

Unisys

DATE: June 15, 1997
TO: J. Lohr/311
FROM: K. Sahu/300.1 *K-S*
SUBJECT: Radiation Report on: OP497
Project: SMEX/LITE
Job #: EV78043
Project part #: OP497 (5962-9452101M2A)

PPM-97-028

cc: T. Miccolis/300.1
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OFA Library/300.1

A radiation evaluation was performed on OP497 (5962-9452101M2A) 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 Co⁶⁰ 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 192 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, except for slew rate.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 92, 93, 94, 95, 96, 97, 98, and 99) were used as radiation samples while SN's 90 and 91 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests to 2.5 kRads. No significant degradation was noted in any parameter.

After the 5.0 kRad irradiation, SN's 93 and 96 exceeded the specification limit of 150pA for one out of four -ibias measurements, with readings of 200pA and 194pA respectively. **All parts passed all other tests.**

After the 10.0 kRad irradiation, SN's 94 and 98 exceeded the specification limit of 150pA for one out of four +ibias measurements, with readings of 164pA and 209pA respectively. All parts exceeded the specification limit of at least one -ibias measurement with readings in the range of 156pA to 199pA. SN 98 exceeded the specification limit of 150pA for one out of four iio measurements, with a reading of 296pA. **All parts passed all other tests.**

After the 15.0 kRad irradiation, SN 97 marginally exceeded the specification limit of -13.0V for Vol_2k with a reading of -12.9V. All parts continued to degrade in both +ibias and -ibias with readings in the ranges of 183pA to 265pA and 222pA to 277pA respectively. SN 98 marginally exceeded the specification limit for iio with a reading of 163pA. SN 95 fell marginally below the specification limit of 1500V/mV for Avs_2k with a reading of 1349V/mV. **All parts passed all other tests.**

After the 20.0 kRad irradiation, several parts marginally exceeded the specification limit of -13.0V for Vol_2k with readings in the range of -12.3V to -12.9V. All parts continued to degrade in both +ibias and -ibias with readings in the ranges of 303pA to 460pA and 248pA to 415pA respectively. Most parts exceeded the specification limit of 150pA for one of four iio measurements with readings in the range of 206pA to 288pA. Most parts fell below the

* 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.

specification limit of 1500V/mV for at least one of four measurements of Avs_2k with readings in the range of 734V/mV to 1432V/mV. **All parts passed all other tests.**

After the 30.0 kRad irradiation, all parts showed a steep increase in +Ibias and -Ibias with readings >2000pA. All parts exceeded the specification limit for Vol_2k. Most parts exceeded the specification limit for some vio tests. SN 97 marginally exceeded the specification limit for one iio test. Most parts fell below the specification limit for Avs_2k with readings in the range of 231 to 758V/mV. **All parts passed all other tests.**

After the 50.0 kRad irradiation, all parts continued to degrade beyond the readings at 30 kRads. Additionally, most parts exceeded the specification limit for at least one iio test and all parts fell below the specification limit for at least one cmrr and +SR test. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, parts showed modest recovery in vio, iio, and cmrr; however, most readings continued to exceed or fall below specification limits. No recovery was noted in any other 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.

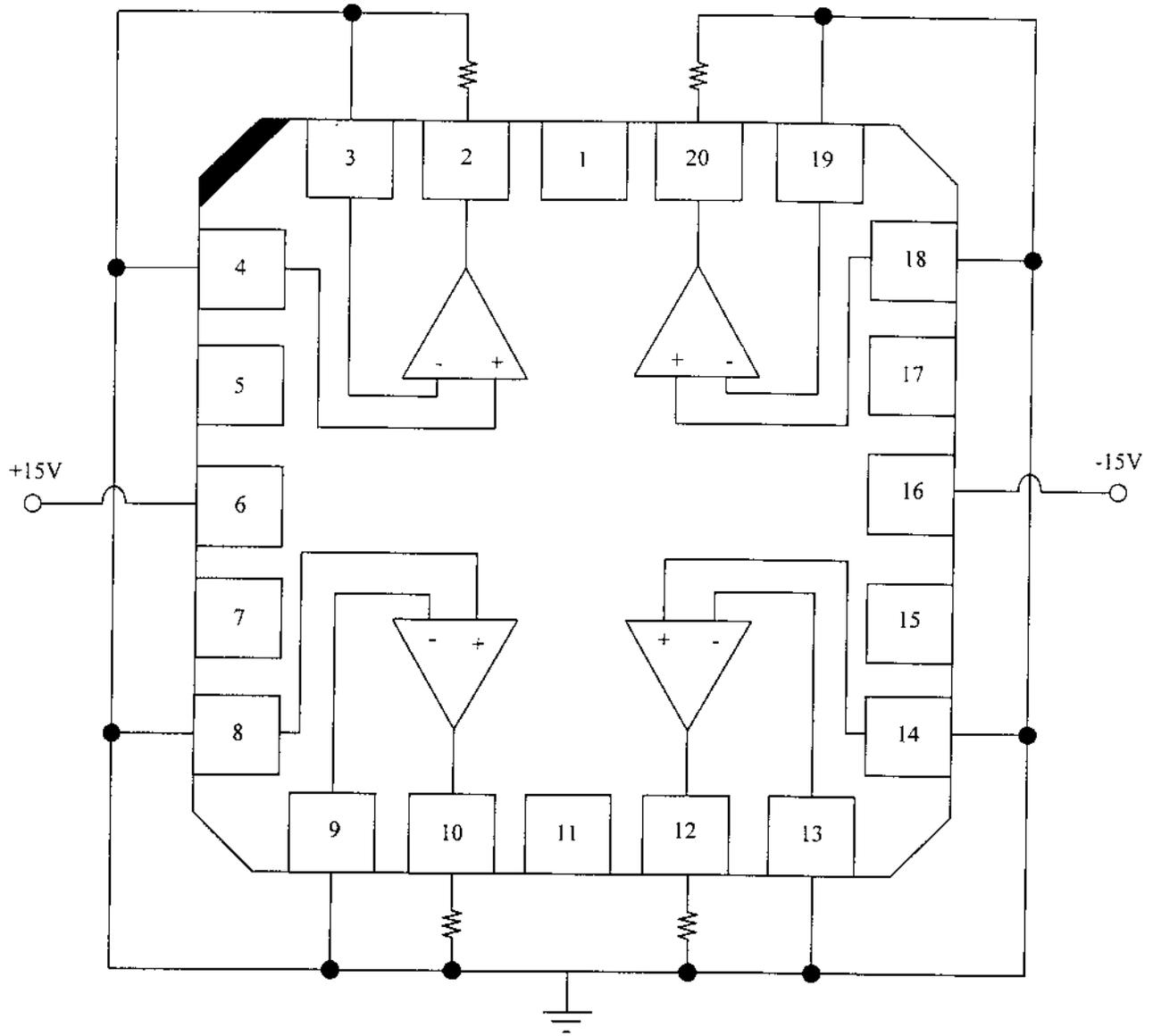
Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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Figure 1. Radiation Bias Circuit for OP497



Pin connection list:

1: NC 2: OUT A 3: -IN A 4: +IN A 5: NC 6: +V 7: NC 8: +IN B 9: -IN B 10: OUT B
 11: NC 12: OUT C 13: -IN C 14: +IN C 15: NC 16: -V 17: NC 18: +IN D 19: -IN D 20: OUT D

Resistors are $15k\Omega \pm 5\%$, $\frac{1}{2}$ W.

Use 20 pin LCC to 8 pin DIP adapters.

TABLE I. Part Information

Generic Part Number:	OP497
SMEX/LITE Part Number	5962-9452101M2A
Charge Number:	EV78043
Manufacturer:	Analog Devices
Lot Date Code (LDC):	C9438
Quantity Tested:	10
Serial Number of Control Samples:	90, 91
Serial Numbers of Radiation Samples:	92, 93, 94, 95, 96, 97, 98, and 99
Part Function:	Quad OP-AMP
Part Technology:	Bipolar
Package Style:	20 Pin LCC
Test Equipment:	A540
Test Engineer:	S. Norris

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

TABLE II. Radiation Schedule for OP497

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	05/02/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	06/04/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT	06/06/97
3) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	06/09/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	06/11/97
4) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	06/11/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	06/13/97
5) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	06/13/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	06/16/97
6) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	06/16/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	06/18/97
7) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	06/18/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	06/20/97
8) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	06/20/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	06/23/97
9) 192 HOUR ANNEALING @25°C	06/23/97
POST-192 HOUR ANNEAL ELECTRICAL MEASUREMENT	06/30/97

Effective Dose Rate = 50,000 RADS/20 DAYS=104.2 RADS/HOUR=0.029 RADS/SEC

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

Table III. Electrical Characteristics of OP497 /1

Test #	Parameter	Units	Test Conditions /2	Spec. min	Lim. max
1	+I _{DD}	mA	No Load per amplifier	0.0	2.5
2	+I _{DD}	mA	No Load per amplifier	-2.5	0.0
3	V _{oh_2k}	V	R _L = 2kΩ	13.0	
4	V _{ol_2k}	V	R _L = 2kΩ		-13.0
5	V _{oh_10k}	V	R _L = 10kΩ	13.0	
6	V _{ol_10k}	V	R _L = 10kΩ		-13.0
7	v _{io}	μV		-150.0	150.0
8	+i _{bias}	pA	V _{CM} = 0V	-150	150
9	-i _{bias}	pA	V _{CM} = 0V	-150	150
10	i _{io}	pA	V _{CM} = 0V	-150	150
11	A _{vs_2k}	V/mV	R _L = 2kΩ, V _{OUT} = ±10V	1500	
12	psrr	dB	V _{CC} = ±2V and ±20V	114	
13	cmrr	dB	V _{CM} = ±13V	114	
14	+SR	V	V _{IN} = ±10V step, λ _v = +1 C _L = 30pF, R _L = 2kΩ, T _A = +25°C	0.0500	

Note:

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.

2/ For all tests, V_{CC} = ±15V unless otherwise specified.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for OP497 /1

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads)												Annealing					
			min	max	Initial		2.5		5.0		10.0		15.0		20.0		30.0		50.0		192 hours @25°C	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	+IDD	mA	0.0	2.5	1.9	0.05	1.9	0.05	1.9	0.05	1.9	0.05	1.9	0.05	1.9	0.05	1.9	0.05	1.9	0.05	1.9	0.05
2	+IDD	mA	-2.5	0.0	-1.9	0.05	-1.9	0.05	-1.9	0.05	-1.9	0.05	-1.9	0.05	-1.9	0.05	-1.9	0.05	-1.9	0.05	-1.9	0.05
3-6	Voh_2k	V	13.0		13.8	0	13.9	0	13.9	0	13.9	0	13.9	0	13.8	0	13.8	0	13.8	0	13.8	0
7-10	Vol_2k	V		-13.0	-13.8	0	-13.8	0	-13.8	0	-13.8	0	-13.4	0.2	-12.7	0.5	-11.9	0.7	-10.2	0.8	-10.5	0.8
11-14	Voh_10k	V	13.0		14.1	0	14.2	0	14.2	0	14.2	0	14.2	0	14.2	0	14.2	0	14.2	0	14.2	0
15-18	Vol_10k	V		-13.0	-14.3	0	-14.3	0.05	-14.3	0.05	-14.3	0.05	-14.2	0	-14.2	0	-14.2	0	-14.2	0	-14.2	0
19-22	vio /3	µA	-150	150	36.6	6.2	43.4	6.0	52.8	8.9	62.5	10.0	83.9	17.5	114	34.5	188	20.6	298	99.3	181	80.6
23-26	+ibias /3	pA	-150	150	69.1	12.4	89.4	16.0	109	19.3	144	28.9	229	30.5	386	44.8	>2000		>2000		>2000	
27-30	-ibias /3	pA	-150	150	91.0	7.2	71.9	21.9	144	39.2	179	16.6	225	43.1	345	58.0	>2000		>2000		>2000	
31-34	itio /3	pA	-150	150	97.5	3.6	91.1	15.5	107	31.4	139	65.4	122	21.4	196	80.8	122	16.9	1817	1585	433	879
35-38	Avs_2k	V/mV	1500		4845	1108	6063	2820	3655	633	3440	857	2114	1020	1506	913	1305	2010	241	83	1359	2284
39-42	psrr	dB	114		136	2.0	135	1.5	131	1.8	5/	5/	5/	5/	5/	5/	5/	5/	5/	5/	5/	5/
43-46	cmrr	dB	114		137	2.3	136	3.2	134	3.0	133	1.9	127	3.5	124	1.8	117	3.3	109	4.8	116	6.7
47-50	+SR	V	0.0500		0.1214	0.0177	0.1135	0.0217	0.1050	0.0079	0.1046	0.0079	0.1096	0.0135	0.1057	0.0117	0.0903	0.0064	0.0296	0.0005	0.0282	0.0015

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 interpretation of the data.
- 4/ "F" indicates that all parts failed this test at this irradiation level or annealing step. "nPmF" indicates that n parts failed this test at this irradiation level or annealing step.
- 5/ No reliable measurements were possible at this irradiation level.

Radiation sensitive parameters: Vol_2k, vio, +Ibias, -Ibias, itio, Avs_2k, psrr, cmrr, +SR.