

DATE: Dec.20, 1996
 TO: G.Kramer/311
 FROM: K. Sahu/300.1
 SUBJECT: Radiation Report on: LM101A(M38510/10103BPA)
 Project: Marshal Space Flight Center/ACIS
 Control #: 15539
 Job #: EE71378
 Project part #: JM38510/10103BPA

PPM-97-007

cc: Dr.J. Howard/MSFC
 A. Sharma/311.0
 OFA Library/300.1

A radiation evaluation was performed LM101A (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 ⁶⁰Co gamma ray source. During the radiation testing, four 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 2.5, 5, 7.5, 10, 15, 20 and 30 krads*. The dose rate was between 0.04 and 0.25 krads/hour (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.

All parts passed initial electrical measurements. All parts passed all electrical tests throughout all irradiation steps.

No significant degradation was observed in any parameter throughout all irradiation and annealing steps.

Table IV provides a summary of the functional test results and the mean and standard deviation values for each parameter for both biased and unbiased parts 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.

* 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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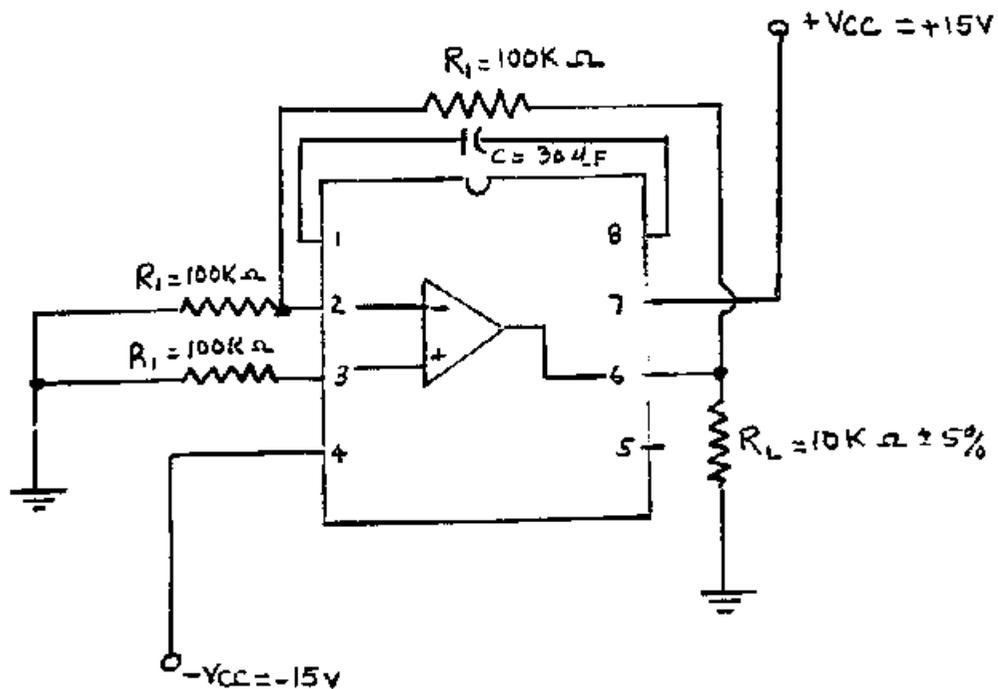
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Figure 1. Radiation Bias Circuit for LM101A(M38510/10103BPA)

Part # M38510/10103BPA

(Generic LM101A)



Radiation Bias Circuit

$C = 30\mu F \pm 10\%$
 $+V_{CC} = +15V DC$
 $-V_{CC} = -15V DC$
 $R_1 = 100K\Omega, \frac{1}{4}W, 5\%$
 $R_L = 10K\Omega, \frac{1}{4}W, 5\%$

sample size: 6

Package style: 8pin DIP

TABLE I. Part Information

Generic Part Number:	LM101A
Project Part Number	JM38510/13501SGX
Control Number:	15539
Charge Number:	EE71378
Manufacturer:	National
Lot Date Code (LDC):	9511
Quantity Tested:	8
Serial Number of Control Samples:	260,261
Serial Numbers of Biased Radiation Samples:	262, 263, 264, 265, 266, 267
Part Function:	Op Amp
Part Technology:	Bipolar
Package Style:	8 Pin Dip
Test Equipment:	A540
Engineer:	S.Norris

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

TABLE II. Radiation Schedule for LM 101A

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	11/25/96
2) 2.5 KRAD IRRADIATION (0.06 KRADS/HOUR)	12/02/96
POST-2.5 KRAD ELECTRICAL MEASUREMENT.....	12/04/96
3) 5 KRAD IRRADIATION (0.06 KRADS/HOUR)	12/04/96
POST-5 KRAD ELECTRICAL MEASUREMENT.....	12/06/96
4) 7.5 KRAD IRRADIATION (0.04 KRADS/HOUR)	12/06/96
POST-10 KRAD ELECTRICAL MEASUREMENT.....	12/09/96
4) 10 KRAD IRRADIATION (0.04 KRADS/HOUR)	12/09/96
POST-10 KRAD ELECTRICAL MEASUREMENT.....	12/11/96
5) 15 KRAD IRRADIATION (0.12 KRADS/HOUR)	12/11/96
POST-15 KRAD ELECTRICAL MEASUREMENT.....	12/13/96
6) 20 KRAD IRRADIATION (0.09 KRADS/HOUR)	12/13/96
POST-20 KRAD ELECTRICAL MEASUREMENT.....	12/16/96
7) 30 KRAD IRRADIATION (0.25 KRADS/HOUR)	12/16/96
POST-30 KRAD ELECTRICAL MEASUREMENT.....	12/18/96

PARTS WERE IRRADIATED UNDER BIAS; SEE FIGURE 1.

Table III. Electrical Characteristics of LM 101A

Test #	Parameters	Units	Spec. Lim.	
			min	max
1	Plus_Icc	mA	0	3.0
2	Minus_Icc	mA	-3.0	0
3	I _{OS_0V}	nA	-10.0	10.0
4	CMRR	dB	80.0	-
5	Plus_PSRR	$\mu\text{V/V}$	-50.0	100.0
6	Minus_PSRR	$\mu\text{V/V}$	-50.0	100.0
7	P_VOUT_2K	V	10.0	-
8	N_VOUT_2K	V	-	-10.0
9	P_AOL	V/mV	50.0	-
10	N_AOL	V/mV	50.0	-
11	V_offset	mV	-3.0	3.0
12	p_iib	nA	1.0	75
13	n_iib	nA	1.0	75
14	+Slew Rate	V/ μs	0.3	-
15	-Slew Rate	V/ μs	-0.3	-

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures for LM101A /1

Test #	Parameters	Units	Spec. Lim./2		Initial		Total Dose Exposure (krads) 3/											
			min	max	mean	sd	5		10		15		20		30			
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
1	Plus_Icc	mA	0	3.0	1.67	.02	1.66	.02	1.63	.02	1.61	.02	1.58	.03	1.56	.02		
2	Minus_Icc	mA	-3.0	0	-1.67	.02	-1.66	.02	-1.63	.02	-1.61	.02	-1.58	.03	-1.56	.02		
3	IIOS_0V	nA	-10.0	10.0	-.51	.12	-.64	.12	-.85	.06	-.97	.05	-1.0	.03	-1.0	.03		
4	CMRR	dB	80.0	-	104	6	105	4.5	103	4	103	4	103	4	102	4		
5	Plus_PSRR	μ V/V	-50.0	100.0	3.6	1.1	3.7	1.2	3.7	1.3	3.8	1.1	3.9	1.1	4.1	1.1		
6	Minus_PSRR	μ V/V	-50.0	100.0	2.1	2.1	2.3	2.0	2.6	1.9	3.0	1.8	3.2	1.1	3.5	1.4		
7	P_VOUT_2K	V	10.0	-	14	0	14	0	14	0	14.0	0	14	0	14	0		
8	N_VOUT_2K	V	-	-10.0	-12.9	0	-12.9	0	-12.9	0	-12.9	0	-12.9	0	-12.9	0		
9	P_AOL	V/mV	50.0	-	269	7.7	280	9.4	305	13	324	12.3	352	23	382	19		
10	N_AOL	V/mV	50.0	-	265	9.5	280	9.7	303	17	323	15	365	24	416	27		
11	V_offset	mV	-3.0	3.0	-1.1	.22	-1.1	.23	-1.08	.21	-1.06	.21	-1.06	.20	-1.05	.23		
12	p_iib	nA	1.0	75	18.4	2.0	21.3	2.6	25.3	2.9	29.8	3.7	34.3	3.1	37.9	4.0		
13	n_iib	nA	1.0	75	18.6	1.9	21.5	2.4	25.9	2.8	30	3.6	33.5	3.0	38.6	4.1		
14	+Slew Rate 4/	V/ μ s	0.3	-	7.0	3.1									3.3	.42		
15	-Slew Rate 4/	V/ μ s	-0.3	-	-5.8	.40									-6.3	.40		

Notes:

- 1/ The mean and standard deviation values were calculated over the six parts irradiated in this testing.
- 2/ 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.
- 3/ The test data after 2.5 and 7.5 krads is available on request.
- 4/ Slew rate measurements were made only initially and after final radiation exposure as bench tests.