

Unisys

DATE: July 15, 1997
TO: J.Lohr/311
FROM: K. Sahu/300.1
SUBJECT: Radiation Report on: LT1009
Project: MIDEX/MAP
Job #: EE78113
Project part #: LT1009-2.5V (5962-8961001XA)

PPM-97-027

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A radiation evaluation was performed on LT1009-2.5V (5962-8961001XA) voltage reference 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 Co⁶⁰ 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 5.0, 10.0, 15.0, 20.0, 30.0, 50.0, and 100.0 kRads.* The dose rate was between 0.06 and 0.50 kRads/hour (see Table II for radiation schedule). After the 100.0 kRad exposure, the parts were annealed for 168 hours at 25°C. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits** listed in Table III.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 3, 4, 5, 6, 7, 8, 9, and 10) were used as radiation samples while SN's 1 and 2 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests upon irradiation to 30.0 kRads. No significant degradation was noted in any of the parts.

After the 50.0 kRad irradiation, all parts fell below the specification limit of 2.495V for V_Z with readings in the range of 2.4810 to 2.4834V. SN's 6 and 9 also fell below the specification limit of -6.000mV for VLoad_1 with readings of -7.500 and -6.016mV respectively. **All parts passed all other tests.**

After the 100 kRad irradiation, all parts fell below the specification limits for V_Z and Vload_1 with readings in the ranges of 2.479 to 2.482V and -7.031 to -9.922mV, respectively. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, the parts did not show any significant recovery.

Table IV provides a summary of the test results with the mean and standard deviation values for each parameter after each irradiation exposure and 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 term Rads, as used in this document, means Rads(silicon). All radiation levels cited are cumulative.

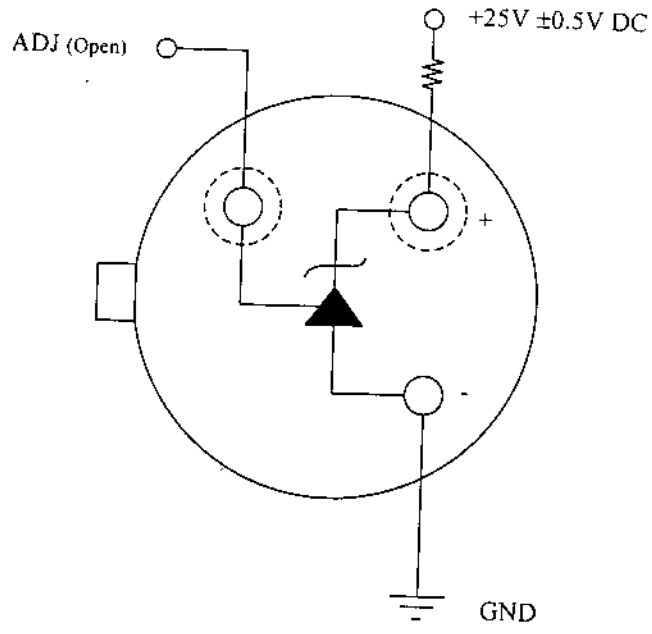
** These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for LT1009



Note: Resistor is $5k\Omega \pm 5\%$, $\frac{1}{4}W$

TABLE I. Part Information

Generic Part Number:	LT1009
MIDEX/MAP Part Number	5962-8961001XA
Charge Number:	EE78113
Manufacturer:	Linear Technology
Lot Date Code (LDC):	9543C
Quantity Tested:	10
Serial Number of Control Samples:	1, 2
Serial Numbers of Radiation Samples:	3, 4, 5, 6, 7, 8, 9, 10
Part Function:	2.5V IC Voltage Reference
Part Technology:	Bipolar
Package Style:	T0-18
Test Equipment:	A540
Test Engineer:	S. Norris

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

TABLE II. Radiation Schedule for LT1009

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	04/14/97
2) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	06/04/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	06/06/97
3) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	06/09/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	06/11/97
4) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	06/11/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	06/13/97
5) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	06/13/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	06/16/97
6) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	06/16/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	06/18/97
7) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	06/18/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	06/20/97
8) 100.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	06/20/97
POST-100.0 KRAD ELECTRICAL MEASUREMENT	06/23/97
9) 168 HOUR ANNEALING @25°C	06/23/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	07/01/97

Effective Dose Rate = 100,000 RADS/20 DAYS = 208.3 RADS/HOUR=0.058 RADS/SEC

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

Table III. Electrical Characteristics of LT1009 /1

Test #	Parameters /1	Units	Test Conditions	Spec. Lim.	
				min	max
1	V_Z	V	$T_A = 25^\circ\text{C}, I_R = 1\text{mA}$	2.495	2.505
2	$V_{\text{Load 1}}$	mV	$400\mu\text{A} \leq I_R \leq 10\text{mA}$	-6.0	6.0
3	V_F	V	$T_A = 25^\circ\text{C}, I_F = 2\text{mA}$	-1.0	-0.4
4	V_{ADJ}	mV	$I_R = 1\text{mA}, V_{\text{ADJ}} = +0.6\text{V to } V_Z - 0.6\text{V}$	0.0	15.0

Notes:

1/ These are the manufacturer's non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for LT1009 /1

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads)												Annealing					
			min	max	5.0		10.0		15.0		20.0		30.0		50.0		100		168 hours @25°C			
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
1	VZ	V	2.495	2.505	2.499	0.0007	2.500	0.0007	2.500	0.0007	2.500	0.0006	2.500	0.0006	2.500	0.0007	2.482	0.0007	2.481	0.0008	2.481	0.0009
2	VLoad_1	mV	-6.0	6.0	-2.98	0.08	-3.22	0.05	-3.19	0.06	-3.80	0.13	-4.43	0.67	-5.43	1.03	-8.68	0.98	-8.84	0.98	-8.84	0.77
3	VF	V	-1.0	-0.4	-0.69	0.004	-0.69	0.003	-0.69	0.003	-0.69	0.003	-0.69	0.004	-0.71	0.003	-0.71	0.004	-0.71	0.004	-0.71	0.002
4	V_ADJ	mV	0.0	15.0	0.48	0.05	0.49	0.08	0.48	0.09	0.50	0.11	0.49	0.04	0.39	0.07	0.36	0.12	0.30	0.12	0.30	0.11

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: Vz, VLoad_1.