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To
J. Lohr
Department
From Code 311
K. Sahu ks
Department
7809
Subject

Date PPM-92-099
Location March 9, 1992
Telephone GSFC
Location 731-8954
cc Lanham

Radiation Report on M54HC373YBF
GGG/WIND/WAVES Control No. 5728

E. Werner/406
M. Kaiser/695
G. Robinson/303

A radiation evaluation was performed on M54HC373YBF 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, four parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation steps were 5, 10, 15 and 20 krads*. After 20 krads, parts were annealed at +25°C for 168 hours and then at +100°C for 168 hours. The dose rate was between 0.11 and 0.12 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 two functional tests (1 MHz) at 4.5 and 6.0V.

All parts passed all tests on irradiation to 5 krads. However, at 10 krads and above, two parts exceeded the specification limits on all three ICC tests and IOZH. After 20 krads, the maximum readings were 82.8 uA for ICCH, 315.0 uA for ICCL and 529.0 uA for ICCZ, against maximum specification limits of 4.0 uA for each. No significant recovery was observed on annealing the parts for 168 hours at 25°C and 168 hours at 100°C. All parts passed the functional tests throughout the radiation exposures and the subsequent annealing treatments at 25°C and 100°C for 168 hours each.

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.

*In this report, the term krads means krads (Si).

TABLE I. Part Information

Generic Part Number:	54HC373
GGS/WIND/WAVES Part Number:	M54HC373YBF
GGS/WIND/WAVES Control Number:	5728
Charge Number:	C23413
Manufacturer:	SGS-Thomson
Lot Date Code:	88916
Quantity Tested:	5
Serial Numbers of Radiation Samples:	131, 132, 133, 134
Serial Numbers of Control Sample:	130
Part Function:	octal latch (tri-state)
Part Technology:	CMOS
Package Style:	20-lead DIP
Test Engineer:	R. Tosh

TABLE II. Radiation Schedule for 54HC373

EVENTS	DATE
1) Initial Electrical Measurements	01/06/92
2) 5 KRAD IRRADIATION (0.11 krads/hour)	01/08/92
POST-5 KRAD ELECTRICAL MEASUREMENT	01/10/92
3) 10 KRAD IRRADIATION (0.12 krads/hour)	01/15/92
POST-10 KRAD ELECTRICAL MEASUREMENT	01/15/92
4) 15 KRAD IRRADIATION (0.12 krads/hour)	01/17/92
POST-15 KRAD ELECTRICAL MEASUREMENT	01/17/92
5) 20 KRAD IRRADIATION (0.11 KRADS/HOUR)	01/21/92
POST-20 KRAD ELECTRICAL MEASUREMENT	01/21/92
6) 168 HOUR ANNEALING @ 25°C	01/29/92
POST-168 HOUR 25°C ANNEAL ELECTRICAL MEASUREMENT	01/29/92
7) 168 HOUR ANNEALING @ 100°C	02/13/92
POST-168 HOUR 100°C ANNEAL ELECTRICAL MEASUREMENT	02/14/92

Table III. Electrical Characteristics of 54HC373

DEVICE	PART TYPE : OCTAL TRANSPARENT LATCH 3-STATE			PCN : S110485A		
	PART NO. : 54HC373AF					
TEST PROGRAM LOCATION			TEST SPECIFICATIONS			
DISK LABEL : TESTK			SGS-THOMSON DATA SHEET, 1988			
RELIABILITY : QUANTIFIED PERMITS 4854						
FUNCTIONAL TESTS PERFORMED						
PARAMETER	V _{CC}	V _{IL}	V _{IH}	CONDITIONS	PINS	LIMITS OVER TEMP.
FUNC1 1	4.5V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL<2.25V / VOH>2.25V
FUNC1 2	4.5V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL<3.00V / VOH>3.00V
LOAD USED AT C I _{OH} = -5.0uA C V _{REF} = 1.5V C I _{IL} = +6.0uA						
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	V _{CC}	V _{IL}	V _{IH}	CONDITIONS	PINS	LIMITS AT +25C ONLY
V _{OH1}	2.0V	0.00V	1.50V	LOAD=-2.0uA	OUTS	>+1.9V / <+2.0V
V _{OH2}	4.5V	1.55V	3.15V	LOAD=-2.0uA	OUTS	>+4.40V / <+4.5V
V _{OH3}	4.5V	1.55V	4.20V	LOAD=-2.0uA	OUTS	>+5.9V / <+6.0V
V _{OH4}	4.5V	1.55V	5.15V	LOAD=-6.0uA	OUTS	>+4.18V / <+4.5V
V _{OH5}	4.5V	1.55V	4.20V	LOAD=-7.9uA	OUTS	>+5.68V / <+6.0V
V _{OL1}	2.0V	0.00V	1.50V	LOAD=+2.0uA	OUTS	>+0.0V / <+0.1V
V _{OL2}	4.5V	1.55V	3.15V	LOAD=+2.0uA	OUTS	>+0.0V / <+0.1V
V _{OL3}	4.5V	1.55V	4.20V	LOAD=+2.0uA	OUTS	>+0.0V / <+0.1V
V _{OL4}	4.5V	1.55V	5.15V	LOAD=+6.0uA	OUTS	>+0.0V / <+0.26V
V _{OL5}	4.5V	1.55V	4.20V	LOAD=+7.9uA	OUTS	>+0.0V / <+0.26V
I _{IH}	4.5V	0.0V	4.5V	V _{IN} = 0.0V	INS	>+0.10uA / <+0.10uA
I _{IL}	4.5V	0.0V	4.5V	V _{IN} = 4.5V	INS	>-0.10uA / <-0.10uA
I _{IZH}	4.5V	0.0V	4.5V	V _{IN} = 0.0V	INS	>+0.50uA / <+0.50uA
I _{IZL}	4.5V	0.0V	4.5V	V _{IN} = 4.5V	INS	>-0.50uA / <-0.50uA
I _{CC1}	4.5V	0.0V	4.5V	V _{IH} = 0.0V	V _{CC}	>+0.00uA / < +4uA
I _{CC2}	4.5V	0.0V	4.5V	V _{IH} = 0.0V	V _{CC}	>+0.00uA / < +4uA
I _{CC3}	4.5V	0.0V	4.5V	V _{IH} = 4.5V	V _{CC}	>+0.00uA / < +4uA
AC PARAMETRIC TESTS PERFORMED						
PARAMETER	V _{CC}	V _{IL}	V _{IH}	CONDITIONS	PINS	LIMITS AT +25C ONLY
TPHL _{1_QN}	4.5V	0.0V	4.5V	ON TO QN		> 2.0NS / < 29.0NS
TPHL _{2_QN}	4.5V	0.0V	4.5V	ON TO QN		> 2.0NS / < 29.0NS
TPHL _{1_QN}	4.5V	0.0V	4.5V	LE TO QN		> 2.5NS / < 35.0NS
TPHL _{2_QN}	4.5V	0.0V	4.5V	LE TO QN		> 2.5NS / < 35.0NS
TPHL _{1_QN}	4.5V	0.0V	4.5V	OE TO QN		> 1.0NS / < 30.0NS
TPHL _{2_QN}	4.5V	0.0V	4.5V	OE TO QN		> 1.0NS / < 30.0NS
TPZH _{1_QN}	4.5V	0.0V	4.5V	OE TO QN		> 2.0NS / < 30.0NS
TPZH _{2_QN}	4.5V	0.0V	4.5V	OE TO QN		> 2.0NS / < 30.0NS

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for 54HC373 1/2/

Parameters	Spec. min	Limit max	Total Dose Exposure (TDE) (krads)										Anneal		Anneal			
			(Pre-Rad.)		0		5		10		15		20		168 hrs @25°C		168 hrs @+100°C	
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1 VCC=4.5			PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
FUNC2 VCC=6.0			PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VOH1	V	1.9	2.0	1.99	0	1.99	0	1.98	0.02	1.98	0.08	0	N/A	0	N/A	0	0.99	0.99
VOH2	V	4.4	5.0	4.49	N/A	4.49	N/A	4.50	0.04	4.49	0.2	4.42	0.2	4.42	0.2	4.43	0.2	0.2
VOH3	V	65.	6.5	5.99	0	5.99	0	6.03	0.06	5.99	0.3	5.89	0.3	5.89	0.3	5.89	0.3	0.3
VOH4	V	4.18	4.5	4.30	0	4.30	0	4.27	0.06	4.23	0.2	4.20	0.2	4.20	0.2	4.21	0.2	0.2
VOH5	V	5.68	6.0	5.79	0	5.79	0	5.79	0.05	5.71	0.3	5.67	0.3	5.67	0.3	5.67	0.3	0.3
VOL1	mV	0	100	0	N/A	0	N/A	0	N/A	249.7	661	1716	2.1	818.3	378	469.5	498	N/A
VOL2	mV	0	100	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	N/A
VOL3	mV	0	100	0	N/A	0	N/A	0.16	0.9	0.63	1.7	0.94	2.0	0.94	2.0	0	N/A	N/A
VOL4	mV	0	260	137.8	8.0	137.5	8.9	136.0	9.3	145.2	13	143.3	10	146.3	12	173.3	36	36
VOL5	mV	0	260	143.8	8.1	144.6	8.7	144.5	9.3	152.6	11	150.8	9.3	152.4	10	170.3	26	26
IIB	nA	-100	100	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	N/A
IIL	nA	-100	100	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	N/A
IOZH	nA	-500	500	0	N/A	0.38	0	523.9	505.5	2.3E6	1.3E7	4.9E6	1.9E7	5.0E6	1.9E7	4.6E6	1.8E7	1.8E7
IOZL	nA	-500	500	0	N/A	0	N/A	0.28	7.1	47.36	86	122.9	171	85.69	142	21.69	8.5	8.5
ICCH	uA	0	4.0	0	N/A	0.66	0.7	19.26	21	2.3E4	3.6E4	3.8E4	3.2E4	8136	7873	3.7E4	3.7E4	3.7E4
ICCL	uA	0	4.0	0	N/A	0.19	0.2	10.56	12	14.66	19	95.0	130	34.5	60	0	N/A	N/A
ICCZ	uA	0	4.0	0	N/A	0.14	0.15	8.95	9.8	21.69	26	157.5	218	64.75	94	3.05	2.9	2.9
TPHL1 DQ	ns	2	29	18.0	1.0	18.7	1.2	18.6	1.2	18.6	1.4	19.5	1.2	19.9	1.3	6.3E4	2.4E5	2.4E5
TPLH1 DQ	ns	2	29	21.2	1.0	22.6	1.0	3.1E4	1.7E5	22.7	1.8	23.0	1.9	23.1	1.9	25.2	5.8	5.8
TPHL2 DQ	ns	2	35	17.9	1.0	18.6	1.2	18.4	1.1	18.9	1.6	18.9	1.6	19	1.8	20.9	4.4	4.4
TPLH2 DQ	ns	2	35	21.2	1.0	22.8	1.0	3.1E4	1.7E5	22.9	1.8	23.2	1.9	23.3	1.9	25.1	5.8	5.8
TPHZ OQ	ns	2	30	18.6	1.0	17.6	1.4	3.1E4	1.7E5	3.1E4	1.7E5	6.3E4	2.4E5	6.3E4	2.4E5	3.7E4	4.8E5	4.8E5
TPLZ OQ	ns	2	30	19.6	1.2	20.6	1.3	20.8	1.3	20.9	1.4	21.3	1.5	21.1	1.5	20.6	1.5	1.5
TPZH OQ	ns	2	30	14.5	1.1	15.7	1.1	16.1	1.1	17.0	1.2	18.4	1.9	18.1	1.5	19.5	2.5	2.5
TPZL OQ	ns	2	30	16.9	1.1	17.4	1.3	3.1E4	1.7E5	3.1E4	1.7E5	3.1E4	1.7E5	3.1E4	1.7E5	3.1E4	1.7E5	1.7E5

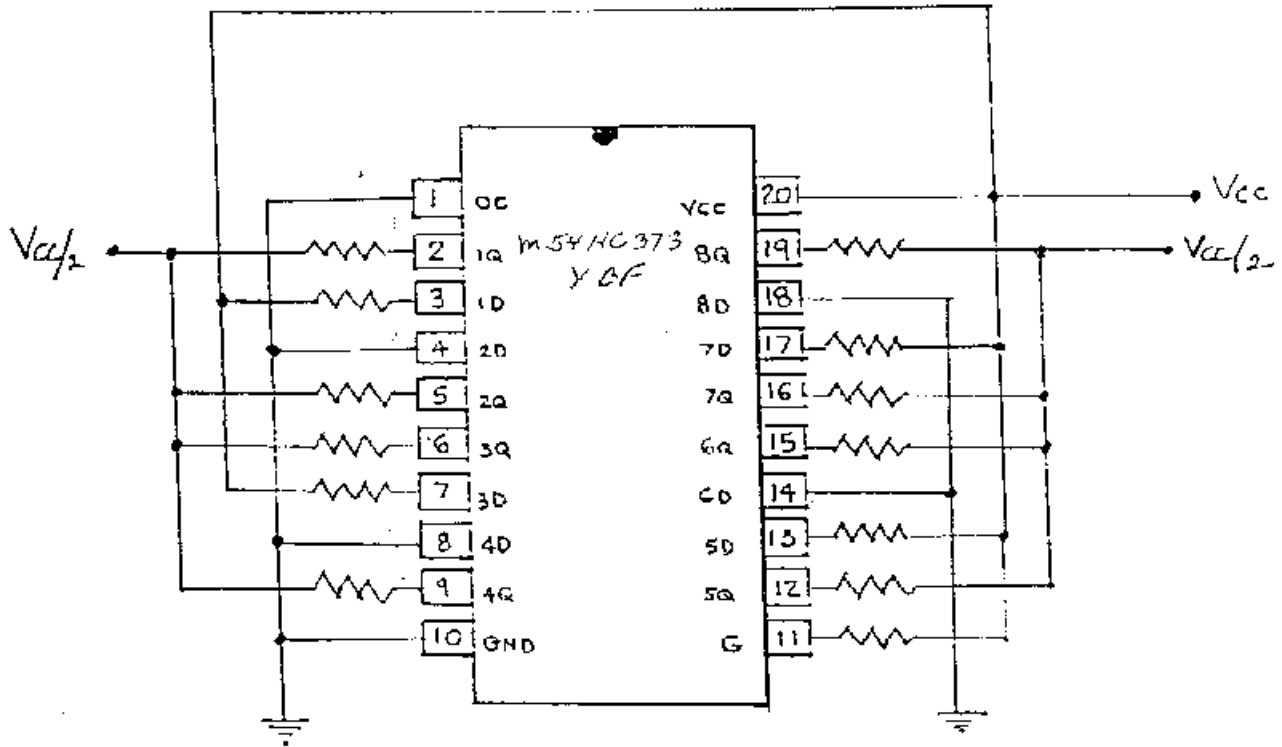
Note:

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.

2/ E6 implies 10 to the 6th power, E4, 10 to the 4th power, etc.

Figure 1. Radiation Bias Circuit for 54HC373



NOTE: . ALL RESISTORS ARE $1K\Omega$ $\frac{1}{4}W$ 5% .
 $V_{cc} = 5V \pm 10\%$