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Date PPM-92-116
Location March 20, 1992
Telephone GSFC
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cc Lanham

Radiation Report on CD54HC4053F3A
GGG/WIND/WAVES Control No. 5733

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A radiation evaluation was performed on CD54HC4053F3A 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 (In this report, the term rad means rad (Si)). 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 0.05 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 six functional tests (1 MHz) at 2.0, 4.5 and 6.0V.

All four irradiated parts exceeded the maximum specification limits for IIZON2, ICCH and ICCL after the first radiation exposure to 5 krads. The readings for IIZON2 were in the range of 1000 - 4000 nA, against the maximum specification limit of 100 nA. The ICCH readings ranged from 30 - 40 uA against a maximum specification limit of 16 uA, while the ICCL readings ranged from 18 - 20 uA against a maximum specification limit of 8 uA. After 10 krads exposure, parts showed increasing degradation for all of these parameters. Additionally, all four parts exceeded maximum specification limits for IIZON1, IIZOFF1 and IIZOFF2 after 10 krads exposure. All parts continued to show increasing degradation for all six parameters at 15 and 20 krads exposure. Also, all parts failed functional test #4 after 15 krads exposure and functional tests #'s 4, 5 and 6 after 20 krads exposure. No significant recovery occurred after annealing for 168 hours at 25°C and 1268 hours at 100°C.

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.

TABLE I. Part Information

| | |
|---|---------------------------|
| Generic Part Number: | 54HC4053 |
| GGs/WIND/WAVES Part Number: | CD54HC4053F3A |
| GGs/WIND/WAVES Control Number: | 5733 |
| Charge Number: | C23418 |
| Manufacturer: | RCA |
| Lot Date Code: | 8805B |
| Quantity Tested: | 5 |
| Serial Numbers of Radiation Samples: | 84, 85, 86, 87 |
| Serial Numbers of Control Sample: | 83 |
| Part Function: | multiplexer/demultiplexer |
| Part Technology: | CMOS |
| Package Style: | 16-lead DIP |
| Test Engineer: | Ted Scharer |

TABLE II. Radiation Schedule for 54HC4053

| EVENTS | DATE |
|--|----------------------|
| 1) Initial Electrical Measurements | 02/03/92 |
| 2) 5 KRAD IRRADIATION (0.12 krads/hour) POST-5 KRAD ELECTRICAL MEASUREMENT | 02/03/92 02/05/92 |
| 3) 10 KRAD IRRADIATION (0.12 krads/hour) POST-10 KRAD ELECTRICAL MEASUREMENT* | 02/05/92 02/12/92 |
| 4) 15 KRAD IRRADIATION (0.12 krads/hour) POST-15 KRAD ELECTRICAL MEASUREMENT | 02/12/92 02/14/92 |
| 5) 20 KRAD IRRADIATION (0.05 KRADS/HOUR) POST-20 KRAD ELECTRICAL MEASUREMENT | 02/14/92 02/18/92 |
| 6) 168 HOUR ANNEALING @ 25°C POST-168 HOUR 25°C ANNEAL ELECTRICAL MEASUREMENT | 02/18/92 03/03/92 |
| 7) 168 HOUR ANNEALING @ 100°C POST-168 HOUR 100°C ANNEAL ELECTRICAL MEASUREMENT | 03/03/92 03/10/92 |

*Testing was delayed five days due to down time on automatic test equipment. Parts were annealed at 25°C while delayed.

all electrical measurements performed at 25°C.

All parts irradiated under bias, see Figure 1.

All annealings performed under bias, see Figure 1.

Table III. Electrical Characteristics of 54HC4053

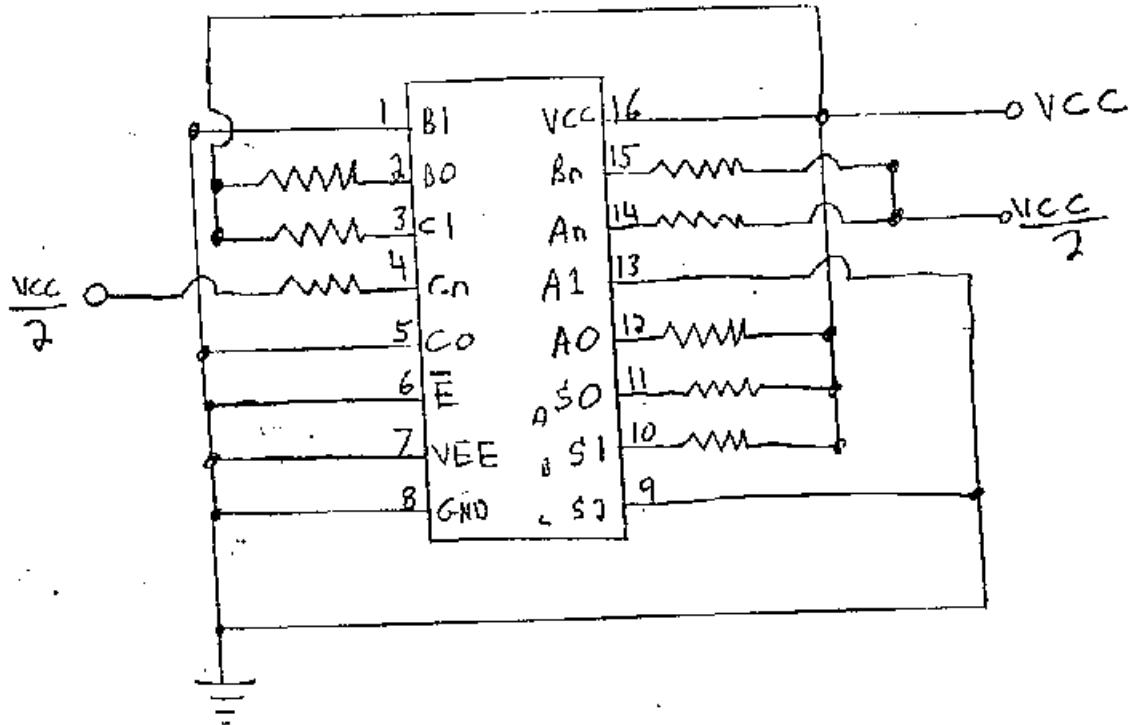
| DEVICE | | PART TYPE : ANALOG MULTIPLEXER/DEMULTIPLEXER | | | | PCN : SI10492A | |
|---|------|--|-------|-------------------------|---------|-------------------|-----------|
| PART NO. : 54HC4053 | | | | | | | |
| TEST PROGRAM LOCATION | | | | TEST SPECIFICATIONS | | | |
| DISK LABEL : LIB 22 | | | | RCA DATA BOOK | | | |
| DIRECTORY : 00AT:PROGRAMS.492J | | | | | | | |
| FUNCTIONAL TESTS PERFORMED | | | | | | | |
| PARAMETER | VCC | VIL | VIH | CONDITIONS | PINS | Tc @ < +25C | |
| ===== | == | == | == | ===== | ===== | ===== | |
| FUNCT 1 | 2.0V | 0.5V | 1.5V | FREQ=1.000MHZ | ALL I/O | VOL<1.0V | VOH>1.0V |
| FUNCT 2 | 4.5V | 1.35V | 3.15V | FREQ=1.000MHZ | ALL I/O | VOL<2.25V | VOH>2.25V |
| FUNCT 3 | 6.0V | 1.8V | 4.2V | FREQ=1.000MHZ | ALL I/O | VOL<3.0V | VOH>3.0V |
| FUNCT 4 | 2.0V | 0.5V | 1.5V | FREQ=1.000MHZ | ALL I/O | VOL<1.0V | VOH>1.0V |
| FUNCT 5 | 4.5V | 1.35V | 3.15V | FREQ=1.000MHZ | ALL I/O | VOL<2.25V | VOH>2.25V |
| FUNCT 6 | 6.0V | 1.8V | 4.2V | FREQ=1.000MHZ | ALL I/O | VOL<3.0V | VOH>3.0V |
| DC PARAMETRIC TESTS PERFORMED | | | | | | | |
| PARAMETER | VCC | VIL | VIH | CONDITIONS | PINS | -55C < Tc < +125C | |
| ===== | == | == | == | ===== | ===== | ===== | |
| I _{IH} | 6.0V | 0.0V | 6.0V | V _{IN} = 6.0V | INS | >-0.10A | <+0.10A |
| I _{IL} | 6.0V | 0.0V | 6.0V | V _{IN} = 0.0V | INS | >-0.10A | <+0.10A |
| PARAMETER | VCC | VIS | VIS | CONDITIONS | PINS | -55C < Tc < +125C | |
| ===== | == | == | == | ===== | ===== | ===== | |
| R _{ON1} | 4.5V | 0V to 4.5V | 4.5V | I _o = 1mA | OUTS | >+0.00HMS | <+180UHMS |
| R _{ON2} | 6.0V | 0V to 6.0V | 6.0V | I _o = 1mA | OUTS | >+0.00HMS | <+180UHMS |
| PARAMETER | VCC | VIS | VIS | CONDITIONS | PINS | -55C < Tc < +125C | |
| ===== | == | == | == | ===== | ===== | ===== | |
| I _{I_{ON1}} | 6.0V | 0.0V | 6.0V | No Load | INS | >-0.10A | <+0.10A |
| I _{I_{ON2}} | 6.0V | 0.0V | 6.0V | No Load | INS | >-0.10A | <+0.10A |
| I _{I_{ZOFF1}} | 6.0V | 6.0V | 6.0V | Channels Off | INS | >-0.10A | <+0.10A |
| I _{I_{ZOFF2}} | 6.0V | 6.0V | 6.0V | Channels Off | INS | >-0.10A | <+0.10A |
| I _{CCH} | 6.0V | 0.0V | 6.0V | V _{OUT} = 0.0V | OUTS | >+0.0MA | <+16UA |
| I _{CCL} | 6.0V | 6.0V | 0.0V | V _{OUT} = 0.0V | OUTS | >+0.0MA | <+8UA |
| COMMENTS/EXCEPTIONS | | | | | | | |
| (1) VIL & VIH are tested during functional tests as Go/NoGo. | | | | | | | |
| (2) 10J Jhms were subtracted from the Resistance Measurements to compensate for the contact and fixture resistance. | | | | | | | |
| (3) The Delta R _{on} measurement was not performed because the difference between the contact resistances between each channel was greater than the Delta R _{on} Limit. | | | | | | | |
| (4) No AC parameters are tested in this program | | | | | | | |
| (5) V _{EE} = 0.0V for all tests in this program | | | | | | | |
| (6) Delta I _{CC} test is not performed. | | | | | | | |

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for 54HC4053 1/

| Parameters | Spec. Limits min 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 | | | P | | P | | P | | P | | P | | P | | P | | P | |
| FUNC2 | | | P | | P | | P | | P | | P | | P | | P | | P | |
| FUNC3 | | | P | | P | | P | | P | | P | | P | | P | | P | |
| FUNC4 | | | P | | P | | P | | P | | P | | P | | P | | P | |
| FUNC5 | | | P | | P | | P | | P | | P | | P | | P | | 3P/1F | |
| FUNC6 | | | P | | P | | P | | P | | P | | P | | P | | P | |
| I IH | nA | -100 | 100 | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | |
| I IL | nA | -100 | 100 | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | |
| R ON 1 | ohms | 0 | 180 | 64.72 | 8.2 | 65.10 | 8.7 | 61.75 | 6.9 | 61.78 | 6.9 | 60.48 | 7.9 | 62.64 | 7.2 | 62.18 | 7.1 | |
| R ON 2 | ohms | 0 | 160 | 51.76 | 6.9 | 52.19 | 7.1 | 51.78 | 6.9 | 50.95 | 7.6 | 50.08 | 8.2 | 52.64 | 7.2 | 52.15 | 7.1 | |
| IIZON1 | nA | -100 | 100 | 0 | N/A | 5.54 | 11 | 2315 | 2374 | 1.8E4 | 1.5E4 | 3.5E4 | 3.6E4 | 3.2E4 | 3.2E4 | 2.5E4 | 2.6E4 | |
| IIZON2 | nA | -100 | 100 | 0 | N/A | 1965 | 2040 | -1E4 | 9464 | -3E4 | 2.3E4 | -5E4 | 3.5E4 | -4E4 | 3E4 | -3E4 | 2.4E4 | |
| IIZOFF1 | nA | -100 | 100 | 0 | N/A | 9.50 | 13 | 1930 | 1942 | 1.2E4 | 1.2E4 | 2.9E4 | 2.9E4 | 2.6E4 | 2.6E4 | 2.1E4 | 2.1E4 | |
| IIZOFF2 | nA | -100 | 100 | 0 | N/A | 0 | N/A | -1877 | 2032 | 9254 | 9593 | -2E4 | 1.8E4 | -1E4 | 1.4E4 | -9550 | 1E4 | |
| ICCH | uA | 0 | 16 | 0 | N/A | 37.46 | 3.3 | 289 | 30 | 959 | 89 | 1926 | 248 | 1645 | 217 | 1261 | 171 | |
| ICCL | uA | 0 | 8 | 0 | N/A | 19.66 | 1.2 | 189 | 13 | 737 | 67 | 1556 | 252 | 1334 | 219 | 1028 | 167 | |

Note:
 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.

Figure 1. Radiation Bias Circuit for 54HC4053



$$VCC = +5.0V \pm 10\%$$