

UNCLASSIFIED

DATE: December 14, 1996

TO: J. Lohr/311.1

PPM-97-005

FROM: K. Sahu/300.1 KS

SUBJECT: Radiation Report on: AMP 03

Project: ASTRO-E/XDS

Control #: 15406

Job #: EE62006

cc: A. Sharma/311

OFA Library/300.1

A radiation evaluation was performed on AMP 03 (Unity-Gain Differential Amplifier) to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Figure 1 and Tables I through IV.

The total dose testing was performed using a Co^{60} gamma ray source. During the radiation testing, four 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 1, 3, 5, 10, 20, 50 and 100 krad*. The dose rate was between 30 and 1760 rads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure, parts were electrically tested according to the test conditions and the specification limits** listed in Table III.

During initial electrical tests, S/N 199 exceeded the maximum specification limit of 10.0 $\mu\text{V/V}$ for PSRR, with a reading of 68.8 $\mu\text{V/V}$. All other parts passed all initial electrical tests.

After the 1 krad irradiation, S/N 196, 198 and 199 exceeded the spec limit for PSRR, with readings ranging from 44.9 to 73.4 $\mu\text{V/V}$. All irradiated parts passed all other electrical tests at this irradiation level.

After the 3 krad irradiation, the same degradation in PSRR in the same parts was observed, with approximately the same values. All irradiated parts passed all other electrical tests at this irradiation level.

After the 5 krad irradiation, the same measurements continued to be seen for PSRR, with readings ranging from 62.9 to 77.9 $\mu\text{V/V}$. In addition, S/N 198 marginally exceeded the maximum specification limit of 0.0080 % for Avs_2K, with a reading of 0.0083 %. All irradiated parts passed all other electrical tests at this irradiation level.

After the 10 krad irradiation, all four irradiated parts exceeded the spec limits for Avs_2K, with readings ranging from 0.0086 to 0.0090 %. The same measurements in PSRR continued to be observed in S/N 196, 198 and 199, with readings ranging from 65.9 to 72.8 $\mu\text{V/V}$. All irradiated parts passed all other electrical tests at this irradiation level.

After the 10 krad irradiation, the parts were annealed for 96 hours at 25°C. After this anneal, the same measurements continued to be observed, with approximately the same values.

After the 20 krad irradiation, the same measurements continued to be observed, with approximately the same values for PSRR, and slightly increased readings for Avs_2K. All irradiated parts passed all other electrical tests at this irradiation level.

* The term rads, as used in this document, means rads(SiO_2). All consecutive annealing times at the same temperature and all radiation levels cited are cumulative.

** These are manufacturer's pre-irradiation data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

After the 50 and 100 krad irradiations, the same measurements continued to be observed, with slightly increasing values for Avs_2K. All irradiated parts continued to pass all other electrical tests at these irradiation levels.

No significant recovery was observed on annealing the parts for 336 hours at 25°C. No rebound effects were observed on further annealing the parts at 100°C.

In summary no significant degradation was observed in these parts up to 100 krads, except for some degradation in - PSRR and Avs 2K. Table IV provides mean and standard deviation values for each parameter initially and after each irradiation exposure.

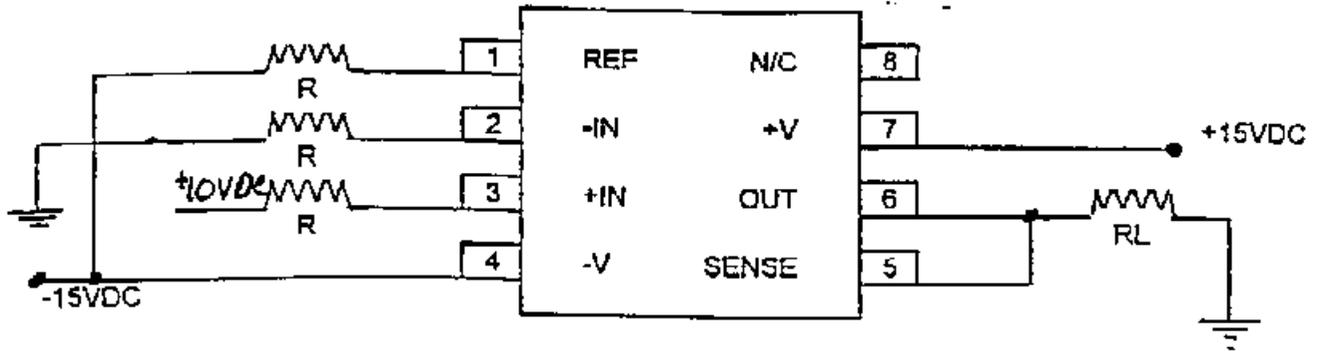
Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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Figure 1. Radiation Bias Circuit for AMP 03



All R's are 25K ohms. $\frac{1}{4}w$
 RL is 1K ohms $\frac{1}{4}w$

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TABLE I. Part Information

Generic Part Numbers:	AMP 03
ASTRO-E/XDS Part Number	AMP03BJ/883C
ASTRO-E/XDS Control Number:	15406
Charge Number:	EE62006
Manufacturer:	PMI
Lot Date Code (LDC):	9505
Quantity Tested:	6
Serial Number of Control Sample:	195
Serial Numbers of Radiation Samples:	196, 197, 198, 199
Part Function:	Unity-Gain Differential Amplifier
Part Technology:	Bipolar
Package Style:	8-pin TO-can
Test Equipment:	A540
Engineer:	A. Duvalsaint

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

TABLE II. Radiation Schedule for AMP 03

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	10/27/96
2) 1 KRAD IRRADIATION* (0.06 KRADS/HOUR).....	10/22/96
POST-1 KRAD ELECTRICAL MEASUREMENT	10/23/96
3) 3 KRAD IRRADIATION (0.03 KRADS/HOUR).....	11/01/96
POST-3 KRAD ELECTRICAL MEASUREMENT.....	11/04/96
4) 5 KRAD IRRADIATION (0.12 KRADS/HOUR).....	11/04/96
POST-5 KRAD ELECTRICAL MEASUREMENT.....	11/05/96
5) 10 KRAD IRRADIATION (0.29 KRADS/HOUR).....	11/05/96
POST-10 KRAD ELECTRICAL MEASUREMENT.....	11/06/96
6) 144-HOUR ANNEALING @25°C	11/06/96
POST-144 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/12/96
7) 20 KRAD IRRADIATION (0.59 KRADS/HOUR).....	11/12/96
POST-20 KRAD ELECTRICAL MEASUREMENT.....	11/13/96
8) 50 KRAD IRRADIATION (1.76 KRADS/HOUR).....	11/13/96
POST-50 KRAD ELECTRICAL MEASUREMENT.....	11/14/96
9) 100 KRAD IRRADIATION (0.56 KRADS/HOUR).....	11/14/96
POST-100 KRAD ELECTRICAL MEASUREMENT	11/18/96
10)336 HOURS ANNEALING @25°C	11/19/96
POST 336 HOURS ANNEALING ELECTRICAL MEASUREMENT	12/03/96
11)168 HOURS ANNEALING @100°C	12/03/96
POST 168 HOURS ANNEALING ELECTRICAL MEASUREMENT	12/10/96

* PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

Table III. Electrical Characteristics of AMP 03

#	Electrical Parameters	Units	Spec. Lim./1	
			min	max
1	I _{dd_15V}	mA	0	3.5
2	I _{ss_15V}	mA	-3.5	0
3	+V _{o_2K}	V	12	-
4	-V _{o_2K}	V	-	-12
5	V _{io}	μV	-700	700
6	A _{vs_2K Er}	%	-	0.008
12	CMRR	dB	80	-
13	+PSRR	μV	-	10
14	-PSRR	μV	-	10
15	+I _{os}	mA	-100	-15
16	-I _{os}	mA	0	45
17	+SR	V	6	-
18	-SR	V	6	-

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for AMP03

Electrical #	Parameters	Units	Spec. Lim./1		Total Dose Exposure (krads)										Annealing		Total Dose Exposure (krads)						Annealing	
					Initial		1		3		5		10		144 hrs. @ 25°C		20		50		100		336 hrs. @ 25°C	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	I _{dd} _15V	mA	0	3.5	2.40	.12	2.40	.12	2.41	.13	2.42	.13	2.43	.13	2.42	.12	2.40	.13	2.32	.12	2.30	.12	2.30	.15
2	I _{ss} _15V	mA	-3.5	0	-2.39	.13	-2.40	.13	-2.41	.13	-2.42	.13	-2.42	.13	-2.42	.13	-2.39	.12	-2.32	.12	-2.31	.12	-2.31	.12
3	+V _o _2K	V	12	-	13.8	.02	13.8	.02	13.8	.02	13.8	.02	13.8	.02	13.8	.02	13.8	.02	13.8	.02	13.8	.02	13.8	.02
4	-V _o _2K	V	-	-12	-13.9	0	-13.9	.01	-13.9	.04	-13.9	0	-13.9	.01	-13.9	.01	-13.8	.16	-13.9	.05	-13.9	.04	-13.9	.05
5	V _{io}	µV	-700	700	-18.8	45	-12.0	46	-8.08	47	-5.26	46	-5.53	49	-5.88	49	-10.1	52	9.05	58	11.5	62	10.5	.60
6	A _{vs} _2K Er	%	-	0.008	0.006	0	0.006	0	0.006	0	0.007	0	0.008	0	0.009	0	0.010	0	0.013	0	0.012	0	.011	.006
12	CMRR	dB	80	-	123	7.9	124	9.4	124	10	124	8.8	124	9.5	121	5.4	124	9.3	126	12	126	11	126	13
13	+PSRR	µV	-	10	2.81	1.5	3.19	1.7	3.46	1.6	3.72	1.7	3.27	2.0	3.14	2.0	3.27	1.8	4.90	2.9	5.32	2.2	4.1	2.0
14	-PSRR	µV	-	10	21.0	28	45.5	26	45.0	27	51.9	29	52.4	29	54.5	31	56.6	32	57.6	33	52.7	30	50.5	16
15	+I _{os}	mA	-100	-15	-52.4	.76	-52.3	.68	-52.7	.72	-52.8	.75	-52.6	.69	-52.8	.57	-52.3	.64	-51.4	.91	-49.8	.99	-50.1	1.1
16	-I _{os}	mA	0	45	20.1	0.8	20.1	.77	19.9	.78	19.7	.77	19.2	.74	19.3	.74	18.3	.69	16.4	.73	15.3	.66	15.2	.7
17	+SR	V	6	-	8.19	.27	8.44	.30	8.44	.36	8.41	.33	8.39	.31	8.44	.32	8.41	.34	8.41	.30	8.45	.25	8.40	.23
18	-SR	V	6	-	8.07	.34	8.31	.40	8.26	.40	8.27	.37	8.25	.39	8.24	.40	8.22	.39	8.22	.41	8.19	.40	8.20	.35

Notes:

- 1/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.
- 2/ The test data for all electrical parameters after high temperature annealing was very similar to the measurements after R.T. annealing and is therefore not included in this table. This data is available on request.