

# UNISYS

DATE: April 28, 1997  
 TO: J. Lohr/311  
 FROM: K. Sahu/300.1 /ks  
 SUBJECT: Radiation Report on: JTXV2N6661  
           Project: MIDEX-MAP  
           Job #: EE78114  
           Project part #: JTXV2N6661

PPM-97-010

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A radiation evaluation was performed on JTXV2N6661 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. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration) and two parts were used as control samples. The total dose radiation levels were 2.5, 5.0, 7.5, 10.0, 15.0, 20.0, and 30.0 kRads.\* The dose rate was between 0.06 and 0.25 kRads/hour (see Table II for radiation schedule). Between the 10.0 and 15.0 kRad exposures, the parts were annealed for 72 hours at 25°C. Between the 15.0 and 20.0 kRad exposures, the parts were annealed for 120 hours at 25°C. After the 30.0 kRad radiation exposure, all parts were annealed for 168 hours at 25°C. 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 10 samples. Eight samples (SN's 238, 239, 240, 241, 242, 243, 244, and 245) were used as radiation samples while SN's 236 and 237 were used as control samples. All parts passed all tests during initial electrical measurements.

After the 2.5, 5.0 and 10.0 kRad irradiation, all parts passed all tests, although significant degradation was observed in VGSth. The VGSth readings were in the range of 0.90 to 0.98 V against the specification limit of 0.8 V. No significant degradation was observed in any other parameter.

After annealing the parts for 72 hours at 25°C, the parts showed some recovery in VGSth, with readings in the range of 0.96 to 1.05 V.

After 15 kRads, all parts failed to meet the specification limit for VGSth. The readings for VGSth were in the range of 0.66 to 0.76 V. Parts also showed significant degradation in IDSS, although all parts measured less than the maximum specification limit of 1000 nA for this parameter.

After annealing the parts for 120 hours at 25°C, the parts showed some recovery in VGSth, with the readings in the range of 0.72 to 0.84 V.

After 20 kRads, increased degradation was observed in VGSth and IDSS. Readings for these parameters ranged from 0.49 to 0.58 V and 15.0 to 25.0  $\mu$ A, respectively. All parts also failed to meet the specification limit of 90 V for VBDSS.

\* 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.

After annealing the parts for 120 hours at 25°C, the parts showed some recovery in VGSth, IDSS and VBDSS. Readings for VGSth and IDSS ranged from 0.55 to 0.65 V and 4.0 to 22.0  $\mu$ A respectively. Three parts passed VBDSS test.

After 30 kRads, the parts showed increased degradation VGSth, IDSS and VBDSS. Readings for VGSth and IDSS ranged from 0.00 to 0.04 V and 1.0 to 4.0 mA respectively. All parts failed VBDSS test.

After annealing the parts for 168 hours at 25°C, the parts showed some recovery in VGSth and IDSS.

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.

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Figure 1. Radiation Bias Circuit for JTXV2N6661

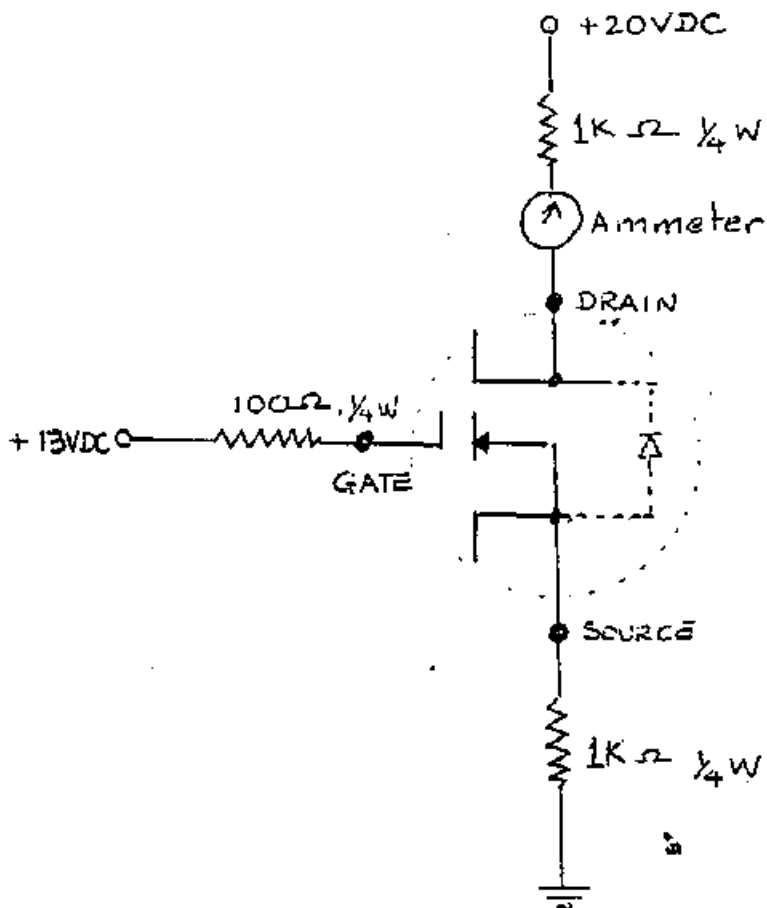


Figure 1 : Radiation bias circuit

NOTES:

- Monitor total DRAIN supply current.
- Record total DRAIN supply current initially, after each RAD exposure and Annealing step.

ax 3/11/97

TABLE I. Part Information

Generic Part Number:	2N6661
EO-1 Part Number	JTXV2N6661
Charge Number:	EE78144
Manufacturer:	SILICONIX
Lot Date Code (LDC):	9636
Quantity Tested:	10
Serial Number of Control Samples:	236, 237
Serial Numbers of Radiation Samples:	238, 239, 240, 241, 242, 243, 244, 245
Part Function:	Transistor
Part Technology:	N-Channel MOSFET
Package Style:	T0-5
Test Equipment:	Testronics
Tester:	J.Fogle

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

TABLE II. Radiation Schedule for JTXV2N6661

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	03/12/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR).....	03/12/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT.....	03/14/97
3) 5 KRAD IRRADIATION (0.062 KRADS/HOUR).....	03/14/97
POST-5 KRAD ELECTRICAL MEASUREMENT.....	03/17/97
4) 7.5 KRAD IRRADIATION (0.062 KRADS/HOUR).....	03/17/97
POST-7.5 KRAD ELECTRICAL MEASUREMENT.....	03/19/97
5) 10.0 KRAD IRRADIATION (0.062 KRADS/HOUR).....	03/19/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT.....	03/21/97
6) 72 HOUR ANNEALING @25°C.....	03/21/97
POST-72 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	03/24/97
7) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR).....	03/24/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT.....	03/26/97
8) 120 HOUR ANNEALING @25°C.....	03/26/97
POST-120 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	04/03/97
9) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR).....	04/03/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT.....	04/07/97
10) 168 HOUR ANNEALING @25°C.....	04/07/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	04/14/97
11) 30.0 KRAD IRRADIATION (0.180 KRADS/HOUR).....	04/14/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT.....	04/17/97
12) 168 HOUR ANNEALING @25°C.....	04/17/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	04/24/97

Effective Dose Rate = 30000 Rads/44 days = 28.4 Rads/ Hour =0.008 Rad/Sec.

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

Table III. Electrical Characteristics of JTXV2N6661

Test #	Parameters	Units	Test Conditions	Spec. Lim.	
				min	max
1	VBDSS	V	V <sub>gs</sub> =0V, I <sub>d</sub> =10 $\mu$ A <sub>dc</sub>	90	
2	IGSS	nA	V <sub>GS</sub> =+20V, V <sub>DS</sub> =0V		100
3	IGSSr	nA	V <sub>GS</sub> =-20V, V <sub>DS</sub> =0V		100
4	IDSS	nA	V <sub>GS</sub> =0V, V <sub>DS</sub> =72V <sub>dc</sub>		1000
5	VGSth	V	V <sub>DS</sub> $\geq$ V <sub>GS</sub> , I <sub>D</sub> =1.0mA <sub>dc</sub>	0.8	2
6	VDS on	V	V <sub>GS</sub> =10V, I <sub>D</sub> =1A, pulsed		4
7	VDS on	V	V <sub>GS</sub> =5V <sub>dc</sub> , I <sub>D</sub> =0.3A <sub>dc</sub> , pulsed		1.6
8	RDS on	ohm	V <sub>GS</sub> =10V <sub>dc</sub> , I <sub>D</sub> =1A <sub>dc</sub> , pulsed		4
9	RDson	ohm	V <sub>GS</sub> =5V <sub>dc</sub> , I <sub>D</sub> =0.3A <sub>dc</sub> , pulsed		5.3
10	VSD	V	V <sub>GS</sub> =0V, I <sub>S</sub> =0.86A <sub>dc</sub> , pulsed	0.7	1.4
13	gfs	mmho	V <sub>DS</sub> =7.5V <sub>dc</sub> , I <sub>D1</sub> =525mA, I <sub>D2</sub> =475mA, pulsed	170	

Note: VGSth tests 11-12-13 are used to calculate gfs. The minimum gfs limit is 170mmho. A dVGS maximum of 294mV corresponds to this. SPEC: MIL-S-19500/547A.