# High and low dose rate and accelerated aging (‘rebound’) testing of the ISL75051SEH low dropout regulator

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## 1. Introduction

This report provides results of a low and high dose rate total dose test followed by an accelerated annealing test (after high dose rate only) of the ISL75051SEH low dropout regulator ('LDO'). The test was conducted in order to determine the sensitivity of the part to total dose irradiation and to the post high dose rate irradiation accelerated aging ('anneal') procedure required by MIL-STD-883.

The ISL75051SxH is available in two versions differing in their total ionizing dose acceptance testing flow. The ISL75051SRH is acceptance tested on a wafer by wafer basis to 100 krad(Si) at high dose rate (50 – 300 rad(Si)/s) only. The ISL75051SEH is acceptance tested on a wafer by wafer basis to 100 krad(Si) at high dose rate (50 – 300 rad(Si)/s) *and* to 50 krad(Si) at low dose rate (0.01 rad(Si)/s). The ISL75051SRH and ISL75051SEH are otherwise identical parts and the results reported in this document apply to both versions.

Method 1019 of MIL-STD-883 requires an accelerated aging test for all integrated circuits containing MOS devices. The samples are to be irradiated to 1.5x the specified maximum total dose at the Test Condition A dose rate of 50 – 300 rad(Si)/s. Following the final electrical testing operation after the last irradiation downpoint, the parts are then annealed at 100$^{o}$C under bias for 168 hours, followed by another electrical testing cycle. For the present test, the flow was as follows:

1. A high dose rate total dose test to 150krad(Si) was performed using the Intersil Palm Bay Gammacell $^{60}$Co irradiator, which has a current dose rate of 50rad(Si)/s. Downpoints were 0, 25, 50, 100 and 150krad(Si), with ATE data taken at each downpoint. Samples were irradiated under bias and with all pins grounded, with a sample size of 6 for each group. In addition 3 control units were used; these were datalogged at each downpoint and were stored at room temperature in between downpoints.
2. Both groups of samples were annealed at 100$^{o}$C under bias for 168 hours. The bias configuration was the standard SMD irradiation bias circuit, which is designed to reverse bias as many transistor structures as practical while minimizing power dissipation.
3. Following the anneal procedure, all samples and control units were electrically tested. All parameters showed excellent stability at all downpoints.

In parallel to the high dose rate irradiation/anneal sequence, a low dose rate test was performed with the objective of determining the low dose rate sensitivity of the part. For this test, the flow was as follows:

1. The low dose rate total dose test to 150krad(Si) is in progress at this time and is through the 100krad(Si) downpoint. The test was performed using the Intersil Palm Bay low dose rate irradiator at a dose rate of 0.01rad(Si)/s. The 0, 50 and 100krad(Si) downpoints are complete, with ATE data taken at each downpoint. Samples were irradiated under bias and with all pins grounded, with a sample size of 4 for each group. Control units were used but the data is not reported.
2. No anneal was performed after the low dose rate test.

As in the high dose rate test, all samples in the low dose rate test showed stable performance to 50krad(Si), but at the 100krad(Si) downpoint a failure was encountered in the grounded irradiation group. Failure analysis was performed with somewhat inconclusive results, with electrical overstress during ATE testing found to be the most likely cause, so the failed part was removed

from the population. We note that low dose rate sensitivity testing has been performed on several other parts using the P6 BiCMOS technology, and all of these parts were found to be ELDRS-free. We will report the 100krad(Si) results for the remaining samples in this document, and a new test has been started. No anneal was performed after the low dose rate test.

## 2. Reference Documents

MIL-STD-883G test method 1019
ISL75051SEH data sheet
DSCC Standard Drawing (SMD) 5962-11212

## 3: Part Description

The ISL75051SEH is a radiation hardened low voltage, high-current, single output low dropout linear voltage regulator (LDO) specified for a 3.0A output current. The device operates over an input voltage range of 2.2V to 5.5V and is capable of providing output voltages of 0.8V to 4V, with the output voltage adjusted by an external resistor divider network. The ENABLE feature allows the part to be placed into a low quiescent current shutdown mode. A submicron BiCMOS process is utilized for this product family to deliver competitive analog performance, efficiency and overall value.

The ISL75051SEH overcurrent protection (OCP) pin allows the short circuit output current limit threshold to be programmed with an external resistor. The BiCMOS design consumes significantly lower quiescent current as a function of load in comparison to bipolar LDOs, which results in higher efficiency and the ability to consider packages with smaller footprints. The quiescent current of the part was traded off against a highly competitive load transient response, resulting in a superior total AC regulation band for an LDO in this category.

The ISL75051SEH is implemented in the submicron P6 power management process, with 0.6um minimum ground rules and three layers of interconnect. Active devices include low voltage CMOS and high voltage DMOS devices as well as complementary bipolar junction transistors. The process is in volume production under MIL-PRF-38535 certification and is used for a wide range of commercial power management devices. Figure 1 shows a pin assignment table for the part.

| Terminal number | Terminal symbol | Terminal number | Terminal symbol |
|---|---|---|---|
| 1 | GND | 10 | EN |
| 2 | $V_{OUT}$ | 11 | OCP |
| 3 | $V_{OUT}$ | 12 | $V_{IN}$ |
| 4 | $V_{OUT}$ | 13 | $V_{IN}$ |
| 5 | $V_{OUT}$ | 14 | $V_{IN}$ |
| 6 | $V_{OUT}$ | 15 | $V_{IN}$ |
| 7 | $V_{OUT}$ | 16 | $V_{IN}$ |
| 8 | ADJ | 17 | $V_{IN}$ |
| 9 | BYP | 18 | PG |

**Figure 1:** IS75051SRH pin assignments.

## 4: Test Description

### 4.1 Irradiation Facilities

The high dose rate total dose irradiation was performed using a Gammacell 220 $^{60}$Co irradiator located in the Palm Bay, Florida Intersil facility. The irradiation was done at a dose rate of 80 rad(Si)/s per a calculated dose rate table, in accordance with MIL-STD-883 Method 1019. The 168-hour anneal was performed at 100$^{o}$C in a small oven, using the same bias board used for the irradiations. The transfer time from the last ATE test to the start of the anneal was two minutes.

The low dose rate irradiation was performed using a Shepherd 484 irradiator at 0.01rad(Si)/s.

### 4.2 Test Fixturing

The configuration used for biased irradiation was in conformance with Standard Microcircuit Drawing (SMD) 5962-11212.

### 4.3 Characterization equipment and procedures

All electrical testing at the irradiation downpoints and following the high temperature anneal was performed at room temperature using the production Eagle ETS364 automated test equipment (ATE) at the Intersil Palm Bay facility. The test program used was 53865A01_SPX5X rev D, which is the released production test program. The same setup was used for all test points. Three controls were run at each test point; no anomalous readings were observed at any time, see also the variables data in Section 6, which plot the control unit data as well as the experimental samples. All test results were datalogged. All parts passed the post-radiation room temperature SMD 5962-11212 limits at all downpoints.

### 4.4 Experimental matrix

The experimental matrix consisted of six samples irradiated at high dose rate with all pins grounded, six samples irradiated at high dose rate under bias and three control units. Additionally, four samples were irradiated at low dose rate with all pins grounded and four samples were irradiated at low dose rate under bias.

Samples of the ISL75051SEH were drawn from production lot 53865A01-WPH2EEHCA, wafer 01. Samples were packaged in the standard 18 lead ceramic flatpack, Intersil package code KKB. All samples were processed through the standard burnin cycle before irradiation, as required by MIL-STD-883, and were screened to the SMD 5962-11212 limits at room, low and high temperatures before the start of total dose testing.

### 4.5 Downpoints

The downpoints for the high dose rate irradiations were 0krad(Si), 25krad(Si), 50krad(Si), 100krad(Si) and 150krad(Si), followed by a 168-hour anneal at +100$^{o}$C. The downpoints to date for the low dose rate irradiations are 0krad(Si), 50krad(Si) and 100krad(Si), with a 150krad(Si) downpoint expected for the fourth quarter of 2012. No anneal was performed after the low dose rate test.

## 5: Results

### 5.1 Test results

The high dose rate test and subsequent anneal the ISL75051SEH is complete and showed no reject devices after irradiation to 150krad(Si) and anneal for 168 hours at 100$^{o}$C, screening to the SMD 5962-11212 post-irradiation limits.

All samples in the low dose rate test showed stable performance to 50krad(Si), but at the 100krad(Si) downpoint a failure was encountered in the grounded irradiation group. Failure analysis was performed and while not conclusive showed electrical overstress during ATE testing as the most likely cause. The failed part was removed from the population. We note that low dose rate sensitivity testing has been performed on several other parts using the P6 BiCMOS technology, and all of these parts were found to be ELDRS-free. We will report the 100krad(Si) results for the remaining samples in this document, and a new test has been started to further validate the low dose rate performance of the part. No anneal was performed after the low dose rate test.

### 5.2 Discussion and Conclusions

All parameters displayed excellent stability and were well within the post-irradiation SMD limits both after the irradiations and the high temperature accelerated aging step. Some parameters showed change over the tests, and we discuss these below.

Figs. 5, 6, 8 and 9: These figures plot the enable rising and falling thresholds for the 2.2V and 6.0V input cases. The parameters show a decrease over high dose rate and then recover to the pre-radiation value after anneal, with no bias sensitivity. The low dose rate data was stable. We note that this result is related to the failed sample encountered at the 100krad(Si) level; failure analysis showed a leaky NMOS device in the Enable input circuitry, but the threshold levels for the pin remained stable. The failure is unexpected and therefore further suspect, as MOS devices are not considered low dose rate sensitive. Additionally the high dose rate data showed excellent stability.

*Figs. 12 and 27:* These figures show the DC output voltage for the 0.52V output, 2.2V input, no load, and 5.0V output, 6.0V input, 3A load cases, respectively. Both parameters show an increase for biased irradiation and a decrease for grounded irradiation, but in both cases the changes are minor. No other DC output voltage parameters show this behavior. The low dose rate data was stable.

*Fig. 30 and 31:* These figures plot the line and load regulation for 1.8V out. The data shows a gradual decrease toward zero over irradiation, then a recovery to near the pre-radiation value. This is the most ‘rebound-like’ response observed in the data, but the parameter remained well within the specifications. The corresponding line and load regulation data at 1.5V out and 5.0V out did not show this behavior. The control units and the low dose rate data were stable.

*Figure 43, 44, 46 and 47:* These curves show the PGOOD falling and rising threshold for the 6.0V and 2.2V in cases. The parameters were stable over irradiation and then showed an increase to above the pre-radiation value, but all remained well within the specifications. The control units and the low dose rate data were stable.

*Figure 53 and 54:* These figures show the output short circuit current at 2.2V in, for the RSET=5.11K and 511Ω cases. The parameters showed a gradual increase over irradiation, followed by a decrease after the anneal, but all remained well within the specifications. The control units and the low dose rate data were stable.

We conclude that all parameters remained well within the specifications over a 100$^{o}$C anneal under bias for 168 hours, indicating a minimal 'rebound' response of the P6 process used for the part. We also conclude that the part displays excellent low dose rate hardness to 50krad(Si) and that the ISL75051SEH shows little or no dose rate or bias sensitivity. The low dose rate test will continue to 150krad(Si) with the failed device removed from the population, while a second low dose rate test at 0.01rad(Si)/s is currently being planned.

**6: Variables data**

The plots in Figures 2 through 56 show data for key ISL75051SEH parameters at all downpoints. The plots show the median as a function of total dose for each of the irradiation conditions; we chose to use the median because of the relatively small sample size of each group. All parts showed excellent stability over high and low dose rate irradiation and over the subsequent anneal and remained well within the specification limits at all downpoints. The data repeatability was excellent, as evidenced by stable control unit readings at all downpoints.

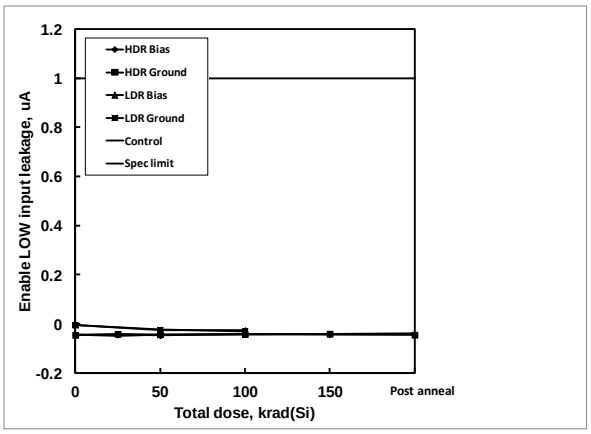


**Figure 2:** ISL75051SEH enable LOW input current as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -0.100µA – +1.000µA.

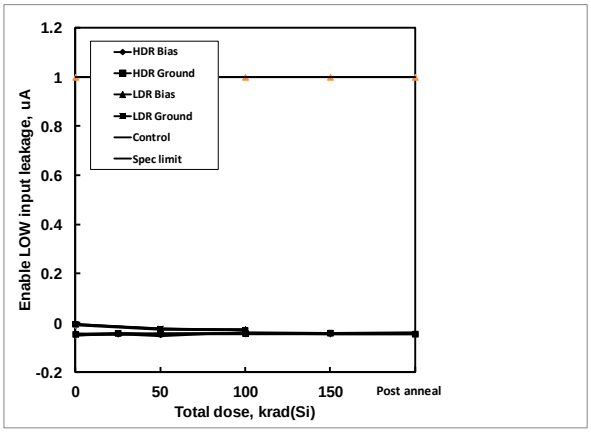


**Figure 3:** ISL75051SEH enable HIGH input current as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -0.100µA – +1.000µA.

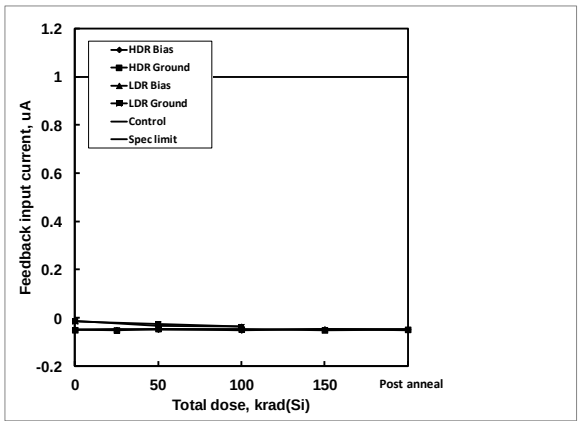


**Figure 4:** ISL75051SEH feedback pin input current as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -1.00µA – +1.00µA.

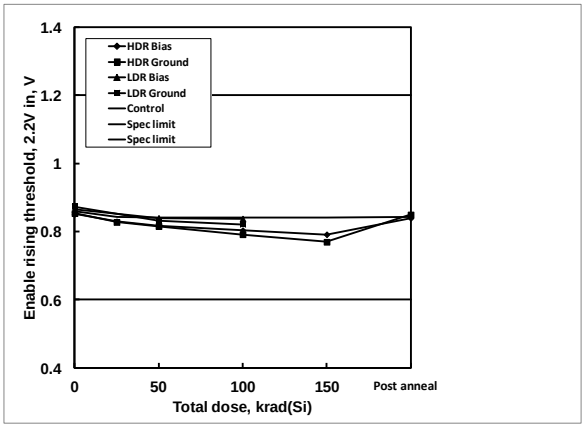


**Figure 5:** ISL75051SEH enable rising threshold, 2.2V input, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.600V – 1.200V.

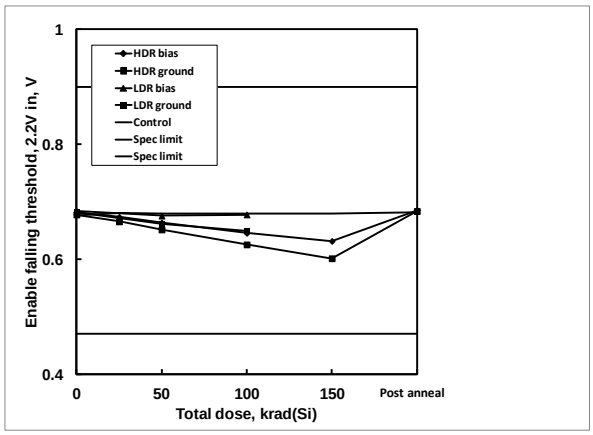


**Figure 6:** ISL75051SEH enable falling threshold, 2.2V input, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.470V – 0.900V.

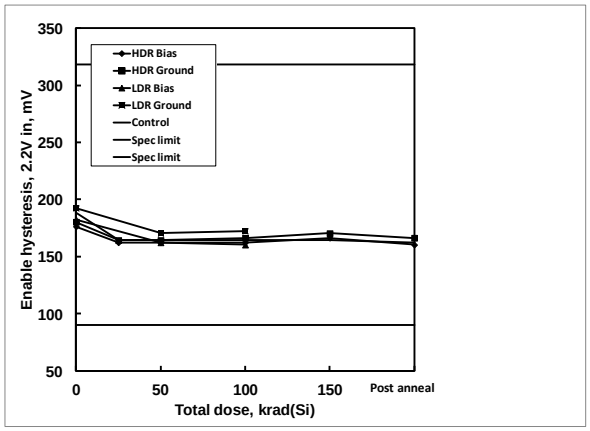


**Figure 7:** ISL75051SEH enable hysteresis, 2.2V input, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 90.0mV – 318.0mV.

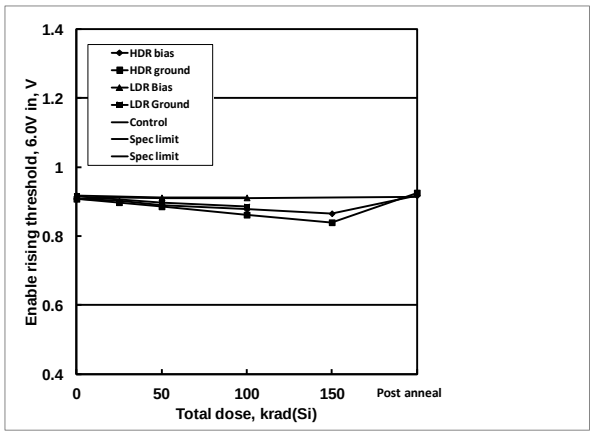


**Figure 8:** ISL75051SEH enable rising threshold, 6.0V input, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.600V – 1.200V.

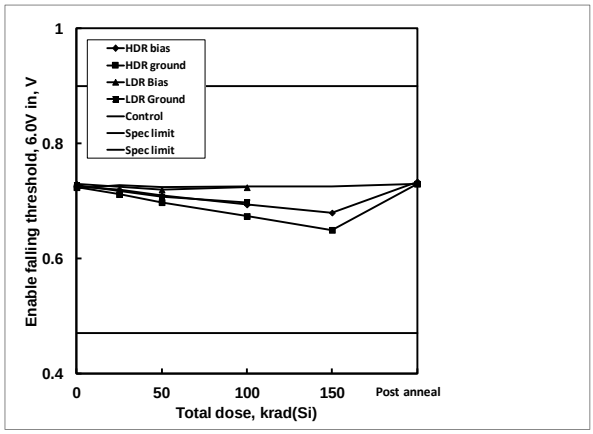


**Figure 9:** ISL75051SEH enable falling threshold, 6.0V input, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.470V – 0.900V.

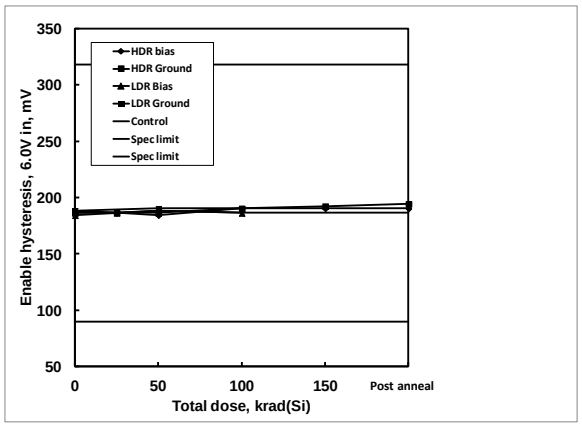


**Figure 10:** ISL75051SEH enable hysteresis, 6.0V input, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 90.0mV – 318.0mV.

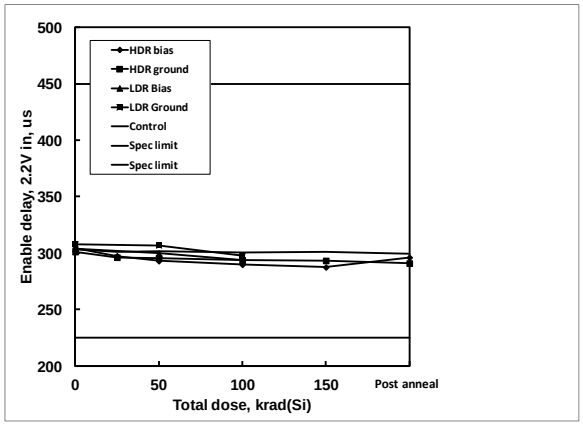


**Figure 11:** ISL75051SEH enable propagation delay, 2.2V input, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 225µs – 450µs.

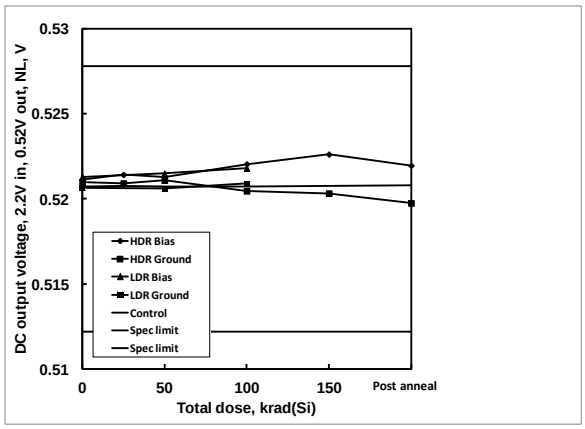


**Figure 12:** ISL75051SEH DC output voltage, 0.52V output, 2.2V input, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.5122V – 0.5278V.

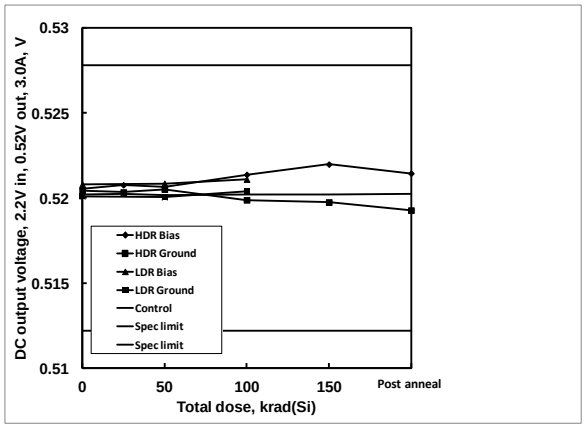


**Figure 13:** ISL75051SEH DC output voltage, 0.52V output, 2.2V input, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.5122V – 0.5278V.

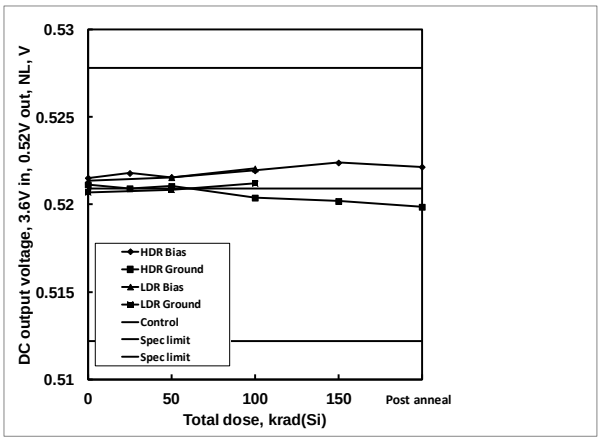


**Figure 14:** ISL75051SEH DC output voltage, 0.52V output, 3.6V input, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.5122V – 0.5278V.

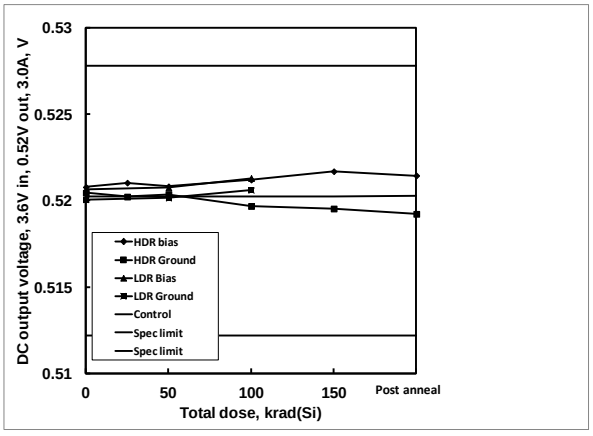


**Figure 15:** ISL75051SEH DC output voltage, 0.52V output, 3.6V input, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.5122V – 0.5278V.

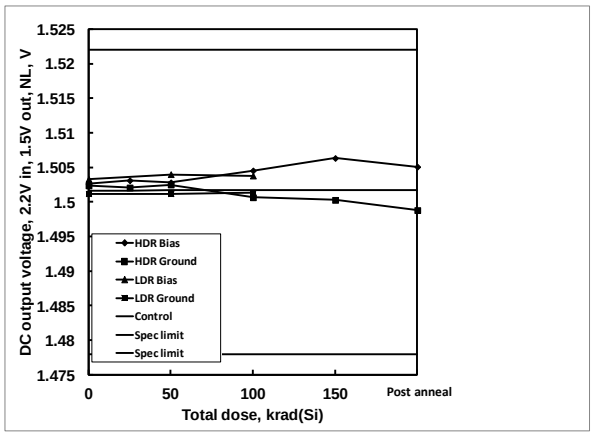


**Figure 16:** ISL75051SEH DC output voltage, 1.5V output, 2.2V input, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 1.4780V – 1.5220V.

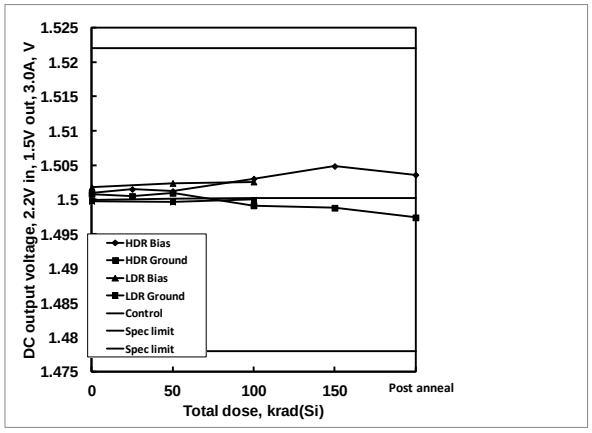


**Figure 17:** ISL75051SEH DC output voltage, 1.5V output, 2.2V input, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 1.4780V – 1.5220V.

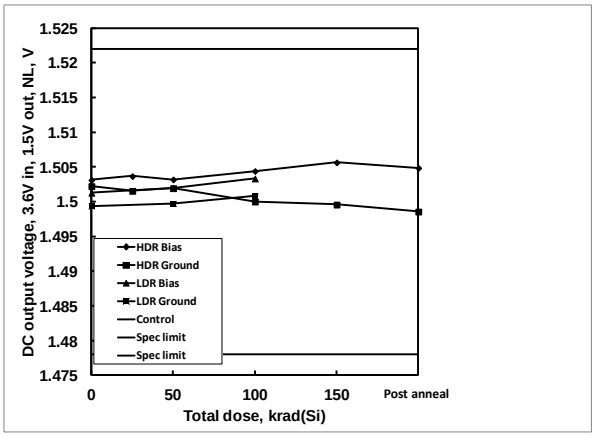


**Figure 18:** ISL75051SEH DC output voltage, 1.5V output, 3.6V input, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 1.4780V – 1.5220V.

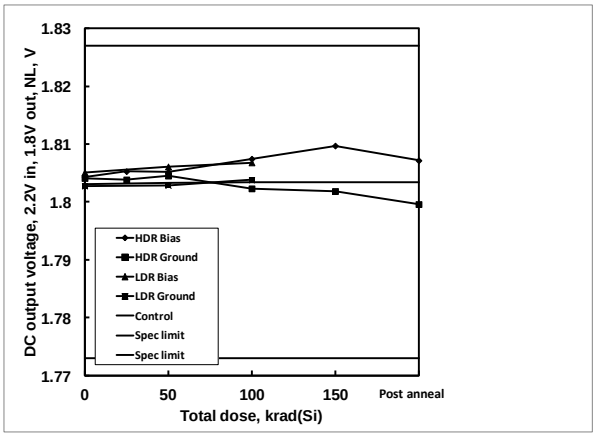


**Figure 20:** ISL75051SEH DC output voltage, 1.8V output, 2.2V input, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 1.7730V – 1.8270V.

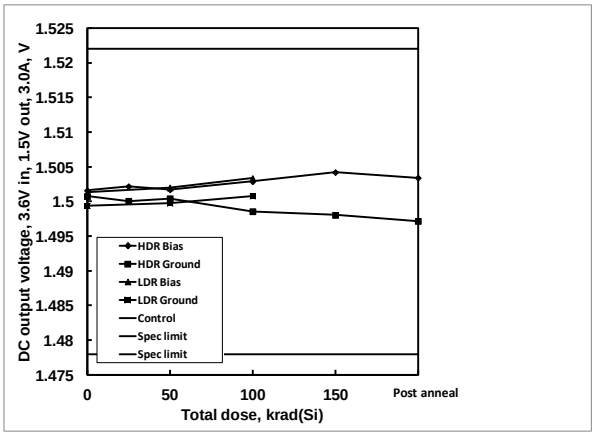


**Figure 19:** ISL75051SEH DC output voltage, 1.5V output, 3.6V input, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 1.4780V – 1.5220V.

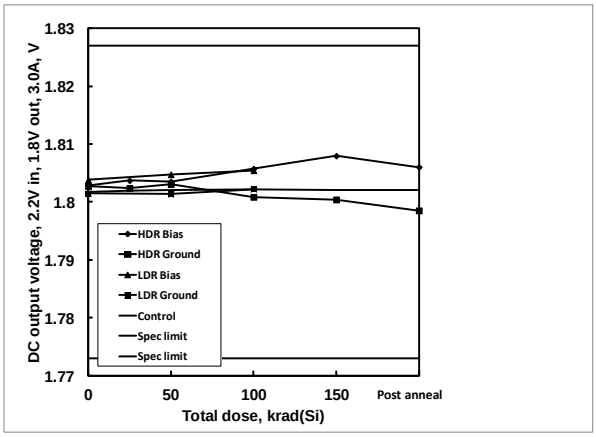


**Figure 21:** ISL75051SEH DC output voltage, 1.8V output, 2.2V input, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 1.7730V – 1.8270V.

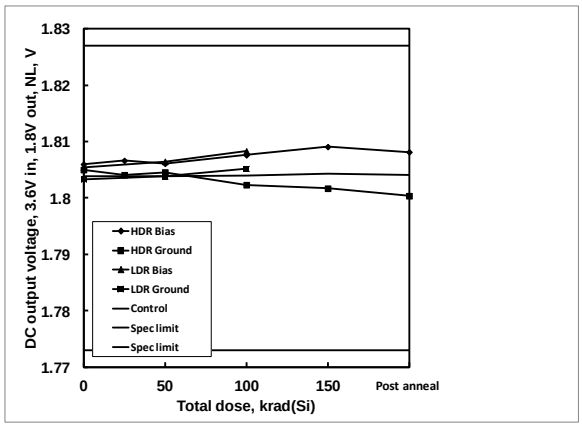


**Figure 22:** ISL75051SEH DC output voltage, 1.8V output, 3.6V input, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 1.7730V – 1.8270V.

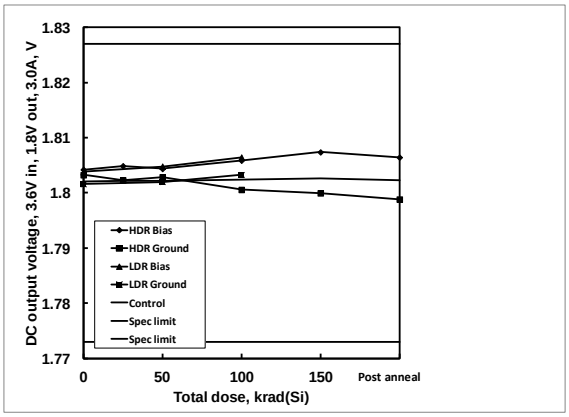


**Figure 23:** ISL75051SEH DC output voltage, 5.0V output, 5.4V input, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 4.9250V – 5.0750V.

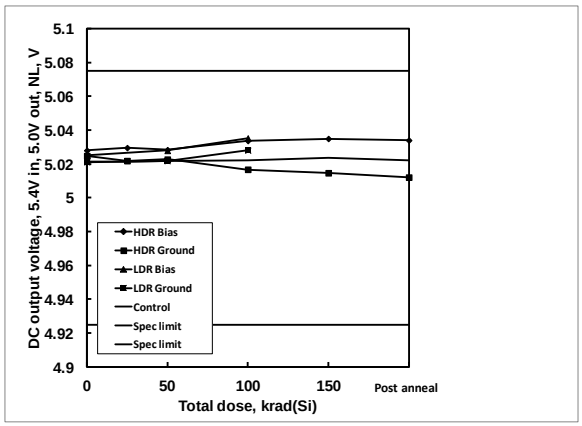


**Figure 24:** ISL75051SEH DC output voltage, 5.0V output, 5.4V input, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 4.9250V – 5.0750V.

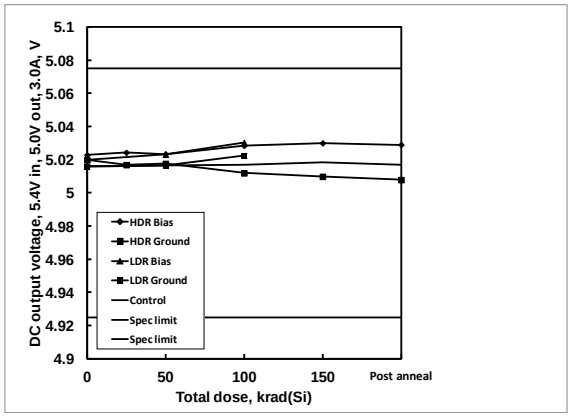


**Figure 25:** ISL75051SEH DC output voltage, 5.0V output, 5.4V input, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 4.9250V – 5.0750V.

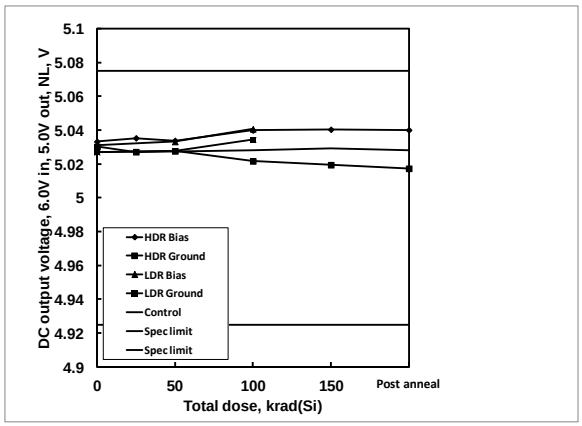


**Figure 26:** ISL75051SEH DC output voltage, 5.0V output, 6.0V input, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 4.9250V – 5.0750V.

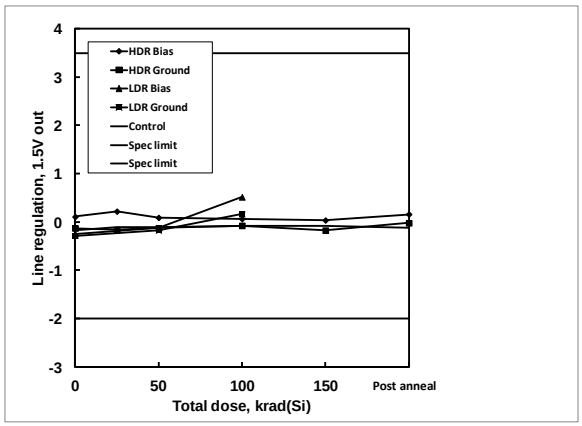


**Figure 28:** ISL75051SEH line regulation, 1.5V out, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -2.000mV – 3.500mV.

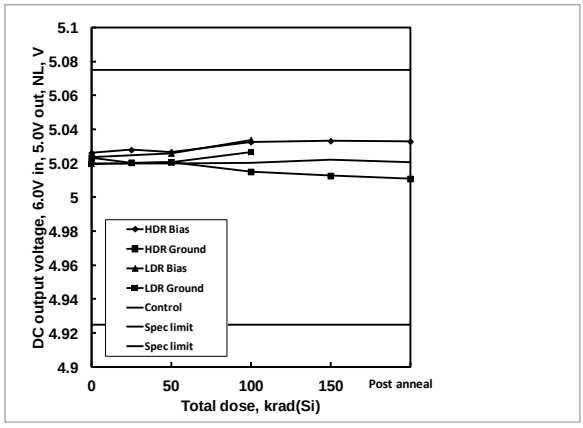


**Figure 27:** ISL75051SEH DC output voltage, 5.0V output, 6.0V input, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 4.9250V – 5.0750V.

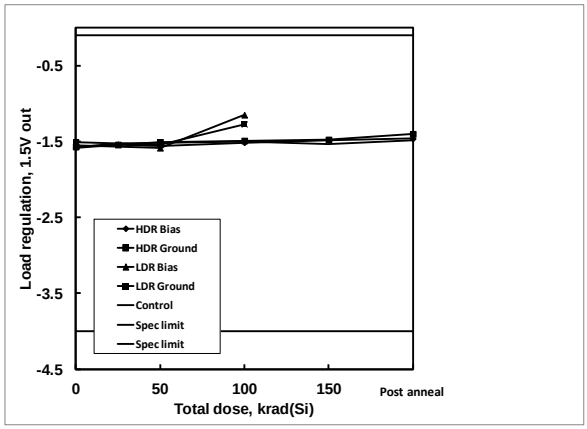


**Figure 29:** ISL75051SEH load regulation, 1.5V out, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -4.000mV to -0.100mV.

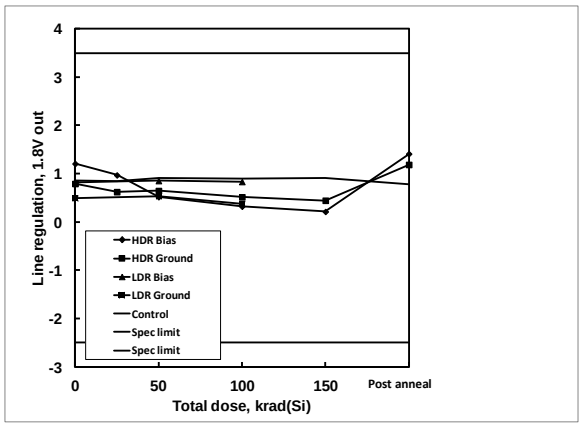


**Figure 30:** ISL75051SEH line regulation, 1.8V out, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -2.500mV to +3.500mV.

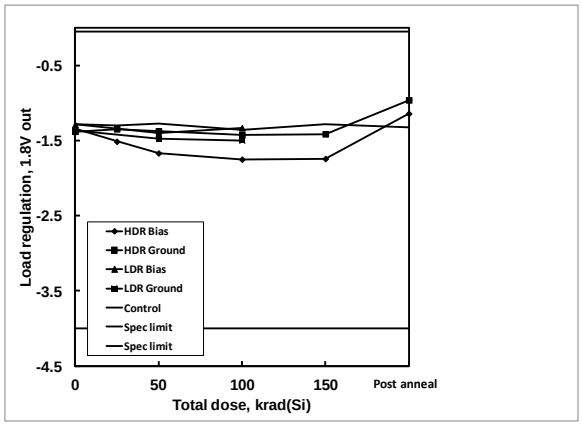


**Figure 31:** ISL75051SEH load regulation, 1.8V out, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -4.000mV to -0.050mV.

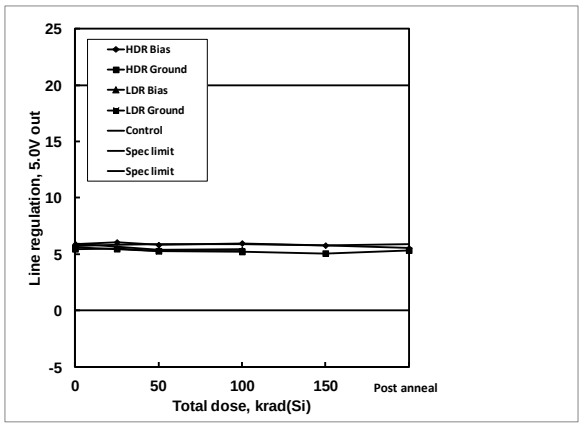


**Figure 32:** ISL75051SEH line regulation, 5.0V out, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0mV to +20.000mV.

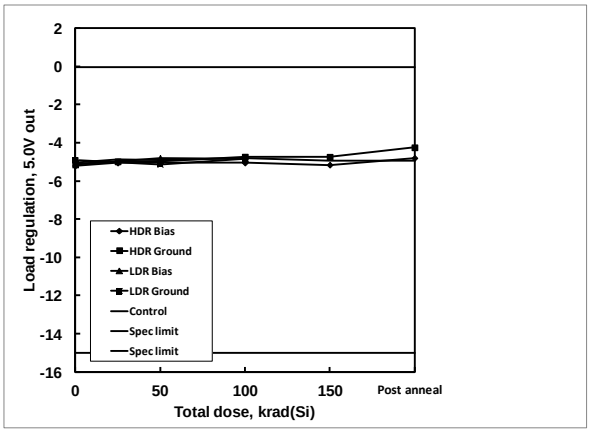


**Figure 33:** ISL75051SEH load regulation, 5.0V out, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -15.000mV to -0.050mV.

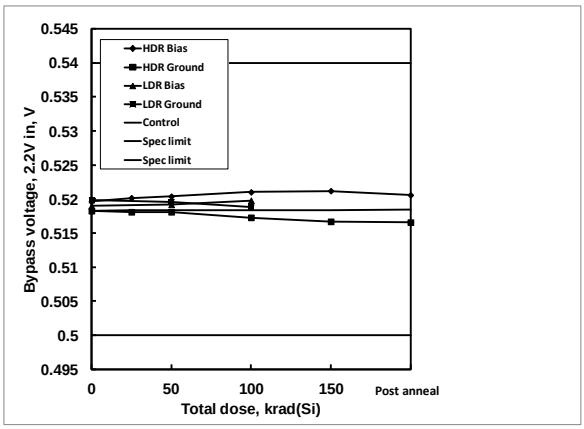


**Figure 34:** ISL75051SEH bypass pin voltage, 2.2V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.500V to 0.540V.

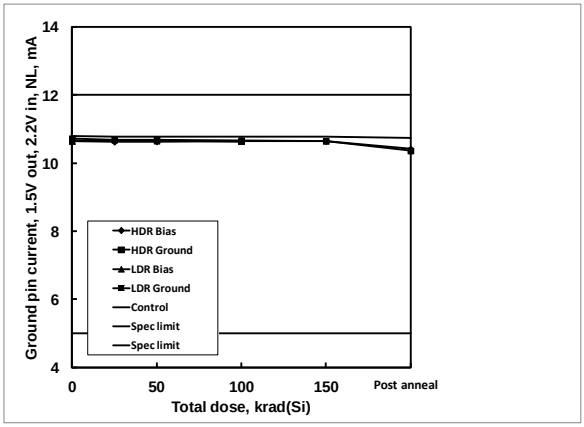


**Figure 35:** ISL75051SEH ground pin current, 1.5V out, 2.2V in, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 5.000mA to 12.000mA.

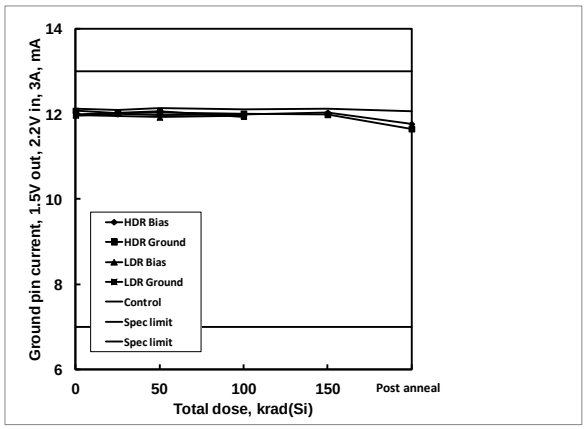


**Figure 36:** ISL75051SEH ground pin current, 1.5V out, 2.2V in, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 7.000mA to 13.000mA.

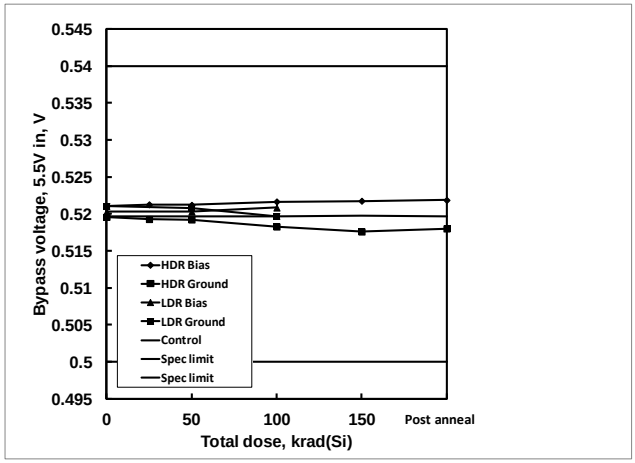


**Figure 37:** ISL75051SEH bypass pin voltage, 6.0V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.500V to 0.540V.

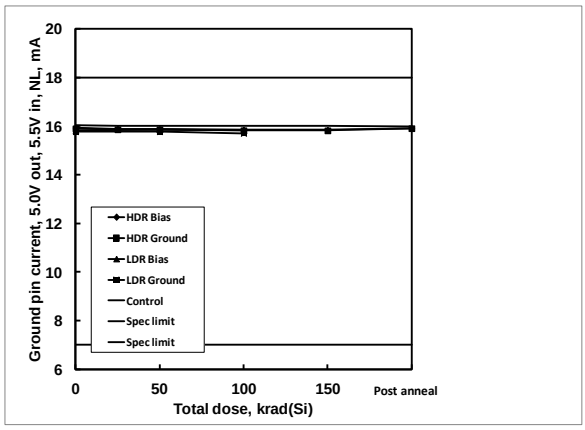


**Figure 38:** ISL75051SEH ground pin current, 1.5V out, 6.0V in, no load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 7.000mA to 18.000mA.

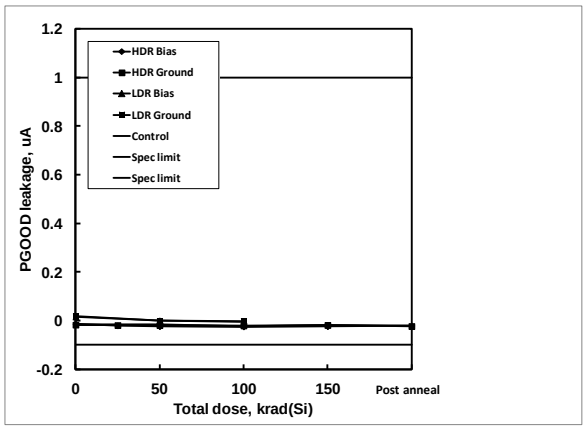


**Figure 40:** ISL75051SEH PGOOD leakage as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are -0.010µA to 1.000µA.

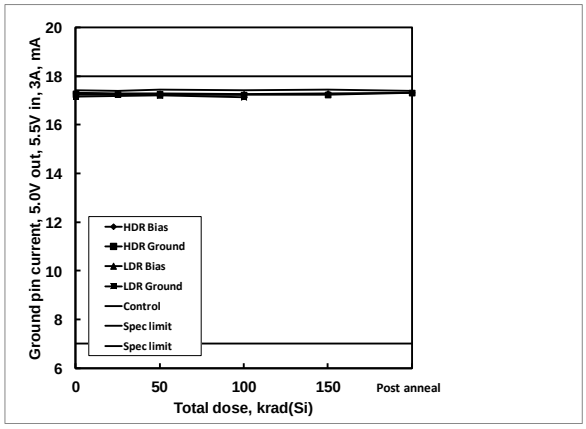


**Figure 39:** ISL75051SEH ground pin current, 1.5V out, 6.0V in, 3A load, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 7.000mA to 18.000mA.

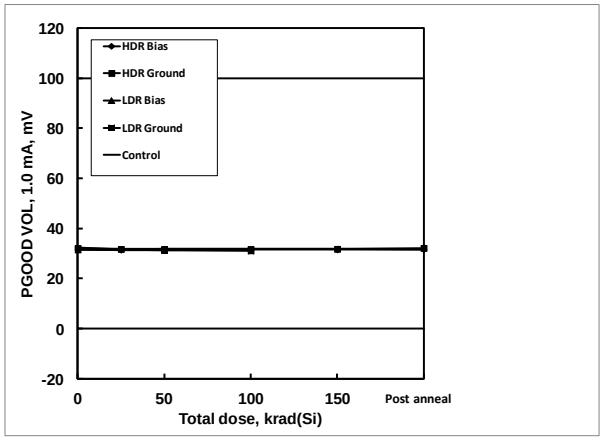


**Figure 41:** ISL75051SEH PGOOD output LOW voltage, 1mA, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0mV to 100.0mV.

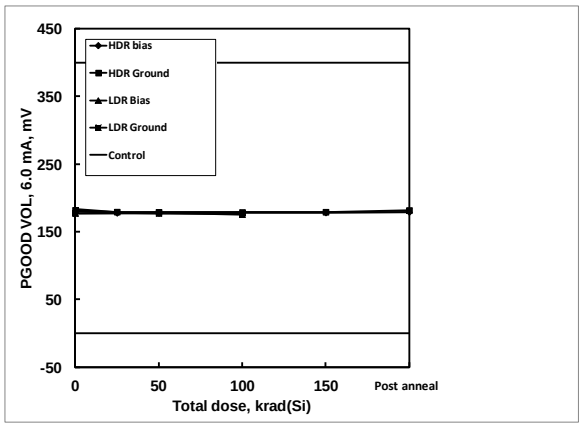


**Figure 42:** ISL75051SEH PGOOD output LOW voltage, 6mA, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0mV to 400.0mV.

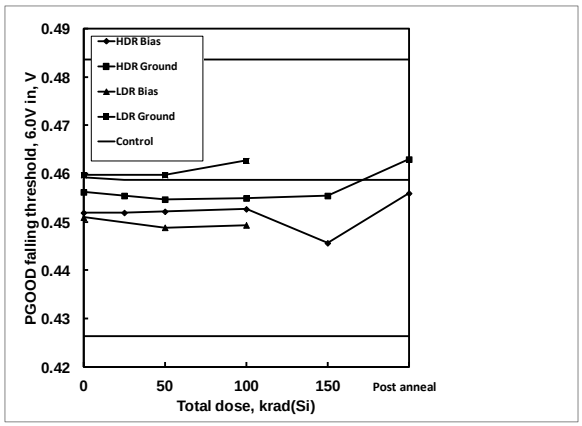


**Figure 44:** ISL75051SEH PGOOD falling threshold, 6.0V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.4420V to 0.4992V.

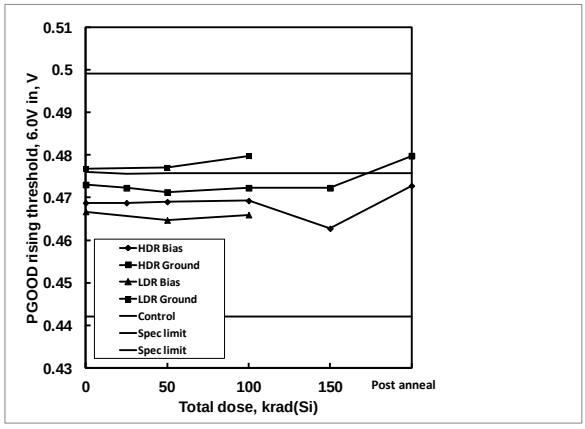


**Figure 43:** ISL75051SEH PGOOD rising threshold, 6.0V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.4264V to 0.4836V.

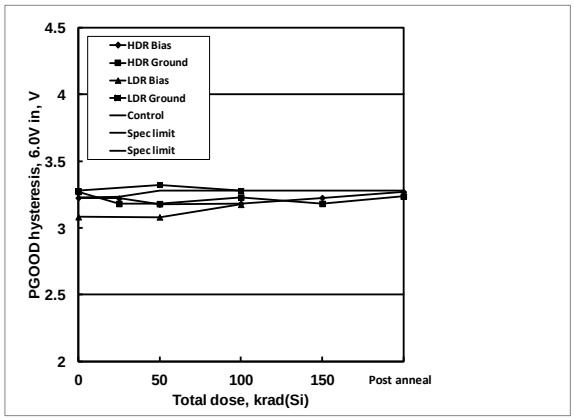


**Figure 45:** ISL75051SEH PGOOD hysteresis, 6.0V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 2.500% to 4.000%.

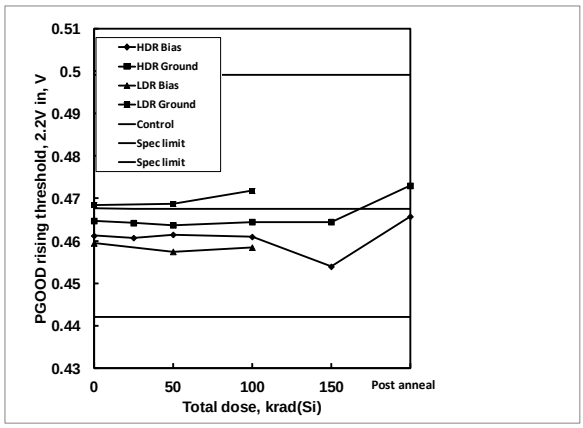


**Figure 46:** ISL75051SEH PGOOD falling threshold, 2.2V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.4264V to 0.4836V.

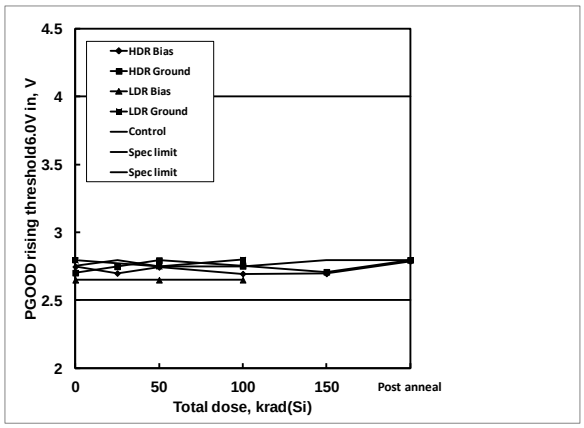


**Figure 48:** ISL75051SEH PGOOD hysteresis, 2.2V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 2.500% to 4.000%.

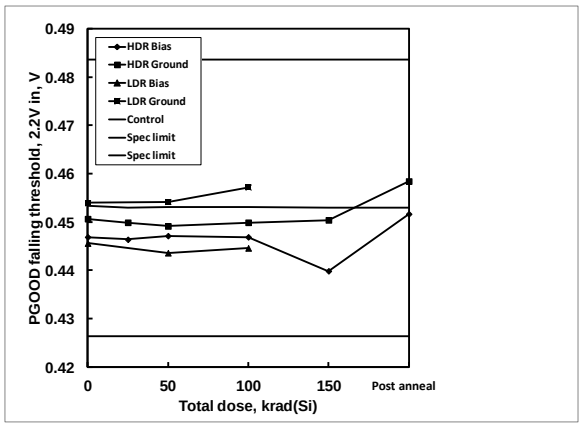


**Figure 47:** ISL75051SEH PGOOD rising threshold, 2.2V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.4420V to 0.4992V.

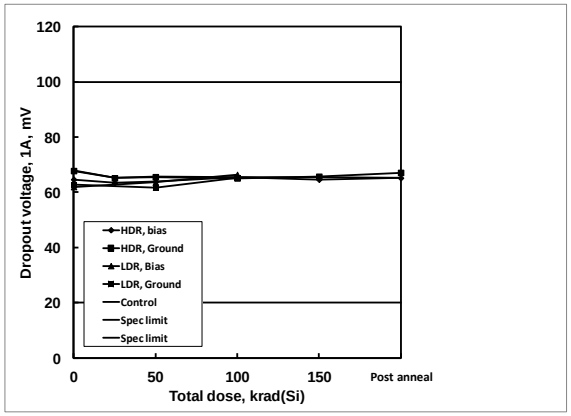


**Figure 49:** ISL75051SEH dropout voltage, 2.5V out, 1A load current, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 20.000mV to 100.000mV.

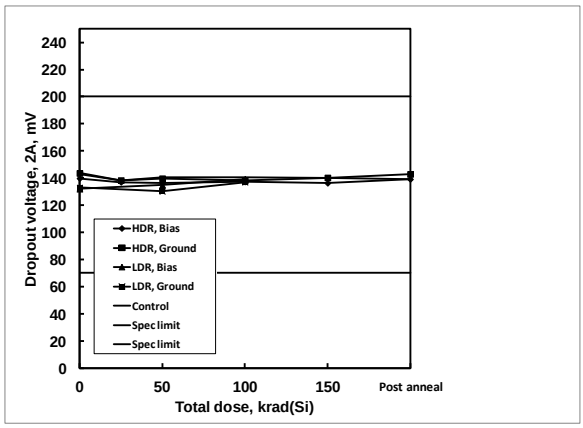


**Figure 50:** ISL75051SEH dropout voltage, 2.5V out, 2A load current, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 70.000mV to 200.000mV.

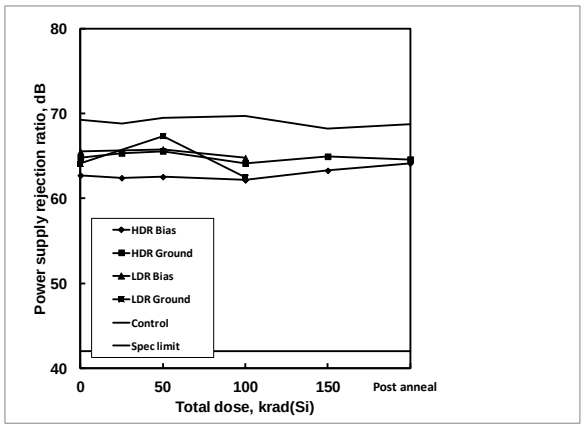


**Figure 52:** ISL75051SEH power supply rejection ratio as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limit is 42dB minimum.

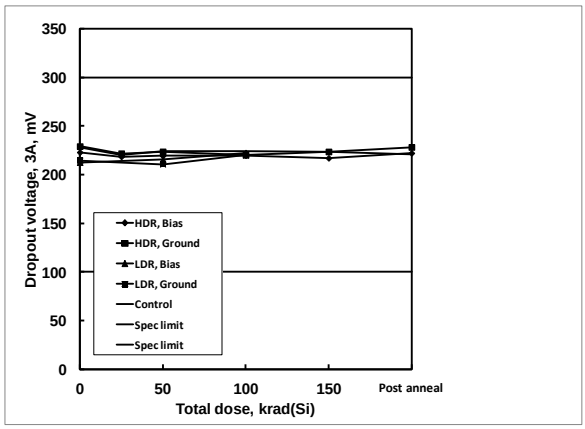


**Figure 51:** ISL75051SEH dropout voltage, 2.5V out, 3A load current, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 100.000mV to 300.000mV.

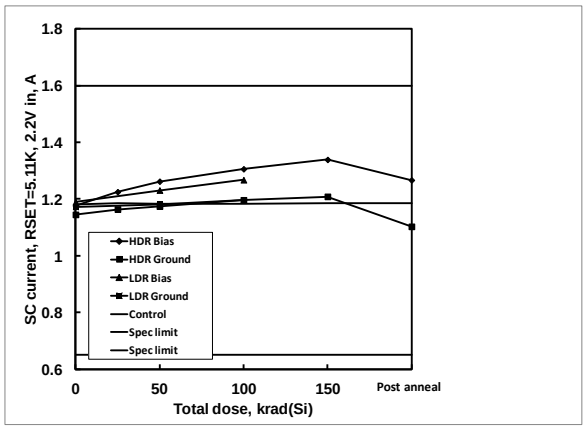


**Figure 53:** ISL75051SEH output short circuit current, 2.2V in, RSET=5.11K, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.650A to 1.600A.

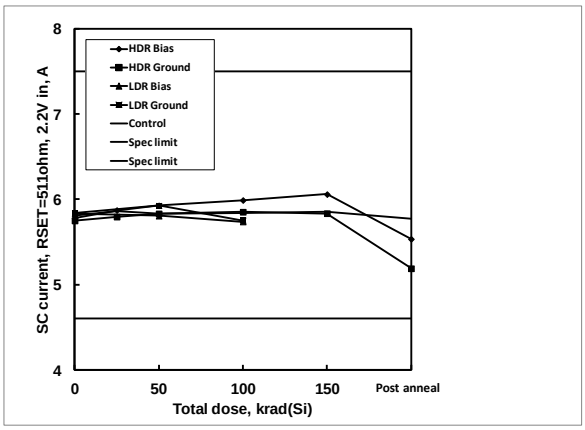


**Figure 54:** ISL75051SEH output short circuit current, RSET=511Ω, 2.2V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 4.600A to 7.500A.

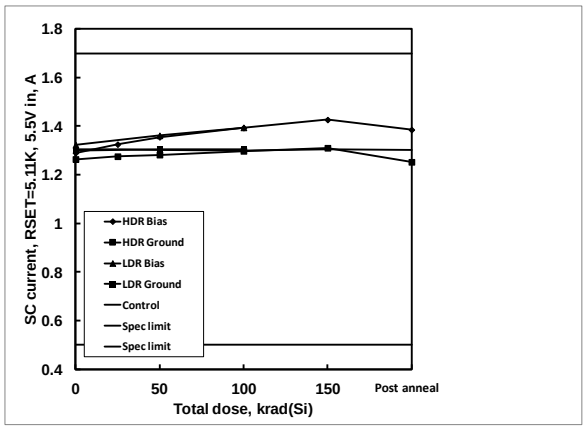


**Figure 55:** ISL75051SEH output short circuit current, RSET=5.11K, 6.0V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 0.500A to 1.700A.

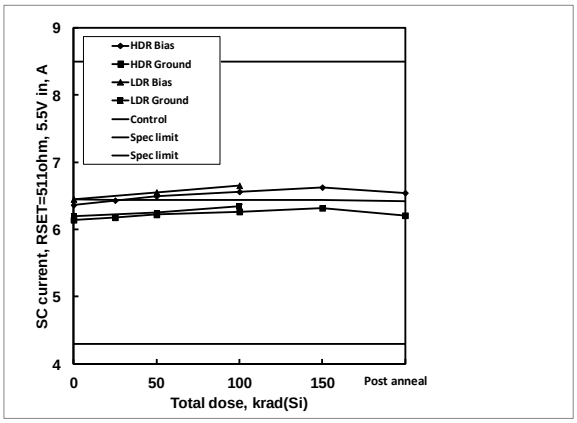


**Figure 56:** ISL75051SEH output short circuit current, RSET=511Ω, 6.0V in, as a function of biased and grounded high and low dose rate irradiation and subsequent high temperature accelerated post-high dose rate aging at 100°C. The dose rate was 80 rad(Si)/s. Sample size was 6 for the high dose rate cells and 4 for the low dose rate cells, and three control units were used for the high dose rate test. The specification limits are 4.300A to 8.500A.

## 7: Appendices

7.1: Reported parameters and figure references.

| Fig. | Parameter | Units | Limit low | Limit high |
|---|---|---|---|---|
| 2 | Enable pin leakage, LOW | µA | -0.1000 | 1.0000 |
| 3 | Enable pin leakage, HIGH | µA | -0.1000 | 1.0000 |
| 4 | Feedback input current | µA | -1.0000 | 1.0000 |
| 5 | Enable rising threshold, 2.2V in | V | 0.6000 | 1.2000 |
| 6 | Enable falling threshold, 2.2V in | V | 0.4700 | 0.9000 |
| 7 | Enable hysteresis, 2.2V in | mV | 90.0000 | 318.0000 |
| 8 | Enable rising threshold, 6.0V in | V | 0.6000 | 1.2000 |
| 9 | Enable falling threshold, 6.0V in | V | 0.4700 | 0.9000 |
| 10 | Enable hysteresis, 6.0V in | mV | 90.0000 | 318.0000 |
| 11 | Enable propagation delay, 2.2V in | µs | 225.0000 | 450.0000 |
| 12 | DC output voltage accuracy, 0.52V out, 2.2V in, NL | V | 0.5122 | 0.5278 |
| 13 | DC output voltage accuracy, 0.52V out, 2.2V in, 3A | V | 0.5122 | 0.5278 |
| 14 | DC output voltage accuracy, 0.52V out, 3.6V in, NL | V | 0.5122 | 0.5278 |
| 15 | DC output voltage accuracy, 0.52V out, 3.6V in, 3A | V | 0.5122 | 0.5278 |
| 16 | DC output voltage accuracy, 1.5V out, 2.2V in, NL | V | 1.4780 | 1.5220 |
| 17 | DC output voltage accuracy, 1.5V out, 2.2V in, 3A | V | 1.4780 | 1.5220 |
| 18 | DC output voltage accuracy, 1.5V out, 3.6V in, NL | V | 1.4780 | 1.5220 |
| 19 | DC output voltage accuracy, 1.5V out, 3.6V in, 3A | V | 1.4780 | 1.5220 |
| 20 | DC output voltage accuracy, 1.8V out, 2.2V in, NL | V | 1.7730 | 1.8270 |
| 21 | DC output voltage accuracy, 1.8V out, 2.2V in, 3A | V | 1.7730 | 1.8270 |
| 22 | DC output voltage accuracy, 1.8V out, 3.6V in, NL | V | 1.7730 | 1.8270 |
| 23 | DC output voltage accuracy, 1.8V out, 3.6V in, 3A | V | 1.7730 | 1.8270 |
| 24 | DC output voltage accuracy, 5.0V out, 5.4V in, NL | V | 4.9250 | 5.0750 |
| 25 | DC output voltage accuracy, 5.0V out, 5.4V in, 3A | V | 4.9250 | 5.0750 |
| 26 | DC output voltage accuracy, 5.0V out, 6.0V in, NL | V | 4.9250 | 5.0750 |
| 27 | DC output voltage accuracy, 5.0V out, 6.0V in, 3A | V | 4.9250 | 5.0750 |
| 28 | DC line regulation, 1.5V out | mV | -2.0000 | 3.5000 |
| 29 | DC load regulation, 1.5V out | mV | -4.0000 | -0.1000 |
| 30 | DC line regulation, 1.8V out | mV | -2.5000 | 3.5000 |
| 31 | DC load regulation, 1.8V out | mV | -4.0000 | -0.0500 |

| | | | | |
|---|---|---|---|---|
| 32 | DC line regulation, 5.0V out | mV | 0.0000 | 20.0000 |
| 33 | DC load regulation, 5.0V out | mV | -15.0000 | -0.0500 |
| 34 | BYP pin, 2,.2V in | V | 0.5000 | 0.5400 |
| 35 | Ground pin current, IQ, 1.5V out, 2.2V in, NL | mA | 5.0000 | 12.0000 |
| 36 | Ground pin current, IQ, 1.5V out, 2.2V in, 3A | mA | 7.0000 | 13.0000 |
| 37 | BYP pin, 6.0V in | V | 0.5000 | 0.5400 |
| 38 | Ground pin current, IQ, 5.0V out, 6.0V in, NL | mA | 7.0000 | 18.0000 |
| 39 | Ground pin current, IQ, 5.0V out, 6.0V in, 3A | mA | 7.0000 | 18.0000 |
| 40 | PGOOD leakage | µA | -0.1000 | 1.0000 |
| 41 | PGOOD VOL, 1mA | mV | 0.0000 | 100.0000 |
| 42 | PGOOD VOL, 6mA | mV | 0.0000 | 400.0000 |
| 43 | PGOOD rising threshold, 6.0V in | V | 0.4264 | 0.4836 |
| 44 | PGOOD falling threshold, 6.0V in | V | 0.4420 | 0.4992 |
| 45 | PGOOD hysteresis, 6.0V in | % | 2.5000 | 4.0000 |
| 46 | PGOOD falling threshold, 2.2V in | V | 0.4264 | 0.4836 |
| 47 | PGOOD rising threshold, 2.2V in | V | 0.4420 | 0.4992 |
| 48 | PGOOD hysteresis, 2.2V in | % | 2.5000 | 4.0000 |
| 49 | Dropout voltage, 2.5V out, 1A | mV | 20.0000 | 100.0000 |
| 50 | Dropout voltage, 2.5V out, 2A | mV | 70.0000 | 200.0000 |
| 51 | Dropout voltage, 2.5V out, 3A | mV | 100.0000 | 300.0000 |
| 52 | PSRR, 2.5V in, 1.8V out, 3A, 300mVpp, 1KHz | dB | 42.0000 | - |
| 53 | Output SC current, RSET=5.11K, 0V out, 2.2V in | A | 0.6500 | 1.6000 |
| 54 | Output SC current, RSET=511ohm, 0V out, 2.2V in | A | 4.6000 | 7.5000 |
| 55 | Output SC current, RSET=5.11K, 0V out, 6.0V in | A | 0.5000 | 1.7000 |
| 56 | Output SC current, RSET=511ohm, 0V out, 6.0V in | A | 4.3000 | 8.5000 |

Note 1: Limits are taken from Standard Microcircuit Drawing (SMD) 5962-11212.

## 8: Document revision history

| Revision | Date | Pages | Comments |
|---|---|---|---|
| 0 | 27 July 2012 | All | Original issue |
| 1 | 16 August 2012 | 2,3 | Add ISL75051SEH language |