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DATE: April 25, 1994
TO: J. Denis/311.1
FROM: K. Sahu/300.1
SUBJECT: Radiation Report on GOES/SXI
Part No. M38510-008-01BCA (LM139)
Control No. 10702

PPM-94-010

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Library/300.1
A. Sharma/311
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A radiation evaluation was performed on LM139 (Quad Voltage Comparator) 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 cobalt-60 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 10, 20, 30, 50, 75 and 100 krads*. The dose rate was between 0.37 and 1.25 krads/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 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 four irradiated parts passed all electrical measurements up to and including the 75 krad level. At the 100 krad irradiation level, section 3 of all four parts failed to meet the minimum specification level of 50 V/mV for A_OL, with readings ranging from 23.45 to 25.90 V/mV. All irradiated parts passed all other electrical tests at the 100 krad level. After annealing for 168 hours at 25°C, no significant changes were observed in any parameter. After annealing for 168 hours at 100°C, no rebound effects were observed.

Table IV provides the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps. Mean and standard deviation values for all parameters except Icc_5V and Icc_30V are given only for section 3 of the parts since this was the only section in which any failures were observed. Values for other sections are available on request.

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 non-irradiated data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

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TABLE I. Part Information

Generic Part Number:	LM139
GOES/SXI Part Number:	M38510/112-01BCA*
GOES/SXI Control Number:	10702
Charge Number:	C42992
Manufacturer:	PMI
Lot Date Code:	9311
Quantity Tested:	5
Serial Number of Control Sample:	61
Serial Numbers of Radiation Samples:	62, 63, 64, 65
Part Function:	Quad Voltage Comparator
Part Technology:	Bipolar
Package Style:	14-pin DIP
Test Equipment:	A540
Test Engineer:	T. Mondy

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

TABLE II. Radiation Schedule for LM139

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	03/25/94
2) 10 KRAD IRRADIATION (0.50 KRADS/HOUR)	03/28/94
POST-10 KRAD ELECTRICAL MEASUREMENT	03/29/94
3) 20 KRAD IRRADIATION (0.50 KRADS/HOUR)	03/29/94
POST-20 KRAD ELECTRICAL MEASUREMENT	03/30/94
4) 30 KRAD IRRADIATION (0.50 KRADS/HOUR)	03/30/94
POST-30 KRAD ELECTRICAL MEASUREMENT	03/31/94
5) 50 KRAD IRRADIATION (1.00 KRADS/HOUR)	03/31/94
POST-50 KRAD ELECTRICAL MEASUREMENT	04/01/94
6) 75 KRAD IRRADIATION (0.37 KRADS/HOUR)	04/01/94
POST-75 KRAD ELECTRICAL MEASUREMENT	04/04/94
7) 100 KRAD IRRADIATION (1.25 KRADS/HOUR)	04/04/94
POST-100 KRAD ELECTRICAL MEASUREMENT	04/05/94
8) 168-HOUR ANNEALING @25°C	04/04/94
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENTS	04/12/94
9) 168 HOUR ANNEALING @100°C*	04/12/94
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENTS	04/19/94

*High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect, due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-8830, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of LM139

Unless Otherwise Specified: T_A =25°C

TEST NAME	SYMBOL	CONDITIONS	LIMITS	
			MIN	MAX
		SUPPLY CURRENT		
5V	Icc	+Vcc = 5V, V_{OUT} = 0V	0.000mA	3.000mA
30V	Icc	+Vcc = 30V, V_{OUT} = 0V	0.000mA	3.000mA
		INPUT OFFSET TESTS		
VOS_5V	V_{IO}	+Vcc = 5V, V_{OUT} = 1.4V	-5.00mV	5.00mV
VOS_30V	V_{IO}	+Vcc = 30V, V_{OUT} = 15V (Note: 1)	-5.00mV	5.00mV
PSRR	PSRR	+Vcc = (5V, 30V), V_{OUT} = 1.4V	70dB	
P_IIB_5V	$+I_{IB}$	+Vcc = 5V, V_{OUT} = 1.4V (Note: 1)	-100.00nA	-1.000nA
N_IIB_5V	$-I_{IB}$	+Vcc = 5V, V_{OUT} = 1.4V (Note: 1)	-100.00nA	-1.000nA
IIOS_5V	I_{IO}	+Vcc = 5V, V_{OUT} = 1.4V (Note: 1)	-25.00nA	25.00nA
P_IIB_30V	$+I_{IB}$	+Vcc = 30V, V_{OUT} = 15V (Note: 1)	-100.00nA	-1.000nA
N_IIB_30V	$-I_{IB}$	+Vcc = 30V, V_{OUT} = 15V (Note: 1)	-100.00nA	-1.000nA
IIOS_30V	I_{IO}	+Vcc = 30V, V_{OUT} = 15V (Note: 1)	-25.00nA	25.00nA
AOL		+Vcc = 5V, V_{OUT} = (11V, 1V)	50 V/mV	
I_SINK		+Vcc = 5V, V_{OUT} = 1.5V (Note: 2)	6.00mA	
V_SAT		+Vcc = 5V, I_{OUT} = 4.0mA (Note: 2)		400.0mV
I_LEAK		+Vcc = 30V, V_{OUT} = 30V		0.500uA

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for M38510/112-01BCA (LM139) /1

Parameters /2		Spec. Lim. /3 min	max	Initial mean	sd	Total Dose Exposure (krads) 10 mean	sd	20 mean	sd	30 mean	sd	50 mean	sd	75 mean	sd	100 mean	sd	Annealing 168 hrs @25°C mean	sd	168 hrs @100°C mean	sd
Icc_5V	mA	0	3.0	0.61	.01	0.60	.01	0.60	.01	0.60	.01	0.60	.01	0.58	.01	0.59	.01	0.58	.01	0.56	.01
Icc_30V	mA	0	3.0	0.77	.01	0.76	.01	0.75	.01	0.75	.01	0.75	.01	0.74	.01	0.78	.01	0.77	.01	0.71	.01
VOS_5V	mV	-5.0	5.0	0.17	.08	0.20	.19	0.19	.19	0.19	.20	0.19	.19	0.22	.20	1.50	.30	1.04	.28	0.13	.12
VOS_30V	mV	-5.0	5.0	0.43	.32	0.26	.11	0.26	.08	0.25	.08	0.25	.08	1.24	.35	3.48	.37	2.91	.34	0.23	.17
PSRR	dB	70		95.1	3.0	106	9.7	108	10	106	10	105	14	89.4	1.8	83.8	.62	84.1	.65	111	18
P_IIB_5V	nA	-100	-1.0	-29.1	2.3	-33.6	2.3	-34.9	2.4	-36.6	2.3	-40.0	2.4	-43.8	2.4	-49.9	2.6	-48.4	2.6	-92.9	26
N_IIB_5V	nA	-100	-1.0	-29.2	2.0	-33.4	2.0	-35.3	1.9	-37.0	1.8	-40.6	1.8	-44.8	1.8	-49.9	1.9	-49.1	2.0	-43.3	2.1
IIOS_5V	nA	-25	25	0.27	.08	0.35	.36	0.44	.37	0.47	.46	0.57	.55	0.67	.64	0.74	.72	0.69	.66	0.41	.45
P_IIB_30V	nA	-100	-1.0	-33.4	2.5	-35.4	2.5	-37.4	2.5	-39.2	2.5	-43.3	2.6	-49.3	2.6	-55.9	2.9	-56.4	2.8	-66.4	2.8
N_IIB_30V	nA	-100	-1.0	-31.6	2.0	-35.6	2.0	-37.6	1.9	-39.5	1.9	-43.5	1.9	-50.1	1.8	-57.8	1.9	-57.2	1.9	-46.6	2.1
IIOS_30V	nA	-25	25	0.54	.37	0.41	.21	0.46	.26	0.52	.40	0.61	.53	0.71	.81	0.85	.96	0.77	.88	0.65	.30
AOL	V/mV	50		220	21	259	31	296	41	339	53	387	59	132	27	24.6	1.1	30.8	1.6	618	182
I_SINK	mA	6.0		19.3	.68	18.1	.65	18.3	.62	18.1	.61	18.5	.57	17.8	.49	17.9	.43	17.2	.44	17.8	.54
V_SAT	mV		400	222	9.3	222	9.3	222	9.1	223	9.4	221	9.2	228	9.1	229	8.9	229	8.9	232	9.2
I_LEAK	pA		0.5	0.26	.03	1.10	.03	0	0	0.65	.03	2.34	.03	0.52	0	0.52	0	1.05	.03	0.78	.03

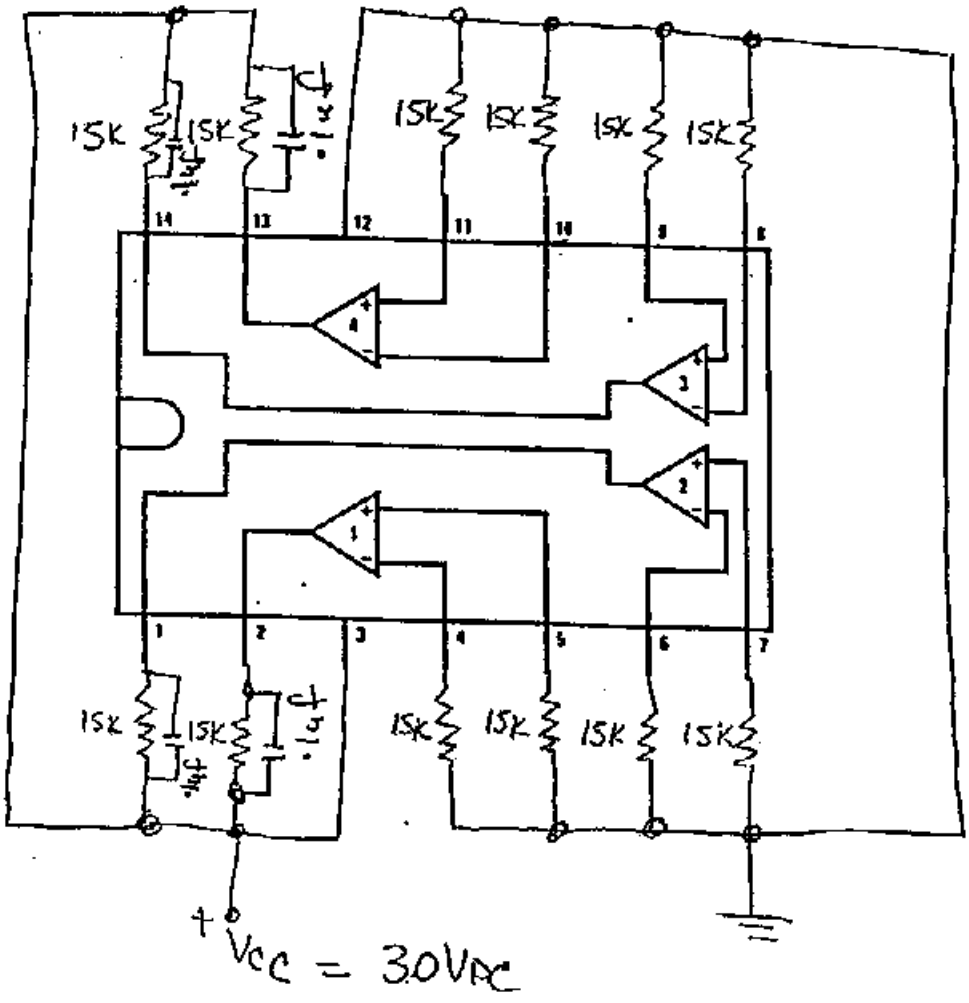
1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing. The control sample remained constant throughout the testing and is not included in this table.

2/ Values for all parameters except Icc_5V and Icc_30V are given only for section 3, which was the only case in which failures occurred. Values for other sections are available on request. Mean and standard deviation values for VOS and IIOS are computed from absolute values.

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

Radiation-sensitive parameters were: A_OL.

Figure 1. Radiation Bias Circuit for LM139



Conditions:

Vcc = 30.0V±0.5VDC
R = 15kOhms, 1/2W
Ta = 25°C