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Interoffice Memorandum

To
R. Sharma
Department
Code 716.3
From
K. Sahu KS
Department
7809
Subject
Radiation Report on ISTP
Non-Common Buy Part No. JTXV2N6849

Rad-91-9
Date
May 1, 1991
Location
GSFC
Telephone
731-8954
Location
Lanham
cc
V. Edson
S. Esmacher
J. Lohr

A radiation evaluation was performed on JTXV2N6849 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, two 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 2.5, 5, 7.5, 10, 15, 20, 30, and 50 krads. After 50 krads, parts were annealed at 25°C for 24 and 168 hours. The dose rate was between 0.1 - 1.0 krad/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits listed in Table III.

All (2) parts passed all tests on irradiation up to 7.5 krads. At 10 krads, both parts failed to meet the maximum VDS specification limit of -2.1V (readings were approximately -2.23V and -2.29V). In addition, timing measurements (TON, TOFF, TR, and TF) could not be made after 10 krads, because the required drain current of -3.25A for these tests was unobtainable. After 15 krads, SN 215 recovered to pass VDS with a reading of -2.03V, while SN 216 failed VDS with a reading of -2.17V. Both parts passed all other tests at this radiation step and timing measurements were made. After 20 krads, both parts failed VDS. Also, SN 216 failed to meet the maximum specification of 300 mOhm for RDS (reading was 322 mOhm), while SN 215 marginally passed with a reading of 298 mOhm. After 30 krads, SN 215 continued to pass RDS, while SN 216 continued to fail this test. Also, both parts failed to meet the maximum specification limit of -4.0V for VGS with readings of -4.2V. Both parts continued to fail VDS and again no timing measurements could be made. After 50 krads, both parts passed RDS, but continued to fail VDS and VGS. Upon annealing the parts for 24 and 168 hours, no recovery was observed in VDS and VGS; however, both parts passed RDS after 24 hours of annealing, and then failed after 168 hours of annealing. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments.

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:	2N6849
ISTP Non-Common Buy Part Number:	JTXV2N6849 (MIL-S-19500/564A)
Manufacturer:	International Rectifier Corp.
Lot Date Codes:	8827 (radiation samples) 8940 (control samples)
Quantity Tested:	4
Serial Numbers of Radiation Samples:	215, 216
Serial Numbers of Control Samples:	211, 212
Part Function:	P-Channel MOSFET
Part Technology:	MOS
Package Style:	TO-39

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	03/23/91
2) 2.5 krads irradiation @ 138 rads/hr Post 2.5 krads Electrical Measurements	04/01/91 04/02/91
3) 5 krads irradiation @ 125 rads/hr Post 5 krads Electrical Measurements	04/02/91 04/03/91
4) 7.5 krads irradiation @ 125 rads/hr Post 7.5 krads Electrical Measurements	04/03/91 04/04/91
5) 10 krads irradiation @ 125 rads/hr Post 10 krads Electrical Measurements	04/04/91 04/05/91
6) 15 krads irradiation @ 250 rads/hr Post 15 krads Electrical Measurements	04/08/91 04/09/91
7) 20 krads irradiation @ 250 rads/hr Post 20 krads Electrical Measurements	04/09/91 04/10/91
8) 30 krads irradiation @ 250 rads/hr Post 30 krads Electrical Measurements	04/10/91 04/11/91
9) 50 krads irradiation @ 1000 rads/hr Post 50 krads Electrical Measurements	04/11/91 04/12/91
10) 24 hrs annealing Post 24 hr Electrical Measurements	04/12/91 04/13/91
11) 168 hrs annealing Post 168 hr Electrical Measurements	04/13/91 04/19/91

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 JTXV2N6849

TEST #	TEST NAME	TEST CONDITION	MIN	MAX	UNIT	METHOD
1	VBR _{DSS}	I _D = -1mA; V _{GS} = 0; COND. C	-100		V	3407
2	V _{GS(th)1}	V _{DS} ≥ V _{GS} ; I _D = -.25mA	-2	-4	V	3403
3	I _{GSS1}	V _{GS} = +20V & -20V; COND. C		±100	nA	3411
4	I _{DSS1}	V _{DS} = -80V; V _{GS} = 0; COND. C		-25	μA	3413
5	V _{DS(on)1}	V _{GS} = -10V; I _D = -4.1A; COND. A; PULSED*		0.3	Ω	3421
6	V _{DS(on)}	V _{GS} = -10V; I _D = -6.5A; COND. A; PULSED*		-2.1	V	3405
7	V _{SD}	V _{GS} = 0; I _S = -6.5A; PULSED*	-2	-4.3	V	4011
8	t _{FS}	I _D = -4.1A; PULSED*	2.5	7.5	S	3475
9	T _{ON}	I _D = -3.25A; V _{SD} = -50V R _{GEN} = 15 Ω; R _{GS} = 15 Ω		60	ns	3472
10	T _{OFF}	CONDITIONS SAME AS T _{ON}		140	ns	3472
DELTA LIMITS : ΔI _{GSS1} = ±20nA OR ±100%; WHICHEVER IS GREATER. ΔI _{DSS1} = ±25μA OR ±100%; WHICHEVER IS GREATER ΔV _{DS(on)} = ±20% ΔV _{GS(th)1} = ±20% t _{pulse} = 800μS DUTY CYCLE ≤ 2%						

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for JTXV2N6849

1/

Parameters		Spec. Limits		Total Dose Exposure (krads)											
				Initials		2.5		5		7.5		10		15	
				min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
-VBDSS	V			Pass		Pass		Pass		Pass		Pass		Pass	
-VGS th	V	2	4	3.0	0	3.1	0	3.2	0	3.3	0	3.4	0	3.5	0
IGSS	nA	0	100	0.8	0.2	0.8	0.1	0.9	0	0.9	0	0.7	0	1.0	0.1
IGSSr	nA	0	100	0.8	0.1	0.4	0.1	0.5	0.1	0.7	0	0.8	0.1	0.8	0.2
-IDSS	uA	0	25	0	0	0	0	.01	0	.04	.01	0.18	.01	0.18	.01
RDS on	mO	0	300	250	1	253	2	264	1	271	1	284	3	274	1
-VDS on	V	0	2.1	1.94	.01	1.96	.01	1.97	.02	2.02	.01	2.26	.03	2.10	.07
-VSD	V	2	4.3	3.7	0	3.8	0	3.8	0	3.8	0	3.8	0	3.9	0.1
-VGS th	V	0	15	5.3	0.1	5.4	0.1	5.5	0.1	5.7	0	5.8	0.1	6.0	0.1
gfs	S	0.5	7.5	1.7	0	1.6	0	1.5	0	1.3	0	1.3	0	1.0	0
TON	ns	-	60	28	1	23	2	25	0	23	3	*		30	0
TOFF	ns	-	140	6	0	8	1	6	0	7	1	*		7	1
TR	ns	-	140	26	2	30	0	30	0	29	1	*		21	1
TF	ns	-	140	37	3	34	4	34	4	33	3	*		20	0

TABLE IV: (continued)

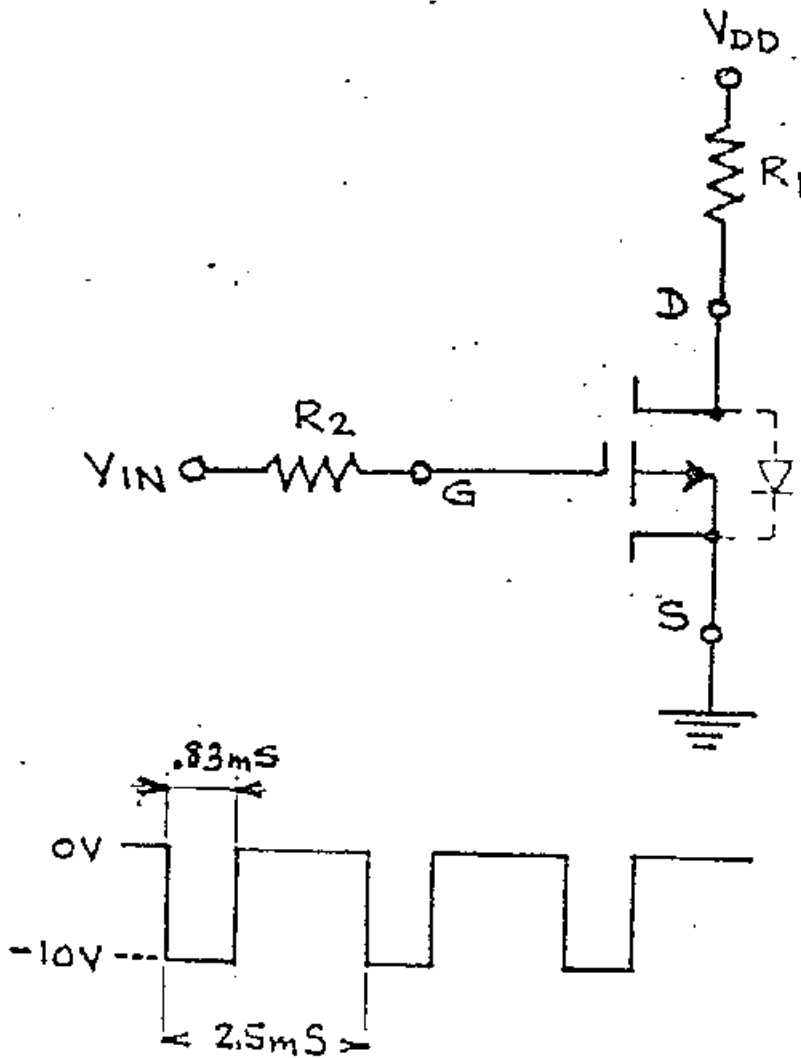
Parameters		Spec. Limits		Initials		Total Dose (krads)						Annealing			
						20		30		50		24 hrs		168 hrs	
		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
-VBDSS	V			Pass		Pass		Pass		Pass		Pass		Pass	
-VGS th	V	2	4	3.0	0	3.8	0.1	4.2	0	4.9	0.1	4.9	0.1	4.8	0
IGSS	nA	0	100	0.8	0.2	0.8	0.2	0.7	0.1	0.9	0.1	0.8	0.1	0.9	0
IGSSr	nA	0	100	0.8	0.1	0.8	0.2	0.9	0	0.8	0.2	0.4	0.1	0.6	0.1
-IDSS	uA	0	25	0	0	0.52	.05	0.80	0.15	0.76	0.12	0.9	0.1	1.2	0.3
RDS on	mO	0	300	260	1	310	12	302	4	293	2	296	2	308	1
-VDS on	V	0	2.1	1.94	.01	2.46	.06	2.42	.03	2.4	0	2.4	0	2.5	0
-VSD	V	2	4.3	3.7	0	4.0	0.1	3.9	0.1	3.8	0.1	3.8	0	3.8	0.1
-VGS th	V	0	15	5.3	0.1	6.1	0	6.8	0.1	7.4	0.1	7.5	0.1	7.4	0.1
gfs	S	0.5	7.5	1.7	0	1.0	0	0.7	0	0.35	0	0.37	0	0.42	0
TON	ns	-	60	28	1	29	1	*		*		*		*	
TOFF	ns	-	140	6	0	7	1	*		*		*		*	
TR	ns	-	140	26	2	25	1	*		*		*		*	
TF	ns	-	140	37	2	20	0	*		*		*		*	

Notes:

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

* indicates that no timing measurements could be made because the maximum drain current that could be obtained was less than 3.25A, which is the amount of ID required by the test setup for these tests.

Figure 1. Radiation Bias Circuit for JTXV2N6849



$$V_{IN} = -10\text{V} @ f = 400\text{Hz} \Rightarrow T = 2.5\text{mS}$$

$$V_{DD} = -28 \pm .5\text{V}$$

$$R_1 = 1\text{K}\Omega @ 1\text{W}$$

$$R_2 = 10\text{K}\Omega @ \frac{1}{4}\text{W}$$