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UNISYS

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Interoffice Memorandum

PPM-91-168

Date

March 15, 1991

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Radiation Report on SMEX

Common Buy Part No. FRL130R3

A radiation evaluation was performed on FRL130R3 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 50 and 100 krads. After 100 krads, parts were annealed at 25°C for 96 and 168 hours, and then irradiation was continued to 200 and 300 krads (cumulative). The dose rate was between 1.5 - 5.0 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.

All parts except one passed all tests on irradiation up to 300 krads without any significant degradation in any of the electrical parameters. The failing part (SN 203) exceeded the specification limit of RDS on at 50 and 100 krads (the readings were 192.0 mOhm and 180.8 mOhm, respectively, against the specification limit of 180.0 mOhm), and exceeded the specification limit of VDS on at 50 krads (the reading was 1.56V against the specification limit of 1.51V). However, SN 203 passed all subsequent tests on irradiation to 300 krads. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at 731-8954.

TABLE I. Part Information

|                                      |  |
|--------------------------------------|--|
| Generic Part Number:                 | FRI.130R3                                |
| SMEX Common Buy Part Number:         | FRI.130R3                                |
| SMEX Common Buy Control Number:      | 1635                                     |
| Manufacturer:                        | Harris                                   |
| Quantity Procured:                   | 203                                      |
| Lot Date Code:                       | C9021                                    |
| Quantity Tested:                     | 10                                       |
| Serial Numbers of Radiation Samples: | 202, 203, 204, 205<br>206, 207, 208, 209 |
| Serial Numbers of Control Samples:   | 200, 201                                 |
| Part Function:                       | N-Channel Power Mosfet                   |
| Part Technology:                     | NMOS                                     |
| Package Style:                       | TO-205A                                  |

TABLE II. Radiation Schedule

| EVENTS                                | DATE     |
|---------------------------------------|----------|
| 1) Initial Electrical Measurements    | 02/12/91 |
| 2) 50 krad irradiation @ 2.5 krad/hr  | 02/13/91 |
| Post 50 krad Electrical Measurements  | 02/14/91 |
| 3) 100 krad irradiation @ 2.5 krad/hr | 02/14/91 |
| Post 100 krad Electrical Measurements | 02/15/91 |
| 4) 96 hrs annealing                   | 02/15/91 |
| Post 96 hr Electrical Measurements    | 02/19/91 |
| 5) 168 hrs annealing                  | 02/19/91 |
| Post 168 hr Electrical Measurements   | 02/22/91 |
| 6) 200 krad irradiation @ 1.5 krad/hr | 02/22/91 |
| Post 200 krad Electrical Measurements | 02/25/91 |
| 7) 300 krad irradiation @ 5.0 krad/hr | 02/25/91 |
| Post 300 krad Electrical Measurements | 02/26/91 |

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 was performed at 25°C under bias.

TABLE III. Electrical Characteristics of PRL130R3

| TEST NO. | TEST NAME    | CONDITION                               | MIN | MAX  | UNIT     | METHOD |
|----------|--------------|---|-----|------|----------|--------|
| 1        | $BV_{DSS}$   | $V_{GS} = 0V$<br>$I_D = 1mA$            | 100 |      | V        | 3407   |
| 2        | $V_{GS(th)}$ | $V_{GS} = V_{DS}$<br>$I_D = 1mA$        | 2   | 4    | V        | 3403   |
| 3        | $I_{GSSF}$   | $V_{GS} = 20V$<br>$V_{DS} = 0V$         |     | 100  | nA       | 3411   |
| 4        | $I_{GSSR}$   | $V_{GS} = -20V$<br>$V_{DS} = 0V$        |     | -100 | nA       | 3411   |
| 5        | $I_{DSS}$    | $V_{GS} = 0V$<br>$V_{DS} = 100V$        |     | 25   | $\mu A$  | 3413   |
| 6        | $V_{DS(on)}$ | $V_{GS} = 10V$<br>$I_D = 8A$ , PULSED * |     | 1.51 | V        | 3405   |
| 7        | $R_{DS(on)}$ | $V_{GS} = 10V$<br>$I_D = 5A$ , PULSED * |     | .180 | $\Omega$ | 3421   |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |
|          |              |   |     |      |          |        |

DELTA LIMITS-

\*  $t_{pulse} = 300\mu S$  (SEE ATTACHED MEMO ON 01-03-91)

TABLE IV: Summary of Electrical Measurements  
after Total Dose Exposures and Annealing for FRL130R3

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| Parameters | Spec. Limits<br>min max | Initials |      | Total Dose (krads) |     |       |     | Anneal |     |         |     | Total Dose (krads) |     |       |     |       |     |
|------------|-------------------------|----------|------|--------------------|-----|-------|-----|--------|-----|---------|-----|--------------------|-----|-------|-----|-------|-----|
|            |                         |          |      | 50                 |     | 100   |     | 96 hrs |     | 168 hrs |     | 200                |     | 300   |     |       |     |
|            |                         | mean     | sd   | mean               | sd  | mean  | sd  | mean   | sd  | mean    | sd  | mean               | sd  | mean  | sd  |       |     |
| VBDSS      | V                       | 100      | -    | 100.1              | 0   | 100.1 | 0   | 100.1  | 0   | 100.1   | 0   | 100.1              | 0   | 100.1 | 0   | 100.1 | 0   |
| VCStb      | V                       | 2        | 4    | 3.1                | 0.1 | 2.8   | 0.2 | 2.7    | 0.2 | 2.7     | 0.2 | 2.7                | 0.2 | 2.5   | 0.2 | 2.4   | 0.2 |
| IGSS       | nA                      | 0        | 100  | 1                  | 0.1 | 1.1   | 0.2 | 1.1    | 0.1 | 1.1     | 0.2 | 1.1                | 0.2 | 1.0   | 0.1 | 1.1   | 0.3 |
| IGSSr      | nA                      | 0        | 100  | 0.8                | 0.1 | 0.8   | 0.2 | 0.8    | 0.1 | 1.0     | 0.2 | 0.9                | 0.1 | 1.0   | 0.2 | 1.0   | 0.2 |
| IDSS       | uA                      | 0        | 25   | 0                  | 0   | 0     | 0   | 0      | 0   | .01     | 0   | .01                | 0   | .01   | 0   | .01   | 0   |
| VDS on     | V                       | 0        | 1.51 | 1.35               | .03 | 1.42  | .06 | 1.39   | .03 | 1.40    | .04 | 1.40               | .03 | 1.41  | .03 | 1.38  | .02 |
| RDS on     | mO                      | 0        | 180  | 169                | 3   | 174   | 6   | 172    | 4   | 172     | 3   | 172                | 3   | 174   | 3   | 171   | 2   |

Note:

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.

Figure 1. Radiation Bias Circuit for FRL130R3

