

**Heavy ion Single Event Effects test of
Power On Reset LP3470
from National Semiconductors**

Test Report

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1 Introduction

This report gives heavy ion SEE test data on the power on reset circuit LP3470 from National Semiconductor. This work has been performed in the frame of the ST5 project.

2 Tested Devices

The tested devices are described in Table 1. A die picture is shown in Figure 2.

| | |
|-----------------------------|--------------------------------|
| Type | LP3470IM5-4.63 |
| Manufacturer | National Semiconductors |
| Function | Tiny power on reset |
| Package | 5 SOP (NS package number MF05) |
| Technology | CMOS |
| Date code | 0036 |
| Package marking | D31C |
| Previous SEE testing | No data available |

Table 1: description of the tested devices.

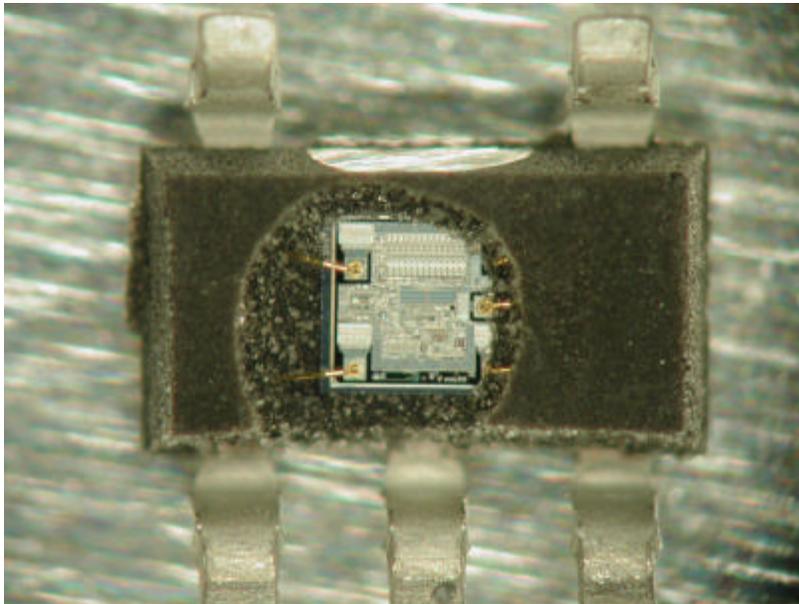


Figure 2: die picture.

3 Test description

3.1 Irradiation facility

The tests have been performed at the Brookhaven National Laboratories in March 2002. The ion beams used are described in Table 2.

| Ion | Energy (MeV) | Average flux (#/cm ² -s) | Range (mm) | LET (MeVcm ² /mg) |
|-------|--------------|-------------------------------------|------------|------------------------------|
| Ni-58 | 266 | ~7E+04 | 42 | 26.5 |
| Cl-35 | 210 | ~6E+04 | 65 | 11.4 |
| Si-28 | 186 | ~3E+04 | 76 | 7.9 |
| O-16 | 127 | ~1.5E+04 | 139 | 2.6 |
| C-12 | 99 | ~2E+04 | 185 | 1.4 |

Table 2: Ions used at BNL.

3.2 Test set-up

The LP3470 has been tested in the typical application configuration: The external capacitor C1 is 100 nF, the pull-up resistor R1 is 50 kΩ, and the power supply voltage is 5V. The device RESET output is monitored by a scope, as soon as the device output deviates from more than 2V from the nominal value, an error is counted.

The nominal power supply current of the board is about 17 μA.

4 Test results

The test results are presented in Table 3.

4.1 SEL

The device is not sensitive to SEL up to a LET of about 27 MeVcm²/mg (maximum tested LET).

4.2 SET

Two different types of events have been observed: glitches of short duration and RESET events. The glitches have a very short duration (less than 1 μs). The RESET events have a long duration. The minimum duration is the reset timeout period. The reset timeout period is 20 ms with a capacitor C1 of 100 nF. Most of the errors are RESET. At high LET, the device sensitivity is very high, and the part stays continuously in RESET. Therefore for a LET higher than 8 MeVcm²/mg we have not been able to measure the device sensitivity.

Figure 1 shows the cross section curves of the RESET errors sensitivity. This part is extremely sensitive with a LET threshold of about 1.5 MeVcm²/mg. The maximum measured cross section is 8E-5 cm²/device.

A worst-case estimation of the RESET rate in the ST5 environment has been performed for the worst-case environment conditions (Galactic Cosmic Rays at solar minimum) and with conservative estimates of the part geometry (thickness of the sensitive volume = 2 μm). The result gives a RESET rate of 3/device-day.

| run# | dut# | ion | tilt | LET | LETeff | fluence_eff | flux_eff | SET | RESET | sigmaSET | sigma RESET |
|------|------|-------|------|-------|--------|-------------|----------|-----|-------|----------|-------------|
| 186 | 1 | Ni-58 | 0 | 26.55 | 26.55 | 1.88E+06 | 5.28E+04 | 0 | >1 | 0.00E+00 | |
| 187 | 1 | Ni-58 | 0 | 26.55 | 26.55 | 4.30E+05 | 5.38E+04 | 0 | >1 | 0.00E+00 | |
| 188 | 1 | Cl-35 | 0 | 11.44 | 11.44 | 5.55E+05 | 5.84E+04 | 0 | >1 | 0.00E+00 | |
| 189 | 1 | Cl-35 | 0 | 11.44 | 11.44 | 1.43E+06 | 5.54E+04 | 0 | >1 | 0.00E+00 | |
| 190 | 1 | Si-28 | 0 | 7.878 | 7.878 | 2.20E+05 | 5.64E+04 | 0 | 4 | 0.00E+00 | 1.82E-05 |
| 192 | 1 | Si-28 | 0 | 7.878 | 7.878 | 7.45E+05 | 2.97E+04 | 0 | 36 | 0.00E+00 | 4.83E-05 |
| 193 | 1 | O-16 | 0 | 2.57 | 2.57 | 8.19E+05 | 1.31E+04 | 0 | 17 | 0.00E+00 | 2.08E-05 |
| 194 | 3 | O-16 | 0 | 2.57 | 2.57 | 1.27E+05 | 6.38E+03 | 0 | 9 | 0.00E+00 | 7.09E-05 |
| 196 | 1 | C-12 | 0 | 1.44 | 1.44 | 1.00E+07 | 3.59E+04 | 0 | 0 | 0.00E+00 | 1.00E-07 |
| 197 | 1 | C-12 | 45 | 1.44 | 2.04 | 9.98E+05 | 2.49E+04 | 2 | 6 | 2.00E-06 | 6.01E-06 |
| 198 | 1 | C-12 | 30 | 1.44 | 1.66 | 1.00E+07 | 3.11E+04 | 1 | 1 | 1.00E-07 | 1.00E-07 |

Table 3: test results.

LP3470

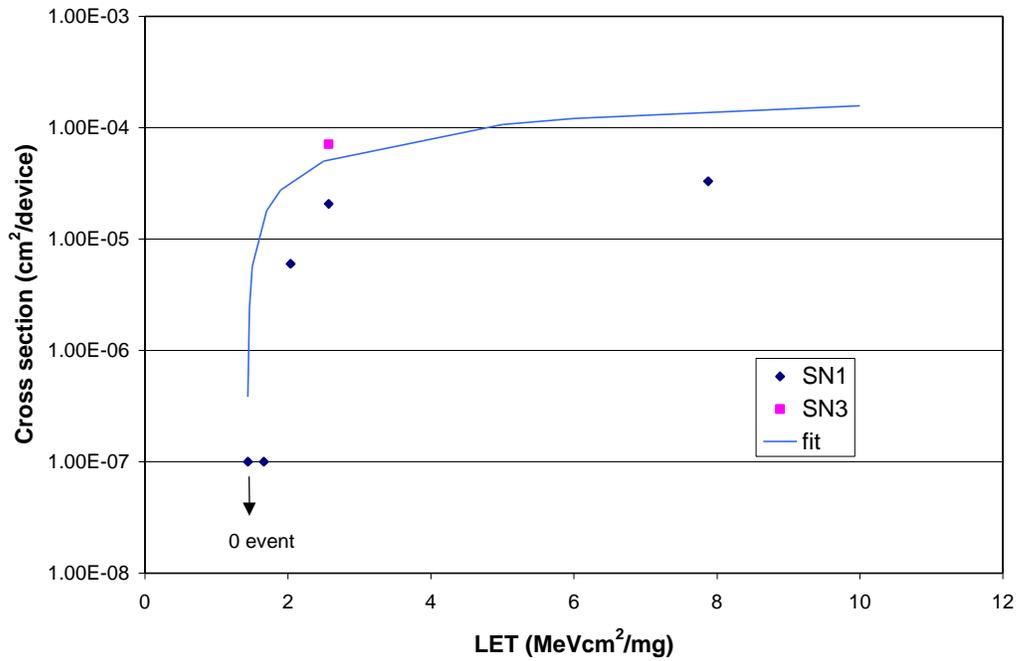


Figure 1: SEU and SEL cross section.

5 Conclusions

The test results show that the voltage supervisor LP3470 is not sensitive to SEL up to a LET of 26 MeVcm²/mg.

The results show a very high SEU sensitivity with a LET threshold at 1.4 MeVcm²/mg and a cross section at saturation higher than 1e-4 cm²/device. During a normal mission day, 3 heavy ion induced resets per day are expected. This rate could be significantly higher during solar events.

The LET threshold indicates possible proton induced sensitivity. If this is the case the event rate on the ST5 orbit will be extremely high. A proton SEE test is recommended.