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PPM-91-757

Date December 24, 1991

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Subject
Radiation Report on ISTP
Non-Common Buy Part No. U401-2

A radiation evaluation was performed on U401-2 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. 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 steps were 5, 10, 20, 50, and 100 krads*. After 100 krads, parts were annealed at 25°C for 24 and 168 hours, and then irradiation was continued to 200 and 300 krads (cumulative). The dose rate was between 0.1 - 5.4 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 eight parts passed initial electrical measurements. However, after the first radiation exposure to 5 krads, all parts exceeded the maximum specification limit of -25pA for IGSS. Readings for this parameter were approximately twice the specification limit. IGSS continued to increase on continued total exposures to 100 krads, although all parts passed all other testing parameters. At 100 krads, average IGSS measurements were approximately -30nA. IGSS readings decreased on annealing for 24 and 168 hours at 25°C, but these measurements were still well into the nano-Amps.

At 200 krads, all parts failed to meet the minimum specification limit for the gate-source breakdown voltage, $V_{(BR)GSS}$. At 300 krads, three parts also failed to meet the minimum specification limit for the gate-gate breakdown voltage, $V_{(BR)G1-G2}$. Table IV provides the mean and standard deviation values for each

parameter after different radiation exposures and annealing treatments.

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

*In this report, the term "rads" is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	U401-2
ISTP Non-Common Buy Part Number:	U401-2
ISTP Non-Common Buy Control Number:	2126
Charge Number:	C90267
Manufacturer:	Siliconix Inc.
Quantity Procured:	247
Lot Date Code:	9112
Quantity Tested:	10
Serial Numbers of Radiation Samples:	206, 207, 208, 209 210, 211, 212, 213
Serial Numbers of Control Samples:	204, 205
Part Function:	Dual, N-Channel Transistor
Part Technology:	JFET
Package Style:	TO-71
Test Engineer:	Anh Phung

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	10/25/91
2) 5 krads irradiation @ 80 rads/hr Post 5 krads Electrical Measurements	11/09/91 11/13/91
3) 10 krads irradiation @ 250 rads/hr Post 10 krads Electrical Measurements	11/13/91 11/14/91
4) 20 krads irradiation @ 550 rads/hr Post 20 krads Electrical Measurements	11/14/91 11/15/91
5) 50 krads irradiation @ 440 rads/hr Post 50 krads Electrical Measurements	11/15/91 11/18/91
6) 100 krads irradiation @ 2500 rads/hr Post 100 krads Electrical Measurements	11/18/91 11/19/91
7) 24 hrs annealing at 25°C Post 24 hr Electrical Measurements	11/19/91 11/20/91
8) 168 hrs annealing at 25°C Post 168 hr Electrical Measurements	11/19/91 11/26/91
9) 200 krads irradiation @ 5400 rads/hr Post 200 krads Electrical Measurements	11/26/91 11/27/91
10) 300 krads irradiation @ 2270 rads/hr Post 300 krads Electrical Measurements	11/27/91 11/29/91

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at 25°C.
- Annealing performed at 25°C under bias.

Table III. Electrical Characteristics of U401-2

Parameter	Test Conditions	Min	Max	Unit
$V_{(BR)G1-G2}$	$I_G = \pm 1\mu A$ $V_{DS} = V_{GS} = 0V$	± 50	--	V
$V_{(BR)GSS}$	$I_G = -1\mu A, V_{DS} = 0V$	-50	--	V
V_{GS}	$V_{DG} = 15V, I_D = 200\mu A$	--	-2.3	V
$ V_{GS1}-V_{GS2} $	$V_{DG} = 10V, I_D = 200\mu A$	--	5	mV
I_{DSS}^*	$V_{DS} = 10V, V_{GS} = 0V$	0.5	10	mA
I_{GSS}	$V_{GS} = -30V, V_{DS} = 0V$	--	-25	pA

$T_A = 25^\circ C$

* $t_{pulse} = 800\mu s, \text{ duty cycle} = 2\%$

Table IV. Summary of Electrical Measurements after
Total Dose Exposures and Annealing for U401-2 1/, 2/, 3/

Parameters	Spec. Limits min max	Pre-Rad		Total Dose Exposure (krads)										Anneal		Total Dose (krads)			
				5		10		20		50		100		168 hrs		200		300	
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VBR G1-G2 V	±50 -	Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		5P/3F	
VBR GSS1 (-)V	50 -	Pass		Pass		Pass		Pass		Pass		Pass		Pass		Fail		Fail	
VBR GSS2 (-)V	50 -	Pass		Pass		Pass		Pass		Pass		Pass		Pass		Fail		Fail	
VGS1 (-)V	- 2.3	1.0	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2
VGS2 (-)V	0 2.3	1.0	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2	1.1	0.2
VGS1-VGS2 mV	- 5	2.2	0.8	2.3	0.8	2.4	0.7	2.0	0.7	2.5	0.8	2.6	0.8	2.0	0.8	2.5	0.7	2.7	0.8
IDSS1 mA	0.5 10	4.1	0.4	4.2	0.4	4.2	0.4	4.2	0.4	4.3	0.4	4.2	0.4	4.2	0.4	4.2	0.4	4.2	0.4
IDSS2 mA	0.5 10	4.1	0.4	4.2	0.4	4.2	0.4	4.2	0.4	4.3	0.4	4.2	0.4	4.2	0.4	4.2	0.4	4.2	0.4
IGSS1 (-)pA	- 25	16	0.6	58	8	90	18	101	17	338	73	28E3	6E3	8E3	2E3	2E6	6E5	3E6	6E5
IGSS2 (-)pA	- 25	16	1.1	67	9	85	19	102	20	340	71	29E3	7E3	8E3	2E3	2E6	3E5	3E6	3E5

Notes:

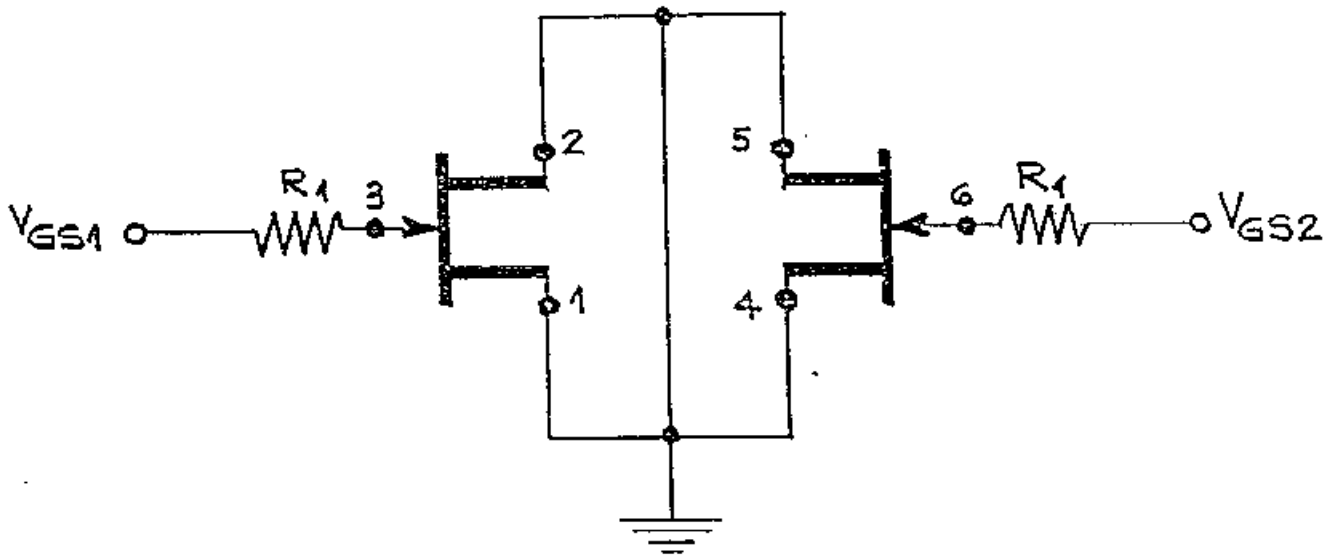
1/ The mean and standard deviation values were calculated over the eight irradiated parts. The control samples remained constant during testing and are not included in this table.

2/ Table IV does not include post 24-hour electrical measurement data. This data is available and can be obtained upon request.

3/ Test parameters ending with a "1" or "2" indicate which transistor was tested from each part. VBR G1-G2 was tested at two polarities. Table IV provides the number of parts which passed this test at both polarities at each step of testing.

Figure 1. Radiation Bias Circuit for U401-2

PIN #	1	SOURCE	1
	# 2	DRAIN	1
	# 3	GATE	1
	# 4	SOURCE	2
	# 5	DRAIN	2
	# 6	GATE	2



$$V_{GS1} = V_{GS2} = -40V$$

$$V_{DS1} = V_{DS2} = 0$$

$$R_1 = 100K \Omega$$