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## Interoffice Memorandum

To  
W. Beyah  
Department  
Code 300.1

From  
K. Sahu KS

Department  
7809

Subject  
Radiation Report on ISTEP  
Non-Common Buy Part No. AD549SH/883B

PPM-91-455  
Date  
July 9, 1991  
Location  
Lanham  
Telephone  
731-8954  
Location  
Lanham  
cc  
G. Krishnan/311  
V. Edson  
S. Esmacher  
D. Krus  
R. Woodward  
F. Grena/692  
J. Scudder/692  
K. Ogilvie/692

A radiation evaluation was performed on AD549 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, eight parts were irradiated under bias (see Figure 1 for bias configuration), and two parts were used as control samples. The total dose radiation steps were 5, 10, 20, 30, 50, 75, and 100 krads. After 100 krads, parts were annealed at 25°C for 24 and 168 hours (cumulative), and then irradiation was continued to 200 and 300 krads. The dose rate was between 0.3 - 5.1 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits listed in Table III.

All (8) parts passed all initial electrical tests; however, after the first radiation exposure of 5 krads, two parts (SNs 287 and 289) failed to meet the maximum specification limit of 500uV for VOS@50 (readings were 529uV and 632uV, respectively). All eight parts passed all other tests. After the next radiation step of 10 krads, all parts failed VOS@50, with three parts exceeding 3.8mV (the upper limit of the testing range of the ATE). All parts exceeded 3.8mV for VOS@50 after 20 and 30 krads irradiation and a general decrease was observed in ICC and AOL, although all parts continued to remain well within the specification limits for all parameters except VOS@50.

After 50 krads irradiation, SN 288 marginally failed IB+ with a reading of 2.04pA against the maximum specification limit of 2.0pA. After 100 krads, all parts marginally failed to meet the maximum specification limit of 2.0pA for I<sub>bias</sub> and IB+.

No significant recovery was observed after annealing the parts for 24 hours; however, after 168 hours of annealing, four parts (SNs 283, 287, 288 and 289) recovered to pass IB± and Ibias, although three parts (SNs 283, 286 and 288) failed to meet the minimum specification limit of 90dB for CMRR and -PSRR (readings ranged from 88.6dB to 95.2dB and from 88.0dB to 94.5dB, respectively). After 200 krads, all parts failed IB± and Ibias while three parts continued to fail CMRR and -PSRR. In addition, significant degradation was observed in AOL readings although these readings were still well beyond the minimum 300kV/V specification limit. After the final exposure to 300 krads, two more parts (SNs 285 and 289) failed CMRR in addition to the same post 200 krad failures. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments.

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

TABLE I: Part Information

Generic Part Number:	AD549
ISTP Non-Common Buy Part Number:	AD549SH/883B
ISTP Non-Common Buy Control Number:	1990
Charge Number:	C90266
Manufacturer:	Analog Devices
Quantity Procured:	54
Lot Date Code:	9107A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	282, 283, 284, 285, 286, 287, 288, 289
Serial Numbers of Control Samples:	280, 281
Part Function:	Ultra-Low Input Bias Current Operational Amplifier
Part Technology:	Bipolar/JFET Inputs
Package Style:	8 Pin DIP

TABLE II: Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	05/09/91
2) 5 krads irradiation @ 280 rads/hr Post 5 krads Electrical Measurements	05/29/91 05/30/91
3) 10 krads irradiation @ 280 rads/hr Post 10 krads Electrical Measurements	05/30/91 05/31/91
4) 20 krads irradiation @ 150 rads/hr* Post 20 krads Electrical Measurements	05/31/91 06/04/91
5) 30 krads irradiation @ 560 rads/hr Post 30 krads Electrical Measurements	06/04/91 06/05/91
6) 50 krads irradiation @ 1110 rads/hr Post 50 krads Electrical Measurements	06/05/91 06/06/91
7) 100 krads irradiation @ 2940 rads/hr Post 100 krads Electrical Measurements	06/06/91 06/07/91
8) 24 hour annealing Post 24 hr Electrical Measurements	06/07/91 06/08/91
9) 168 hour annealing Post 168 hr Electrical Measurements	06/07/91 06/14/91
10) 200 krads irradiation @ 1575 rads/hr Post 200 krads Electrical Measurements	06/14/91 06/17/91
11) 300 krads irradiation @ 5130 rads/hr Post 300 krads Electrical Measurements	06/17/91 06/18/91

\* A power failure in the ATE room on 06/03/91 necessitated leaving the parts in the radiation lab under bias for one day, which resulted in an additional 1krad exposure.

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 performed at 25°C under bias.

Table III. Electrical Characteristics of AD549

VCC = ±15V unless otherwise specified.

Test	Conditions	Limits		Units
		Min	Max	
I <sub>ICC</sub>			700	uA
-I <sub>ICC</sub>		-700		uA
V <sub>OS@50</sub>		-500	500	uV
I <sub>b+</sub>		-2	2	pA
I <sub>b-</sub>		-2	2	pA
I <sub>Bias</sub>		-2	2	pA
I <sub>OS</sub>		-2	2	pA
AOL	R <sub>L</sub> = 10 kOhm	300		V/mV
CMRR	dV <sub>o</sub> = 20V	90		dB
+PSRR	dV <sub>o</sub> =13V, +VCC: 5V to 18V	90		dB
-PSRR	dV <sub>o</sub> =13V, -VCC: -18V to -5V	90		dB

TABLE IV: Summary of Electrical Measurements  
after Total Dose Exposures and Annealing for AD549 1/, 2/

Parameters	Spec. Limits min max	Total Dose Exposure (krads)															
		Initials		5		10		20		30		50		100			
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
+ICC	uA	-	700	615	3	610	2	607	6	601	5	599	5	597	5	594	5
-ICC	(-) uA	-	700	609	3	608	2	604	6	598	6	598	5	596	5	594	5
VDS350	uV	-	500	90	30	421	118	>3.8E3	-								
I <sub>OS</sub>	pA	-2	2	.08	.03	0.12	.04	0.14	.04	.09	.05	0.18	.06	0.2	.06	0.2	.05
I <sub>B-</sub>	pA	-2	2	0.8	0.1	0.8	0.1	0.9	0.1	1.0	.05	1.1	.17	1.5	.26	2.6	0.2
I <sub>B-</sub>	pA	-2	2	0.8	0.1	0.8	0.2	0.7	0.1	0.9	.08	0.9	0.1	1.25	0.34	2.4	0.2
I <sub>bias</sub>	pA	-2	2	0.8	0.1	0.9	0.1	0.8	0.1	0.9	.06	1.0	0.1	1.4	0.3	2.5	0.2
AOL	kV/V	300	-	2.1E3	0.2E3	2.2E3	0.1E3	2.0E3	0.2E3	1.7E3	0.1E3	1.6E3	0.2E3	1.4E3	0.2E3	1.1E3	0.1E3
CMRR	dB	90	-	105	3	107	5	107	9	108	10	109	11	107	10	109	14
+PSRR	dB	90	-	120	4	121	5	120	8	121	10	122	11	121	9	122	12
-PSRR	dB	90	-	105	3	108	6	107	7	108	8	108	8	107	7	109	7

<Table IV continued on next page>

TABLE IV. (continued)

Parameters	Spec. Limits min max	Initials mean sd		Annealing				Total Dose (krads)					
				24 hrs.		168 hrs.		200		300			
				mean	sd	mean	sd	mean	sd	mean	sd		
+ICC	uA	-	700	615	3	594	5	593	5	590	5	586	5
-ICC	(-)uA	-	700	609	3	594	5	594	5	592	5	592	5
VOS@50	uV	-	500	90	30	>3.8E3	-	>3.8E3	-	>3.8E3	-	>3.8E3	-
IOS	pA	-	2	.08	.03	0.2	0.1	0.5	0.7	0.4	0.2	0.2	0.1
IB+	pA	-	2	0.8	0.1	2.3	0.2	2.0	0.4	5.1	0.7	7.0	1.0
IB-	pA	-	2	0.8	0.1	2.2	0.3	1.7	0.5	4.9	1.0	7.0	1.1
Ibias	pA	-	2	0.8	0.1	2.2	0.2	1.8	0.2	5.0	0.8	7.0	1.0
AOL	kV/V	300	-	2.1E3	0.2E3	1.2E3	0.2E3	1.3E3	0.2E3	806	82	660	55
CMRR	dB	90	-	105	3	107	10	91	2	91	2	89	2
+PSRR	dB	90	-	120	4	123	13	107	3	106	3	104	2
-PSRR	dB	90	-	106	3	108	9	91	3	91	2	90	2

## 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/ '>3.8E3' for VOS@50 indicates that parts exceeded the upper limit (3.8mV) of the testing range of the ATE for this parameter.

Figure 1. Radiation Bias Circuit for AD549

