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 SUBJECT: Radiation Report on: DAC8800
 Project: NASA/MSFC Support
 Control #: 15373
 Job #: ER61130

PPM-97-001

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A radiation evaluation was performed on DAC8800 (D-to-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 Figure 1 and Tables I through III.

The total dose testing was performed using a Co⁶⁰ gamma ray source. During the radiation testing, two 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 1, 2 and 3 krad^{*}. After the 2 krad irradiation, the parts were annealed at 25°C for 48 hours. The dose rate was between 0.015 and 0.059 krad/hour (see Table II for radiation schedule). After each radiation exposure, parts were electrically tested according to the specification limits^{**} listed in Table III.

All parts passed all initial electrical tests.

After the 1 krad irradiation, both irradiated parts exceeded the maximum specification limit of 2.000 mA for Icc_{h_ttl} and Icc_{l_ttl}. S/N 59 read 2.894 and 2.938 mA, respectively, and S/N 60 read 4.066 and 3.287 mA, respectively. Both parts also exceeded the maximum specification limit of 0.400 mA for Icc_{h_cmos} and Icc_{l_cmos}, with readings of 3.081 and 3.120 mA for S/N 59 and 3.542 and 3.536 mA, respectively, for S/N60. Both irradiated parts also marginally fell below the minimum specification limit of -0.0010% for PSSR_B through PSSR_H, with readings ranging from -0.0011% to -0.0013%. Both irradiated parts passed all other electrical tests at this level.

After the 2 krad irradiation, both parts continued to exceed specification limits for Icc_{h_ttl}, Icc_{l_ttl}, Icc_{h_cmos} and Icc_{l_cmos}, with readings ranging from 6.130 to 7.592 mA for Icc_{h_ttl} and Icc_{l_ttl}, and from 6.066 to 5.722 mA for Icc_{h_cmos} and Icc_{l_cmos}. In addition, both irradiated parts exceeded the maximum specification limit of 24.0 mw for s_PD, with readings of 91.1 mw for S/N 59 and 90.8 mw for S/N 60.

Both irradiated parts continued to fall below the minimum specification limit for PSSR_B through PSSR_H, with readings ranging from -0.0021% to -0.0028%, and both parts also fell below the minimum specification limit of -0.0010% for PSSR_A, with readings of -0.0021%. In addition, at this irradiation level, both irradiated parts marginally exceeded specification limits for: DNL_C, DNL_E, DNL_F and DNL_G for S/N 59 and DNL_B, DNL_D, DNL_E, VZSW_F, TE F, DNL_F and DNL_G for S/N 60. Both irradiated parts passed all other electrical tests at this level.

After annealing for 48 hours at 25°C, a very small amount of recovery was observed in Icc and other parameters.

After the 3 krad irradiation, the same degradation was observed, with approximately the same readings.

* The term rads, as used in this document, means rads(SiO₂). 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.

After annealing at 100°C for 168 hours, no rebound effects were observed.

Table III provides the data 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 me at (301) 731-8954.

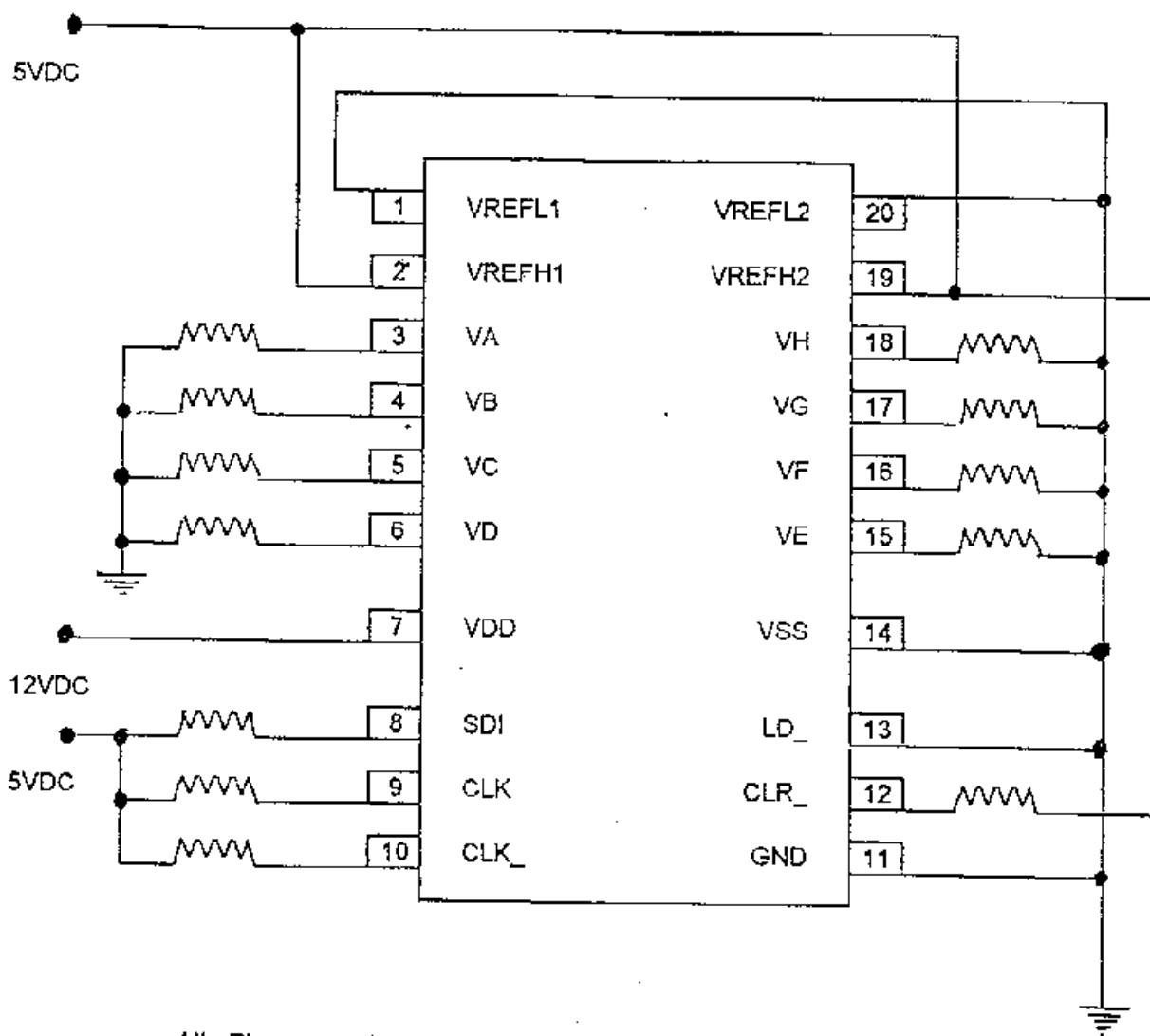
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Figure 1. Radiation Bias Circuit for DAC8800

DAC8800
OCTAL 8 BIT CMOS D/A CONVERTER
RADIATION BIAS CIRCUIT



All R's are 2K ohms.

TABLE 1. Part Information

Generic Part Numbers:	DAC8800
MSFC Part Number	DAC8800
MSFC Control Number:	15373
Charge Number:	ER61130
Manufacturer:	PMI
Lot Date Code (LDC):	9351
Quantity Tested:	3
Serial Number of Control Sample:	58
Serial Numbers of Radiation Samples:	59, 60
Part Function:	D-to-A Converter
Part Technology:	CMOS
Package Style:	20-pin DIP
Test Equipment:	S-50
Engineer:	C. Nguyen

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

TABLE II. Radiation Schedule for DAC8800

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	08/09/96
2) 1 KRAD IRRADIATION* (0.015 KRADS/HOUR).....	09/13/96
POST-1 KRAD ELECTRICAL MEASUREMENT.....	09/26/96
3) 2 KRAD IRRADIATION (0.050 KRADS/HOUR).....	09/26/96
POST-2 KRAD ELECTRICAL MEASUREMENT.....	09/27/96
4) 48-HOUR ANNEALING @25°C.....	09/27/95
POST-48 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	09/29/95
5) 3 KRAD IRRADIATION (0.059 KRADS/HOUR).....	09/30/96
POST-3 KRAD ELECTRICAL MEASUREMENT.....	10/01/96
6) 168-HOUR ANNEALING @ 100°C.....	10/01/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	10/08/95

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

** The post-1 krad electrical measurements were delayed for 12 days due to test equipment problems. The parts were kept without bias (shorted) during this time.

TABLE IIIa: Summary of Electrical Measurements after Total Dose Exposures and Annealing for DAC8800

#	Electrical Parameters	Units	Spec. Lim/1		Total Dose Exposure (krads)						Annealing		TDE (krads)		Annealing	
					Initial		1		2		48 hrs. @ 25°C		3		168 hrs. @ 100°C	
					S/N59	S/N60	S/N59	S/N60	S/N59	S/N60	S/N59	S/N60	S/N59	S/N60	S/N59	S/N60
1	I _{cc} t _{tl}	mA	0	2	0.8	0.8	2.9	4.1	7.6	7.6	7.0	7.6	6.2	7.5	6.4	6.4
2	I _{cc} t _{tl}	mA	0	2	0.2	0.2	2.9	3.3	6.2	6.1	5.8	6.2	6.9	7.8	6.7	6.7
3	I _{cc} c _{mos}	mA	0	0.4	0.2	0.2	3.1	3.5	5.7	5.7	4.5	5.8	5.7	7.0	5.9	5.9
4	I _{cc} c _{mos}	μA	0	0.4	0.2	0.2	3.1	3.5	6.1	6.1	4.9	6.1	6.8	7.7	6.6	6.6
5	s _{PD}	μs		24	9	9	35	49	91	91	84	92	74	90	77	77
6	I _{ih} SDI	μA	-1	1	-0.2	-0.2	-0.2	-0.2	0.2	-0.2	-0.2	-0.2	-0.3	-0.2	-0.2	0.2
7	I _{ih} CLR	μA	-1	1	0.1	0	0	0	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1	-0.2	-0.2
8	I _{ih} CLK	μA	-1	1	-0.3	-0.2	0	0	0	-0.1	-0.3	-0.1	-0.1	-0.3	-0.2	-0.2
9	I _{ih} LD	μA	-1	1	-0.1	-0.1	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2
10	I _{il} SDI	μA	-1	1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
11	I _{il} CLR	μA	-1	1	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.2	-0.3	-0.2	-0.2	-0.2	-0.2
12	I _{il} CLK	μA	-1	1	-0.2	-0.2	0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
13	I _{il} LD	μA	-1	1	-0.4	-0.3	-0.4	-0.3	-0.3	-0.3	-0.2	-0.3	-0.2	-0.2	-0.2	-0.2
14	PSRR _A	%	-0.00	0.001	-0.000	-0.000	-0.000	-0.000	-0.002	-0.002	-0.001	-0.002	-0.003	-0.004	-0.003	-0.003
15	PSRR _B	%	-0.00	0.001	-0.000	-0.000	-0.001	-0.001	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004	-0.004	0.004
16	PSRR _C	%	-0.00	0.001	-0.001	-0.001	-0.001	-0.001	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004	-0.004	-0.004
17	PSRR _D	%	-0.00	0.001	-0.000	-0.000	-0.001	-0.001	-0.003	-0.003	-0.003	-0.003	0.004	-0.004	-0.004	-0.004
18	PSRR _E	%	-0.00	0.001	-0.000	-0.000	-0.001	-0.001	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004	-0.004	-0.004
19	PSRR _F	%	-0.00	0.001	-0.000	-0.000	-0.001	-0.001	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004	-0.004	-0.004
20	PSRR _G	%	-0.00	0.001	-0.000	-0.000	0.001	-0.001	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004	0.004	-0.004
21	PSRR _H	%	-0.00	0.001	-0.000	-0.000	-0.001	-0.001	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
22	GSFE _A	lsb	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0
23	VZSE _A	lsb	-0.5	0.5	0.2	0.2	0.1	0	0.2	0.2	0	0	0	0	0	0
24	TE _A	lsb	-0.5	0.5	0.1	0.1	0.2	-0.1	0	0	-0.1	0	-0.2	0	-0.2	0
25	DNL _A	lsb	-1	1	0.2	0.2	0.1	0.3	0.5	0.5	0.2	0.5	0.5	1.0	0.5	0.8
26	GSFE _B	lsb	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0
27	VZSE _B	lsb	-0.5	0.5	0	0	0	0	0.2	0.2	0	-0.1	-0.1	-3.6	-0.1	-0.1

Notes:

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

TABLE IIIb: Summary of Electrical Measurements after Total Dose Exposures and Annealing for DAC8800

#	Electrical Parameters	Units	Spec. Limit		Total Dose Exposure (krads)				Annealing		TDE (krads)		Annealing			
					Initial		1		2		48 hrs. @ 150°C		3		168 hrs. @ 100°C	
					S/N59	S/N60	S/N59	S/N60	S/N59	S/N60	S/N59	S/N60	S/N59	S/N60	S/N59	S/N60
28	TE_B	lsb	-0.5	0.5	0.1	0	-0.1	-0.1	-0.2	-0.2	0.30	-0.3	-0.456	-0.8	-0.4	-0.4
29	DNL_B	lsb	-1	1	0.2	0.2	0.5	0.5	0.972	1.009	0.98	1.047	1.6	1.7	1.4	1.4
30	GSFE_C	lsb	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0
31	VZSE_C	lsb	-0.5	0.5	0	0	-0.1	0	0.2	0.2	-0.1	0	-0.1	-0.1	-0.1	-0.1
32	TE_C	lsb	-0.5	0.5	0.1	0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.4	-0.449	-0.393	-0.377
33	DNL_C	lsb	-1	1	0.2	0.2	0.5	0.5	1.003	0.996	1.006	1.037	1.6	1.7	1.5	1.4
34	GSFE_D	lsb	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0
35	VZSE_D	lsb	-0.5	0.5	0	0	0	0.1	0.3	0.3	0	-1.8	0	-0.1	-0.1	-0.1
36	TE_D	lsb	-0.5	0.5	0.1	0.1	-0.2	-0.1	-0.2	-0.2	-0.3	-0.6	-0.449	-0.464	-0.413	-0.385
37	DNL_D	lsb	-1	1	0.2	0.2	0.5	0.5	1.031	1.039	1.014	1.4	1.6	1.7	1.5	1.4
38	GSFE_E	lsb	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0
39	VZSE_E	lsb	-0.5	0.5	0.1	0.1	0	0	0.3	0.2	0.2	0.1	0.2	0.2	0.1	0.1
40	TE_E	lsb	-0.5	0.5	0.1	0.1	-0.1	-0.2	-0.3	-0.3	-0.3	-0.3	-0.497	-0.485	-0.466	-0.413
41	DNL_E	lsb	-1	1	0.2	0.2	0.6	0.6	1.084	1.086	1.1	1.2	1.8	1.8	1.6	1.5
42	GSFE_F	lsb	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0
43	VZSE_F	lsb	-0.5	0.5	0	0	0	-0.1	0.3	-3.2	0	0	0	0	-2.9	0
44	TE_F	lsb	-0.5	0.5	0.1	0.1	-0.2	-0.1	-0.2	-0.7	-0.3	-0.3	-0.461	-0.479	-0.831	-0.396
45	DNL_F	lsb	-1	1	0.2	0.2	0.6	0.6	1.081	1.1	1.1	1.1	1.7	1.8	1.6	1.5
46	GSFE_G	lsb	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0
47	VZSE_G	lsb	-0.5	0.5	0	0	0	-0.1	0.2	0.2	-0.1	-0.1	-0.1	0	-0.1	-0.1
48	TE_G	lsb	-0.5	0.5	0.1	0	-0.2	-0.1	-0.2	-0.2	-0.4	-0.3	-0.528	-0.482	-0.489	-0.411
49	DNL_G	lsb	-1	1	0.2	0.2	0.6	0.5	1.081	1.078	1.1	1.1	1.7	1.8	1.6	1.5
50	GSFE_H	lsb	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0
51	VZSE_H	lsb	-0.5	0.5	0.2	0.2	0	0	0.3	0.3	0.1	0	0.3	0.408	0.316	0.282
52	TE_H	lsb	-0.5	0.5	0.1	0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	0.1	0.1	0.1
53	DNL_H	lsb	-1	1	0.2	0.2	0.5	0.5	0.4	0.4	0.3	0.4	0.3	0.3	0.2	0.2

Notes:

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