

**UNISYS**

DATE: July 3, 1995  
 TO: J. Lohr/311  
 FROM: K. Sahu/300.1 *KS*  
 SUBJECT: Radiation Report on: SMP11  
           Project: CASSINI/CIRS  
           Control #: 11825  
           Job #: EE56308  
           Project part #: 5962-8954101CA

PPM-95-163

cc: B. Posey/300.1  
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 OFA Library/300.1

A radiation evaluation was performed on SMP11 (Sample and Hold Amplifier) 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  $\text{Co}^{60}$  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 0.08 and 1.21 krad/hour (see Table II for radiation schedule). After the 100 krad exposure, 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 step, 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 measurements up to and including the 20 krad irradiation.

After the 30 krad irradiation, S/N 52 and 53 fell below the minimum specification limit of 82.0 dB for psrr, with readings of 79.6 dB. All other irradiated parts passed all electrical measurements at this level.

After the 50 krad irradiation, S/N 52 and 53 continued to exceed the specification limit for psrr, with readings of 78.1 and 80.4 dB, respectively. In addition, 52, 53, 54, 55, 56, 58 and 59 exceeded the maximum specification limit of 65.00 nA for +IIB, with readings ranging from 66.19 to 83.30 nA, and S/N 53, 54, 56 and 58 fell below the minimum specification limit of -2.00  $\mu\text{A}$  for ILC, with readings ranging from -3.04 to -2.07. S/N 56 also fell below the minimum specification limit of -15.00  $\mu\text{A}$  for IS/H\_1, with a reading of -16.31  $\mu\text{A}$ .

After annealing for 168 hours at 25°C, S/N 52 and 53 read within specification limits for psrr, but S/N 58 and 59 fell below the minimum specification limit for psrr, with readings of 78.6 and 80.2 dB, respectively. S/N 55 and 58 read within specification limits for +IIB, S/N 53, 54 and 58 read within specification limits for ILC and S/N 56 read within specification limits for IS/H\_1.

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

Table IV provides a summary of the functional test results and the mean and standard deviation values for each parameter after each irradiation exposure and annealing step.

\* 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.

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

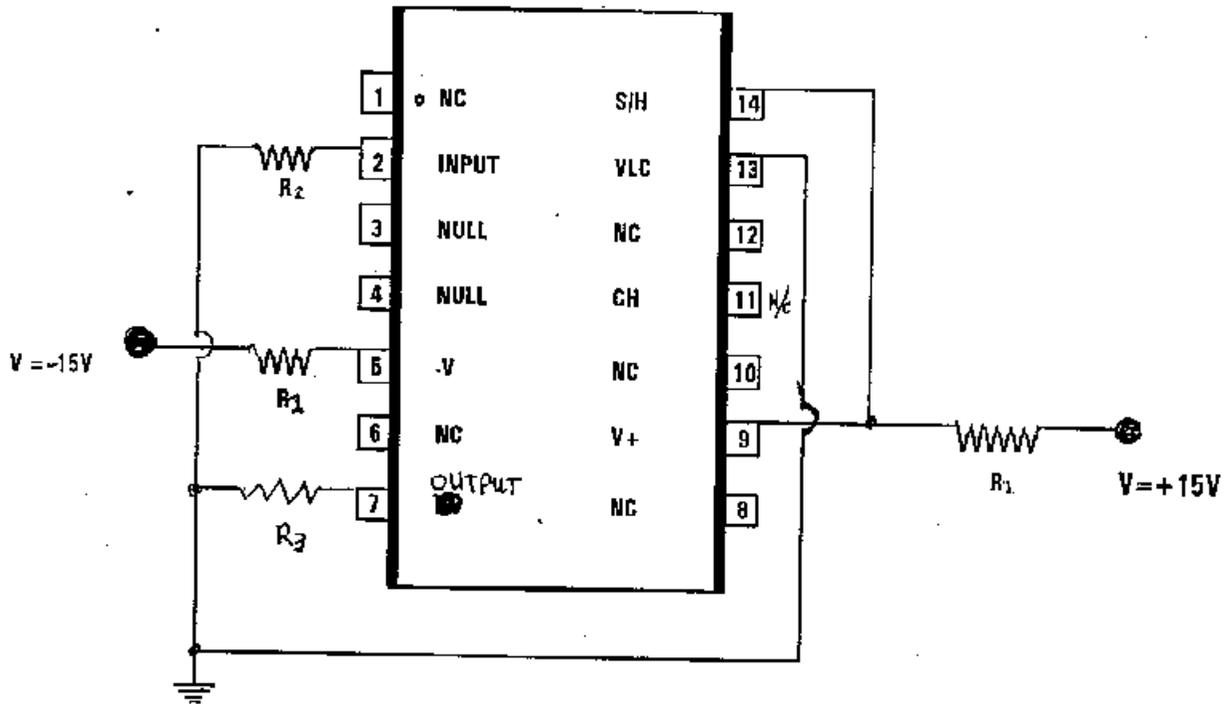
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Figure 1. Radiation Bias Circuit for SMP11



**NOTE:**

- $R_1 = 100\Omega$  10%  $\frac{1}{4}W$
- $R_2$  are  $1Kohms$  10%  $\frac{1}{4}W$
- $R_3 = 10K\Omega$  10%  $\frac{1}{4}W$

TABLE I. Part Information

Generic Part Number:	SMP11*
CASSINI/CIRS Part Number	5962-8954101CA
CASSINI/CIRS Control Number:	11825
Charge Number:	EE56308
Manufacturer:	PMI
Lot Date Code (LDC):	9435
Quantity Tested:	10
Serial Number of Control Samples:	50, 51
Serial Numbers of Radiation Samples:	52, 53, 54, 55, 56, 57, 58, 59
Part Function:	Sample and Hold Amplifier
Part Technology:	Bipolar
Package Style:	14-pin DIP
Test Equipment:	A540
Engineer:	T. Mondy

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

TABLE II. Radiation Schedule for SMP11

EVENT .....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	05/31/95
2) 2.5 KRAD IRRADIATION (0.15 KRADS/HOUR) .....	05/31/95
POST-2.5 KRAD ELECTRICAL MEASUREMENT.....	06/01/95
3) 5 KRAD IRRADIATION (0.15 KRADS/HOUR) .....	06/01/95
POST-5 KRAD ELECTRICAL MEASUREMENT.....	06/02/95
4) 10 KRAD IRRADIATION (0.08 KRADS/HOUR) .....	06/02/95
POST-10 KRAD ELECTRICAL MEASUREMENT.....	06/05/95
5) 15 KRAD IRRADIATION (0.30 KRADS/HOUR) .....	06/05/95
POST-15 KRAD ELECTRICAL MEASUREMENT.....	06/06/95
6) 20 KRAD IRRADIATION (0.30 KRADS/HOUR) .....	06/06/95
POST-20 KRAD ELECTRICAL MEASUREMENT.....	06/07/95
7) 30 KRAD IRRADIATION (0.59 KRADS/HOUR) .....	06/07/95
POST-30 KRAD ELECTRICAL MEASUREMENT.....	06/08/95
8) 50 KRAD IRRADIATION (1.21 KRADS/HOUR) .....	06/08/95
POST-50 KRAD ELECTRICAL MEASUREMENT.....	06/09/95
9) 168-HOUR ANNEALING @ 25°C .....	06/09/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	06/16/95
10) 168-HOUR ANNEALING @ 100°C .....	06/16/95
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	06/23/95

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

Table III. Electrical Characteristics of SMP11

Test #	Test Name	Units	Test Conditions	Spec. Limits	
				Min.	Max.
1	IDD	mA		2	6
2	ISS	mA		-6	-2
3	+IIB	nA	$V_{IN} = 0\text{ V}$	-65	65
4	+VSW	V	$R_L = 2.5\text{ k}\Omega$	11	
5	-VSW	V	$R_L = 2.5\text{ k}\Omega$		
6	VZS	$\mu\text{V}$	$V_{S/H} = 3.5\text{ V}$	0	-11
7	+Av_10v	V/V	$V_{IN} = +10\text{ V}, R_L = 5\text{ k}\Omega$	0.99963	1500
8	-Av_10v	V/V	$V_{IN} = -10\text{ V}, R_L = 5\text{ k}\Omega$	0.99963	
9	+Av_5v	V/V	$V_{IN} = +5\text{ V}, R_L = 2.5\text{ k}\Omega$	0.99963	
10	-Av_5v	V/V	$V_{IN} = -5\text{ V}, R_L = 2.5\text{ k}\Omega$	0.99963	
11	dVCH	$\mu\text{V/ms}$			200
12	psrr	dB	$V^+ = +9\text{ V to } +18\text{ V}, V^- = -9\text{ V to } -18\text{ V}$	82	
13	IS/H_l	$\mu\text{A}$	$V_{S/H} = 0.6\text{ V}$	-15	0
14	IS/H_h	$\mu\text{A}$	$V_{S/H} = 5\text{ V}$	-1	1
15	Vth_h	V		0.8	2
16	Vth_s	V		0.8	2
17	ILC	$\mu\text{A}$	$V_{LC} = 0\text{ V}$	-2	0

**TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for SMP11 /1**

Test #	Parameters	Units	Spec. Lim./2 min max		Total Dose Exposure (krads)																Annealing			
					Initial		2.5		5		10		15		20		30		50		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
1	IDD	mA	2	6	4.65	.04	4.61	.04	4.58	.04	4.51	.04	4.46	.04	4.40	.04	4.31	.06	4.27	.10	4.30	.07	4.36	.05
2	ISS	mA	-6	-2	-4.65	.04	-4.60	.04	-4.57	.04	-4.51	.04	-4.46	.04	-4.40	.04	-4.31	.06	-4.27	.10	-4.30	.07	-4.36	.05
3	+IIB	nA	-65	65	43.9	1.6	44.8	1.7	46.7	1.6	49.5	1.5	53.5	1.5	55.9	1.2	62.0	2.1	70.7	6.4	67.7	5.8	59.7	2.5
4	+VSW	V	11	-	11.8	.01	11.8	.01	11.8	.01	11.8	.01	11.8	.01	11.9	.01	11.8	.01	11.9	.02	11.9	.01	11.9	.01
5	-VSW	V	-	-11	-12.0	0	-12.0	0	-12.0	0	-12.0	0	-12.0	0	-12.0	0	-12.0	0	-12.0	0	-12.0	0	-12.0	0
6	VZS	µV	0	1500	157	158	69.0	88	201	135	78.0	129	73.0	53	132	94	137	175	49.0	62	78.0	78	34.0	53
7	+Av_10v	V/V	0.99963	-	1.00024	0	1.00024	0	1.00024	0	1.00028	0	1.00007	0	0.99996	0	0.99985	0	0.99984	0	1.00003	0	1.00024	0
8	-Av_10v	V/V	0.99963	-	1.00074	0	1.00076	0	1.00083	0	1.00074	0	1.00077	0	1.00070	0	1.00067	0	1.00059	0	1.00073	0	1.00091	0
9	+Av_5v	V/V	0.99963	-	1.00088	0	1.00077	0	1.00093	0	1.00087	0	1.00055	0	1.00042	0	1.00022	0	1.00017	0	1.00055	0	1.00091	0
10	-Av_5v	V/V	0.99963	-	1.00123	0	1.00127	0	1.00150	0	1.00138	0	1.00128	0	1.00110	0	1.00100	0	1.00094	0	1.00120	0	1.00152	0
11	dVCH	µV/ms	-	200	5.00	5.0	5.00	5.0	2.00	4.0	6.00	6.00	6.00	7.0	2.00	3.0	8.00	11	6.00	2.0	5.00	5.0	7.00	6.0
12	psrr	dB	82	-	102	7.8	101	11	107	9.0	99.3	12	90.0	7.4	98.1	11	93.6	13	85.8	6.4	89.8	12	95.1	11
13	IS/H_l	µA	-15	0	-3.00	.09	-4.00	.08	-4.00	.09	-5.00	.21	-6.00	.47	-8.00	.79	-9.00	2.0	-9.00	0	-9.00	2.0	-6.00	.99
14	IS/H_h	µA	-1	1	-0.15	.02	-0.10	.02	-0.10	.02	-0.10	.02	-0.10	.01	-0.10	.02	-0.10	.02	-0.14	.01	-0.20	.02	-0.20	.02
15	Vth_h	V	0.8	2	1.09	.02	1.00	.16	1.06	.03	1.09	.02	1.30	0	1.30	0	1.30	0	1.30	0	1.30	0	1.30	0
16	Vth_s	V	0.8	2	1.25	0	1.25	0	1.25	0	1.22	.03	1.43	.03	1.52	.03	1.59	.04	1.78	.10	1.76	.12	1.51	.07
17	ILC	µA	-2	0	-0.33	.01	-0.40	.02	-0.50	.04	-0.80	.08	-1.00	.12	-2.00	.17	-1.00	.11	-2.00	.56	-2.00	.33	-1.00	.08

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 these tests were performed.

**Radiation-sensitive parameters: psrr, +IIB, ILC and IS/H\_l.**