PPM 92-299

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Paramax Systems
Corporation

4700 Boston Way
Lanham MD 20706

Memorandum

PARAMAX
A Unisys Company

PPM-92-299

DATE: December 7, 1992
TO: B. Fafaul
FROM: K. Sahu
SUBJECT: Radiation Report on FAST/HCI
Part No. JANTXV4N24
Control No.7349

cc: L. Shiflett/745.1
A. Sharma/311
Library/300.1
L. Cusick/740.4
SMEX, PPM File

A radiation evaluation was performed on 4N24 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 40 krads*. After 40 krads, parts were annealed at +25°C for 168 hours. The irradiation was then continued to 60 krads (cumulative). 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.

All ten parts passed initial (pre-rad) electrical tests. All irradiated parts passed all electrical tests up to and including the 20-krad irradiation step. After the 30-krad irradiation, One part (SN 55) exceeded the maximum specification limit of 100nA for ICEoff, with a reading of 112na and one part (SN 59) exceeded the maximum specification limit of 0.3V for VCESAT, with a reading of 0.319V. After the 40-krad irradiation, five parts (SN 55, 56, 57, 58 and 59) exceeded the maximum specification limit for ICEoff, with readings ranging from 105.6 to 166.4nA, and four parts (SN 53, 57, 58 and 59) exceeded the maximum specification limit for VCESAT with readings ranging from 0.303 to 0.337V.

Parts showed partial recovery on annealing at 25°C for 168 hours. Two parts (SN 55 and 56) continued to fail ICEoff, with readings

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*The term rads, as used in this document, means rads(silicon).
**These are manufacturers' non-irradiated data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

of 106.8 and 102nA, respectively, and two parts (SN 53 and 59) failed VCESAT, with readings of 0.301 and 0.323V, respectively.

On continued irradiation to 60 krads (cumulative), three parts (SN 55, 56 and 58) failed ICEoff, with readings ranging from 103.2 to 160nA and five parts (SN 53, 55, 57, 58 and 59) failed VCESAT, with readings ranging from 0.302 to 0.347V.

After annealing at 100°C for 168 hours to determine rebound effects, all parts exceeded the maximum specification limit for VCESAT, with readings ranging from 0.303 to 0.399V.

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.

TABLE I. Part Information

Generic Part Number:	4N24
FAST/HCI Part Number	JANTXV4N24
Control Number:	7349
Charge Number:	33111
Manufacturer:	Micropac
Lot Date Code:	9233
Quantity Tested:	10
Serial Numbers of Radiation Samples:	53, 54, 55, 56, 57, 58, 59, 60
Serial Number of Control Samples:	51, 52
Part Function:	Opto-Coupler
Part Technology:	Bipolar
Package Style:	TOx can
Test Engineer:	Anh Phung

TABLE II. Radiation Schedule for 4N24

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	10/29/92
2) 5-KRAD IRRADIATION (0.25 krads/hour)	11/02/92
POST-5-KRAD ELECTRICAL MEASUREMENT	11/03/92
3) 10-KRAD IRRADIATION (0.25 krads/hour)	11/03/92
POST-10-KRAD ELECTRICAL MEASUREMENT	11/04/92
4) 20-KRAD IRRADIATION (0.5 krads/hour)	11/04/92
POST-20-KRAD ELECTRICAL MEASUREMENT	11/05/92
5) 30-KRAD IRRADIATION (0.5 KRADS/HOUR)	11/05/92
POST-30-KRAD ELECTRICAL MEASUREMENT	11/06/92
6) 40-KRAD IRRADIATION (0.15 KRADS/HOUR)	11/06/92
POST-40-KRAD ELECTRICAL MEASUREMENT	11/09/92
7) 168 HOURS ANNEALING AT +25°C*	11/09/92
POST-168-HOUR ELECTRICAL MEASUREMENT	11/16/92
8) 60-KRAD IRRADIATION (1.0 KRADS/HOUR)	11/16/92
POST-60-KRAD ELECTRICAL MEASUREMENTS	11/17/92
9) 168 HOURS ANNEALING AT +100°C**	11/17/92
POST-168-HOUR ELECTRICAL MEASUREMENTS	11/24/92

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT +25°C.

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

*Annealing was under bias for the first 118 hours of annealing and without bias for the final 50 hours, due to a power outage.

**High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-883D, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of 4N24

TST#	TEST NAME	TEST CONDITIONS	MIN	MAX	UNIT	METHOD
1	IR	VR = 2V		100	uA	4016
2	VF	IF = 10 mADC	0.8	1.3	V	4011
3	ICEOFF	VCE = 20V , IF = 0		100	nA	3041
4	VBRCEO	IC = 1 mA , IB=0 , IF=0	35		V	3011
5	VBRCBO	IC =100uA , IF=0 , IB=0	35		V	3001
6	VBREBO	IE =100uA , IC=0 , IE=0	4		V	3026
7	ICE/ON1	VCE = 5V , IF = 10 mA	10		mA	
8	ICE/ON2	VCE = 5V , IF = 2 mA	0.4		mA	
9	VCESAT	IC = 10 mA, IF = 20 mA		0.3	V	
10	HFE	VCE = 5V , IC=10mA,IF=0	400			

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for 4N24 1/

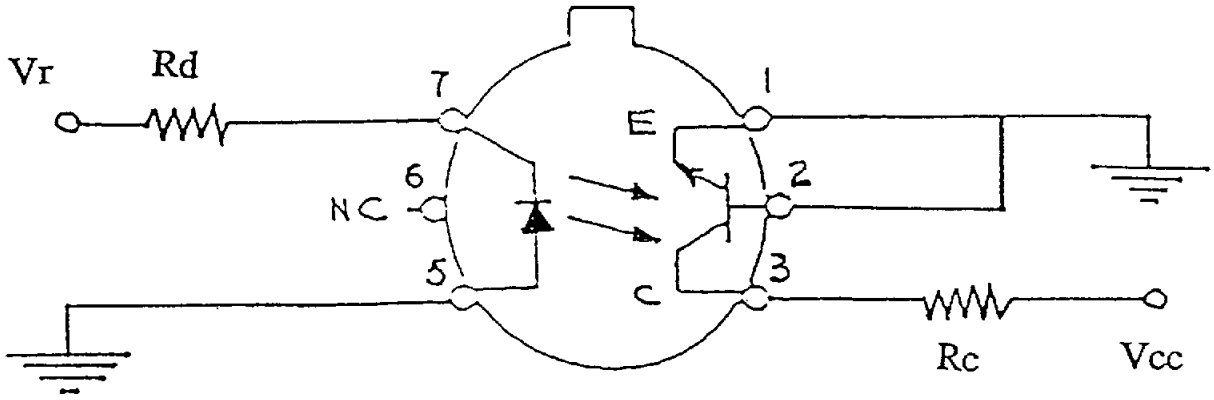
				Total Dose Exposure (TDE) (krads)														Anneal		TDE(krads)		Anneal	
		Spec.	Lim./2	0 (Pre-Rad.)		5		10		20		30		40		168 hrs @25°C		60		168 hrs @+100°C	
Parameters		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
IR	nA	0	10000	-0.3	0.2	-0.4	.14	-0.4	.13	-0.3	.13	-0.1	.26	0.09	.48	-0.3	0.3	-0.3	.18	0.25	.08
VF	V	0.8	1.3	1.15	0	1.15	0	1.15	0	1.15	0	1.15	0	1.15	0	1.15	0	1.16	0	1.15	0
ICEoff	nA	0	100	0.90	1.5	4.0	4.7	11.1	10	35.9	16	73.4	33	118	46	82.1	26	100	41	15.3	4
VBRCEO	V	35	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VBRCBO	V	35	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VBREBO	V	4	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
ICE/ON1	mA	10	-	36.7	2	36.2	2.2	35.9	2.4	33.8	6.1	33.0	6.3	32.4	6.5	32.4	6.7	32.4	6.9	31.0	6.7
ICE/ON2	mA	0.4	-	11.0	2.8	10.5	2.8	10.0	2.7	9.01	2.5	8.04	2.3	7.12	2.1	7.18	2.1	6.28	1.9	5.02	1.5
VCESAT	V	0	0.3	0.25	.01	0.25	.01	0.26	.01	0.27	.01	0.28	.02	0.30	.02	0.29	.02	0.31	.02	0.34	.03
HFEs		400	-	1126	261	1110	254	1093	252	1077	247	1060	243	1043	237	1029	235	993	226	830	176

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 manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

Table III. Radiation Bias Circuit for 4N24



Vcc	=	28 V, max
Vr	=	1.6 V, max
Rd	=	20 Kohm +/- 5 %, 1/4 W
Rc	=	10 Kohm +/- 5 %, 1/4 W