

**UNISYS**

DATE: April 20, 1995  
TO: J. Lohr/311  
FROM: K. Sahu/300.1 *KS*  
SUBJECT: Radiation Report on: LT1021-10  
Project: CASSINI/CIRS  
Control #: 12096  
Job #: EE56101  
Project part #: JM38510/12409SGA

PPM-95-145

cc: B. Posey/300.1  
A. Sharma/311.0  
OFA Library/300.1

A radiation evaluation was performed on LT1021-10 (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 <sup>60</sup>Co gamma ray source. During the radiation testing, five 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 5, 10, 15, 20, 30, 50, 75 and 100 krad<sup>s</sup>. The dose rate was between 0.08 and 1.47 krad/hour, depending on the total dose level (see Table II for radiation schedule). After the 100 krad irradiation, the parts were annealed for 168 hours at 25°C, after which the parts were annealed for 168 hours at 100°C. After the radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits<sup>\*\*</sup> listed in Table III.

All parts passed initial electrical measurements. Some increasing degradation in V\_Line\_1 and V\_Line\_2 was observed during successive irradiation steps, however, all irradiated parts passed all electrical tests throughout all irradiation and annealing steps. After annealing for 168 hours at 100°C, no rebound effects were observed.

Table IV provides a summary of the functional test results and 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.

<sup>\*</sup> The term rads, as used in this document, means rads(silicon). All radiation levels cited are cumulative.

<sup>\*\*</sup> 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 LT1021-10

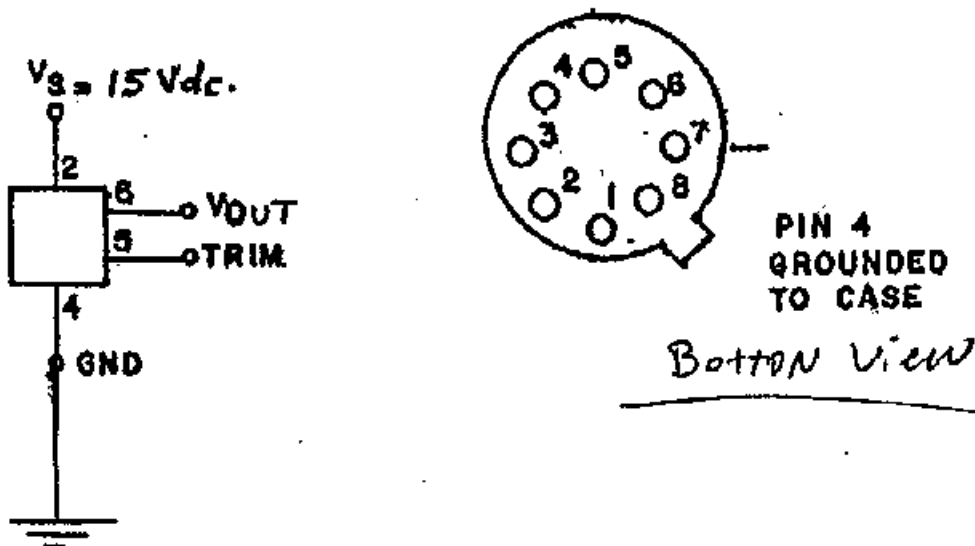


TABLE I. Part Information

Generic Part Number:	LT1021-10*
CASSINI/CIRS Part Number	JM38510/I2409SGA
CASSINI/CIRS Control Number:	12096
Charge Number:	EE56101
Manufacturer:	Linear Technology Corp.
Lot Date Code (LDC):	9131
Quantity Tested:	5
Serial Number of Control Samples:	1
Serial Numbers of Radiation Samples:	2, 3, 4, 5
Part Function:	Voltage Reference
Part Technology:	Bipolar
Package Style:	8-pin TOx Can
Test Equipment:	A540
Engineer:	T. Mondy

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

TABLE II. Radiation Schedule for LT1021-10

EVENT .....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	02/23/95
2) 5 KRAD IRRADIATION (0.29 KRADS/HOUR) .....	03/14/95
POST-5 KRAD ELECTRICAL MEASUREMENT.....	03/15/95
3) 10 KRAD IRRADIATION (0.25 KRADS/HOUR) .....	03/15/95
POST-10 KRAD ELECTRICAL MEASUREMENT.....	03/16/95
4) 15 KRAD IRRADIATION (0.29 KRADS/HOUR) .....	03/16/95
POST-15 KRAD ELECTRICAL MEASUREMENT.....	03/17/95
5) 20 KRAD IRRADIATION (0.08 KRADS/HOUR) .....	03/17/95
POST-20 KRAD ELECTRICAL MEASUREMENT.....	03/20/95
6) 30 KRAD IRRADIATION (0.59 KRADS/HOUR) .....	03/20/95
POST-30 KRAD ELECTRICAL MEASUREMENT.....	03/21/95
7) 50 KRAD IRRADIATION (1.18 KRAD/HOUR) .....	03/21/95
POST-50 KRAD ELECTRICAL MEASUREMENT.....	03/22/95
8) 75 KRAD IRRADIATION (1.47 KRAD/HOUR) .....	03/22/95
POST-75 KRAD ELECTRICAL MEASUREMENT.....	03/23/95
9) 100 KRAD IRRADIATION (1.47 KRAD/HOUR) .....	03/23/95
POST-100 KRAD ELECTRICAL MEASUREMENT.....	03/24/95
10) 168-HOUR ANNEALING @25°C .....	03/24/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	04/04/95
11) 168-HOUR ANNEALING @100°C .....	04/04/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	04/11/95

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

Table III. Electrical Characteristics of LT1021-10

Test #	Parameter	Units	Test Conditions	Spec. Limits	
				Min	Max
1	ICC	mA	$V_{IN}=15V, I_L=0.0mA$	-	1.700
2	V Out	V	$V_{IN}=15V, I_L=0.0mA$	9.950	10.050
3	V Line 1	$\mu V$	$I_L=0.0mA, V_{IN}=(11.5V \leq V_{IN} \leq 14.5V)$	-120.00	120.00
4	V Line 2	$\mu V$	$I_L=-100mA, V_{IN}=(14.5V \leq V_{IN} \leq 40V)$	-500.00	500.00
5	V Load 1	mV	$V_{IN}=15V, I_L=0.0mA, (-10mA \leq I_L \leq 0.0mA)$ 3ms Pulse	-2.500	2.500
6	V TRIM	V	$V_{IN}=15V, I_L=0.0mA$	4.300	-
7	V Shunt Reg	mV	$V_{IN}=OPEN, (1.7mA \leq I_L \leq 10mA)$ 3ms Pulse	-8.300	8.300
8	I SHUNT	mA	$V_{IN}=OPEN, V_{OUT}=9.95V$	-	1.500

**TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for LT1021-10 /1**

Test #	Parameters	Units	Spec. Lim/2 min max		Total Dose Exposure (krads)																Annealing									
					Initial		5		10		15		20		30		50		75		100		168 hrs @ 25°C		168 hrs @ 100°C					
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
1	ICC	mA	-	1.700	1.11	.01	1.11	.01	1.10	.01	1.10	.01	1.10	.01	1.08	.01	1.08	.01	1.05	.02	1.06	.02	1.07	.02	1.08	.02	1.07	.02	1.08	.02
2	V <sub>Out</sub>	V	9.950	10.050	10.0	.01	10.0	.01	9.99	.01	9.99	.01	9.99	.01	9.98	.01	9.98	.01	9.98	.01	9.98	.01	9.98	.01	9.98	.01	9.98	.01	9.98	.01
3	V <sub>Line 1</sub>	µV	-120.00	120.00	-70.3	9.0	-19.5	32	-109	0	-93.8	0	-109	0	-109	0	-105	7.8	73		73		73		-89.8	7.8				
4	V <sub>Line 2</sub>	µV	-500.00	500.00	-154	36	-154	43	-166	16	-153	23	-160	46	-193	21	-177	36	-220	19	-213	24	-225	16	-194	54				
5	V <sub>Load 1</sub>	mV	-2.500	2.500	-1.47	.07	-1.50	.06	-1.50	.06	-1.44	.02	-1.53	.05	-1.61	.10	-1.51	.04	-1.51	.07	-1.49	.07	-1.49	.09	-1.43	.03				
6	V <sub>TRIM</sub>	V	4.300	-	5.06	.01	5.06	.01	5.06	.01	5.06	0	5.06	0	5.06	0	5.06	0	5.06	.01	5.06	0	5.06	.01	5.06	0	5.06	.01	5.06	0
7	V <sub>Shunt Reg</sub>	mV	-8.300	8.300	3.04	.18	3.09	.14	3.16	.21	3.11	.24	3.14	.15	3.28	.15	3.25	.18	3.33	.20	3.34	.21	3.32	.19	3.43	.18				
8	I <sub>SHUNT</sub>	mA	-	1.500	0.93	.01	0.93	.01	0.93	.01	0.93	.01	0.93	.01	0.92	.01	0.92	.01	0.93	.01	0.93	.01	0.93	.01	0.93	.01	0.93	.01	0.93	.01

## 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/ No reliable data could be obtained for this parameter at this step.