

UNISYS

DATE: December 7, 1994 PPM-95-108

TO: J. Lohr/311.1

FROM: K. Sahu/300.1 *KS*

SUBJECT: Radiation Report on CASSINI/CIRS
Part No. AD565
Control No. 11425

cc: A. Sharma/311
Library/300.1

A radiation evaluation was performed on AD565 (12-bit DAC) 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 5, 10, 15, 20, 30, 50, 75 and 100 krads*. The dose rate was between 0.08 and 1.47 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 100 krad irradiation, parts were annealed at 25°C for 168 hours, after which the parts were annealed at 100°C for 168 hours. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits** listed in Table III.

On initial electrical measurements, S/N 62 exceeded the maximum specification limit of ± 0.50 lsb for LE, with a reading of 1.11 lsb. All other irradiated parts read within the specification limits for all electrical measurements.

At the 5 krad irradiation level, S/N 62, again exceeded the maximum specification limit of ± 0.50 lsb for LE, with a reading of 1.16 lsb. All other irradiated parts read within the specification limits for all electrical measurements.

At the 10 krad level, S/N 62 and 67 exceeded the maximum specification limit for LE, with readings of 2.85 and 0.54 lsb, respectively. Throughout all the following irradiation steps, various parts exceeded the maximum specification limit of ± 0.50 lsb for LE, with the exception of S/N 65 and 66, which passed all electrical tests throughout all irradiation and annealing steps. Values for LE for the other parts ranged from 0.54 to 2.85 lsb.

After annealing for 168 hours at 25°C, no recovery was observed.

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

Table IV provides a summary of the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

*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.

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TABLE I. Part Information

Generic Part Number:	AD565
CASSINI/CIRS Part Number:	M38510/12103BJA
CASSINI/CIRS Control Number:	11425
Charge Number:	EE44634
Manufacturer:	Analog Devices
Lot Date Code:	9132A
Quantity Tested:	10
Serial Number of Control Samples:	61, 62
Serial Numbers of Radiation Samples:	63, 64, 65, 66, 67, 68, 69, 70
Part Function:	12-bit DAC
Part Technology:	Bipolar
Package Style:	24-pin DIP
Test Equipment:	A540
Test Engineer:	C. Nguyen

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

TABLE II. Radiation Schedule for AD565

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	10/25/94
2) 5 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-5 KRAD ELECTRICAL MEASUREMENT	10/25/94 10/26/94
3) 10 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-10 KRAD ELECTRICAL MEASUREMENT	10/26/94 10/27/94
4) 15 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-15 KRAD ELECTRICAL MEASUREMENT	10/27/94 10/28/94
5) 20 KRAD IRRADIATION (0.08 KRADS/HOUR) POST-20 KRAD ELECTRICAL MEASUREMENT	10/28/94 10/31/94
6) 30 KRAD IRRADIATION (0.59 KRADS/HOUR) POST-30 KRAD ELECTRICAL MEASUREMENT	10/31/94 11/01/94
7) 50 KRAD IRRADIATION (1.18 KRADS/HOUR) POST-50 KRAD ELECTRICAL MEASUREMENT	11/01/94 11/02/94
8) 75 KRAD IRRADIATION (1.47 KRADS/HOUR) POST-75 KRAD ELECTRICAL MEASUREMENT	11/02/94 11/03/94
9) 100 KRAD IRRADIATION (1.47 KRADS/HOUR) POST-100 KRAD ELECTRICAL MEASUREMENT	11/03/94 11/04/94
10) 168-HOUR ANNEALING @25°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/04/94 11/14/94
11) 168-HOUR ANNEALING @100°C** POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/14/94 11/21/94

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

*High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-883D, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of AD565

TEST CONDITIONS: VCC = 15V, VEE = -15V unless otherwise noted;

Test temperature : 25oC

Test name	Min	Max	Condition
-----	-----	-----	-----
Icc	1.00 ma	5.00 ma	All Input bits = 2.4v
Iee	-18.00 ma	-5.00 ma	All Input bits = 0.8v
Vref	9.900 v	10.100 v	
Ref_R	15.0 Kohm	25.0 Kohm	
IFS	-2.70 ma	-1.60 ma	All input logic "1"
+Pss	-0.04 lsb	0.04 lsb	VCC=13.5v to 16.5v; VEE=-15v
-Pss	-0.10 lsb	0.10 lsb	VEE=-13.5v to -16.5v; VCC=15v
Iih B1	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B2	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B3	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B4	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B5	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B6	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B7	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B8	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B9	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B10	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B11	-300.0 ua	300.0 ua	Vin = 5.5v
Iih B12	-300.0 ua	300.0 ua	Vin = 5.5v
Iil B1	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B2	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B3	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B4	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B5	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B6	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B7	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B8	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B9	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B10	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B11	-100.0 ua	100.0 ua	Vin = 0.0v
Iil B12	-100.0 ua	100.0 ua	Vin = 0.0v
LE	-0.50 lsb	0.50 lsb	All codes
MCE	-1.00 lsb	1.00 lsb	All codes

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for AD565 /1

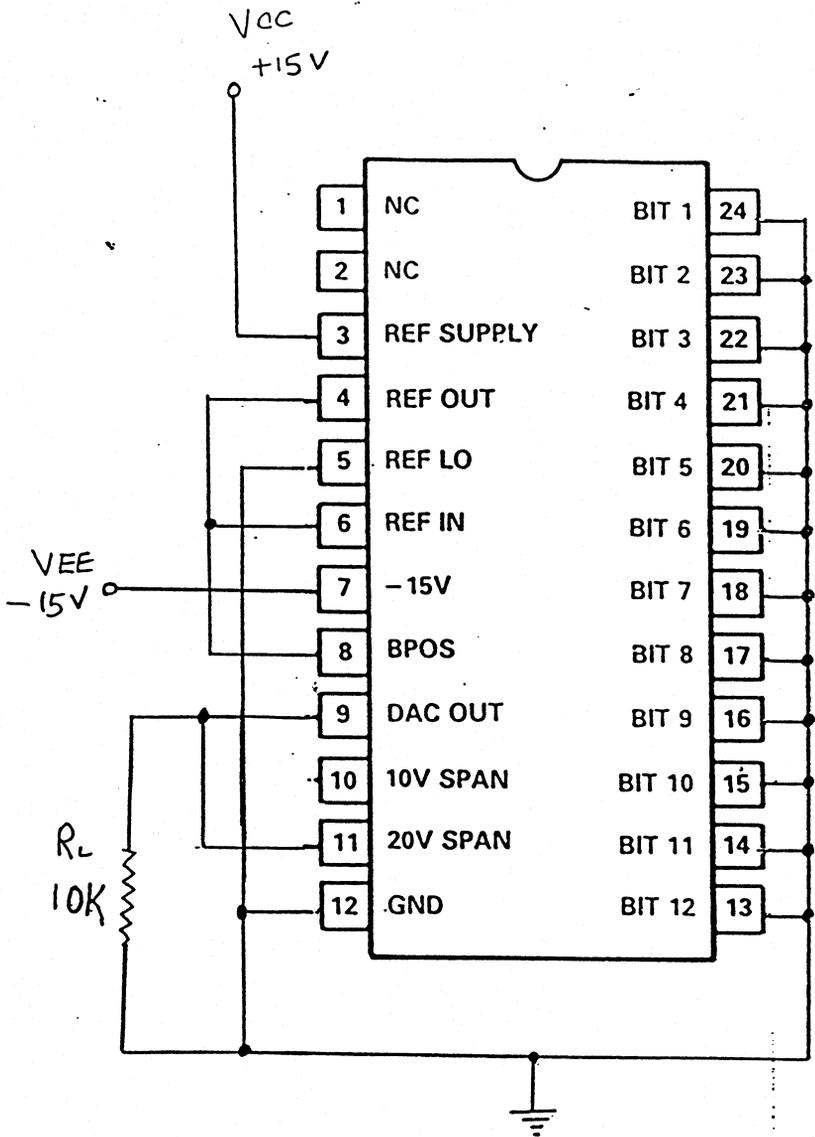
Test #	Parameters	Units	Spec. Lim./2		Total Dose Exposure (krads)										Annealing											
			min	max	Initial		5		10		15		20		30		50		75		100		168 hrs @25°C		168 hrs @100°C	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Icc	mA	1.00	5.00	1.68	.02	1.69	.02	1.68	.02	1.68	.02	1.68	.02	1.68	.02	1.68	.01	1.69	.02	1.69	.02	1.69	.02	1.69	.02
2	Iee	mA	-18.00	-5.00	-8.30	.11	-8.26	.11	-8.20	.10	-8.19	.10	-8.14	0	-8.14	0	-8.08	.10	-7.98	.08	-7.93	0	-7.98	.11	-8.14	0
3	Vref	V	9.900	10.100	10.0	0	10.0	0	10.0	0	10.0	0	10.0	0	10.0	0	10.0	0	10.0	0	10.0	0	10.0	0	10.0	0
4	Ref R	Ohms	15.0	25.0	19.6	.25	19.6	.26	19.5	.25	19.6	.26	19.7	.50	19.5	.25	19.5	.19	19.6	.19	19.5	.26	19.5	.25	19.5	.25
5	IFS	mA	-2.70	-1.60	-2.01	0	-2.01	0	-2.01	.01	-2.01	0	-2.01	0	-2.01	0	-2.01	0	-2.01	0	-2.01	0	-2.01	0	-2.01	0
6	+Pss	Isb	-0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	-Pss	Isb	-0.10	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Iih B1	µA	-300.0	300.0	218	3.0	217	0	217	0	218	0	218	0	218	0	218	0	218	0	219	0	218	0	218	0
9	Iih B2	µA	-300.0	300.0	219	3.0	218	0	217	0	218	0	218	0	218	0	219	0	218	0	219	0	218	0	218	0
10	Iih B3	µA	-300.0	300.0	219	3.0	218	0	218	0	218	0	218	0	218	0	218	0	218	0	219	0	218	0	218	0
11	Iih B4	µA	-300.0	300.0	219	3.0	218	0	218	0	218	0	218	0	218	0	219	0	218	0	219	0	218	0	218	0
12	Iih B5	µA	-300.0	300.0	219	3.0	218	0	218	0	218	0	218	0	218	0	219	0	218	0	219	0	218	0	218	0
13	Iih B6	µA	-300.0	300.0	219	3.0	218	0	218	0	218	0	218	0	218	0	219	0	218	0	219	0	218	0	218	0
14	Iih B7	µA	-300.0	300.0	219	3.0	218	0	218	0	219	0	218	0	218	0	218	0	218	0	219	0	219	0	218	0
15	Iih B8	µA	-300.0	300.0	219	3.0	218	0	218	0	218	0	218	0	218	0	219	0	218	0	219	0	218	0	218	0
16	Iih B9	µA	-300.0	300.0	218	3.0	217	0	217	0	218	0	218	0	218	0	218	0	217	0	219	0	218	0	218	0
17	Iih B10	µA	-300.0	300.0	219	3.0	218	0	217	0	218	0	218	0	218	0	218	0	217	0	219	0	218	0	218	0
18	Iih B11	µA	-300.0	300.0	218	4.0	217	0	217	0	218	0	218	0	218	0	218	0	217	0	218	0	218	0	218	0
19	Iih B12	µA	-300.0	300.0	218	4.0	217	0	217	0	217	0	218	0	218	0	218	0	217	0	219	0	218	0	218	0
20	Iil B1	µA	-100.0	100.0	29.0	.64	28.0	.76	28.0	.59	28.0	1.0	28.0	.99	28.0	1.0	28.0	1.0	28.0	1.0	28.0	2.0	28.0	1.0	28.0	.61
21	Iil B2	µA	-100.0	100.0	29.0	.64	28.0	.80	28.0	.65	28.0	1.0	28.0	1.0	28.0	1.0	28.0	1.0	28.0	1.0	28.0	2.0	28.0	1.0	27.0	.75
22	Iil B3	µA	-100.0	100.0	29.0	.95	28.0	.53	28.0	1.0	28.0	1.0	28.0	1.0	28.0	1.0	28.0	2.0	27.0	1.0	28.0	2.0	28.0	1.0	27.0	.85
23	Iil B4	µA	-100.0	100.0	29.0	.79	27.0	.90	28.0	.61	28.0	.87	28.0	.81	28.0	1.0	28.0	.93	28.0	1.0	28.0	2.0	28.0	1.0	27.0	.91
24	Iil B5	µA	-100.0	100.0	29.0	.86	28.0	.71	28.0	.65	28.0	1.0	28.0	.71	28.0	1.0	27.0	1.0	28.0	1.0	28.0	1.0	28.0	1.0	27.0	.65
25	Iil B6	µA	-100.0	100.0	28.0	.77	28.0	.69	28.0	.78	28.0	.94	28.0	.77	28.0	1.0	27.0	1.0	28.0	1.0	28.0	1.0	28.0	1.0	27.0	.46
26	Iil B7	µA	-100.0	100.0	29.0	.55	28.0	.86	28.0	.55	28.0	.91	28.0	.95	28.0	1.0	27.0	.86	28.0	1.0	28.0	1.0	28.0	1.0	27.0	.45
27	Iil B8	µA	-100.0	100.0	28.0	.80	27.0	.85	28.0	.71	28.0	1.0	28.0	.94	28.0	1.0	27.0	.96	28.0	1.0	28.0	1.0	28.0	1.0	27.0	.96
28	Iil B9	µA	-100.0	100.0	28.0	1.0	28.0	.83	27.0	.66	28.0	1.0	28.0	.97	28.0	1.0	27.0	.96	28.0	1.0	28.0	2.0	27.0	1.0	27.0	1.0
29	Iil B10	µA	-100.0	100.0	28.0	.84	27.0	.73	27.0	.58	28.0	.94	27.0	.57	28.0	.98	27.0	1.0	28.0	1.0	28.0	1.0	27.0	1.0	27.0	.44
30	Iil B11	µA	-100.0	100.0	28.0	.79	27.0	.66	27.0	1.0	28.0	.99	27.0	.96	28.0	1.0	27.0	1.0	28.0	1.0	28.0	2.0	27.0	1.0	27.0	.77
31	Iil B12	µA	-100.0	100.0	28.0	.75	27.0	.72	27.0	.68	28.0	1.0	28.0	.79	28.0	1.0	27.0	.96	28.0	1.0	28.0	2.0	27.0	1.0	27.0	.93
32	LE	Isb	-0.50	0.50	0.24	.11	0.23	.12	0.29	.19	0.29	.37	0.33	.28	0.45	.45	0.52	.32	0.89	.71	0.66	.28	0.42	.18	0.28	.13
33	MCE	Isb	-1.00	1.00	0.50	0	0.50	0	0.50	0	0.50	0	0.50	0	0.50	0	0.50	0	0.50	0	0.50	0	0.50	0	0.50	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 non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

Radiation-sensitive parameter: LE.

Figure 1. Radiation Bias Circuit for AD565



$V_{CC} = +15\text{ V} \pm 0.5\text{ V}$

$V_{EE} = -15\text{ V} \pm 0.5\text{ V}$

$R_L = 10\text{ k}\Omega + 10\%, \frac{1}{4}\text{W}$

$T_A = 25^\circ\text{C}$