



DATE: May 17, 1995  
TO: J. Lohr/311  
FROM: K. Sahu/300.1 *KS*  
SUBJECT: Radiation Report on: LM136  
Project: CASSINI/CIRS  
Control #: 11816  
Job #: EE56325  
Project part #: 8418001XX

PPM-95-152

cc: B. Posey/300.1  
A. Sharma/311  
OFA Library/300.1

A radiation evaluation was performed on LM136 (Voltage Regulator) 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 <sup>60</sup>Co gamma ray source. During the radiation testing, four parts were irradiated under bias (see Figure 1 for bias configuration) and one part was used as a control sample. The total dose radiation levels were 2.5, 5, 10, 15, 20, 30, 50, 75 and 100 krads\*. The dose rate was between 0.04 and 1.47 krads/hour (see Table II for radiation schedule). After each radiation exposure and annealing step, parts were electrically tested according to the test conditions and the specification limits\*\* listed in Table III.

All parts passed initial electrical measurements. All irradiated parts passed all electrical tests up to and including the 30 krad irradiation. After the 50 krad irradiation, some degradation was seen in Delta Vr, but it was not possible to obtain reliable data for this parameter, due to cable problems in the test setup. All irradiated parts continued to pass all other electrical tests up to and including the 100 krad level.

After annealing for 168 hours at 25°C, no recovery was observed. After annealing for 168 hours at 100°C, no rebound effects were observed.

Table IV provides a summary of 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.

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\* 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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Figure 1. Radiation Bias Circuit for LM136

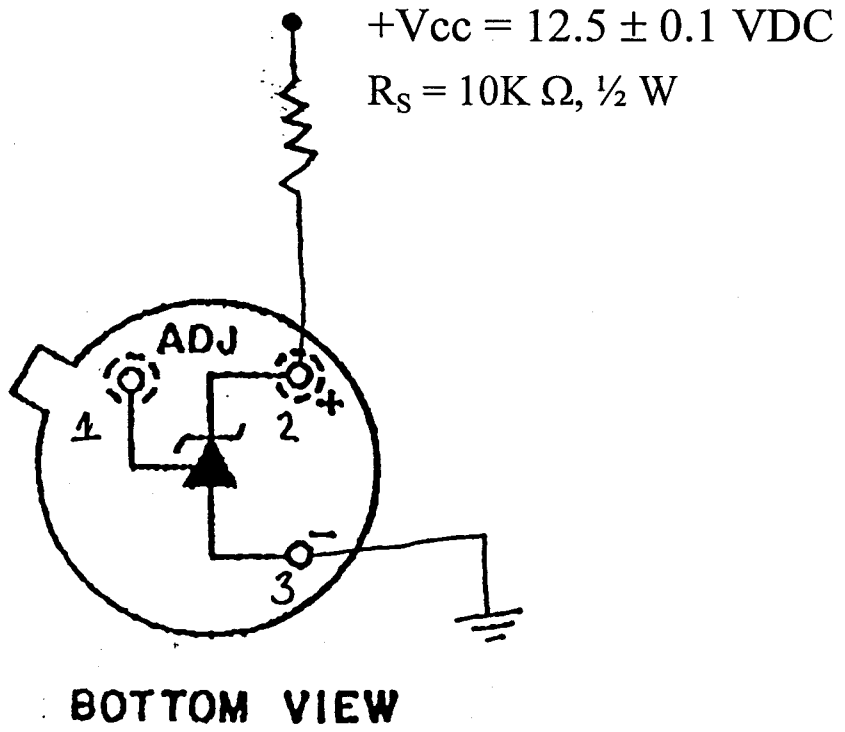


TABLE I. Part Information

Generic Part Number:	LM136*
CASSINI/CIRS Part Number	8418001XX
CASSINI/CIRS Control Number:	11816
Charge Number:	EE56325
Manufacturer:	LTC
Lot Date Code (LDC):	9342A
Quantity Tested:	5
Serial Number of Control Samples:	1
Serial Numbers of Radiation Samples:	2, 3, 4, 5
Part Function:	Voltage Regulator
Part Technology:	Bipolar
Package Style:	3-pin TOx can
Test Equipment:	Bench test setup
Engineer:	T. Mondy

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

TABLE II. Radiation Schedule for LM136

EVENT .....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	04/05/95
2) 2.5 KRAD IRRADIATION (0.15 KRADS/HOUR) .....	04/06/95
POST-2.5 KRAD ELECTRICAL MEASUREMENT.....	04/07/95
3) 5 KRAD IRRADIATION (0.04 KRADS/HOUR) .....	04/07/95
POST-5 KRAD ELECTRICAL MEASUREMENT.....	04/10/95
4) 10 KRAD IRRADIATION (0.29 KRADS/HOUR) .....	04/10/95
POST-10 KRAD ELECTRICAL MEASUREMENT.....	04/11/95
5) 15 KRAD IRRADIATION (0.29 KRADS/HOUR) .....	04/11/95
POST-15 KRAD ELECTRICAL MEASUREMENT.....	04/12/95
6) 20 KRAD IRRADIATION (0.29 KRADS/HOUR) .....	04/12/95
POST-20 KRAD ELECTRICAL MEASUREMENT.....	04/13/95
7) 30 KRAD IRRADIATION (0.59 KRADS/HOUR) .....	04/13/95
POST-30 KRAD ELECTRICAL MEASUREMENT.....	04/14/95
8) 50 KRAD IRRADIATION (0.31 KRADS/HOUR) .....	04/14/95
POST-50 KRAD ELECTRICAL MEASUREMENT.....	04/17/95
9) 75 KRAD IRRADIATION (1.47 KRADS/HOUR) .....	04/18/95
POST-75 KRAD ELECTRICAL MEASUREMENT.....	04/19/95
10) 100 KRAD IRRADIATION (0.39 KRADS/HOUR) .....	04/21/95
POST-100 KRAD ELECTRICAL MEASUREMENT.....	04/24/95
7) 168-HOUR ANNEALING @25°C.....	04/24/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	05/01/95
8) 168-HOUR ANNEALING @ 100°C .....	05/03/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	05/10/95

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

Table III. Electrical Characteristics of LM136

Test Name	Lower Limit	Upper Limit	Test Conditions
Vr1	2.4650 V	2.5150 V	Vadj = Open
Vr2	2.3900 V	2.4900 V	Vadj = 0.7 V
Vr3	2.4900 V	2.6900 V	Vadj = 1.9 V
DeltaVr		6.0000 V	400 $\mu$ A $\leq$ Ir $\leq$ 10 mA
Iadj	-125.0000 $\mu$ A	125.0000 $\mu$ A	Vadj = 0.7 V

**TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for LM136 /1**

Test #	Parameters	Units	Spec. Lim./2		Total Dose Exposure (krads)											
			min	max	Initial		2.5		5		10		15			
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
1	Vr 1	V	2.4650	2.5150	2.4987	.003	2.4987	.003	2.4986	.003	2.4978	.003	2.4974	.003		
2	Vr 2	V	2.3900	2.4900	2.4427	.003	2.4431	.003	2.4428	.003	2.4419	.003	2.4416	.003		
3	Vr 3	V	2.4900	2.6900	2.6076	.002	2.6077	.002	2.6076	.002	2.6068	.002	2.6065	.002		
4	DeltaVr	mV	-	6.0000	/3		/3		/3		/3		/3			
5	Iadj	µA	-125.0000	125.0000	-11.5140	.137	-11.4825	.167	-11.4440	.129	-11.5055	.160	-11.4808	.143		

Test #	Parameters	Units	Spec. Lim./2		Total Dose Exposure (krads)													
			min	max	20		30		50		75		100		168 hours at 25°C		168 hours at 100°C	
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Vr 1	V	2.4650	2.5150	2.4969	.003	2.4959	.003	2.4946	.003	2.4928	.003	2.4931	.003	2.4930	.003	2.4979	.003
2	Vr 2	V	2.3900	2.4900	2.4413	.003	2.4403	.002	2.4393	.003	2.4378	.003	2.4380	.003	2.4379	.003	2.4424	.003
3	Vr 3	V	2.4900	2.6900	2.6062	.002	2.6052	.002	2.6044	.002	2.6027	.003	2.603	.003	2.6031	.003	2.6074	.003
4	DeltaVr	mV	-	6.0000	/3		5.6750	.320	6.9750	.624	/3		8.8250	1.10	10.0000	1.16	7.1500	.300
5	Iadj	µA	-125.0000	125.0000	-11.3943	.158	-11.4050	.200	-11.2448	.180	-11.2363	.168	-11.2648	.188	-11.2598	.161	-11.3558	.162

Notes:

- 1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing. The control sample remained constant throughout the testing and is 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.
- 3/ Reliable readings could not be obtained for this parameter at these levels, due to cable problems.

**Radiation-sensitive parameter: Delta Vr.**

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Test #	Parameters	Units	Spec. Lim./2		Total Dose Exposure (krads)											
			min	max	Initial		2.5		5		10		15			
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
1	Vr 1	V	2.4650	2.5150	2.4987	.003	2.4987	.003	2.4986	.003	2.4978	.003	2.4974	.003		
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			min	max	20		30		50		75		100		168 hours at 25°C		168 hours at 100°C	
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Vr 1	V	2.4650	2.5150	2.4969	.003	2.4959	.003	2.4946	.003	2.4928	.003	2.4931	.003	2.4930	.003	2.4979	.003
2	Vr 2	V	2.3900	2.4900	2.4413	.003	2.4403	.002	2.4393	.003	2.4378	.003	2.4380	.003	2.4379	.003	2.4424	.003
3	Vr 3	V	2.4900	2.6900	2.6062	.002	2.6052	.002	2.6044	.002	2.6027	.003	2.603	.003	2.6031	.003	2.6074	.003
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