

Unisys

DATE: April 10, 1998
TO: S. Hull/562
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SUBJECT: Radiation Report on: **2N4858 (Motorola) (LDC 9333)**
Project: MAP Subsystems
Job #: C80720
Project part #: JANTXV2N4858

PPM-98-003

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A radiation evaluation was performed on **JANTXV2N4858 N-Channel J-FET transistor (Motorola)** 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^{60} gamma ray source. During the radiation testing, three parts were irradiated under bias (see Figure 1 for bias configuration) and one part was used as a control sample. The total dose radiation levels were 5.0, 10.0, 15.0, 20.0, 30.0, 50.0, 75.0, and 100.0 kRads.* The dose rate was between 0.250 and 1.250 Rads/hour (0.069 to 0.347 Rads/s). After the 100.0 kRad irradiation, the parts were annealed for 168 hours at 25°C. See Table II for the radiation schedule and effective dose rate calculation. The effective dose rate over all testing was 0.072 Rads/sec. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits** listed in Table III.

Initial electrical measurements were made on 4 samples. Three samples (SN's 88, 89 and 90) were used as radiation samples while SN 87 was used as a control sample. All parts passed all tests during initial electrical measurements.

All parts passed all tests through 100 kRads.

After annealing the parts for 168 hours at 25°C, parts showed no significant change in any parameter.

Table IV provides a summary of the test results with the mean and standard deviation values for each parameter after each irradiation exposure and annealing step.

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 radiation levels cited are cumulative.

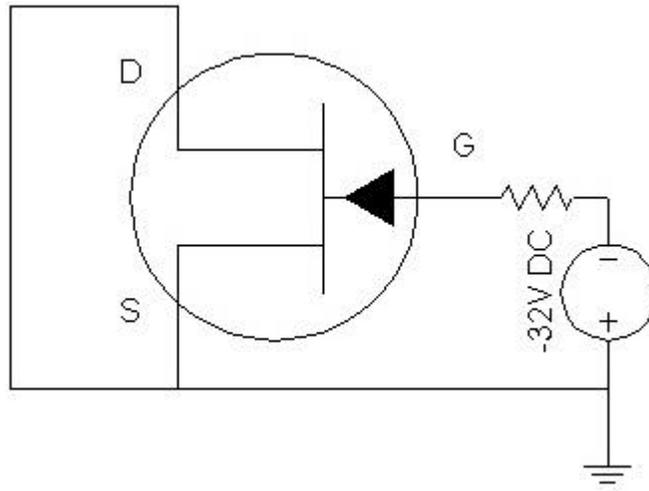
** These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for 2N4858



Resistor is $10\text{k}\Omega \pm 5\%$, $\frac{1}{2}\text{W}$.

TABLE I. Part Information

Generic Part Number:	2N4858
MAP Subsystem Part Number	JANTXV2N4858
Charge Number:	C80720
Manufacturer:	Motorola
Lot Date Code (LDC):	9333
Quantity Tested:	4
Serial Number of Control Samples:	87
Serial Numbers of Radiation Samples:	88, 89 and 90
Part Function:	N-Channel J-FET Transistor
Part Technology:	J-FET
Package Style:	TO-5
Test Equipment:	Testronics/Bench Tests
Test Engineer:	S. Norris/B. Chong

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for 2N4858

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	02/20/98
2) 5.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	02/24/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	02/25/98
3) 10.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	02/27/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/02/98
4) 15.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	03/02/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/03/98
5) 20.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	03/03/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/04/98
6) 30.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	03/04/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/06/98
7) 50.0 KRAD IRRADIATION (1.000 KRADS/HOUR)	03/06/98
POST-50.0 KRAD ELECTRICAL MEASUREMENT	03/09/98
8) 75.0 KRAD IRRADIATION (1.250 KRADS/HOUR)	03/09/98
POST-75.0 KRAD ELECTRICAL MEASUREMENT	03/10/98
9) 100.0 KRAD IRRADIATION (1.250 KRADS/HOUR).....	03/10/98
POST-100.0 KRAD ELECTRICAL MEASUREMENT	03/11/98
10) 168 HOUR ANNEALING @25°C	03/11/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	03/17/98

Effective Dose Rate = 100,000 RADS/16 DAYS=260.4 RADS/HOUR=0.072 RADS/SEC

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

Table III. Electrical Characteristics of 2N4858 /1

Test #	Parameter	Units	Test Conditions	Spec. min	Lim. max
1	VBRGSS	V	$I_G = -1\text{mA}$, $V_{DS} = 0\text{V}$	40	
2	IDSS	mA	$V_{DS} = 15\text{V}$, $V_{GS} = 0\text{V}$, pulsed	8	80
3	VDS on	V	$I_D = 5\text{mA}$, $V_{GS} = 0\text{V}$	0	0.5
4	RDS on	Ω	$V_{GS} = 0\text{V}$, $I_D = 0\text{A}$, $I_d = 100\text{mA ac(rms)}$	0	60
5	Vgs off	V	$V_{DS} = 15\text{V}$, $I_D = 500\text{pA}$		0.1
6	Id off	pA	$V_{DS} = 15\text{V}$, $V_{GS} = -10\text{V}$	-250	250
7	Igss	pA	$V_{GS} = -20\text{V}$, $V_{DS} = 0\text{V}$	-250	

Notes:

1/ These are the manufacturer's non-irradiated data sheet specification limits. The manufacturer provided no post-irradiation limits at the time the tests were performed.

2/ Vgs off, Io off, and Igss were measured on the bench due to limitations in the automatic tester.

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 2N4858 /1

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads)																		Annealing			
					Initial		5.0		10.0		15.0		20.0		30.0		50.0		75.0		100.0		168 hours @25°C			
			min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	VBRGSS	V	40		P		P		P		P		P		P		P		P		P		P		P	
2	IDSS	mA	8	80	42.8	3.1	45.0	4.8	45.5	5.1	44.6	5.0	43.9	4.5	45.2	5.1	45.2	4.7	45.6	4.5	46.0	4.9	44.2	4.6		
3	VDS on	V	0.5		0.16	0.01	0.16	0.01	0.16	0.01	0.16	0.01	0.16	0.01	0.16	0.01	0.16	0.01	0.16	0.01	0.16	0.01	0.16	0.01	0.16	0.01
4	RDS on	W		60	29	1.7	29	1.7	28	1.9	29	1.7	29	1.2	29	1.7	29	1.7	29	1.7	29	1.4	29	1.7		
5	Vgs off	V	-4.0	-0.8	-3.4	0.2	-3.4	0.2	-3.5	0.2	-3.4	0.2	-3.4	0.2	-3.4	0.2	-3.5	0.2	-3.4	0.2	-3.4	0.2	-3.6	0.2		
6	Id off	pA	-250	250	51	1	2	0.5	7	1	2	1	-10	4	-13	6	-18	12	-37	16	-44	18	-29	11		
7	Igss	pA	-250	250	-9	1	-8	1	-28	7	-26	8	-53	15	-59	22	-84	19	-117	29	-135	35	-143	55		

Notes:

- 1/ The mean and standard deviation values were calculated over the three parts irradiated in this testing. The control samples remained constant throughout the testing and are 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.

Radiation sensitive parameters: None.