

Unisys

DATE: April 24, 1998 PPM-98-010
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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 limits³ 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.

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.

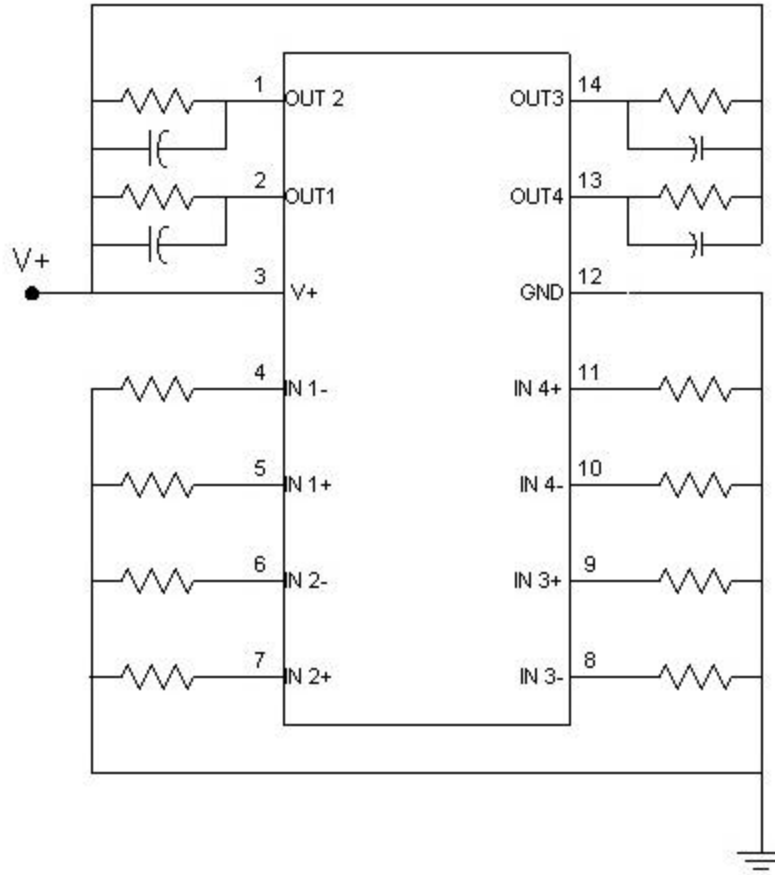
³ These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for PM139



Notes:

1. Resistors are $15\text{k}\Omega \pm 10\%$, $\frac{1}{2}\text{W}$.
2. Capacitors are $0.1\mu\text{f} \pm 10\%$, 50V .
3. $V+ = 15\text{V}$.

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 | I _{cc_5V} | mA | V _{CC} = 5V, V _{OUT} = 0V | 0 | 2.0 |
| 2 | I _{cc_30V} | mA | V _{CC} = 30V, V _{OUT} = 0V | 0 | 3.0 |
| 3-6 | V _{OS_5V} | mV | V _{CC} = 5V, V _{OUT} = 1.4V | -5.0 | 5.0 |
| 7-10 | V _{OS_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 | I _{IOS_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 | I _{IOS_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.

