Government Systems Group

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DATE: January 12, 1995

PPM-95-118

TO: B. Fafaul/311
FROM: K. Sahu/300.1 KSahu
SUBJECT: Radiation Report on HST/CAL
Part No. SDM3304
Control No. 11132

cc: A. Sharma/311.0
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A radiation evaluation was performed on SDM3304 (NPN Darlington Power Transistor) 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}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 5, 10, 15, 20, 30, 50, 75, and 100 krads*. The dose rate was between 0.08 and 1.5 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 100 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 tests up to and including the 100 krad level.

After annealing for 168 hours at 25°C, all parts passed all electrical tests.

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.

*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.

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TABLE I. Part Information

Generic Part Number:	SDM3304
HST/CAL Part Number:	SDM3304
HST/CAL Control Number:	11132
Charge Number:	ES56029
Manufacturer:	Solitron
Lot Date Code:	9442
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:	NPN Darlington Power Transistor
Part Technology:	Bipolar
Package Style:	TO5
Test Equipment:	Cistronics
Test Engineer:	P. Srioudom

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

TABLE II. Radiation Schedule for SDM3304

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	12/01/94
2) 5 KRAD IRRADIATION (0.3 KRADS/HOUR)	12/01/94
POST-5 KRAD ELECTRICAL MEASUREMENT	12/02/94
3) 10 KRAD IRRADIATION (0.08 KRADS/HOUR)	12/02/94
POST-10 KRAD ELECTRICAL MEASUREMENT	12/05/94
4) 15 KRAD IRRADIATION (0.3 KRADS/HOUR)	12/05/94
POST-15 KRAD ELECTRICAL MEASUREMENT	12/06/94
5) 20 KRAD IRRADIATION (0.3 KRADS/HOUR)	12/06/94
POST-20 KRAD ELECTRICAL MEASUREMENT	12/07/94
6) 30 KRAD IRRADIATION (0.6 KRADS/HOUR)	12/07/94
POST-30 KRAD ELECTRICAL MEASUREMENT	12/08/94
7) 50 KRAD IRRADIATION (0.3 KRADS/HOUR)	12/09/94
POST-50 KRAD ELECTRICAL MEASUREMENT	12/12/94
8) 75 KRAD IRRADIATION (1.5 KRADS/HOUR)	12/12/94
POST-75 KRAD ELECTRICAL MEASUREMENT	12/13/94
9) 100 KRAD IRRADIATION (1.5 KRADS/HOUR)	12/13/94
POST-100 KRAD ELECTRICAL MEASUREMENT	12/14/94
10) 168-HOUR ANNEALING @25°C	12/14/94
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/21/94
11) 168-HOUR ANNEALING @100°C*	12/21/94
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/28/94

*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 SDM3304

Test Number	Test Name	Units	Test Conditions	Minimum	Maximum
1	VBRCEO	V	I_c = 100mA	60	
2	HFEs		I_c = 2.5A	1000	
3	VCESAT	V	I_c = 2.5A	0	2.0

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for SDM3304 /1

Test #	Parameters	Units	Spec. Lim./2 min	Spec. Lim./2 max	Total Dose Exposure (krads)																		Annealing			
					Initial		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
1	VBRCEO	V	60		P		P		P		P		P		P		P		P		P		P		P	
2	HFEs		1000		7357	3058	6969	2794	6795	2776	6886	2694	6779	2717	6743	2635	6210	2382	6151	2243	6171	2198	6118	2219	6133	2180
3	VCESAT	mV	0	2	1.28	0.04	1.27	0.04	1.28	0.05	1.28	0.05	1.27	0.04	1.27	0.04	1.27	0.03	1.29	0.04	1.30	0.03	1.30	0.04	1.28	0.04

otes:

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 the tests were performed.

3/ In the VBRCEO tests, "P" means that all parts passed this test at this irradiation or annealing level, "F" means that all parts failed this test at this irradiation or annealing level and "nPmF" means that n parts passed at this level and m parts failed at this level.

Radiation-sensitive parameters: NONE.

Figure 1. Radiation Bias Circuit for SDM3304