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Memorandum

PARAMAX
A Unisys Company

DATE: June 9, 1992 PPM-92-181

TO: S. Pszcolka/311

FROM: K. Sahu/7809 KS

SUBJECT: Radiation Report GDS/CS2 Project
Part No. M38510/14801BPA (Control No. 5105)
Generic Part No. TL431

cc: R. Woodward/300.1
A. Sharma/311
Library/300.1

A radiation evaluation was performed on the M38510/14801BPA 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, six parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation steps were 10, 20, 30, 40, and 50 krad^s. After 50 krad^s, the parts were annealed at 25°C for 168 hours. The dose rate was between 150 and 515 rads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, the parts were electrically tested at 25°C according to the test conditions and the specification limits listed in Table III.

All parts passed all parametric tests through 50 krad^s of exposure and after annealing at 25°C for 168 hours. No significant degradation of the parts due to radiation exposures was observed.

Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment. Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

* In this report, the term "rads" is used as an abbreviation for rads (Si).

TABLE I. Part Information

| | |
|---|--------------------------------|
| Generic Part Number: | TL431 |
| CDS/CS2 Part Number: | M38510/14801BPA |
| Control Number: | 5105 |
| Charge Number: | C23723 |
| Manufacturer: | Motorola Inc. |
| Lot Date Code: | 9148 |
| Quantity Tested: | 6 |
| Serial Numbers of Radiation Samples: | 62, 63, 64, 65, 66, 67 |
| Serial Number of Control Sample: | 61 |
| Part Function: | Programmable Voltage Regulator |
| Part Technology: | Silicon Monolithic |
| Package Style: | 8 pin DIP |
| Test Engineer: | T. Mondy |

TABLE II. Radiation Schedule for M38510/14801BPA

| EVENTS | DATE |
|---|----------|
| 1) INITIAL (PRE-IRRADIATION) ELECTRICAL MEASUREMENT | 05/12/92 |
| 2) 10 KRAD IRRADIATION (512 rads/hour) | 05/12/92 |
| POST 10 KRAD ELECTRICAL MEASUREMENT | 05/13/92 |
| 3) 20 KRAD IRRADIATION (500 rads/hour) | 05/13/92 |
| POST 20 KRAD ELECTRICAL MEASUREMENT | 05/14/92 |
| 4) 30 KRAD IRRADIATION (500 rads/hour) | 05/14/92 |
| POST 30 KRAD ELECTRICAL MEASUREMENT | 05/15/92 |
| 5) 40 KRAD IRRADIATION (150 rads/hour) | 05/15/92 |
| POST 40 KRAD ELECTRICAL MEASUREMENT | 05/19/92 |
| 6) 50 KRAD IRRADIATION (500 rads/hour) | 05/19/92 |
| POST 50 KRAD ELECTRICAL MEASUREMENT | 05/20/92 |
| 7) 168 HOURS ANNEALING AT 25°C | 05/20/92 |
| POST 168 HOURS ELECTRICAL MEASUREMENT | 05/27/92 |

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at +25°C.
- All annealing steps were performed under bias.

Table III. Electrical Characteristics of M38510/14801BPA

Unless Otherwise Specified:
 $T_A = 25^\circ\text{C}$, $V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$

| TEST UNITS | CONDITIONS | LIMIT | | |
|---------------|---|-------|-------|-----------------|
| | | Min | Max | Units |
| V_{REF} | $V_{KA} = V_{REF}$ | 2.44 | 2.55 | V _{dc} |
| V_{KA10} | $R_2 = 3.33 \text{ Kohms}$ | 8.00 | 12.00 | V _{dc} |
| V_{KA36} | $R_2 = 746 \text{ ohms}$ | 31.00 | 36.00 | V _{dc} |
| dV_R/dV_K | $R_2 = 3.33 \text{ Kohms}$ | | -2.70 | mV/V |
| dV_R/dV_K | $R_2 = 746 \text{ ohms}$ | | -2.00 | mV/V |
| I_{REF} | | -0.1 | 4.00 | uA |
| I_{MIN} | $V_{KA} = V_{REF}$ $I_{KMIN} = 1\text{mA}$ | 2.40 | 2.60 | V _{dc} |
| I_{OFF} | $V_{KA} = 36\text{V}$ $V_{REF} = 0\text{V}$ | -0.1 | 1.00 | uA |
| Z_{KA} | $V_{KA} = V_{REF}$, $I_K = 1 \text{ to } 100\text{mA}$ | | 0.50 | ohms |

Exceptions:

- Noise test test is not performed.

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for M38510/14801BPA 1/, 2/

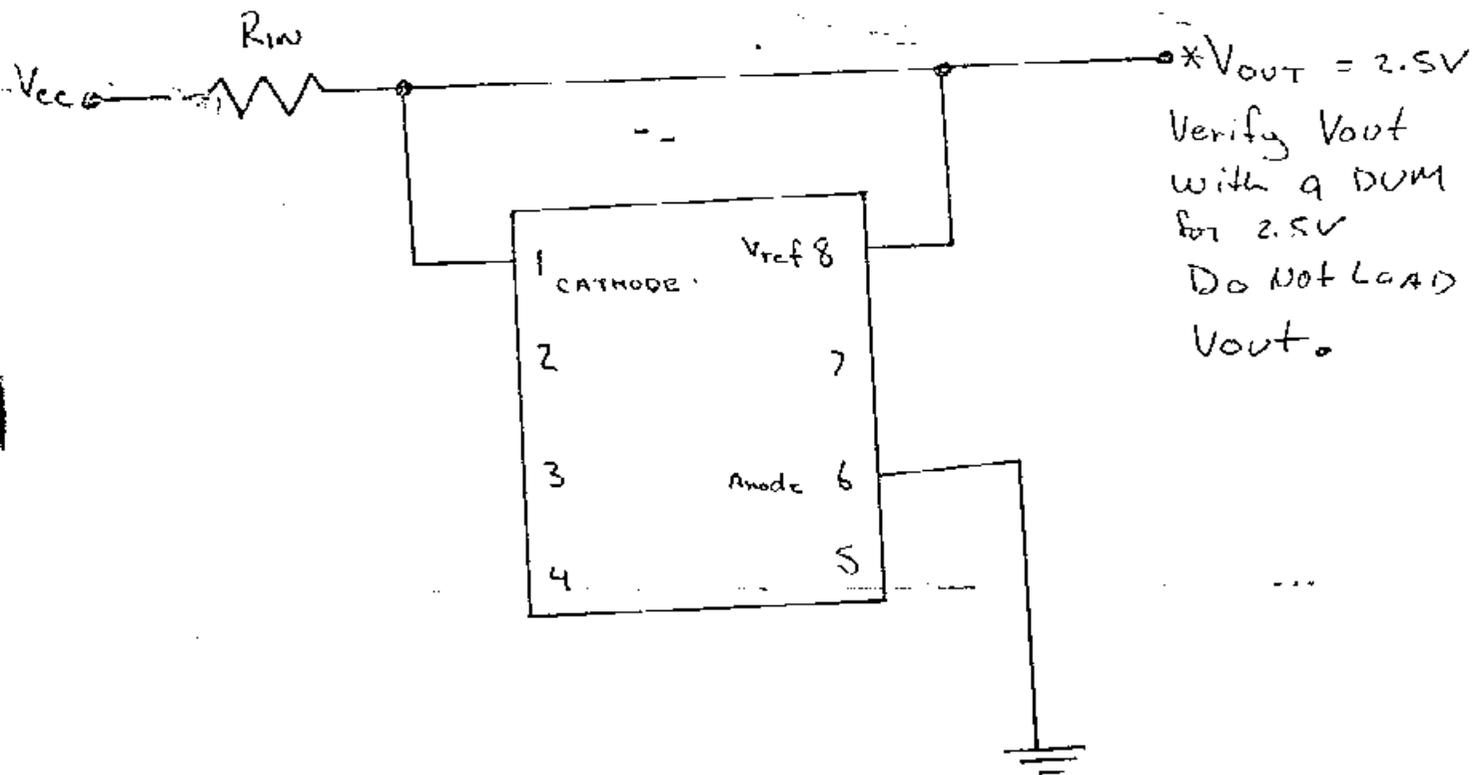
| Parameters | Spec Limits min max | Total Dose Exposure (TDE) (krads) | | | | | | | | | | Anneal | |
|------------|------------------------|-----------------------------------|------|--------|------|--------|-------|--------|-------|--------|-------|------------------|-------|
| | | 0 (Proc-Rad) | | 10 | | 20 | | 40 | | 50 | | 168 hrs @25°C | |
| | | mean | sd | mean | sd | mean | sd | mean | sd | mean | sd | mean | sd |
| IMIN | V 2.40 2.60 | 2.48 | 0.01 | 2.48 | 0.01 | 2.48 | 0.01 | 2.48 | 0.01 | 2.49 | 0.01 | 2.48 | 0.01 |
| VREF | V 2.44 2.55 | 2.48 | 0.01 | 2.48 | 0.01 | 2.48 | 0.01 | 2.48 | 0.01 | 2.49 | 0.01 | 2.48 | 0.01 |
| VKA10 | V 8.00 12.00 | 9.94 | 0.03 | 9.94 | 0.03 | 9.94 | 0.03 | 9.94 | 0.03 | 9.95 | 0.03 | 9.95 | 0.03 |
| VKA36 | V 31.00 36.00 | 35.38 | 0.11 | 35.39 | 0.11 | 35.39 | 0.11 | 35.38 | 0.11 | 35.39 | 0.11 | 35.39 | 0.11 |
| IREF | mA -100 4000 | 1764.2 | 95.7 | 1799.1 | 99.3 | 1832.3 | 103.7 | 1911.0 | 106.5 | 1942.6 | 107.4 | 1927.0 | 107.8 |
| IOPF | mA -100 1000 | 18.2 | 5.4 | 29.9 | 12.0 | 12.5 | 2.6 | 34.3 | 4.3 | 25.3 | 1.4 | 14.7 | 6.5 |
| D(VR1) | uV/V 0 -2700 | -790.3 | 6.0 | -792.1 | 11.3 | -793.9 | 19.0 | -817.0 | 10.2 | -811.2 | 20.9 | -811.8 | 11.3 |
| D(VR2) | uV/V 0 -2000 | -424.9 | 6.7 | -422.5 | 6.9 | -429.0 | 8.4 | -431.1 | 4.6 | -436.4 | 14.2 | -429.7 | 6.9 |
| ZKA | OHMS 0 0.50 | 0.15 | 0.01 | 0.15 | 0.01 | 0.20 | 0.11 | 0.19 | 0.07 | 0.23 | 0.08 | 0.16 | 0.01 |

Notes:

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

2/ Post 30 krads statistics are not provided in Table IV. This data is available upon request.

Figure 1. Radiation Bias Circuit for M38510/14801BPA



$$I_{cathode} = 5mA \quad (\text{BIAS CONDITION OF SMA PER DUT})$$

$$R_{iw} = 2k\Omega, 44W @ 10\%$$

$$V_{cc} = 2.5V + (5mA \times 2k\Omega) = 12.5V \pm 0.5V$$