

Unisys

DATE: April 10, 1998
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SUBJECT: Radiation Report on: **2N5115 (Solitron) (LDC 9430)**
Project: MAP Subsystems
Job #: C80720
Project part #: JANTXV2N5115

PPM-98-004

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A radiation evaluation was performed on **JANTXV2N5115 P-Channel J-FET transistor (Solitron)** 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, 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 5.0, 10.0, 15.0, 20.0, 30.0, 50.0, 75.0, and 100.0 kRads.* The dose rate was between 0.125 and 1.250 Rads/hour (0.035 to 0.347 Rads/s). The effective dose rate over all testing was 0.089Rads/sec. See Table II for the radiation schedule and effective dose rate calculation. After the 100.0 kRad irradiation, the 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 77, 78, 79, 80, 81, 82, 83, and 84) were used as radiation samples while SN's 75 and 76 were used as control samples. All parts passed all tests during initial electrical measurements.

After the 5.0 kRad irradiation, SN81 catastrophically failed $I_d(\text{off})$ and I_{gss1} and was removed from further testing at this time. The failure does not appear to be due to radiation damage. **All other parts passed all tests up to 15 kRads.**

After the 20.0 kRad irradiation, SN's 78 and 84 marginally exceeded the specification limit for I_{gss1} with reading of 519pA and 640pA respectively. **All parts passed all other tests.**

After the 30.0, 50.0 and 75.0 kRad irradiations, all parts exceeded the specification limit for I_{gss1} with readings in the range of 770 to 2010pA. **All parts passed all other tests.**

After the 100.0 kRad irradiation, SN's 77, 79 and 84 marginally exceeded the specification limit of 500pA for $I_d(\text{off})$ with readings of 562, 513 and 569pA respectively. All parts continued to exceed the specification limit for I_{gss1} with readings in the range of 1360 to 1810pA. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, parts showed significant recovery in $I_d(\text{off})$ with all parts passing. All parts, however, showed a continued increase in I_{gss1} with readings in the range of 1820 to 2300pA. This increase indicates that the parts may show a greater increase in I_{gss1} when tested at lower dose rates than those used in this evaluation.

* 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.

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.

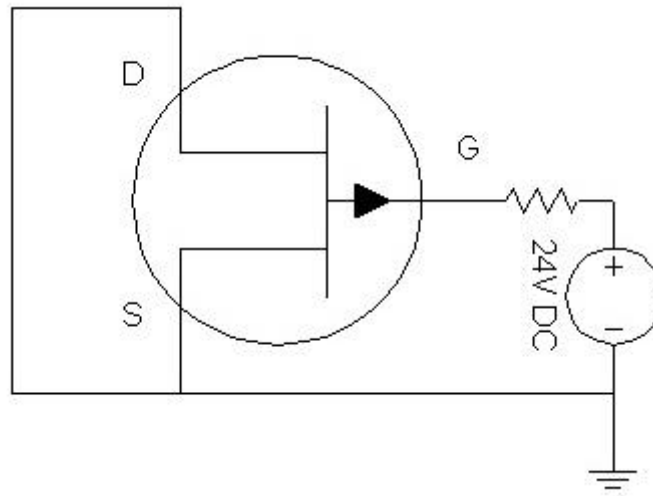
Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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Figure 1. Radiation Bias Circuit for 2N5115



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

TABLE I. Part Information

Generic Part Number:	2N5115
MAP Subsystem Part Number	JANTXV2N5115
Charge Number:	C80720
Manufacturer:	Solitron
Lot Date Code (LDC):	9430
Quantity Tested:	10
Serial Number of Control Samples:	75, 76
Serial Numbers of Radiation Samples:	77, 78, 79, 80, 81, 82, 82 and 84
Part Function:	P-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 2N5115

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	03/06/98
2) 5.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	03/06/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/09/98
3) 10.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	03/09/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/10/98
4) 15.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	03/10/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/11/98
5) 20.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	03/11/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/12/98
6) 30.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	03/12/98
POST-30.0 KRAD ELECTRICAL MEASUREMENT	03/13/98
7) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	03/13/98
POST-50.0 KRAD ELECTRICAL MEASUREMENT	03/16/98
8) 75.0 KRAD IRRADIATION (1.250 KRADS/HOUR)	03/16/98
POST-75.0 KRAD ELECTRICAL MEASUREMENT	03/17/98
9) 100.0 KRAD IRRADIATION (1.250 KRADS/HOUR).....	03/17/98
POST-100.0 KRAD ELECTRICAL MEASUREMENT	03/18/98
10) 168 HOUR ANNEALING @25°C	03/18/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	03/24/98

Effective Dose Rate = 100,000 RADS/13 DAYS=320.5 RADS/HOUR=0.089 RADS/SEC

The effective dose rate is lower than that of the individual radiation steps as it takes into account the time needed to test the parts.

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

Table III. Electrical Characteristics of 2N5115 /1

Test #	Parameter	Units	Test Conditions	Spec. min	Lim. max
1	IDSS	mA	$V_{DS} = -15V, V_{GS} = 0V$	15	60
2	VDS on	V	$I_D = -7mA, V_{GS} = 0V$	0	0.8
3	Id off	pA	$V_{DS} = -15V, V_{GS} = 7V$	-500	500
4	Igss	pA	$V_{GS} = 20V, V_{DS} = 0V$		500
5	Vgs off	V	$V_{DS} = -15V, I_D = 1nA$	3.0	6.0
6	RDS on	W	$V_{GS} = 0V, I_D = 0A, f = 1MHz$	0	100
7	VBRGSS	V	$I_G = 1mA, V_{DS} = 0V$	30	

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/ Id off, Igss, Vgs off, RDS on, and VBRGSS 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 2N5115 /1

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads)																				Annealing	
					Initial		5.0 /3		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	IDSS	mA	15	60	23	1.2	23	1.2	23	1.0	23	1.0	23	1.0	23	1.3	23	1.6	23	1.3	23	1.6	26	0.1		
2	VDS on	V	0	0.8	0.6	0.05	0.6	0.05	0.6	0.05	0.6	0.07	0.6	0.07	0.6	0.04	0.7	0.07	0.7	0.07	0.7	0.07	0.7	0.07	0.7	0.03
3	Id off	pA	-500	500	-6	4.3	17	11	92	9.4	137	28	138	12	173	17	312	57	380	53	504	49	378	45		
4	Igss1	pA		500	30	11	151	12	276	24	357	32	493	66	893	105	1241	113	1726	186	1531	154	2056	166		
5	Vgs off	V	3	6	4.4	0.6	4.5	0.6	4.4	0.6	4.3	0.6	4.4	0.6	4.4	0.6	4.4	0.6	4.4	0.6	4.4	0.6	4.4	0.6	4.4	0.6
6	Rds on	W		100	78	6	82	6	81	6	80	6	79	6	79	5	82	6	82	5	86	7	87	6		
7	VBRGSS /4	V	30		P		P		P		P		P		P		P		P		P		P			

Notes:

- 1/ The mean and standard deviation values were calculated over the eight 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.
- 3/ SN 81 failed catastrophically at this level and was removed from further testing at this time. The reason for the failure of this part is not known.
- 4/ VBRGSS is a Pass/Fail test. All parts passed all of these tests through 100kRads.

Radiation sensitive parameters: Id(off), Igss1.