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DATE: November 19, 1997 PPM-97-050
TO: S. Hull/562
FROM: K. Sahu/300.1
SUBJECT: Radiation Report on: AD667
Project: SMEX/LITE
Job #: C78111
Project part #: AD667

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OFA Library/300.1

A radiation evaluation was performed on AD667 (12 bit ADC) 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, five parts were irradiated under bias (see Figure 1 for bias configuration) and one part was used as a control sample. The total dose radiation levels were 2.5, 5.0, 7.5, 10.0, 15.0, 20.0, 30.0, and 50.0 kRads.* The dose rate was between 0.062 and 0.625 kRads/hour (0.017 to 0.174 Rads/s). After the 50.0 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 overall testing was 0.032 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 6 samples. Five samples (SN's 741, 742, 743, 744, and 745) were used as radiation samples while SN 740 was used as a control sample. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 50.0 kRads with no significant degradation in any parameter.

After the 100.0 kRad irradiation, all parts showed degradation in DNL with three parts marginally exceeding the specification limit of 0.75lsb for DNL with readings of 0.78, 0.77, and 0.78lsb. The other two parts had readings of 0.74lsb. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, parts showed no significant recovery in any parameter. The three parts that exceeded the specification limit for DNL had readings of 0.76, 0.79 and 0.84lsb.

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.

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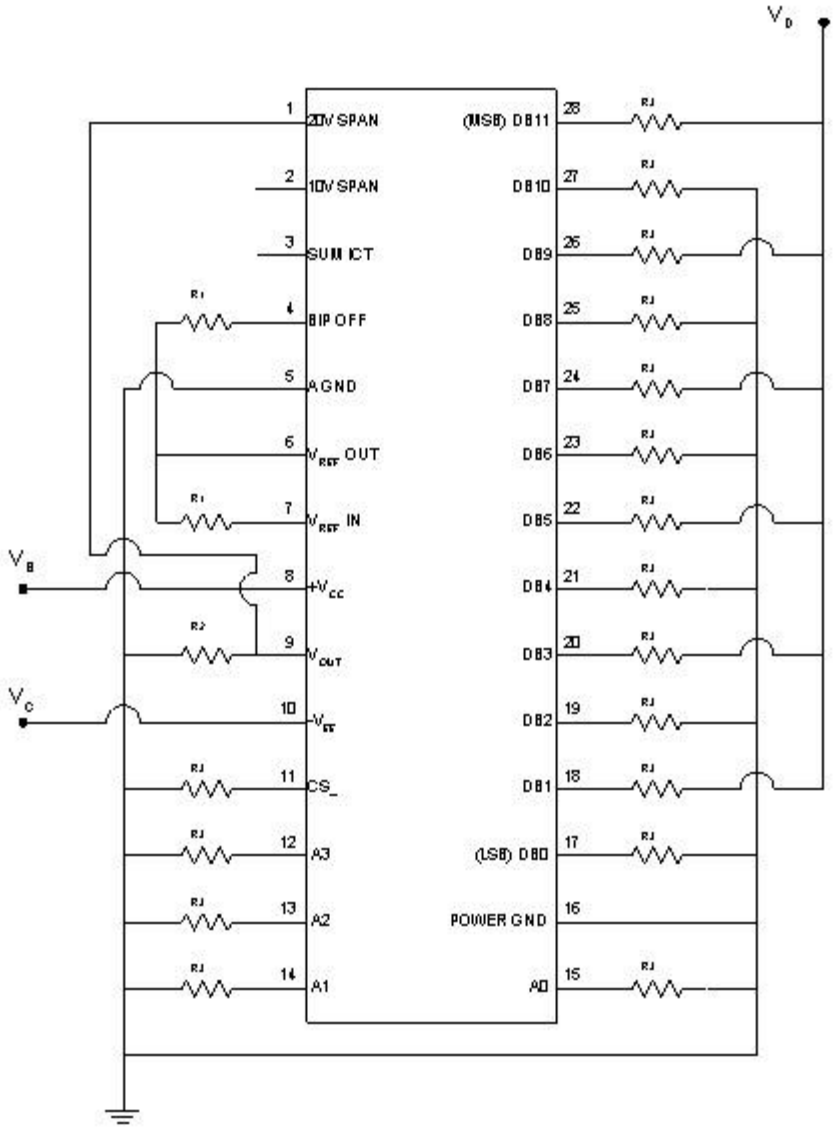
Figure 1. Radiation Bias Circuit for AD667



Notes:

1. V_B = +15VDC ±0.5V.
2. V_C = -15VDC ±0.5V.
3. V_D = +5VDC ±0.5V.
4. R1 = 50Ω ±5%, ¼W.
5. R2 = 620Ω ±5%, ¼W.
6. R3 = 2kΩ ±5%, ¼W.
7. I_B <12mA (for one part).
8. I_C <25mA (for one part).
9. I_D <1.7mA (for one part).

TABLE I. Part Information

Generic Part Number:	AD667
SMEX/LITE Part Number	AD667
Charge Number:	C78111
Manufacturer:	Analog Devices
Lot Date Code (LDC):	9641
Quantity Tested:	6
Serial Number of Control Sample:	740
Serial Numbers of Radiation Samples:	741, 742, 743, 744, and 745
Part Function:	12 bit DAC
Part Technology:	Bipolar
Package Style:	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 AD667

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	09/19/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	10/03/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT	10/06/97
2) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	10/06/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	10/08/97
2) 7.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	10/08/97
POST-7.5 KRAD ELECTRICAL MEASUREMENT	10/10/97
3) 10.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	10/27/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	10/29/97
4) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	10/29/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	10/31/97
5) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	10/31/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	11/03/97
6) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	11/03/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	11/05/97
7) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	11/05/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	11/07/97
8) 100.0 KRAD IRRADIATION (0.625 KRADS/HOUR)	11/07/97
POST-100.0 KRAD ELECTRICAL MEASUREMENT	11/10/97
9) 168 HOUR ANNEALING @25°C	11/10/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/17/97

Effective Dose Rate = 100,000 RADS/36 DAYS=115.7 RADS/HOUR=0.032 RADS/SEC
The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim-annealing step.

The time interval between the 7.5 and 10 kRad steps was due to a repair of the ATE.

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

Table III. Electrical Characteristics of AD667 /1

Test #	Parameter	Units	Test Conditions	Spec. min	Lim. max
1	IDD1	mA	V_{CC} = 16.5V, V_{EE} = -16.5V, meas. on V_{CC}	0.0	12.0
2	IDD2	mA	V_{CC} = 11.4V, V_{EE} = -11.4V, meas. on V_{CC}	0.0	12.0
3	IEE1	mA	V_{CC} = 16.5V, V_{EE} = -16.5V, meas. on V_{EE}	-25.0	0.0
4	IEE2	mA	V_{CC} = 11.4V, V_{EE} = -11.4V, meas. on V_{EE}	-25.0	0.0
5	VREF	V	V_{CC} = 12.0V, V_{EE} = -12.0V	9.9	10.1
66-22	Iih	mA	V_{CC} = 15.0V, V_{EE} = -15.0V, vtest = 5.5V	-10.0	10.0
23-39	Iil	mA	V_{CC} = 15.0V, V_{EE} = -15.0V, vtest = 0.8V	-5.0	5.0
40	LE	lsb	V_{CC} = 15.0V, V_{EE} = -15.0V	-0.500	0.500
41	DNL	lsb	V_{CC} = 15.0V, V_{EE} = -15.0V	-0.750	0.750

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.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for AD667 /1

Test #	Parameters	Units	Spec. Lim. /2 min	Spec. Lim. /2 max	Initial mean	Initial sd	Total Ionizing Dose (kRads) 5.0 mean	5.0 sd	10.0 mean	10.0 sd	20.0 mean	20.0 sd	30.0 mean	30.0 sd	50.0 mean	50.0 sd	100.0 mean	100.0 sd	Annealing 168 hours @25°C mean	Annealing 168 hours @25°C sd
1	IDD1	mA	0.0	12.0	6.3	0.04	6.2	0.05	6.2	0.05	6.2	0.04	6.1	0.05	6.1	0.03	6.1	0.03	6.0	0.02
2	IDD2	mA	0.0	12.0	6.1	0	6.0	0.05	6.0	0.05	5.9	0.05	5.9	0.03	5.9	0.02	5.8	0.05	5.8	0.02
3	IEE1	mA	-25.0	0.0	-21.9	0.1	-21.8	0.2	-21.7	0.2	-21.6	0.1	-21.6	0.1	-21.5	0.1	-21.4	0.2	-21.4	0.1
4	IEE2	mA	-25.0	0.0	-20.6	0.1	-20.5	0.2	-20.4	0.2	-20.3	0.1	-20.2	0.2	-20.2	0.1	-20.1	0.1	-20.1	0.1
5	VREF	V	9.90	10.10	10.00	0	10.00	0	10.00	0	10.00	0.001	10.00	0.001	10.00	0.001	10.00	0.002	10.00	0.001
6-22	Iih	mA	-10.0	10.0	1.11	0.17	1.15	0.11	1.27	0.13	1.34	0.10	1.47	0.10	1.58	0.11	1.99	0.12	1.77	0.21
23-39	Iil	mA	-5.0	5.0	-0.89	0.17	-1.02	0.22	-0.84	0.10	-0.83	0.16	-0.80	0.16	-0.87	0.29	-0.83	0.15	-0.86	0.12
40	LE	lsb	-0.500	0.500	0.047	0.005	0.032	0.004	0.030	0.006	0.026	0.005	0.028	0.004	0.026	0.005	0.038	0.004	0.034	0.008
41	DNL	lsb	-0.750	0.750	0.134	0.012	0.192	0.007	0.254	0.014	0.316	0.020	0.360	0.060	0.486	0.048	0.782	0.041	0.772	0.041

Notes:

1/ The mean and standard deviation values were calculated over the five parts irradiated in this testing. The control samples remained constant throughout testing and are not included in this tab

2/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer ath the time the tests were performed.

Radiation sensitive parameters: DNL.