PPM 92-251

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Paramax Systems
Corporation

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Lanham MD 20706

Memorandum

PARAMAX
A Unisys Company

DATE: October 20, 1992

PPM-92-251

TO: D. Kapoor/311.1

FROM: K. Sahu/7809 KS

SUBJECT: Radiation Report on TOMS/C4 Project.
Part No. MD82C59AB7011 (control no.5822)

cc: R. Shelley/303
A. Sharma/31[illegible]
A. Casasnovas
Library/300.1

A radiation evaluation was performed on the MD82C59AB7011 (82C59) Programmable Priority Interrupt Controller 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 on four samples, using a cobalt-60 gamma-ray source. One part was used as a control sample. The total dose radiation steps were 2.5, 5, 10, 15, 20 and 30 krads (the term rad as used here means rad(Si)). The dose rate was between 0.07 and 0.5 krads/hour, depending on the total dose level (see Table II for radiation schedule). The parts were kept under bias during irradiation and annealing treatments (see Figure 1 for bias configuration). After the 20-krad exposure, the parts were annealed at +25°C for 168 hours and 288 hours (cumulative). After these annealing steps, the parts were irradiated to a total accumulated dose of 30 krads. Finally, the parts were annealed for 168 hours at +100°C. After each radiation exposure and annealing treatment, the parts were electrically tested at +25°C according to the test conditions and the specification limits listed in Table III. These tests included two functional tests at 1.36 MHz and three functional tests at 1 MHz.

All five parts passed the initial electrical tests. All four irradiated parts passed all electrical tests up to the 10 krad exposure. After the 10-krad irradiation, all parts exceeded the maximum specification limit of 10uA for ICCSBH and ICCSBL, with readings between 46uA and 72uA. These values decreased after the 15 krad exposure to between 31uA and 39uA. After the 20-krad irradiation, the values for ICCSBH and ICCSBL ranged between 37uA and 46uA.

After 168 hours of annealing at 25°C, one part recovered to within the maximum specification limits for ICCSBH and ICCSBL and the other two parts had readings of 20uA. On continued annealing to 288 hours (cumulative), two parts recovered to within the maximum specification limits for ICCSBH and ICCSBL and the other parts had readings of 19uA. On further irradiation to 30 krads, all four parts exceeded the maximum specification limits, with readings of 45uA. After annealing for 168 hours at +100°C, all parts passed all electrical tests. No rebound effects were observed after annealing at 100°C.

All parts passed all functional tests throughout all irradiation and annealing steps.

Table IV gives the mean and standard deviation values for each parameter after differ[illegible] 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:	82C59
TOMS/C4 Part Number:	MD82C59AB7011
Control Number:	5822
Charge Number:	C24005
Manufacturer:	Harris Corporation
Lot Date Code:	8902
Quantity Tested:	5
Serial Number of Radiation Samples:	223, 224, 225, 227
Serial Number of Control Sample:	222
Part Function:	Programmable Priority Interrupt Controller
Part Technology:	CMOS
Package Style:	28-pin DIP
Test Engineer:	A. Karygiannis

TABLE II. Radiation Schedule for 82C59

EVENTS	DATE
1) INITIAL (PRE-IRRADIATION) ELECTRICAL MEASUREMENT	09/04/92
2) 2.5- KRAD IRRADIATION (0.11 krads/hour)	09/15/92
POST-2.5-KRAD ELECTRICAL MEASUREMENT	09/16/92
3) 5-KRAD IRRADIATION (0.13 krads/hour)	09/16/92
POST-5-KRAD ELECTRICAL MEASUREMENT	09/17/92
4) 10-KRAD IRRADIATION (0.25 krads/hour)	09/17/92
POST-10-KRAD ELECTRICAL MEASUREMENT	09/18/92
5) 15-KRAD IRRADIATION (0.07 krads/hour)	09/18/92
POST-15-KRAD ELECTRICAL MEASUREMENT	09/21/92
6) 20-KRAD IRRADIATION (0.26 krads/hour)	09/21/92
POST-20-KRAD ELECTRICAL MEASUREMENT	09/22/92
7) 168 HOURS ANNEALING AT +25°C	09/22/92
POST-168-HOUR ELECTRICAL MEASUREMENTS	10/01/92
8) 288 HOURS (CUMULATIVE) ANNEALING AT +25°C	10/02/92
POST-120-HOUR ELECTRICAL MEASUREMENTS	10/06/92
8) 30-KRAD IRRADIATION (0.5 krads/hour)	10/06/92
POST-30-KRAD ELECTRICAL MEASUREMENT	10/07/92
9) 168 HOURS ANNEALING AT +100°C	10/07/92
POST-168-HOUR ELECTRICAL MEASUREMENT	10/15/92

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT +25°C.

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

Table III. Electrical Characteristics of 82C59

TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
FUNCT 1	4.5V	0.4V	2.6V	FREQ =1.36MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT 2	4.5V	0.4V	2.6V	FREQ =1.00MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT 3	5.5V	0.4V	2.6V	FREQ =1.36MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT 4	5.5V	0.4V	2.6V	FREQ =1.00MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT 5	5.5V	0.0V	5.5V	FREQ =1.00MHz	ALL I/O	VOL<0.4V , VOH>3.0V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
VOH1	4.5V	0.8V	2.2V	LOAD=-2.5MA	OUTS	>+3.0V , <+5.5V
VOH2	4.5V	0.8V	2.2V	LOAD=-100UA	OUTS	>+4.1V , <+5.5V
VOL	4.5V	0.8V	2.2V	LOAD=+2.5MA	OUTS	>+0.0V , <+0.4V
IIH	5.5V	0.0V	5.5V	VTST= 5.5V	INS	>+0.0A , <+1.0UA
IIH_IR	5.5V	0.0V	5.5V	VTST= 5.5V	IR INS	>+0.0A , <+10UA
IIL	5.5V	0.0V	5.5V	VTST= 0.0V	INS	>-1.0UA , <+0.0A
IIL_IR	5.5V	0.0V	5.5V	VTST= 0.0V	IR INS	>-500UA , <+0.0A
IOZH	5.5V	0.0V	5.5V	VOUT= 5.5V	OUTS	>-10UA , <+10UA
IOZL	5.5V	0.0V	5.5V	VOUT= 0.0	OUTS	>-10UA , <+10UA
ICCSBH	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>+0.0A , <+10UA
ICCSBL	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0A , <+10UA

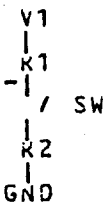
PARAMETER	ABSOLUTE DELTA LIMITS AT +25C	PERCENTAGE DELTA LIMITS @ +25C
VOH1	>-100MV , <+100MV	> -20% , < +20%
VOH2	>-100MV , <+100MV	> -20% , < +20%
VOL	> -40MV , < +40MV	> -20% , < +20%
IIH	>-100NA , <+100NA	> -20% , < +20%
IIH_IR	> -1UA , < +1UA	> -20% , < +20%
IIL	>-100NA , <+100NA	> -20% , < +20%
IIL_IR	> -50UA , < +50UA	> -20% , < +20%
IOZH	> -1UA , < +1UA	> -20% , < +20%
IOZL	> -1UA , < +1UA	> -20% , < +20%
ICCSBH	> -1UA , < +1UA	> -20% , < +20%
ICCSBL	> -1UA , < +1UA	> -20% , < +20%

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
TRLDVH_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD/INTA->D	>0.0NS , <160.0NS
TRLDVL_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD/INTA->D	>0.0NS , <160.0NS
TRHDLZ_1	4.5V	0.4V	2.6V	C=2,VCMP=VOL+.5V	RD/INTA->D	>10.0NS , <100.0NS
TRHDHZ_1	4.5V	0.4V	2.6V	C=2,VCMP=VOH-.5V	RD/INTA->D	>10.0NS , <100.0NS
TJHIH_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	IR->INT	>0.0NS , <350.0NS
TIALCV_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->CAS	>0.0NS , <565.0NS
TRLEL1_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->EN	>0.0NS , <125.0NS
TRHEHI_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->EN	>0.0NS , <60.0NS
TRLELR_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD->EN	>0.0NS , <125.0NS
TRHEHR_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD->EN	>0.0NS , <60.0NS
TAHDVH_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	CS->D	>0.0NS , <210.0NS
TAHDVL_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	CS->D	>0.0NS , <210.0NS
TCVDVH_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	CAS->D	>0.0NS , <300.0NS
TCVDVL_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	CAS->D	>0.0NS , <300.0NS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
TRLDVH_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD/INTA->D	>0.0NS , <160.0NS
TRLDVL_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD/INTA->D	>0.0NS , <160.0NS
TRHDLZ_2	5.5V	0.4V	2.6V	C=2,VCMP=VOL+.5V	RD/INTA->D	>10.0NS , <100.0NS
TRHDHZ_2	5.5V	0.4V	2.6V	C=2,VCMP=VOH-.5V	RD/INTA->D	>10.0NS , <100.0NS
TJHIH_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	IR->INT	>0.0NS , <350.0NS
TIALCV_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->CAS	>0.0NS , <565.0NS
TRLEL1_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->EN	>0.0NS , <125.0NS
TRHEHI_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->EN	>0.0NS , <60.0NS
TRLELR_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD->EN	>0.0NS , <125.0NS
TRHEHR_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD->EN	>0.0NS , <60.0NS
TAHDVH_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	CS->D	>0.0NS , <210.0NS
TAHDVL_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	CS->D	>0.0NS , <210.0NS
TCVDVH_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	CAS->D	>0.0NS , <300.0NS
TCVDVL_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	CAS->D	>0.0NS , <300.0NS

Table III. Electrical Characteristics of 82C59 - cont.

LOAD USED



AC PARAMETRIC TEST LOAD CONDITIONS

TEST CONDITION	V1	R1	R2	SWT1
C=1	1.7V	523	--	OPEN
C=2	VCC	1.9K	1.8K	CLOSED

COMMENTS/EXCEPTIONS

(1) THESE PARAMETERS WERE TESTED DURING FUNCTIONAL # 1 AND #3 AS GO/NOGO : tAHRL, tRHAX, tRLRH, tAHWL, tWHAX, tWLWH, tDVWH, tWHDX, tJLJH, tCVIAL, tRHRL, tWHWL & tCHCL

(2) VIL & VIH ARE TESTED DURING VOL & VOH TESTS AS GO/NOGO.

(3) DUE TO S-50 (ATE) LIMITATIONS, ALL PROPAGATION DELAYS AND TRI-STATE MEASUREMENTS WERE MADE WITH A CAPACITIVE LOAD (CL) OF APPROXIMATELY 50pF to 60pF (STRAY CAPACITANCE OF THE TABLE).

(4) (JL) ADDED PERCENTAGE DELTA LIMITS ON 10-07-91.

HARDWARE REQUIREMENTS	TEST TEMPERATURES	
DEVICE CONFIGURATION : 28-PIN DIP S-50 LOAD BOARD # 12 : CLOSE DIP SWITCH FOR DUT PIN 14 (GND).	25 DEG. C. -55 DEG. C. 125 DEG. C.	X X X
PROGRAMMER : JUAN RAFAEL LANDER	DATE : 05-15-89 UPDATE : 10-07-91 (JL)	

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for MD82C59AB7011 1/

			Total Dose Exposure (TDE) (krads)*										Anneal		Anneal		TDE		Anneal	
	Spec Limit		0 (Pre-Rad)		5		10		15		20		168 hrs @25°C		288 hrs @25°C		30 krads		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
FUNC1 4.5V, 1.36MHz			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
FUNC2 4.5V, 1.00MHz			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
FUNC3 5.5V, 1.36MHz			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
FUNC4 5.5V, 1.00MHz			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
FUNC4 5.5V, 1.00MHz			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1 V	3	5.5	4.38	.01	4.38	.01	4.38	.02	4.38	.02	4.12	1.02	4.37	.01	4.38	.01	3.61	1.7	4.38	.01
VOH2 V	4.1	5.5	4.49	0	4.49	.01	4.49	.02	4.48	.03	4.23	1.04	4.48	0	4.49	0	3.54	1.8	4.49	0
VOL mV	0	400	85.4	14	86.6	15	88.2	17	87.5	17	51.2	187	89.8	17	89.5	18	69.6	302	87.3	14
IIH uA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIH_IR uA	0	10	0.78	0.1	0.67	0.1	0.61	0.1	**	**	0.60	0.1	0.54	.08	0.53	.08	0.54	.11	0.47	.58
IIL uA	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL_IR uA	-500	0	-140	3.7	-134	3.8	-128	4.1	-127	3.9	-125	3.8	-124	4.2	-124	3.9	-120	4.2	-115	6.4
IOZH uA	-10	10	0	0	0	0	.01	.01	.01	.02	.03	.04	.01	.01	0	.01	.09	0.1	0	0
IOZL uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICCSBH uA	0	10	0	0	0	0	57.0	9.4	37.0	3.5	46.0	0	10.0	10.0	9.50	9.50	45.0	0	0	0
ICCSBL uA	0	10	0	0	0	0	52.5	7.1	33.0	3.5	37.0	0	10.0	10.0	4.75	8.2	45.0	0	0	0
TRLDVH_1 ns	0	160	41.9	3.8	41.6	3.8	42.0	3.9	42.6	4.0	43.1	4.0	43.4	4.1	43.9	4.0	44.6	4.0	46.7	4.6
TRLDVL_1 ns	0	160	42.0	2.5	41.9	2.6	42.4	2.6	42.7	2.7	43.2	2.7	43.6	2.8	43.9	2.8	44.5	2.9	47.5	3.3
TRHDLZ_1 ns	10	100	49.8	2.7	49.4	2.7	49.3	2.7	49.1	2.6	49.1	2.6	49.7	2.6	49.4	2.6	49.2	2.5	51.8	3.0
TRHDHZ_1 ns	10	100	51.5	5.2	52.0	5.2	52.5	5.5	52.8	5.5	53.2	5.5	53.6	5.4	53.1	5.4	53.9	5.6	55.2	5.0
TOHIH_1 ns	0	350	58.7	2.4	58.5	2.4	58.5	2.3	59.4	2.5	59.9	2.5	60.9	2.5	60.8	2.4	61.6	2.5	65.8	2.8
TIALCV_1 ns	0	565	33.2	1.0	32.9	1.0	33.2	1.0	33.8	1.1	34.3	1.0	34.6	1.1	35.1	1.0	35.9	1.1	36.9	1.2
TRLELI_1 ns	0	125	41.9	1.1	41.9	1.1	42.9	1.1	42.8	1.1	43.4	1.1	43.9	1.1	43.9	1.1	44.9	1.1	46.4	1.3
TRHEHI_1 ns	0	50	27.9	0.8	27.7	0.8	27.6	0.9	27.6	0.8	27.7	0.8	28.2	0.8	27.9	0.8	27.8	0.8	30.3	1.0
TRLELR_1 ns	0	125	33.5	0.8	33.2	0.8	33.6	0.7	33.5	0.7	33.8	0.7	34.3	0.8	34.3	0.7	34.7	0.8	37.1	0.9
TRHEHR_1 ns	0	50	31.6	0.8	31.5	0.8	31.6	0.8	31.8	0.8	31.9	0.8	32.3	0.9	32.1	0.8	32.3	0.9	33.5	1.0
TAHDVH_1 ns	0	210	48.7	2.3	48.1	2.4	48.2	2.5	48.6	2.6	48.8	2.7	49.2	2.7	49.8	2.7	49.9	2.8	52.7	3.1
TAHDVL_1 ns	0	210	47.6	1.7	47.1	1.8	47.3	1.8	47.4	1.8	47.5	1.9	48.4	1.6	48.2	1.9	48.2	2.0	51.7	2.0

TABLE IV (cont.): Summary of Electrical Measurements After Total Dose Exposures and Annealing for MD82C59AB7011 1/

			Total Dose Exposure (TDE) (krads)										Anneal		Anneal		TDE		Anneal	
	Spec Limit		0 (Pre-Rad)		5		10		15		20		168 hrs @25°C		288 hrs @25°C		30 krads		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
TCVDVH_1 ns	0	300	66.3	10	65.9	10	66.3	10	67.1	10	67.7	10	68.4	10	68.9	10	69.7	10	73.4	11
TCVDVL_1 ns	0	300	46.7	13	46.6	13	47.1	13	47.5	13	48.1	14	48.5	14	48.7	14	49.5	14	51.7	13
TRLDVH_2 ns	0	160	35.9	3.1	35.5	3.2	35.9	3.2	36.3	3.3	36.7	3.3	36.9	3.4	37.4	3.4	38.0	3.4	39.1	3.7
TRLDVL_2 ns	0	160	36.4	2.3	36.2	2.3	36.6	2.4	36.7	2.4	37.1	2.5	37.4	2.5	37.6	2.6	38.1	2.6	39.8	2.9
TRHDLZ_2 ns	10	100	45.6	2.8	45.2	2.8	45.0	2.8	44.9	2.7	44.9	2.7	45.3	2.7	45.0	2.6	44.8	2.5	47.1	3.1
TRHDHZ_2 ns	10	100	48.5	5.4	49.0	5.4	49.3	5.5	49.4	5.7	49.8	5.7	50.1	5.6	49.7	5.6	50.3	5.8	51.3	5.1
TOHIH_2 ns	0	350	49.3	1.9	49.0	1.9	49.1	1.9	49.6	1.8	49.9	1.9	50.6	1.9	50.3	1.8	50.8	1.9	53.4	2.1
TIALCV_2 ns	0	565	28.3	0.8	27.9	0.8	28.1	0.8	28.5	0.8	28.8	0.8	29.4	1.6	29.5	0.8	30.0	0.9	30.4	0.9
TRLELI_2 ns	0	125	36.9	0.8	36.8	0.9	37.6	0.8	37.5	0.8	37.9	0.9	38.2	0.9	38.2	0.8	38.9	0.9	39.7	1.0
TRHEHI_2 ns	0	50	24.9	0.6	24.6	0.6	24.5	0.6	24.5	0.6	24.4	0.6	24.9	0.6	24.5	0.6	24.3	0.6	26.3	0.7
TRLELR_2 ns	0	125	29.9	0.6	29.5	0.6	29.9	0.7	29.7	0.6	29.8	0.6	30.3	0.6	30.2	0.6	30.5	0.6	32.1	0.7
TRHEHR_2 ns	0	50	28.3	0.6	28.3	0.6	28.2	0.6	28.3	0.6	28.3	0.7	28.7	0.7	28.5	0.6	28.5	0.7	29.2	0.8
TAHDVH_2 ns	0	210	44.3	2.0	43.7	2.1	44.0	2.2	44.1	2.2	44.3	2.3	44.6	2.3	45.1	2.3	46.2	2.4	47.0	2.5
TAHDVL_2 ns	0	210	43.3	1.5	42.8	1.6	43.0	1.6	42.9	1.6	43.0	1.7	43.4	1.7	43.6	1.7	43.6	1.7	45.8	1.7
TCVDVH_2 ns	0	300	57.5	8.8	57.0	8.8	57.3	8.7	57.6	8.7	58.1	8.7	58.5	8.8	59.0	8.7	59.5	8.7	61.7	9.4
TCVDVL_2 ns	0	300	40.7	12	40.5	12	40.9	13	41.1	13	41.5	13	41.8	13	42.0	13	42.6	13	43.7	12

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

*The 2.5-krad exposure produced no significant change in parameters and is omitted for clarity.
**No reliable reading was obtainable at this point.

Figure 1. Radiation Bias Circuit for 82C59