

# Unisys

DATE: August 23, 1999  
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SUBJECT: Radiation Report on **AD845 (Analog Devices) (LDC 9846)**  
PROJECT: HST/COS

PPM-99-026

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A radiation evaluation was performed on **AD845 (5962-8964501P) Precision, 16MHz CBFET Op Amp (Analog Devices)** to determine the total dose tolerance of these parts. The total dose testing was performed using a  $\text{Co}^{60}$  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, 10.0, 20.0, 30.0, and 50.0kRads.<sup>1</sup> The effective dose rate was 0.14kRads/hour (0.04 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 50.0kRad irradiation, the parts were annealed under bias at 25°C for 168 hours.<sup>2</sup> After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits<sup>3</sup> listed in Table III. An executive summary of the test results is provided below in bold, followed by a detailed summary of the test results after each radiation level and annealing step.

**All parts passed all tests up to 20kRads. After the 30 and 50kRad irradiations, SN 53 fell significantly outside the specification limits for Icc, P\_PSRR\_A, and Vol. After annealing the parts at 25°C for 168 hours, the parts showed a slight increase in degradation, however all parts except for SN 53 passed all tests.**

Initial electrical measurements were made on 10 samples. Eight samples (SN's 62, 63, 64, 65, 66, 67, 68, and 69) were used as radiation samples while SN's 60 and 61 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 20.0kRads.

After the 30 and 50kRad irradiations, SN53 went outside the specification limit for three parameters. It exceeded the specification limit of 12.000mA for Icc with readings of 13.656mA after 30kRads and 13.356mA after 50kRads, fell marginally below the specification limit of 88dB for P\_PSRR\_A with a reading of 86.5dB and failed the Voltage Swing Test (Vol). **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, the parts showed a slight increase in degradation. SN 53 continued to fail as before. All other parts passed all 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.

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

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<sup>1</sup> The term Rads, as used in this document, means Rads (silicon). All radiation levels cited are cumulative.

<sup>2</sup> The temperature 25°C as used in this document implies room temperature.

<sup>3</sup> These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

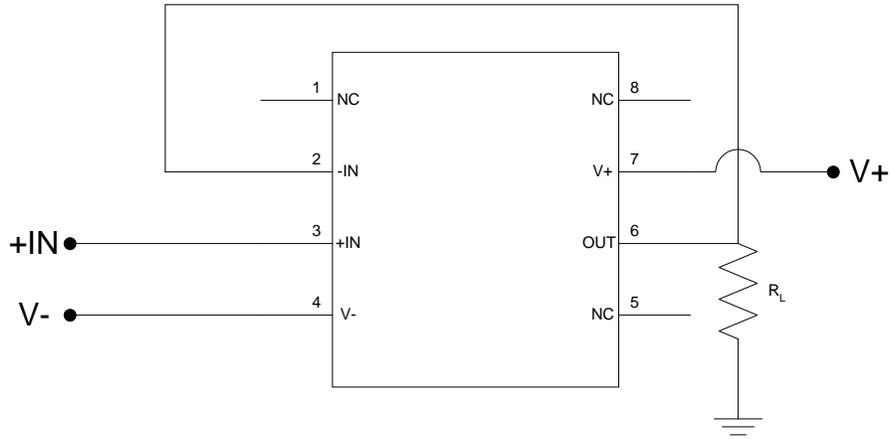
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Figure 1. Radiation Bias Circuit for AD845



Notes:

1.  $V+ = +15.0V \pm 0.5V$  DC.
2.  $V- = -15.0V \pm 0.5V$  DC.
3.  $+IN = +3.0V \pm 0.25V$  DC.
4.  $R_L = 2k\Omega \pm 5\%$ ,  $\frac{1}{4}W$ .

TABLE I. Part Information

Generic Part Number:	AD845
HST/COS Part Number	5962-8964501P
HST/COS TID Requirement	10kRads (RDM = 5)
Charge Number:	M90431
Manufacturer:	Analog Devices
Lot Date Code (LDC):	9846
Quantity Tested:	6
Serial Numbers of Control Samples:	50
Serial Numbers of Radiation Samples:	51, 52, 53, 54, 55
Part Function:	Precision, 16MHz CBFET Op Amp
Part Technology:	Complementary Bipolar with JFET Inputs
Package Style:	8 Pin DIP
Test Equipment:	A-540
Test Engineer:	S. Archer-Davies

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for AD845

EVENT .....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS .....	07/23/99
2) 2.5 KRAD IRRADIATION (0.114 KRADS/HOUR).....	07/26/99
POST-2.5 KRAD ELECTRICAL MEASUREMENT .....	07/27/99
3) 5.0 KRAD IRRADIATION (0.114 KRADS/HOUR).....	07/27/99
POST-5.0 KRAD ELECTRICAL MEASUREMENT .....	07/28/99
4) 10.0 KRAD IRRADIATION (0.109 KRADS/HOUR).....	07/28/99
POST-10.0 KRAD ELECTRICAL MEASUREMENT .....	07/30/99
5) 20.0 KRAD IRRADIATION (0.143 KRADS/HOUR).....	07/30/99
POST-20.0 KRAD ELECTRICAL MEASUREMENT .....	08/02/99
6) 30.0 KRAD IRRADIATION (0.143 KRADS/HOUR).....	08/02/99
POST-30.0 KRAD ELECTRICAL MEASUREMENT .....	08/05/99
7) 50.0 KRAD IRRADIATION (0.213 KRADS/HOUR).....	08/05/99
POST-50.0 KRAD ELECTRICAL MEASUREMENT .....	08/10/99
8) 168 HOUR ANNEALING @25°C.....	08/10/99
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	08/17/99

Effective Dose Rate = 50,000 RADS/15 DAYS=138.9 RADS/HOUR=0.04 RADS/SEC

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

Table III. Electrical Characteristics AD845 (1)

Test #	Parameter	Units	Spec. Limit		Test Conditions
			min	max	
1	I <sub>cc</sub>	mA		12.0	V <sub>OUT</sub> = 0V
2	V <sub>offset</sub>	mV	-1.00	1.00	V <sub>CM</sub> = 0V
3	+I <sub>b</sub>	nA	-2.00	2.00	V <sub>CM</sub> = 0V
4	-I <sub>b</sub>	nA	-2.00	2.00	V <sub>CM</sub> = 0V
5	I <sub>io</sub>	nA	-0.30	0.30	V <sub>CM</sub> = 0V
6	P <sub>PSRR_A</sub>	dB	88		±V <sub>S</sub> = ±5V to ±15V
7	P <sub>PSRR_B</sub>	dB	88		±V <sub>S</sub> = ±5V to ±15V
8	CMRR	dB	86		V <sub>CM</sub> = ±10V
9	Gain	dB	106		V <sub>OUT</sub> = ±10V, R <sub>L</sub> = 500Ω
10	V <sub>oh</sub>	V	12.5		R <sub>L</sub> ≥ 500Ω
11	V <sub>ol</sub>	V		-12.5	R <sub>L</sub> ≥ 500Ω
12	Slew_Rate_A	V/μs	94		A <sub>V</sub> = +10, R <sub>L</sub> = 500Ω, C <sub>L</sub> = 100pF

Notes:

(1) These are the manufacturer's non-irradiated data sheet specification limits. The manufacturer provided no post-irradiation limits at the time the tests were performed.

**TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for AD845 (1)**

Test #	Parameters	Units	Spec. Lim. (2)		Total Dose Exposure (kRads Si)														Annealing	
					Initial		2.5		5.0		10.0		20.0		30.0		50.0		168 hours @25°C	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Icc	mA		12.0	9.929	0.188	9.906	0.193	9.891	0.195	9.898	0.196	9.885	0.191	10.599	1.539	10.528	1.423	10.543	1.449
2	Voffset	mV	-1.00	1.00	-0.02	0.05	-0.10	0.05	-0.11	0.05	-0.12	0.04	-0.07	0.04	0.12	0.27	0.32	0.17	0.32	0.17
3	+Ib	nA	-2.00	2.00	0.16	0.09	0.32	0.19	0.26	0.11	0.22	0.07	0.37	0.10	0.24	0.07	0.32	0.11	0.22	0.16
4	-Ib	nA	-2.00	2.00	0.25	0.17	0.26	0.14	0.27	0.06	0.19	0.16	0.38	0.08	0.24	0.11	0.32	0.29	0.273	0.19
5	Iio	nA	-0.30	0.30	0.16	0.09	0.15	0.09	0.10	0.09	0.12	0.09	0.12	0.09	0.11	0.08	0.23	0.06	0.24	0.07
6	P_PSRR_A	dB	88		107	12	123	12	117	14	108	15	119	25	100	10	108	12	103	9
7	P_PSRR_B	dB	88		106	0	106	0	106	0	106	0	107	0	109	18	117	20	116	18
8	CMRR	dB	86		112	0	112	0	112	0	112	0	113	0	113	0.4	113	0.4	113	0.4
9	Gain	dB	106		113	0	113	0	113	0	113	0	113	0	113	0	113	0	113	0.4
10	Voh	V	12.5		14.1	0	14.1	0	14.1	0	14.1	0	14.0	0	14.0	0	13.9	0.2	13.9	0.2
11	Vol (3)	V		-12.5	-13.7	0	-13.7	0	-13.7	0	-13.6	0	-13.2	0	4P/1F		4P/1F		4P/1F	
12	Slew_Rate_A	V/ms	94		261	15	267	13	233	18	231	12	220	10	224	14	215	16	211	7

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
- (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) For VOL, one part failed significantly enough to make the mean and sd meaningless. All other parts passed with readings similar to those at 20kRads.

**Radiation sensitive parameters: Icc, P\_PSRR\_A, Vol.**