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DATE: September 18, 1992 PPM-92-237
TO: J. Lohr/311
FROM: K. Sahu/7809 KS
SUBJECT: Radiation Report GGS/WIND/3D PLASMA Project
Part No. SNJ54HC4066J (Control No. 6301)

cc: L. Rabb/406
A. Sharma/311
Library/300.1

A radiation evaluation was performed on the SNJ54HC4066J 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, the parts were annealed at 25°C for 168 hours. The dose rate was between 74 and 238 rads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, the parts were electrically tested at 25°C according to the test conditions and the specification limits listed in Table III. These tests included three functional tests at 1 MHz (test voltages = 2 V, 4.5 V and 9 V).

One control sample (S/N 70) exceeded the specification limits for ICCH at each electrical step. All other parts passed all parametric tests initially. However, after 5 krads of exposure five parts exceeded the maximum specification limit of 40 uA for ICCH with a maximum reading of 122 uA. Upon further irradiation to 10 krads the ICCH parameter continued to degrade with all six irradiated parts exceeding the specification limit. After 20 krads of exposure three parts failed functionally at 2 V, however, all parts passed functionally at 4.5 V and 9 V. The three functional failures were accompanied by ICCH and ICCL readings over 8 mA. The other three parts continued to exceed the ICCH limit. After 168 hours of annealing at 25°C under bias, the three functional failures showed no recovery. Parametrically, all of the parts showed no significant recovery after annealing.

Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment. 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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* In this report, the term "rads" is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	54HC4066
GGG/WIND/3D PLASMA Part Number:	SNJ54HC4066J
Control Number:	6301
Charge Number:	C23770
Manufacturer:	Texas Instruments
Lot Date Code:	9031A
Quantity Tested:	8
Serial Numbers of Radiation Samples:	69, 80, 81, 82, 83, 84
Serial Number of Control Sample:	70, 203
Part Function:	Quad Analog Switch
Part Technology:	CMOS
Package Style:	14 pin DIP
Test Engineer:	T. Scharer

TABLE II. Radiation Schedule for SNJ54HC4066J

EVENTS	DATE
1) INITIAL (PRE-IRRADIATION) ELECTRICAL MEASUREMENT	08/26/92
2) 5 KRAD IRRADIATION (238 rads/hour) POST 5 KRAD ELECTRICAL MEASUREMENT	08/27/92 08/28/92
3) 10 KRAD IRRADIATION (74 rads/hour) POST 10 KRAD ELECTRICAL MEASUREMENT	08/28/92 08/31/92
4) 15 KRAD IRRADIATION (115 rads/hour) POST 15 KRAD ELECTRICAL MEASUREMENT	08/31/92 09/02/92
5) 20 KRAD IRRADIATION (119 rads/hour) POST 20 KRAD ELECTRICAL MEASUREMENT	09/02/92 09/04/92
6) 168 HOURS ANNEALING AT 25°C POST 168 HOURS ELECTRICAL MEASUREMENT	09/04/92 09/11/92

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.
- All annealing steps were performed under bias.

Table III. Electrical Characteristics of SNJ54HC4066J

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
FUNCT 1	2.0V	0.3V	1.3V	FREQ=1.0 MHz	ALL I/O	VOL<1.0V / VOH>1.05V
FUNCT 2	4.5V	0.3V	3.15V	FREQ=1.0 MHz	ALL I/O	VOL<2.25V / VOH>2.25V
FUNCT 3	9.0V	1.0V	6.5V	FREQ=1.0 MHz	ALL I/O	VOL<3.00V / VOH>3.00V
$LOAD\ U_{SD} \leq \begin{cases} I_{OH} = -1.0mA \\ V_{REF} = V_{CC} / 2 \\ I_{OL} = +1.0mA \end{cases}$ (except 9V VCC : VREF = 3.00V)						
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
R_ON_1	4.5V	0.0V	4.5V	VA = 0 TO 4.5V	ALL CHNLS	220 Ohms (MAX)
R_0cCIA_1	4.5V	0.0V	4.5V	VA = 0 TO 4.5V	ALL CHNLS	20 Ohms (MAX)
R_ON_2	4.5V	0.0V	4.5V	VA = 4.5V	ALL CHNLS	120 Ohms (MAX)
R_0cCIA_2	4.5V	0.0V	4.5V	VA = 4.5V	ALL CHNLS	20 Ohms (MAX)
I_IH1	2.0V	0.0V	2.0V	VIN = 2.0V	C INPUTS	>+0.00A / <+1.00A
I_IH2	6.0V	0.0V	6.0V	VIN = 6.0V	C INPUTS	>+0.00A / <+1.00A
I_IL1	2.0V	0.0V	2.0V	VIN = 0.0V	C INPUTS	>-1.00A / <+0.00A
I_IL2	6.0V	0.0V	6.0V	VIN = 0.0V	C INPUTS	>-1.00A / <+0.00A
I_SOFF1	3.5V	0.0V	3.5V	VS = +/-0.5V	ALL CHNLS	>-0.50A / <+0.60A
I_SOFF2	9.0V	0.0V	6.5V	VS = +/-0.5V	ALL CHNLS	>-0.80A / <+0.80A
I_SON1L	3.5V	0.0V	3.5V	VA = 0.0V	ALL CHNLS	>-1.00UA / <+1.00UA
I_SON1H	9.0V	0.0V	6.5V	VA = 5.5V	ALL CHNLS	>-1.00UA / <+1.00UA
I_SON2L	3.5V	0.0V	3.5V	VA = 0.0V	ALL CHNLS	>-1.00UA / <+1.00UA
I_SON2H	9.0V	0.0V	6.5V	VA = 6.5V	ALL CHNLS	>-1.00UA / <+1.00UA
I_ICM	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>+0.0A / <+4.0UA
I_ICL	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0A / <+4.0UA
COMMENTS/EXCEPTIONS						
(1) VIL & VIH were tested during FUNCTIONAL tests as Go/NoGo.						
(2) NO AC TEST IS PERFORMED						
(3) All tests at VCC = 9.0V are performed with 6.5V across the channels rather than 9V(VCC) due to ATC limitation.						
(4) ICC is measured at VCC = 5.5V only.						
(5) The on-resistance, R_ONs, are measured at VCC = 5.5V only.						
(6) The limits for the on-leakage current (ISON) test is set at 1uA rather than the specified limits of the datasheet. The readings for this measurements should be used to detect any drift only.						
(7) C1 and Cf tests are not performed.						

TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing for SNJ54HC4066J

1/, 2/, 3/, 4/

Parameters	Spec Limits min max	Total Dose Exposure (TDE) (krads)										Anneal			
		0 (Pre-Rad)		5		10		15		20		168 hrs @25°C			
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
FUNC1	2.0 V			Pass		Pass		Pass		Pass		3 Fail		3 Fail	
FUNC2	4.5 V			Pass		Pass		Pass		Pass		Pass		N/A	
FUNC3	9.0 V			Pass		Pass		Pass		Pass		Pass		N/A	
R_ON_1	Ohms	-	220	93.89	6.97	95.14	5.00	95.12	5.02	95.95	4.96	116.71	41.36	120.85	44.93
DEL_R_1	Ohms	-	20	15.02	5.00	10.01	0.00	10.06	0.07	10.08	0.07	71.29	55.13	74.54	66.07
R_ON_2	Ohms	-	120	40.08	0.03	41.32	3.31	43.83	4.85	45.50	4.98	45.50	8.17	47.60	10.11
DEL_R_2	Ohms	-	20	0.06	0.04	5.03	4.97	10.04	0.04	10.03	0.03	15.04	7.65	20.02	10.01
IIH1	uA	0	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IIH2	uA	0	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IIL1	uA	-1.0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IIL2	uA	-1.0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISOFF1	uA	-0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	****	****	****	****
ISOFF2	uA	-0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	****	****	****	****
ISON1L	uA	-1.0	1.0	-0.74	0.09	-0.74	0.09	0.00	0.09	-0.69	0.13	-0.73	0.09	-0.74	0.09
ISON1H	uA	-1.0	1.0	-0.77	0.02	-0.77	0.01	-0.77	0.01	-0.76	0.01	-0.77	0.02	-0.77	0.01
ISON2L	uA	-1.0	1.0	-0.44	0.32	-0.44	0.33	-0.44	0.32	-0.43	0.32	-0.44	0.31	-0.46	0.31
ISON2H	uA	-1.0	1.0	-0.25	0.25	-0.25	0.25	-0.25	0.25	-0.25	0.25	-0.3	0.4	-0.4	0.4
ICCL	uA	0	40	0.49	0.05	4.61	0.55	3.80	0.54	3.56	0.56	4010	4050	4254	4254
ICCH	uA	0	40	15.87	12.39	81.50	35.95	164.52	105.43	305.77	77.44	4015	3649	4242	3899

Notes:

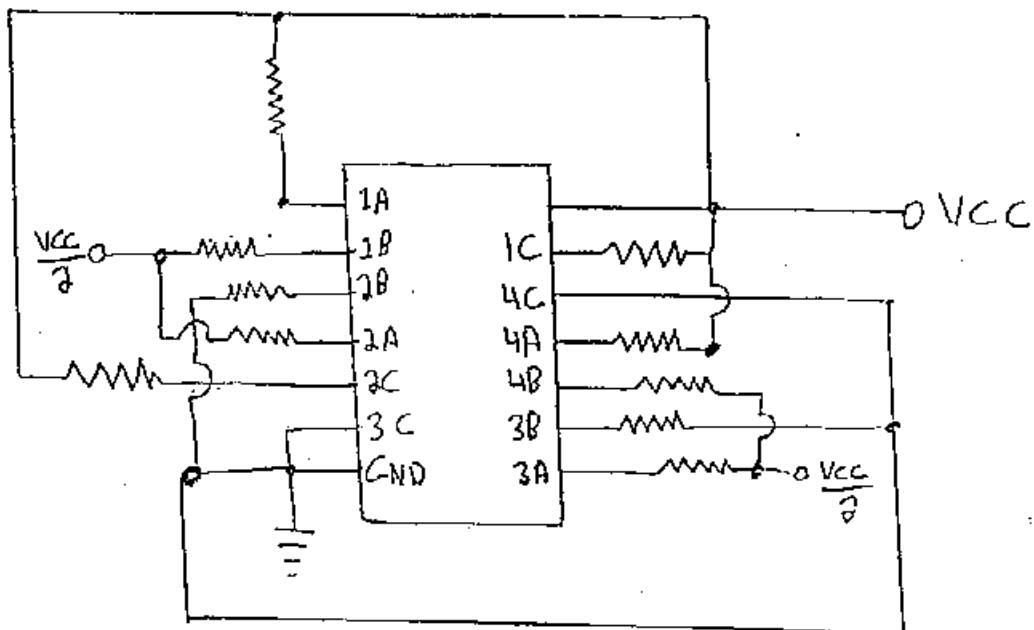
1/ The mean and standard deviation values were calculated over the six parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ "****" indicates meaningful data was unattainable due to parts failing functionally.

3/ Functional testing at 4.5 V and 9 V was not performed after the annealing step due to ATE problems.

4/ Any excessive delta R1 and delta R2 readings are attributable to variations within the Automated Test Equipment (ATE).

Figure 1. Radiation Bias Circuit for SNJ54HC4066J



$$V_{CC} = 12V \pm 10\%$$

$$\frac{V_{CC}}{2} = 6V \pm 10\%$$

$$R = 1k\Omega \pm 10\%, \frac{1}{4}W$$

Switches 1,2 are ON
Switches 3,4 are OFF

$$I_{\text{switch}} = \frac{6V}{2000\Omega} = 3mA \text{ maximum}$$