182, 183, 184, 185, 186, 187
Part Function:	OP AMP
Part Technology:	Bipolar
Package Style:	8 Pin Can
Test Equipment:	A540
Test Engineer:	A. Naji

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

TABLE II. Radiation Schedule for OP27

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	04/02/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	04/04/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT	04/07/97
3) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	04/07/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	04/09/97
4) 7.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	04/09/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	04/11/97
5) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	04/11/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	04/14/97
6) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	04/14/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	04/16/97
7) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	04/16/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	04/18/97
8) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	04/18/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	04/21/97
9) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	04/21/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	04/23/97
10) 168 HOUR ANNEALING @25°C	04/23/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/30/97

Effective Dose Rate = 50,000 RADS/26 DAYS = 80.1 RADS/HOUR=0.022 RADS/SEC.

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

Table III. Electrical Characteristics of OP27 /1

Test #	Parameters	Units	Test Conditions	Spec. Lim. /2 min	max
1	Plus_Icc	mA	+Vs = 15V	0.000	6.000
2	Minus_Icc	mA	-Vs = -15V	-6.000	0.000
3	VOS	µV	+Vs = 15V, -Vs = -15V	-25.0	25.0
4	P_IIB	nA	$+V_s$ = 15V, $-V_s$ = -15V	-40.0	40.0
5	N_IIB	nA	$+V_s$ = 15V, $-V_s$ = -15V	-40.0	40.0
6	IIOS	nA	$+V_s$ = 15V, $-V_s$ = -15V	-35.0	35.0
7	CMRR	dB	V_{CM} = ± 11V	114	
8	PSRR	dB	Vs = ±4V to ± 18V	100	
9	P_VOUT_2K	V	R_L = 2kΩ	12.0	
10	N_VOUT_2K	V	R_L = 2kΩ		-12.0
11	P_VOUT_600	V	R_L = 600Ω	10.0	
12	N_VOUT_600	V	R_L = 600kΩ		-10.0
13	P_AOL_2K	V/mV	R_L = 2kΩ, V_o = +10V	1000	
14	N_AOL_2K	V/mV	R_L = 2kΩ, V_o = -10V	1000	
15	P_AOL_600	V/mV	R_L = 2kΩ, V_o = +10V	800	
16	N_AOL_600	V/mV	R_L = 2kΩ, V_o = -10V	800	

Notes:

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

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for OP27 /1

Test #	Parameters	Units	Spec. Lim. /2 min	Spec. Lim. /2 max	Initial mean	Initial sd	Total Dose Exposure (kRads) 2.5 mean	2.5 sd	5.0 mean	5.0 sd	7.5 mean	7.5 sd	10.0 mean	10.0 sd	15.0 mean	15.0 sd	20.0 mean	20.0 sd	30.0 mean	30.0 sd	50.0 mean	50.0 sd	Annealing 168 hours @25°C mean	Annealing 168 hours @25°C sd
1	Plus_Icc	mA	0.000	6.000	3.424	0.083	3.358	0.078	3.362	0.080	3.302	0.079	3.263	0.081	3.181	0.081	3.131	0.077	3.049	0.082	2.881	0.085	3.039	0.082
2	Minus_Icc	mA	-6.000	0.000	-3.414	0.083	-3.346	0.078	-3.349	0.079	-3.290	0.079	-3.252	0.081	-3.171	0.080	3.124	0.074	-3.040	0.082	-2.873	0.085	-3.028	0.081
3	VOS /3	uV	-25.0	25.0	10.7	7.0	5.9	3.9	6.0	2.1	6.2	5.1	5.2	3.9	6.5	4.8	6.4	4.2	6.4	6.0	5.8	5.1	6.7	5.5
4	P_IIB /3	nA	-40.0	40.0	1.4	1.2	1.6	0.8	1.8	0.8	2.0	0.7	2.5	1.1	7.0	1.6	18.3	2.9	48.1	5.7	133	11.8	63.8	5.1
5	N_IIB /3	nA	-40.0	40.0	1.8	1.5	1.1	1.1	1.4	0.9	1.3	0.8	1.7	0.9	5.9	1.6	16.9	2.8	46.2	5.5	130	11.8	61.5	5.0
6	IIOS	nA	-35.0	35.0	1.4	0.2	1.3	0.2	1.1	0.1	1.2	0.2	1.2	0.2	1.2	0.2	1.4	0.2	2.0	0.3	2.9	0.3	2.4	0.2
7	CMRR	dB	114		1336	5.5	132	6.7	132	7.1	133	6.5	132	4.5	132	2.3	131	4.1	131	2.2	131	3.5	132	5.5
8	PSRR	dB	100		145	1.0	145	3.9	144	4.5	144	3.2	144	5.8	143	9.6	144	10.2	147	6.0	139	11.1	143	12.2
9	P_VOUT_2K	V	12.0		14.0	0	14.0	0	14.0	0	14.0	0	14.0	0	14.0	0	14.0	0	14.0	0	14.0	0	14.0	0
10	N_VOUT_2K	V		-12.0	-14.0	0	-14.0	0	-14.0	0	-14.0	0	-14.0	0	-14.0	0	-14.0	0	-14.0	0	-14.0	0	-14.0	0
11	P_VOUT_600	V	10.0		13.2	0.05	13.2	0.05	13.2	0.07	13.2	0.05	13.2	0.05	13.2	0.05	13.1	0.05	13.1	0.05	13.0	0	13.1	0.05
12	N_VOUT_600	V		-10.0	-12.9	0.2	-13.0	0.2	-13.0	0.3	-12.8	0.3	-12.7	0.1	-12.6	0.05	-12.5	0.07	-12.5	0.07	-12.4	0	-12.4	0.05
13	P_AOL_2K	V/mV	1000		3355	125	3417	107	3284	125	3277	55	3225	100	3154	156	3047	88	2880	82	2677	96	2870	88
14	N_AOL_2K	V/mV	1000		3203	168	3106	171	2947	178	3038	97	3048	206	2863	138	2827	146	2753	138	2625	112	2813	144
15	P_AOL_600	V/mV	800		5371	322	5461	304	5371	363	5285	424	5066	378	4868	315	4700	267	4378	244	3791	133	4313	126
16	N_AOL_600	V/mV	800		2205	225	2062	171	2021	232	2048	204	2045	208	1990	245	1962	223	1888	172	1843	177	1948	245

Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the 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/ The data analysis for these parameters is based on the absolute value of the measurement. This allows a much more meaningful interperatation of the data.

Radiation sensitive parameters: P_IIB and N_IIB.