

**UNISYS**

DATE: December 7, 1994 PPM-95-107

TO: J. Lohr/311.1

FROM: K. Sahu/300.1 *KS*

SUBJECT: Radiation Report on CASSINI/CIRS  
Part No. RP7820  
Control No. 11424

cc: A. Sharma/311  
Library/300.1

A radiation evaluation was performed on RP7820 (8-bit Flash A/D 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  $^{60}\text{Co}$  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 2.5, 5, 10, 15, 20, 30 and 50 krad\*. The dose rate was between 0.06 and 1.18 krad/hour, depending on the total dose level (see Table II for radiation schedule). After the 50 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.

All parts passed initial electrical measurements. All irradiated parts passed all electrical and functional tests up to and including the 10 krad irradiation level.

At the 15 krad level, S/N 73, 77 and 79 exceeded the maximum specification limit of  $\pm 3.00 \mu\text{A}$  for at least one of eight ioh tests (DB0-DB7), with readings ranging from 3.21 to 5.13  $\mu\text{A}$  and S/N 76 marginally exceeded the maximum specification limit of  $\pm 0.25 \text{ lsb}$  for PS sens, with a reading of 0.27 lsb. All other parts passed all other electrical tests.

At the 20 krad level, S/N 73, 74, 76, 77, 78 and 79 exceeded the maximum specification limit for various ioh tests, with readings ranging from 3.02 to 5.13  $\mu\text{A}$ . In addition, S/N 79 exceeded the maximum specification limit of 0.40 V for INT, with a reading of 1.02 V.

At the 30 krad level, all irradiated parts except S/N 75 exceeded the maximum specification limit for at least one ioh test and three parts (S/N 73, 77 and 79) exceeded the maximum specification limit for all eight, with readings ranging from 3.13 to 5.13  $\mu\text{A}$ . In addition, S/N 72 exceeded the maximum specification limit of 0.40 V for INT, with a reading of 1.02 V.

At the 50 krad level, all irradiated parts failed at least one ioh test and five parts (S/N 73, 76, 77, 78 and 79) failed all eight, with readings ranging from 3.22 to 5.13  $\mu\text{A}$ .

\*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.

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.

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TABLE I. Part Information

Generic Part Number:	RP7820
CASSINI/CIRS Part Number:	RP7820
CASSINI/CIRS Control Number:	11424
Charge Number:	EE44542
Manufacturer:	Space Electronics, Inc.
Lot Date Code:	9234
Quantity Tested:	10
Serial Number of Control Samples:	70, 71
Serial Numbers of Radiation Samples:	72, 73, 74, 75, 76, 77, 78, 79
Part Function:	8-bit Flash A/D Converter
Part Technology:	High-Speed CMOS
Package Style:	20-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 RP7820

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	10/03/94
2) 2.5 KRAD IRRADIATION (0.15 KRADS/HOUR) POST-2.5 KRAD ELECTRICAL MEASUREMENT	10/05/94 10/06/94
3) 5 KRAD IRRADIATION (0.15 KRADS/HOUR) POST-5 KRAD ELECTRICAL MEASUREMENT	10/06/94 10/07/94
4) 10 KRAD IRRADIATION (0.06 KRADS/HOUR) POST-10 KRAD ELECTRICAL MEASUREMENT	10/07/94 10/11/94
5) 15 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-15 KRAD ELECTRICAL MEASUREMENT	10/11/94 10/12/94
6) 20 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-20 KRAD ELECTRICAL MEASUREMENT	10/12/94 10/13/94
7) 30 KRAD IRRADIATION (0.15 KRADS/HOUR) POST-30 KRAD ELECTRICAL MEASUREMENT	10/14/94 10/17/94
8) 50 KRAD IRRADIATION (1.18 KRADS/HOUR) POST-50 KRAD ELECTRICAL MEASUREMENT	10/17/94 10/18/94
9) 168-HOUR ANNEALING @25°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/18/94 10/25/94
10) 168-HOUR ANNEALING @100°C** POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/25/94 11/01/94

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 RP7820

Test temperature : 25°C

Test	Test name	Min	Max	Condition
1	ICC	0.00 ma	16.00 ma	CS = RD = 0v
2	DB7 voh	2.40 v		iout = -0.36ma
3	DB6 voh	2.40 v		"
4	DB5 voh	2.40 v		"
5	DB4 voh	2.40 v		"
6	DB3 voh	2.40 v		"
7	DB2 voh	2.40 v		"
8	DB1 voh	2.40 v		"
9	DB0 voh	2.40 v		"
10	INP voh	2.40 v		"
11	OFL voh	2.40 v		"
12	DB7 vol		0.40 v	iout = 1.6ma
13	DB6 vol		0.40 v	"
14	DB5 vol		0.40 v	"
15	DB4 vol		0.40 v	"
16	DB3 vol		0.40 v	"
17	DB2 vol		0.40 v	"
18	DB1 vol		0.40 v	"
19	DB0 vol		0.40 v	"
20	INP vol		0.40 v	"
21	OFL vol		0.40 v	"
22	PS sens	-0.25 ls	0.25 lsb(+)	
23	CS_iih	-0.00 ua	1.00 ua	vil=0.6v vih=2.4v
24	WR_iih	-0.00 ua	3.00 ua	"
25	RD_iih	-0.0 0ua	1.00 ua	"
26	CS_iil	-1.0 ua	0.00 ua	"
27	WR_iil	-1.0 ua	0.00 ua	"
28	RD_iil	1.0 ua	0.00 ua	"
29	MODE_iih	0.0 ua	200.00 ua(+)	vil=1.5v vih=3.5v
30	MODE_iil	-1.0 ua	1.00 ua	"
31	DB7 ioh	-3.00 ua	3.00 ua	vl=0.0v vh=5.0v
32	DB6 ioh	-3.00 ua	3.00 ua	"
33	DB5 ioh	-3.00 ua	3.00 ua	"
34	DB4 ioh	-3.00 ua	3.00 ua	"
35	DB3 ioh	-3.00 ua	3.00 ua	"
36	DB2 ioh	-3.00 ua	3.00 ua	"

Table III (cont'd.), Electrical Characteristics of RP7820

37	DB1 ioh	-3.00 ua	3.00 ua	*
38	DB0 ioh	-3.00 ua	3.00 ua	*
39	DB7 iol	-3.00 ua	3.00 ua	*
40	DB6 iol	-3.00 ua	3.00 ua	*
41	DB5 iol	-3.00 ua	3.00 ua	*
42	DB4 iol	-3.00 ua	3.00 ua	*
43	DB3 iol	-3.00 ua	3.00 ua	*
44	DB2 iol	-3.00 ua	3.00 ua	*
45	DB1 iol	-3.00 ua	3.00 ua	*
46	DB0 iol	-3.00 ua	3.00 ua	*
47	Vin iih	-3.00 ua	3.00 ua	*
48	Vin iil	-3.00 ua	3.00 ua	*
49	Ref. Resist	600.0 ohms	1500.0 ohms	
50	Missing codes		0.000	
51	TUE	-1.000 lsb	1.000 lsb	
52	tc_WR/RD	0.00 us	1.38 us	WR/RD mode
53	t_intl	0.0 ns	100.0 ns	

**TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for RP7820 /1**

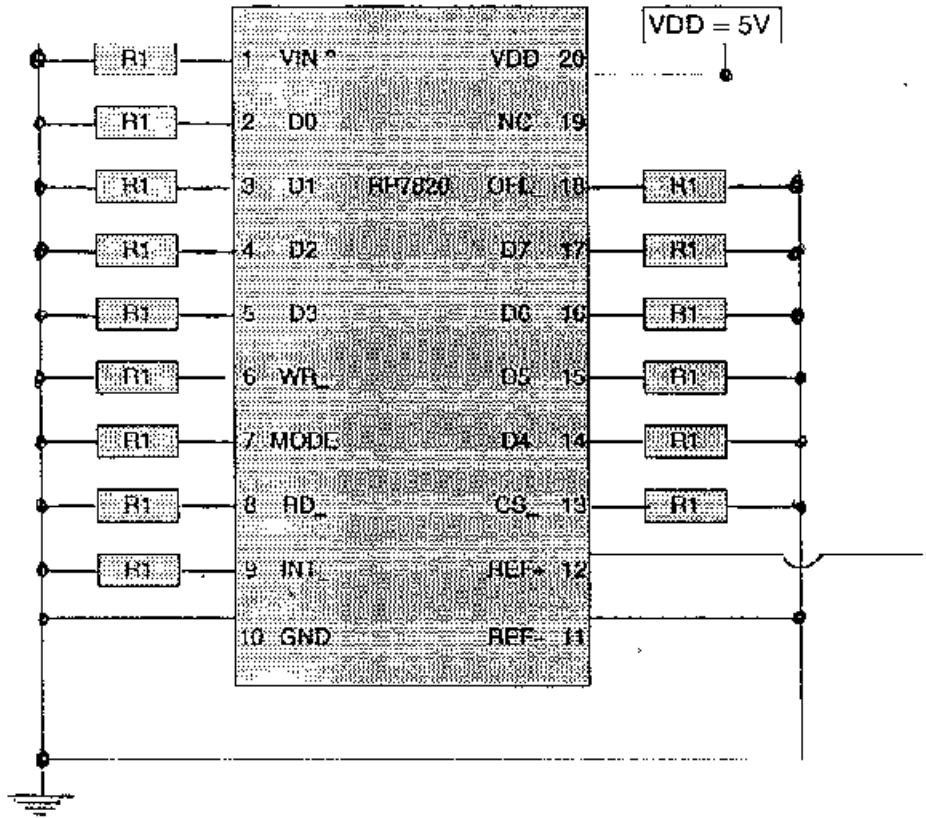
Test #	Parameters	Units	Spec. Lim./Z	Total Dose Exposure (kRad)										168 hrs @25°C		168 hrs @100°C			
				2.5		5		10		15		20		30		50		Annealing	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	ICC	mA	0	1.43	.32	1.43	.31	1.25	.51	1.12	.19	0.89	.35	0.72	.25	2.83	.12		
2	DB7 veh	V	2.40	4.24	.01	4.24	.01	4.24	.01	4.26	.01	4.25	.02	4.20	.03	4.21	.01		
3	DB6 veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
4	DB5 veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
5	DB4 veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
6	DB3 veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
7	DB2 veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
8	DB1 veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
9	DB0 veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
10	INT veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
11	OP1 veh	V	2.40	4.23	.01	4.23	.01	4.24	.01	4.25	.01	4.24	.02	4.21	.03	4.21	.01		
12	DB2 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
13	DB3 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
14	DB4 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
15	DB5 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
16	DB6 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
17	DB7 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
18	DB8 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
19	DB9 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
20	INT vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
21	OP1 vol	V	0.40	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00	0.40	.00		
22	PS sens	inh	0.25	0.25	.00	0.25	.00	0.25	.00	0.25	.00	0.25	.00	0.25	.00	0.25	.00		
23	CS inh	inh	1.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00		
24	WR inh	inh	1.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00		
25	RD inh	inh	1.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00		
26	CS inh	inh	1.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00		
27	WR inh	inh	1.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00		
28	RD inh	inh	1.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00		
29	MODE inh	inh	1.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00		
30	MODE inh	inh	1.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00	1.00	.00		
31	DB7 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
32	DB6 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
33	DB5 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
34	DB4 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
35	DB3 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
36	DB2 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
37	DB1 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
38	DB0 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
39	DB7 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
40	DB6 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
41	DB5 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
42	DB4 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
43	DB3 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
44	DB2 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
45	DB1 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
46	DB0 inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
47	Via inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
48	Via inh	inh	3.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00	3.00	.00		
49	Ref. Resist	Ohm	600	1500	1056	44	1056	44	1056	44	1056	44	1056	44	1056	44	1056		
50	Measuring codes	inh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
51	TUE	inh	-1.000	1.000	0.65	0	0.65	0	0.65	0	0.65	0	0.65	0	0.65	0	0.65		
52	IC WR/RD	inh	1.38	0.38	.01	0.79	.01	0.79	.01	0.79	.01	0.79	.01	0.79	.01	0.79	.01		
53	IC inh	inh	0	1.00	0.62	3.4	0.62	3.4	0.62	3.4	0.62	3.4	0.62	3.4	0.62	3.4	0.62		

Notes:

- 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.
- 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 parameters: iob, PS sens and INT.**

Figure 1. Radiation Bias Circuit for RP7820



R1 2K to 47K, ¼W Min. ±