PPM-91-0392

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UNISYS

Interoffice Memorandum

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Code 300.1
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Subject
Radiation Report on ISTP
Non-Common Buy Part No. LM108A

PPM-91-0392
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June 10, 1991
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A radiation evaluation was performed on LM108A 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 25, 50, 75, and 100 krads. After 100 krads, parts were annealed at 25°C for 24 and 168 hours, and then the irradiation was continued to 200 krads (cumulative). The dose rate was between 0.5 - 5.5 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 measurements. However, after the first radiation exposure of 25 krads, parts exceeded the maximum specified limits on I_{OS}, I_b+ and I_b-. The I_{OS} readings for four of the irradiated parts were in the range of 200 - 500 pA (against the maximum specification limits of 200 pA), two of the irradiated parts (SN 404 and SN 408) were reading I_{OS} > 3.7 nA*. Also, all the irradiation parts were reading I_b+ and I_b- values > 3.7 nA* (against the specification limit of 2 nA). However, parts passed all other tests at 25 krads. On further irradiation to 50 krads, parts continued to exceed the specification limits on I_b+, I_b-, and I_{OS} (readings for all these parameters were > 3.7 nA). Also, seven parts exceeded the specification limit of 500 μV for V_{OS}; however, all parts continued to pass all other tests.

After 75 krads exposure, all parts showed a marked level of degradation in A_{OL}. The readings for A_{OL} were in the range of 20 - 35 kV/V for seven of the irradiation parts against the specification limit of a minimum of 80 kV/V. The readings for I_b+ and I_b- were in the range of 30 - 65 nA, and for I_{OS} were in the range 2 - 10 nA.

After 100 krads exposure, parts failed functionally as no measurements could be made for A_{OL}, CMRR and PSRR on seven of the irradiated parts. Some recovery was observed on annealing the parts for 24 and 168 hours, but the parts still were way beyond the specification limits on most of the parameters. On continued irradiation to 200 krads, parts failed functionally and no measurements could be made. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. It also provides a summary of functional test results after each radiation/annealing step.

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

*The test equipment range for $I_{b}+$, $I_{b}-$, and I_{OS} was inadvertently set at > 3.7 nA for all radiation steps except for 75 krads. Although a range of 3.7 nA covered the specification limit adequately, it was not adequate to measure the radiation induced degradation. However, an estimate of radiation induced degradation in $I_{b}+$, $I_{b}+$, and I_{OS} can be obtained from 75 krads level, where the range was broadened to 100 nA. See table IV for more information on these measurements.

TABLE I. Part Information

Generic Part Number:	LM108A
ISTP Non-Common Buy Part Number:	M38510/10104BGA
ISTP Non-Common Buy Control Number:	2102
Charge No.:	C6401I
Manufacturer:	Linear Technology Corp.
Quantity Procured:	43
Lot Date Codes:	9013
Quantity Tested:	10
Serial Numbers of Radiation Samples:	400, 402, 403, 404, 405, 406, 407, 408
Serial Numbers of Control Samples:	87, 401
Part Function:	Operational Amplifier
Part Technology:	Bipolar
Package Style:	8 Pin Can

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	03/27/91
2) 25 krads irradiation @ 1.25 rads/hr	04/12/91
Post 25 krads Electrical Measurements	04/13/91
3) 50 krads irradiation @ 570 rads/hr	04/13/91
Post 50 krads Electrical Measurements	04/15/91
4) 75 krads irradiation @ 1388.9 rads/hr	04/15/91
Post 75 krads Electrical Measurements	04/16/91
5) 100 krads irradiation @ 1562.5 rads/hr	04/16/91
Post 100 krads Electrical Measurements	04/17/91
6) 24 hour annealing	04/17/91
Post 24 hr Electrical Measurements	04/18/91
7) 168 hour annealing	04/18/91
Post 168 hr Electrical Measurements	04/24/91
8) 200 krads irradiation @ 5555 rads/hr	04/25/91
Post 200 krads Electrical Measurements	04/26/91

Notes:

1) All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.

2) All electrical measurements were performed off-site at 25°C.

3) Annealing performed at 25°C under bias.

Table III. Electrical Characteristics of LM108A

Conditions

$^{+}V_{CC} = +15V$, $^{-}V_{CC} = -15V$,
$T_A = +25°C$, $R_S = 50$ Ohm

Test	Other Conditions	MIN	MAX
$+I_{CC}$	$V_o = 0V$		600 μA
$-I_{CC}$	$V_o = 0V$		600 μA
V_{OS}	Bin #1 $V_{CC}^+ = 35V$, $V_{CC}^- = -5V$	-0.5 mV	0.5 mV
	Bin #2 $V_{CC}^+ = 5V$, $V_{CC}^- = -35V$	-0.5 mV	0.5 mV
	Bin #3 $V_{CC}^+ = 20V$, $V_{CC}^- = -20V$	-0.5 mV	0.5 mV
	Bin #4 $V_{CC}^+ = 5V$, $V_{CC}^- = -5V$	-0.5 mV	0.5 mV
I_{OS}	Bin #1 $V_{CC}^+ = 35V$, $V_{CC}^- = -5V$		200 pA
	Bin #2 $V_{CC}^+ = 5V$, $V_{CC}^- = -35V$		200 pA
	Bin #3 $V_{CC}^+ = 20V$, $V_{CC}^- = -20V$		200 pA
	Bin #4 $V_{CC}^+ = 5V$, $V_{CC}^- = -5V$		200 pA
I_b^+	Bin #1 $V_{CC}^+ = 35V$, $V_{CC}^- = -5V$		2 nA
	Bin #2 $V_{CC}^+ = 5V$, $V_{CC}^- = -35V$		2 nA
	Bin #3 $V_{CC}^+ = 20V$, $V_{CC}^- = -20V$		2 nA
	Bin #4 $V_{CC}^+ = 5V$, $V_{CC}^- = -5V$		2 nA
I_b^-	Bin #1 $V_{CC}^+ = 35V$, $V_{CC}^- = -5V$		2 nA
	Bin #2 $V_{CC}^+ = 5V$, $V_{CC}^- = -35V$		2 nA
	Bin #3 $V_{CC}^+ = 20V$, $V_{CC}^- = -20V$		2 nA
	Bin #4 $V_{CC}^+ = 5V$, $V_{CC}^- = -5V$		2 nA
A_{OL}	V_O=+/-15V, R_L=10kohms, V_{CC}=+/-15V	80 kV/V	
	V_O=+/-2V, R_L=2kohms, V_{CC}=/-5V	20 kV/V	
CMRR	$V_{cm} = +/- 15V$	96 dB	
+PSRR	$V_{CC}^+ = (+20,+10)$, $V_{CC}^- = -20$ V	96 dB	
-PSRR	$V_{CC}^+ = +20$ V, $V_{CC}^- = (-20,-10)$	96 dB	
$+V_O$	R_L= 10 KOhm	16 V	
$-V_O$	R_L= 10 KOhm	16 V	

TABLE IV: Summary of E[illegible]rical Measurements after Total Dose Exposures and Annealing for LM108A 1/, 2/, 3/

Parameters		Spec. Limits min	Spec. Limits max	Initials mean	Initials sd	Total Dose Exposure (krads) 25 mean	25 sd	50 mean	50 sd	75 mean	75 sd	100 mean	100 sd	Annealing 24 hrs mean	24 hrs sd	168 hrs mean	168 hrs sd	Total Dose Exposure (krads) 200 mean	200 sd
+Icc	µA		600	341	5	335	5	335	6	325	4	352	7	321	5	319	3	*	
-Icc	µA		600	356	5	339	3	335	4	330	4	371	10	322	4	326	4	*	
|Vos@50|	µV		500	260	40	80	30	526	270	2500	2000	*		*		*		*	
Ios	pA		200	59	7	>3.7		>3.7		6500	6000	*		*		*		*	
Ib+	nA		2	.55	.04	>3.7		>3.7		62000	2000	*		*		*		*	
Ib-	nA		2	.53	.04	>3.7		>3.7		6500	2000	*		*		*		*	
AOL	kV/V	80		>2000		670	250	125	30	35	5	10	10	7	7	20	11	*	
CMRR	dB	96		106	.2	106	.2	121	30	89	10	0	0	46	45	82	9	*	
+PSRR	dB	96		133	4	+		122	30	103	10	78	2	121	6	118	7	*	
-PSRR	dB	96		105	.1	103	.2	105	10	98	5	99	5	100	6	94	3	*	
+Vo	V	15		18.9	.1	18.9	.1	18.9	.1	18.9	.1	18.9	.1	18.9	.1	18.9	.1	*	
-Vo	V	15		18.9	.1	18.9	.1	18.9	.1	18.9	.1	18.9	.1	18.9	.1	18.9	.1	*	

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.

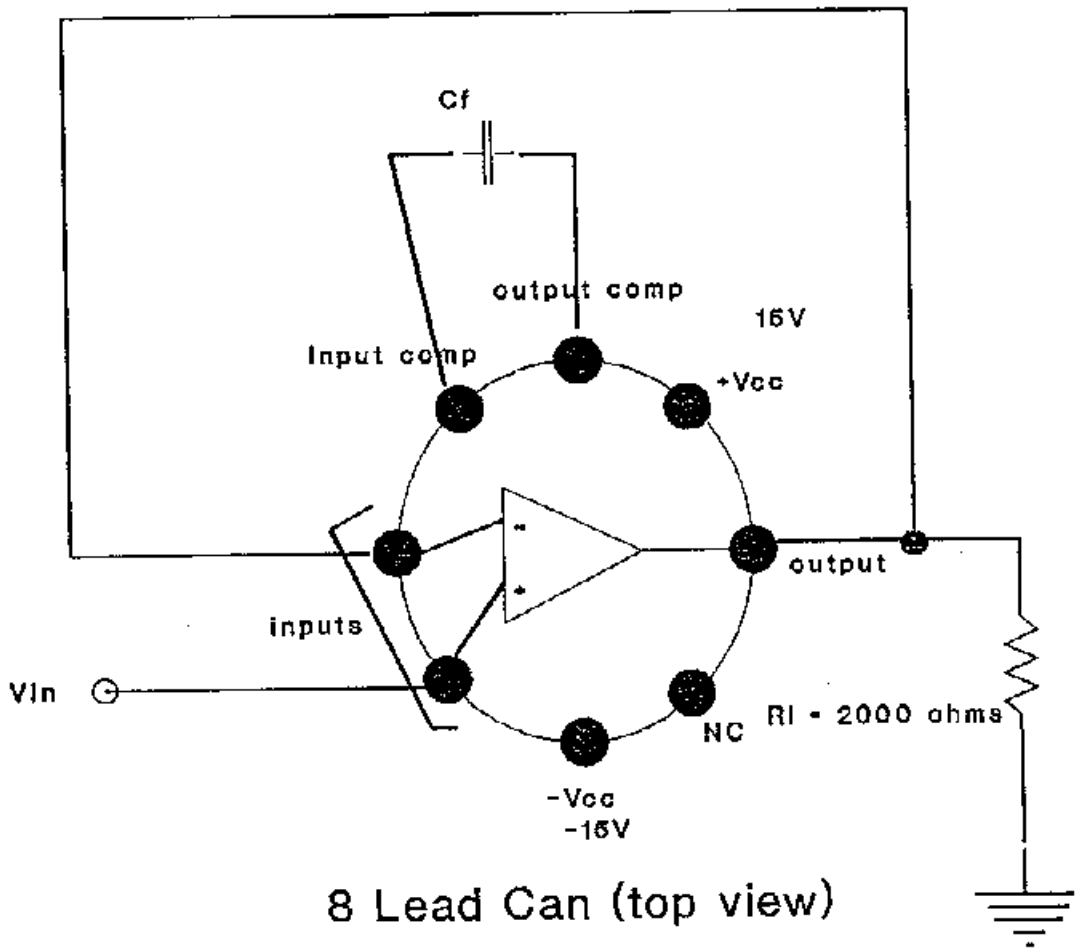
2/ Due to catastrophic failure of all parts at 200 krads, measurements could not be taken.

3/ This data represents the average of bin #1 only. The data from other bins was very similar to bin #1, and is available on request.

* No reliable measurements would be made for these parameters at the noted radiation/annealing step due to failures of the parts.

+ No reliable measurements could be made for this parameter at the noted radiation step due to part exceeding the specification limit.

Figure 1: Radiation Bias Circuit for LM108A



8 Lead Can (top view)

Cf = 30pF

+/- Vcc = +/- 15 V +/- 0.5V

Test Conditions (TA = 25 degrees celcius)

Vin = 3.0 V +/- .3 V