

UNISYS

DATE: March 20, 1995

PPM-95-136

TO: A. Sharma/311.0

FROM: K. Sahu/300.1 KS

SUBJECT: Radiation Report on: SSP21110-25

Project: FUSE

Control #: 11500

Job #: ER52804

Project part #: SSP21110-25

cc: A. Mecum/311.0

G. Kramer/311

OFA Library/300.1

A radiation evaluation was performed on SSP21110-25 (Solid State Power 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 ⁶⁰Co gamma ray source. During the radiation testing, six 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, 7.5, 10, 15, 20, 30, 50, 75 and 100 krad*. The dose rate was between 0.13 and 1.47 krad/hour, depending on the total dose level (see Table II for radiation schedule). After the 100 krad irradiation, the 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 tests up to and including the 30-krad irradiation level. At the 50-krad level, S/N 13 exceeded the maximum specification limit of 0.40 V for Status1_vol, with a reading of >1.02 V, which was the maximum measurement capability of the test setup.

At the 75-krad level, S/N 11, 12 and 13 read >1.02 V for Status1_vol and S/N 12 read <10 μs, which is the minimum measurement capability of the test setup.

At the 100-krad level, S/N 11, 12, 13, 14 and 16 read >1.02 V for Status1_vol. In addition, S/N 14 exceeded the maximum specification limit of 20.0 ns for S1_risetime and S2_risetime, with readings of 93.8 and 89.9 ns, respectively. S/N 14 exceeded the maximum specification limit of 20.0 ns for S2_falltime, with a reading of 78.5 ns, and S/N 16 exceeded the maximum specification limit of 20.0 ns for S1_risetime, S2_risetime, S1_falltime and S2_falltime, with readings of 175.7, 334.8, 86.5 and 168.5 ns, respectively. S/N 12, 13 and 16 read <10 μs for S1_toff.

After annealing for 168 hours at 25°C, S/N 14 and 16 recovered to within specification limits for Status1_vol and all irradiated parts recovered to within specification limits for S1_toff, except for S/N 16, which continued to read <10 μs.

After annealing for 168 hours at 100°C, no rebound effects were observed. All irradiated parts passed all other electrical tests throughout all irradiation and annealing steps.

*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 different irradiation exposures 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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TABLE I. Part Information

Generic Part Number:	SSP21110-25*
FUSE Part Number:	SSP21110-25
FUSE Control Number:	11500
Charge Number:	ER52804
Manufacturer:	ILC
Lot Date Code:	unknown
Quantity Tested:	8
Serial Number of Control Samples:	17, 18
Serial Numbers of Radiation Samples:	11, 12, 13, 14, 15, 16
Part Function:	Solid State Power Converter
Part Technology:	Hybrid (using power MOSFET switches)
Package Style:	10-pin DIP
Test Equipment:	A540
Test Engineer:	Cu Nguyen

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

TABLE II. Radiation Schedule for SSP21110-25

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	01/11/95
2) 2.5 KRAD IRRADIATION (0.15 KRADS/HOUR) POST-2.5 KRAD ELECTRICAL MEASUREMENT	01/24/95 01/25/95
3) 5 KRAD IRRADIATION (0.15 KRADS/HOUR) POST-5 KRAD ELECTRICAL MEASUREMENT	01/25/95 01/26/95
4) 7.5 KRAD IRRADIATION (0.15 KRADS/HOUR) POST-7.5 KRAD ELECTRICAL MEASUREMENT	01/26/95 01/27/95
5) 10 KRAD IRRADIATION (0.39 KRADS/HOUR) POST-10 KRAD ELECTRICAL MEASUREMENT	01/27/95 01/30/95
6) 15 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-15 KRAD ELECTRICAL MEASUREMENT	01/30/95 01/31/95
7) 20 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-20 KRAD ELECTRICAL MEASUREMENT	01/31/95 02/01/95
8) 30 KRAD IRRADIATION (0.59 KRADS/HOUR) POST-30-KRAD ELECTRICAL MEASUREMENT	02/01/95 02/02/95
9) 50 KRAD IRRADIATION (1.18 KRADS/HOUR) POST-50-KRAD ELECTRICAL MEASUREMENT	02/02/95 02/03/95
10) 75 KRAD IRRADIATION (1.47 KRADS/HOUR) POST-75-KRAD ELECTRICAL MEASUREMENT	02/06/95 02/07/95
11) 100 KRAD IRRADIATION (1.47 KRADS/HOUR) POST-100-KRAD ELECTRICAL MEASUREMENT	02/07/95 02/08/95
12) 168-HOUR ANNEALING @25°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	02/08/95 02/15/95
13) 168-HOUR ANNEALING @100°C* POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	02/15/95 02/22/95

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 SSP21110-25

Test #	Parameter	Units	Conditions	Lower Limit	Upper Limit
1	ICC 4.5V	mA	Vcc = 4.5 V	0	50.00
2	ICC 5.5V	mA	Vcc = 5.5 V	0	50.00
3	Control iih1	μ A	control voltage = 5.0 V	-1.00	50.00
4	Control iih2	μ A	control voltage = 2.4 V	-1.00	50.00
5	Control iil	μ A	control voltage = 0.8 V	-50.00	1.00
6	Status1 voh	V	Vcc = 4.5 V, Ioh = -1.0 mA	2.40	
7	Status2 voh	V	Vcc = 4.5 V, Ioh = -1.0 mA	2.40	
8	Status1 vol	V	Vcc = 4.5 V, Iol = 2.5 mA		0.400
9	Status2 vol	V	Vcc = 4.5 V, Iol = 2.5 mA		0.400
10	S1 risetime	ns			20.0
11	S2 risetime	ns			20.0
12	S1 falltime	ns			20.0
13	S2 falltime	ns			20.0
14	S1 ton	ms			7.50
15	S2 ton	ms			7.50
16	S1 toff	ms			5.00
17	S2 toff	ms			5.00

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for SSP21110-25 /1

Test #	Parameters	Units	Spec. Lim./2 min	max	Total Dose Exposure (krads)																				Annealing					
					Initial		2.5		5		7.5		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	mean	sd	mean	sd
1	ICC_4.5V	mA	0	50.00	28.2	.11	27.9	.77	27.7	.78	27.4	.69	27.3	.72	26.9	.65	26.7	.55	26.1	.55	25.4	.59	24.8	.69	24.4	.66	24.5	.61	24.5	.78
2	ICC_5.5V	mA	0	50.00	28.9	2.1	28.6	2.5	28.2	2.6	27.9	2.5	27.8	2.4	27.4	2.2	27.1	2.1	26.4	1.9	25.5	1.6	24.8	1.4	24.3	1.3	24.4	1.4	24.5	1.5
3	Control_ah1	µA	-1.00	50.00	0.04	.10	0.04	.01	0.05	.01	0.04	.01	0.05	.01	0.05	.01	0.04	.01	0.05	.01	0.04	.01	0.04	.01	0.05	.01	0.05	.01	0.04	.01
4	Control_ah2	µA	-1.00	50.00	0.05	.01	0.05	.01	0.05	.01	0.05	.01	0.05	.01	0.05	.01	0.06	0	0.06	.01	0.05	0	0.06	.01	0.05	.01	0.05	.01	0.06	.01
5	Control_ah	µA	-50.00	1.00	0.04	.01	0.04	.01	0.04	.01	0.04	.01	0.04	.01	0.04	.01	0.04	.02	0.04	.01	0.03	.01	0.03	.01	0.02	.01	0.03	.02	0.04	.01
6	Status1_voh	V	2.40	-	4.14	0	4.13	0	4.14	0	4.14	0	4.14	0	4.13	0	4.13	0	4.13	0	4.14	0	4.14	0	4.14	0	4.13	.01	4.12	.01
7	Status2_voh	V	2.40	-	4.10	.01	4.12	.03	4.10	.01	4.10	.01	4.13	.03	4.13	.01	4.11	0	4.13	.02	4.13	.09	4.11	.12	4.29	.09	4.23	.11	4.09	0
8	Status1_vol/3	V	-	0.400	0.13	.05	0.10	0	0.10	0	0.10	0	0.10	0	0.10	0	0.10	0	0.10	0	SP1F		3P3F		1P5F		3P3F		0.17	.08
9	Status2_vol	V	-	0.400	0.14	.05	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0	0.11	0
10	S1_risetime	ns	-	20.0	2.45	.31	2.39	.67	1.70	.03	1.21	.11	1.12	.02	1.17	.03	1.17	.06	1.14	.06	1.17	.04	1.12	.04	45.7	74	1.15	.04	1.16	.05
11	S2_risetime	ns	-	20.0	2.72	.30	2.51	.69	1.31	.08	1.22	.08	1.16	.03	1.17	.05	1.18	.02	1.22	.06	1.21	.06	1.10	.05	574	1000	1.26	.06	1.24	.01
12	S1_falltime	ns	-	20.0	2.78	.17	2.39	.80	1.18	.07	1.20	.09	1.28	.06	1.26	.09	1.30	.10	1.21	.07	1.26	.08	1.10	.07	15.4	35	1.26	.07	1.24	.05
13	S2_falltime	ns	-	20.0	2.60	.35	2.35	.91	1.22	.06	1.25	.06	1.17	.06	1.24	.05	1.23	.06	1.25	.08	1.25	.09	1.20	.06	1.068	2.528	1.26	.07	1.25	.06
14	S1_ton	ms	-	7.50	1.95	.34	1.19	.10	1.08	.39	0.92	.37	1.20	0	1.06	.20	1.17	.08	1.17	.08	0.79	.61	0.57	.63	0.36	0	0.36	.56	1.22	.13
15	S2_ton	ms	-	7.50	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0	0.02	0
16	S1_toff/4	ms	-	5.00	0.23	.43	1.00	.95	1.30	.87	1.14	.87	1.27	.96	0.84	.91	0.69	.96	0.68	.93	0.36	.78	SP1F		3P3F		SP1F		1.13	.89
17	S2_toff	ms	-	5.00	0.04	0	0.04	0	0.04	0	0.04	0	0.04	0	0.04	0	0	0	0.04	0	0.04	0	0.04	0	0.04	0	0.04	0	0.04	0

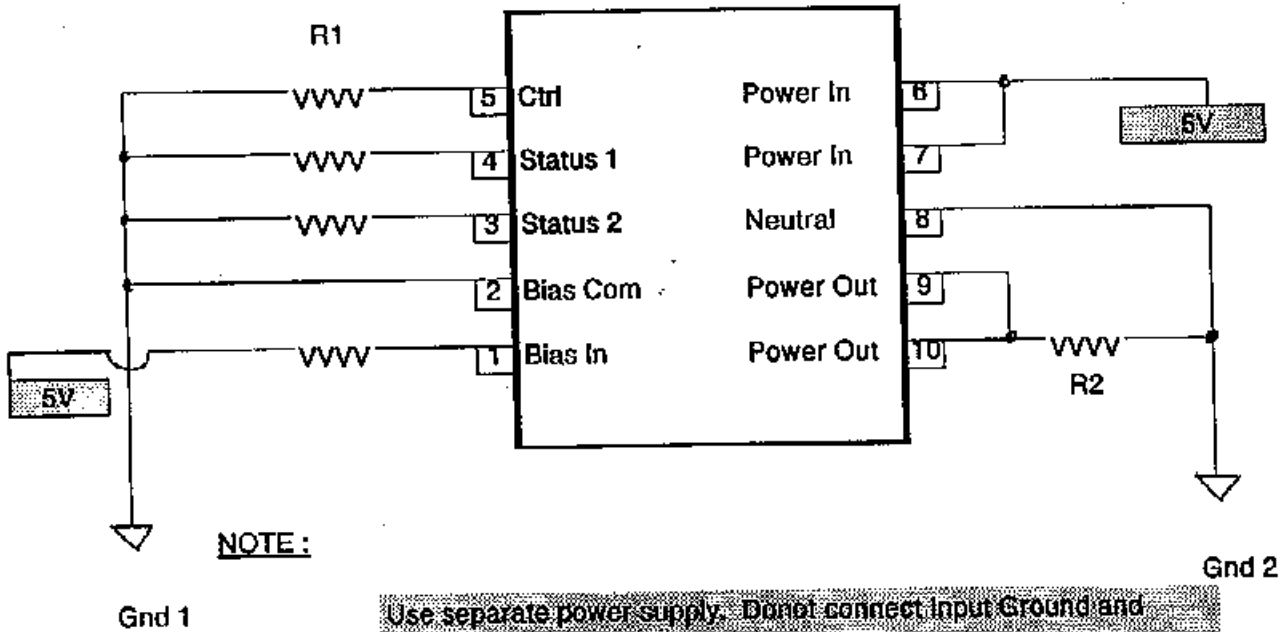
Notes:

- 1/ The mean and standard deviation values were calculated over the six 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/ The maximum measurement capability of the test setup for Status1_vol was 1.02V, therefore, when the reading for any part exceeded 1.02V, the results are given as "nPmF", where n parts passed the test and m parts failed the test at this level.
- 4/ The minimum measurement capability of the test setup for S1_toff was 10.0µs, therefore, when the reading for any part fell below 10.0µs, the results are given as "nPmF", where n parts passed the test and m parts failed the test at this level.

Radiation-sensitive parameter: Status1_vol, S1_risetime, S2_risetime, S1_falltime, S2_falltime, S1_toff.

Figure 1. Radiation Bias Circuit for SSP21110-25

Bottom View



R1 = 1 Kohms ; +/- 10% ; 1/4w

R2 = 100 ohms ; +/- 10% ; 1/2 w