PPM-91-712

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UNISYS

Interoffice Memorandum

(95)

To
A. Sharma
Department
Code 311
From
K. Sahu KS
Department
7809
Subject

Radiation Report on
GPEP Part No. 54ACTQ08
Control No. 4656

PPM-91-712
Date
Dec. 6, 1991
Location
GSFC
Telephone
731-8954
Location
Lanham
cc
T. Perry
S. Archer-Davies
G. Jacobs

A radiation evaluation was performed on 54ACTQ08 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 V 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 two parts were used as control samples. The total dose radiation steps were 5, 10, 15, 20, 50, 80 and 100 krads*. After 100 krads, parts were annealed without bias at +25°C for 168 hours. The dose rate was between 55 - 1,500 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 @ +25°C according to the test conditions and the specification limits listed in Table III. These tests included two functional tests (1MHz, at VCC voltages of 4.5V and 5.5V) after each radiation and annealing step.

All four parts passed initial electrical measurements at testing temperatures of -55°C, 25°C and 125°C. All parts passed functionally throughout the radiation testing to 100 krads and the subsequent 168 hours of annealing at a testing temperature of 25°C. In addition, all parts passed all parametric tests to 100 krads. No significant degradation was observed in any of the test parameters throughout the testing. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. Table V provides this data at high/low temperature pre-irradiation electrical measurements. Tables IV & V also provide a summary of the 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.

*In this report, the term rads is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	54ACTQ08
GPEP Part Number:	54ACTQ08
GPEP Control Number:	4656
Charge Number:	C14348
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9107A
Quantity Tested:	6
Serial Numbers of Radiation Samples:	171, 172, 173, 174
Serial Number of Control Samples:	169, 170
Part Function:	Quad 2 Input AND Gate
Part Technology:	CMOS
Package Style:	14-Pin DIP
Test Engineer:	C. Nguyen

TABLE II. Radiation Schedule for 54ACTQ08

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements at 25°C, -55°C and 125°C	10/01/91
2) 5 krads irradiation @ 250 rads/hour	10/07/91
Post 5 krads Electrical Measurements*	10/09/91
3) 10 krads irradiation @ 250 rads/hour	10/10/91
Post 10 krads Electrical Measurements	10/11/91
4) 15 krads irradiation @ 55 rads/hour	10/11/91
Post 15 krads Electrical Measurements	10/15/91
5) 20 krads irradiation @ 250 rads/hour	10/15/91
Post 20 krads Electrical Measurements	10/16/91
6) 50 krads irradiation @ 1,500 rads/hour	10/16/91
Post 50 krads Electrical Measurements*	10/18/91
7) 80 krads irradiation @ 440 rads/hour	10/18/91
Post 80 krads Electrical Measurements*	10/23/91
8) 100 krads irradiation @ 1,000 rads/hour	10/24/91
Post 100 krads Electrical Measurements	10/25/91
9) 168 hours annealing @ +25°C without bias	10/25/91
Post 168 hours Electrical Measurements	11/07/91

* These electrical measurements were not performed according to the planned schedule because the ATE (S-50) was under repair.

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, unless otherwise noted.
- The parts were annealed without bias at 25°C.

Table III. Electrical Characteristics of 54ACTQ08

FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ 25°C
FUNCT 1	4.5V	0.0V	4.5V	FREQ=1.00MHz	I/O	VOL<2.25V; VOH>2.25V
FUNCT 2	5.5V	0.0V	5.5V	FREQ=1.00MHz	I/O	VOL<2.75V; VOH>2.75V

LOAD USED <= IOH = -5.0 mA, VREF = 1.5 V, IOL = +5.0 mA

DC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ 25°C
VOH1	4.5V	0.4V	2.4V	LOAD=-50uA	OUTS	>4.4V ; <4.5V
VOH2	4.5V	0.0V	4.5V	LOAD=-24mA	OUTS	>3.86V ; <4.5V
VOH3	5.5V	0.4V	2.4V	LOAD=-50uA	OUTS	>5.4V ; <5.5V
VOH4	5.5V	0.0V	5.5V	LOAD=-24mA	OUTS	>4.86V ; <5.5V
VOH5	5.5V	0.0V	5.5V	LOAD=-50mA	OUTS	>3.85V ; <5.5V
VOL1	4.5V	0.4V	2.4V	LOAD=+50uA	OUTS	>0.0V ; <0.1V
VOL2	4.5V	0.0V	4.5V	LOAD=+24mA	OUTS	>0.0V ; <0.36V
VOL3	5.5V	0.4V	2.4V	LOAD=+50uA	OUTS	>0.0V ; <0.1V
VOL4	5.5V	0.0V	5.5V	LOAD=+24mA	OUTS	>0.0V ; <0.36V
VOL5	5.5V	0.0V	5.5V	LOAD=+50mA	OUTS	>0.0V ; <1.65V
IIH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	> 0.0uA; <0.1uA
IIL	5.5V	0.0V	5.5V	VIN = 0.0V	INS	>-0.1uA; <0.0uA
ICCH	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>0.0uA ; <8.0uA
ICCL	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>0.0uA ; <8.0uA
DEL_ICC	5.5V	0.0V	5.5V	VIN = 3.4V	VCC	>0.0uA ; <1.6mA

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	PINS	LIMITS @ 25°C
TPHL	4.5V	0.0V	4.5V	DN TO QN	>1.5nS; <7.0nS
TPLH	4.5V	0.0V	4.5V	DN TO QN	>1.5nS; <7.0nS

Table III (Continued). Electrical Characteristics of 54ACTQ08

FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55°C, 125°C
FUNCT 1	4.5V	0.0V	4.5V	FREQ=1.00MHz	I/O	VOL<2.25V; VOH>2.25V
FUNCT 2	5.5V	0.0V	5.5V	FREQ=1.00MHz	I/O	VOL<2.75V; VOH>2.75V

LOAD USED <= IOH = -5.0 mA, VREF = 1.5 V, IOL = +5.0 mA

DC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ -55°C, 125°C
VOH1	4.5V	0.4V	2.4V	LOAD=-50uA	OUTS	>4.4V ; <4.5V
VOH2	4.5V	0.0V	4.5V	LOAD=-24mA	OUTS	>3.7V ; <4.5V
VOH3	5.5V	0.4V	2.4V	LOAD=-50uA	OUTS	>5.4V ; <5.5V
VOH4	5.5V	0.0V	5.5V	LOAD=-24mA	OUTS	>4.7V ; <5.5V
VOH5	5.5V	0.0V	5.5V	LOAD=-50mA	OUTS	>3.85V ; <5.5V
VOL1	4.5V	0.4V	2.4V	LOAD=+50uA	OUTS	>0.0V ; <0.1V
VOL2	4.5V	0.0V	4.5V	LOAD=+24mA	OUTS	>0.0V ; <0.5V
VOL3	5.5V	0.4V	2.4V	LOAD=+50uA	OUTS	>0.0V ; <0.1V
VOL4	5.5V	0.0V	5.5V	LOAD=+24mA	OUTS	>0.0V ; <0.5V
VOL5	5.5V	0.0V	5.5V	LOAD=+50mA	OUTS	>0.0V ; <1.65V
IIH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	> 0.0uA; <1.0uA
IIL	5.5V	0.0V	5.5V	VIN = 0.0V	INS	>-1.0uA; <0.0uA
ICCH	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>0.0uA ; <160uA
ICCL	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>0.0uA ; <160uA
DEL_ICC	5.5V	0.0V	5.5V	VIN = 3.4V	VCC	>0.0uA ; <1.6mA

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	PINS	LIMITS @ -55°C, 125°C
TPHL	4.5V	0.0V	4.5V	DN TO QN	>1.5nS; <7.5nS
TPLH	4.5V	0.0V	4.5V	DN TO QN	>1.5nS; <7.5nS

COMMENTS/EXCEPTIONS

1 - VIL & VIH tested during VOL & VOH tests as GO/NO GO. VIL=0.4v and VIH=2.4V were used to compensate for voltage forcing problems on the S-50.
2 - IOLD & IOHD are tested in VOL5 & VOH5.
3 - Tests not performed: VOLP, VOLV, VIHD, VILD
4 - TPHL & TPLH limits were given by the manufacturer.

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54ACTQ08 1/ 2/

Parameters	Spec Limits @ 25°C min	Spec Limits @ 25°C max	Total Dose Exposure (TDE) (krads): 0 (Pre-Rad) mean	0 (Pre-Rad) sd	5 mean	5 sd	10 mean	10 sd	15 mean	15 sd	20 mean	20 sd	50 mean	50 sd	80 mean	80 sd	100 mean	100 sd	Anneal 168 hours mean	Anneal 168 hours sd
FUNC1 @ 1 MHz			P		P		P		P		P		P		P		P		P	
FUNC2 @ 1 MHz			P		P		P		P		P		P		P		P		P	
VOH1_4.5V V	4.4	4.5	4.49	0.01	4.49	0	4.48	0	4.49	0	4.49	0	4.50	0	4.49	0	4.49	0	4.49	0
VOH2_4.5V V	3.86	4.5	4.18	0.01	4.16	0.02	4.15	0.04	4.18	0	4.18	0.01	4.17	0.02	4.14	0.04	4.16	0.01	4.17	0
VOH3_5.5V V	5.4	5.5	5.49	0	5.49	0	5.49	0	5.49	0	5.50	0	5.50	0	5.50	0	5.50	0	5.50	0
VOH4_5.5V V	4.86	5.5	5.22	0.01	5.20	0.02	5.20	0.04	5.22	0.01	5.22	0.01	5.22	0.01	5.19	0.04	5.21	0.01	5.22	0
VOH5_5.5V V	3.85	5.5	4.91	0.03	4.86	0.05	4.85	0.07	4.92	0.01	4.90	0.02	4.89	0.03	4.83	0.07	4.88	0.03	4.90	0.01
VOL1_4.5V V	0	0.10	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
VOL2_4.5V V	0	0.36	0.17	0.01	0.21	0.02	0.19	0.02	0.17	0	0.17	0.01	0.17	0.01	0.19	0.03	0.18	0.01	0.16	0
VOL3_5.5V V	0	0.10	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
VOL4_5.5V V	0	0.36	0.15	0.01	0.18	0.02	0.17	0.02	0.14	0	0.15	0.01	0.15	0.01	0.17	0.03	0.16	0.01	0.14	0
VOL5_5.5V V	0	1.65	0.33	0.03	0.39	0.05	0.37	0.06	0.31	0.01	0.32	0.01	0.33	0.02	0.38	0.10	0.33	0.03	0.30	0.01
IIH nA	0	100	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
IIL nA	-100	0	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
ICCH uA	0	8.0	0	-	0	-	0.01	0	0.02	0.01	0.04	0.03	0.31	0.30	0.31	0.19	0.84	0.81	0.51	0.35
ICCL uA	0	8.0	0	-	0	-	0	-	0	0	0.01	0.01	0.23	0.25	0.21	0.15	0.54	0.55	0.33	0.24
DELTA ICC mA	0	1.60	0.73	0.02	0.72	0.02	0.72	0.02	0.71	0.03	0.70	0.03	0.64	0.02	0.57	0.01	0.52	0.02	0.53	0.02
TPHL nS	1.5	7.5	6.40	0.22	6.05	0.27	6.01	0.30	6.07	0.32	6.11	0.34	6.22	0.64	6.56	0.27	6.51	0.27	5.32	0.13
TPLH nS	1.5	7.5	5.62	0.26	4.97	0.24	4.97	0.27	4.99	0.31	5.01	0.31	5.22	0.65	4.90	0.24	4.79	0.22	4.47	0.29

Notes:

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/ Prior to irradiation the two control samples and four radiation samples were electrically tested at 25°C, -55°C and 125°C. This test data, as well as data collected at 25°C after all of the radiation steps, is available upon request.

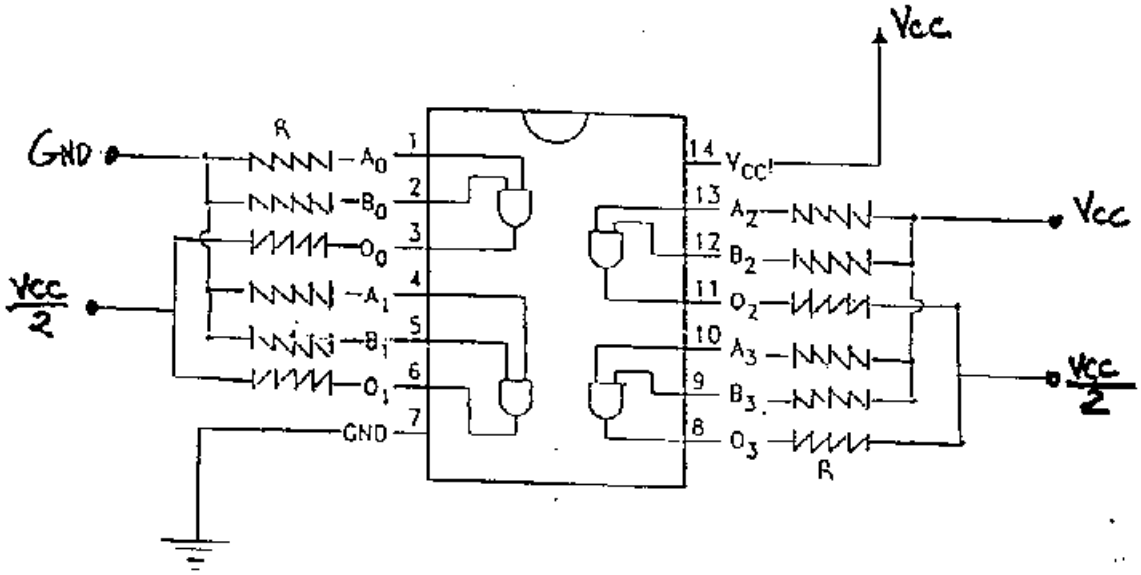
Table V. Summary of Low and High Temperature
Pre-Rad Electrical Measurements for 54ACTQ08

Parameters		Spec. Limits min	max	Low Temp. -55°C mean	sd	High Temp. 125°C mean	sd
Func1 @VCC=4.5V				P	-	P	-
Func2 @VCC=5.5V				P	-	P	-
VOH1	V	4.4	4.5	4.49	0	4.49	0
VOH2	V	3.7	4.5	4.25	0.03	4.07	0.01
VOH3	V	5.4	5.5	5.49	0	5.49	0
VOH4	V	4.7	5.5	5.28	0.02	5.14	0.01
VOH5	V	3.85	5.5	5.04	0.06	4.71	0.02
VOL1	mV	0	100	0	-	0	-
VOL2	mV	0	500	143.3	22.2	249.0	8.4
VOL3	mV	0	100	0	-	0	-
VOL4	mV	0	500	128.8	24.6	213.6	8.3
VOL5	mV	0	1650	280.9	70.2	466.3	17.4
IIH	nA	0	1000	0	-	0	-
IIL	nA	-1000	0	0	-	0	-
ICCH	uA	0	160	0	-	0.12	0.03
ICCL	uA	0	160	0	-	0.14	0.03
DEL_ICC	mA	0	1.6	0.81	0.03	0.66	0.02
TPHL	ns	1.5	7.5	5.80	0.42	5.87	0.23
TPLH	ns	1.5	7.5	5.29	0.25	6.05	0.24

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.

Figure 1. Radiation Bias Circuit for 54ACTQ08DMQB



$T_A = 25°C$ To $100°C$

ALL R = $2.2\,K\Omega \pm 10\%$ $\frac{1}{4}W$

$V_{CC} = 5V \pm 0.5V$