

UNISYS

DATE: June 6, 1997
TO: J.Lohr/311
FROM: K. Sahu/300.1 *KS*
SUBJECT: Radiation Report on: AD624SD/883B
Project: MIDEX/MAP
Job #: EE78119
Project part #: AD624SD/883B

PPM-97-023

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

A radiation evaluation was performed on AD624SD/883B 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 5.0, 10.0, 15.0, 20.0, 30.0, 50.0, and 100.0 kRads.* The dose rate was between 0.06 and 1.25 kRads/hour (see Table II for radiation schedule). After the 100.0 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 28, 29, 30, 31, 32, and 33) were used as radiation samples while SN's 26 and 27 were used as the control sample. All parts passed all tests during initial electrical measurements.

All parts passed all tests upon irradiation to 5.0 kRads. No significant degradation was observed in any test parameter.

After the 10.0 kRad irradiation, SN 33 fell slightly below the specification limit of 110 dB for P_cmrr_x500 with a reading of 109dB. **All parts passed all other tests.**

After the 15.0 kRad irradiation, SN 33 marginally failed to meet the specification limits for P_cmrr_x100, P_cmrr_x500 and N_cmrr_x500 with readings of 99.7dB, 103dB and 104dB respectively. **All parts passed all other tests.**

After the 20.0 kRad irradiation, all parts fell marginally below the specification limit of 70dB for both P_cmrr_x1 and N_cmrr_x1 with readings in the range of 60 to 67dB. SN 33 continued to fail with readings similar to those at 15.0 kRads. **All parts passed all other tests.**

After the 30.0 kRad irradiation, all parts fell below the specification limit for both P_cmrr_x1 and N_cmrr_x1 with readings in the range of 52 to 55dB. Most parts marginally failed to meet specification limits for P_cmrr_x100, N_cmrr_x100, P_cmrr_x200, P_cmrr_x500 and N_cmrr_x500. All readings were within 10% of the specification limits. SN 33 also marginally exceeded the specification limit of 0.5% for ERROR_x500_% with a reading of 0.846%. SN's 32 and 33 exceeded the specification limit of 50nA for P_iib with readings of 51 and 60nA

* 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.

respectively. All parts exceeded the specification limit of 50nA for N_iib with readings in the range of 51 to 70nA. **All parts passed all other tests.**

After the 50.0 kRad irradiation, all parts fell below the specification limit for both P_cmrr_x1 and N_cmrr_x1 with readings similar to those at 30.0 kRads. Most parts failed to meet the specification limits for P_cmrr_x100 and N_cmrr_x100 with readings similar to those before. SN 28 fell slightly below the specification limit for both P_cmrr_x200 and N_cmrr_x200 with readings of 99dB for both. SN's 28 and 33 fell below the specification limit for both P_cmrr_x500 and N_cmrr_x500. SN 28's readings were both 107dB, and SN 33's readings were 100 and 101dB respectively. SN 33 again marginally exceeded the specification limit for ERROR_x500_% with a reading of 0.585%. All parts exceeded the specification limit for both P_iib and N_iib with readings of 75 to 102nA. **All parts passed all other tests.**

After the 100.0 kRad irradiation, all parts fell below the specification limit for both P_cmrr_x1 and N_cmrr_x1 with readings in the ranges of 52 to 54dB and 52 to 53dB respectively. Most parts failed to meet the specification limits for both P_cmrr_x100 and N_cmrr_x100 with readings similar to those before. SN 28 fell slightly below the specification limit for both P_cmrr_x200 and N_cmrr_x200 with readings of 99dB for both. SN 32 fell below the specification limit for P_cmrr_x200 with a reading of 89dB. Several parts fell below the specification limit for both P_cmrr_x500 and N_cmrr_x500 with readings similar to those before. SN's 30 and 33 exceeded the specification limit of 0.5% for ERROR_x500_% with readings of 0.565% and 0.614% respectively. All parts exceeded the specification limit for both P_iib and N_iib with readings of 126 to 174nA. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, the parts showed no significant recovery.

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.

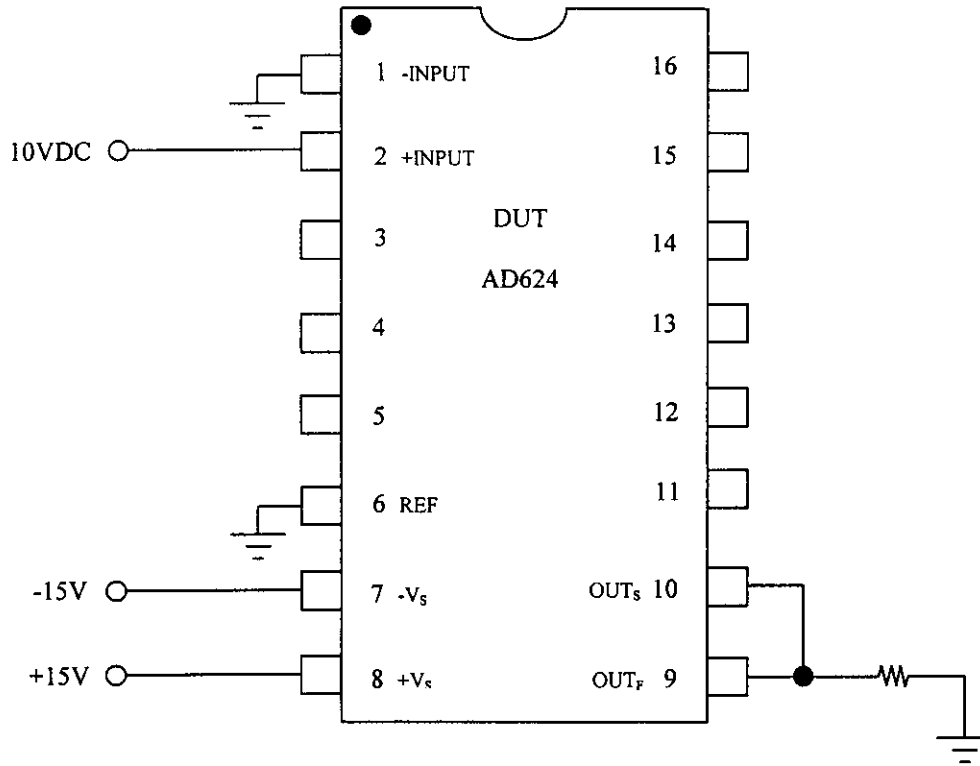
Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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Figure 1. Radiation Bias Circuit for AD624SD/883B



Notes:

1. Resistors 2.0k Ω , 1/4 W, 5%.
2. Gain = 1. See manufacturer's data book for optional bias conditions. Not shorting pin 3 (RG₂) to pin 11, 12 or 13 results in an overall gain of 1 for the device.

TABLE I. Part Information

Generic Part Number:	AD624SD/883B
MIDEX/MAP Part Number	none given
Charge Number:	EE78119
Manufacturer:	Analog Devices
Lot Date Code (LDC):	9608F
Quantity Tested:	8
Serial Number of Control Samples:	26, 27
Serial Numbers of Radiation Samples:	28, 29, 30, 31, 32, 33
Part Function:	Instrumentation Amplifier
Part Technology:	Bipolar
Package Style:	16 Pin DIP
Test Equipment:	A540
Test Engineer:	A. Naji

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

TABLE II. Radiation Schedule for AD624SD/883B

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	04/14/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	05/02/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT	05/05/97
3) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	05/05/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	05/08/97
4) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	05/08/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	05/12/97
5) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	05/12/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	05/14/97
6) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	05/14/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	05/16/97
7) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	05/16/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	05/19/97
8) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	05/19/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	05/21/97
9) 100.0 KRAD IRRADIATION (1.250 KRADS/HOUR)	05/21/97
POST-100.0 KRAD ELECTRICAL MEASUREMENT	05/23/97
10) 168 HOUR ANNEALING @25°C	05/23/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	05/30/97

Effective Dose Rate = 100,000 RADS/20 DAYS = 208.3 RADS/HOUR=0.058 RADS/SEC.

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

Table III. Electrical Characteristics of AD624SD/883B /1

Test #	Parameters	Units	Test Conditions	Spec. Lim.	
				min	max
1	+I _{CC}	mA	G = 1	0	5.0
2	-I _{CC}	mA	G = 1	-5.0	0
3	P _{cmrr_x1}	dB	G = 1, V _{IN} = 0V to +10V	70	
4	N _{cmrr_x1}	dB	G = 1, V _{IN} = 0V to -10V	70	
5	P _{cmrr_x100}	dB	G = 100, V _{IN} = 0V to +10V	100	
6	N _{cmrr_x100}	dB	G = 100, V _{IN} = 0V to -10V	100	
7	P _{cmrr_x200}	dB	G = 200, V _{IN} = 0V to +10V	100	
8	N _{cmrr_x200}	dB	G = 200, V _{IN} = 0V to -10V	100	
9	P _{cmrr_x500}	dB	G = 500, V _{IN} = 0V to +10V	110	
10	N _{cmrr_x500}	dB	G = 500, V _{IN} = 0V to -10V	110	
11	ERROR_x1_%	±% max	G = 1, V _O = ±10V		0.05
12	ERROR_x100_%	±% max	G = 100, V _O = ±10V		0.05
13	ERROR_x200_%	±% max	G = 200, V _O = ±10V		0.05
14	ERROR_x500_%	±% max	G = 500, V _O = ±10V		0.05
15	P _{psrr_x1}	dB	G = 1, V _S = +12V, +15V	75	
16	N _{psrr_x1}	dB	G = 1, V _S = -12V, -15V	75	
17	V _{os}	μV	V _{IN} = 0V	-75.0	75.0
18	P _{lib}	nA	G = 1	-50.0	50.0
19	N _{lib}	nA	G = 1	-50.0	50.0
20	I _{os}	nA	G = 1	35.0	35.0

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 AD624SD/833B /1

Test #	Parameters	Units	Spec. Lim. /2	Total Dose (kRad/s)												Annealing								
				Initial		2.5		5.0		10.0		15.0		20.0		30.0		50.0		100.0		168 hours @25°C		
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
1	+ICC	mA	0	5.0	3.84	0.10	3.84	0.10	3.81	0.10	3.77	0.11	3.75	0.11	3.75	0.11	3.75	0.11	3.72	0.10	3.69	0.10	3.65	0.11
2	-ICC	mA	-5.0	0	-3.86	0.10	-3.86	0.10	-3.84	0.10	-3.81	0.10	-3.79	0.11	-3.79	0.11	-3.77	0.10	-3.73	0.11	-3.71	0.10	-3.65	0.10
3	P_cmrr_x1	dB	70		87	4.9	88	4.8	90	5.7	82	7.8	83	8.9	83	8.9	62	2.2	53	1.4	53	0.8	53	0.8
4	N_cmrr_x1	dB	70		84	5.0	81	6.2	85	5.8	82	5.9	87	8.4	87	8.4	61	0.7	53	0.4	52	0.5	52	0.4
5	P_cmrr_x100	dB	100		124	6.1	121	4.6	117	4.3	112	5.0	112	7.2	112	7.2	108	5.2	98	5.2	97	4.4	95	3.6
6	N_cmrr_x100	dB	100		124	7.6	123	11.1	122	9.8	112	3.7	111	6.2	111	6.2	108	3.9	101	10.6	96	3.4	95	2.5
7	P_cmrr_x200	dB	100		125	7.1	123	10.7	125	9.3	114	5.1	112	6.8	112	6.8	114	6.4	108	10.5	103	3.4	103	4.1
8	N_cmrr_x200	dB	100		124	7.5	123	12.2	126	8.7	115	4.0	112	5.4	112	5.4	115	5.9	107	7.3	104	4.0	104	5.9
9	P_cmrr_x500	dB	110		119	5.1	117	4.3	125	7.8	122	13.2	116	11.1	116	11.1	118	12.4	112	9.5	115	12.6	113	8.7
10	N_cmrr_x500	dB	110		117	4.4	115	3.4	127	11.1	123	13.0	118	12.8	118	12.8	19	12.6	111	8.5	114	11.7	113	7.9
11	ERROR_x1_%	% max		0.05	1E-3	3E-4	8E-4	7E-5	7E-4	2E-4	6E-4	9E-4	5E-4	4E-4	4E-4	7E-3	1.5E-3	0.018	0.002	0.002	0.021	0.002	0.022	0.002
12	ERROR_x100_%/3	% max		0.25	0.051	0.030	0.062	0.047	0.110	0.034	0.085	0.094	0.074	0.047	0.044	0.076	0.076	0.044	0.187	0.106	0.203	0.065	0.225	0.067
13	ERROR_x200_%/3	% max		0.5	0.141	0.088	0.076	0.059	0.179	0.057	0.086	0.058	0.092	0.030	0.030	0.090	0.065	0.165	0.035	0.157	0.062	0.173	0.069	0.073
14	ERROR_x500_%/3	% max		0.5	0.091	0.068	0.085	0.029	0.284	0.122	0.100	0.082	0.135	0.098	0.121	0.074	0.121	0.074	0.247	0.303	0.249	0.168	0.257	0.135
15	P_pstrr_x1	dB	75		80	1.7	80	0.9	80	1.2	80	1.5	81	3.4	81	3.4	81	2.0	88	2.7	87	3.7	84	2.3
16	N_pstrr_x1	dB	75		94	4.8	97	8.3	94	3.3	101	6.2	94	5.0	98	6.0	98	6.0	99	6.4	92	3.6	93	2.2
17	Vos	uV	-75.0	75.0	-1.2	0.5	-1.3	0.4	-1.4	0.5	-2.2	0.7	-1.6	0.8	0.8	4.5	0.8	18.7	1.3	16.2	0.9	16.7	0.9	17.5
18	P_Iib	nA	-50.0	50.0	-2.8	2.6	3.0	3.0	8.0	3.1	18.7	3.7	17.4	4.1	4.1	34.7	4.8	49.2	5.9	86	8.2	143	13.4	
19	N_Iib	nA	-50.0	50.0	-2.7	2.3	2.16	2.6	7.1	2.9	16.6	3.5	24.3	4.5	29.8	4.5	29.8	4.5	57.5	6.0	83	8.1	137	11.3
20	Ios	nA	35.0	35.0	-0.1	0.4	0.9	0.7	1.0	0.7	2.2	0.7	4.0	0.6	4.8	1.1	4.8	1.1	-8.6	1.6	3.1	1.9	12.9	2.8

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/ These parameters were bench tested due to limitations in the ADS40.

Radiation sensitive parameters: P_cmrr_1x, 100x, 200x, 500x; N_cmrr_1x, 100x, 200x, 500x; ERROR_500x; P_Iib; N_Iib.