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Paramax Systems
Corporation

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Lanham MD 20706

Memorandum

PARAMAX
A unisys Company

PPM-92-308

DATE: Dec. 21, 1992
TO: B. Fafaul
FROM: K. Sahu KS
SUBJECT: Radiation Report on FAST/HCI
Part No. M38510/10104BGC (LM108)
Control No. 7353

cc: L. Shiflett/745.1
A. Sharma/311
Library/300.1
L. Cusick/740.4
SMEX, PPM File

A radiation evaluation was performed on LM108 (Op Amp) 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 and 40 krads*. After 40 krads, parts were annealed at +25°C for 432 hours. The irradiation was then continued to 60 krads (cumulative). The dose rate was between 0.25 and 1.0 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 at 25°C according to the test conditions and the specification limits** listed in Table III.

All ten parts passed initial (pre-rad) electrical tests. All eight irradiated parts passed all electrical tests up to and including the 5-krad step. After the 10-krad exposure, all eight irradiated parts exceeded the maximum specification limit of 2 nA for Ib+ and Ib-. All eight irradiated parts continued to fail Ib+ and Ib- throughout all subsequent irradiation and annealing steps. After the 20-krad exposure, some parts exceeded the maximum specification limit of 200 pA for Ios. These parts continued to fail Ios throughout all subsequent irradiation and annealing step.

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*The term rads, as used in this document, means rads(silicon).
**These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

After annealing for 168 hours at 25°C, Some parts exceeded the maximum specification limit of 500 uV for Vos@50. These failures continued throughout all subsequent irradiation and annealing steps. All parts passed all other electrical tests throughout all irradiation and annealing steps.

After continued irradiation to 60 krads (cumulative), failures in Ib+, Ib-, Ios and Vos@50 continued to be observed.

Table IV presents a summary of the parametric failures after each irradiation and annealing step. It also provides the range of readings observed in each of the failing parameters at different irradiation and annealing steps. Note that failures in Ib+, Ib- and Ios were marginal up to 20 krads.

No rebound effects were observed after annealing for 168 hours at 100°C.

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:	LM108
Part Number:	M38510/10104BGC
FAST/HCI Control Number:	7353
Charge Number:	C33115
Manufacturer:	Linear Tech Corp.
Lot Date Code:	9120
Quantity Tested:	10
Serial Numbers of Radiation Samples:	52, 53, 54, 55, 56, 57, 58, 59
Serial Numbers of Control Samples:	50, 51
Part Function:	Op Amp
Part Technology:	Bipolar
Package Style:	8-lead TOx Can
Test Engineer:	A. Phung

TABLE II. Radiation Schedule for LM108

EVENTS	DATE
1) Initial Electrical Measurements	10/28/92
2) 5 KRAD IRRADIATION (0.26 KRADS/HOUR)	11/02/92
POST-5 KRAD ELECTRICAL MEASUREMENT	11/03/92
3) 10 KRAD IRRADIATION (0.25 KRADS/HOUR)	11/03/92
POST-10 KRAD ELECTRICAL MEASUREMENT	11/05/92
4) 20 KRAD IRRADIATION (0.5 KRADS/HOUR)	11/05/92
POST-20 KRAD ELECTRICAL MEASUREMENT	11/06/92
5) 30 KRAD IRRADIATION (0.5 KRADS/HOUR)	11/09/92
POST-30 KRAD ELECTRICAL MEASUREMENT	11/10/92
6) 40 KRAD IRRADIATION (0.23 KRADS/HOUR)	11/10/92
POST-40 KRAD ELECTRICAL MEASUREMENT	11/13/92
7) 432 HOUR* ANNEALING @25°C	11/13/92
POST-432 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/01/92
8) 60 KRAD IRRADIATION (1.0 KRADS/HOUR)	12/01/92
POST-60 KRAD ELECTRICAL MEASUREMENT	11/03/92
9) 168 HOUR ANNEALING @100°C**	12/03/92
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/10/92

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT 25°C.

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

*Parts were kept under bias at 25°C for 432 hours instead of the usual 168 hours while test equipment was undergoing repair.

**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 LM108

T_A=25°C, Vcc+=+15V, Vcc-=-15V, Rs=50 Ohm othewise unless Specified.

TEST	CONDITIONS	LIMIT		UNITS
		Min	Max	
+Icc	Vcc+=+15V,Vcc-=-15V,Vo=0V		.6	mA
-Icc	Vcc+=+15V,Vcc-=-15V,Vo=0V	.6		mA
Vos50	Vcc+=35V,Vcc-=-5V	-.5	.5	mV
	Vcc+=5V,Vcc-=-35V	-.5	.5	mV
	Vcc+=20V,Vcc-=-20V	-.5	.5	mV
	Vcc+=5V,Vcc-=-5V	-.5	.5	mV
Ios	Vcc+=35V,Vcc-=-5V	-.2	.2	nA
	Vcc+=5V,Vcc-=-35V	-.2	.2	nA
	Vcc+=20V,Vcc-=-20V	-.2	.2	nA
	Vcc+=5V,Vcc-=-5V	-.2	.2	nA
Ib+	Vcc+=35V,Vcc-=-5V	-.1	2	nA
	Vcc+=5V,Vcc-=-35V	-.1	2	nA
	Vcc+=20V,Vcc-=-20V	-.1	2	nA
	Vcc+=5V,Vcc-=-5V	-.1	2	nA

Table III. Electrical Characteristics of LM108 (cont.)

TEST	CONDITIONS	LIMIT		UNITS
		Min	Max	
Ib-	Vcc+=35V,Vcc-=-5V	-.1	2	nA
	Vcc+=5V,Vcc-=-35V	-.1	2	nA
	Vcc+=20V,Vcc-=-20V	-.1	2	nA
	Vcc+=5V,Vcc-=-5V	-.1	2	nA
CMRR	Vcm=+/-15V	96		dB
+PSRR	Vcc+=(+20,+10), Vcc-=-20V	96		dB
-PSRR	Vcc+=+20V, Vcc-=(-20,-10)	96		dB
Av	Vo=+/-15V,RL=10K,Vcc=+/-15V	80		V/mV
	Vo=+/-2V,RL=10K,Vcc=+/-5V	20		V/mV
V_{OUT}	RL=10K	-16	16	V

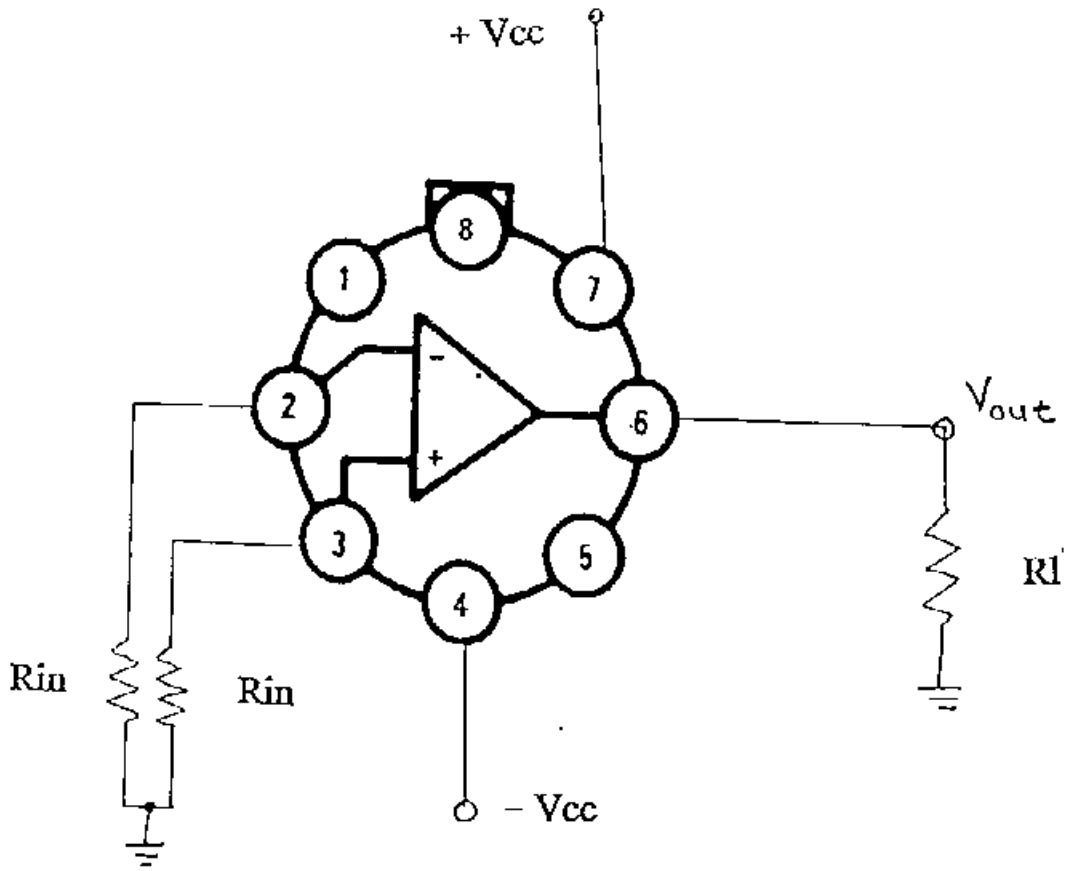
Table IV. Summary of Failed Electrical Tests After Total Dose Exposures and Annealing Steps for LM108/1

Total Dose	# of Parts		Failing		
	Passed	Failed	Parameters	Limit	Range/2
Initial (0)	8	0			
5 krads	8	0			
10 krads	0	8	Ib+ Ib-	2 nA 2 nA	2.5 - 3.7 nA 2.5 - 3.7 nA
20 krads	0	8	Ib+ Ib- Ios	2 nA 2 nA 200 pA	37 - 54 nA 37 - 53 nA 204 - 253 pA
40 krads	0	8	Ib+ Ib- Ios	2 nA 2 nA 200 pA	-2 - 11 nA 2.5 - 32 nA 572 pA - 27nA
Anneal 432 hrs. at 25°C	0	8	Ib+ Ib- Ios Vos@50	2 nA 2 nA 200 pA 500 uV	15 - 26 nA 17 - 25 nA 519 pA - 2nA 558 - 938 uV
60 krads	0	8	Ib+ Ib- Ios Vos@50	2 nA 2 nA 200 pA 500 uV	29 - 60 nA 26 - 54 nA 1 - 7nA 517uV - 2mV
Anneal 168 hrs. at 100°C	0	8	Ib+ Ib- Ios Vos@50	2 nA 2 nA 200 pA 500 uV	4.4 - 6.8 nA 4.4 - 6.8 nA 1 - 3nA 503 uV - 2mV

1/ Data at 30 krads are unavailable due to tester difficulties.

2/ This column gives the range of readings of the failed parameters at each irradiation and annealing step.

Figure 1. Radiation Bias Circuit for LM108



+ Vcc = + 15 + / - 0.5 V
- Vcc = - 15 + / - 0.5 V
Rin = 2 Kohm + / - 5 % , 1/4 W .
Rl = 10 Kohm + / - 5 % , 1/4 W .