

Unisys

DATE: December 12, 1997
TO: S. Hull/562
FROM: K. Sahu/S. Kniffin/300.1
SUBJECT: Radiation Report on: AD630
Project: MAP INST.
Job #: M78276
Project part #: AD630 (5962-89807012A)

PPM-97-056

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A radiation evaluation was performed on AD630 (5962-89807012A) Balanced Modulator/Demodulator (Analog Devices) 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, 50.0, 75.0, and 100.0 kRads.* The dose rate was between 0.063 and 0.625 kRads/hour (0.017 to 0.174 Rads/s). After the 100.0 kRad exposure, the parts were annealed for 168 hours at 25°C. See Table II for the radiation schedule and effective dose rate calculation. The effective dose rate over all testing was 0.043 Rads/sec. 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 10 samples. Eight samples (SN's 53, 54, 55, 56, 57, 58, 59, and 60) were used as radiation samples while SN's 51 and 52 were used as control samples. All parts passed all tests during initial electrical measurements.

The parts were subdivided into to two groups with different biasing conditions for pin 9. SN's 53, 54, 55, and 56 were biased with pin 9 connected to ground and SN's 57, 58, 59, and 60 were biased with pin 9 connected to +7VDC.

All parts passed all tests to 50.0 kRads. No significant degradation was noted in any parameter.

After the 75.0 kRad irradiation, SN 56 fell marginally below the specification limit of 90dB for AOL with a reading of 86dB. **All parts passed all other tests.**

After the 100.0 kRad irradiation, SN's 53, 54, 55, 56, and 58 fell below the specification limit for AOL with readings in the range of 58 to 87dB. SN's 57 and 59 marginally exceeded the specification limit of 300nA for I_BPOS with readings of 315 and 344nA. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, parts showed significant recovery with only SN 57 continuing to marginally exceed the specification limit for I_BPOS with a reading of 308nA. **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.

* 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.

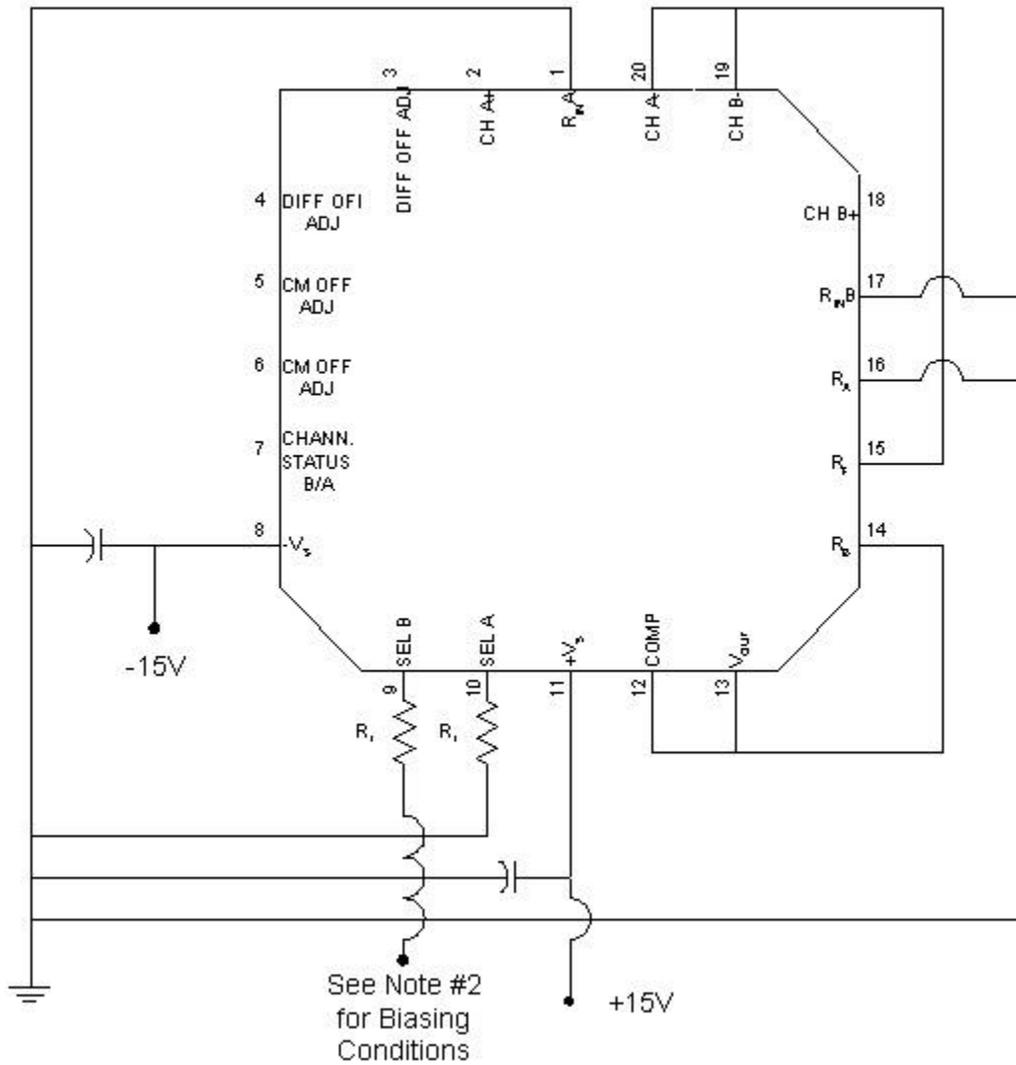
Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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Figure 1. Radiation Bias Circuit for AD630



Notes:

1. Resistors are $10\text{k}\Omega \pm 5\%$ $\frac{1}{4}\text{W}$.
2. Pin 9: SN's 53, 54, 55, and 56 were biased with pin 9 connected to ground and SN's 57, 58, 59, and 60 were biased with pin 9 connected to +7VDC.

TABLE I. Part Information

Generic Part Number:	AD630
MAP INST. Part Number	5962-89807012A
Charge Number:	M78276
Manufacturer:	Analog Devices
Lot Date Code (LDC):	9617B
Quantity Tested:	10
Serial Number of Control Samples:	51, 52
Serial Numbers of Radiation Samples:	53, 54, 55, 56, 57, 58, 59, and 60
Part Function:	Balanced Modulator/Demodulator
Part Technology:	Bipolar
Package Style:	20 Pin LCC
Test Equipment:	A540
Test Engineer:	D. Davis

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

TABLE II. Radiation Schedule for AD630

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	11/04/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	11/05/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT	11/07/97
3) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	11/07/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	11/10/97
4) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	11/10/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	11/12/97
5) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	11/14/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	11/17/97
6) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	11/17/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	11/19/97
7) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	11/19/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	11/21/97
8) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	11/21/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	11/24/97
9) 75.0 KRAD IRRADIATION (0.625 KRADS/HOUR)	11/24/97
POST-75.0 KRAD ELECTRICAL MEASUREMENT	11/26/97
10) 100.0 KRAD IRRADIATION (0.625 KRADS/HOUR).....	11/26/97
POST-100.0 KRAD ELECTRICAL MEASUREMENT	12/01/97
11) 168 HOUR ANNEALING @25°C	12/01/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/08/97

Effective Dose Rate = 100,000 RADS/27 DAYS=154.3 RADS/HOUR=0.043 RADS/SEC

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

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

Table III. Electrical Characteristics of AD630 /1

Test #	Parameter	Units	Test Conditions /2	Spec. min	Lim. max
1	functional test				
2	VOUT_PLUS	V	$R_L = 2k\Omega$	10.0	
3	VOUT_NEG	V	$R_L = 2k\Omega$		-10.0
4	I_BPOS	nA		-300	300
5	AOL	dB		90	
6	AMPL_OFFSET	mV		-500	500
7	PSSR	dB		90	
8	IOS_POS	mA		-50.0	0.0
9	IOS_NEG	mA		0.0	50.0
10	I_SINK	mA	$V_{OL} = -V_S + 0.4V$	1.6	
11	ICB_A	nA		-300	300
12	ICB_B	nA		-300	300
13	IQ_PLUS	mA		0.0	5.0
14	IQ_NEG	mA		-5.0	0

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, $\pm V_S = \pm 15V$, $T_A = 25^\circ C$ unless otherwise specified.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for AD630 /1

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads)																				Annealing			
					Initial		2.5		5.0		10.0		15.0		20.0		30.0		50.0		75.0		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	mean	sd	mean	sd
1	Functional Test	/3			P		P		P		P		P		P		P		P		P		P		P			
2	VOUT_PLUS	V	10.0		11.24	0	11.24	0	11.25	0	11.25	0	11.24	0	11.24	0	11.24	0	11.24	0	11.24	0	11.24	0	11.24	0	11.24	0
3	VOUT_NEG	V		-10.0	-11.26	0	-11.26	0	-11.25	0	-11.25	0	-11.26	0	-11.26	0	-11.26	0	-11.26	0	-11.26	0	-11.26	0	-11.26	0	-11.26	0
4	I_BPOS	nA	-300	300	128	12.0	144	13.4	160	14.1	192	13.7	181	14.0	187	19.9	195	17.8	197	25.8	206	33.6	204	96.3	212	41.6		
5	AOL	dB	90		94	1.2	94	1.0	94	0.9	94	1.1	93	1.3	94	0.7	93	1.1	93	0.8	93	3.7	84	18.3	94	4.3		
6	AMPL_OFFSET/4	mV	-500	500	240	129	209	112	262	153	226	132	266	116	245	143	188	127	246	130	278	147	259	176	262	128		
7	PSRR	dB	90		104	2.6	104	2.8	103	2.9	101	2.5	100	2.0	101	2.8	110	6.6	112	3.9	113	8.9	103	8.0	110	9.8		
8	IOS_POS	mA	-50.0	0.0	-24.6	0.2	-24.6	0.2	-24.6	0.2	-24.5	0.2	-24.4	0.2	-24.4	0.2	-24.2	0.2	-24.2	0.2	-24.1	0.2	-24.0	0.1	-24.1	0.2		
9	IOS_NEG	mA	0.0	50.0	24.6	0.5	24.7	0.4	24.8	0.4	24.6	0.5	23.9	0.3	23.9	0.3	23.9	0.3	23.9	0.3	23.5	0.5	23.0	0	23.3	0.4		
10	I_SINK	mA	1.6		10.9	0.3	10.9	0.3	10.8	0.2	10.8	0.2	10.7	0.3	10.7	0.2	10.6	0.2	10.5	0.2	10.4	0.2	10.4	0.2	10.4	0.3		
11	ICB_A	nA	-300	300	104	10.6	108	11.6	115	11.9	122	10.3	122	11.0	125	15.6	127	14.6	134	17.0	148	19.8	172	33.9	155	25.0		
12	ICB_B	nA	-300	300	120	11.4	121	10.2	125	12.1	135	11.3	136	13.0	136	12.6	141	13.4	141	12.5	151	13.6	156	11.9	152	15.0		
13	IQ_PLUS	mA	0.0	5.0	3.517	0.048	3.515	0.048	3.514	0.048	3.518	0.049	3.538	0.051	3.538	0.053	3.569	0.059	3.563	0.058	3.562	0.055	3.567	0.059	3.567	0.055		
14	IQ_NEG	mA	-5.0	0.0	-3.516	0.048	-3.516	0.048	-3.517	0.048	-3.521	0.047	-3.539	0.053	-3.543	0.053	-3.570	0.059	-3.559	0.055	-3.560	0.055	-3.565	0.061	-3.559	0.056		

- 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.
 - 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.
 - 4/ The mean and standard deviation values were calculated over the absolute value of the measurement in this test. This will provide a more meaningful interpretation of the data for this parameter.

Radiation sensitive parameters: I_BPOS, AOL.