UNISYS

DATE: December 21, 1993
TO: J. Lohr/311.1
FROM: K. Sahu/300.1 jCS
SUBJECT: Radiation Report on GGS/WIND/TGRS
Part No. 54HC123
Control No. 2020C

PPM-93-105

cc: A. Sharma/311
Library/300.1

A radiation evaluation was performed on 54HC123 (Dual Monostable Multivibrator) 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, two parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation levels were 2, 5, 7.5, 10, 15, 20 and 30 krads. The dose rate was between .036 and 0.15 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 30 krad irradiation, parts were annealed at 25°C for 168 hours, after which the parts were annealed at 100°C for 168 hours. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits listed in Table III. Electrical tests included six functional tests at 2.0 MHz; one at V_{CC} = 2.0 V, three at V_{CC} = 4.5 V and two at V_{CC} = 6.0 V.

All parts passed initial electrical measurements. All irradiated parts passed all parametric tests up to and including the 2.5 krad irradiation level. At the 5 krad irradiation level, all irradiated parts exceeded the maximum specification limit of 160 uA for ICC1, with readings ranging from 219 to 412 uA. All parts continued to exceed the maximum specification limit for ICC1 throughout all subsequent irradiation and annealing steps, with readings exceeding 10 mA at the 30 krad level. All parts failed the 2V functional test at the 30 krad level and continued to fail this test after annealing at 25°C and 100°C. After annealing for 168 hours at 100°C, all parts passed all electrical tests except for the 2V functional test.

All parts passed all other electrical tests, including the 4.5V and 6V functional tests, throughout all irradiation and annealing steps.

Table IV provides a summary of the functional test results, as well as 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.

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*The term rads, as used in this document, means rads(silicon). All radiation levels cited are cumulative.

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TABLE I. Part Information

Generic Part Number:	54HC123
ISTP/SOHO/CELIAS Part Number:	5962-8684701EA
ISTP/SOHO/CELIAS Control Number:	2020C
Charge Number:	C33735
Manufacturer:	Harris
Lot Date Code:	9019B
Quantity Tested:	5
Serial Number of Control Sample:	7
Serial Numbers of Radiation Samples:	8, 9, 10, 11
Part Function:	Dual Monostable Multivibrator
Part Technology:	CMOS
Package Style:	16-pin DIP
Test Equipment:	Sentry S-50
Test Engineer:	T. Scharer

TABLE II. Radiation Schedule for 54HC123

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	09/13/93
2) 2.5 KRAD IRRADIATION (0.036 KRADS/HOUR)	10/15/93
POST-2.5 KRAD ELECTRICAL MEASUREMENT	10/18/93
3) 5 KRAD IRRADIATION (0.05 KRADS/HOUR)	10/18/93
POST-5 KRAD ELECTRICAL MEASUREMENT	10/20/93
4) 7.5 KRAD IRRADIATION (0.05 KRADS/HOUR)	10/20/93
POST-7.5 KRAD ELECTRICAL MEASUREMENT	10/22/93
5) 10 KRAD IRRADIATION (0.04 KRADS/HOUR)	10/22/93
POST-10 KRAD ELECTRICAL MEASUREMENT	10/25/93
6) 15 KRAD IRRADIATION (0.11 KRADS/HOUR)	10/25/93
POST-15 KRAD ELECTRICAL MEASUREMENT	10/27/93
7) 20 KRAD IRRADIATION (0.12 KRADS/HOUR)	10/27/93
POST-20 KRAD ELECTRICAL MEASUREMENT	10/29/93
8) 30 KRAD IRRADIATION (0.15 KRADS/HOUR)	10/29/93
POST-30 KRAD ELECTRICAL MEASUREMENT	11/01/93
9) 168-HOUR ANNEALING @25°C	11/01/93
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/12/93
10) 168-HOUR ANNEALING @100°C**	11/12/93
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/19/93

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

*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 54HC123

TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT 25/-55/125C	ILOAD
FUNC 1	4.5V	0.0V	4.50V	FREQ = 2 MHZ	ALL I/O	VOH>2.25V/VOL<2.25V	2MA
FUNC 2	2.0V	0.5V	1.50V	FREQ = 2 MHZ	ALL I/O	VOH>1.9V /VOL<0.1V	20UA
FUNC 3	4.5V	1.35V	3.15V	FREQ = 2 MHZ	ALL I/O	VOH>4.4V /VOL<0.1V	20UA
FUNC 4	6.0V	1.8V	4.20V	FREQ = 2 MHZ	ALL I/O	VOH>5.9V /VOL<0.1V	20UA
FUNC 5	4.5V	1.35V	3.15V	FREQ = 2 MHZ	ALL I/O	VOH>3.7V /VOL<0.4V	4.0MA
FUNC 6	6.0V	1.8V	4.20V	FREQ = 2 MHZ	ALL I/O	VOH>5.2V /VOL<0.4V	5.2MA
VOH1Q	2.0V	0.50V	1.50V	LOAD=-.02MA	O/P	>1.90V / <2.0V	
VOH2Q	4.5V	1.35V	3.15V	LOAD=-.02MA	O/P	>4.40V / <4.5V	
VOH3Q	6.0V	1.80V	4.20V	LOAD=-.02MA	O/P	>5.90V / <6.0V	
VOH4Q	4.5V	1.35V	3.15V	LOAD=-4.0MA	O/P	>3.70V / <4.5V	
VOH5Q	6.0V	1.80V	4.20V	LOAD=-5.2MA	O/P	>5.20V / <6.0V	
VOL1Q	2.0V	0.50V	1.50V	LOAD=0.02MA	O/P	>0.0V / <0.10V	
VOL2Q	4.5V	1.35V	3.15V	LOAD=0.02MA	O/P	>0.0V / <0.10V	
VOL3Q	6.0V	1.80V	4.20V	LOAD=0.02MA	O/P	>0.0V / <0.10V	
VOL4Q	4.5V	1.35V	3.15V	LOAD=4.00MA	O/P	>0.0V / <0.40V	
VOL5Q	6.0V	1.80V	4.20V	LOAD=5.20MA	O/P	>0.0V / <0.40V	
IIH	6.0V	0.00V	6.00V	VIN=6.00V	I/P	> 0.0UA / <1.0UA	
IIL	6.0V	0.00V	6.00V	VIN=0.00V	I/P	>-1.0UA / <0.0UA	
ICCH	6.0V	0.00V	6.00	VIN=6.00V	VCC	>0.0A / <160UA	
ICCL	6.0V	0.00V	6.00V	VIN=0.00V	VCC	>0.0V / <160UA	

AC PARAMETRIC TESTS

PARAMETER		VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
TPLHQ	A&B	2.0V	0.0V	2.0V	F=2 MHz,	OUTPUTS	> 0ns / < 300ns
TPLHQ	R	2.0V	0.0V	2.0V	F=2 MHz,	OUTPUTS	> 0ns / < 300ns
TPHLQ_	A&B	2.0V	0.0V	2.0V	F=2 MHz,	OUTPUTS	> 0ns / < 320ns
TPHLQ_	R	2.0V	0.0V	2.0V	F=2 MHz,	OUTPUTS	> 0ns / < 320ns
TPHLQ	R	2.0V	0.0V	2.0V	F=2 MHz,	OUTPUTS	> 0ns / < 215ns
TPLHQ_	R	2.0V	0.0V	2.0V	F=2 MHz,	OUTPUTS	> 0ns / < 215ns
TPLHQ	A&B	4.5V	0.0V	4.5V	F=2 MHz,	OUTPUTS	> 0ns / < 60ns
TPLHQ	R	4.5V	0.0V	4.5V	F=2 MHz,	OUTPUTS	> 0ns / < 60ns
TPHLQ_	A&B	4.5V	0.0V	4.5V	F=2 MHz,	OUTPUTS	> 0ns / < 64ns
TPHLQ_	R	4.5V	0.0V	4.5V	F=2 MHz,	OUTPUTS	> 0ns / < 64ns
TPHLQ	R	4.5V	0.0V	4.5V	F=2 MHz,	OUTPUTS	> 0ns / < 43ns
TPLHQ_	R	4.5V	0.0V	4.5V	F=2 MHz,	OUTPUTS	> 0ns / < 43ns
TPLHQ	A&B	6.0V	0.0V	6.0V	F=2 MHz,	OUTPUTS	> 0ns / < 51ns
TPLHQ	R	6.0V	0.0V	6.0V	F=2 MHz,	OUTPUTS	> 0ns / < 51ns
TPHLQ_	A&B	6.0V	0.0V	6.0V	F=2 MHz,	OUTPUTS	> 0ns / < 54ns
TPHLQ_	R	6.0V	0.0V	6.0V	F=2 MHz,	OUTPUTS	> 0ns / < 54ns
TPHLQ	R	6.0V	0.0V	6.0V	F=2 MHz,	OUTPUTS	> 0ns / < 37ns
TPLHQ_	R	6.0V	0.0V	6.0V	F=2 MHz,	OUTPUTS	> 0ns / < 37ns

COMMENTS/EXCEPTIONS

1) VIH AND VIL WERE CHECKED WITHIN THE VOH AND VOL TESTS AND FUNCTIONAL TESTS 2 THROUGH 6.
2) DUT ORIENTATION IS CHECKED.
3) VOL AND VOH FOR QNOT AND Q RESPECTIVELY WERE TESTED GO/NO DURING THE FUNCTIONAL TESTS 2 THROUGH 6. VOL AND VOH FOR Q AND QNOT RESPECTIVELY WERE TESTED DURING VOL AND VOH.
4) DUT PIN NUMBERS 7 AND 15 WERE NOT TESTED FOR IIL AND IIH SINCE THE EXTERNAL R AND C COULD NOT BE REMOVED FROM THE TEST FIXTURE AND PREVENTED THE MEASUREMENTS FROM BEING MADE.
5) EXTERNAL COMPONENTS: RX = 10 KOHMS , CX = 0.1 UF (SOCKET ADAPTER "MV 3")
6) TEST ICC (ACTIVE STATE SUPPLY CURRENT) WAS NOT PERFORMED FOR THE REASON GIVEN IN STEP 4.
7) THE TESTS HAVE NOT BEEN VERIFIED AT THE TEMPERATURE EXTREMES.

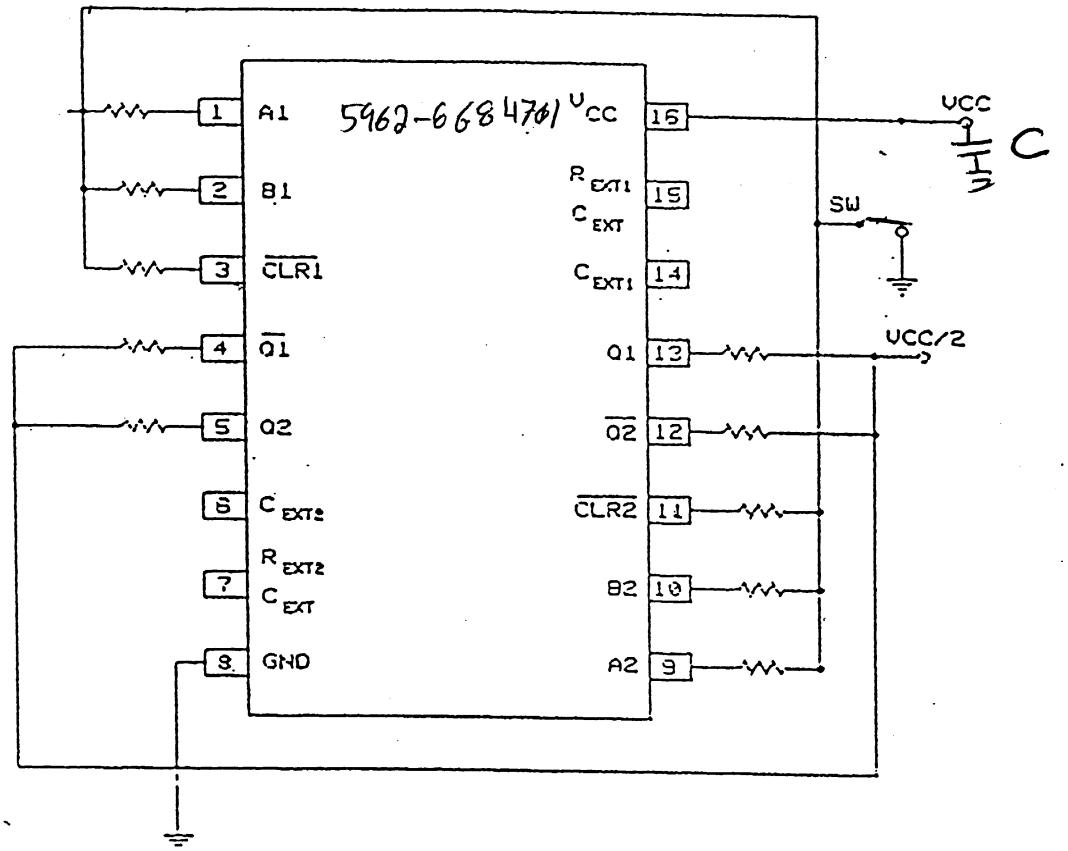
TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for 54HC123 /1

					Total Dose Exposure (krads)												Annealing			
			Initials		2.5		5		7.5		10		15		20		30		168 hrs @25øC		168 hrs @100øC	
Parameters/2		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1, 4.5V, 1 MHz		-	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC2, 2.0V, 1 MHz		-	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		FAIL		FAIL		FAIL	
FUNC3, 4.5V, 1 MHz		-	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC4, 6.0V, 1 MHz		-	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC5, 4.5V, 1 MHz		-	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC6, 6.0V, 1 MHz		-	-	PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VOH1Q	V	1.9	2	1.99	0	1.99	0	1.99	0	1.99	0	1.99	0	1.99	0	1.99	0	1.99	0	1.99	0	1.99	0
VOH2Q	V	4.4	4.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	.01
VOH3Q	V	5.9	6	5.99	0	5.99	0	5.99	0	5.99	0	5.99	0	5.99	0	5.99	0	5.99	0	5.99	0	5.99	0
VOH4Q	V	3.7	4.5	4.35	0	4.35	0	4.35	0	4.35	0	4.35	0	4.35	0	4.34	.01	4.33	0	4.34	0	4.33	.01
VOH5Q	V	5.2	6	5.84	0	5.85	0	5.85	0	5.85	0	5.84	0	5.84	0	5.84	0	5.83	.01	5.84	.01	5.83	.01
VOL1Q	mV	0	100	0	0	0	0	0	0	0	0	0	0	2.38	4.2	4.38	4.5	11.5	3.6	9.13	1.2	2.25	3
VOL2Q	mV	0	100	0	0	0	0	0	0	0	0	0	0	7.38	6.9	8.50	5.8	18.5	5.4	14.9	2.3	5.5	4.2
VOL3Q	mV	0	100	0	0	0	0	0	0	1	1.7	5.13	.33	9.75	7.5	10.5	6.4	22.4	5.9	18.6	2.5	7.63	3.9
VOL4Q	mV	0	400	123	3	117	2.9	116	3.1	119	2.7	121	3.7	123	16	119	11	124	9.6	121	5.5	111	11
VOL5Q	mV	0	400	126	3	120	3	122	2.9	126	3	129	4.4	128	13	128	14	136	11	132	6	121	14
IIH	µA	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL	µA	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ICC1	µA	0	160	0	0	2.13	5.6	367	85	1001	208	17955	342	37609	579	51823	680	98188	10988	88036	10490	71737	10279
TPLH1_A1	ns	0	300	91.5	4.9	90.5	5.3	91.5	6	92.5	6.5	94	7.2	99.6	9.5	105	13	221	61	211	66	178	67
TPLH1_A2	ns	0	300	92.8	5.4	91.8	5.8	92.8	6.5	93.8	6.9	95.5	7.4	102	9.3	108	12	5E5	5E5	2.5E5	4.3E5	179	63
TPHL1_A1	ns	0	320	92.4	4.9	89.5	5.3	87.8	6.1	87.3	6.6	87.7	7.3	91.2	9.5	95.2	13	217	64	186	58	153	47
TPHL1_A2	ns	0	320	92.8	5.4	90.1	5.7	88.5	6.5	88.1	6.9	88.6	7.4	92.6	9.2	98.2	12	5E5	5E5	2.5E5	4.3E5	169	60
TPLH2A_CQ	ns	0	215	60.5	1.5	57.3	1.5	54.5	1.6	53.1	1.5	51.8	1.5	48.7	1.3	46.7	1.5	2.5E5	4.3E5	1.3E5	3.3E5	46.6	1.6
TPHL2A_CQ	ns	0	215	51.9	1.5	50.9	1.5	50.9	1.6	51.2	1.6	51.4	1.6	50.7	1.5	50.6	1.7	2.9E5	4.5E5	1.3E5	3.3E5	54.8	1.8
TPLH1_B1	ns	0	60	25	1.2	24.5	1.2	24.7	1.3	24.6	1.3	24.7	1.3	24.8	1.3	25	1.4	25.8	1.6	25.6	1.6	28.4	1.6
TPLH1_B2	ns	0	60	26.3	1.3	25.5	1.3	25.3	1.4	25.2	1.3	25.2	1.4	25.1	1.4	25.4	1.5	26.2	1.8	28.9	1.7	28.7	1.7
TPHL1_B1	ns	0	64	25.5	1.2	24.8	1.2	24.8	1.2	24.6	1.3	24.6	1.3	24.6	1.3	24.7	1.4	25.1	1.6	27.9	1.6	27.7	1.6
TPHL1_B2	ns	0	64	25.5	1.3	24.8	1.3	24.8	1.3	24.6	1.3	24.5	1.4	24.6	1.4	24.6	1.5	25.2	1.7	27.9	1.6	27.7	1.6
TPLH2B_CQ	ns	0	43	19.1	.53	18.3	.51	18	.53	17.7	0.5	17.4	0.5	17	.46	16.6	.48	15.9	.46	19	.45	19	.43
TPHL2B_CQ	ns	0	43	15.8	.44	15.4	0.4	15.4	.42	15.3	.45	15.2	.44	15	.39	14.8	.41	14.6	.44	17.5	.42	17.6	0.4
TPLH1_C1	ns	0	51	20.1	.87	19.7	.86	19.9	.87	19.8	.87	19.8	.87	19.9	.85	19.9	0.9	20.3	.99	23.1	.98	23	.99
TPLH1_C2	ns	0	51	20.1	.99	19.8	.98	19.8	1	19.7	.98	19.8	1	19.6	.99	20	1	20.3	1.1	23.1	1.1	23	1.1
TPHL1_C1	ns	0	54	20.4	.88	20	.87	20	.86	19.9	.87	19.9	.86	19.9	.85	20	.92	20.2	1	23	1	22.9	.99
TPHL1_C2	ns	0	54	20.4	.99	19.9	.98	20	.99	19.9	.98	19.9	1	19.8	.98	19.8	1	20.1	1.1	22.8	1.1	22.8	1.1
TPLH2C_CQ	ns	0	37	15.6	.41	15.2	.37	15.1	.37	14.9	.39	14.8	.38	14.7	.35	14.5	.37	14.1	.35	17.1	.33	17.1	.31
TPHL2C_CQ	ns	0	37	13.5	.28	13.2	.29	13.2	.31	13.2	.29	13.2	0.3	13	.29	12.9	0.3	12.7	0.3	15.6	.28	15.6	.26

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

2/ In the functional tests, "PASS" means that all samples passed this functional test at this radiation or annealing level, "FAIL" means that all samples failed this test at this radiation or annealing level, and "nP/mF" means that n samples passed at this level and m samples failed at this level.

Figure 1. Radiation Bias Circuit for 54HC123



1) V^{CC} = +5.0 VDC ± 500 mV

2) All R = 2 kΩ ± 10 %, 1/4 W.

3) C = 0.01 uF, 50 V.