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Interoffice Memorandum

To
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Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on ISTEP
Non-Common Buy Part No. M54HC08YBF

PPM-91-407

Date
June 17, 1991Location
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731-8954Location
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A radiation evaluation was performed on M54HC08YBF 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, eight 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, 5, 7.5, 10, 13.5 and 18.5 krads. After 18.5 krads, parts were annealed at 25°C for 24 and 168 hours. The dose rate was between 73 - 263 rads/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 three functional tests (at 10 MHz) after each radiation and annealing step.

All (8) parts passed all tests, except ICCL/H, up to 18.5 krads. All parts began failing ICCL after 10 krads irradiation (readings ranged from 1.4uA to 6.6uA against the maximum specification limit of 1uA). All parts began failing ICCH after 13.5 krads (readings ranged from 1.4uA to 15.4uA against the maximum specification limit of 1uA). Continued degradation in these parameters was observed after 18.5 krads. Some recovery was observed after 24 and 168 hours of annealing, but the parts were still way beyond the specification limit for ICCL/H. 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 301-731-8954.

TABLE I. Part Information

Generic Part Number:	M54HC08
ISTP Non-Common Buy Part Number:	M54HC08YBF
ISTP Non-Common Buy Control Number:	2017B and 2026B
Charge No. :	C90301
Manufacturer:	SGS Thomson
Quantity Procured:	43 (2017B) and 72 (2026B)
Lot Date Code:	88938
Quantity Tested:	10
Serial Numbers of Radiation Samples:	202, 203, 204, 205, 206, 207, 208, 209
Serial Numbers of Control Samples:	200, 201
Part Function:	Quad 2-Input AND Gate
Part Technology:	HCMOS
Package Style:	14 Pin DIP

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	05/02/91
2) 2.5 krads irradiation @ 143 rads/hr Post 2.5 krads Electrical Measurements	05/07/91 05/08/91
3) 5 krads irradiation @ 139 rads/hr Post 5 krads Electrical Measurements	05/08/91 05/09/91
4) 7.5 krads irradiation @ 132 rads/hr Post 7.5 krads Electrical Measurements	05/09/91 05/10/91
5) 10 krads irradiation @ 125 rads/hr Post 10 krads Electrical Measurements	05/10/91 05/11/91
6) 13.5 krads irradiation @ 73 rads/hr Post 13.5 krads Electrical Measurements	05/11/91 05/13/91
7) 18.5 krads irradiation @ 263 rads/hr Post 18.5 krads Electrical Measurements	05/13/91 05/14/91
8) 24 hrs annealing Post 24 hr Electrical Measurements	05/14/91 05/15/91
9) 168 hrs annealing Post 168 hr Electrical Measurements	05/14/91 05/21/91

Notes:

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

Table III. Electrical Characteristics of M54HC08YBF

TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
FUNCT 1	4.5V	0.00V	4.50V	FREQ=10.00MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT 2	5.0V	0.00V	5.00V	FREQ=10.00MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT 3	5.5V	0.00V	5.50V	FREQ=10.00MHz	ALL I/O	VOL<1.5V , VOH>1.5V
(IOH = -50UA STD Load <= (VREF= 1.0V (IOL = 50UA						
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
VOH1	2.0V	0.5V	1.50V	LOAD= -20UA	OUTS	>+1.9V , <+2.0V
VOH2	4.5V	1.35V	3.15V	LOAD= -20UA	OUTS	>+4.4V , <+4.5V
VOH3	6.0V	1.8V	4.20V	LOAD= -20UA	OUTS	>+5.9V , <+6.0V
VOH4	4.5V	1.35V	3.15V	LOAD= -4MA	OUTS	>+4.18V , <+4.5V
VOH5	6.0V	1.8V	4.20V	LOAD=-5.2MA	OUTS	>+5.68V , <+6.0V
VOL1	2.0V	0.5V	1.50V	LOAD= +20UA	OUTS	>+0.0V , <+0.1V
VOL2	4.5V	1.35V	3.15V	LOAD= +20UA	OUTS	>+0.0V , <+0.1V
VOL3	6.0V	1.8V	4.20V	LOAD= +20UA	OUTS	>+0.0V , <+0.1V
VOL4	4.5V	1.35V	3.15V	LOAD= +4MA	OUTS	>+0.0V , <+0.26V
VOL5	6.0V	1.8V	4.20V	LOAD=+5.2MA	OUTS	>+0.0V , <+0.26V
IIL	6.0V	0.0V	6.0V	VIN = 0.0V	INS	>-0.1UA , <+0.1UA
IIH	6.0V	0.0V	6.0V	VIN = 6.0V	INS	>-0.1UA , <+0.1UA
ICCL	6.0V	0.0V	6.0V	VIN = 0.0V	VCC	>+0.0A , <+1UA
ICCH	6.0V	0.0V	6.0V	VIN = 6.0V	VCC	>+0.0A , <+1UA

Table III. (continued)

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
TPD _H	4.5V	0.0V	3.0V	LOAD=+/-4MA	OUTS	>+0.0NS , <+18.0NS
TPD _L	4.5V	0.0V	3.0V	LOAD=+/-4MA	OUTS	>+0.0NS , <+18.0NS

COMMENTS/EXCEPTIONS

- (1) VIL AND VIH WERE TESTED GO/NOGO DURING VOL AND VOH TESTS.
- (2) AC PARAMETERS ARE TESTED AT VCC = 4.5V ONLY.
- (3) OUTPUT TRANSITION TIMES TTLH AND TTHL ARE NOT TESTED.

TABLE IV: Summary of Functional Measurements after Total Dose Exposures and Annealing for M54HC08YBF

1/ 2/

Parameter	Spec. Limits min max	Initials mean sd	Total Dose Exposure (krads)														Annealing		
			2.5		5		7.5		10		13.5		18.5		168 hrs				
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd			
Func1@10MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func2@10MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func3@10MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1	V 1.9 2.0	2.00	0	2.00	0	2.00	0	2.00	0	2.00	0	1.99	0	1.98	.02	1.99	.01		
VOH2	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	.01	4.49	.01		
VOH3	V 5.9 6.0	6.0	0	5.99	0	5.99	0	5.99	0	5.99	0	5.99	0	5.98	.01	5.98	.01		
VOH4	V 4.18 4.50	4.30	.01	4.30	.01	4.30	.01	4.29	.02	4.30	.01	4.29	.01	4.28	.01	4.28	.01		
VOH5	V 5.68 6.0	5.78	.01	5.79	.01	5.79	.01	5.78	.02	5.78	.01	5.78	.01	5.77	.01	5.78	.01		
VOL1	mV 0 100	0	0	0	0	0	0	0	0	0	0	0	0	*		*			
VOL2	mV 0 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
VOL3	mV 0 100	0	0	0	0	0.3	1.2	0.8	1.8	1.8	2.4	2.3	2.7	3.2	3.3	2.6	2.9		
VOL4	mV 0 260	126	5	125	5	125	6	133	15	124	7	125	8	126	10	127	9		
VOL5	mV 0 260	134	5	135	6	135	7	149	19	134	7	136	8	136	9	137	9		
IIL	nA -100 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
IILH	nA -100 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
IOCL	nA 0 1000	0	0	4.8	10.5	108	43	226	74	3.9E3	2.0E3	64E3	35E3	6E5	3E5	3.1E5	1.9E5		
IOCH	nA 0 1000	0	0	0	0	10.5	5.5	26	12	539	292	1E4	5E3	1E5	5E4	5E4	3E4		
TPLH	ns 0 18	13.0	0.6	12.6	0.7	12.0	0.7	11.8	0.7	11.3	0.8	10.9	1.0	10.5	1.2	10.8	1.2		
TPHL	ns 0 18	7.2	0.5	6.7	0.4	6.7	0.4	6.8	0.4	6.8	0.4	6.8	0.5	6.8	0.7	7.0	0.6		

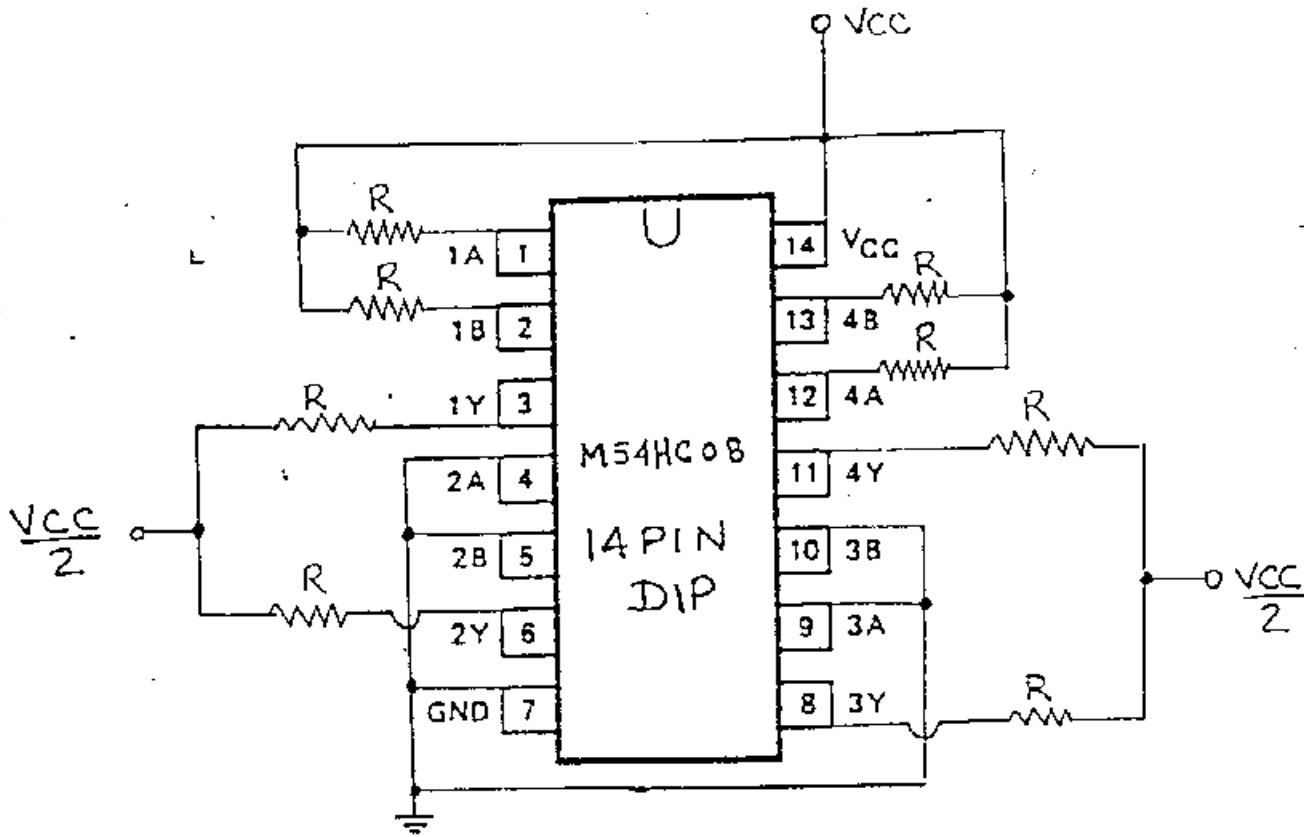
Notes:

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

2/ Table IV does not include post 24 hour annealing measurements. This data is available and can be obtained upon request.

* No reliable VOL1 measurements were made after 20 krads and above.

Figure 1. Radiation Bias Circuit for M54HC08YBF



M54HC08
14 PIN DIP

$$VCC = 5.0V \pm 10\%, \quad \frac{VCC}{2} = 2.5V \pm 10\%$$

$$R = 1.0 \text{ K Ohm}, 5\%, \frac{1}{4} \text{ W}$$