Unisys

DATE: April 24, 1998 PPM-98-010
TO: J. Dafnis/303
FROM: K. Sahu/S. Kniffin/300.1
SUBJECT: Radiation Report on **PM139 (Analog Devices) (LDC 9720A)**
PROJECT: GOES (ITT)

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A radiation evaluation was performed on **PM139 Quad Low Power, Precision Comparator (Analog Devices)** to determine the total dose tolerance of these parts. The total dose testing was performed using a Co^{60} gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration) and three parts were used as control samples. The total dose radiation levels were 20.0, 40.0, 60.0, 80.0, 100.0, 150.0, and 200.0 kRads.[1] The dose rate was 1.200 kRads/hour (0.33 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 200.0 kRad irradiation, the parts were annealed under bias at 25°C and tested after 4, 24 and 168 hours.[2] After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits[3] listed in Table III. An executive summary of the test results is provided below in bold. For detailed information, refer to Tables I through IV and Figure 1.

Initial electrical measurements were made on 11 samples. Eight samples (SN's 254, 255, 257, 258, 259, 260, 263, and 264) were used as radiation samples while SN's 256, 261 and 262 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests through 200.0 kRads.

After annealing the parts for 4 hours, 24 hours and 168 hours at 25°C, parts showed no significant change in any parameter.

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.

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[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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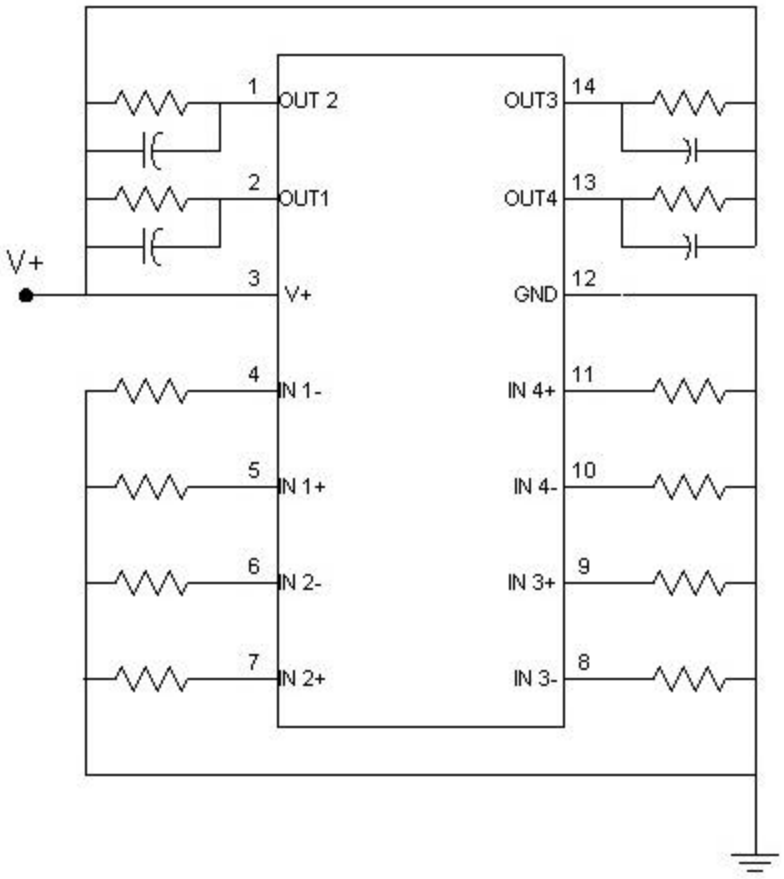
Figure 1. Radiation Bias Circuit for PM139



Notes:
1. Resistors are 15kΩ ±10%, ½W.
2. Capacitors are 0.1μf ±10%, 50V.
3. V+ = 15V.

TABLE I. Part Information

Generic Part Number:	PM139
GOES ITT Part Number	PM139
Charge Number:	C80709
Manufacturer:	Analog Devices
Lot Date Code (LDC):	9720A
Quantity Tested:	11
Serial Number of Control Samples:	256, 261, 262
Serial Numbers of Radiation Samples:	254, 255, 257, 258, 259, 260, 263, and 264
Part Function:	Quad Low Power, Precision Comparator
Part Technology:	Bipolar
Package Style:	14-Pin DIP
Test Equipment:	A540/Bench Tests
Test Engineer:	S. Archer-Davies

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

TABLE II. Radiation Schedule for PM139

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	03/23/98
2) 20.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	03/23/98
POST-20.0 KRAD ELECTRICAL MEASUREMENT	03/24/98
3) 40.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	03/24/98
POST-40.0 KRAD ELECTRICAL MEASUREMENT	03/25/98
4) 60.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	03/25/98
POST-60.0 KRAD ELECTRICAL MEASUREMENT	03/26/98
5) 80.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	03/26/98
POST-80.0 KRAD ELECTRICAL MEASUREMENT	03/27/98
6) 72 HOUR ANNEALING @25°C *	03/27/98
POST-72 HOUR ANNEAL ELECTRICAL MEASUREMENT	03/30/98
7) 100.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	03/30/98
POST-100.0 KRAD ELECTRICAL MEASUREMENT	03/31/98
8) 150.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	04/31/98
POST-150.0 KRAD ELECTRICAL MEASUREMENT	04/02/98
9) 200.0 KRAD IRRADIATION (0.450 KRADS/HOUR) **	04/02/98
POST-200.0 KRAD ELECTRICAL MEASUREMENT	04/06/98
10) 4 HOUR ANNEALING @25°C	04/06/98
POST-4 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/06/98
11) 24 HOUR ANNEALING @25°C	04/06/98
POST-24 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/07/98
12) 168 HOUR ANNEALING @25°C	04/07/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/13/98

Effective Dose Rate = 200,000 RADS/14 DAYS=595.2 RADS/HOUR=0.17 RADS/SEC
The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim-annealing step.

* This 72 hour annealing step was added to maintain the prescribed dose rate due to the weekend.
** The dose rate was adjusted to allow the parts to receive radiation dose over the weekend.

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

Table III. Electrical Characteristics of PM139 /1

Test #	Parameter	Units	Test Conditions	Spec. min	Lim. max
1	Icc_5V	mA	V_{CC} = 5V, V_{OUT} = 0V	0	2.0
2	Icc_30V	mA	V_{CC} = 30V, V_{OUT} = 0V	0	3.0
3-6	VOS_5V	mV	V_{CC} = 5V, V_{OUT} = 1.4V	-5.0	5.0
7-10	VOS_30V	mV	V_{CC} = 30V, V_{OUT} = 15V	-5.0	5.0
11-14	PSRR	dB	V_{CC} = 5V to 30V, V_{OUT} = 1.4V	70	
15-18	P_IIB_5V	nA	V_{CC} = 5V, V_{OUT} = 1.4V	-100	-1
19-22	N_IIB_5V	nA	V_{CC} = 5V, V_{OUT} = 1.4V	-100	-1
23-26	IIOS_5V	nA	V_{CC} = 5V, V_{OUT} = 1.4V	-25	25
27-30	P_IIB_30V	nA	V_{CC} = 30V, V_{OUT} = 15V	-100	-1
31-34	N_IIB_30V	nA	V_{CC} = 30V, V_{OUT} = 15V	-100	-1
35-38	IIOS_30V	nA	V_{CC} = 30V, V_{OUT} = 15V	-25	25
43-46	I_SINK	mA	V_{CC} = 15V, 11V < V_{OUT} < 1V, R_L = 15kΩ	8.0	
47-50	V_SAT	mV	V_{CC} = 15V, V_{OUT} = 1.5V, $-V_{IN}$ = 1V, $+V_{IN}$ = 0V		400
51-54	I_LEAK	μA	V_{CC} = 15V, I_{OUT} = 4.0mA, $-V_{IN}$ = 1V, $+V_{IN}$ = 0V		0.50
55-58	Open Loop Gain	dB	V_{CC} = 15V, 11V < V_{OUT} < 1V, R_L = 15kΩ	94	

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/ Due to limitations in the automatic test equipment, tests 55-58 were made on the bench.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for PM139 /1

							Total Dose Exposure (kRads Si)								Annealing		Total Dose Exposure (kRads Si)						Annealing					
					Initial		20.0		40.0		60.0		80.0		72 hours @25°C		100.0		150.0		200.0		4 hours @25°C		24 hours @25°C		168 hours @25°C	
Test #	Parameters	Units	Spec. Lim. /2 min	max	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	0	2.0	0.7	0.05	0.7	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.7	0.1	0.6	0.1	0.6	0.1	0.6	0.1
2	-Icc	mA	0	3.0	0.8	0	0.8	0.05	0.7	0.1	0.7	0.1	0.7	0.1	0.6	0.1	0.7	0.1	0.7	0.1	0.8	0.1	0.7	0.1	0.7	0.1	0.5	0.1
3-6	VOS_5V	mV	-5.0	5.0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0	0.2	0
7-10	VOS_30V	mV	-5.0	5.0	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1
11-14	PSRR	dB	70		98	9	98	8	97	5	96	5	96	7	99	9	97	4	96	3	84	7	84	6	88	7	77	6
15-18	P_IIB_5V	nA	-100	-1	-31	1	-37	2	-40	3	-44	6	-44	2	-42	5	-48	2	-52	9	-60	4	-60	4	-59	4	-59	3
19-22	N_IIB_5V	nA	-100	-1	-31	1	-37	2	-40	3	-44	6	-44	2	-42	5	-48	2	-52	9	-60	4	-60	4	-59	4	-59	3
23-26	IIOS_5V	nA	-25	25	1	0	1	0.5	2	1	2	1	7	4	6	2	1	1	1	1	1	1	1	1	1	1	1	1
27-30	P_IIB_30V	nA	-100	-1	-31	1	-40	2	-44	2	-49	3	-45	5	-44	5	-51	3	-56	9	-66	4	-66	4	-65	4	-65	3
31-34	N_IIB_30V	nA	-100	-1	-31	1	-40	2	-44	2	-49	3	-45	5	-44	5	-51	3	-56	9	-66	4	-66	4	-65	4	-65	3
35-38	IIOS_30V	nA	-25	25	1	0	1	1	2	1	2	1	6	3	7	3	1	1	1	1	3	1	3	1	3	1	1	1
43-46	I_SINK	mA	8.0		19	1	19	1	18	1	18	0	18	0	18	0	17	1	17	0	16	1	16	1	17	1	17	1
47-50	V_SAT	mV		400	238	2	236	2	236	2	235	3	235	2	237	2	247	2	248	7	264	2	260	2	252	2	238	3
51-54	I_LEAK	?A		0.50	0.05	0	0.05	0	0.06	0.02	0.07	0.03	0.10	0	0.10	0	0.10	0	0.10	0	0.16	0	0.15	0	0.10	0	0.21	0
55-58	Open Loop Gain	dB	94		97	1	97	1	96	1	96	1	96	1	96	1	96	1	97	1	96	1	96	1	96	1	96	1

Notes:

1/ The mean and standard deviation values were calculated over the eight 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: None.