UNISYS

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Interoffice Memorandum

To
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Department
Code 311

From
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Department
7809

Subject
Radiation Report on
ISTP Common Buy Part No. HM1-6617/883

PPM-91-065

Date
February 8, 1991

Location
GSFC

Telephone
731-8954

Location
Lanham

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A radiation evaluation was performed on HM1-6617/883 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 VI 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 eight radiation samples comprised of two parts from each lot date code (LDC) procured for ISTP Common Buy. For more information on the radiation samples and lot date codes, refer to Table I.

The total dose radiation steps were 2.5, 6.3, 10, 15, 20, 30 and 50 krads. After 50 krads, parts were annealed at 25°C for 24 and 168 hours. The dose rate was between 0.06 - 1.0 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 the specification limits listed in Table III. These tests included a total of five functional tests (at 1 and 7.4 MHz) after each radiation and annealing step.

All parts passed all tests on irradiation up to 2.5 krads. After 6.3 krads, two parts (SNs 4 and 5) exceeded the specification limits for ICCSBL and ICCSBH. These parts were reading in the range of 170 - 400 uA against the specification limit of 100 uA. However, these parts passed all functional tests and were within the specification limits for all other tests. The remaining six parts passed all tests on irradiation up to 6.3 krads. At the next irradiation step of 10 krads, all parts exceeded the specification limits on ICCSBL and ICCSBH (readings were in the range of 300 - 3200 uA), and two parts (SNs 4 and 5) exceeded the specification limits on ICCOP also. After 15 and 20 krads, all parts exceeded the specification limits on ICCOP, ICCSBL and ICCSBH, while two parts (SNs 4 and 5) showed IOZL and

IOZH failures too. However, all parts passed all functional tests on irradiation up to 20 krads.

The first functional failures occurred after radiation exposure to 30 krads, when SN 5 failed one functional test. However, all other (7) parts passed all functional tests on irradiation up to 30 krads, though showing significant degradation in DC parameters. At 50 krads, all parts failed most of the functional tests, as well as a number of DC and AC parametric tests. On annealing for 24 and 168 hours, parts showed some recovery in DC parameters, but continued to fail a number of functional and AC parametric tests. 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 the functional test results after each radiation and annealing step.

The test results indicate that the parts with LDC 8821 failed parametrically (ICCBL/H) between 2.5 to 6.3 krads, while parts from all other LDCs (8910, 8948 and 9015) failed parametrically between 6.3 and 10 krads. The functional failure level was between 20 to 30 krads for LDC 8821, and between 30 - 50 krads for the remaining LDCs.

ICCSBL/H was the most radiation sensitive parameter for this part type. Tables V and VI show the ICCSBL and ICCSBH measurements for each of the eight parts measured in this evaluation after 2.5, 6.3, 10 and 20 krads exposure.

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:	HM1-6617/883
ISTP Common Buy Part Number:	HM1-6617/883
ISTP Common Buy Control Number:	3866
Manufacturer:	Harris
Quantity Procured:	
Lot Date Codes:	8821, 8910, 8948, 9015
Quantity Tested:	10
Serial Numbers of Radiation Samples*:	3,8 (LDC 9015); 6,7 (LDC 8948) 4,5 (LDC 8821); 9,10 (LDC 8910)
Serial Numbers of Control Samples:	1,2 (LDC 8910)
Part Function:	2k x 8 PROM
Part Technology:	CMOS
Package Style:	24-Pin DIP

* Radiation testing was performed on samples from each of the four LDCs that comprised the total population of parts procured for ISTP Common Buy. The testing was aimed to determine if there was a significant variation with LDC. If so, to determine in which LDC parts showed the highest radiation tolerance. To illustrate the variation in radiation characteristics in parts with different LDCs, Tables V and VI show the parametric measurements of ICCSBL and ICCSBH (the most radiation sensitive parameters for these parts) for SNs 3, 4, 5, 6, 7, 8, 9, 10. It appears SNs 4 and 5 (LDC 8821) showed maximum degradation.

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	12/21/90
2) 2.5 krads irradiation @ 125 rads/hr	12/27/90
Post 2.5 krads Electrical Measurements	12/28/90
3) 6.34 krads irradiation @ 60 rads/hr	12/28/90
Post 6.34 krads Electrical Measurements	12/31/90
4) 10 krads irradiation @ 83 rads/hr	12/31/90
Post 10 krads Electrical Measurements	01/02/91
5) 15 krads irradiation @ 250 rads/hr	01/02/91
Post 15 krads Electrical Measurements	01/03/91
8) 20 krads irradiation @ 250 rads/hr	01/03/91
Post 20 krads Electrical Measurements	01/04/91
9) 30 krads irradiation @ 147 rads/hr	01/04/91
Post 30 krads Electrical Measurements	01/07/91
10) 50 krads irradiation @ 1 krad/hr	01/07/91
Post 50 krads Electrical Measurements	01/08/91
11)24 hrs annealing	
Post 24 hr Electrical Measurements	01/09/91
12) 168 hrs annealing	
Post 168 hr Electrical Measurements	01/15/91

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 performed at 25°C under bias.

TABLE III. Electrical Characteristics of HM1-6617/883

Functional Testing*

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS
FUNCT. #1	4.5V	0.8V	2.5V	FREQ=1.0MHz,	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT. #2	5.0V	0.8V	3.0V	FREQ=1.0MHz,	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT. #3	5.5V	0.8V	3.5V	FREQ=1.0MHz,	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT. #4	4.5V	0.0V	3.0V	FREQ=7.4MHz,	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT. #5	5.5V	0.0V	3.0V	FREQ=7.4MHz,	ALL I/O	VOL<1.5V , VOH>1.5V

* All parts came from the manufacturer with all (16kbits) at logical zero. The functional tests consisted of reading all bits at different values of VCC at 1MHz and 7.4MHz.

DC Parametric Tests

PARAM	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS (25C,-55C,125C)	DELTAS (25C) ABSOLUTE	DELTAS (25C) PERCENTAGE
VOL	4.5V	0.0V	4.5V	LOAD=4.8MA	OUTS	> 0.0V, <0.4V	+-40MV	+-10%
IIH	5.5V	0.0V	5.5V	TESTV=5.5V	INS	>-0NA , <1UA	+-100NA	+-10%
IIL	5.5V	0.0V	5.5V	TESTV=0.0V	INS	>-1UA , <0NA	+-100NA	+-10%
IOZH	5.5V	0.0V	5.5V	TESTV=5.5V	OUTS	>-1UA , <1UA		+-10%
IOZL	5.5V	0.0V	5.5V	TESTV=0.0V	OUTS	>-1UA , <1UA		+-10%
ICCSBL	5.5V	0.0V	5.5V	TESTV=0.0V	VCC	> 0MA , <100UA		+-10%
ICCSBH	5.5V	0.0V	5.5V	TESTV=5.5V	VCC	> 0MA , <100UA		+-10%
ICCOP	5.5V	0.0V	5.5V	FREQ =1MHZ	VCC	> 0MA , <20MA		+-10%

TABLE III. (continued)

AC Parametric Tests

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS (25C,-55C,125C)	
TGHQZ	4.5V	0.0V	3.0V	VREF = 1.5V, VCOMP= 1.0V, IOH =-10MA, IOL =+10MA	/G -> Q	>0NS	<40NS
TEHQZ	4.5V	0.0V	3.0V	VREF = 1.5V, VCOMP= 1.0V, IOH =-10MA, IOL =+10MA	/E -> Q	>0NS	<45NS
TGLQX	4.5V	0.0V	3.0V	VREF = 1.5V, VCOMP= 1.0V, IOH =-10MA, IOL =+10MA	/G -> Q	>5NS	<1US (MAX. TEST CYCLE)
TELQX	4.5V	0.0V	3.0V	VREF = 1.5V, VCOMP= 1.0V, IOH =-10MA, IOL =+10MA	/E -> Q	>5NS	<1US (MAX. TEST CYCLE)
TGHQZ	5.5V	0.0V	3.0V	VREF = 1.5V, VCOMP= 1.0V, IOH =-10MA, IOL =+10MA	/G -> Q	>0NS	<40NS
TEHQZ	5.5V	0.0V	3.0V	VREF = 1.5V, VCOMP= 1.0V, IOH =-10MA, IOL =+10MA	/E -> Q	>0NS	<45NS
TGLQX	5.5V	0.0V	3.0V	VREF = 1.5V, VCOMP= 1.0V, IOH =-10MA, IOL =+10MA	/G -> Q	>5NS	<1US (MAX. TEST CYCLE)
TELQX	5.5V	0.0V	3.0V	VREF = 1.5V, VCOMP= 1.0V, IOH =-10MA, IOL =+10MA	/E -> Q	>5NS	<1US (MAX. TEST CYCLE)

SPECIAL COMMENTS AND EXCEPTIONS

(1) TESTS PERFORMED within FUNCTIONAL #1,#2 & #3 :
    -- VIH & VIL.
    -- TAVEL (A LE) 15ns before (E_ TE).
    -- TELAX (A TE) 20ns after (E_ TE).
(2) TESTS PERFORMED within FUNCTIONAL #4 & #5 :
    -- TELEH E_ Low width 95ns.
    -- TEHEL E_ High width 40ns.
    -- TELEL 135nS E_ Repetition Cycle.
    -- TAVEL (A LE) 15ns before (E_ TE).
    -- TELAX (A TE) 20ns after (E_ TE).
(3) TEST NOT PERFORMED because of unprogrammed DUT :
    -- VOH , TAVQV , TELQV , TGLQV.

TABLE IV: Summary of Electrical Meas ents after
Total Dose Exposures and Annealing for HM1-6617/883 1/, 2/

		Spec. Limits		Initials		Total Dose Exposure (krads)										Annealing			
						2.5		10		20		30		50		24 hrs.		168 hrs.	
Parameters		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Func1 @ 1MHz				Pass		Pass		Pass		Pass		7P/1F		8Fail		8Fail		8Fail	
Func2 @ 1MHz				Pass		Pass		Pass		Pass		Pass		8Fail		8Fail		8Fail	
Func3 @ 1MHz				Pass		Pass		Pass		Pass		Pass		8Fail		8Fail		2P/6F	
Func4 @ 7.4MHz				Pass		Pass		Pass		Pass		Pass		1P/7F		1P/7F		1P/7F	
X Func5 @ 7.4MHz				Pass		Pass		Pass		Pass		Pass		3P/5F		4P/4F		Pass	
VOL	mV	0	400	155	18	159	22	161	23	174	27	122	287	*	*	*	*	*	*
IIH	nA	0	1E3	0	-	0	-	0	-	0	-	0	-	2.4	11.6	1.4	6.9	0.1	1.1
IIL	nA	-1E3	0	0	-	0	-	0	-	0	-	0	-	-0.1	0.7	0	-	0	-
IOZH	nA	-1E3	1E3	0	-	0	-	0	-	443	2E3	24E3	29E3	2E5	1E5	1E5	1E5	1E5	5E4
IOZL	nA	-1E3	1E3	0		0		0		8E6	27E6	52E6	50E6	>1E8	-	>1E8	-	>1E8	-
ICCSBL	uA	0	100	0		0		1E3	913	13E3	2E3	15E3	4.4	15E3	3.9	15E3	4.5	15E3	4.4
ICCSBH	uA	0	100	0		0		1E3	1E3	14E3	2E3	15E3	4.4	15E3	3.9	15E3	3.0	15E3	4.4
ICCOP	mA	0	20	13.5	0.5	13.4	0.5	19.0	3.3	30.0	.01	30.0	.02	30.0	.01	30.0	.02	30.0	.02
TGHQZ1	ns	0	40	16.5	2.3	16.0	2.3	15.8	2.3	15.4	2.1	16E3	12E4	4E5	5E5	2E5	4E5	1E5	3E5
TEHQZ1	ns	0	45	26.2	2.7	25.9	2.7	26.2	2.7	26.6	2.8	28.3	3.0	4E5	5E5	3E5	4E5	1E5	3E5
TGLQZ1	ns	5	1E3	22.1	1.3	21.9	1.3	22.1	1.4	22.9	1.5	25.8	15.7	7E5	4E5	7E5	5E5	5E5	5E5
TELQZ1	ns	5	1E3	151	2	151	2	150	2	150	2	31E3	17E4	>1E6	-	9E5	2E5	7E5	5E5
X TGHQZ2	ns	0	40	16.9	2.3	16.3	2.4	16.2	2.3	15.7	2.3	15.3	2.2	2E5	4E5	1E5	3E5	5E4	2E5
X TEHQZ2	ns	0	45	24.9	2.6	24.6	2.7	24.8	2.7	25.1	2.7	26.4	2.8	2E5	4E5	2E5	4E5	3E4	2E5
X TGLQZ2	ns	5	1E3	20.8	1.3	20.6	1.2	20.8	1.3	21.5	1.3	22.3	1.6	4E5	5E5	3E5	4E5	6E4	2E5
X TELQZ2	ns	5	1E3	144	2	144	2	144	2	144	2	144	2	5E5	5E5	5E5	5E5	2E5	4E5

Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in the 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 V. ICCSBL vs. Total Dose *

LDC, SN

Total Dose	8821		9015		8948		8910	
	#4	#5	#3	#8	#6	#7	#9	#10
2.5k	0	0	0	0	0	0	0	0
6.3k	0.2	0.3	0	0	0.02	0	0.02	0.1
10k	2.1	3.1	0.3	0.4	0.8	0.7	0.7	1.4
20k	15	15	9.9	11.1	15	12.8	14.6	15

* All measuremnets in mA.

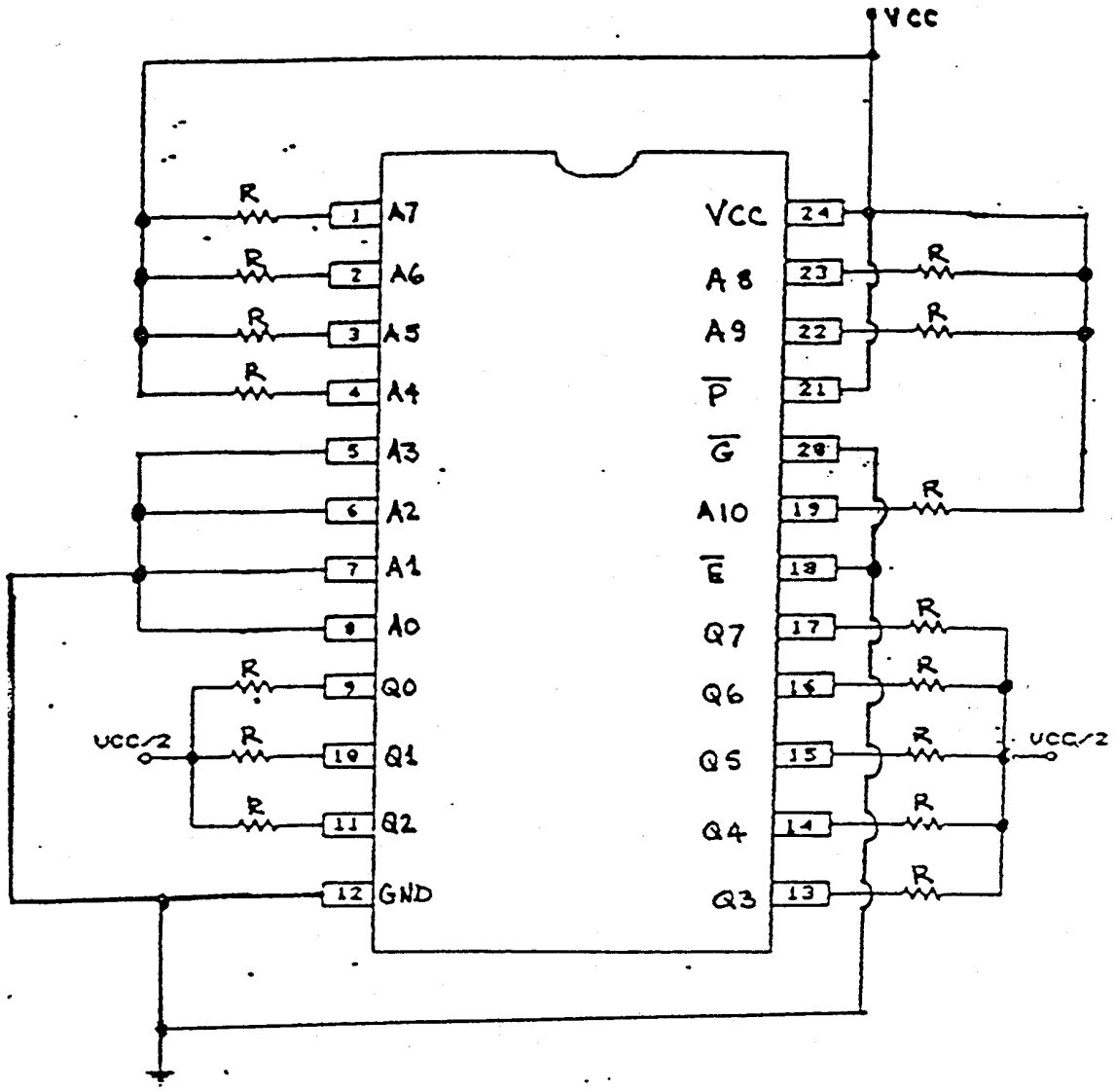
Table VI. ICCSBH vs. Total Dose *

LDC, SN

Total Dose	8821		9015		8948		8910	
	#4	#5	#3	#8	#6	#7	#9	#10
2.5k	0	0	0	0	0	0	0	0
6.3k	0.2	0.4	0	0	0.02	0	0.03	0.1
10k	2.4	3.5	0.3	0.5	0.9	0.8	0.9	1.6
20k	15	15	10.3	10.9	15	12.3	14.1	15

* All measuremnets in mA.

Figure 1. Radiation Bias Circuit for HM1-6617/883



Notes:

1. All resistors 2 KΩ, 1/4W 10%
2. VCC = 5. V ±5%
   GND = 0V
3. All power supplies must be at zero volts when the boards are inserted into the ovens. After insertion, apply VCC first, then activate the VCC/2 power supply.
4. T_A = 25°C

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