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Memorandum

PPM-93-045

DATE: Mar. 23, 1993
TO: J. Lohr/311.1
FROM: K. Sahu/300.1 *KS*
SUBJECT: Radiation Report on ISTEP/WAVES
Part No. M38510/11608BCA (DG307A)
Control No. 2105A

cc: A. Sharma/311
Library/300.1 ✓

A radiation evaluation was performed on DG307A (Dual SPDT Switch) 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 Cobalt-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 steps were 2.5, 5, 10, 15, 20 and 30 krads*. After the 20-krad irradiation, the parts were annealed at 25°C for 168 hours and then irradiated to 30 krads (cumulative). The dose rate was between 0.04 and 0.29 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested at 25°C according to the test conditions and the specification limits** listed in Table III. These tests included one functional test at 10 kHz.

All ten parts passed initial (pre-rad) electrical tests. All eight irradiated parts passed all electrical test up to and including the 5-krad irradiation level. At the 10-krad level, one part (S/N 54) exceeded the specification limits for Idoff1 of ± 10.0 nA, with readings of -72.8 and 66.6 nA, and one part (S/N 59) marginally exceeded the maximum specification limit of 70 ohms for Ron3, with a reading of 70.7 ohms. After the 15-krad irradiation, five parts (S/N 53, 55, 57, 58 and 59) exceeded the maximum specification limits of 50.0 ohms for Ron1

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

**These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

and 70.0 ohms for Ron3, with readings ranging from 50.6 to 57.6 ohms for Ron1 and 72.2 to 98.4 ohms for Ron3. S/N 54 continued to exceed the maximum specification limit of ± 10.0 nA for Idoff1, with a reading of 247.5 nA and also exceeded the maximum specification limit of ± 10 nA for Isoff1, with a reading of 117.5 nA. At the 20-krad level, five parts (S/N 53, 55, 57, 58 and 59) exceeded the maximum specification limits for Ron1 and Ron3 with readings ranging from 54.4 to 66.3 ohms for Ron1 and 85.5 to 140.0 ohms for Ron3. In addition, two parts (S/N 52 and 54) exceeded the specification limits for Idoff1, with readings of -11.5 and -677 nA, respectively, and one part (S/N 54) exceeded the specification limits for Isoff1, with a reading of 140 nA.

After the 20-krad irradiation, the parts were annealed for 168 hours at 25°C. After annealing, seven parts (S/N 52, 53, 55, 56, 57, 58 and 59) exceeded the maximum specification limits for Ron1 and Ron3, with readings ranging from 51.3 to 69.9 ohms for Ron1 and 72.0 to 203 ohms for Ron3. One part (S/N 56) recovered to within specification limits for Ron1.

At the 30-krad level, seven parts (S/N 52, 53, 55, 56, 57, 58 and 59) exceeded the maximum specification limits for Ron1 and Ron3, with readings ranging from 51.6 to 72.8 ohms for Ron1 and 75.7 to 324 ohms for Ron3. In addition, one part (S/N 54) exceeded the specification limits for Idoff1, with a reading of -12.5 nA.

After the 30-krad irradiation, the parts were annealed at 100°C for 168 hours to observe rebound effects. Four parts (S/N 53, 55, 57 and 59) showed some rebound effect for Ron3, with readings of 1.78 Kohms and one part (S/N 53) exceeded the maximum specification limit of 70 ohms for Ron4, with a reading of 1.9 Kohms.

All Parts passed the functional test throughout all irradiation and annealing steps. No significant changes were observed in any other parameters throughout all irradiation and annealing steps.

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:	DG307A
Part Number:	M38510/11608BCA*
ISTP/WAVES Control Number:	2105A
Charge Number:	C33260
Manufacturer:	Siliconix
Lot Date Code:	9224A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	52, 53, 54, 55, 56, 57, 58, 59
Serial Numbers of Control Samples:	50, 51
Part Function:	Dual SPDT Switch
Part Technology:	CMOS
Package Style:	14-lead DIP package
Test Equipment:	3260
Test Engineer:	T. Mondy

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

TABLE II. Radiation Schedule for DG307A

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	02/17/93
2) 2.5 KRAD IRRADIATION (0.14 KRADS/HOUR) POST-2.5 KRAD ELECTRICAL MEASUREMENT	02/18/93 02/19/93
3) 5 KRAD IRRADIATION (0.04 KRADS/HOUR) POST-5 KRAD ANNEAL ELECTRICAL MEASUREMENTS	02/19/93 02/22/93
4) 10 KRAD IRRADIATION (0.25 KRADS/HOUR) POST-10 KRAD ELECTRICAL MEASUREMENTS	02/22/93 02/23/93
5) 15 KRAD IRRADIATION (0.26 KRADS/HOUR) POST-15 KRAD ANNEAL ELECTRICAL MEASUREMENTS	02/28/93 02/25/93
6) 20 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-20 KRAD ELECTRICAL MEASUREMENTS	02/25/93 02/26/93
7) 168 HOUR ANNEALING @25°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENTS	02/26/93 03/05/93
8) 30 KRAD IRRADIATION (0.15 KRADS/HOUR) POST-30 KRAD ELECTRICAL MEASUREMENTS	03/05/93 03/09/93
9) 168 HOUR ANNEALING @100°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENTS	03/08/93 03/16/93

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT 25°C.

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

Table III. Electrical Characteristics of DG307A

Test	Units	Specification Limits		Conditions
		Min	Max	
FUNC1	P/F			Vd = 15, 0 V, f = 10 kHz
Ron1	ohms	0	50	Vd = -10 V, Is = -10 mA
Ron2	ohms	0	50	Vd = 10 V, Is = -10 mA
Ron3	ohms	0	70	$\pm V = \pm 10V$, Vd = -7.5V, Is = +10mA
Ron4	ohms	0	70	$\pm V = \pm 10V$, Vd = +7.5V, Is = -10mA
Idon1	nA	-10*	10*	Vd = + 14 V, Vs = + 14 V
Idoff1	nA	-10*	10*	Vd = + 14 V, Vs = - 14 V
Isoff1	nA	-10*	10*	" "
IIL	uA	-1.0	0	Vin = 0 V
IIH	uA	0	1.0	Vin = 15 V
ICCP1	uA	0	10.0	$\pm V = \pm 15 V$, Logic = 0 V
ICCN1	uA	-10	0	" "

*Specified at ± 1 nA and ± 2 nA, but due to ATE limitation, these limits can only be checked at ± 10 nA. Currents less than ± 3 nA are forced to zero.

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for DG307A 1/

Parameters	10KHz	Spec. Lim./2 min max	Total Dose Exposure (krads)										Anneal 168 hrs @25°C		TDE 30 krad		Anneal 168 hrs @100°C			
			0 Pre-Rad		2.5		5		10		15		20		mean sd		mean sd		mean sd	
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	PASS		PASS		PASS	
FUNC	10KHz	PASS/FAIL	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
Ron1	ohms	0 50	29.0	1.1	31.0	.80	34.3	2.2	39.4	5.2	43.7	8.2	46.5	11	48.0	13	50.4	14	49.3	16
Ron2	ohms	0 50	26.7	.49	28.3	1.2	31.4	3.1	34.9	4.3	37.5	4.3	39.6	4.2	39.3	4.0	41.6	3.9	35.3	5.4
Ron3	ohms	0 70	39.2	1.1	41.4	1.5	46.0	4.9	52.6	10	59.5	19	72.2	32	84.4	51	102	80	456	713
Ron4	ohms	0 70	38.5	.78	41.9	2.6	46.4	4.1	51.6	3.7	56.8	3.2	61.9	3.8	69.1	2.8	65.5	3.6	396	733
Idon1	nA	-10 10	0	0	0	0	0	1.2	17	14	50	47	111	121	116	1.2	58	3.9	0	0
Idoff1/3	nA	-10 10	0	0	0	0	0	1.2	0.01	0.1	20.2	95	34.6	187	0.51	1.5	1.74	4.4	0	0
Isoff1/3	nA	-10 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL	uA	-1 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIH	uA	0 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCP1	uA	0 10	0	0	0	0	0.01	0	0.08	.29	0.13	.51	0.23	.85	0.01	0	0.01	.02	0	.95
ICCN1	uA	-10 0	0	0	0	0	0.01	0	.09	.32	.15	.57	.24	.90	.01	.01	.02	.02	0	.32

Notes:

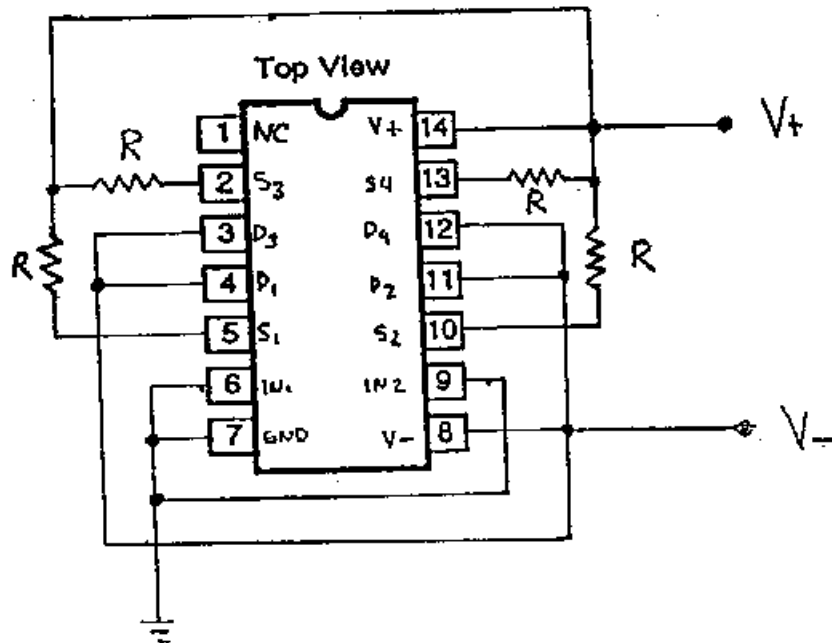
1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

3/ After the 10-krad irradiation, values of Idoff1 and Isoff1 ranged from -677 nA to 248 nA. The mean values are not calculated from absolute values of the data, therefore, the mean does not reflect the actual range of values. The standard deviation, however, indicates the range of readings.

Radiation sensitive parameters were Ron1, Iccn1, Idoff1 and Isoff1.

Figure 1. Radiation Bias Circuit for DG307A



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

$V_+ = 15.0 \text{ VDC} \pm 0.5 \text{ VDC}$

$V_- = -15.0 \text{ VDC} \pm 0.5 \text{ VDC}$

$R = 3.3 \text{ Kohms}$