

# Unisys

DATE: January 03, 2000  
TO: B. Forsbacka/562  
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SUBJECT: Radiation Report on **U310 (Siliconix) (LDC 9548)**  
PROJECT: HST/COS

PPM-99-043

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A radiation evaluation was performed on **U310 N-Channel JFET (Siliconix)** to determine the total dose tolerance of these parts. The total dose testing was performed using a  $\text{Co}^{60}$  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, 20.0, 30.0, and 50.0kRads.<sup>1</sup> The average dose rate was 0.16kRads/hour (0.05Rads/s). See Table II for the radiation schedule and average dose rate calculation. After the 50.0kRad irradiation, the parts were annealed under bias at 25°C for 168 hours.<sup>2</sup> After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits<sup>3</sup> listed in Table III. An executive summary of the test results is provided below in bold, followed by a detailed summary of the test results after each radiation level and annealing step.

**All parts passed all tests up to 30kRads. After the 50kRad irradiation, seven parts fell marginally below the specification limit for IGSS\_1. After annealing the parts at 25°C for 168 hours, the readings showed a slight continued decrease for IGSS\_1. See Figure 2 for more details. No significant change was noted in any other parameter.**

Initial electrical measurements were made on 10 samples. Eight samples (SN's 140, 141, 206, 412, 436, 455, 907, and 956) were used as radiation samples while SN's 039 and 327 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 30.0kRads.

After the 50kRad irradiation, seven parts fell marginally below the specification limit of -150pA for IGSS\_1 with readings in the range of -163 to -240pA. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, the parts showed a slight increase in the readings for IGSS\_1. No significant change was noted in any other 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 us at (301) 731-8954.

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<sup>1</sup> The term Rads, as used in this document, means Rads (silicon). All radiation levels cited are cumulative.

<sup>2</sup> The temperature 25°C as used in this document implies room temperature.

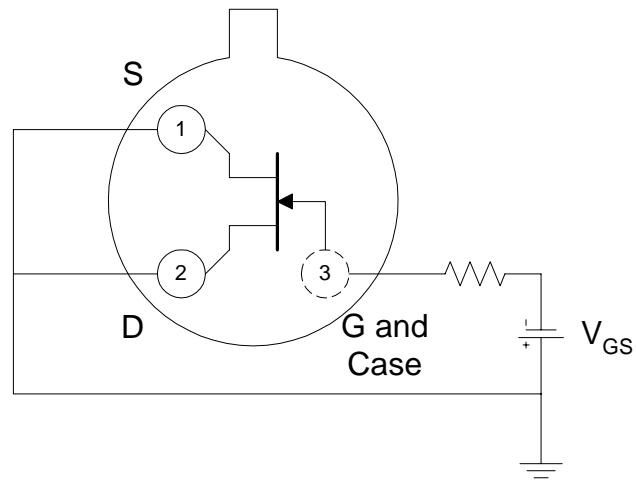
<sup>3</sup> These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation specification limits or radiation tolerance guarantees at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for U310



Notes:

1.  $V_{GS} = -20.0V \pm 0.2V$ .
2.  $R = 10k\Omega, 5\%, \frac{1}{2}W$ .
3. Top View.

TABLE I. Part Information

Generic Part Number:	U310
HST/COS Part Number	746-002D 17856
HST/COS TID Requirement	10kRads (RDM = 5)
Charge Number:	C00177
Manufacturer:	Siliconix
Lot Date Code (LDC):	9548
Quantity Tested:	10
Serial Numbers of Control Samples:	039, 327
Serial Numbers of Radiation Samples:	140, 141, 206, 412, 436, 455, 907, 956
Part Function:	N-Channel JFET
Part Technology:	JFET
Package Style:	3 Pin TO-52 Can
Test Equipment:	Testronics
Test Engineer:	S. Norris, N. Shah

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

TABLE II. Radiation Schedule for U310

EVENT .....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS .....	11/24/99
2) 5.0 KRAD IRRADIATION (0.125 KRADS/HOUR).....	12/06/99
POST-5.0 KRAD ELECTRICAL MEASUREMENT .....	12/08/99
3) 10.0 KRAD IRRADIATION (0.109 KRADS/HOUR).....	12/08/99
POST-10.0 KRAD ELECTRICAL MEASUREMENT .....	12/10/99
4) 20.0 KRAD IRRADIATION (0.144 KRADS/HOUR).....	12/10/99
POST-20.0 KRAD ELECTRICAL MEASUREMENT .....	12/13/99
5) 30.0 KRAD IRRADIATION (0.219 KRADS/HOUR).....	12/13/99
POST-30.0 KRAD ELECTRICAL MEASUREMENT .....	12/15/99
6) 50.0 KRAD IRRADIATION (0.172 KRADS/HOUR).....	12/15/99
POST-50.0 KRAD ELECTRICAL MEASUREMENT .....	12/21/99
7) 168 HOUR ANNEALING @25°C.....	12/21/99
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	12/27/99

Average Dose Rate = 50,000 RADS/304 HOURS=164.5 RADS/HOUR=0.05RADS/SEC

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

Table III. Electrical Characteristics U310 (1)

Test #	Parameter	Units	Spec. Limit		Test Conditions
			min	max	
1	IGSS_1	pA		-150	$V_{GS} = -15V, V_{DS} = 0V$
2	IGSS_2	nA		-1000	$V_{GS} = -25V, V_{DS} = 0V$
3	IDSS	mA	20	60	$V_{GS} = 0V, V_{DS} = 10V, \text{pulsed}$
4	VGS(F)	V		1.0	$I_G = 1mA, V_{DS} = 0V$
5	VGSoff	V	-1.0	-6.0	$I_D = 1nA, V_{DS} = 10V$

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.

**TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for U310 (**

Test #	Parameters	Units	Spec. Lim. (2)		Total Dose Exposure (kRads Si)												Annealing	
					Initial		5.0		10.0		20.0		30.0		50.0		168 hours @25°C	
					min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	IGSS_1	pA		-150	-12	0.6	-15	3.5	-22	5.5	-53	20	-85	17	-179	29	-240	45
2	IGSS_2	nA		-1000	0.3	0.1	0.2	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.4	0.1	0.6	0.2
3	IDSS	mA	20	60	21	0	21	0	21	0	21	0	21	0	21	0	21	0
4	VGS(F)	V		1.0	0.7	0	0.7	0	0.7	0	0.7	0	0.7	0	0.7	0	0.7	0
5	VGSoff	V	-1.0	-6.0	-2.8	0.3	-2.9	0.3	-2.8	0.3	-2.8	0.3	-2.8	0.3	-2.8	0.3	-2.8	0.3

Notes:

- (1) The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout testing.
- (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: IGSS\_1.**