ISL70592SEH

Total Dose Test Report

TR069
Rev.0.00
Aug 20, 2018

Introduction

This report documents the results of low and high dose rate total dose testing of the ISL70592SEH precision current source. The parts did not undergo a post-exposure high temperature anneal because the circuits do not contain MOS elements. The tests were conducted to provide an assessment of the total dose hardness of the part and to determine any dose rate or bias sensitivity. Parts were irradiated under bias and with all pins grounded at low dose rate to 75krad(Si) and at high dose rate to 150krad(Si). The ISL70592SEH is rated at 100krad(Si) at high dose rate (50 – 300rad(Si)/s) and at 75krad(Si) at low dose rate (0.01rad(Si)/s) and is acceptance tested on a wafer-by-wafer basis to these limits.

Part Description

The ISL70592SEH is a 1mA precision current source, designed for thermistor and other resistive sensor excitation applications and provides a precision output current (±1%) across voltages of 3V to 40V and across temperatures of -55°C to +125°C. This device is fabricated in the proprietary Renesas PR40 Silicon on Insulator (SOI) process and is immune to single event latch-up.

The ISL70592SEH is a bipolar, monolithic floating current source. The part contains a bandgap core that generates a temperature-independent voltage, and through feedback, forces the total current running through the part to also be independent of temperature. The high output impedance leaves ample room for variations in the power supply voltage and allows it to be insensitive to voltage drops across long lines, resulting in a typical initial accuracy of ±0.5% with an accuracy over radiation of less than ±1% of the initial value of the part. The part can withstand a forward operating voltage of 40V and a reverse voltage of -0.5V.

The pin configuration for the ISL70592SEH is shown in Figure 1, with the pin descriptions shown in Table 1. The part is available in a 4 Ld CDFP Package.

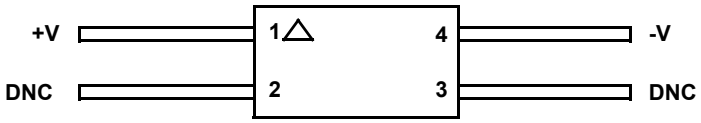


Figure 1. ISL70592SEH Pin Configuration

Table 1. ISL70592SEH Pin Descriptions

Pin Number	Pin Name	Description
1	+V	Positive voltage lead, range 3V to 40V with respect to -V.
2	DNC	DNC (Do Not Connect) = OPEN (Float). Internally connected.
3	DNC	DNC (Do Not Connect) = OPEN (Float). Internally connected.
4	-V	Negative voltage lead.
-	Package lid	Internally connected to -V (Pin 4).

Related Literature

For a full list of related documents, visit our website:

- ISL70592SEH product page

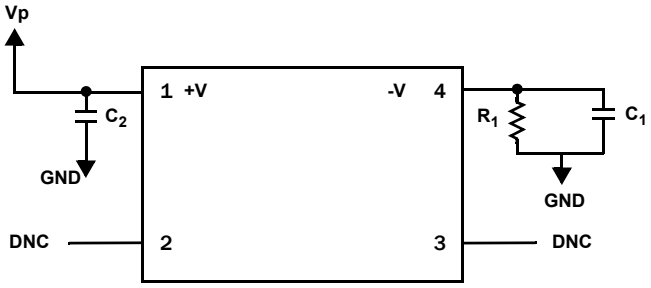
1. Test Description

1.1 Irradiation Facilities

High Dose Rate (HDR) testing was performed at 187.16rad(Si)/s using a Gammacell 220 industry standard irradiator located in the Renesas facility in Palm Bay, Florida. Low Dose Rate (LDR) testing was performed at 0.01rad(Si)/s using the Renesas Palm Bay Hopewell Designs N40 panoramic irradiator. Both irradiators use PbAl spectrum hardening filters to shield the test board and devices under test against low energy secondary gamma radiation. Approximately half of the samples were biased and half had all pins grounded during irradiation.

1.2 Test Fixturing

Figure 2 shows the configuration used for biased irradiation at both dose rates. Note that the part is biased at 40V.



Notes:
1. Vp = +40V, ±10%
2. R_1 = 1kΩ, 1%, 1/4 Watt (Per Socket)
3. C_1 = 0.01µF, 50V, 10% (Per Socket)
4. C_2 = 0.01µF, 50V, 10% (Per Socket)
5. DNC = Do Not Connect

Figure 2. ISL70592SEH TID Bias Schematic

1.3 Characterization Equipment and Procedures

All electrical testing was performed at room temperature outside the irradiator, using production Automated Test Equipment (ATE) with data-logging at each downpoint.

1.4 Experimental Matrix

Irradiation was performed in accordance with the guidelines of MIL-STD-883 Test Method 1019. The experimental matrix consisted of 10 samples irradiated at LDR under bias,10 samples irradiated at LDR with all pins grounded, 5 samples irradiated at HDR under bias, and 4 samples irradiated at HDR with all pins grounded. Three control units were used for both types of irradiation.

The ISL70592SEH samples were from wafer lot XAL2XB. All samples were packaged in the 4 Ld ceramic flatpack package (package code K4.A). Samples were processed through the standard burn-in cycle before irradiation.

1.5 Downpoints

Downpoints for the LDR tests were 0, 10, 30, 50, and 75krad(Si). Downpoints for the HDR tests were 0, 30, 50, 100, and 150krad(Si).

2. Test Results

2.1 Attributes Data

Total dose testing of the ISL70592SEH is complete. All tested parameters passed the SMD limits. Table 2 summarizes the results.

Table 2. ISL70592SEH Total Dose Test Attributes Data

Dose Rate (rad(Si)/s)	Bias	Sample Size	Downpoint	Pass (Note 1)	Fail
0.01	Biased (Figure 2)	10	Pre-irradiation	10	0
			10krad(Si)	10	0
			30krad(Si)	10	0
			50krad(Si)	10	0
			75krad(Si)	10	0
0.01	GND	10	Pre-irradiation	10	0
			10krad(Si)	10	0
			30krad(Si)	10	0
			50krad(Si)	10	0
			75krad(Si)	10	0
187.16	Biased (Figure 2)	5	Pre-irradiation	5	0
			30krad(Si)	5	0
			50krad(Si)	5	0
			100krad(Si)	5	0
			150krad(Si)	5	0
187.16	GND	4	Pre-irradiation	4	0
			30krad(Si)	4	0
			50krad(Si)	4	0
			100krad(Si)	4	0
			150krad(Si)	4	0

Note:
1. ‘Pass’ indicates a sample that passes all SMD limits.

2.2 Key Parameter Listing

Table 3 lists the SMD parameters that are considered indicative of part performance. These parameters are plotted in Figures 3 through 10. All limits are taken from the ISL70592SEH SMD; see the SMD 5962-18217 for further details.

Table 3. ISL70592SEH SMD Total Dose Parameters (T_A = +25°C)

Figure Number	Parameter	Symbol	Limit, Low	Limit, High	Unit
3	Output Current at 40V	I_{O40V}	0.9990	1.0110	mA
4	Output Current at 30V	I_{O30V}	0.9950	1.0080	mA
5	Output Current at 20V	I_{O20V}	0.9940	1.0070	mA
6	Output Current at 12V	I_{O12V}	0.9930	1.0070	mA
7	Output Current at 3V	I_{O3V}	0.9910	1.0070	mA
8	Output Impedance	R_{OUT}	4	-	MΩ
9	Turn-On Time at 4V	t_{ON}	-	230	µs
10	Turn-On Time at 40V	t_{ON}	-	170	µs

2.3 Key Parameter Variables Data

The plots in Figures 3 through 10 illustrate the TID response of the SMD parameters outlined in "Key Parameter Listing" on page 4. The plots show the average tested values of the parameters as a function of total dose for each of the irradiation conditions, biased and grounded, at LDR and HDR. For example, the legend LDR_Bias indicates the average LDR response for biased parts. The plots also include error bars at each downpoint, representing the minimum and maximum measured values of the samples, although in some plots the error bars might not be visible due to their values compared to the scale of the graph.

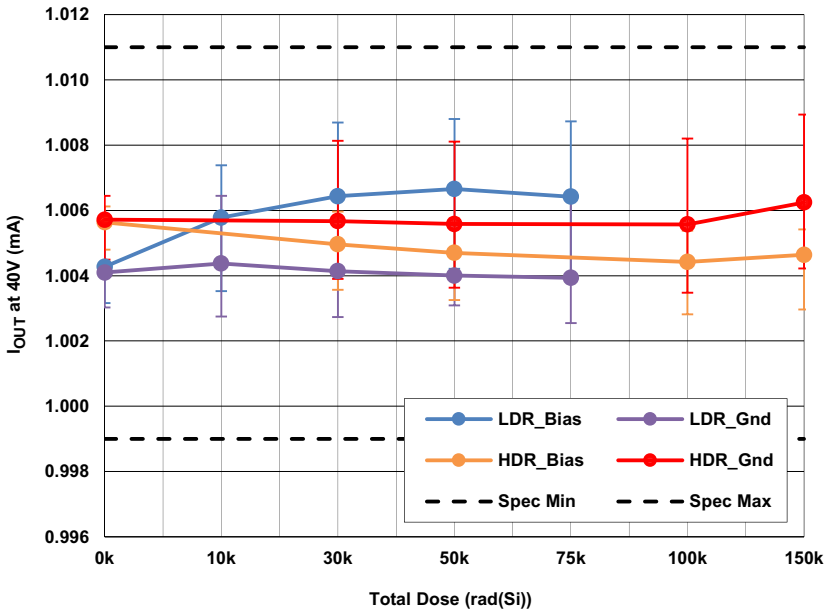


Figure 3. ISL70592SEH output current at 40V (I_{O40V}), as a function of total dose irradiation at LDR and at HDR for biased and grounded configurations. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are 0.999mA minimum and 1.011mA maximum.

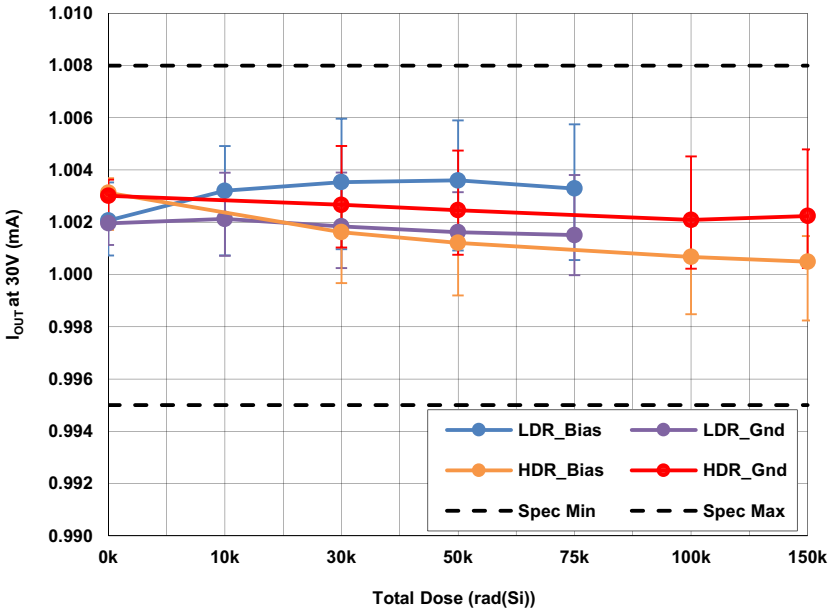


Figure 4. ISL70592SEH output current at 30V (I_{O30V}), as a function of total dose irradiation at LDR and at HDR for biased and grounded configurations. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are 0.995mA minimum and 1.008mA maximum.

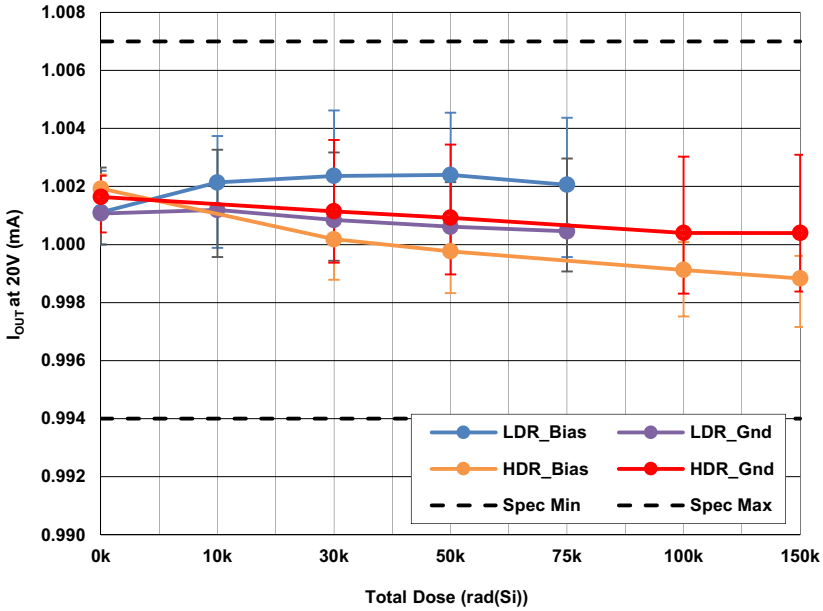


Figure 5. ISL70592SEH output current at 20V (I_{O20V}), as a function of total dose irradiation at LDR and at HDR for biased and grounded configurations. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are 0.994mA minimum and 1.007mA maximum.

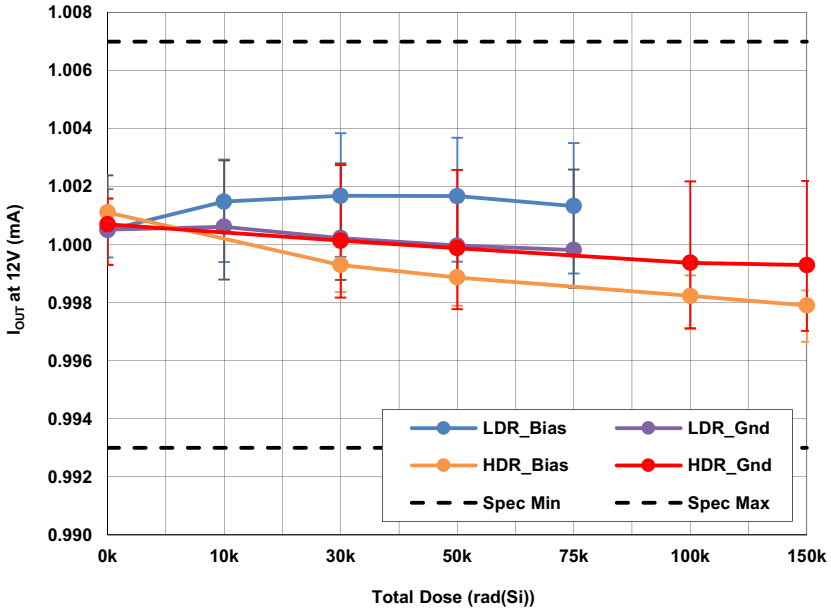


Figure 6. ISL70592SEH output current at 12V (I_{O12V}), as a function of total dose irradiation at LDR and at HDR for biased and grounded configurations. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are 0.993mA minimum and 1.007mA maximum.

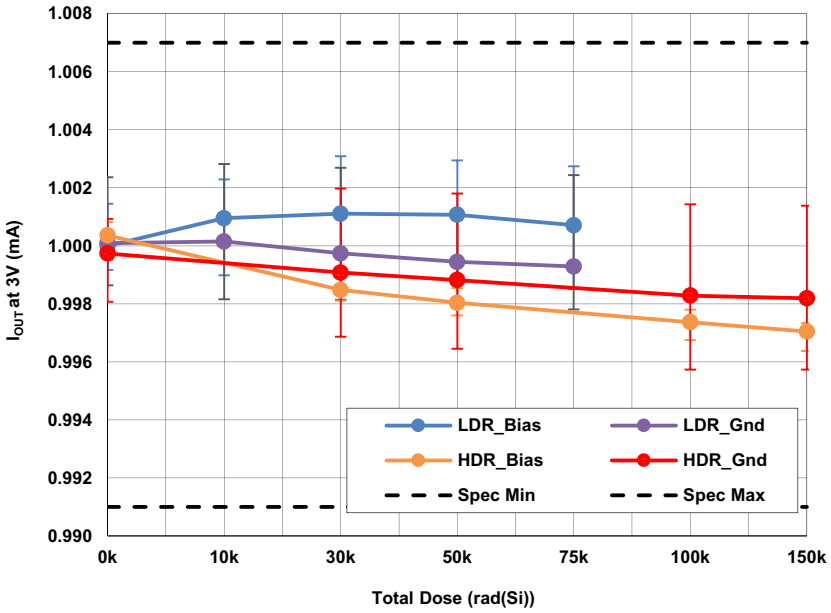


Figure 7. ISL70592SEH output current at 3V (I_{O3V}), as a function of total dose irradiation at LDR and at HDR for biased and grounded configurations. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are 0.991mA minimum and 1.007mA maximum.

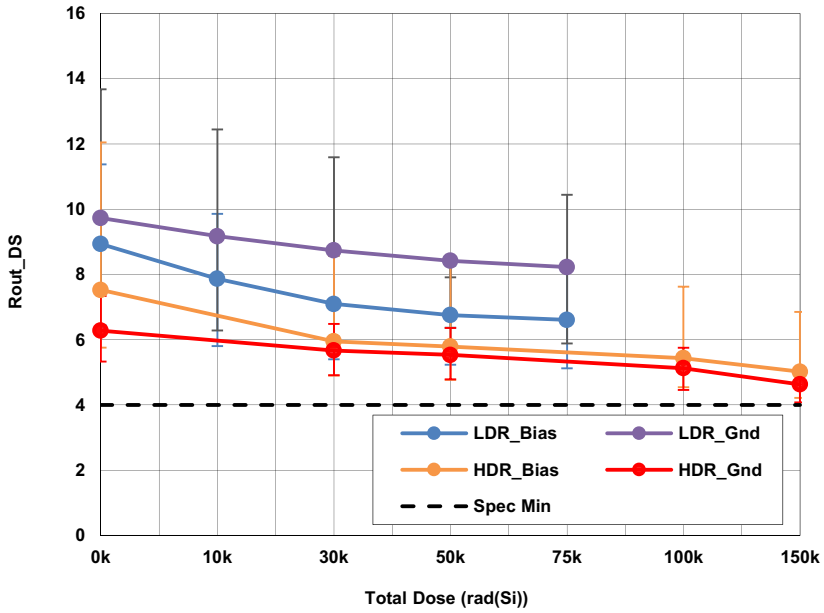


Figure 8. ISL70592SEH output impedance (R_{OUT}), as a function of total dose irradiation at LDR and at HDR for biased and grounded configurations. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 4MΩ minimum.

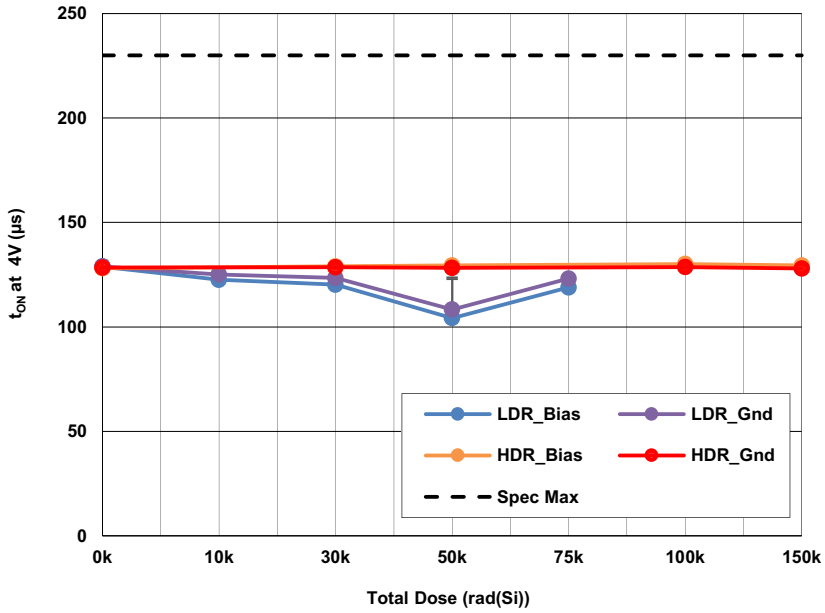


Figure 9. ISL70592SEH turn-on time at 4V (t_{ON}), as a function of total dose irradiation at LDR and at HDR for biased and grounded configurations. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 230µs maximum.

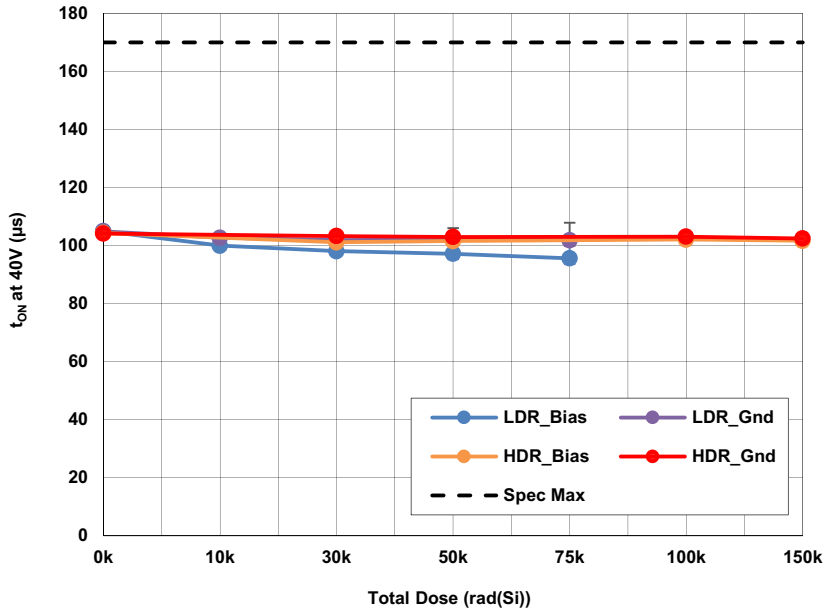


Figure 10. ISL70592SEH turn-on time at 40V (t_{ON}), as a function of total dose irradiation at LDR and at HDR for biased and grounded configurations. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 170µs maximum.

3. Discussion and Conclusion

The results of the LDR and HDR total dose tests of the ISL70592SEH precision current source are reported. All tested SMD parameters passed at all downpoints. No dose rate or bias sensitivity was observed. "Attributes Data" on page 3 summarizes the attributes data for the test. "Key Parameter Listing" on page 4 reviews the SMD parameters for the part. Finally, "Key Parameter Variables Data" on page 4 provides plots of the total dose response for the selected parameters.

4. Revision History

Rev.	Date	Description
0.00	Aug 20, 2018	Initial Release

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