DATE: July 28, 1995 PPM-95-165

TO: J. Lohr/311
FROM: K. Sahu/300.1
SUBJECT: Radiation Report on CASSINI/CIRS
Part No. PA10M
Control No. 11822

cc: A. Sharma/311.0
OFA Library/300.1

A radiation evaluation was performed on PA10M (Power Operational 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 Tables I through IV and Figure 1.

The total dose testing was performed using a Co^{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 levels were 5, 10, 15, 20, 30, 50, 75 and 100 krads*. The dose rate was between 0.29 and 1.67 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 100 krad irradiation, parts were annealed at 25°C for 168 hours, after which the parts were annealed at 100°C for 168 hours. 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 parts passed initial electrical measurements. All irradiated parts passed all tests throughout all irradiation steps with no observable radiation-induced effects.

After annealing for 168 hours at 25°C, no significant recovery was observed and after annealing for 168 hours at 100°C, no rebound effects were observed.

Table IV provides a summary of the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps before retesting of the parts.

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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*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. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

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TABLE I. Part Information

Generic Part Number:	PA10
CASSINI/CIRS Part Number:	5962-9082801HXC
CASSINI/CIRS Control Number:	11822
Charge Number:	C56425
Manufacturer:	Apex Microtech
Lot Date Code:	9416
Quantity Tested:	10
Serial Number of Control Samples:	60, 61
Serial Numbers of Radiation Samples:	62, 63, 64, 65, 66, 67, 68, 69
Part Function:	Power OP- AMP
Part Technology:	Linear
Package Style:	Metal Can
Test Equipment:	A540
Test Engineer:	T. Mondy

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

TABLE II. Radiation Schedule for PA10M

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	06/14/95
2) 5 KRAD IRRADIATION (0.29 KRADS/HOUR)	06/19/95
POST-5 KRAD ELECTRICAL MEASUREMENT	06/20/95
3) 10 KRAD IRRADIATION (0.29 KRADS/HOUR)	06/20/95
POST-10 KRAD ELECTRICAL MEASUREMENT	06/21/95
4) 15 KRAD IRRADIATION (0.29 KRADS/HOUR)	06/21/95
POST-15 KRAD ELECTRICAL MEASUREMENT	06/22/95
5) 20 KRAD IRRADIATION (0.29 KRADS/HOUR)	06/22/95
POST-20 KRAD ELECTRICAL MEASUREMENT	06/23/95
6) 30 KRAD IRRADIATION (0.15 KRADS/HOUR)	06/23/95
POST-30 KRAD ELECTRICAL MEASUREMENT	06/26/95
7) 50 KRAD IRRADIATION (1.67 KRADS/HOUR)	06/26/95
POST-50 KRAD ELECTRICAL MEASUREMENT	06/27/95
8) 75 KRAD IRRADIATION (1.56 KRADS/HOUR)	06/27/95
POST-75 KRAD ELECTRICAL MEASUREMENT	06/28/95
9) 100 KRAD IRRADIATION (1.47 KRADS/HOUR)	06/28/95
POST-100 KRAD ELECTRICAL MEASUREMENT	06/29/95
10) 168-HOUR ANNEALING @25°C	06/29/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	07/06/95
11) 168-HOUR ANNEALING @100°C*	07/06/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	07/13/95

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

*High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-883D, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of PA10M

Unless Otherwise Specified: T_A =25°C, VCC = +/- 40Vdc, V_{OUT}=0V , Gain = 100

TEST NAME	SYMBOL	CONDITIONS	LIMITS	
			MIN	MAX
		SUPPLY CURRENT		
Plus_Icc	Icc	V_{OUT} = 0V	0.0ma	30.0mA
Minus_Icc	Icc	V_{OUT} = 0V	-30.0mA	0.0mA
		INPUT OFFSET TESTS		
VOS_10V	V_{IO}	V_{OUT} = 0V , V_{CC} = +/- 10Vdc	-12.00mV	12.00mV
VOS_40V	V_{IO}	V_{OUT} = 0V , V_{CC} = +/- 40Vdc	-6.00mV	6.00mV
VOS_45V	V_{IO}	V_{OUT} = 0V , V_{CC} = +/- 45Vdc	-7.00mV	7.00mV
P_IIB_0V	$+I_{IB}$	V_{OUT} = 0V	-30.00nA	30.00nA
N_IIB_0V	$-I_{IB}$	V_{OUT} = 0V	-30.00nA	30.00nA
IIOS_0V	I_{IO}	V_{OUT} = 0V	-30.00nA	30.00nA
CMRR	CMRR	V_{CC} = +/- 15Vdc , V_{CM} = +/- 9V	74dB	
		AMPLIFIER OUTPUT TESTS		
P_VOUT_1K	V_{OP}	Iout =80mA, V_{CC} = +/- 45Vdc	40.0V	
N_VOUT_2K	V_{OP}	Iout =-80mA, V_{CC} = +/- 45Vdc		-40.0V

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for PA10M /1

Test #	Parameters	Unit	Spec. Lim./2 min	Spec. Lim./2 max	Initial mean	Initial sd	Total Dose Exposure (krads) 5 mean	5 sd	10 mean	10 sd	15 mean	15 sd	20 mean	20 sd	30 mean	30 sd	50 mean	50 sd	75 mean	75 sd	100 mean	100 sd	Annealing 168 hrs @25°C mean	168 hrs @25°C sd	168 hrs @100°C mean	168 hrs @100°C sd
1	Plus_Icc	mA	0	30	18.6	0.08	18.3	0.07	17.9	0.08	18.4	0.09	18.6	0.08	18.6	0.09	18.5	0.18	18.3	0.07	18.3	0.08	18.8	0.26	18.6	0.26
2	Minus_Icc	mA	-30	0	-18.5	0.08	-18.2	0.07	-17.9	0.08	-18.4	0.09	-18.6	0.09	-18.6	0.09	-18.5	0.18	-18.2	0.07	-18.2	0.08	-18.3	0.24	-18.6	0.26
3	Vos_10V	mV	-12	12	-0.36	0.32	0.18	0.52	-0.69	0.58	-0.41	0.52	-0.55	0.59	0.14	0.52	0.77	1.40	0.47	0.37	0.71	0.41	0.46	1.02	0.03	1.45
4	Vos_40V	mV	-6	6	-0.69	0.34	-0.18	0.33	0.12	0.31	0.09	0.32	0.22	0.32	0.61	0.31	0.99	0.81	1.27	0.37	0.88	0.65	1.17	0.79	0.31	0.86
5	Vos_45V	mV	-7	7	-0.66	0.35	-0.42	0.39	-0.08	0.33	-0.11	0.04	0.0	0.36	0.43	0.33	0.71	0.87	1.14	0.29	1.39	0.27	0.86	0.91	0.02	1.09
6	P_IIB_0V	nA	-30	30	3.49	1.25	3.91	1.24	3.21	1.10	3.65	1.27	3.33	1.26	3.50	1.35	3.84	3.60	5.31	1.35	7.66	1.38	7.44	4.75	7.08	4.48
7	N_IIB_0V	nA	-30	30	14.6	1.39	14.9	1.76	13.1	1.39	15.1	1.77	14.0	1.55	14.5	1.92	15.1	5.06	16.6	2.24	19.1	2.38	18.9	6.12	17.3	5.88
8	IIOS_0V	nA	-30	30	-11.2	0.57	-11.0	0.89	-9.88	0.74	-11.4	0.96	-10.7	0.89	-11.0	1.21	-11.1	2.93	-11.2	1.51	-11.5	1.56	-11.4	3.75	-10.2	3.12
9	CMR_18V	dB	74	-	111	4.71	103	5.89	103	6.83	97.5	6.03	96.6	5.95	105	4.81	110	11.8	114	5.62	118	5.24	110	7.02	108	9.15
10	P_VOUT	V	40	-	42.3	0.04	42.4	0.04	42.4	0.04	42.4	0.04	42.3	0.04	42.3	0.04	42.3	0.04	42.3	0.04	42.3	0.04	42.3	0.12	42.3	0.12
11	N_VOUT	V	-	-40	-41.5	0.02	-41.5	0.03	-41.5	0.03	-41.5	0.03	-41.5	0.03	-41.4	0.03	-41.5	0.03	-41.5	0.03	-41.5	0.03	-41.5	0.07	-41.5	0.08

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/ 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.

Radiation-sensitive parameters: None

Figure 1. Radiation Bias Circuit for PA10M