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Memorandum

PARAMAX
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PPM-93-046

DATE: Mar. 23, 1993
TO: J. Lohr/311.1
FROM: K. Sahu/300.1 KS
SUBJECT: Radiation Report on ISTP/WAVES
Part No. M38510/12302BEA (HI-201)
Control No. 2106A

cc: A. Sharma/311
Library/300.1 ✓

A radiation evaluation was performed on HI-201 (Quad SPST 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, after which the parts were irradiated to 30 krads (cumulative). The dose rate was between 0.13 and 0.50 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.

After the 2.5-krad irradiation, two parts (S/N 62 and 63) failed catastrophically, drawing currents of absolute values between 17 uA and 99 mA for Isoff1, Idoff1, and Idon1, whose specification limits are ± 10 nA, and S/N 63 also drew currents ranging in absolute value from 31 to 34 mA for IIL, IIH1 and IIH2, whose specification limits are 500 nA. In addition, both parts also drew currents ranging in absolute value from 7.0 to 44.5 mA for ICCP1 and ICCN1, whose specification limits are ± 1.5 mA.

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*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.

Both parts also failed the functional test after the 2.5-krad irradiation.

After annealing at room temperature for 72 hours, these parts showed no recovery and were removed from further testing and from inclusion in the statistics. The values of mean and standard deviation in Table IV, therefore, are for six samples.

All other irradiated parts passed all electrical tests up to and including the 15-krad irradiation level.

At the 20-krad level, one part (S/N 64) exceeded the maximum specification limit of 200 ohms for Ron2, with a reading of 304 ohms. All other parts passed all electrical tests. The parts were then annealed for 168 hours at 25°C. After this anneal, S/N 64 continued to fail Ron2, with a reading of 336 ohms, and S/N 67 exceeded the maximum specification limit of 1.5 mA for ICCP1, with a reading of 2.64 mA. S/N 67 also failed the functional test.

The parts were then irradiated to 30 krads (cumulative). At this point, S/N 64 continued to fail Ron2, with a reading of 726 ohms, and ICCP1, with a reading of 1.66 mA. It also continued to fail the functional test. At this level, S/N 69 exceeded the specification limits of $\pm$ 10 nA for Isoff1 and Idoff1, with readings of 8.2 mA and -9.6 mA, respectively. S/N 67 read within specification limits for all parameters.

After the 30-krad irradiation, the parts were annealed at 100°C for 168 hours to observe rebound effects. The following rebound effects were observed: S/N 64 had a reading of 19.2 Kohms for Ron2 and 6.48 mA for ICCP1, representing an increase over the readings before annealing and S/N 67 and 69 read 7.00 mA and 6.16 mA, respectively, for ICCP1, although they both read within specification limits before annealing.

No significant changes were observed in any other parameters throughout all irradiation and annealing steps. One part (S/N 68) passed all electrical tests 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:	HI-201
Part Number:	M38510/12302BEA*
ISTP/WAVES Control Number:	2106A
Charge Number:	C33261
Manufacturer:	Harris
Lot Date Code:	9137B
Quantity Tested:	10
Serial Numbers of Radiation Samples:	62, 63, 64, 65, 66, 67, 68, 69
Serial Numbers of Control Samples:	60, 61
Part Function:	Quad SPST Switch
Part Technology:	CMOS
Package Style:	16-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 HI-201

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	02/17/93
2) 2.5 KRAD IRRADIATION (0.14 KRADS/HOUR)	02/18/93
POST-2.5 KRAD ELECTRICAL MEASUREMENT	02/19/93
3) 72-HOUR ANNEALING @ 25°C	02/19/93
POST-72 HOUR ANNEAL ELECTRICAL MEASUREMENTS	02/22/93
4) 5 KRAD IRRADIATION (0.13 KRADS/HOUR)	02/23/93
POST-5 KRAD ELECTRICAL MEASUREMENTS	02/24/93
5) 10 KRAD IRRADIATION (0.28 KRADS/HOUR)	02/24/93
POST-10 KRAD ELECTRICAL MEASUREMENTS	02/25/93
6) 15 KRAD IRRADIATION (0.29 KRADS/HOUR)	02/25/93
POST-15 KRAD ELECTRICAL MEASUREMENTS	02/26/93
7) 20 KRAD IRRADIATION (0.37 KRADS/HOUR)	02/26/93
POST-20 KRAD ELECTRICAL MEASUREMENTS	03/01/93
8) 168-HOUR ANNEALING @25°C	02/26/93
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENTS	03/09/93
9) 30 KRAD IRRADIATION (0.50 KRADS/HOUR)	03/08/93
POST-30 KRAD ELECTRICAL MEASUREMENTS	03/10/93
10) 168-HOUR ANNEALING @100°C	03/08/93
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENTS	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 HI-201

Test	Units	Specification Limits		Conditions
		Min	Max	
FUNC1	P/F			Vd = 15, 0 V, f = 10 kHz
Ron1	ohms	0	175	Vs = +10 V, Id = -1 mA
Ron2	ohms	0	200	±V=±10V, Vs=7.5V, Id=-1mA
Ron3	ohms	0	175	Vs = -10 V, Id = +1 mA
Ron4	ohms	0	200	±V=±10V, Vs=-7.5V, Id=+1mA
Isoff1	nA	-10*	10*	Vd = -14 V, Vs = +14 V
Idoff1	nA	-10*	10*	Vd = +14 V, Vs = +14 V
Idon1	nA	-10*	10*	Vd = +14 V, Vs = +14 V
IIL	uA	-0.5	0.5	Vin = 0.8 V
IIH1	uA	-0.5	0.5	Vin = 2.4 V
IIH2	uA	-0.5	0.5	Vin = 15 V
ICCP1	mA	0	1.5	± V = ± 15 V, Logic = 0.8 V
ICCN1	mA	-1.5	0	" "

*Specified at ± 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 HI-201 1/

Parameters		Spec. Lim./2 min	max	Total Dose Exposure: 0 Pre-Rad mean	sd	2.5 krads mean	sd	Anneal: 72 hrs. @25°C mean	sd	Total Dose Exposure (TDE) (krads): 5 mean	sd	10 mean	sd	15 mean	sd	20 mean	sd	Anneal: 168 hrs @25°C mean	sd	TDE: 30 krads mean	sd	Anneal: 168 hrs @100°C mean	sd
FUNC/3 10KhZ		PASS/FAIL		PASS		PASS		PASS		PASS		PASS		PASS		PASS		5P1F		5P1F		1P5F	
Ron1	ohms	0	175	50.2	1.8	51.8	18	53.5	20	51.0	9.4	52.0	9.8	54.0	11	57.3	6.7	55.6	8.6	61.6	7.8	65.1	21
Ron2	ohms	0	200	76.2	3.6	66.4	19	67.9	20	76.5	13	79.8	5.7	85.2	19	90.0	44	89.3	48	114	117	568	3E3
Ron3	ohms	0	175	8.00	.66	9.85	5.5	10.0	5.6	9.69	1.3	9.89	1.5	10.9	1.7	11.0	1.9	10.3	1.6	11.3	1.2	10.3	1.4
Ron4	ohms	0	200	8.04	.65	9.66	4.7	9.88	4.7	9.67	1.3	9.97	1.5	11.0	1.7	11.2	1.8	10.7	1.7	11.7	1.4	10.4	1.4
Isoff1/4	nA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8E3	1E6	8E3	1E6
Idoff1/4	nA	-10	10	0.04	.34	0	0	0	0	0	0	0	0	0.05	.40	0	0	0	0	2E4	2E6	2E4	2E6
Idon1/4	nA	-10	10	0	0	0	0	0	0	0	0	-.04	.38	0	0	0	0	0	0	1E3	8E3	1E3	8E3
IIL	uA	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIH1	uA	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIH2	uA	-0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCP1	mA	0	1.5	0.52	.01	5.08	13	6.07	13	0.52	.01	0.53	.02	0.54	.04	0.59	.01	0.75	.55	0.83	.59	2.38	2.8
ICCN1	mA	-1.5	0	-.20	0	-2.1	3.6	-2.1	3.9	-.21	.02	-.24	.03	-.26	.05	-.31	.01	-.44	.43	-.47	.38	-2.1	2.8

Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing up to and including the 2.5-krad level and subsequent 72-hour anneal. Beyond this level, S/N 62 and 63 were removed from further radiation testing and are not included in this table.

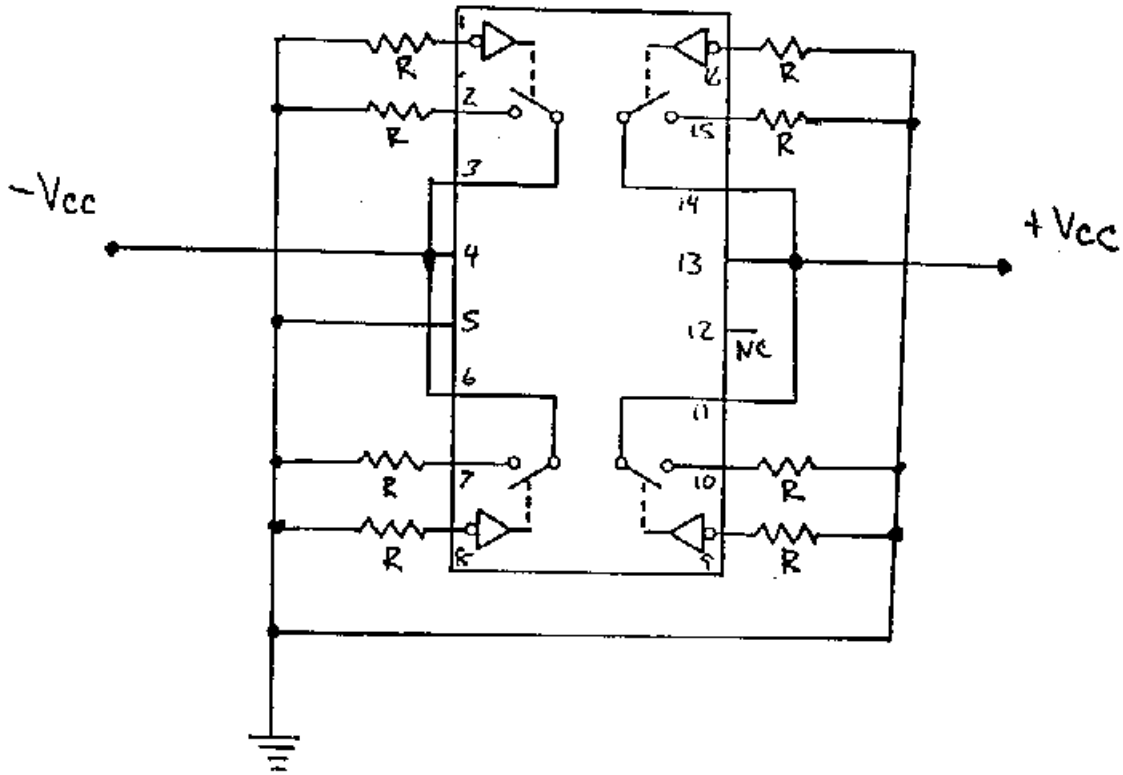
2/ These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

3/ "PASS" indicates that all parts passed the functional test at this level and "FAIL indicates that all parts failed the functional test at this level. "nPmF"/fs indicates that n parts passed and m parts failed the functional test at the given level. S/N 62 and 63 failed catastrophically after 2.5 krads and did not recover, and were not exposed to any further irradiation. Therefore, mean and standard deviation values in this table are based on a complement of 6 samples.

4/ After the 30-krad irradiation, values of Isoff1, Idoff1 and Idon1 ranged from -9.6 to +8.2 mA. 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 Ron2, ICCP1, Isoff1 and Idoff1.

Figure 1. Radiation Bias Circuit for HI-201



Ta = 25°C

+Vcc = 15.0 VDC ± 0.5 VDC

-Vcc = -15.0 VDC ± 0.5 VDC

R = 3.3 Kohms, 1/2W