Unisys

DATE: June 08, 1998 PPM-98-017
TO: R. Koehler/303
FROM: K. Sahu/S. Kniffin/300.1
SUBJECT: Radiation Report on **MAX913 (LDC 9704)**
PROJECT: Integral Spectrometer

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A radiation evaluation was performed on **MAX913 Single, Ultra Fast, Low Power, Precision TTL Comparator (Maxim)** 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, 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 5.0, 10.0, 15.0, 20.0, 30.0, 50.0, 75.0, and 100.0 kRads.[1] The dose rate was between 0.125 and 0.625 kRads/hour (0.035 to 0.174 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 100.0 kRad irradiation, the parts were annealed under bias at 25°C and tested after 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. A summary of the test results is provided below, for detailed information, refer to Tables I through IV and Figure 1.

Initial electrical measurements were made on 6 samples. Five samples (SN's 316, 317, 318, 319, and 320) were used as radiation samples while SN 315 was used as a control sample. All parts passed all tests during initial electrical measurements.

**All parts passed all tests up to 100.0 kRads. No significant degradation was noted in any parameter.**

After annealing the parts for 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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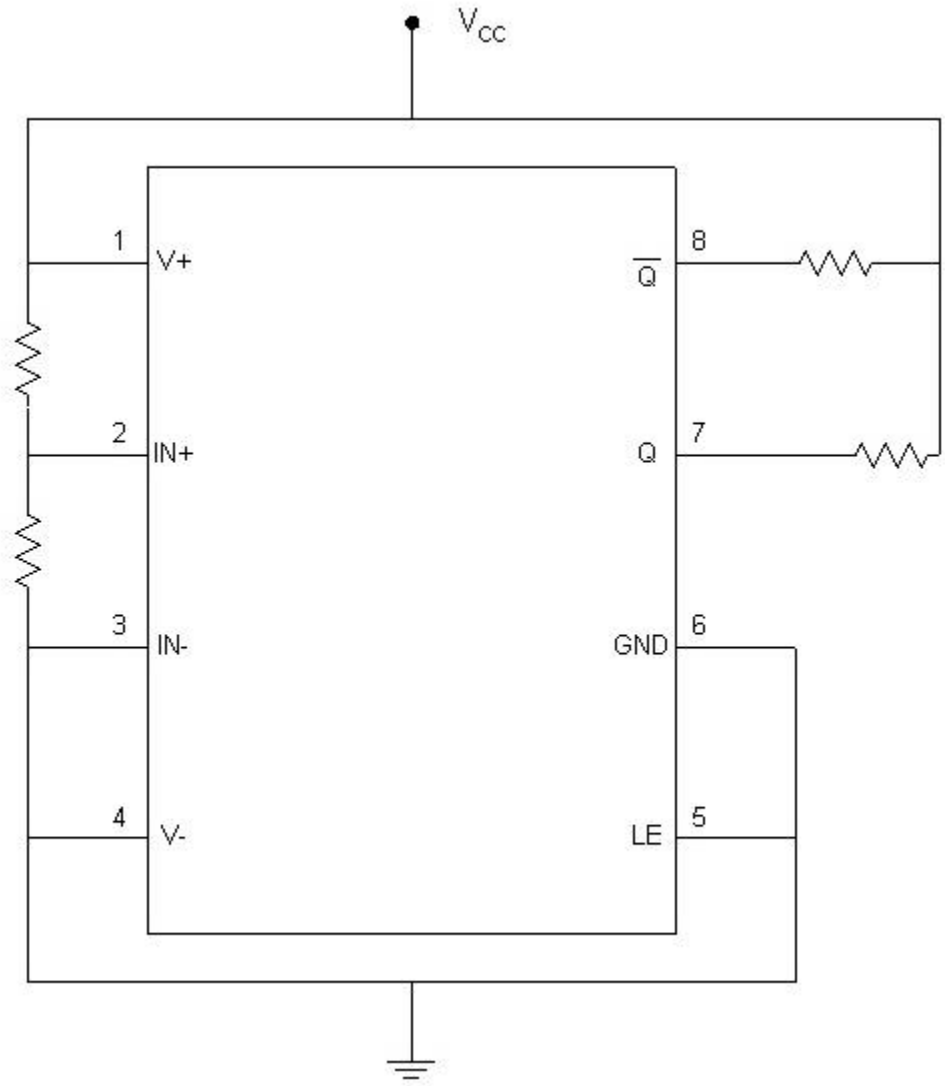
Figure 1. Radiation Bias Circuit for MAX913




Notes:
1. R = 1kΩ ±5%, ¼W.
2. $V_{CC}$ = 5V ±5%.

TABLE I. Part Information

| | |
|---|---|
| Generic Part Number: | MAX913 |
| Integral Spectrometer Part Number | MAX913 |
| Charge Number: | C80777 |
| Manufacturer: | MAXIM |
| Lot Date Code (LDC): | 9704 |
| Quantity Tested: | 6 |
| Serial Number of Control Samples: | 315 |
| Serial Numbers of Radiation Samples: | 316, 317, 318, 319, and 320 |
| Part Function: | Single, ultra fast, low power, precision TTL comparator |
| Part Technology: | Bipolar |
| Package Style: | 8-Pin DIP |
| Test Equipment: | A540 |
| Test Engineer: | S. Norris |

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

TABLE II. Radiation Schedule for MAX913

| EVENT | DATE |
|---|---|
| 1) INITIAL ELECTRICAL MEASUREMENTS | 04/27/98 |
| 2) 5.0 KRAD IRRADIATION (0.125 KRADS/HOUR) | 05/11/98 |
| POST-5.0 KRAD ELECTRICAL MEASUREMENT | 05/13/98 |
| 3) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR) | 05/13/98 |
| POST-10.0 KRAD ELECTRICAL MEASUREMENT | 05/15/98 |
| 4) 15.0 KRAD IRRADIATION (0.077 KRADS/HOUR) | 05/15/98 |
| POST-15.0 KRAD ELECTRICAL MEASUREMENT | 05/18/98 |
| 5) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR) | 05/18/98 |
| POST-20.0 KRAD ELECTRICAL MEASUREMENT | 05/20/98 |
| 6) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR) | 05/20/98 |
| POST-30.0 KRAD ELECTRICAL MEASUREMENT | 05/22/98 |
| 7) 50.0 KRAD IRRADIATION (0.225 KRADS/HOUR) | 05/22/98 |
| POST-50.0 KRAD ELECTRICAL MEASUREMENT | 05/26/98 |
| 8) 75.0 KRAD IRRADIATION (0.625 KRADS/HOUR) | 05/26/98 |
| POST-75.0 KRAD ELECTRICAL MEASUREMENT | 05/28/98 |
| 9) 100.0 KRAD IRRADIATION (0.625 KRADS/HOUR) | 05/29/98 |
| POST-100.0 KRAD ELECTRICAL MEASUREMENT | 06/01/98 |
| 10) 168 HOUR ANNEALING @25°C | 06/01/98 |
| POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT | 06/08/98 |

Effective Dose Rate = 100,000 RADS/20 DAYS=208.3 RADS/HOUR=0.06 RADS/SEC

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

Table III. Electrical Characteristics of MAX913 /1

| Test # | Parameter /2 | Units | Test Conditions /2 | Spec. min | Lim. max |
|---|---|---|---|---|---|
| 1 | Icc | mA | | | 10 |
| 2 | Iee | mA | | -2.00 | |
| 3 | Vos | mV | $R_S \leq 100\Omega$ | | 2.00 |
| 4 | Gain_V/V | V/V | $1V \leq V_Q \leq 2V$ | 1500 | |
| 5 | +Ib | µA | | | 8.000 |
| 6 | -Ib | µA | | -8.000 | |
| 7 | Ios | nA | | | 500 |
| 8 | Voh_Q | V | $V+ \geq 4.5V$, $I_{OUT} = 1mA$ | 2.70 | |
| 9 | Vol_Qn | V | $I_{SINK} = 4mA$ | | 0.50 |
| 10 | Vol_Q | V | $I_{SINK} = 4mA$ | | 0.50 |
| 11 | Voh_Qn | V | $V+ \geq 4.5V$, $I_{OUT} = 1mA$ | 2.70 | |
| 12 | Voh_Q_10mA | V | $V+ \geq 4.5V$, $I_{OUT} = 10mA$ | 2.40 | |
| 13 | Voh_Qn_10mA | V | $V+ \geq 4.5V$, $I_{OUT} = 10mA$ | 2.40 | |
| 14 | Latch Current | µA | $V_{LE} = 0V$ | -20 | |
| A | Propagation Delay | ns | $\Delta V_{IN} = 100mV$, $V_{OD} = 5mV$ /3 | | 14 |

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/ For all tests: V+ = +5V, V- = -5V, $V_Q$ = 1.4V, $V_{LE}$ = 0V unless otherwise noted.

3/ Propagation delay was measured with a bench setup initially and after 100kRads.

# TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for MAX913

| | | | | | | | Total Dose Exposure (kRads Si) | | | | | | | | | | | | | | | | Annealing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Initial | | 5.0 | | 10.0 | | 15.0 | | 20.0 | | 30.0 | | 50.0 | | 75.0 | | 100.0 | | 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 |
| 1 | Icc | mA | | 10 | 5.72 | 0.05 | 5.97 | 0.05 | 5.67 | 0.05 | 5.66 | 0.05 | 5.65 | 0.05 | 5.63 | 0.04 | 5.64 | 0.05 | 5.62 | 0.04 | 5.64 | 0.05 | 5.62 | 0.05 |
| 2 | Iee | mA | -2.00 | | -0.47 | 0.01 | -0.46 | 0.01 | -0.44 | 0.01 | -0.44 | 0.01 | -0.44 | 0.01 | -0.44 | 0.01 | -0.44 | 0.01 | -0.44 | 0.01 | -0.46 | 0.01 | -0.45 | 0.01 |
| 3 | Vos | mV | | 2.00 | 0.21 | 0.02 | 0.18 | 0.03 | 0.19 | 0 | 0.21 | 0 | 0.18 | 0 | 0.19 | 0 | 0.21 | 0.03 | 0.22 | 0.03 | 0.20 | 0 | 0.28 | 0.03 |
| 4 | Gain_V/V | V/V | 1500 | | 19136 | 1951 | 24394 | 4599 | 20877 | 61 | 18547 | 67 | 21797 | 61 | 20826 | 65 | 19068 | 2192 | 18320 | 2044 | 19213 | 58 | 14107 | 1819 |
| 5 | +Ib | ? A | | 8.000 | 0.001 | 0.001 | 0.002 | 0 | 0.002 | 0 | 0.002 | 0 | 0.003 | 0 | 0.001 | 0 | 0.001 | 0 | 0.002 | 0 | 0.001 | 0 | 0.002 | 0 |
| 6 | -Ib | ? A | -8.000 | | 0.004 | 0 | 0.006 | 0.001 | 0.007 | 0 | 0.007 | 0 | 0.008 | 0 | 0.006 | 0.001 | 0.006 | 0.001 | 0.007 | 0.001 | 0.005 | 0 | 0.006 | 0 |
| 7 | Ios | nA | | 500 | 2.63 | 1.00 | 4.25 | 1.12 | 4.38 | 0 | 4.75 | 1.37 | 4.63 | 1.37 | 5.19 | 1.12 | 4.25 | 1.12 | 5.25 | 1.37 | 4.69 | 0 | 4.38 | 0 |
| 8 | Voh_Q | V | 2.70 | | 3.92 | 0.01 | 3.97 | 0.01 | 3.91 | 0.01 | 3.91 | 0.02 | 3.91 | 0.01 | 3.90 | 0.01 | 3.91 | 0.02 | 3.90 | 0.01 | 3.90 | 0.01 | 3.89 | 0.01 |
| 9 | Vol_Qn | V | | 0.50 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 |
| 10 | Vol_Q | V | | 0.50 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 | 0.11 | 0 |
| 11 | Voh_Qn | V | 2.70 | | 3.79 | 0.01 | 3.84 | 0.01 | 3.78 | 0.01 | 3.78 | 0.01 | 3.78 | 0.01 | 3.77 | 0.01 | 3.78 | 0.01 | 3.77 | 0.01 | 3.77 | 0.01 | 3.77 | 0.01 |
| 12 | Voh_Q_10mA | V | 2.40 | | 3.79 | 0.01 | 3.86 | 0.01 | 3.78 | 0.01 | 3.78 | 0.01 | 3.78 | 0.01 | 3.78 | 0.01 | 3.78 | 0.01 | 3.78 | 0.01 | 3.78 | 0.01 | 3.77 | 0.01 |
| 13 | Voh_Qn_10mA | V | 2.40 | | 3.78 | 0.01 | 3.86 | 0.01 | 3.78 | 0.01 | 3.77 | 0.01 | 3.78 | 0.01 | 3.77 | 0.01 | 3.78 | 0.01 | 3.77 | 0.01 | 3.77 | 0.01 | 3.77 | 0.01 |
| 14 | Latch Current | ? A | -20 | | -6.25 | 0 | -5.75 | 1.12 | -6.25 | 0 | -6.25 | 0 | -6.56 | 0 | -6.25 | 0 | -6.25 | 0 | -6.25 | 0 | -6.25 | 0 | -6.25 | 0 |
| A | Propagation Delay | ns | | 14 | 9.21 | 0.10 | | | | | | | | | | | | | | | | | 9.20 | 0.09 |

Notes:

1/ The mean and standard deviation values were calculated over the five parts irradiated in this testing. The control samples remained constant throughout testing and are not included in this

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/ Due to the complexity of the bench setup needed to read the propogation delay, the measurements were only made initially and after final annealing.

**Radiation sensitive parameters: None.**