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Interoffice Memorandum

PPM-92-036

To  
G. Krishnan

Date  
January 23, 1992

Department  
Code 311

Location  
GSFC

From  
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Telephone  
731-8954

Department  
7809

Location  
Lanham

Subject  
Radiation Report on  
ISTP/EPACT Part No. 2N5096

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A radiation evaluation was performed on 2N5096 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. A slight decrease in each of the three hFE tests was observed for all three parts after each radiation exposure, but all parts remained above the minimum specification limits for these tests to 100 krads and on annealing at 25°C for 168 hours. 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:	2N5096
ISTP/EPACT Part Number:	2N5096
ISTP/EPACT Control Number:	5471
Manufacturer:	SSDI
Lot Date Code:	9125
Quantity Tested:	4
Serial Numbers of Radiation Samples:	84, 104, 140
Serial Number of Control Sample:	74
Part Function:	PNP 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 2N5096

Parameter	Test Condition	Min	Max	Unit
$V_{BRCEO}$	$I_C = 50\text{mAdc}$ , pulsed*	450	-	Vdc
$V_{BRCBO}$	$I_C = 100\mu\text{A}$	500	-	Vdc
$V_{BREBO}$	$I_E = 20\mu\text{A}$	6	-	Vdc
$I_{CBO}$	$V_{CB} = 500\text{Vdc}$	-	500	nAdc
$I_{EBO}$	$V_{EB} = 4\text{Vdc}$	-	250	nAdc
$h_{FE1}$	$I_C = 1\text{mAdc}$ , $V_{CE} = 10\text{Vdc}$	20	200	
$h_{FE2}$	$I_C = 25\text{mAdc}$ , $V_{CE} = 10\text{Vdc}$	40	250	
$h_{FE3}$	$I_C = 100\text{mAdc}$ , $V_{CE} = 15\text{Vdc}$	20	200	
$V_{CE(SAT)}$	$I_C = 25\text{mAdc}$ , $I_B = 2.5\text{mAdc}$	-	3.0	Vdc
$V_{BE(SAT)}$	$I_C = 25\text{mAdc}$ , $I_B = 2.5\text{mAdc}$	-	1.0	Vdc

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

TABLE IV: Summary of Electrical Measurements after  
Total Dose Exposures and Annealing for 2N5096

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	500	-	Pass		Pass		Pass		Pass		Pass		Pass	
VBREBO	V	6	-	Pass		Pass		Pass		Pass		Pass		Pass	
ICBO	nA	-	500	102	4	101	8	107	7	109	5	109	5	114	4
IEBO	nA	-	250	-.2	0.1	-.2	0.1	-.2	0.1	-.3	0.1	-.1	0.1	-.3	0.1
hFE1		20	200	55	0.5	54	0.6	53	0.5	50	0.4	47	0.5	44	0
hFE2		40	250	56	0.5	55	0.6	54	0.4	53	0.4	51	0.4	51	0.4
hFE3		20	200	53	0.4	52	0.4	51	0.5	51	0.4	48	0.5	49	0.5
VCESAT	V	-	3.0	0.4	0	0.4	0	0.4	0	0.5	.03	0.5	.06	.65	.04
VEESAT	V	-	1.0	0.8	0	0.8	0	0.8	0	0.8	0	0.8	0	0.8	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 2N5096

