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PPM-92-037

To
G. Krishnan

Department
Code 311

From
K. Sahu KS

Department
7809

Subject
Radiation Report on
ISTP/EPACT Part No. 2N5097

Date
January 23, 1992

Location
GSFC

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A radiation evaluation was performed on 2N5097 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, three parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation steps were 10, 20, 50 and 100 krads*. After 100 krads, the parts were annealed at 25°C for 168 hours. The dose rate was between 0.4 to 1.5 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, the parts were electrically tested according to the test conditions and the specification limits listed in Table III.

All three parts passed all tests on irradiation to 100 krads; however, significant decreases in the hFE tests were observed. hFE1 and hFE2 were affected the most by the radiation exposure. Average hFE1 readings dropped from 46, during pre-irradiation electrical measurements, to 29 during post 100-krad electrical measurements, and a corresponding drop from 67 to 55 occurred in average hFE2 measurements. At 100 krads, one part (SN 22) was just meeting the minimum specification limit of 50 for hFE2, with a reading of 50.3. Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment.

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

*In this report, the term "rads" is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	2N5097
ISTP/EPACT Part Number:	2N5097
ISTP/EPACT Control Number:	5472
Manufacturer:	SSDI
Lot Date Code:	8902
Quantity Tested:	4
Serial Numbers of Radiation Samples:	18, 22, 26
Serial Number of Control Sample:	15
Part Function:	NPN Transistor
Part Technology:	Bipolar
Package Style:	TO-5
Test Engineer:	A. Phung

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	12/16/91
2) 10 krads irradiation @ 540 rads/hr	12/17/91
Post 10 krads Electrical Measurements	12/18/91
3) 20 krads irradiation @ 430 rads/hr	12/18/91
Post 20 krads Electrical Measurements	12/19/91
4) 50 krads irradiation @ 1540 rads/hr	12/19/91
Post 50 krads Electrical Measurements	12/20/91
5) 100 krads irradiation @ 740 rads/hr	12/20/91
Post 100 krads Electrical Measurements	12/23/91
6) 168 hrs annealing	12/23/91
Post 168 hr Electrical Measurements	12/30/91

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at 25°C.
- Annealing performed at 25°C under bias.

Table III. Electrical Characteristics of 2N5097

Parameter	Test Condition	Min	Max	Unit
V_{BRCEO}	$I_C = 50\text{mA dc, pulsed}^*$	450	-	Vdc
V_{BRCE0}	$I_C = 100\mu\text{A}$	600	-	Vdc
V_{BREBO}	$I_E = 20\mu\text{A}$	6	-	Vdc
I_{CBO}	$V_{CB} = 500\text{Vdc}$	-	500	nA dc
I_{EBO}	$V_{EB} = 4\text{Vdc}$	-	250	nA dc
h_{FE1}	$I_C = 1\text{mA dc, } V_{CE} = 10\text{Vdc}$	25	250	
h_{FE2}	$I_C = 25\text{mA dc, } V_{CE} = 5\text{Vdc}$	50	300	
h_{FE3}	$I_C = 100\text{mA dc, } V_{CE} = 5\text{Vdc}$	15	250	
$V_{CE(SAT)}$	$I_C = 25\text{mA dc, } I_B = 2.5\text{mA dc}$	-	0.5	Vdc
$V_{BE(on)}$	$I_C = 25\text{mA dc, } V_{CE} = 5\text{Vdc, pulsed}$	-	1.0	Vdc

*Pulse width = 800us, Duty Cycle = 2%

TABLE IV: Summary of Electrical Measurements after
Total Dose Exposures and Annealing for 2N5097

1/

Parameters		Spec. Limits		Pre-Rad	Total Dose Exposure (krads)								Anneal		
					10		20		50		100		168 hrs		
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
VBRCEO	V	450	-	Pass		Pass		Pass		Pass		Pass		Pass	
VBRCEO	V	600	-	Pass		Pass		Pass		Pass		Pass		Pass	
VBREBO	V	6	-	Pass		Pass		Pass		Pass		Pass		Pass	
ICBO	µA	-	500	48	7	47	8	44	8	50	8	54	9	41	3
IEBO	nA	-	250	3	0.1	0.4	0.1	0.4	0.1	0.7	0.3	9.5	5.0	6.0	2.0
hFE1		25	250	46	4	42	4	38	3	34	3	29	2	29	2
hFE2		50	300	67	3	64	3	61	4	59	3	55	3	55	3
hFE3		15	250	21	0.4	21	0.4	20	0.3	20	0.3	19	0.3	19	0.3
VCEsat	V	0	0.5	.16	.01	.17	.03	.16	.03	.17	.06	.17	.03	.17	.06
VBE on	V	0	1.0	0.7	0	0.7	0	0.7	0	0.7	0	0.7	0	0.7	0

Note:

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

Figure 1. Radiation Bias Circuit for 2N5097

