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Memorandum

PARAMAX
A Unisys Company

DATE: June 30, 1992

PPM-92-202

TO: C. Eveland/300.1

FROM: K. Sahu/7809 ks

SUBJECT Radiation Report on CSEFW Project Part No.
MIC4469AJB (Control No. 5847)

cc: A. Sharma/311
Library/300.1

A radiation evaluation was performed on the MIC4469AJB CMOS Quad Driver to determine the total dose tolerance of this part. 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, five 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 2.5, 5, 7.5, 10, 15 and 20 krads*. After 20 krads, the parts were annealed at 25°C for 168 hours, followed by a second anneal at 100°C for 168 hours. The dose rate was between .02 and .11 krads/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.

All parts passed all initial electrical measurements and all post-irradiation electrical measurements up to 5 krads. After 7.5 krads, two parts exceeded the maximum specification limits for ICC2 and all parts displayed an increased in ICC2 and propagation delay times. After 15 krads, all parts exceeded specification limits for ICC2 and three parts exceeded specification limits for propagation delay. After 20 krads, four parts exceeded specification limits for propagation delay. ICC2 and propagation delay failures continued throughout both annealing steps, showing little or no recovery. Parts remained functional throughout all irradiation and annealing steps. No significant degradation was observed in any other test parameter.

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.

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

TABLE I. Part Information

| | |
|-----------------------------------------|-------------------------|
| Generic Part Number: | MIC4469 |
| CSEFW Part Number: | MIC4469ASE |
| Control Number: | 5847 |
| Charge Number: | C23720 |
| Manufacturer: | Micrel |
| Lot Date Code: | 9123 |
| Quantity Tested: | 6 |
| Serial Numbers of Radiation Samples: | 206, 207, 208, 209, 210 |
| Serial Number of Control Sample: | 205 |
| Part Function: | Quad Driver |
| Part Technology: | CMOS |
| Package Style: | 14-pin DIP |
| Test Engineer: | T. Mondy |

TABLE II. Radiation Schedule for MIC4469ASB

| EVENTS | DATE |
|---------------------------------------------------------------------------------------|----------------------|
| 1) INITIAL (PRE-IRRADIATION) ELECTRICAL MEASUREMENT | 05/05/92 |
| 2) 2.5 KRAD IRRADIATION (57 rads/hour) POST 2.5 KRAD ELECTRICAL MEASUREMENT | 05/13/92 05/15/92 |
| 3) 5 KRAD IRRADIATION (36 rads/hour) POST 5 KRAD ELECTRICAL MEASUREMENT | 05/15/92 05/19/92 |
| 4) 7.5 KRAD IRRADIATION (57 rads/hour) POST 7.5 KRAD ELECTRICAL MEASUREMENT | 05/19/92 05/21/92 |
| 5) 10 KRAD IRRADIATION (21.6 rads/hour) POST 10 KRAD ELECTRICAL MEASUREMENT | 05/21/92 05/26/92 |
| 6) 15 KRAD IRRADIATION (113.6 rads/hour) POST 15 KRAD ELECTRICAL MEASUREMENT | 05/26/92 05/28/92 |
| 7) 20 KRAD IRRADIATION (54.6 rads/hour) POST 20 KRAD ELECTRICAL MEASUREMENT | 05/28/92 06/01/92 |
| 8) 168 HOUR ANNEAL AT 25°C POSR ROOM TEMPERATURE ANNEAL ELECTRICAL MEASUREMENT | 06/01/92 06/08/92 |
| 9) 168 HOUR ANNEAL AT 100°C POST HIGH TEMPERATURE ANNEAL ELECTRICAL MEASUREMENT | 06/08/92 06/17/92 |

Notes:

- All parts were irradiated under bias at the Co-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 MIC4469AJB

| TEST # | TEST NAME | TEST CONDITIONS | -55oC | | +25oC | | +125oC | | UNITS |
|--------|-------------------------|------------------------------------------------|-------|-----|-------|------|--------|-----|-------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| 1 | ICC1 | VIN=0, 4.5 VDC VDD=4.5 VDC | 0 | 8 | 0 | 4 | 0 | 8 | mA |
| 2 | ICC2 | VIN=0, 18 VDC VDD=18 VDC | 0 | 8 | 0 | 4 | 0 | 8 | mA |
| 3 | ROHI | VIN=0, 18 VDC IOUT=-10 mA VDD=18 VDC | 0 | 30 | 0 | 15 | 0 | 30 | Ohms |
| 4 | ROLO | VIN=0, 18 VDC IOUT=10 mA VDD=18 VDC | 0 | 30 | 0 | 15 | 0 | 30 | Ohms |
| 5 | VOL18 | VIN=0.8, 2.4 VDC ILOAD=10 mA VDD=18 VDC | 0 | 300 | 0 | 150 | 0 | 300 | mVDC |
| 6 | VOH18 | VIN=0.8, 2.4 VDC ILOAD=-10 mA VDD=18 VDC | 17.7 | - | 17.85 | - | 17.7 | - | VDC |
| 7 | I IH | VIN=0, 18 VDC VDD=18 VDC | -1 | +1 | -1 | +1 | -1 | +1 | uA |
| | I IL | VIN=0, 18 VDC VDD=18 VDC | -1 | +1 | -1 | +1 | -1 | +1 | uA |
| 9 | TD1B 2/ | VIN=0, 5 VDC VDD=18 VDC | - | - | 0.4 | 75 | - | - | nS |
| 10 | TD2B 2/ | VIN=0, 5 VDC VDD=18 VDC | - | - | 0.4 | 75 | - | - | nS |
| 11 | TD1A 2/ | VIN=0, 5 VDC VDD=18 VDC | - | - | 0.4 | 75 | - | - | nS |
| 12 | TD2A 2/ | VIN=0, 5 VDC VDD=18 VDC | - | - | 0.4 | 75 | - | - | nS |
| 13 | TF 2/ 4/ | VIN=0, 5 VDC VDD=18 VDC | - | - | 0.4 | 25 | - | - | nS |
| 14 | TR 2/ 4/ | VIN=0, 5 VDC VDD=18 VDC | - | - | 0.4 | 25 | - | - | nS |
| 15 | VIL 3/ | VDD=18 VDC | - | 0.8 | - | 0.8 | - | 0.8 | VDC |
| 16 | VIH 3/ | VDD=18 VDC | 2.4 | - | 2.4 | - | 2.4 | - | VDC |
| 17 | DELTA 5/ ROHI, ROLO | SEE TESTS 3 & 4 | - | - | -1.5 | +1.5 | - | - | Ohms |
| 18 | DELTA 5/ IS4P5, IS18 | SEE TESTS 1 & 2 | - | - | -400 | +400 | - | - | uA |

TABLE III (cont.) ELECTRICAL CHARACTERISTICS OF MIC4469AJB

- 1/ Tests in the Micrel data sheet which are not performed: I_{pk} (peak output current), I (latch-up protection withstand reverse current). Functional tests are performed at VDD=4.5, 18V with VIL=0V, VIH=VDD, VOL=0.5, 1.0V and VOH=4.0, 17.0V.
- 2/ A 500pF + system capacitance is placed on the outputs during AC testing. The lower limit for AC tests is taken as 0.4 ns to force readings of 0ns to be failures.
- 3/ VIL and VIH are tested during VOH and VOL.
- 4/ These tests are not performed on the S-3260 since reliable results could not be obtained. *They are tested on the bench (in a sample of 1000).*
- 5/ Delta limits were arbitrarily chosen and are not cause for failure.

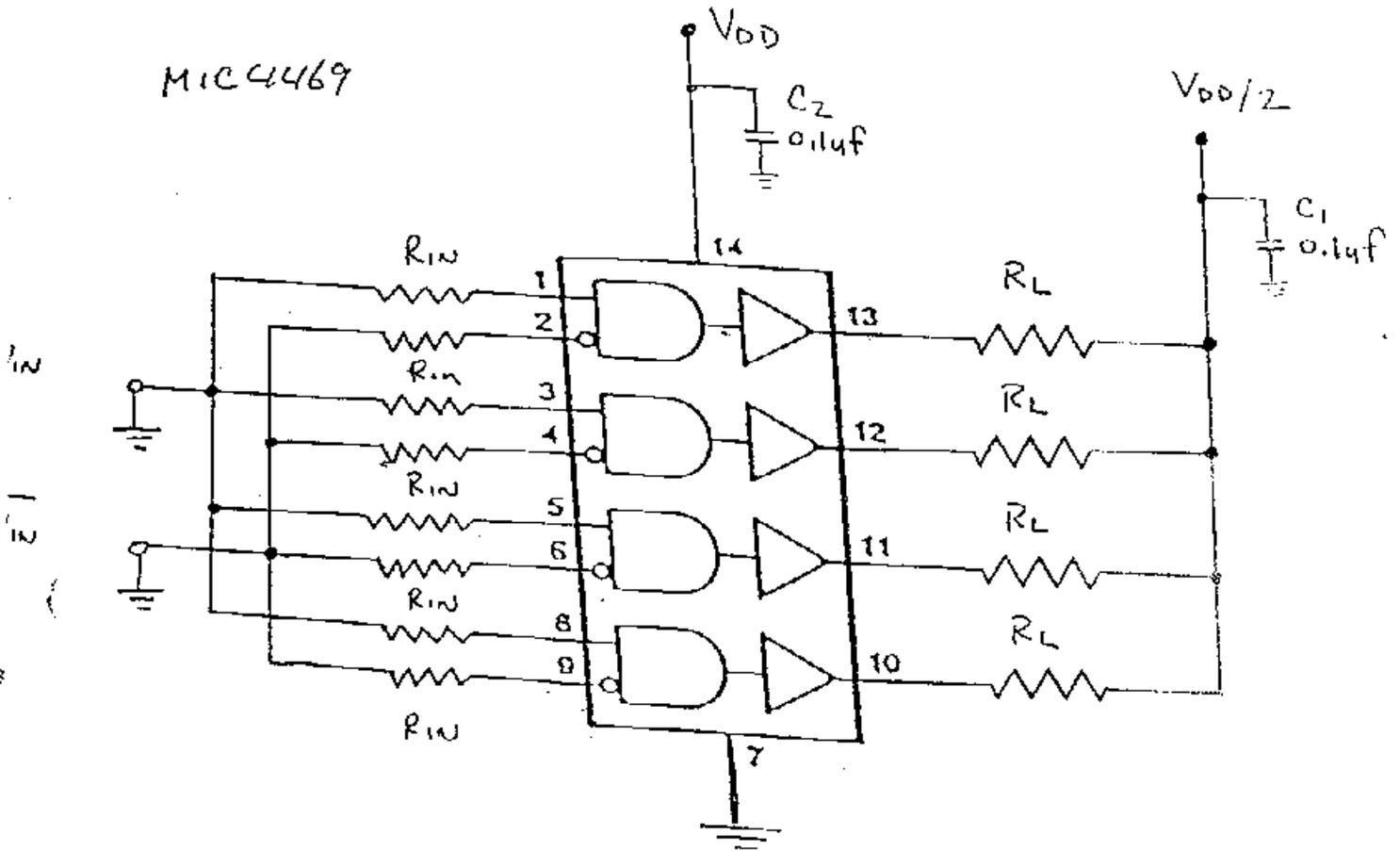
TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for MIC4469AJB 1/

| Parameters | Spec. Limits min max | Total Dose Exposure (TDE) (krads) | | | | | | | | | | | | Anneal | | | | | |
|------------|-------------------------|-----------------------------------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|--------|-----|------------------|-----|--------------------|-----|
| | | 0 (Pre-Rad.) | | 2.5 | | 5 | | 7.5 | | 10 | | 15 | | 20 | | 24 hrs. @25°C | | 168 hrs @+100°C | |
| | | mean | sd | 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 | | * | |
| ICC1 mA | 0 4 | 0.53 | .02 | 0.52 | .02 | 0.70 | .02 | 1.25 | 0.8 | 1.45 | 1 | 1.50 | 1 | 1.50 | 1 | 1.39 | 0.8 | 1.18 | 0.5 |
| ICC2 mA | 0 4 | 2.25 | 0.2 | 2.11 | 0.2 | 2.28 | 0.3 | 3.11 | 1 | 3.97 | 1.5 | 4.56 | 2.1 | 4.56 | 2.1 | 5.10 | 2.2 | 5.04 | 1.3 |
| ROHI ohms | 0 15 | 9.17 | 0.3 | 9.51 | 0.3 | 9.88 | 0.5 | 10.4 | 0.5 | 11 | 0.7 | 11.1 | 0.9 | 11.1 | 0.9 | 11.3 | 1 | 10.7 | 0.7 |
| ROHO ohms | 0 15 | 8.55 | 1.0 | 8.52 | 0.8 | 8.34 | 0.4 | 8.44 | 0.6 | 8.50 | 0.4 | 8.54 | 0.4 | 8.54 | 0.4 | 8.69 | 0.4 | 9 | 0.5 |
| VOL18 mV | 0 150 | 79.1 | 4 | 81.5 | 4.1 | 82.4 | 4.1 | 82.6 | 3.8 | 85.1 | 4.1 | 85.6 | 4.1 | 85.6 | 4.1 | 86.9 | 4.1 | 89.7 | 4.6 |
| VOH18 V | 17.85 - | 17.9 | .01 | 17.9 | .01 | 17.9 | .01 | 17.9 | 0 | 17.9 | 0 | 17.9 | 0 | 17.9 | 0 | 17.9 | .02 | 17.9 | 0 |
| IIN nA | -1000 1000 | 5.16 | 0.7 | 20.4 | 8.9 | 53.7 | 26 | 31.8 | 20 | 239 | 151 | 53.4 | 41 | 63.4 | 41 | 23.7 | 6.6 | 7.9 | 1.1 |
| IIL nA | -1000 1000 | -0.08 | 0.4 | -12 | 7.8 | -39 | 22 | -20 | 17 | -77 | 123 | -45 | 36 | -45 | 36 | -10 | 5.3 | -0.08 | 0.5 |
| TD1B ns | 0.4 75 | 43.2 | 1.9 | 53 | 1.9 | 48.4 | 2.0 | 54 | 3.0 | 53.5 | 4.7 | 72.1 | 6.2 | 72.1 | 6.2 | 80.2 | 11 | 129 | 23 |
| TD2B ns | 0.4 75 | 41.0 | 2.2 | 42.8 | 2.3 | 44.4 | 2.1 | 47.4 | 2.6 | 53.5 | 3.2 | 59.5 | 3.0 | 59.5 | 3.0 | 68.6 | 4.5 | 82.1 | 7.5 |
| TD1A ns | 0.4 75 | 30.2 | 1.8 | 31.0 | 1.9 | 31.8 | 1.8 | 32.1 | 1.9 | 33.8 | 2 | 36 | 1.3 | 36 | 1.3 | 37.4 | 1.4 | 38.1 | 1.7 |
| TD2A ns | 0.4 75 | 32.7 | 2.6 | 34.3 | 2.6 | 36.9 | 2.1 | 39.9 | 2.4 | 45.3 | 3.3 | 49 | 3.7 | 49 | 3.7 | 52.5 | 5.4 | 80.7 | 10 |

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.
 *No reliable data were available for this point.

FIGURE 1. RADIATION BIAS CIRCUIT FOR MIC4469AJB



$$R_L = 910\Omega, \frac{1}{2} W$$

$$C_1 = C_2 = 0.1\mu f @ 50V$$

$$R_{IN} = 470\Omega, \frac{1}{4} W$$

$$V_{DD} = 18.0V \pm 0.5V_{oc}$$

$$\frac{V_{DD}}{2} = 9.0V \pm 0.5V_{oc}$$