PPM-91-654

ADVISORY ON THE USE OF THIS DOCUMENT

The information contained in this document has been developed solely for the purpose of providing general guidance to employees of the Goddard Space Flight Center (GSFC). This document may be distributed outside GSFC only as a courtesy to other government agencies and contractors. Any distribution of this document, or application or use of the information contained herein, is expressly conditioned upon, and is subject to, the following understandings and limitations:

(a) The information was developed for general guidance only and is subject to change at any time;

(b) The information was developed under unique GSFC laboratory conditions which may differ substantially from outside conditions;

(c) GSFC does not warrant the accuracy of the information when applied or used under other than unique GSFC laboratory conditions;

(d) The information should not be construed as a representation of product performance by either GSFC or the manufacturer;

(e) Neither the United States government nor any person acting on behalf of the United States government assumes any liability resulting from the application or use of the information.

(84)

UNISYS

Interoffice Memorandum

PPM-91-654

To
W. Beyah

Department
Code 311

From
K. Sahu KS

Department
7809

Subject
Radiation Report on 2N5087
(ISTP/NC(TGRS) Project)

Date
Oct. 28, 1991

Location
GSFC

Telephone
731-8954

Location
Lanham

cc
G. Krishnan/311
G. Smith/663
B. Teegarden/663
D. Krus
R. Woodward

A radiation evaluation was performed on 2N5087 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 10, 20, 50 and 100 krads (the term *rad* as used here means rad(Si)). After 100 krads, parts were annealed at +25°C for 24 and 168 hours. After this annealing, parts were irradiated to a total accumulated dose of 300 krads, after which they were annealed at +100°C for 168 hours. The dose rate was between 0.45 and 5 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.

Parts passed all tests and stayed within the specified limits up to 50 krads of irradiation. After 50 krads, 4 parts marginally failed to meet the minimum specification limits for hFE1. After 100 krads of irradiation, all parts failed to meet the minimum specification limits for hFe1, hFE2 and hFE3. On annealing at +25°C for 24 and 168 hours, parts showed slight recovery, but still failed to meet minimum specification limits for hFE1, hFE2 and hFE3 Continued irradiation to a total accumulated dose of 300 krads produced additional degradation. After annealing at +100°C for 168 hours, parts showed slight recovery, but still failed to meet minimum specification limits for the same parameters.

Table IV gives 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.

TABLE I. Part Information

Generic Part Number:	2N5087
ISTP/NC (TGRS) Part Number:	ISTP-5961-33
ISTP/NC (TGRS) Control Number:	2564A
Charge Number:	C14581
Manufacturer:	Motorola
Lot Date Code:	9101
Quantity Tested:	10
Serial Numbers of Radiation Samples:	58, 59, 60, 61, 62, 63, 64, 65
Serial Number of Control Samples:	56, 57
Part Function:	PNP Amplifier Transistor
Part Technology:	Bipolar
Package Style:	TOX can
Test Engineer:	Anh Phung

TABLE II. Radiation Schedule for 2N5087

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	08/29/91
2) 10- KRAD IRRADIATION (0.5 krads/hour)	09/18/91
POST-10-KRAD ELECTRICAL MEASUREMENT	09/19/91
3) 20-KRAD IRRADIATION (0.5 krads/hour)	09/19/91
POST-20-KRAD ELECTRICAL MEASUREMENT	09/20/91
4) 50-KRAD IRRADIATION (0.447 krads/hour)	09/20/91
POST-50-KRAD ELECTRICAL MEASUREMENT	09/23/91
5) 100-KRAD IRRADIATION (2.5 KRADS/HOUR)	09/23/91
POST-100-KRAD ELECTRICAL MEASUREMENT	09/24/91
6) 24 HOURS ANNEALING AT +25°C	09/24/91
POST-24-HOURS ELECTRICAL MEASUREMENT	09/25/91
7) 168 HOURS ANNEALING AT +25°C	09/25/91
POST-168-HOURS ELECTRICAL MEASUREMENT	10/01/91
8) 200-KRAD IRRADIATION (5.0 KRADS/HOUR)	10/01/91
POST-200-KRAD ELECTRICAL MEASUREMENTS	10/02/91
9) 300-KRAD IRRADIATION (4.655 KRADS/HOUR)	10/02/91
POST-300-KRAD ELECTRICAL MEASUREMENTS	10/03/91
10) 168 HOURS ANNEALING AT +100°C	10/03/91
POST-168 HOURS AT +100°C ELECTRICAL MEASUREMENTS	10/10/91

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT +25°C.

ALL PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS, SEE FIGURE 1.

Table III. Electrical Characteristics of 2N5087

MB #: ES14152 DATE: 03-12-91
PART #: 2N5087 AMPLIFIER PNP TRANSISTOR
CTRL #: 2564 CIS :
PCN : 9505 -- 5087
TRAVELER ENGINEER : AP
TRAVELER REVIEWER :
TEST SPEC. : MOTOROLA DATA BOOK 1989 AMENDMENT --
DATE : DATE :

ELECTRICAL CHARACTERISTICS TABLE

TEST #	TEST NAME	TEST CONDITION	MIN	MAX	UNIT	METHOD
1	$V_{BR_{CEO}}$	I_C=1mA ; I_B=0	50		V	
2	$V_{BR_{CBO}}$	I_C=100μA ; I_E=0	50		V	
3	I_{CBO1}	V_{CB}=10V ; I_E=0		10	nA	
4	I_{CBO2}	V_{CB}=35V ; I_E=0		50	nA	
5	I_{EBO}	V_{BE}=3V ; I_C=0		50	nA	
6	h_{FE1}	I_C=100μA ; V_{CE}=5V	250	800		
7	h_{FE2}	I_C=1mA ; V_{CE}=5V	250			
8	h_{FE3}	I_C=10mA ; V_{CE}=5V ; PULSED*	250			
9	$V_{CE(SAT)}$	I_C=10mA ; I_B=1mA		0.3	V	
10	$V_{BE(ON)}$	I_C=1mA ; V_{CE}=5V		0.85	V	

DELTA LIMITS : ΔI_{CBO1} = 15 nA OR ±100% ; WHICHEVER IS GREATER.
Δh_{FE1} = ±20%

*t_{pulse}=800μS ; DUTY CYCLE ≤2%

Form 0011 91 PAGE # of

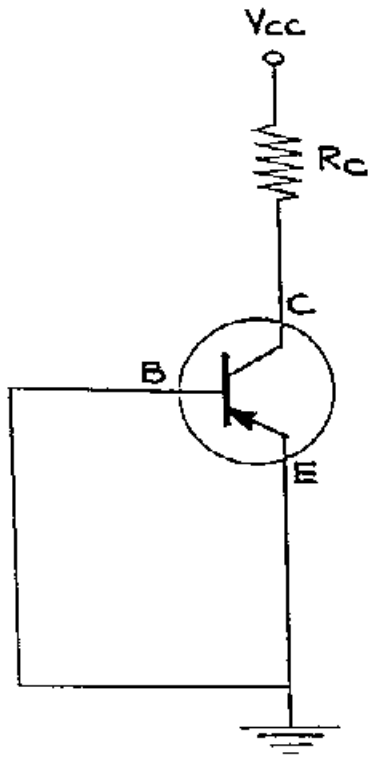
TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for 2N5087 1/

	Spec. Limi		Total Dose Exposure (TDE) (krads)										Anneal				TDE (krads)				Anneal	
			0 (Pre-Rad.)		10		20		50		100		24 hrs. @25°C		168 hrs @25°C		200		300		168 hrs @+100°C	
Parameters	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VBRCEO V	50	-	50	0	50	0	50	0	50	0	50	0	50	0	50	0	50	0	50	0	50	0
VBRCBO V	50	-	50	0	50	0	50	0	50	0	50	0	50	0	50	0	50	0	50	0	50	0
ICBO1 nA	-	10	-.04	0	0	.01	.02	.01	.01	.01	.08	.01	.05	.01	.03	.01	.03	.01	.03	0	.02	0
ICBO2 nA	-	50	0.2	0.2	.16	.03	.15	.03	.13	.07	0.3	.08	0.35	0.1	.125	.07	.175	.05	.35	0.1	.23	0.1
IEBO nA	-	50	-.18	.05	-.23	.27	-.21	.05	-.25	.06	-.18	.05	-.18	.05	-.23	.05	-0.2	.04	-.18	.05	-.23	.05
hFE1	250	800	332	20.6	312	15.8	294	14.1	249	11.5	186	8.0	195	6.6	199	7.8	149	6.3	123	5.2	194	7.3
hFE2	250	-	331	20.2	313	8.8	303	4.0	274	4.2	236	5.0	242	3.2	242	5.1	204	4.1	183	5.0	236	7.6
hFE3	250	-	305	4.5	292	4.5	283	4.1	264	4.0	243	3.6	247	3.8	245	3.9	220	3.5	208	3.7	239	3.6
VCE(SAT) V	-	0.3	.052	0	.055	0	.056	0	.06	0	.064	0	.064	0	.063	0	.068	0	.071	0	.062	0
VBE(ON) V	-	0.85	.658	0	.662	0	.664	0	.669	0	0.66	0	.658	0	.663	0	.668	0	.665	0	.662	0

Note:

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.

Figure 1. Radiation Bias Circuit for 2N5087



Vcc = - 40V

Rc = 10K Ω ±5% @ ¼W