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PPM-92-055

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Code 711.3  
From  
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Department  
7809  
Subject  
Radiation Report on ISTP/711-HYDRA  
Part No. AD544SH/883B

Date  
February 7, 1992  
Location  
GSFC  
File No.  
731-8954  
Location  
Lanham  
S. Jung  
A. Sharma/311  
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A radiation evaluation was performed on AD544 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 cobalt-60 gamma ray source. During the radiation testing, five parts were irradiated under bias (see Figure 1 for bias configuration), and two parts were used as a control samples. The total dose radiation steps were 10, 20, 30, 50, 75 and 100 krads\*. After 100 krads, the parts were annealed under bias at 25°C for 168 hours, and then irradiation was continued to 200 and 300 krads (cumulative). The dose rate was between 0.2 and 5.0 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, the parts were electrically tested at 25°C according to the test conditions and the specification limits listed in Table III.

All five parts passed all tests on irradiation to 10 krads. At 20 krads, all parts exceeded the specification limit of 25pA for  $I_{b+}$  and  $I_{b-}$ , and one part (SN 92) marginally exceeded the maximum specification limit of 1mV for  $V_{OS}$ . Average readings for  $I_{b+}$  and  $I_{b-}$  were approximately 30pA. At 30 krads, all parts exceeded the specification limit for  $V_{OS}$ . The average of the readings for this parameter was twice the specification limit. On continued exposure to 50, 75 and 100 krads,  $V_{OS}$  and  $I_{b+}$  readings increased well beyond the specification limits. No significant recovery was observed after annealing the parts under bias at 25°C for 168 hours.

On continued radiation exposure to 200 and 300 krads,  $V_{OS}$  and  $I_{b+}$  continued to increase, although all parts continued to pass all other tests. Table IV provides the mean and standard deviation values for each parameter at each radiation exposure and annealing treatment.

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

\*In this report, the term "rads" is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	AD544
ISTP/711-HYDRA Part Number:	AD544SH/883B
ISTP/711-HYDRA Control Number:	5570
Charge Number:	C23390
Manufacturer:	Analog Devices
Lot Date Code:	9112A
Quantity Tested:	7
Serial Numbers of Radiation Samples:	92, 93, 94, 95, 96
Serial Numbers of Control Samples:	126, 127
Part Function:	Operational Amplifier
Part Technology:	Bipolar with BiFET Inputs
Package Style:	TO-3 (8-Pin)
Test Engineer:	T. Mondy

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	12/30/91
2) 10 krads irradiation @ 500 rads/hr Post 10 krads Electrical Measurements	12/30/91 12/31/91
3) 20 krads irradiation @ 230 rads/hr Post 20 krads Electrical Measurements	12/31/91 01/02/92
4) 30 krads irradiation @ 500 rads/hr Post 30 krads Electrical Measurements	01/02/92 01/03/92
5) 50 krads irradiation @ 300 rads/hr Post 50 krads Electrical Measurements	01/03/92 01/06/92
6) 75 krads irradiation @ 920 rads/hr Post 75 krads Electrical Measurements	01/06/92 01/08/92
7) 100 krads irradiation @ 1250 rads/hr Post 100 krads Electrical Measurements	01/08/92 01/09/92
8) 168 hrs annealing at 25°C Post 168 hr Electrical Measurements	01/09/92 01/16/92
9) 200 krads irradiation @ 5000 rads/hr Post 200 krads Electrical Measurements	01/16/92 01/17/92
10) 300 krads irradiation @ 5000 rads/hr Post 300 krads Electrical Measurements	01/17/92 01/18/92

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at 25°C.
- Annealing was performed under bias.

Table III. Electrical Characteristics of AD544

$T_A = 25^\circ\text{C}$ ,  $V_{CC+} = +15\text{V}$ ,  $V_{CC-} = -15\text{V}$ ,  $R_s = 50\ \Omega$ , unless otherwise specified.

Test	Conditions	Limit		Unit
		Min	Max	
+I <sub>CC</sub>	V <sub>o</sub> =0V	-	2.5	mA
-I <sub>CC</sub>	V <sub>o</sub> =0V	-	2.5	mA
V <sub>OS050</sub>		-1	1	mV
V <sub>OSRs</sub>	R <sub>s</sub> = 100 Ω	-1	1	mV
I <sub>OS</sub>		-15	15	pA
I <sub>b+</sub>		-25	25	pA
I <sub>b-</sub>		-25	25	pA
I <sub>bias</sub>		-25	25	pA
CMRR	V <sub>cm</sub> = ±10V	80	-	dB
+PSRR	V <sub>CC+</sub> =(+15,+5), V <sub>CC-</sub> =-15V	80	-	dB
-PSRR	V <sub>CC+</sub> =+15V, V <sub>CC-</sub> =(-15,-5)	80	-	dB
AOL	V <sub>o</sub> =±10V, R <sub>L</sub> =2kΩ	50	-	kV/V
+V <sub>OUT</sub>	R <sub>L</sub> =2kΩ	10	-	V
-V <sub>OUT</sub>	R <sub>L</sub> =2kΩ	10	-	V

Notes:

- 1) Common Mode Voltage Range (V<sub>cm</sub>) performed Go/NoGo in the CMRR test.
- 2) V<sub>OS050</sub> test included as additional information only and should not be considered as pass/fail criteria.

TABLE IV: Summary of Electrical Measurements  
after Total Dose Exposures and Annealing for AD544

1/

Parameters		Spec. Limits min max		Total Dose Exposure (krads)											
				Pre-Rad		10		20		30		50		75	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
+Icc	mA	-	2.5	1.6	.03	1.6	.03	1.5	.03	1.5	.03	1.5	.03	1.5	.03
-Icc	mA	-	2.5	1.6	.03	1.6	.03	1.5	.03	1.5	.03	1.5	.03	1.5	.03
VOS @50	uV	-1000	1000	-55	75	-156	181	-699	263	-2100	320	-3000	400	-3670	480
IOS	pA	-15	15	-0.2	.05	-1.6	0.9	-4.3	0.9	-8.3	1.5	-12.7	2.5	-36	4
Ib+	pA	-25	25	4.2	.14	12.8	1.4	28.0	2.6	49	3	102	6	191	5
Ib-	pA	-25	25	4.4	.18	14.3	1.8	33	2.9	58	3	115	8	230	8
Ibias	pA	-25	25	4.3	.16	13.5	1.6	31	2.7	54	4	110	4	210	7
VOS Rs	uV	-1000	1000	-55	75	-156	181	-699	263	-2100	320	-3000	400	-3670	480
AOL	kV/V	50	-	223	12	203	8.3	191	6	180	3	162	0.5	140	1.0
CMRR	dB	80	-	92	4	91	4	91	3	91	3	91	2.2	90	1.7
+PSRR	dB	80	-	111	5	109	5	108	5	108	5	107	5	106	4.6
-PSRR	dB	80	-	90	7	90	5	89	5	89	4	88	3.4	88	2.9
+Vo	V	10	-	13.9	0	13.9	.05	13.9	0	13.9	0	13.9	0	13.9	0
-Vo	V	10	-	13.1	0	13.1	.01	13.1	0	13.1	0	13.1	0	13.1	0

<Table IV continued on next page>

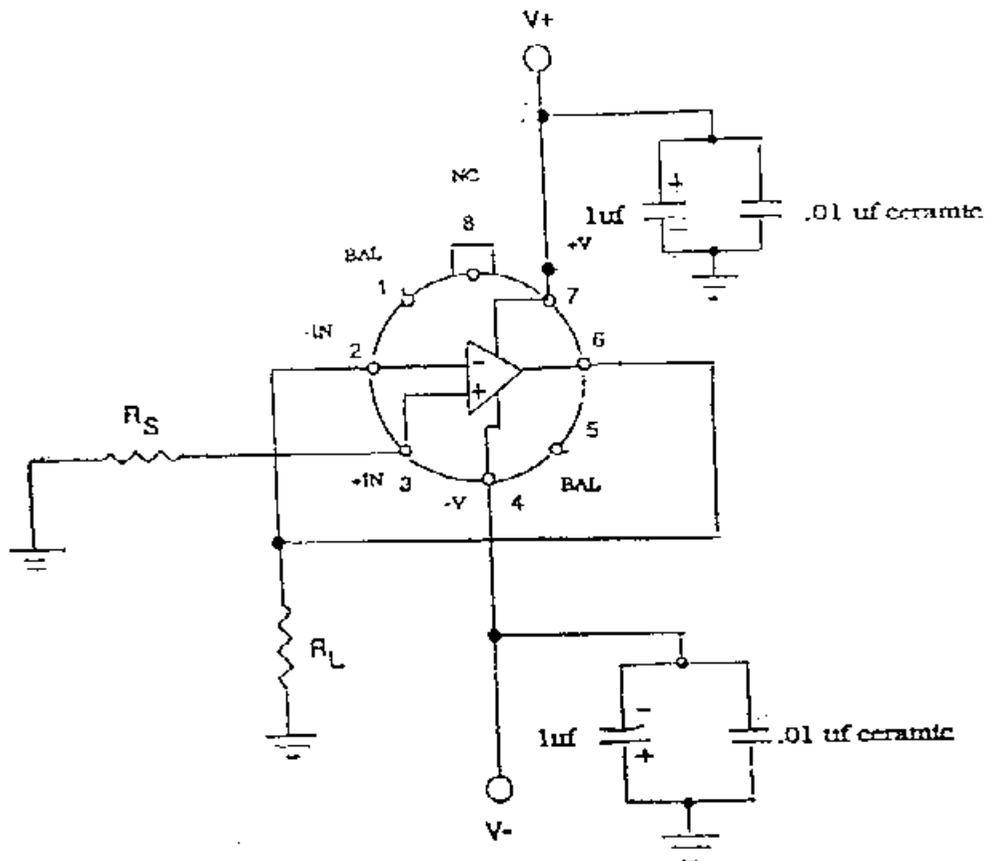
Table IV. (continued)

Parameters		Spec. Limits		Pre-Rad		TDE (krads)		Anneal		TDE (krads)			
						100		168 hrs		200		300	
						min	max	mean	sd	mean	sd	mean	sd
+Icc	mA	-	2.5	1.6	.03	1.5	.03	1.5	0	1.5	0	1.4	.03
-Icc	mA	-	2.5	1.6	.03	1.5	.03	1.5	0	1.5	0	1.4	.03
VOS @50	uV	-1000	1000	-55	75	-5400	528	-6700	300	-11E3	300	-15E3	300
IOS	pA	-15	15	-0.2	.05	-42	6	-35	2	-73	5	-102	8
Ib+	pA	-25	25	4.2	.14	236	5	183	4	430	15	680	20
Ib-	pA	-25	25	4.4	.18	278	9	225	8	510	10	775	15
Ibias	pA	-25	25	4.3	.16	257	6	200	6	470	10	730	15
VOS Rs	uV	-1000	1000	-55	75	-5400	528	-6700	300	-11E3	300	-15E3	300
AOL	kV/V	50	-	223	12	131	3	133	2	104	3	79	3
CMRR	dB	80	-	92	4	90	1.3	89	1	89	1	89	1
+PSRR	dB	80	-	111	5	106	5	106	3	105	2	106	3
-PSRR	dB	80	-	90	7	88	2.5	87	2	86	3	86	3
+Vo	V	10	-	13.9	0	13.9	.01	13.9	0	14	0	13.9	0
-Vo	V	10	-	13.1	0	13.1	.01	13.1	0	13.1	0	13.1	0

## Note:

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

Figure 1. Radiation Bias Circuit for AD544



$$+V_{cc} = 15V \pm 0.5V$$

$$-V_{cc} = -15V \pm 0.5V$$

$$R_S = 820 \Omega$$

$$R_L = 1.5 K \Omega$$

$$T_A = 25^\circ C$$