PPM - 91-053

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UNISYS

Interoffice Memorandum

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Date
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Subject
Radiation Report on MR8251A/B (SMEX Common Buy Part No. 5962-87548023A.)

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A radiation evaluation was performed on MR8251A/B 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, seven 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 2.5, 7.5, 10, 15, 20, 30, 55, 80 and 175 krads. After 175 krads, parts were annealed at 25°C for 24 and 240 hours. The dose rate was between 0.1 - 5.0 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 specification limits listed in Table III. A total of sixteen functional tests were also performed to characterize the performance of the device in both SYN and ASYN mode at 1.0 and 3.1 MHz. Refer to Table III for more details of functional testing.

All parts passed all tests on irradiation up to 30 krads. At 55 krads, two parts (SN's 3 and 4) exceeded the specification limits on IOZH and IOZL. However, the remaining five parts stayed well within the specification limits for all parameters and passed all functional tests up to 55 krads. After the next radiation steps of 80 and 175 krads, several parts failed a number of functional tests, in addition to IOZH and IOZL failures. Also, at 175 krads the parts showed significant increase in the AC parameters (reading more than one millisecond against the specification limit of 200 nanoseconds). Parts showed no recovery on annealing for 24 and 240 hours at 25°C. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. It also provides a summary of functional test results after each radiation/annealing step.

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

TABLE I. Part Information

Generic Part Number:	MR8251A/B
SMEX Common Buy Part Number:	5962-87548023A
SMEX Common Buy Control Number:	1753
Manufacturer:	Intel
Quantity Procured:	44
Lot Date Code:	8931
Quantity Tested:	9
Serial Numbers of Radiation Samples:	3,4,6,7,8,9,10
Serial Numbers of Control Samples:	1,2
Part Function:	Programmable Communications Interface (USART)
Part Technology:	NMOS
Package Style:	28-Pin LCC

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	11/19/90
2) 2.5 krads irradiation @ 125 rads/hr	11/26/90
Post 2.5 krads Electrical Measurements	11/27/90
3) 7.5 krads irradiation @ 250 rads/hr	11/28/90
Post 7.5 krads Electrical Measurements	11/29/90
4) 10 krads irradiation @ 125 rads/hr	11/29/90
Post 10 krads Electrical Measurements	11/30/90
5) 15 krads irradiation @ 74 rads/hr	11/30/90
Post 15 krads Electrical Measurements	12/03/90
6) 20 krads irradiation @ 250 rads/hr	12/03/90
Post 20 krads Electrical Measurements *	12/05/90
7) 30 krads irradiation @ 500 rads/hr	12/05/90
Post 30 krads Electrical Measurements	12/06/90
8) 55 krads irradiation @ 250 rads/hr	12/06/90
Post 55 krads Electrical Measurements	12/10/90
9) 80 krads irradiation @ 1250 rads/hr	12/10/90
Post 80 krads Electrical Measurements	12/11/90
10) 175 krads irradiation @ 5000 rads/hr	12/11/90
Post 175 krads Electrical Measurements *	12/17/90
11) 24 hrs annealing	12/18/90
Post 24 hr Electrical Measurements	
12) 240 hrs annealing	12/28/90
Post 240 hr Electrical Measurements	

Notes:

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

* Anomalous Event: The Automatic Tester was down on 12/04/90 and 12/12/90 when the parts came out of the radiation chamber after 20 and 175 krads steps, respectively. The parts were kept under bias until the measurements could be made on 12/05/90 and 12/17/90, respectively.

TABLE III. Electrical Characteristics of MR8251A/B

DC Parameters

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
VOH1 1/	4.5V	0.0V	4.5V	LOAD=-400UA	OUTS	>+2.4V , <+5.5V
VOH2 1/	4.5V	0.8V	2.2V	LOAD=-400UA	OUTS	>+2.4V , <+5.5V
VOL1 1/	4.5V	0.0V	4.5V	LOAD=+2.2MA	OUTS	>+0.0V , <+0.45V
VOL2 1/	4.5V	0.8V	2.2V	LOAD=+2.2MA	OUTS	>+0.0V , <+0.45V
IIH	5.5V	0.0V	5.5V	VTST= 5.5V	INS	>+0.0A , <+10.0UA
IIL	5.5V	0.0V	5.5V	VTST= 0.0V	INS	>-10.0UA , <+0.0A
IOZH	5.5V	0.0V	5.5V	VOUT= 5.5V	OUTS	>-10UA , <+10UA
IOZL	5.5V	0.0V	5.5V	VOUT= 0.0V	OUTS	>-10UA , <+10UA
ICC	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>+0.0A , <+120MA

1/ VOH and VOL could not be measured under static conditions, because the test equipment (S50) does not have a high speed programmable measurable unit. These were therefore measured as GO/NOGO tests under functional tests, #12 thru #16. See the functional test table for more details.

AC Parameters

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
TRDZL	4.5V	0.45V	2.4V	VTEST= 0.8V	DATA	>+0.0NS , <+200.0NS
TRDZH	4.5V	0.45V	2.4V	VTEST= 2.0V	DATA	>+0.0NS , <+200.0NS
TDFLZ	4.5V	0.45V	2.4V	VTEST= 1.5V	DATA	>+10.0NS , <+250.0NS
TDFHZ	4.5V	0.45V	2.4V	VTEST= 0.8V	DATA	>+10.0NS , <+250.0NS

TABLE III. (continued)

GO/NOGO AC Parameters 1/

(1) ADDRESS STABLE BEFORE READ TAR 0.0 NS.
(2) ADDRESS HOLD TIME TO READ TRA 0.0NS.
(3) READ PULSE WIDTH TRR 250.0NS.
(4) ADDRESS STABLE BEFORE WRITE TAW 0.0NS.
(5) ADDRESS HOLD TIME TO WRITE TWA 20.0NS.
(6) WRITE PULSE WIDTH TWW 250.0NS.
(7) DATA SETUP TIME FOR WRITE TDW 150.0NS.
(8) DATA HOLD TIME FOR WRITE TWD 20.0NS.
(9) RECOVERY TIME BETEEN WRITES TRV FOR MODE INSTRUCTION 6 CLOCK CYCLES.
(10) MINIMUM CLOCK PERIOD TCY 320.0NS.
(11) MINIMUM CLOCK HIGH PULSE WIDTH 140.0NS.
(12) MINIMUM CLOCK LOW PULSE WIDTH 90.0NS.
(13) TRANSMITTER INPUT CLOCK PULSE WIDTH TTPW 1X BAUD RATE = 12 CLOCK CYCLES
(14) RECEIVER INPUT CLOCK PULSE WIDTH TRPW 1X BAUD RATE = 12 CLOCK CYCLES.
(15) MAXIMUM CLOCK FREQUENCY = 3.125MHZ.

1/ These AC parameters are tested as GO/NOGO under functional testing.

TABLE III. (continued)

Functional Tests 1/, 2/

PARAMETER	VCC	VIL	VIH	CONDITIONS	MODE	LIMITS AT +25C
FUNCT # 1	4.5V	0.0V	4.5V	FREQ =1.000MHZ	ASYNC	VOL<1.5V , VOH>1.5V
FUNCT # 2	5.0V	0.0V	5.0V	FREQ =1.000MHZ	ASYNC	VOL<1.5V , VOH>1.5V
FUNCT # 3	5.5V	0.0V	5.5V	FREQ =1.000MHZ	ASYNC	VOL<1.5V , VOH>1.5V
FUNCT # 4	4.5V	0.0V	4.5V	FREQ =1.000MHZ	SYNC	VOL<1.5V , VOH>1.5V
FUNCT # 5	5.0V	0.0V	5.0V	FREQ =1.000MHZ	SYNC	VOL<1.5V , VOH>1.5V
FUNCT # 6	5.5V	0.0V	5.5V	FREQ =1.000MHZ	SYNC	VOL<1.5V , VOH>1.5V
FUNCT # 7	5.0V	0.45V	2.4V	FREQ =1.000MHZ	ASYNC	VOL<1.5V , VOH>1.5V
FUNCT # 8	5.0V	0.45V	2.4V	FREQ =3.125MHZ	SYNC	VOL<1.5V , VOH>1.5V
FUNCT # 9	5.0V	0.45V	2.4V	FREQ =3.125MHZ	ASYNC	VOL<1.5V , VOH>1.5V
FUNCT # 10	5.0V	0.45V	2.4V	FREQ =1.000MHZ	ASYNC	VOL<1.5V , VOH>1.5V
FUNCT # 11	5.0V	0.45V	2.4V	FREQ =3.125MHZ	ASYNC	VOL<1.5V , VOH>1.5V
FUNCT # 12	5.0V	0.0V	5.0V	FREQ =1.000MHZ	ASYNC	VOL<0.45V, VOH>2.4V
FUNCT # 13	5.0V	0.0V	5.0V	FREQ =1.000MHZ	ASYNC	VOL<0.45V, VOH>2.6V
FUNCT # 14	5.0V	0.0V	5.0V	FREQ =1.000MHZ	ASYNC	VOL<0.45V, VOH>2.8V
FUNCT # 15	5.0V	0.0V	5.0V	FREQ =1.000MHZ	ASYNC	VOL<0.45V, VOH>3.0V
FUNCT # 16	5.0V	0.0V	5.0V	FREQ =1.000MHZ	ASYNC	VOL<0.45V, VOH>3.2V

FUNCTIONAL TESTS 12 THROUGH 16 TEST VOH GO/NOGO AND EXECUTE THE SAME PATTERN

1/ Functional tests were performed to characterize the device performance in transmitting and receiving in both SYN and ASYN mode, at VCC of 4.5V, 5.5V and 5.0V and at frequencies of 1.0MHz and 3.125MHz.

2/ Functional Tests 12 through 16 characterize the VOH level by comparing a valid logic "1" to 2.4, 2.6, 2.8, 3.0 and 3.2V. Also, the VOL level is tested by considering any value below 0.45V as a passing logic "0", and any value above 0.45V as a failing logic "0".

TABLE IV: Summary of AC and DC trical Measurements after Total Dose Exposures and Annealing for MR8251A/B 1/, 2/

Parameters		Spec. Limits min	Spec. Limits max	Initials mean	Initials sd	Total Dose Exposure (krads) 10 mean	10 sd	30 mean	30 sd	55 mean	55 sd	80 mean	80 sd	175 mean	175 sd	Annealing 24 hrs. mean	24 hrs. sd	240 hrs. mean	240 hrs. sd
IIH	nA	0	1E4	0	-	1.1	7.2	0	-	0	-	0.1	1.2	9.7	19.8	8.4	17.4	3.4	7.4
IIL	nA	-1E4	0	0	-	0	-	0	-	0	-	0	-	-2.5	7.2	-2.1	6.2	-0.8	2.7
IOZH	uA	-10	10	0	-	0	-	0	-	10.6	36.1	147	372	2E3	3E3	2E3	3E3	2E3	3E3
IOZL	uA	-10	10	0	-	0	-	0	-	4.9	16.9	75.9	191	526	921	519	912	491	862
ICC	mA	0	120	68.6	2.1	73.9	2.2	75.4	2.8	75.6	3.2	79.5	4.0	81.5	8.9	79.0	7.6	73.9	3.9
TRDZL	ns	0	200	35.1	0.9	34.6	1.0	37.0	1.3	38.1	2.0	37.1	2.8	>1E6	-	>1E6	-	>1E6	-
TRDZH	ns	0	200	28.2	1.1	27.0	1.1	29.0	1.3	30.4	1.8	30.1	1.8	>1E6	-	>1E6	-	>1E6	-
TDFLZ	ns	10	250	47.7	0.9	46.9	0.8	45.7	0.9	45.7	1.3	48.8	8.6	>1E6	-	>1E6	-	>1E6	-
TDFHZ	ns	10	250	33.6	0.8	38.1	0.8	38.1	3.4	38.3	1.6	38.1	5.6	>1E6	-	>1E6	-	>1E6	-

Notes:

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

2/ Table IV provides radiation characteristics of parts at selected total dose exposures. The data at other radiation exposures is available and can be obtained upon request.

TABLE IV (continued): Functional Test Summary for MR8251A/B.

Functional Test	Initials	Total Dose Exposure (krads)					Annealing	
		15	30	55	80	175	24 hrs.	240 hrs.
1	Pass	Pass	Pass	Pass	Pass	2P/5F	2P/5F	1P/6F
2	Pass	Pass	Pass	Pass	3P/4F	7 Fail	1P/6F	1P/6F
3	Pass	Pass	Pass	Pass	Pass	2P/5F	3P/4F	2P/5F
4	Pass	Pass	Pass	Pass	6P/1F	2P/5F	1P/6F	7 Fail
5	Pass	Pass	Pass	Pass	2P/5F	7 Fail	1P/6F	7 Fail
6	Pass	Pass	Pass	Pass	6P/1F	2P/5F	3P/4F	2P/5F
7	Pass	Pass	Pass	Pass	Pass	2P/5F	3P/4F	7 Fail
8	Pass	Pass	Pass	Pass	6P/1F	3P/4F	3P/4F	2P/5F
9	Pass	Pass	Pass	Pass	6P/1F	3P/4F	3P/4F	2P/5F
10	Pass	Pass	Pass	Pass	Pass	2P/5F	3P/4F	7 Fail
11	Pass	Pass	Pass	Pass	Pass	3P/4F	3P/4F	2P/5F
12	-	-	-	Pass	Pass	1P/6F	1P/6F	7 Fail
13	-	-	-	Pass	Pass	1P/6F	1P/6F	7 Fail
14	-	-	-	Pass	Pass	1P/6F	1P/6F	7 Fail
15	-	-	-	Pass	Pass	1P/6F	1P/6F	7 Fail
16	-	-	-	Pass	6P/1F	1P/6F	1P/6F	7 Fail

Figure 1. Radiation Bias Circuit for MR8251A/B