PPM-91-538

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UNISYS

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Interoffice Memorandum

To
J. Lohr
Department
Code 311
From
K. Sahu KS
Department
7809
Subject
Radiation Report on ISTP/WAVES
Part No. IRHF7230

PPM-91-538
Date
Sept. 10, 1991
Location
GSFC
Telephone
731-8954
Location
Lanham
cc
R. Sharma
S. Esmacher

A radiation evaluation was performed on IRHF7230 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. Parts were separated into two test groups of five parts each. In each group, four parts were irradiated and one part was used as a control sample. During the radiation testing, Test Group A (TGA) parts were irradiated without bias, while Test Group B (TGB) parts were irradiated under bias (see Figure 1 for bias configuration). 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 (cumulative), and then irradiation was continued to 100, 200 and 300 krads. The dose rate was between 0.1 - 5.0 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 according to the test conditions and the specification limits listed in Table III.

All four parts in Test Group A and all four parts in Test Group B passed all tests on irradiation up to 300 krads. Tables IVA and IVB provide the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments for Test Group A and Test Group B, respectively.

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:	IRHF7230
ISTP/WAVES Part Number:	IRHF7230
ISTP/WAVES Control Number:	4579
Charge Number:	C14432
Manufacturer:	International Rectifier
Lot Date Code:	9033
Quantity Tested:	10
Serial Numbers of Radiation Samples:	7, 8, 9, 10 (TGA) 2, 3, 4, 5 (TGB)
Serial Numbers of Control Samples:	6 (TGA) 1 (TGB)
Part Function:	N-Channel Power MOSFET
Part Technology:	MOSFET
Package Style:	TO-205
Test Engineer:	Anh Phung

TABLE II. Radiation Schedule for TGA and TGB

EVENTS	DATE
1) Initial Electrical Measurements	07/09/91
2) 2.5 krads irradiation @ 125 rads/hr	07/15/91
Post 2.5 krads Electrical Measurements	07/16/91
3) 5 krads irradiation @ 125 rads/hr	07/16/91
Post 5 krads Electrical Measurements	07/17/91
4) 7.5 krads irradiation @ 125 rads/hr	07/17/91
Post 7.5 krads Electrical Measurements	07/18/91
5) 10 krads irradiation @ 125 rads/hr	07/18/91
Post 10 krads Electrical Measurements	07/19/91
6) 15 krads irradiation @ 75 rads/hr	07/19/91
Post 15 krads Electrical Measurements	07/22/91
7) 20 krads irradiation @ 250 rads/hr	07/22/91
Post 20 krads Electrical Measurements	07/23/91
8) 30 krads irradiation @ 500 rads/hr	07/23/91
Post 30 krads Electrical Measurements	07/24/91
9) 50 krads irradiation @ 1000 rads/hr	07/24/91
Post 50 krads Electrical Measurements	07/25/91
10) 24 hour annealing	07/25/91
Post 24 hr Electrical Measurements	07/26/91
11) 168 hour annealing	07/25/91
Post 168 hr Electrical Measurements	08/01/91
12) 100 krads irradiation @ 2500 rads/hr	08/01/91
Post 100 krads Electrical Measurements	08/02/91
13) 200 krads irradiation @ 1470 rads/hr	08/02/91
Post 200 krads Electrical Measurements	08/05/91
14) 300 krads irradiation @ 5000 rads/hr	08/05/91
Post 300 krads Electrical Measurements	08/06/91

Notes:

- All parts in TGB were irradiated under bias at the ^{60}Co gamma-ray facility at GSFC.
- All electrical measurements were performed off-site at 25°C.
- Annealing of parts in TGB performed at 25°C under bias.

Table III. Electrical Characteristics of IRHF7230

T_A = 25°C UNLESS OTHERWISE SPECIFIED

NO.	PARAMETER	TEST CONDITION	MIN	MAX	UNIT	METHOD
1	BV_{DSS}	V_{GS} = 0 I_D = 1mA	200		V	3407
2	$R_{DS(ON)1}$	V_{GS} = 12V I_D = 3.5A, PULSED*		0.40	Ω	3421
3	$R_{DS(ON)2}$	V_{GS} = 12V I_D = 5.5A, PULSED*		0.45	Ω	3421
4	$V_{GS(th)}$	V_{DS} = V_{GS} I_D = 1mA	2	4	V	3403
5	g_{FS}	V_{DS} = 15V I_{DS} = 3.5A, PULSED*	2.5		S(℧)	3475
6	I_{DSS1}	V_{DS} = 200V V_{GS} = 0		25	μA	3413
7	I_{GSS1}	V_{GS} = 20V		100	nA	3411
	I_{GSS2}	V_{GS} = -20V		-100	nA	3411
9	V_{SD}	V_{GS} = 0 I_S = 5.5A, PULSED*		1.4	V	4011
1	I_{DSS2}	V_{DS} = 200V V_{GS} = 0, T_A = 125°C		250	μA	3413
10	$t_{D(ON)}$	V_{DD} = 100V I_D = 5.5A, R_{GS} = R_{GEN} = 7.5Ω		30	nS	3472
11	$t_{D(OFF)}$	—〃—		50	nS	3472
12	t_r	—〃—		50	nS	3472
13	t_f	—〃—		40	nS	3472

DELTA LIMITS : $\Delta I_{GSS1\&2}$ = ±20nA OR ±100%, WHICHEVER IS GREATER.
ΔI_{DSS} = ±15μA OR ±100%, WHICHEVER IS GREATER.
$\Delta V_{GS(th)}$ = ±20%

*t_{pulse} = 800μS, DUTY CYCLE = 2% SEE ATTACHED MEMO.

TABLE IVA: Summary of Elec. .l Measurements after
Total Dose Exposures and Annealing for IRHF7230 1/

Group A - Parts irradiated without bias

				Total Dose Exposure (krads)															
			Initials		2.5		5		7.5		10		15		20		30		
	Spec. Limits																		
Parameters	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	
VBDSS V	200		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
VGSth V	2	4	3.9	.01	3.9	.01	3.9	.03	3.8	.06	3.8	.01	3.7	.03	3.7	1.0	3.5	.04	
IGSS nA	0	100	1.0	.05	1.1	.07	1.0	.03	1.1	.07	1.1	.07	1.3	.13	1.2	0.1	1.0	.03	
IGSSr nA	0	100	0.8	.17	0.7	.07	0.8	0	0.8	.03	0.8	0	0.9	0.1	0.8	0.3	0.8	.07	
IDSS nA	0	25E3	4.9	0.5	4.8	0.4	5.4	0.4	8.9	1.8	6.8	0.4	8.9	0.5	9.8	0.6	12.5	0.8	
RDS1on mOhm	0	400	303	0.4	310	3.1	306	2.8	327	9.3	303	6.3	318	5.4	338	11.3	315	13.4	
RDS2on mOhm	0	450	320	0.6	327	3.7	324	3.6	345	10.5	320	0.6	335	5.3	349	8.5	327	8.6	
VSD V	0	1.4	1.17	0	1.24	.01	1.21	.02	1.23	.03	1.19	.01	1.24	.03	1.30	.03	1.20	.03	
VGSth V	0	15	5.84	0	5.84	.01	5.81	.01	5.78	.01	5.78	.01	5.76	.01	5.74	.01	5.69	.02	
gfs Mho	2.5		3.64	.03	3.57	.02	3.63	.04	3.59	.03	3.65	.04	3.62	.02	3.61	.03	3.61	.03	
Td(on) ns		30	29	0.3	28	0.3	27	0.3	28	0.3	28	0	29	0.3	28	0.3	28	0.3	
Td(off) ns		50	8	0.3	9	0.3	8	0.3	9	0.3	8	0.3	9	0.3	9	0.3	9	0.3	
Tr ns		50	23	3.0	21	3.0	20	0.7	18	0.7	16	0.3	17	1	19	0.3	19	0.3	
Tf ns		40	9	0.3	9	0.3	9	0.7	9	0.3	7	0.3	8	0.3	8	0	9	0.3	

TABLE IVA(...t.)

Group A - Parts irradiated without bias

Parameters		Spec. Limits min	max	Initials mean	sd	TDE (kRads) 50 mean	sd	Annealing 24 hrs mean	sd	168 hrs mean	sd	Total Dose (krads) 100 mean	sd	200 mean	sd	300 mean	sd
VBDSS	V	200		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VGSth	V	2	4	3.9	.01	3.4	.05	3.4	.06	3.4	.06	3.2	.05	3.1	.03	3.2	.01
IGSS	nA	0	100	1.0	.05	1.1	.07	1.2	.03	1.0	.03	1.0	.03	1.1	.07	1.1	.07
IGSSr	nA	0	100	0.8	.17	0.8	.17	0.9	.03	0.7	.07	0.7	.03	0.9	.03	0.8	.03
IDSS	nA	0	25E3	4.9	0.5	16.6	1.1	17.4	0.7	16.8	0.8	25.1	0.9	57.6	4.8	97.9	8.5
RDS1on	mOhm	0	400	303	0.4	336	9.4	314	11.1	328	13.3	318	14.0	309	4.6	322	9.1
RDS2on	mOhm	0	450	320	0.6	342	5.5	328	8.2	337	8.9	332	11.2	326	5.3	338	6.7
VSD	V	0	1.4	1.17	0	1.27	.01	1.19	.03	1.24	.04	1.22	.04	1.15	.03	1.16	.03
VGSth	V	0	15	5.64	0	5.64	.01	5.65	.02	5.66	.02	5.67	.01	6.04	.04	6.52	.06
gfs	Mho	2.5		3.64	.03	3.57	.04	3.56	.04	3.58	.05	3.54	.03	3.47	.03	3.43	.05
Td(on)	ns		50	29	0.3	28	0.3	28	0.3	28	0.3	27	0.3	27	0.3	27	0.7
Td(off)	ns		50	8	0.3	9	0.3	10	0.7	9	0.3	10	0.7	10	0.7	8	0.7
Tr	ns		50	23	3.0	18	1	17	0.3	19	0.3	20	0.3	19	0.3	19	0
Tf	ns		40	9	0.3	8	0.3	8	0.3	9	0.3	9	0.7	8	0.7	7	0.7

Note:

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.

TABLE IVB: Summary of Ele[illegible]al Measurements after Total Dose Exposures and Annealing for IRHF7230 1/

Group B - Parts irradiated under bias

Parameters		Spec. Limits min	Spec. Limits max	Initials mean	Initials sd	Total Dose Exposure (krads) 2.5 mean	2.5 sd	5 mean	5 sd	7.5 mean	7.5 sd	10 mean	10 sd	15 mean	15 sd	20 mean	20 sd	30 mean	30 sd
VBDSS	V	200		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VGSth	V	2	4	3.9	.03	3.9	.02	3.9	.02	3.8	.02	3.9	.02	3.8	.02	3.8	.02	3.8	.02
IGSS	nA	0	100	0.8	.03	1.1	.07	1.1	.07	1.1	.07	0.9	0	1.0	.03	1.1	.07	1.1	.07
IGSSr	nA	0	100	0.6	0.1	0.6	.07	0.8	.03	0.8	.03	0.7	.07	0.9	.07	0.8	.07	0.8	.03
IDSS	nA	0	25E3	4.3	0.2	4.6	.07	5.3	0.1	6.3	.07	6.4	.03	8.2	0.2	9.2	0.2	15.0	1.9
RDS1on	mOhm	0	400	301	1.8	322	3.7	314	1.4	325	4.2	306	5.7	315	9.3	344	11.3	321	8.4
RDS2on	mOhm	0	450	318	1.9	341	5.1	332	1.5	344	4.1	320	3.0	327	5.6	348	7.0	335	6.8
VSD	V	0	1.4	1.16	.01	1.31	.02	1.25	.01	1.29	.02	1.19	.02	1.21	.03	1.32	.03	1.22	.03
VGSth	V	0	15	5.78	.01	5.80	.02	5.80	.01	5.79	.02	5.79	.02	5.80	.01	5.80	.01	5.78	.02
gfs	Mho	2.5		3.69	.01	3.67	.03	3.68	.03	3.66	.01	3.71	.04	3.69	.05	3.67	.02	3.67	.01
Td(on)	ns		30	28	0.3	28	0.3	26	0.3	27	0.7	28	0	28	0.3	29	0.3	28	0.3
Td(off)	ns		50	9	0.3	9	0.3	8	0.7	9	0.3	9	0.3	9	0.3	11	0.3	9	0.3
Tr	ns		50	18	0.7	17	1	20	0.7	17	0.3	17	0.3	19	0.3	20	0.3	19	0.3
Tf	ns		40	8	0.3	8	0.3	8	0.3	8	0	7	0	7	0.3	8	0.3	8	0.3

Table IVB continued on next page.

TABLE IVB(cont.)

Group B - Parts irradiated under bias

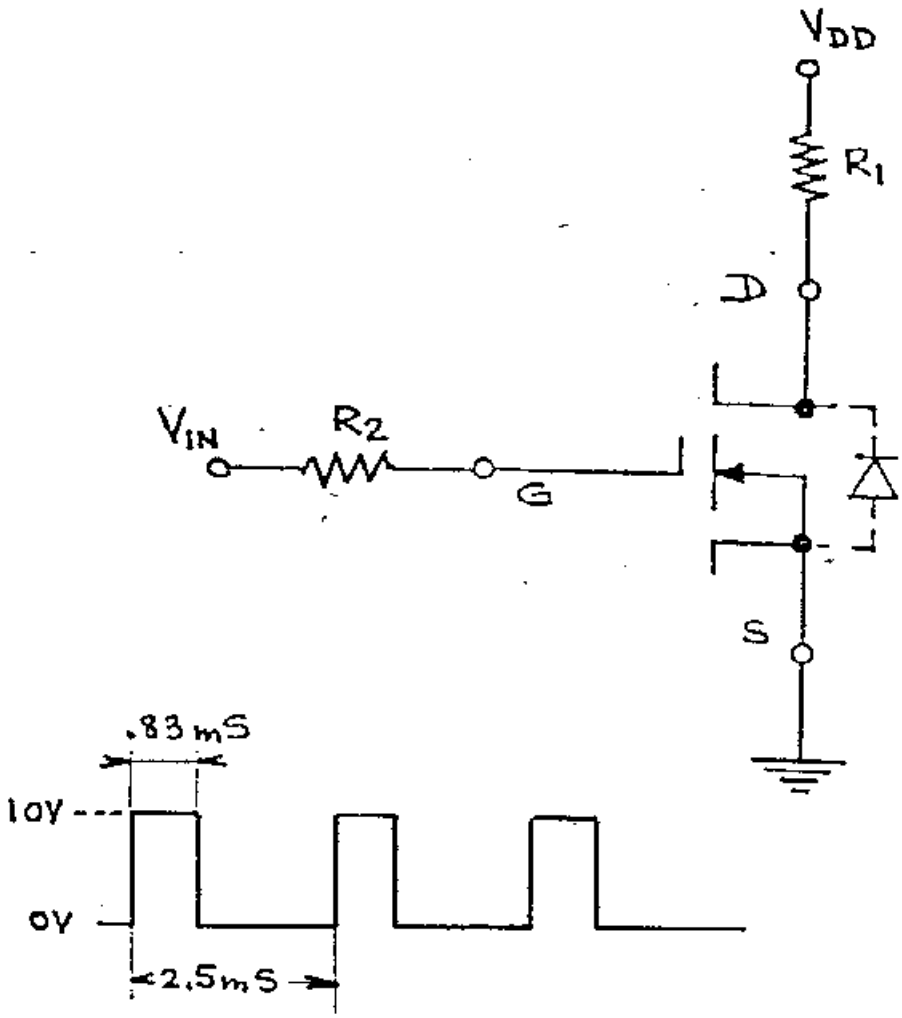
Parameters		Spec. Limits min	Spec. Limits max	Initials mean	Initials sd	TDE (kRads) 50 mean	TDE (kRads) 50 sd	Annealing 24 hrs mean	Annealing 24 hrs sd	Annealing 168 hrs mean	Annealing 168 hrs sd	Total Dose (krads) 100 mean	Total Dose (krads) 100 sd	Total Dose (krads) 200 mean	Total Dose (krads) 200 sd	Total Dose (krads) 300 mean	Total Dose (krads) 300 sd
VBDSS	V	200		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VGSth	V	2	4	3.9	.03	3.7	.02	3.8	.02	3.8	.02	3.7	.01	3.8	.01	3.9	.01
IGSS	nA	0	100	0.8	.03	1.1	0	1.0	.03	1.1	.07	0.9	.03	1.0	.03	1.0	.03
IGSSr	nA	0	100	0.6	0.1	0.8	0.1	0.7	.07	0.8	.07	0.7	.07	0.8	.07	0.9	.07
IDSS	nA	0	25E3	4.3	0.2	16.9	0.4	15.5	0.2	14.5	0.3	23.4	0.4	41.9	0.4	61.9	0.7
RDS1on	mOhm	0	400	301	1.8	315	2.4	330	5.9	307	3.2	309	4.5	318	3.8	317	1.4
RDS2on	mOhm	0	450	318	1.9	332	2.8	343	4.0	325	4.1	325	2.5	335	4.1	335	1.4
VSD	V	0	1.4	1.16	.01	1.22	.01	1.27	.02	1.19	.02	1.19	.02	1.22	.02	1.18	.01
VGSth	V	0	15	5.78	.01	5.81	.02	5.84	.01	5.89	.02	5.96	.03	6.40	.03	6.80	.04
gfs	Mho	2.5		3.69	.01	3.67	.02	3.68	.01	3.67	.01	3.65	.02	3.61	.01	3.63	.04
Td(on)	ns		30	28	0.3	28	0	28	0.3	28	0	27	0.3	27	0.3	27	0.3
Td(off)	ns		50	9	0.3	9	1	8	0	8	0.3	8	0	9	0.7	7	0.3
Tr	ns		50	18	0.7	16	0.7	18	0	19	0.3	20	0	20	0	21	0.3
Tf	ns		40	8	0.3	7	0.3	7	0	8	0.3	8	0.3	8	0.3	8	0.3

Note:

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.

Figure 1. Radiation Bias Circuit for IRHF7230

(Test Group B only)



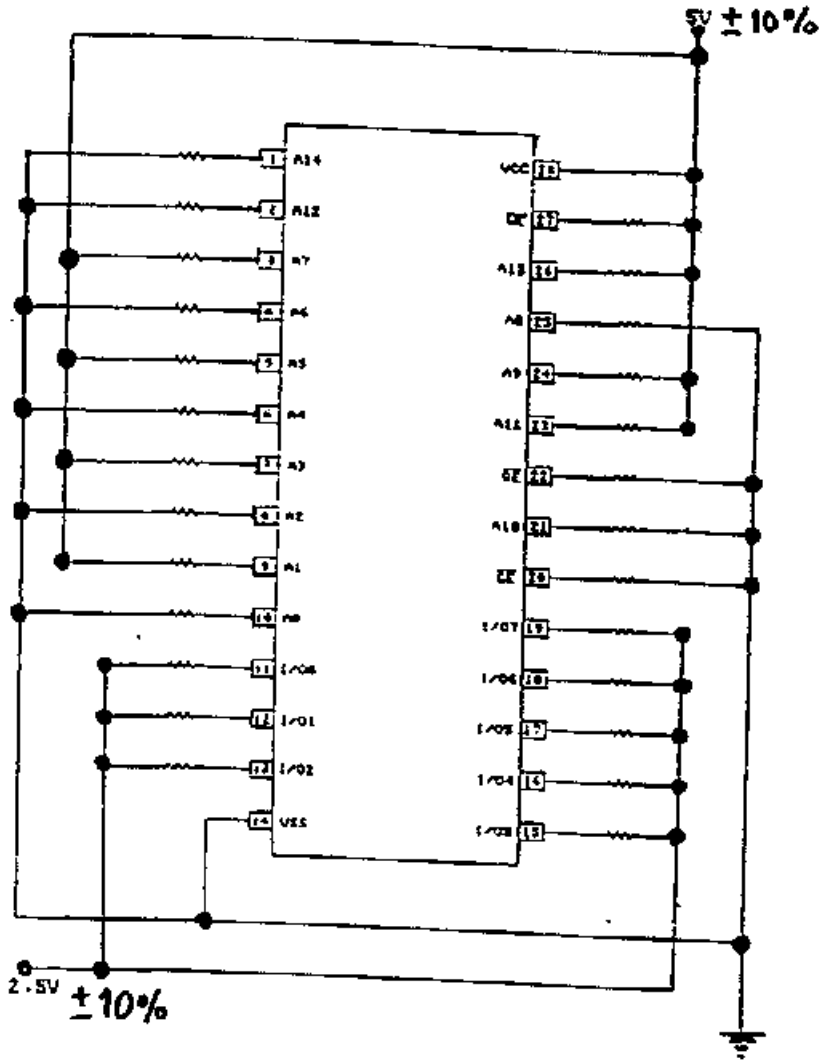
V_{IN} = 10V @ f = 400Hz ⇒ T = 2.5mS

V_{DD} = 28 ± 0.5V

R_1 = 1KΩ ± 5%, 1W

R_2 = 10KΩ ± 5% 1/4W

Figure 1. Radiation Bias Circuit for DM28C256



Note: All resistors are 2K Ohms ±10%, 1/4 watt.