ISL71090SEH25

Neutron Test Report

TR037
Rev.0.00
Aug 31, 2017

Introduction

This report summarizes results of 1MeV equivalent neutron testing of the ISL71090SEH25 precision voltage reference. The test was conducted in order to characterize the sensitivity of the part to Displacement Damage (DD) caused by neutron or proton environments. Neutron irradiation fluences ranged from $2x10^{12}n/cm^2$ to $1x10^{14}n/cm^2$. This project was carried out in collaboration with Boeing Satellite Systems (El Segundo, CA), whose support is gratefully acknowledged.

Related Literature

- For a full list of related documents please visit our website
  - ISL71090SEH25, ISL71090SEH Family product pages

Part Description

The ISL71090SEH25 is a low noise 2.5V precision voltage reference with a wide supply voltage range from 4.0V to 30V, with four output voltage options selected through on-chip trimming. The ISL71090SEH25 is built on the Intersil PR40 bonded-wafer process, which uses dielectric isolation for important electrical and SEE performance improvements. The part achieves sub 2µV peak-to-peak 0.1Hz noise and a 10ppm/°C temperature coefficient with an initial voltage accuracy of 0.05%. The base ISL71090SEH offers four output voltage options including 1.25V, 2.5V, 5.0V, and 7.5V. It also features a 10ppm/°C temperature coefficient and excellent line and load regulation. The device is offered in an 8 Ld hermetic flatpack, with the pin assignment shown in Table 1 for reference. Applications include instrumentation, data acquisition systems, and strain and pressure sensing for space applications. Detailed features and specifications for all four variants may be found in the applicable Intersil datasheets.

TABLE 1. ISL71090SEH25 PIN ASSIGNMENTS

TERMINAL #	TERMINAL SYMBOL
1	DNC, Note 1
2	VIN
3	COMP
4	GND
5	TRIM
6	VOUT
7	DNC, Note 1
8	DNC, Note 1

NOTE:

1. DNC indicates a device pin that is not available for any external connections.

The ISL71090SEH25 is specified for a total dose (TID) tolerance of 100krad(Si) at high (50-300rad(Si)/s) dose rate and at 50krad(Si) at low (<0.01rad(Si)/s) dose rate, as specified in MIL-STD-883 test method 1019. The part is acceptance tested on a wafer-by-wafer basis at low dose rate to 50krad(Si) and at high dose rate to 100krad(Si). The ISL71090SEH25 is also SEE tolerant to a Linear Energy Transfer (LET) value of $86.4MeV \cdot cm^2/mg$ and features latchup-free performance.

Test Description

Irradiation Facilities

Neutron irradiation was performed at the White Sands Missile Range fast burst reactor. Parts were tested in an unbiased configuration with all leads shorted together in accordance with TM 1017 of MIL-STD-883. As neutron irradiation activates many of the heavier elements found in a packaged integrated circuit, the parts exposed at the higher neutron levels required ‘cooldown’ time before being shipped back to Intersil (Palm Bay, FL) for electrical testing.

Test Fixturing

No formal irradiation test fixturing was involved, as these DD tests (informally referred to as ‘bag tests’) irradiate the parts in an electrically inactive state with all leads shorted together.

Characterization Equipment and Procedures

Electrical testing was performed before and after irradiation using Intersil production Automated Test Equipment (ATE). All electrical testing was performed at room temperature.

Experimental Matrix

Testing proceeded in accordance with the guidelines of MIL-STD-883 TM 1017. The experimental matrix consisted of five samples irradiated at $2x10^{12}n/cm^2$, five irradiated at $1x10^{13}n/cm^2$, five irradiated at $3x10^{13}n/cm^2$, and five irradiated at $1x10^{14}n/cm^2$. Five control units were used. The ISL71090SEHF25/PROTO samples were drawn from fabrication lot X3C6PAB. Samples were packaged in the standard hermetic 8 Ld ceramic flatpack production package, code K8.A. Samples were screened to the SMD limits over temperature before the start of neutron testing. The neutron data discussed in this report applies to all four of the ISL71090SEH variants.

Results

Neutron testing of the ISL71090SEH25 is complete and the results are reported in the balance of this report. It should be carefully realized when interpreting the data that each neutron irradiation was performed on a different five-unit sample; this is *not* total dose testing, where the damage is cumulative over a number of downpoints.

Attributes Data

TABLE 2. ISL71090SEH25 ATTRIBUTES DATA.

PART #	SERIAL	SAMPLE SIZE	FLUENCE, (n/cm^2)	PASS (Note 2)	FAIL	NOTES
ISL71090SEH25	1-5	5	2x10^{12}	5	0	All passed
ISL71090SEH25	6-10	5	1x10^{13}	0	5	All failed, parametric
ISL71090SEH25	11-15	5	3x10^{13}	0	5	All failed, parametric
ISL71090SEH25	16-20	5	1x10^{14}	0	5	All failed, nonfunctional

NOTE:
2. 'Pass' is defined as a sample that passes all SMD limits.

Variables Data

The plots in Figures 1 through 5 show data plots for key parameters before and after irradiation to each level. The reported parameters and their datasheet limits are shown in "Appendices" on page 5. The plots show the population median of each parameter as a function of neutron irradiation, as well as the population minimum and maximum. We chose to plot the median because of the small sample sizes (five per cell) involved. We also show the applicable electrical limits taken from the SMD; it should be carefully noted that these limits are provided for *guidance only* as the ISL71090SEH25 is not specified or guaranteed for the neutron environment. Intersil does not design, qualify or guarantee its parts for the DD environment, but has performed some limited neutron testing for customer guidance.

Variables Data Plots

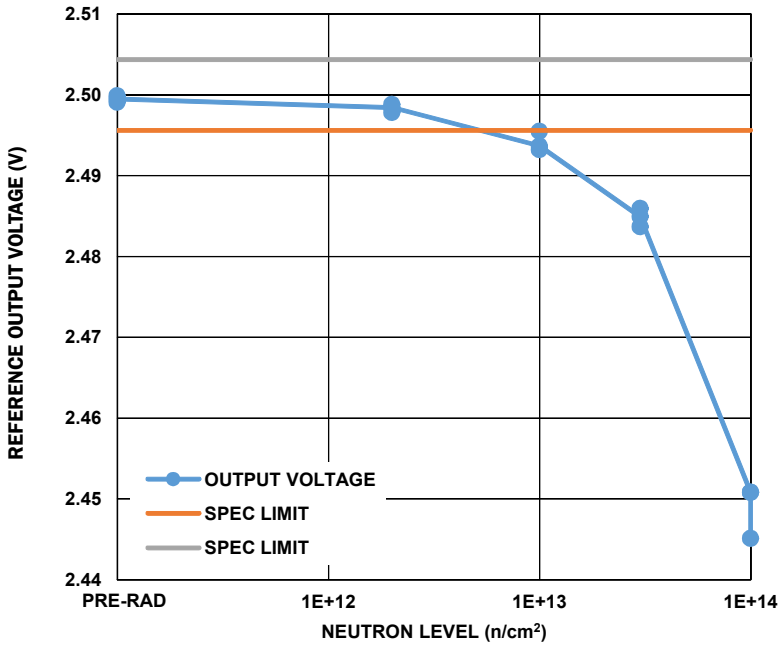

FIGURE 1. ISL71090SEH25 output voltage as a function of 1MeV equivalent neutron irradiation at 2x10^{12}n/cm^2, 1x10^{13}n/cm^2, 3x10^{13}n/cm^2, and 1x10^{14}n/cm^2. The plot shows the median, minimum, and maximum at each level. Sample size for each cell was five. The SMD post-irradiation specification limits are 2.495625V to 2.504375V.

Variables Data Plots (Continued)

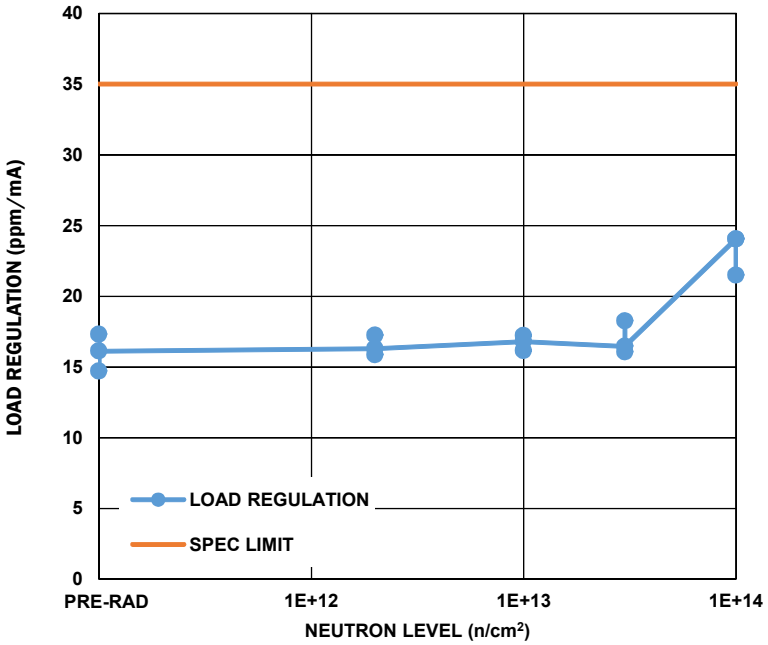

FIGURE 2. ISL71090SEH25 load regulation, sourcing, 0mA to 20mA, as a function of 1MeV equivalent neutron irradiation at $2x10^{12}n/cm^2$, $1x10^{13}n/cm^2$, $3x10^{13}n/cm^2$, and $1x10^{14}n/cm^2$. The plot shows the median, minimum, and maximum at each level. Sample size for each cell was five. The SMD post-irradiation specification limit is 35ppm/mA maximum.

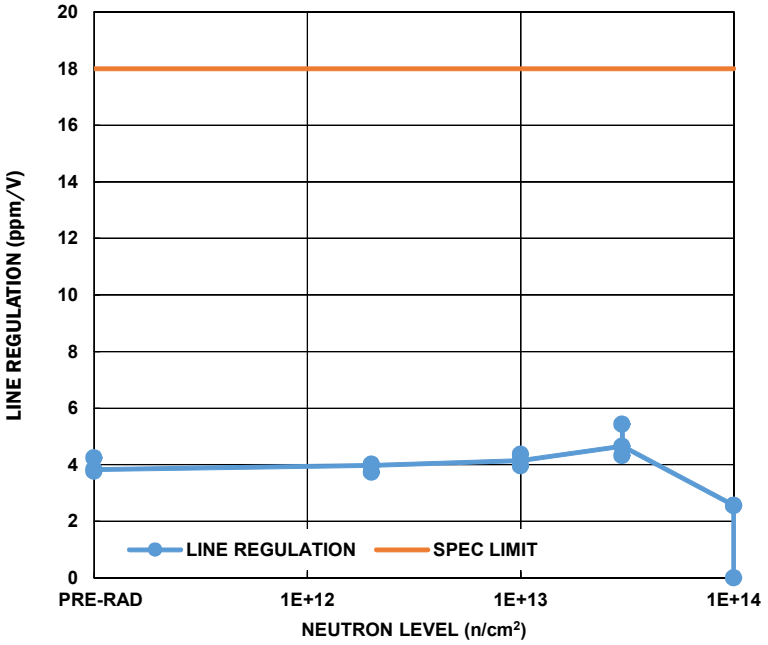

FIGURE 3. ISL71090SEH25 line regulation as a function of 1MeV equivalent neutron irradiation at $2x10^{12}n/cm^2$, $1x10^{13}n/cm^2$, $3x10^{13}n/cm^2$, and $1x10^{14}n/cm^2$. The plot shows the median, minimum, and maximum at each level. Sample size for each cell was five. The SMD post-irradiation specification limit is 18ppm/V maximum.

Variables Data Plots (Continued)

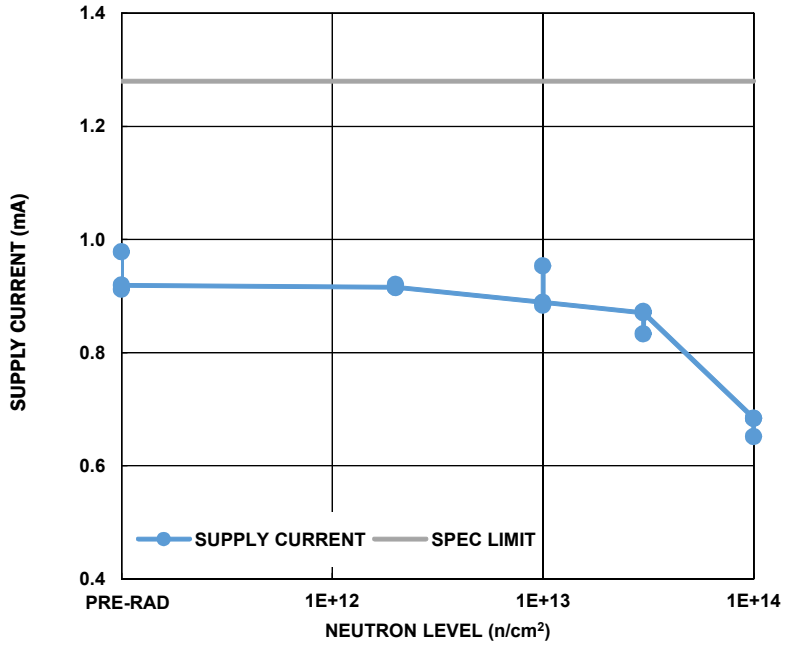

FIGURE 4. ISL71090SEH25 supply current as a function of 1MeV equivalent neutron irradiation at $2x10^{12}n/cm^2$, $1x10^{13}n/cm^2$, $3x10^{13}n/cm^2$, and $1x10^{14}n/cm^2$. The plot shows the median, minimum, and maximum at each level. Sample size for each cell was five. The SMD post-irradiation specification limit is 1.28mA maximum.

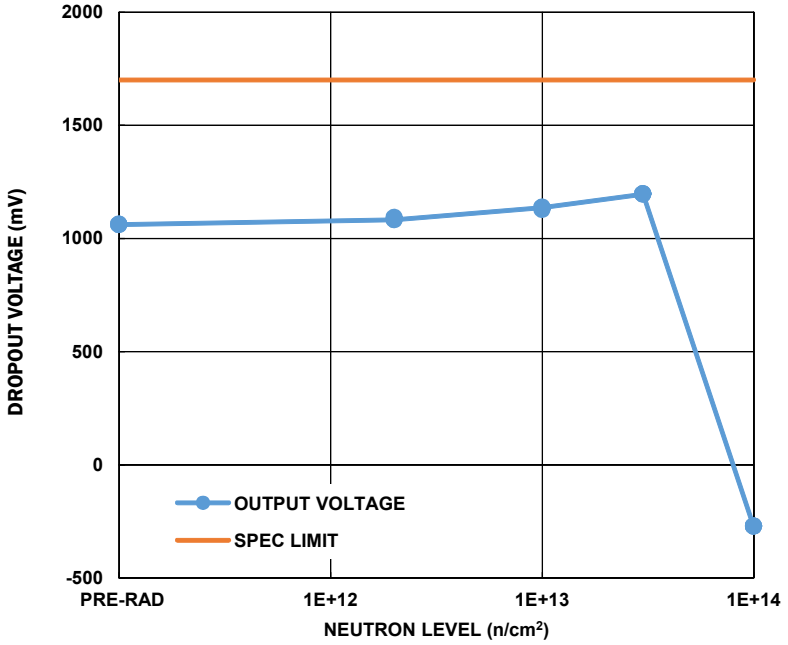

FIGURE 5. ISL71090SEH25 dropout voltage as a function of 1MeV equivalent neutron irradiation at $2x10^{12}n/cm^2$, $1x10^{13}n/cm^2$, $3x10^{13}n/cm^2$, and $1x10^{14}n/cm^2$. The plot shows the median, minimum, and maximum at each level. Sample size for each cell was five. The SMD post-irradiation specification limit is 1700mV maximum.

Conclusion

This report summarizes results of 1MeV equivalent neutron testing of the ISL71090SEH25 2.5V voltage reference. The test was conducted in order to determine the sensitivity of the part to Displacement Damage (DD) caused by neutron or proton environments in space. Neutron fluences ranged from $2x10^{12}n/cm^2$ to $1x10^{14}n/cm^2$. This project was carried out in collaboration with Boeing Satellite Systems (El Segundo, CA), and their support is gratefully acknowledged.

The samples met all specifications (Bin 1) after $2x10^{12}n/cm^2$, but failed parametrically at the $1x10^{13}n/cm^2$ and $3x10^{13}n/cm^2$ levels. The samples were nonfunctional after $1x10^{14}n/cm^2$.

Appendices

Reported Parameters

These limits are post-total dose parametric limits from the SMD and are provided for guidance only as the part is not designed or guaranteed for the neutron environment.

TABLE 3. REPORTED PARAMETERS

FIG.	PARAMETER	LIMIT LOW	LIMIT HIGH	UNIT
1	Output voltage	2.495625	2.504375	V
2	Load regulation, sourcing	-	35.0	ppm/mA
3	Line regulation	-	18.0	ppm/V
4	Power supply current	-	1.28	mA
5	Dropout voltage	-	1700	mV

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(Rev.4.0-1 November 2017)

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