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Memorandum

PPM-92-311

DATE: Dec. 23, 1992  
TO: D. Kapoor/311  
FROM: K. Sahu KS  
SUBJECT: Radiation Report on HST  
Part No. JANTXV2N6782  
Control No. 7540

cc: A. Sharma/311  
Library/300.1 ✓

A radiation evaluation was performed on 2N6782 (N-channel FET) 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, six parts were irradiated under bias in two groups (see Figure 1 for bias configuration) and one part was used as a control sample. The total dose radiation levels for Group 1 were 2 and 3 krads\* and the total dose radiation levels for Group 2 were 2, 3, 5 and 10 krads. After irradiation, parts in Group 1 were annealed at 100°C for 21, 70 and 232 hours and parts in Group 2 were annealed at 100°C for 21, 114 and 183 hours. The dose rate was between 0.04 and 0.25 krads/hour for both groups (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested at ambient room temperature according to the test conditions and the specification limits\*\* listed in Table III.

All irradiated parts passed all electrical tests throughout all irradiation and annealing steps. No rebound effects were observed after annealing at 100°C. Table IV provides a summary of the functional test results, as well as 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.

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\*The term rads, as used in this document, means rads(silicon).  
All radiation levels cited are cumulative.  
\*\*These are manufacturers' non-irradiated 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: 2N6782

Part Number: JANTXV2N6782

HST  
Control Number: 7540

Charge Number: C33146

Manufacturer: International Rectifier Corp.

Lot Date Code: 9230

Quantity Tested: 7

Serial Numbers of  
Radiation Samples: Group 1: 21, 22, 23; Group 2: 24, 25, 26

Serial Number of  
Control Sample: 20

Part Function: N-channel FET

Part Technology: FET

Package Style: 3-pin TOx can

Test Engineer: T Scharer

TABLE II. Radiation Schedule for 2N6782 1/, 2/, 3/

EVENTS	DATE
1) Initial Electrical Measurements	12/01/92
2) 2 KRAD IRRADIATION (0.10 KRADS/HOUR) (Groups 1 and 2)	12/04/92
POST-2 KRAD ELECTRICAL MEASUREMENT	10/04/92
3) 3 KRAD IRRADIATION (0.04 KRADS/HOUR) (Groups 1 and 2)	12/04/92
POST-3 KRAD ELECTRICAL MEASUREMENT/3	12/07/92
4) 5 KRAD IRRADIATION (0.10 KRADS/HOUR) (Group 2)	12/07/92
POST-5 KRAD ELECTRICAL MEASUREMENT	12/08/92
5) 10 KRAD IRRADIATION (0.25 KRADS/HOUR)	12/08/92
POST-10 KRAD ELECTRICAL MEASUREMENT	12/09/92
6) 21 HOUR ANNEALING @100°C (Group 1)	12/07/92
POST-21 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/08/92
7) 70 HOUR ANNEALING @100°C (Group 1)	12/08/92
POST-70 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/10/92
8) 232 HOUR ANNEALING @100°C (Group 1)	12/10/92
POST-232 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/15/92
9) 21 HOUR ANNEALING @100°C (Group 2)	12/09/92
POST-21 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/10/92
10) 114 HOUR ANNEALING @100°C (Group 2)	12/10/92
POST-114 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/14/92
11) 183 HOUR ANNEALING @100°C (Group 2)	12/14/92
POST-183 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/17/92

1/ All electrical measurements were performed at 25°C. All radiation levels cited are cumulative.

2/ Parts were irradiated and annealing under bias. See Figure 1.

3/ Note that annealing durations were not 10, 48 AND 168 hours, (as required in the Ball Aerospace plan) due to scheduling constraints.

4/ After irradiation at 3 krads was completed, parts were under anneal at 25°C for 43 hours before testing could be performed.

Table III. Electrical Characteristics of 2N6782

Test	Conditions	Min.	Max.	Units
VBDSS	$I_d = 1 \text{ mA DC}$	100		V DC
VGSt <sub>h</sub>	$I_o = 0.25 \text{ mA DC}$	2.0	4.0	V DC
IGSS	$V_{gs} = 20 \text{ V DC}$	0	100	nA DC
IGSSr	$V_{gs} = 20 \text{ V DC}$	0	100	nA DC
IDSS	$V_{ds} = 80 \text{ V DC}$	0	25	uA DC
VDS on	$V_{gs} = 0 \text{ V DC}$	0.75	2.10	V DC
RDS on	$V_{gs} = 10 \text{ V DC}$	0	600	mohm
VSD	$I_s = 3.50 \text{ A DC}$	0.75	1.5	V DC
VGSt <sub>h</sub>	$I_o = 3.50 \text{ A DC}$	0	15	V DC
g <sub>fs</sub>	$I_o = 2.25 \text{ A DC}$	1.0	3.0	mho
td (on)	$I_d = 2.25 \text{ A DC}$	0	15	ns
td (off)	$I_d = 2.25 \text{ A DC}$	0	25	ns

TABLE I: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for 2N6782 1/

Parameters		Spec. Lim./2 min max		Total Dose Exposure						Anneal							
				0 (Pre-Rad.)		2		3		21 hrs. @100°C		70 hrs. @100°C		232 hrs. @100°C			
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
VBDSS	V	100	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VGsth	V	2.0	4.0	2.99	.05	2.92	.07	2.87	.05	2.86	.04	2.86	.04	2.87	.04	2.87	.04
IGSS	nA	0	100	1.1	0	1.3	0	1.3	0	1.1	.17	1.1	.15	1.2	.12	1.2	.12
IGSSr	nA	0	100	0.9	.35	0.4	.20	0.5	.12	0.4	.15	0.4	.10	0.4	.10	0.4	.10
IDSS	uA	0	25	1.4	.17	1.6	0	1.3	.31	1.4	.21	0.9	.87	1.3	.25	1.3	.25
VDS on	V	0	2.1	1.61	.08	1.60	.08	1.60	.08	1.59	.07	1.60	.07	1.60	.06	1.60	.06
RDS on	mohm	0	600	446	19	442	12	443	19	442	17	446	17	443	17	443	17
VSD	V	0.75	1.5	1.02	.01	1.02	.01	1.02	.01	1.02	.01	1.02	.01	1.02	.01	1.02	.01
VGsth	V	0	15	5.46	.07	5.39	.06	5.35	.08	5.35	.08	5.36	.07	5.37	.06	5.37	.06
gfs	mho	1.0	3.0	2.08	.14	2.06	.12	2.10	.08	2.10	.08	2.09	.08	2.08	.07	2.08	.07
td(on)	ns	0	15	10	1	10	0	10	0	10	1	10	1	9	1	9	1
td(off)	ns	0	25	17	1	17	1	17	1	17	1	17	1	17	1	17	1

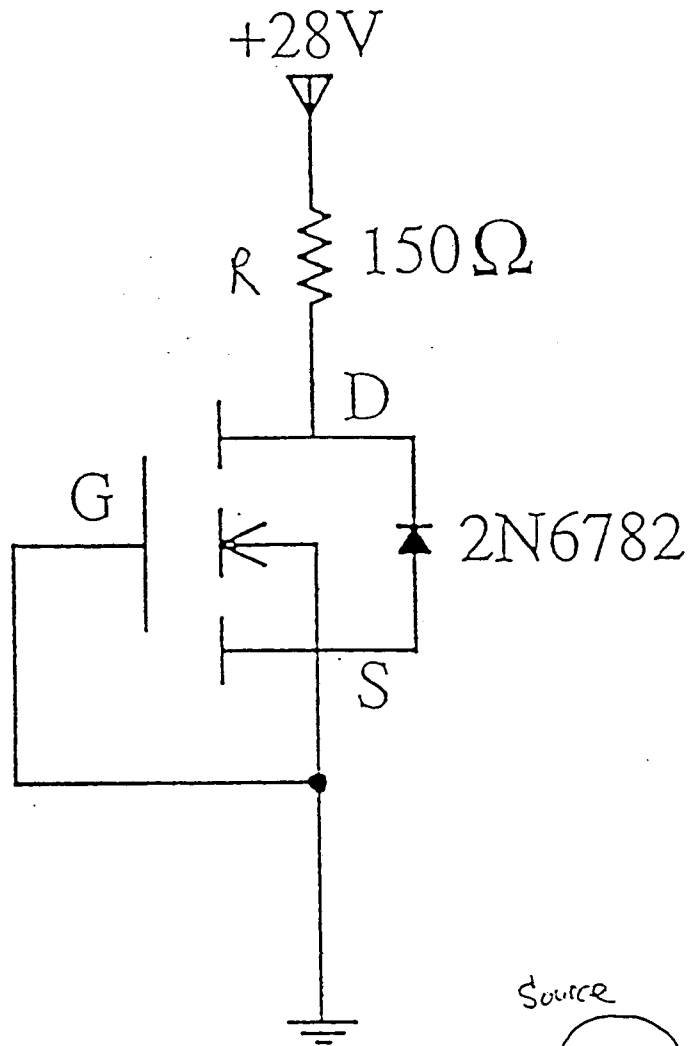
  

Parameters		Spec. Lim./2 min max		Total Dose Exposure						Anneal									
				0 (Pre-Rad.)		2		3		5		10		21 hrs. @100°C		114 hrs. @100°C		183 hrs. @100°C	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VBDSS	V	100	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS			
VGsth	V	2.0	4.0	3.03	.11	2.94	.11	2.90	.11	2.81	.10	2.65	.10	2.62	.09	2.64	.09		
IGSS	nA	0	100	1.2	.17	1.2	.23	1.2	.17	1.1	.20	1.1	.28	1.1	.15	1.1	.15		
IGSSr	nA	0	100	0.6	.15	0.3	.10	0.3	.10	0.5	.15	0.5	.10	0.4	.06	0.5	.10		
IDSS	uA	0	25	1.5	.10	1.9	.46	1.2	.32	1.3	.25	1.6	.06	1.6	.06	1.5	.17		
VDS on	V	0	2.1	1.65	.06	1.64	.06	1.63	.06	1.64	.06	1.59	.06	1.64	.06	1.62	.06		
RDS on	mohm	0	600	455	15	453	16	451	15	454	15	443	15	453	14	450	15		
VSD	V	0.75	1.5	1.02	0	1.02	0	1.02	0	1.02	0	1.02	0	1.02	0	1.02	0		
VGsth	V	0	15	5.57	.16	5.51	.17	5.47	.17	5.39	.17	5.23	.16	5.24	.16	5.26	.16		
gfs	mho	1.0	3.0	2.03	.11	2.00	.12	2.00	.10	2.02	.13	2.04	.18	2.04	.18	2.03	.14		
td(on)	ns	0	15	10	1	10	1	10	0	10	1	9	1	10	0	10	0		
td(off)	ns	0	25	16	1	16	1	17	1	17	1	18	1	17	0	17	1		

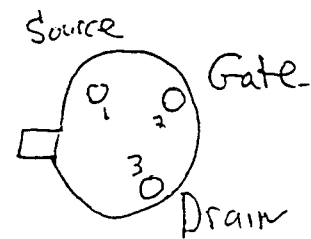
Notes:

- 1/ The mean and standard deviation values were calculated over the six parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.
- 2/ These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

Figure 1. Radiation Bias Circuit for 2N6782



$R = 150\Omega \pm 10\%$ ,  $\frac{1}{4}W$   
 $I_D \leq 25\mu A$  @ Ambient  $25^\circ C$   
 $I_D \leq 25\mu A$  @  $T_A = 125^\circ C$



Bottom View