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PPM-92-114

DATE: March 24, 1992
TO: S. Pszcolka/311
FROM: K. Sahu/7809 *KS*
SUBJECT: Radiation Report on 4N49
(CDS/CS2 Project)

PARAMAX
A Unisys Company

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A radiation evaluation was performed on 4N49 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, 30 and 50 krads*. After 50 krads, parts were annealed at +25°C for 24 and 168 hours. The dose rate was between 0.15 and 1 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 at +25°C according to the test conditions and the specification limits listed in Table III.

Parts passed all tests and stayed within the specified limits up to 30 krads of irradiation. After 30 krads, 1 part failed to meet the minimum specification limits for IC(ON)1. After 50 krads of irradiation, 3 parts failed to meet the minimum specification limit for IC(ON)1. Also, after 50 krads of irradiation, 2 parts exceeded the maximum specification limit for IC(OFF)1. No significant degradation was observed in any other parameters. The parts showed no significant recovery after annealing for 24 and 168 hours at 25°C.

Table IV gives the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps.

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 rad as used here means rad(Si).

TABLE I. Part Information

Generic Part Number:	4N49
CDS/CS2 Part Number:	JTXV4N49
Control Number:	5112
Charge Number:	C23564
Manufacturer:	Texas Instruments
Lot Date Code:	9012
Quantity Tested:	10
Serial Numbers of Radiation Samples:	202, 203, 204, 205, 206, 207, 208, 209
Serial Number of Control Samples:	200, 201
Part Function:	Opto-Coupler
Part Technology:	Bipolar
Package Style:	TOX can
Test Engineer:	Anh Phung

TABLE II. Radiation Schedule for 4N49

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	02/18/92
2) 5- KRAD IRRADIATION (0.25 krads/hour)	02/25/92
POST-5-KRAD ELECTRICAL MEASUREMENT	02/26/92
3) 10-KRAD IRRADIATION (0.25 krads/hour)	02/26/92
POST-10-KRAD ELECTRICAL MEASUREMENT	02/27/92
4) 20-KRAD IRRADIATION (0.5 krads/hour)	02/27/92
POST-20-KRAD ELECTRICAL MEASUREMENT	02/28/92
5) 30-KRAD IRRADIATION (0.148 KRADS/HOUR)	02/28/92
POST-30-KRAD ELECTRICAL MEASUREMENT	03/02/92
6) 50 KRAD IRRADIATION (0.996 KRADS/HOUR)	03/02/92
POST-50-KRAD ELECTRICAL MEASUREMENT	03/03/92
7) 24 HOURS ANNEALING AT +25°C	03/03/92
POST-24-HOUR ELECTRICAL MEASUREMENT	03/04/92
8) 168 HOURS ANNEALING AT +25°C	03/04/92
POST-168-HOUR ELECTRICAL MEASUREMENTS	03/10/92

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT +25°C.

ALL PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

Table III. Electrical Characteristics of 4N49

TEST #	TEST NAME	TEST CONDITION	MIN	MAX	UNIT	METHOD
1	I_R	$V_R = 2V$		100	μA	401G
2	V_{F1}	$I_F = 10mA$	0.8	1.5	V	4011
3	V_{BRCEO}	$I_C = 1mA ; I_B = 0 ; I_F = 0$	40		V	3011
4	$V_{BR CBO}$	$I_C = 100\mu A ; I_F = 0 ; I_E = 0$	45		V	3001
5	V_{BREBO}	$I_E = 100\mu A ; I_C = 0 ; I_F = 0$	7		V	302G
6	$I_{C(OFF)1}$	$V_{CE} = 20V ; I_B = 0 ; I_F = 0$		100	nA	3041
7	$I_{CB(OFF)}$	$V_{CB} = 20V ; I_F = 0$		10	nA	
8	h_{FE}	$V_{CE} = 5V ; I_C = 10mA ; I_F = 0$	100			307G
9	$I_{C(ON)1}$	$V_{CE} = 5V ; I_F = 1mA$	2	10	mA	
10	$I_{CB(ON)}$	$V_{CB} = 5V ; I_F = 10mA$	30		μA	
11	$V_{CE(SAT)}$	$I_C = 2mA ; I_F = 2mA$		0.3	V	
DELTA LIMITS : $\Delta I_R = 25\mu A$ OR 100% $\Delta I_{C(OFF)1} = 25nA$ OR 100% $\Delta h_{FE} = \pm 20\%$ $\Delta I_{C(ON)1} = \pm 25\%$						

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for 4N49 1/

Parameters	Spec. Limits min max	Total Dose Exposure (TDE) (krads)												Anneal		Anneal			
		C (Pre-Rad.)		5		10		20		30		50		24 hrs @25°C		168 hrs @+25°C			
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
IR	nA	0	1E5*	0.7	0.1	0.7	0.4	1.0	0.7	1.0	0.8	1.4	0.9	1.1	0.9	0.6	0.7	0.4	0.5
VF1	V	0.8	1.5	1.20	.02	1.20	.02	1.20	.02	1.20	.02	1.20	.02	1.20	.02	1.20	.02	1.21	.02
VERCEO	V	40	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VERC30	V	45	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VEREBO	V	7	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
IC (OFF) 1	nA	0	100	.29	0.8	0.31	0.1	6.0	4.3	5.9	2.2	15.9	22	141.9	283	136.0	290	95.9	191
ICB (OFF)	nA	0	10	.09	0.2	0.2	0.2	0.3	0.3	0.5	0.4	1.5	0.9	5.8	8.1	4.4	6.5	3.5	4.7
IC (ON) 1	mA	2	10	5.40	0.6	4.79	0.6	4.15	0.6	3.22	0.7	2.65	0.7	2.18	0.9	2.46	0.8	2.51	0.8
ICB (ON)	uA	30	-	129.3	13	124.6	13	120.1	12	116.2	12	108.8	12	100.3	11	102	12	101.7	11
VCE SAT	V	0	0.3	.086	0	.090	0	.094	.01	.092	.01	.111	.01	.129	.02	.125	.02	.124	.02
hFE		100	-	981.2	155	866.8	151	808.6	154	698.6	170	682.3	190	639.3	217	671.6	210	686	203

Note:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing.

* 1E5 means 1 x 10 to the 5th power.

The control samples remained constant throughout the testing and are not included in this table.

Figure 1. Radiation Bias Circuit for 4N49

