

Unisys

DATE: November 08, 1999
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SUBJECT: Radiation Report on **LM117K (National Semiconductor) (LDC 9808)**
PROJECT: MAP

PPM-99-034

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A radiation evaluation was performed on **LM117K (M38510/11704BTA) 3-Terminal Adjustable Voltage Regulator (National Semiconductor)** to determine the total dose tolerance of these parts. 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 10.0, 20.0, and 30.0kRads.¹ The average dose rate was 0.29kRads/hour (0.08Rads/s). See Table II for the radiation schedule and average dose rate calculation. After the 30.0kRad irradiation, the parts were annealed under bias at 25°C for 168 hours.² After each radiation exposure and annealing step, parts were electrically tested according to the test conditions and the specification limits³ listed in Table III. An executive summary of the test results is provided below in bold, followed by a detailed summary of the test results after each radiation level and annealing step. See Table IV and Figure 2 for more details.

All parts passed all tests through 10kRads. After the 20 and 30kRad irradiations, all parts exceeded the specification limit for V_Line_1. After annealing the parts at 25°C for 168 hours, the parts showed no significant recovery in V_Line_1.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 92, 93, 94, 95, 96, 97, 98 and 99) were used as radiation samples while SN's 90 and 91 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 10.0kRads.

After the 20 and 30kRad irradiation, all parts exceeded the specification limit of 9.00mV for V_Line_1 with readings in the range of 9.2 to 18.2mV. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, the parts showed no significant recovery in V_Line_1.

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 us at (301) 731-8954.

¹ The term Rads, as used in this document, means Rads (silicon). All radiation levels cited are cumulative.

² The temperature 25°C as used in this document implies room temperature.

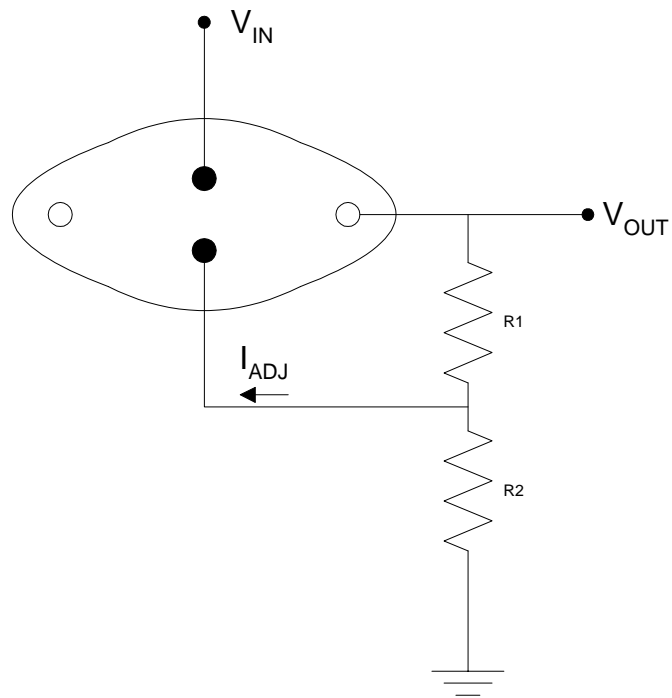
³ These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for LM117K



Notes:

1. $V_{IN} = +15V$.
2. $R_1 = 240\Omega \pm 5\%$, $\frac{1}{2}W$.
3. $R_2 = 1.8k\Omega \pm 5\%$, $\frac{1}{2}W$.
4. $I_{ADJ} \approx 7mA$.
5. Case is V_{OUT} .

TABLE I. Part Information

Generic Part Number:	LM117K
MAP Part Number	M38510/11704BTA
MAP TID Requirement	30kRads (RDM = 2)
Charge Number:	C00166
Manufacturer:	National Semiconductor
Lot Date Code (LDC):	9808
Quantity Tested:	10
Serial Numbers of Control Samples:	90, 91
Serial Numbers of Radiation Samples:	92, 93, 94, 95, 96, 97, 98, 99
Part Function:	3-Terminal Adjustable Voltage Regulator
Part Technology:	Bipolar
Package Style:	TO-3 Metal Can
Test Equipment:	A540
Test Engineer:	A. Duvalsaint

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for LM117K

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	10/19/99
2) 10.0 KRAD IRRADIATION (0.526 KRADS/HOUR).....	10/20/99
POST 10.0 KRAD ELECTRICAL MEASUREMENT	10/21/99
3) 20.0 KRAD IRRADIATION (0.526 KRADS/HOUR).....	10/21/99
POST-20.0 KRAD ELECTRICAL MEASUREMENT	10/22/99
4) 30.0 KRAD IRRADIATION (0.151 KRADS/HOUR).....	10/22/99
POST-30.0 KRAD ELECTRICAL MEASUREMENT	10/25/99
5) 168 HOUR ANNEALING @25°C.....	10/25/99
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	11/02/99

Average Dose Rate = 30,000 RADS/103 HOURS=291 RADS/HOUR=0.08RADS/SEC

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

Table III. Electrical Characteristics LM117K (1)

Test #	Parameter	Units	Spec. Limit		Test Conditions (2)
			min	max	
1	IQ_3V	mA	-3.0	-0.50	V_{IN} = 3.0V
2	IQ_13V	mA	-3.0	-0.50	V_{IN} = 13.0V
3	IQ_40V	mA	-5.0	-1.0	V_{IN} = 40V
4	IADJ_3V	μA	-100	-15	V_{DIFF} = 3V
5	IADJ_40V	μA	-100	-15	V_{DIFF} = 40V
6	Delta_IADJ_1	μA	-5.00	5.00	(IADJ_3V - IADJ_40V)
7	V_Out_1	V	1.20	1.30	V_{IN} = 3.0V
8	V_Out_2	V	1.20	1.30	V_{IN} = 5.0V
9	V_Out_3	V	1.20	1.30	V_{IN} = 40V
10	V_Line_1	mV	-9.00	9.00	3.0V ≤ V_{IN} ≤ 40V
11	V_Load_1	mV	-3.50	3.50	V_{IN} = 5.0V, 2.5mA ≤ I_L ≤ 198mA
12	V_Load_2	mV	-3.50	3.50	V_{IN} = 40V, 2.5mA ≤ I_L ≤ 100mA
13	V_Out_4	V	1.20	1.30	V_{IN} = 40V, I_L = 198mA
14	V_Out_5	V	1.20	1.30	V_{IN} = 3.0V, I_L = 400mA

Notes:

(1) These are the manufacturer's non-irradiated data sheet specification limits. The manufacturer provided no post-irradiation limits at the time the tests were performed.

(2) I_L = 5mA unless otherwise specified.

E IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for LM11

Test #	Parameters	Units	Spec. Lim. (2)		Total Dose Exposure (kRads Si)									Annealing	
					Initial		10.0		20.0		30.0		168 hours @25°C		
					min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean
1	IQ_3V	mA	-3.0	-0.50	-1.22	0.01	-1.08	0.06	-0.83	0.20	-0.75	0.13	-0.72	0.09	
2	IQ_13V	mA	-3.0	-0.50	-1.44	0.01	-1.33	0.05	-1.12	0.18	-1.05	0.12	-1.05	0.09	
3	IQ_40V	mA	-5.0	-1.0	-3.1	0.04	-3.0	0.05	-2.9	0.33	-2.8	0.13	-2.8	0.08	
4	IADJ_3V	mA	-100	-15	-52	1	-52	1	-52	1	-51	1	-51	1	
5	IADJ_40V	mA	-100	-15	-54	1	-55	1	-56	1	-55	1	-54	1	
6	Delta_IADJ_1	mA	-5.00	5.00	2.97	0.11	3.14	0.09	3.59	0.21	3.85	0.17	3.73	0.24	
7	V_Out_1	V	1.20	1.30	1.26	0.01	1.26	0.01	1.27	0.01	1.25	0.02	1.24	0.02	
8	V_Out_2	V	1.20	1.30	1.26	0.01	1.26	0.01	1.27	0.01	1.25	0.02	1.24	0.02	
9	V_Out_3	V	1.20	1.30	1.26	0.01	1.26	0.01	1.28	0.01	1.26	0.02	1.26	0.02	
10	V_Line_1	mV	-9.00	9.00	3.07	0.04	5.25	0.42	11.13	2.16	13.48	1.15	13.45	1.66	
11	V_Load_1	mV	-3.50	3.50	0.13	0.08	-0.16	0.10	-1.10	0.21	-1.57	0.21	-1.43	0.19	
12	V_Load_2	mV	-3.50	3.50	0.64	0.24	0.25	0.27	-0.86	0.36	-1.28	0.29	-1.15	0.28	
13	V_Out_4	V	1.20	1.30	1.26	0.01	1.26	0.01	1.27	0.01	1.26	0.02	1.26	0.02	
14	V_Out_5	V	1.20	1.30	1.26	0.01	1.26	0.01	1.27	0.01	1.25	0.02	1.25	0.02	

Notes:

- (1) The mean and standard deviation values were calculated over the seven parts irradiated in this testing. The control samples remained constant throughout 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: V_Line_1.