

**UNISYS**

DATE: May 17, 1996  
TO: P. Gagne  
FROM: K. Sahu/300.1 *KS*  
SUBJECT: Radiation Report on: FST180  
Project: MASUNI040896 (non-NASA job)  
Control #: 15146  
Job #: HAFF112  
Project part #: FST180

PPM-96-006

cc: D. Krus/300.1  
OFA Library/300.1

A radiation evaluation was performed on FST180 (NPN 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 Co<sup>60</sup> gamma ray source. The parts were tested in general accordance with MIL-STD-883, Method 1019. During the radiation testing, four parts were irradiated under bias (see Figure 1 for bias configuration). One part was used as a control sample. The total dose radiation levels were 50 and 100 krads\*. The dose rate was 1.19 krads/hour (see Table II for radiation schedule). After each radiation exposure, parts were electrically tested according to the test conditions and the specification limits\*\* listed in Table III

During initial (pre-irradiation) electrical measurements, S/N 13, 14 and 15 fell below the minimum specification limit of 65 for HFEs3, with readings of 57.74, 57.80 and 59.03, respectively. S/N 13 also fell below the minimum specification limit of 25 for HFEs1, with a reading of 24.10.

After the 50 and 100 krad irradiations, additional degradation in HFEs1, HFEs2 and HFEs3 was observed. After 100 krads, the mean values for HFEs1, HFEs2 and HFEs3 were 36.12, 54.81 and 56.03, respectively, against minimum specification limits of 25, 40 and 65, respectively. All irradiated parts passed all other electrical tests throughout initial readings and both irradiation steps.

Table IV provides a summary of the mean and standard deviation values for each parameter initially and after each irradiation exposure.

Based on the results of this test, the total-dose radiation characteristics of these parts are acceptable for a total-mission-dose space radiation environment of up to 100 krads, if some degradation in HFEs can be tolerated.

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 consecutive annealing times at the same temperature and 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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ADVISORY ON THE USE OF THIS DOCUMENT

The information contained in this document has been developed solely for the purpose of providing radiation characteristics under total dose irradiation from a Co<sup>60</sup> gamma-ray source. The parts were tested in general accordance with MIL-STD-883, Method 1019. A lower dose rate than 50 rads(Si)/sec was used in this testing to better simulate the space radiation environment. This information is applicable to the space radiation environment, but not to a nuclear radiation environment.

The users of this information should be aware that the total dose radiation characteristics of electronic parts can vary significantly with the lot date code, and even within the same lot date code; therefore, an appropriate radiation design margin should be used.

Since radiation testing is considered "destructive testing" under MIL-STD-883, Method 1019, the parts used in this test should not be used in any other application.

Neither Unisys Corporation, nor any person acting on behalf of Unisys Corporation, assumes any liability resulting from the application or use of this information.

Figure 1. Radiation Bias Circuit for FST180

$$T_A = +25^{\circ}\text{C} \pm 3^{\circ}\text{C}.$$

$$V_{CC} = +12\text{Vdc}.$$

$$I_{\text{bias}} = 13.33\text{mA. (MAX)}$$

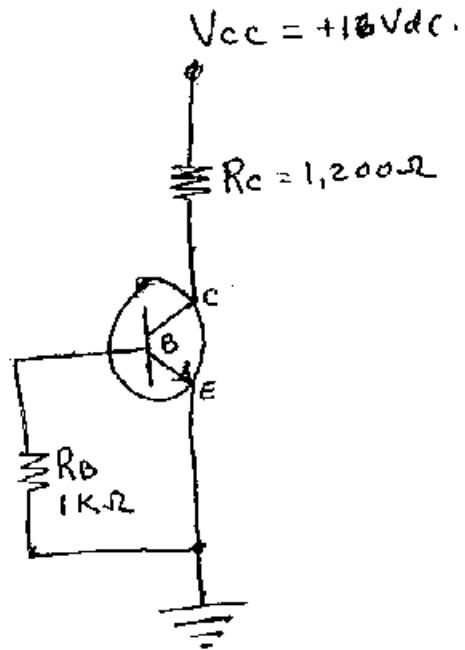


TABLE I. Part Information

Generic Part Number:	FST180*
Project	MASUNI040896 (non-NASA job)
Project Part Number	FST180
Control Number:	15146
Charge Number:	HAFF112
Manufacturer:	unknown
Lot Date Code (LDC):	Lot # 9402C101-5
Quantity Tested:	5
Serial Number of Control Samples:	12
Serial Numbers of Radiation Samples:	13, 14, 15, 16
Part Function:	NPN Transistor
Part Technology:	Bipolar
Package Style:	TO-5 can
Test Equipment:	S-50
Engineer:	C. Arcila

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

TABLE II. Radiation Schedule for FSI180

EVENT .....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	05/03/96
2) 50 KRAD IRRADIATION (1.19 KRADS/HOUR)* .....	05/06/96
POST-50 KRAD ELECTRICAL MEASUREMENT.....	05/08/96
3) 100 KRAD IRRADIATION (1.19 KRADS/HOUR) .....	05/08/96
POST-100 KRAD ELECTRICAL MEASUREMENT.....	05/10/96

\*The dose rate in the space radiation environment is approximately 100 times smaller than this dose rate; therefore, this low dose rate provides a more accurate simulation of the radiation effects during the actual mission.

PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

Table III. Electrical Characteristics of FST180

Test #	Test Name	Min	Max
1	ICB0	0	100 nA
2	VCESAT1	0	0.3 V
3	VCESAT2	0	0.25 V
4	VCESAT3	0	0.4 V
5	VBESAT1	0	0.85 V
6	VBESAT2	0	1.2 V
7	HFEs1	25	-
8	HFEs2	40	-
9	HFEs3	65	-

**Table IV: Total Dose Exposures and Annealing for FST180 /1**

Test #	Parameters	Units	Spec. Lim./2 min max		Initial		Total Dose Exposure (krads)			
					25°C		50		100	
					mean	sd	mean	sd	mean	sd
1	ICB0	nA	0	100	1.6	.18	1.3	.11	1.3	.11
2	VCESAT1	V	0	0.3	.215	.01	.218	.01	.220	.01
3	VCESAT2	V	0	0.25	.140	0	.141	0	.141	0
4	VCESAT3	V	0	0.4	.179	0	.179	0	.179	0
5	VBESAT1	V	0	0.85	.757	0	.761	0	.761	0
6	VBESAT2	V	0	1.2	.848	0	.851	0	.852	0
7	HFEs1	-	25	-	44.97	14	39.02	10	36.12	8.0
8	HFEs2	-	40	-	63.36	8.2	59.14	6.3	54.81	5.8
9	HFEs3	-	65	-	60.27	3.6	57.37	2.9	56.03	2.8

## Notes:

- 1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing. The control sample remained constant throughout the testing and is 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.