Government Systems Group

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DATE: May 18, 1995 PPM-95-151
TO: S. Hull/311.1 KS
FROM: K. Sahu/300.1
SUBJECT: Radiation Report on: DAC8408
Project: HST/ADD
Control #: 10995
Job #: EI56356
Project part #: 5962-8967801XA

cc: A. Nguyen/300.1
A. Sharma/311
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A radiation evaluation was performed on DAC8408 (D-A Converter) 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 $^{60}$Co gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration) and two parts were used as control samples. The total dose radiation levels were 1, 2, 3, 5 and 10 krads* . The dose rate was between 0.05 and 0.30 krads/hour (see Table II for radiation schedule). After each radiation exposure and annealing step, parts were electrically tested according to the test conditions and the specification limits** listed in Table III.

During initial electrical measurements, one part (S/N 85) exceeded the maximum specification limit of 0.0010% for PSR_A, with a reading of 0.0014%. All other parts passed all electrical tests.

At the 1 krad irradiation level, all irradiated parts exceeded the maximum specification limit of 50.00 µA for Icc_0V and Icc_5V, with readings ranging from 1739 to 1981 µA for Icc_0V and from 4082 to 4648 µa for Icc_5V. All irradiated parts also exceeded the maximum specification limit of 1.000 mA for Icc_vih, with readings ranging from 4.25 to 4.82 mA. All irradiated parts exceeded the maximum specification limit of 0.400 V for Vol DB1, with readings ranging from 4.95 to >5.0 V, and S/N 83, 84, 85, 86 and 88 exceeded the maximum specification limit of 0.400 V for Vol DB0, with the same readings.

In addition, at the 1 krad level, all irradiated parts:

- exceeded the maximum specification limit of 1.00 lsb for GFSE_A, GFSE_B, GFSE_C and GFSE_D, with readings ranging from 7.1 to 13.4 lsb,
- exceeded the maximum specification limit of 0.0010 % for PSR_A, PSR_B, PSR_C and PSR_D, with readings ranging from 0.0819 to 0.1288 %,
- exceeded the maximum specification limit of 0.250 lsb for INL_A, INL_B, INL_C and INL_D, with readings ranging from 2.8 to 12.8 lsb, and
- exceeded the maximum specification limit of 0.500 lsb for DNL_A, DNL_B, DNL_C and DNL_D, with readings ranging from 1.7 to 8.5 lsb.

At the 2, 3, 5 and 10 krad level, increasing degradation in the above and additional parameters continued. Refer to the attached data for details.

* The term rads, as used in this document, means rads(silicon). All radiation levels cited are cumulative.

** These are manufacturer's pre-irradiation data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

Table IV provides a summary of the mean and standard deviation values for each parameter after each irradiation exposure.

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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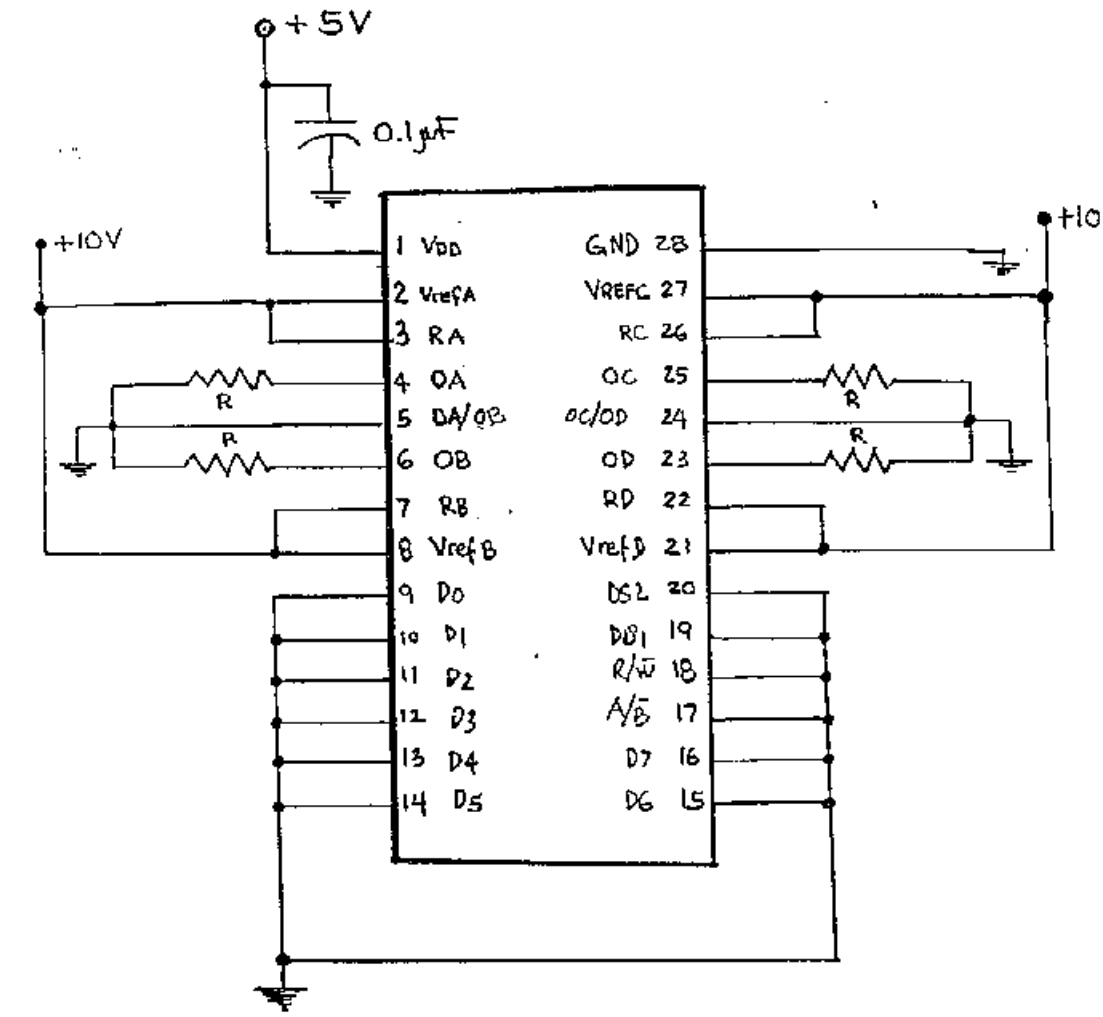
Figure 1. Radiation Bias Circuit for DAC8408




ALL R = 2KΩ ¼W 5%.

TABLE I. Part Information

| | |
|---|---|
| Generic Part Number: | DAC8408* |
| HST/ADD Part Number | 5962-8967801XA |
| HST/ADD Control Number: | 10995 |
| Charge Number: | EI56356 |
| Manufacturer: | PMI |
| Lot Date Code (LDC): | 9449 |
| Quantity Tested: | 8 |
| Serial Number of Control Samples: | 80, 81 |
| Serial Numbers of Radiation Samples: | 82, 83, 84, 85, 86, 87, 88, 89 |
| Part Function: | D-A Converter |
| Part Technology: | CMOS |
| Package Style: | 28-pin DIP |
| Test Equipment: | A540 |
| Engineer: | C. Nguyen |

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

TABLE II. Radiation Schedule for DAC8408

| EVENT | DATE |
|---|---|
| 1) INITIAL ELECTRICAL MEASUREMENTS | 04/18/95 |
| 2) 1 KRAD IRRADIATION (0.06 KRADS/HOUR) | 04/19/95 |
| POST-1 KRAD ELECTRICAL MEASUREMENT | 04/20/95 |
| 3) 2 KRAD IRRADIATION (0.06 KRADS/HOUR) | 04/20/95 |
| POST-2 KRAD ELECTRICAL MEASUREMENT | 04/21/95 |
| 4) 3 KRAD IRRADIATION (0.05 KRADS/HOUR) | 04/21/95 |
| POST-3 KRAD ELECTRICAL MEASUREMENT | 04/22/95 |
| 5) 5 KRAD IRRADIATION (0.11 KRADS/HOUR) | 04/22/95 |
| POST-5 KRAD ELECTRICAL MEASUREMENT | 04/23/95 |
| 6) 10 KRAD IRRADIATION (0.30 KRADS/HOUR) | 04/23/95 |
| POST-10 KRAD ELECTRICAL MEASUREMENT | 04/24/95 |

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

Table III. Electrical Characteristics of DAC8408

| Test # | Test Name | Min | Max | Condition |
|---|---|---|---|---|
| 1 | Icc_0v | | 50.00 µA | Vin = 0.0 V |
| 2 | Icc_5V | | 50.00 µA | Vin = 5.0 V |
| 3 | Icc_vil | | 1.00 mA | Vin = 0.8 V |
| 4 | Icc_vih | | 1.00 mA | Vin = 2.4 V |
| 5 | Iih DB7 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 6 | Iih DB6 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 7 | Iih DB5 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 8 | Iih DB4 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 9 | Iih-DB3 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 10 | Iih DB2 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 11 | Iih DB1 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 12 | Iih DB0 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 13 | Iih DS1 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 14 | Iih DS2 | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 15 | Iih AB_ | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 16 | Iih RW_ | -1.00 µA | 1.00 µA | Vtest = 5.0 V |
| 17 | Iil DB7 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 18 | Iil DB6 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 19 | Iil DB5 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 20 | Iil DB4 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 21 | Iil DB3 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 22 | Iil DB2 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 23 | Iil DB1 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 24 | Iil DB0 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 25 | Iil DS1 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 26 | Iil DS2 | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 27 | Iil AB_ | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 28 | Iil RW_ | -1.00 µA | 1.00 µA | Vtest = 0.0 V |
| 29 | Voh DB7 | 4.00 V | | Iout = 0.4 mA |
| 30 | Voh DB6 | 4.00 V | | Iout = 0.4 mA |
| 31 | Voh DB5 | 4.00 V | | Iout = 0.4 mA |
| 32 | Voh DB4 | 4.00 V | | Iout = 0.4 mA |
| 33 | Voh DB3 | 4.00 V | | Iout = 0.4 mA |
| 34 | Voh DB2 | 4.00 V | | Iout = 0.4 mA |
| 35 | Voh DB1 | 4.00 V | | Iout = 0.4 mA |
| 36 | Voh DB0 | 4.00 V | | Iout = 0.4 mA |
| 37 | Vol DB7 | | 0.400 V | Iout = 1.6 mA |
| 38 | Vol DB6 | | 0.400 V | Iout = 1.6 mA |
| 39 | Vol DB5 | | 0.400 V | Iout = 1.6 mA |
| 40 | Vol DB4 | | 0.400 V | Iout = 1.6 mA |
| 41 | Vol DB3 | | 0.400 V | Iout = 1.6 mA |
| 42 | Vol DB2 | | 0.400 V | Iout = 1.6 mA |
| 43 | Vol DB1 | | 0.400 V | Iout = 1.6 mA |
| 44 | Vol DB0 | | 0.400 V | Iout = 1.6 mA |
| 45 | GSFE_A | -1.00 lsb | 1.00 lsb | Gain error DAC A |
| 46 | GFSE_B | -1.00 lsb | 1.00 lsb | Gain error DAC B |
| 47 | GFSE_C | -1.00 lsb | 1.00 lsb | Gain error DAC C |
| 48 | GFSE_D | -1.00 lsb | 1.00 lsb | Gain error DAC D |
| 49 | PSR_A | -0.0010 % | 0.0010 % | Delta VDD = +/-10% |
| 50 | PSR_B | -0.0010 % | 0.0010 % | Delta VDD = +/-10% |
| 51 | PSR_C | -0.0010 % | 0.0010 % | Delta VDD = +/-10% |
| 52 | PSR_D | -0.0010 % | 0.0010 % | Delta VDD = +/-10% |
| 53 | INL_A | -0.250 lsb | 0.250 lsb | |
| 54 | DNL_A | -0.500 lsb | 0.500 lsb | |
| 55 | INL_B | -0.250 lsb | 0.250 lsb | |
| 56 | DNL_B | -0.500 lsb | 0.500 lsb | |
| 57 | INL_C | -0.250 lsb | 0.250 lsb | |
| 58 | DNL_C | -0.500 lsb | 0.500 lsb | |
| 59 | INL_D | -0.250 lsb | 0.250 lsb | |
| 60 | DNL_D | -0.500 lsb | 0.500 lsb | |

# TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for DAC8408 /1

| Test # | Parameters | Units | Spec. Lim./2 min | Spec. Lim./2 max | Initial mean | Initial sd | Total Dose Exposure (krads) 1 mean | 1 sd | 2 mean | 2 sd | 3 mean | 3 sd | 5 mean | 5 sd | 10 mean | 10 sd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Icc_0V | µA | - | 50.00 | -3.00 | 1.0 | 1903 | 95 | 6686 | 1992 | 7875 | 1407 | 8498 | 1620 | 6640 | 144 |
| 2 | Icc_5V | µA | - | 50.00 | -1.00 | 1.0 | 4445 | 206 | 7665 | 1997 | 8845 | 1410 | 9449 | 1609 | 7587 | 154 |
| 3 | Icc_vil | mA | - | 1.000 | 0 | 0 | 0.02 | 0 | 2.21 | 1.9 | 3.19 | 1.3 | 3.27 | 1.6 | 0.46 | .04 |
| 4 | Icc_vih | mA | - | 1.000 | 0.44 | .01 | 4.61 | .21 | 7.69 | 2.0 | 8.87 | 1.4 | 9.46 | 1.6 | 7.58 | .15 |
| 5 | Iih DB7 | µA | -1.00 | 1.00 | -0.20 | .03 | -0.20 | .04 | -0.08 | .08 | -0.09 | .07 | 0 | .03 | 0.20 | .08 |
| 6 | Iih DB6 | µA | -1.00 | 1.00 | -0.40 | .06 | -0.30 | .07 | -0.22 | .09 | -0.20 | .06 | -0.20 | .06 | -0.20 | .10 |
| 7 | Iih DB5 | µA | -1.00 | 1.00 | -0.25 | .06 | -0.30 | .04 | -0.10 | .06 | -0.10 | .05 | -0.05 | .06 | 0.16 | .10 |
| 8 | Iih DB4 | µA | -1.00 | 1.00 | -0.30 | .08 | -0.30 | .05 | -0.20 | .08 | -0.20 | .05 | -0.04 | .05 | 0.08 | .08 |
| 9 | Iih DB3 | µA | -1.00 | 1.00 | -0.40 | .04 | -0.40 | .02 | -0.20 | .05 | -0.20 | .06 | -0.04 | .12 | 0.09 | .07 |
| 10 | Iih DB2 | µA | -1.00 | 1.00 | -0.30 | .08 | -0.30 | .02 | -0.20 | .06 | -0.20 | .05 | -0.09 | .06 | 0.07 | .01 |
| 11 | Iih DB1 | µA | -1.00 | 1.00 | -0.30 | .08 | -0.40 | .03 | -0.40 | .07 | -0.40 | .05 | -0.30 | .03 | -0.20 | .03 |
| 12 | Iih DB0 | µA | -1.00 | 1.00 | -0.40 | .05 | -0.30 | .09 | -0.40 | .04 | -0.40 | .04 | -0.40 | .04 | -0.30 | .03 |
| 13 | Iih DS1 | µA | -1.00 | 1.00 | -0.40 | .06 | -0.40 | .03 | -0.40 | .02 | -0.40 | .03 | -0.30 | .08 | -0.30 | .05 |
| 14 | Iih DS2 | µA | -1.00 | 1.00 | -0.30 | .04 | -0.40 | .05 | -0.40 | .05 | -0.30 | .03 | -0.40 | .03 | -0.40 | .04 |
| 15 | Iih AB_ | µA | -1.00 | 1.00 | -0.20 | .06 | -0.20 | .05 | -0.20 | .04 | -0.30 | .07 | -0.30 | .05 | -0.20 | .06 |
| 16 | Iih RW_ | µA | -1.00 | 1.00 | -0.40 | .07 | -0.40 | .05 | -0.40 | .05 | -0.40 | .06 | -0.40 | .03 | -0.30 | .05 |
| 17 | Iil DB7 | µA | -1.00 | 1.00 | -0.20 | .05 | -0.20 | .02 | -0.30 | .01 | -0.30 | .03 | -0.23 | .06 | -0.20 | .04 |
| 18 | Iil DB6 | µA | -1.00 | 1.00 | -0.20 | .02 | -0.20 | .04 | -0.20 | .04 | -0.20 | .04 | -0.20 | .04 | -0.16 | .02 |
| 19 | Iil DB5 | µA | -1.00 | 1.00 | -0.20 | .04 | -0.20 | .03 | -0.20 | .02 | -0.20 | .02 | -0.20 | .05 | -0.20 | .03 |
| 20 | Iil DB4 | µA | -1.00 | 1.00 | -0.20 | .04 | -0.20 | .05 | -0.20 | .03 | -0.20 | .03 | -0.20 | .03 | -0.17 | .02 |

## Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the 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.

3/ Extreme degradation in this parameter occurred at this level.

**Radiation-sensitive parameters: Icc, Vol, Voh, GFSE, PSR, INL and DNL.**

# TABLE IV (Cont'd.): Summary of Electrical Measurements after Total Dose Exposures and Annealing for DAC8408 /1

| Test # | Parameters | Units | Spec. Lim./2 min | Spec. Lim./2 max | Initial mean | Initial sd | Total Dose Exposure (krads) 1 mean | 1 sd | 2 mean | 2 sd | 3 mean | 3 sd | 5 mean | 5 sd | 10 mean | 10 sd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | Iil DB3 | µA | -1.00 | 1.00 | -0.20 | .06 | -0.20 | .05 | -0.20 | .02 | -0.20 | .03 | -0.20 | .05 | -0.20 | .01 |
| 22 | Iil DB2 | µA | -1.00 | 1.00 | -0.20 | .05 | -0.20 | .05 | -0.20 | .04 | -0.20 | .03 | -0.20 | .03 | -0.20 | .02 |
| 23 | Iil DB1 | µA | -1.00 | 1.00 | -0.20 | .03 | -0.20 | .03 | -0.20 | .02 | -0.20 | .03 | -0.20 | .02 | -0.10 | .02 |
| 24 | Iil DB0 | µA | -1.00 | 1.00 | -0.20 | .04 | -0.20 | .03 | -0.30 | .03 | -0.20 | .05 | -0.20 | .03 | -0.10 | .03 |
| 25 | Iil DS1 | µA | -1.00 | 1.00 | -0.20 | .03 | -0.20 | .03 | -0.20 | .02 | -0.20 | .01 | -0.20 | .03 | -0.20 | .02 |
| 26 | Iil DS2 | µA | -1.00 | 1.00 | -0.20 | .04 | -0.20 | .03 | -0.20 | .03 | -0.25 | .03 | -0.20 | .02 | -0.20 | .03 |
| 27 | Iil AB_ | µA | -1.00 | 1.00 | -0.20 | .02 | -0.20 | .02 | -0.20 | .02 | -0.20 | .02 | -0.20 | .03 | -0.20 | .02 |
| 28 | Iil RW_ | µA | -1.00 | 1.00 | -0.20 | .05 | -0.20 | .05 | -0.20 | .03 | -0.20 | .04 | -0.20 | .03 | -0.20 | .02 |
| 29 | Voh DB7 | V | 4.00 | - | 4.95 | .02 | 4.99 | 0 | 0.11 | .04 | 0.58 | 1.4 | 3.95 | .04 | 4.15 | .05 |
| 30 | Voh DB6 | V | 4.00 | - | 4.95 | .02 | 4.99 | 0 | 0.11 | .04 | 0.25 | .48 | 4.08 | .05 | 4.01 | .06 |
| 31 | Voh DB5 | V | 4.00 | - | 4.95 | .02 | 4.99 | 0 | 0.12 | .04 | 1.00 | 1.7 | 3.88 | .01 | 3.85 | .03 |
| 32 | Voh DB4 | V | 4.00 | - | 4.95 | .02 | 4.99 | 0 | 0.12 | .04 | 1.06 | 1.8 | 4.02 | .03 | 4.03 | .04 |
| 33 | Voh DB3 | V | 4.00 | - | 4.95 | .02 | 4.99 | 0 | 0.19 | .19 | 1.15 | 1.7 | 4.02 | .05 | 4.02 | .04 |
| 34 | Voh DB2 | V | 4.00 | - | 4.95 | .02 | 4.99 | 0 | 0.13 | .04 | 1.16 | 1.7 | 3.98 | .03 | 3.96 | .08 |
| 35 | Voh DB1 | V | 4.00 | - | 4.95 | .02 | 4.99 | 0 | 3.17 | 2.5 | 2.42 | 2.5 | 4.08 | .04 | 4.08 | .04 |
| 36 | Voh DB0 | V | 4.00 | - | 4.95 | .02 | 4.99 | 0 | 1.97 | 2.5 | 1.64 | 2.1 | 4.07 | .05 | 4.02 | .07 |
| 37 | Vol DB7 | V | - | 0.400 | 0.10 | 0 | 0.10 | 0 | 0.12 | .01 | 0.68 | 1.6 | 4.51 | .05 | 4.71 | .03 |
| 38 | Vol DB6 | V | - | 0.400 | 0.09 | 0 | 0.10 | .01 | 0.11 | .01 | 0.24 | .34 | 0.40 | 0 | 0.46 | .03 |
| 39 | Vol DB5 | V | - | 0.400 | 0.10 | 0 | 0.09 | 0 | 0.15 | .11 | 0.39 | .45 | 0.40 | 0 | 0.40 | 0 |
| 40 | Vol DB4 | V | - | 0.400 | 0.10 | 0 | 0.09 | 0 | 0.17 | .14 | 0.32 | .27 | 0.40 | 0 | 0.40 | 0 |

## Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the 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.

3/ Extreme degradation in this parameter occurred at this level.

**Radiation-sensitive parameters: Icc, Vol, Voh, GFSE, PSR, INL and DNL.**

# TABLE IV (Cont'd.): Summary of Electrical Measurements after Total Dose Exposures and Annealing for DAC8408 /1

| Test | | | Spec. Lim./2 | | Total Dose Exposure (krads) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Initial | | 1 | | 2 | | 3 | | 5 | | 10 | |
| # | Parameters | Units | min | max | mean | sd | mean | sd | mean | sd | mean | sd | mean | sd | mean | sd |
| 41 | Vol DB3 | V | - | 0.400 | 0.10 | 0 | 0.09 | 0 | 0.19 | .14 | 0.26 | .15 | 0.40 | 0 | 0.40 | 0 |
| 42 | Vol DB2 | V | - | 0.400 | 0.10 | 0 | 0.09 | 0 | 0.15 | .10 | 0.36 | .26 | 0.40 | 0 | 0.40 | 0 |
| 43 | Vol DB1 | V | - | 0.400 | 0.09 | 0 | 4.97 | .02 | 3.15 | 2.5 | 2.09 | 2.4 | 0.69 | .25 | 0.40 | 0 |
| 44 | Vol DB0 | V | - | 0.400 | 0.09 | 0 | 3.13 | 2.5 | 1.95 | 2.5 | 1.07 | 1.6 | 0.57 | .24 | 0.40 | 0 |
| 45 | GSFE_A | lsb | -1.00 | 1.00 | -0.58 | .11 | 10.6 | .76 | /3 | | /3 | | /3 | | /3 | |
| 46 | GSFE_B | lsb | -1.00 | 1.00 | -0.66 | .11 | 8.81 | .67 | /3 | | /3 | | /3 | | /3 | |
| 47 | GSFE_C | lsb | -1.00 | 1.00 | -0.59 | .06 | 10.7 | 1.8 | /3 | | /3 | | /3 | | /3 | |
| 48 | GSFE_D | lsb | -1.00 | 1.00 | -0.59 | .10 | 8.92 | .74 | /3 | | /3 | | /3 | | /3 | |
| 49 | PSR_A | % | -0.0010 | 0.0010 | .0003 | .0004 | 0.101 | .010 | .0007 | .0050 | -.0023 | .0044 | .0023 | .0084 | .0001 | .00003 |
| 50 | PSR_B | % | -0.0010 | 0.0010 | -6E-7 | 7E-7 | .001 | .005 | .0013 | .0029 | .0003 | .0011 | .0029 | .0084 | .00006 | .0005 |
| 51 | PSR_C | % | -0.0010 | 0.0010 | .0003 | 4E-7 | 0.094 | .01 | -.0018 | .0068 | -.0033 | .0074 | -.0010 | .0054 | -.0001 | .00004 |
| 52 | PSR_D | % | -0.0010 | 0.0010 | -.0004 | 5E-7 | .0934 | .004 | .0016 | .0049 | .0005 | .0023 | .0009 | .0033 | -.0001 | .0001 |
| 53 | INL_A | lsb | -0.250 | 0.250 | 0.08 | .02 | 6.69 | .58 | /3 | | /3 | | /3 | | /3 | |
| 54 | DNL_A | lsb | -0.500 | 0.500 | 0.07 | .02 | 5.36 | .14 | /3 | | /3 | | /3 | | /3 | |
| 55 | INL_B | lsb | -0.250 | 0.250 | 0.11 | .02 | 3.76 | .18 | /3 | | /3 | | /3 | | /3 | |
| 56 | DNL_B | lsb | -0.500 | 0.500 | 0.13 | .03 | 2.35 | .12 | /3 | | /3 | | /3 | | /3 | |
| 57 | INL_C | lsb | -0.250 | 0.250 | 0.07 | .03 | 7.75 | 3.1 | /3 | | /3 | | /3 | | /3 | |
| 58 | DNL_C | lsb | -0.500 | 0.500 | 0.07 | .02 | 6.04 | 1.5 | /3 | | /3 | | /3 | | /3 | |
| 59 | INL_D | lsb | -0.250 | 0.250 | 0.11 | .03 | 3.70 | .37 | /3 | | /3 | | /3 | | /3 | |
| 60 | DNL_D | lsb | -0.500 | 0.500 | 0.14 | .03 | 2.30 | .24 | /3 | | /3 | | /3 | | /3 | |

## Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the 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.

3/ Extreme degradation in this parameter occurred at this level.

**Radiation-sensitive parameters: Icc, Vol, Voh, GFSE, PSR, INL and DNL.**