

ISL70617SEH

Total Dose Testing

TR041

Rev 0.00

January 3, 2017

## Introduction

This report provides results of a Total Ionizing Dose (TID) test of the [ISL70617SEH](#) instrumentation amplifier. The test was conducted in order to determine the sensitivity of the parts to the total dose environment. Irradiations were performed to 75krad(Si) at 0.01rad(Si)/s under biased and grounded conditions and were followed by a biased anneal at +100°C for 168 hours. The dates of the testing, including biased anneal, were April 4, 2016 to July 22, 2016. No rejects to the SMD parametric limits were encountered.

## Related Literature

- For a full list of related documents, visit our website
  - [ISL70617SEH](#) product page
  - MIL-STD-883 test method 1019

## Part Description

The ISL70617SEH is a differential input, differential output instrumentation amplifier designed for precision Analog-to-Digital Converter (ADC) applications. The part operates across a supply range of 8V ( $\pm 4V$ ) to 36V ( $\pm 18V$ ) and features a differential input voltage range of  $\pm 30V$ . The output stage has rail-to-rail output drive capability optimized for ADC driver applications. The gain of the ISL70617SEH can be programmed from 0.1 to 10,000 via two external resistors,  $R_{IN}$  and  $R_{FB}$ . The gain accuracy is determined by the matching of  $R_{IN}$  and  $R_{FB}$ . The gain resistors use Kelvin sensing, which removes gain error terms due to PC trace resistance. The input and output stages have individual power supply pins, which enable input signals riding on a high common-mode voltage to be level shifted to a low voltage device, such as an A/D converter. The rail-to-rail output stage can be powered from the same supplies as the ADC, which preserves the ADC maximum input dynamic range and eliminates ADC input overdrive.

The companion [ISL70517SEH](#) is a differential input, single-ended output version of the ISL70617SEH. Total ionizing dose test results for the ISL70517SEH are discussed elsewhere.

These versatile amplifiers are suitable for a variety of general purpose applications in addition to ADC applications. Additional features not found in other instrumentation amplifiers enable high levels of DC precision and excellent AC performance. The ISL70517SEH and ISL70617SEH are offered in the 24 Ld ceramic flatpack package and their specifications are ensured across the -55°C to +125°C temperature range. The reader is referred to the relevant Intersil datasheets and other on-line information for further detail.

## Test Description

### Irradiation Facilities

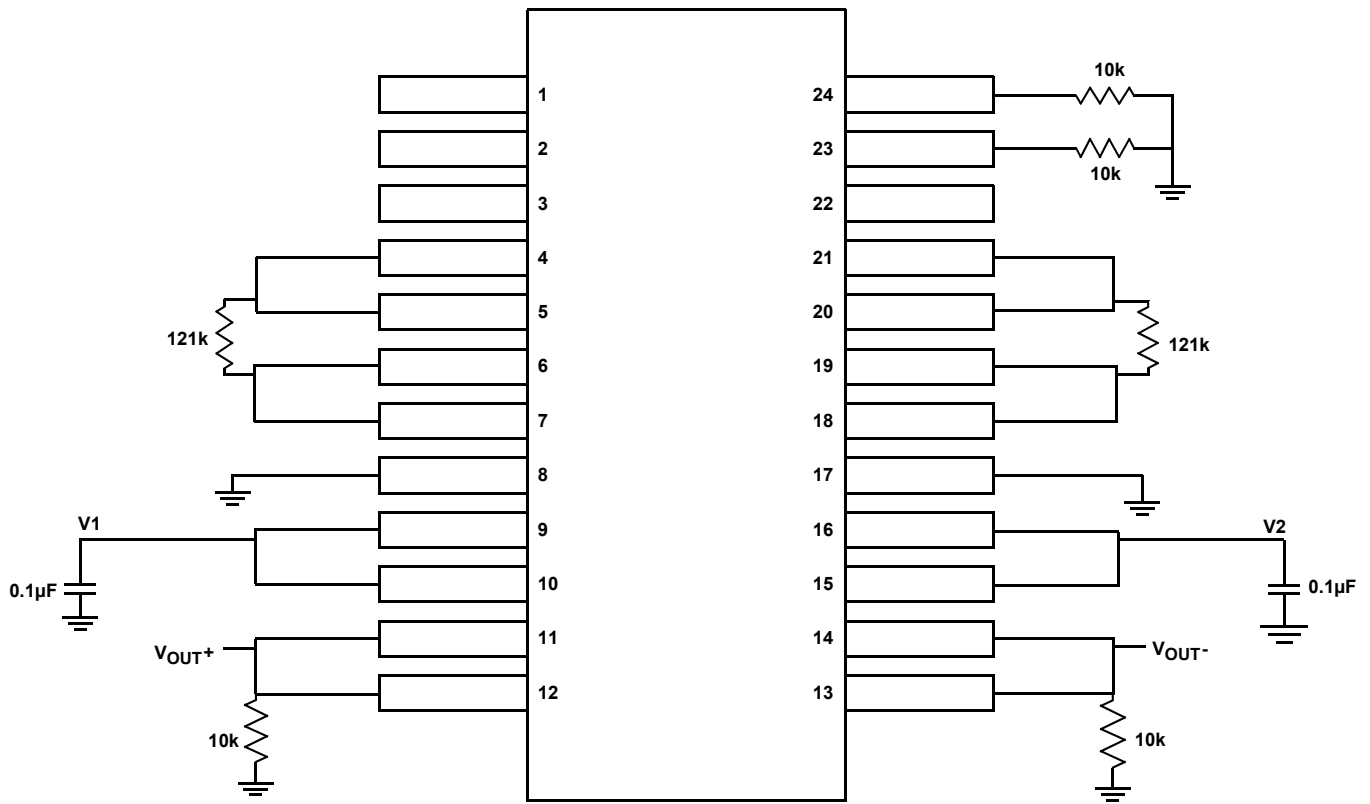
Irradiations were performed using a Hopewell Designs N40 panoramic vault-type low dose rate  $^{60}\text{Co}$  irradiator located in the Palm Bay, Florida Intersil facility. The dose rate was 0.0089rad(Si)/s (8.9mrad(Si)/s). The irradiator uses a PbAl spectrum hardening filter to shield the test board and devices under test against low energy secondary gamma radiation.

### Test Fixturing

[Figure 1 on page 3](#) shows the configuration and power supply sequencing used for biased irradiation.

TABLE 1. ISL70517SEH AND ISL70617SEH PINOUTS

PIN NUMBER	ISL70517SEH DESCRIPTION	ISL70617SEH DESCRIPTION
1	No internal connection	No internal connection
2	Internal use, do not connect	Internal use, do not connect
3	Internal use, do not connect	Internal use, do not connect
4	+R <sub>FB</sub>	+R <sub>FB</sub>
5	+R <sub>FB</sub> sense	+R <sub>FB</sub> sense
6	-R <sub>FB</sub> sense	-R <sub>FB</sub> sense
7	-R <sub>FB</sub>	-R <sub>FB</sub>
8	Ground	Ground
9	V <sub>CC</sub>	V <sub>CC</sub>
10	V <sub>CO</sub>	V <sub>CO</sub>
11	+V <sub>FB</sub>	+V <sub>FB</sub>
12	V <sub>OUT</sub>	+V <sub>OUT</sub>
13	No internal connection	-V <sub>OUT</sub>
14	V <sub>REF</sub>	-V <sub>FB</sub>
15	V <sub>EO</sub>	V <sub>EO</sub>
16	V <sub>EE</sub>	V <sub>EE</sub>
17	No internal connection	V <sub>CMO</sub>
18	-R <sub>IN</sub>	-R <sub>IN</sub>
19	-R <sub>IN</sub> sense	-R <sub>IN</sub> sense
20	+R <sub>IN</sub> sense	+R <sub>IN</sub> sense
21	+R <sub>IN</sub>	+R <sub>IN</sub>
22	Internal use, do not connect	Internal use, do not connect
23	IN-	IN-
24	IN+	IN+
Package Lid	Tied internally to terminal 8 (ground)	Tied internally to terminal 8 (ground)



V1 = +15V

V2 = -15V

All resistors are 1% 1/4W (surface mount resistors)

All capacitors are 10% 50V (surface mount ceramic chip capacitors)

FIGURE 1. ISL70517SEH, ISL70617SEH LDR SCHEMATIC

## Characterization Equipment and Procedures

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

## Experimental Matrix

Testing proceeded in accordance with the guidelines of MIL-STD-883 Test Method 1019. The experimental matrix consisted of ten samples irradiated under bias and ten samples irradiated with all pins grounded. Six control units were used.

Samples of the ISL70617SEH were drawn from fabrication lot X4J4A and were packaged in the production hermetic 24 Ld ceramic flatpack, package outline drawing (POD) K24.A. The samples were processed through the standard burn-in cycle and were screened to the SMD 5962-15246 limits at room, LOW, and HIGH temperatures before irradiation.

## Downpoints

Downpoints were 0krad(Si), 10krad(Si), 30krad(Si), 50krad(Si), and 75krad(Si). The samples were subjected to a high temperature biased anneal for 168 hours at +100°C following irradiation.

## Results

### Attributes Data

Testing at low dose rate of the ISL70617SEH is complete and showed no reject devices after irradiation or anneal. [Table 2](#) summarizes the results.

TABLE 2. ISL70617SEH LOW DOSE RATE TOTAL DOSE TEST ATTRIBUTES DATA

PART	RATE	BIAS	SAMPLE SIZE	DOWNPOINT	BIN 1 ( <a href="#">Note 1</a> )	REJECTS
ISL70617SEH	0.0089rad(Si)/s	<a href="#">Figure 1</a>	10	Pre-irradiation	10	
				10krad(Si)	10	0
				30krad(Si)	10	0
				50krad(Si)	10	0
				75krad(Si)	10	0
				Anneal, 168 hours at +100°C	10	0
ISL70617SEH	0.0089rad(Si)/s	Grounded	10	Pre-irradiation	10	
				10krad(Si)	10	0
				30krad(Si)	10	0
				50krad(Si)	10	0
				75krad(Si)	10	0
				Anneal, 168 hours at +100°C	10	0

NOTE:

- Bin 1 indicates a device that passes all pre-irradiation specification limits.

## Variables Data

The plots in [Figures 2](#) through [47](#) show data at all downpoints. The plots show the average tested values of key parameters as a function of total dose for each of the two irradiation conditions, Biased (B) and Unbiased (U). PA on the graphs stands for Post-Anneal. The plots also show error bars at each downpoint,

representing the minimum and maximum measured values of the samples. The figure sequence and the symbols of the reported parameters are consistent with those used in the SMD. All parameters showed excellent stability over irradiation, with no observed dose rate or bias sensitivity.

## Variables Data Plots

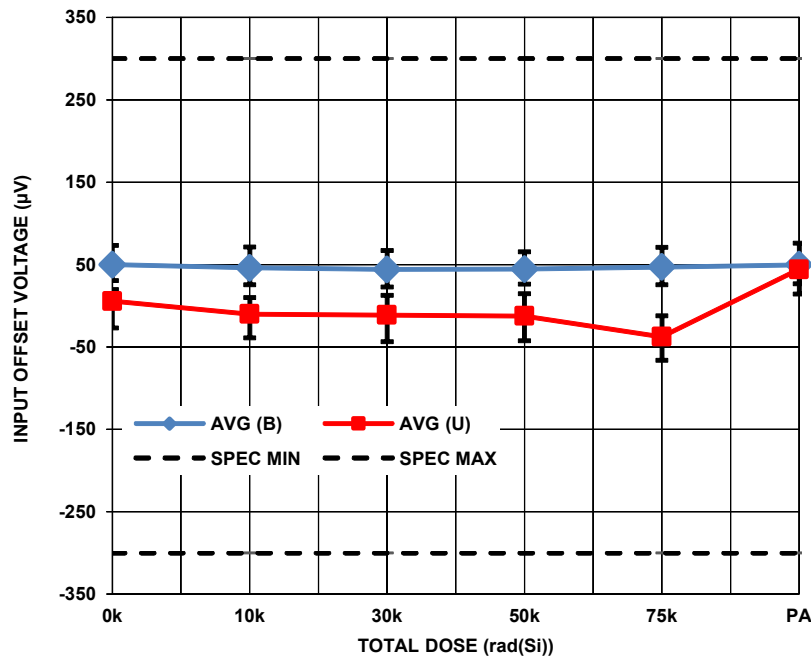


FIGURE 2. ISL70617SEH input amplifier input offset voltage for  $\pm 18V$  supplies as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-300\mu V$  to  $300\mu V$ .

Variables Data Plots (Continued)

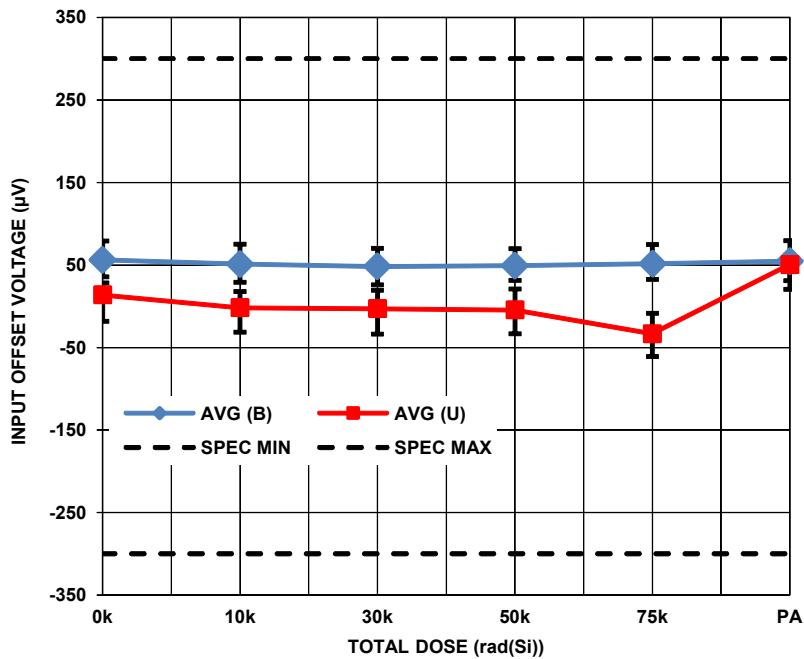


FIGURE 3. ISL70617SEH input amplifier input offset voltage for  $\pm 4V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and unbiased (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-300\mu V$  to  $300\mu V$ .

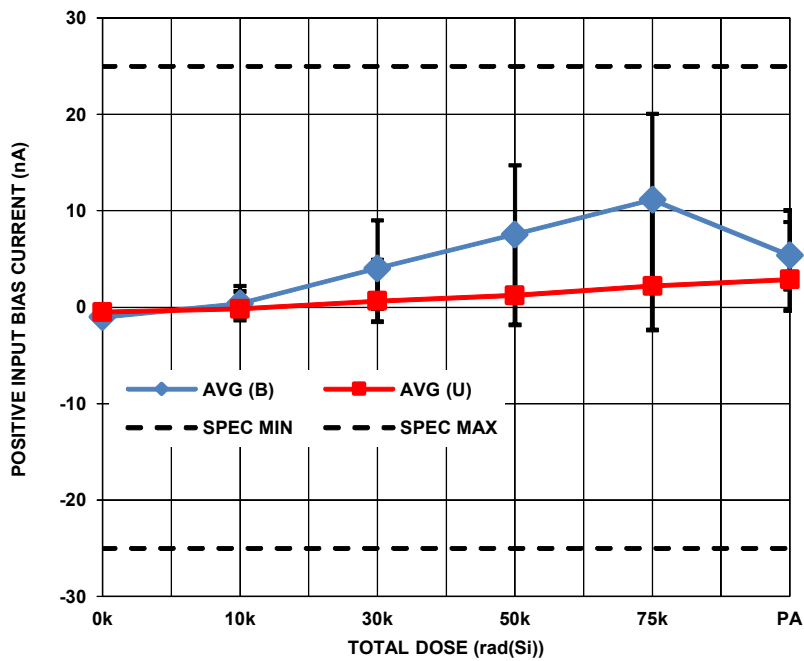


FIGURE 4. ISL70617SEH input amplifier positive input bias current for  $\pm 18V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-25nA$  to  $25nA$ .

Variables Data Plots (Continued)

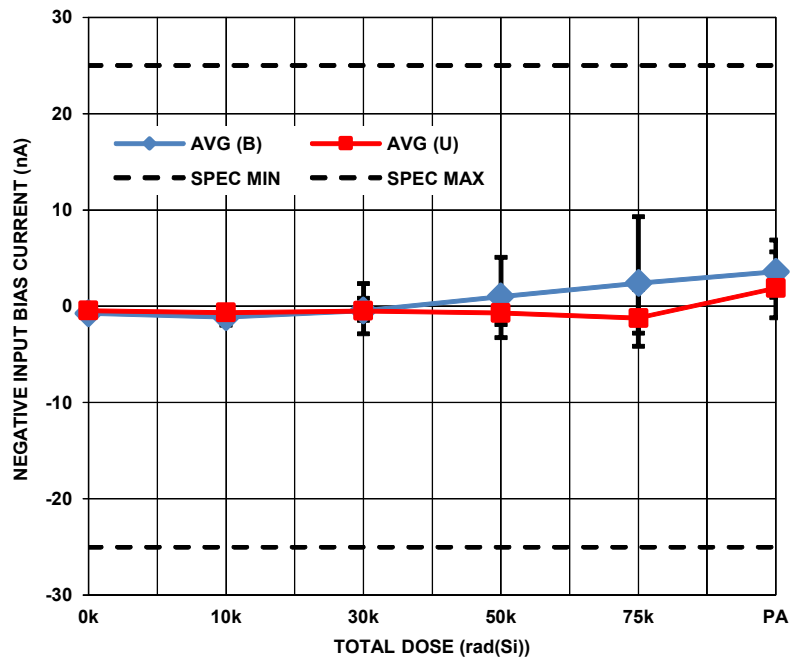


FIGURE 5. ISL70617SEH input amplifier negative input bias current for  $\pm 18V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-25nA$  to  $25nA$ .

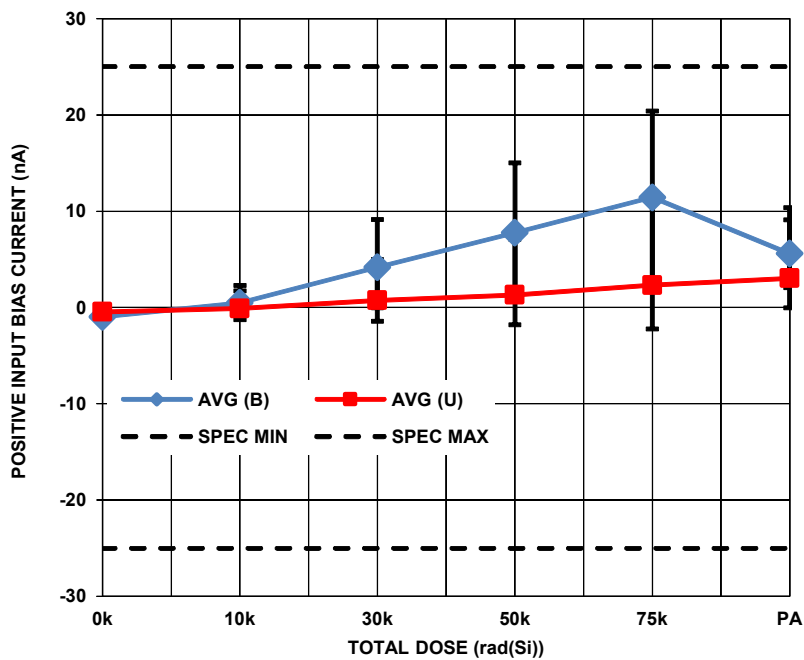


FIGURE 6. ISL70617SEH input amplifier positive input bias current for  $\pm 5V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-25nA$  to  $25nA$ .

Variables Data Plots (Continued)

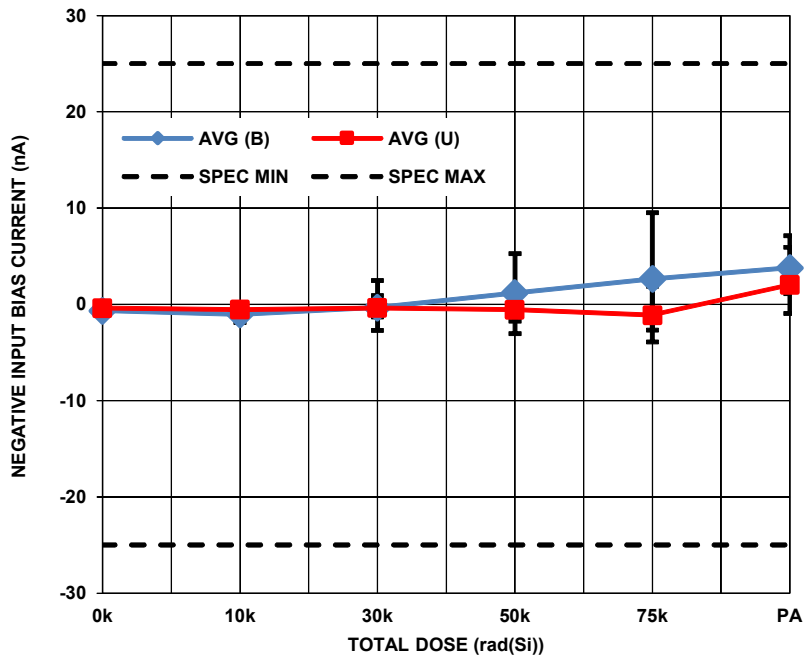


FIGURE 7. ISL70617SEH input amplifier negative input bias current for  $\pm 5V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -25nA to 25nA.

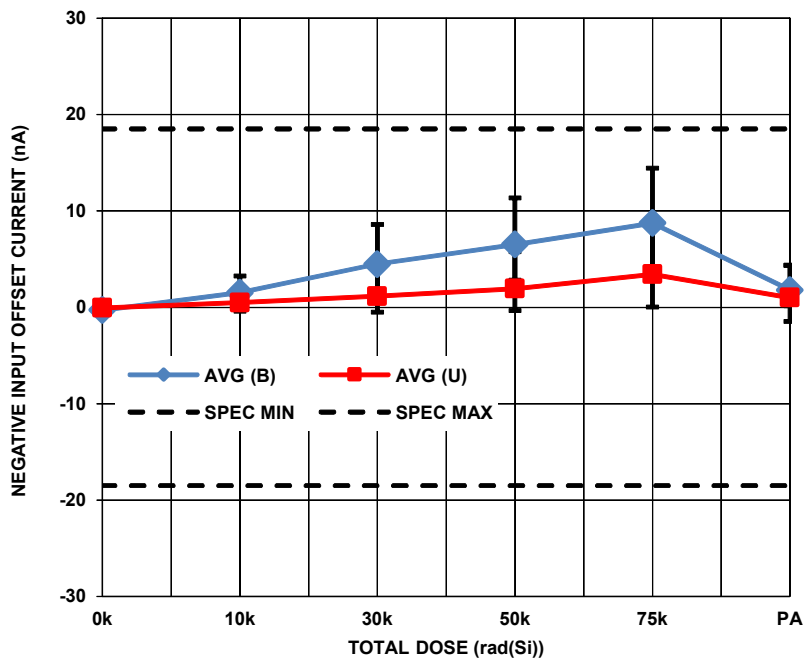


FIGURE 8. ISL70617SEH input amplifier input offset current for  $\pm 18V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -18.5nA to 18.5nA.



Variables Data Plots (Continued)

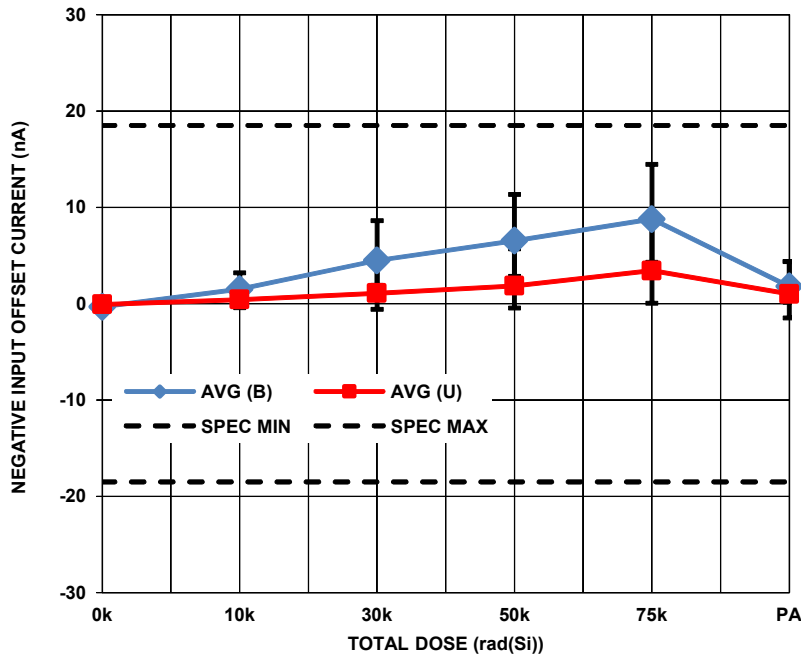


FIGURE 9. ISL70617SEH input amplifier input offset current for  $\pm 5V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-18.5nA$  to  $18.5nA$ .

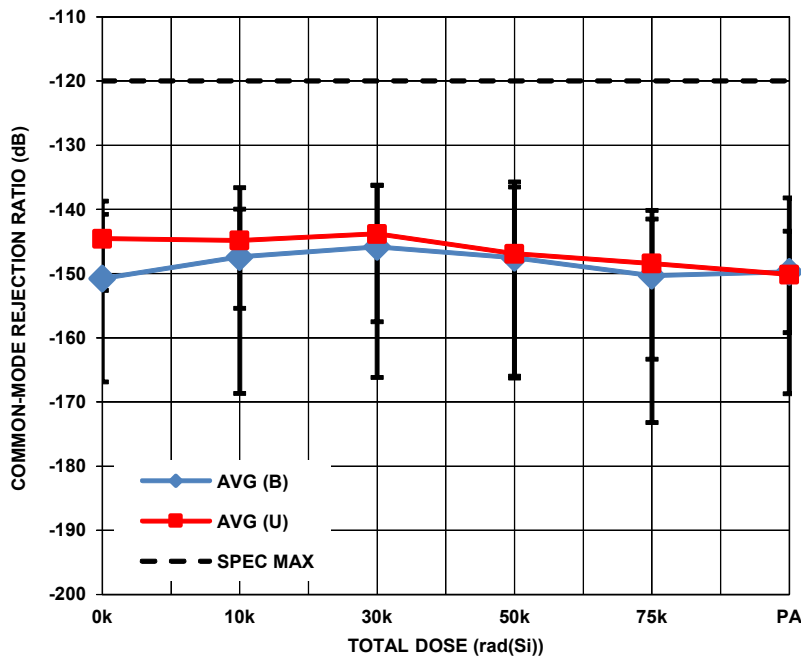


FIGURE 10. ISL70617SEH common-mode rejection ratio,  $\pm 15V$  supplies, gain of 100, as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is  $-120dB$  maximum.

Variables Data Plots (Continued)

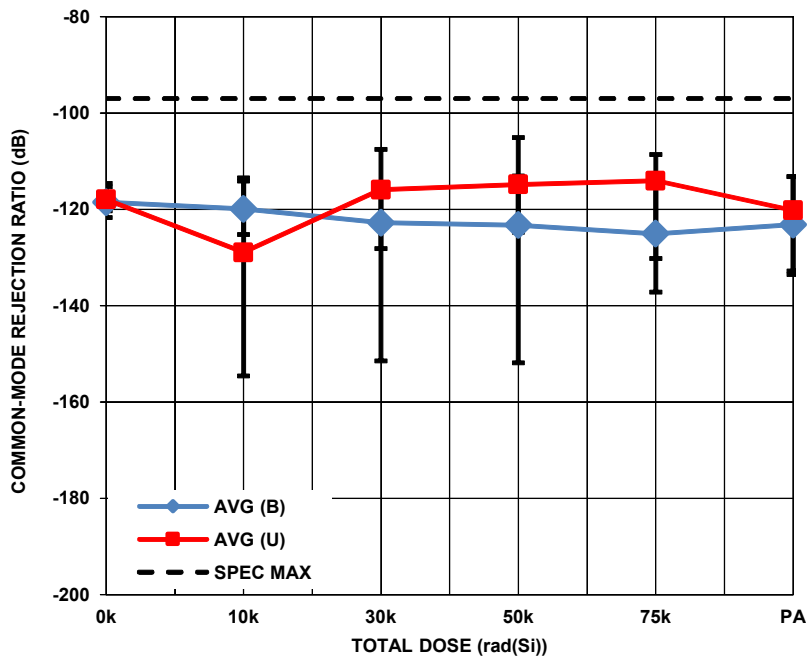


FIGURE 11. ISL70617SEH common-mode rejection ratio,  $\pm 15V$  supplies, gain of 1, as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -97dB maximum.

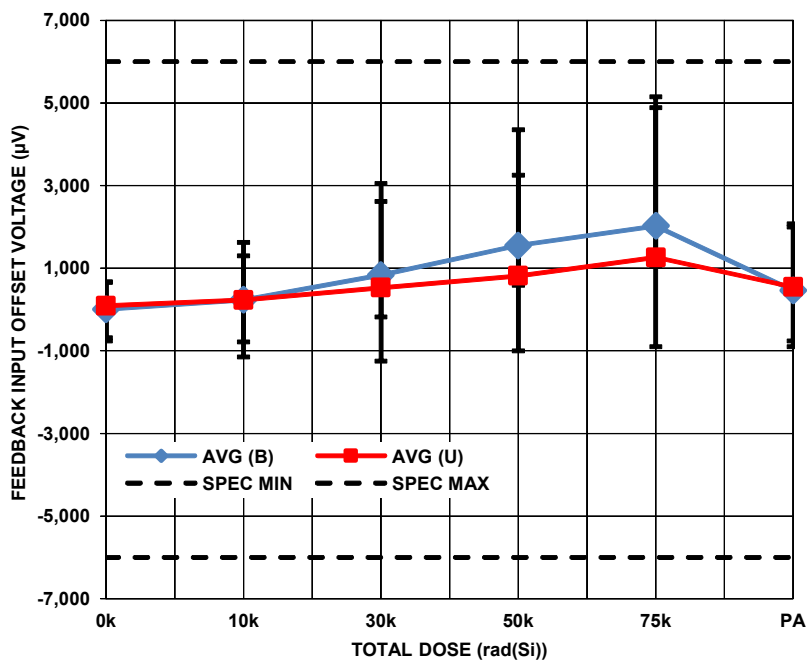


FIGURE 12. ISL70617SEH feedback input offset voltage,  $\pm 18V$  supplies, as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -6000 $\mu V$  to 6000 $\mu V$ .

Variables Data Plots (Continued)

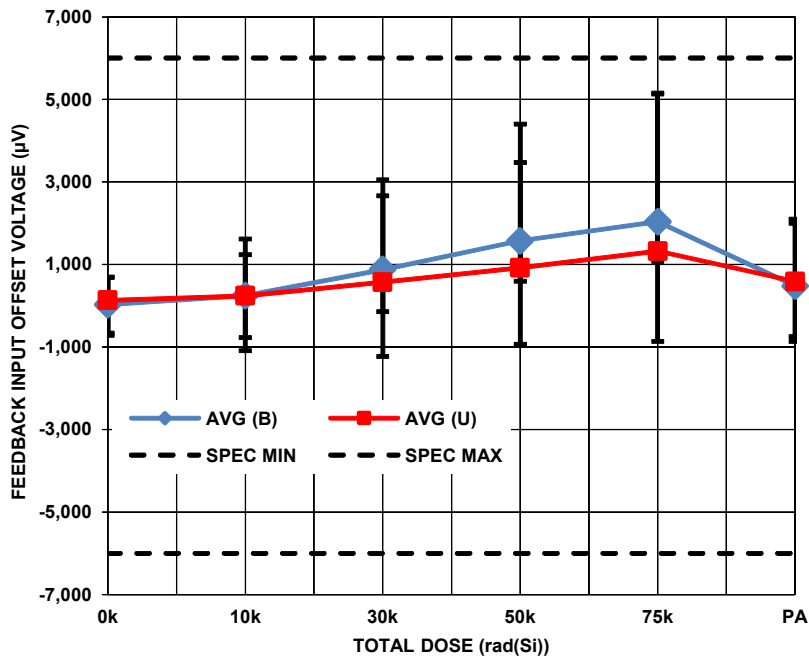


FIGURE 13. ISL70617SEH feedback input offset voltage,  $\pm 4V$  supplies, as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-6000\mu V$  to  $6000\mu V$ .

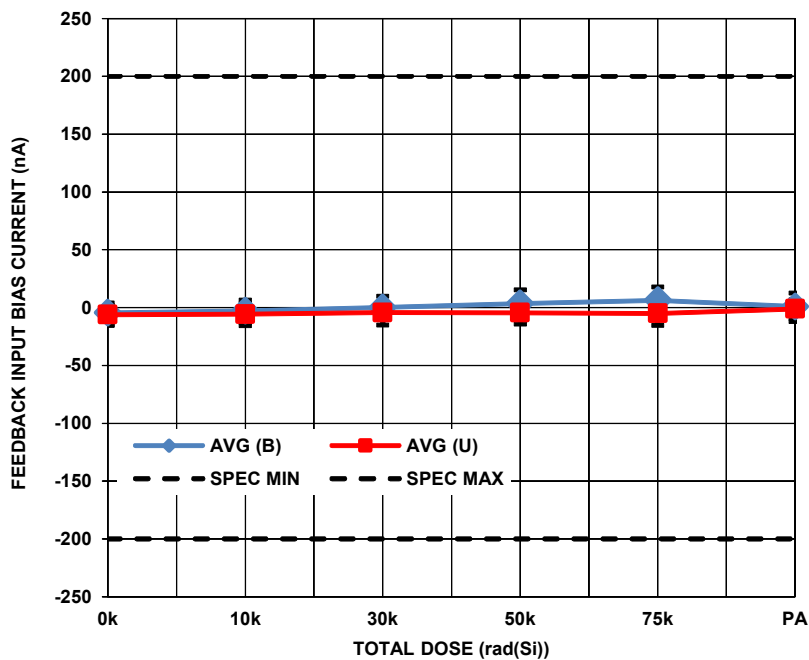


FIGURE 14. ISL70617SEH feedback input bias current,  $\pm 18V$  supplies, as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-200nA$  to  $200nA$ .

## Variables Data Plots (Continued)

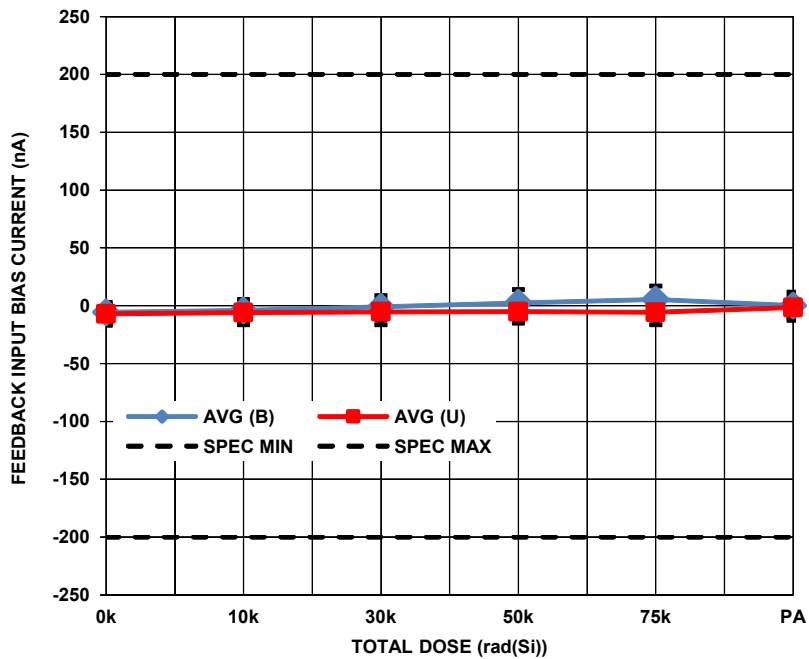


FIGURE 15. ISL70617SEH feedback input bias current,  $\pm 4V$  supplies, as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are  $-200nA$  to  $200nA$ .

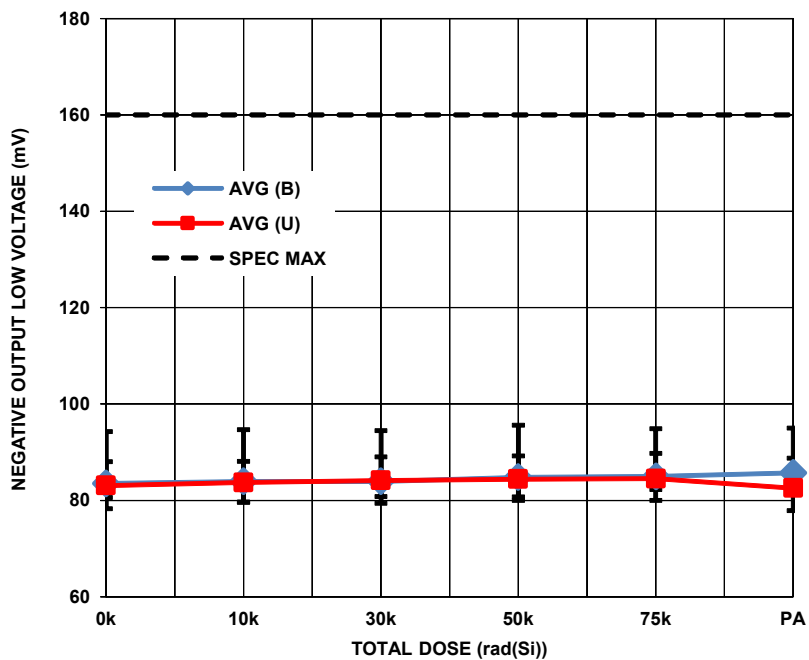


FIGURE 16. ISL70617SEH negative output LOW output voltage with  $I_{OUT} = 0mA$  at  $\pm 18V$  supplies as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 160mV maximum. The positive output LOW voltage (not shown) showed similar stability.

Variables Data Plots (Continued)

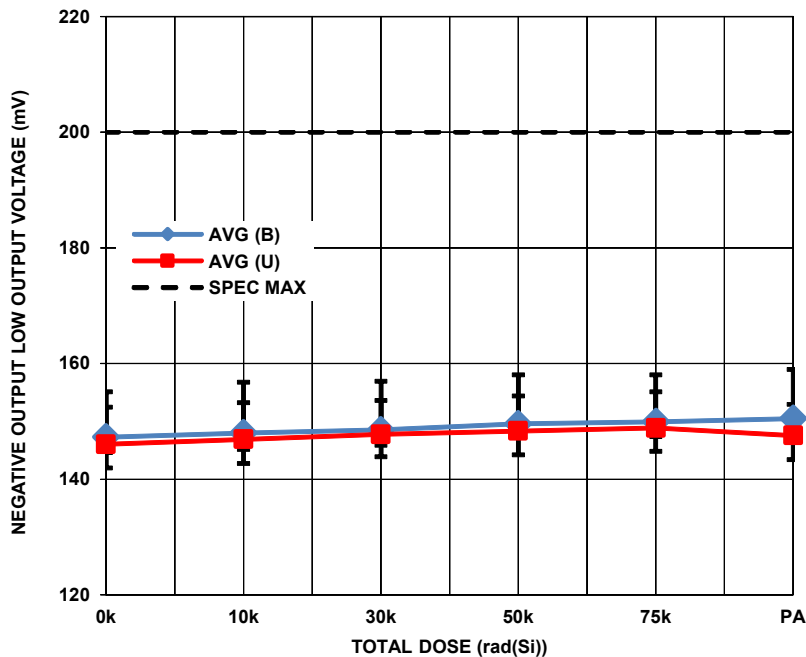


FIGURE 17. ISL70617SEH negative output LOW output voltage with  $I_{OUT} = 1.5\text{mA}$  at  $\pm 18\text{V}$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 200mV maximum. The positive output LOW voltage (not shown) showed similar stability.

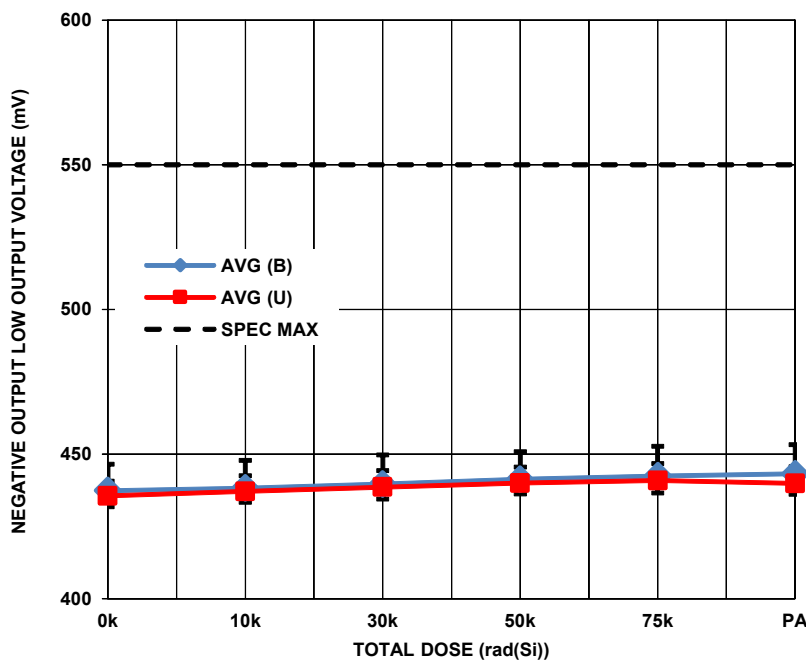


FIGURE 18. ISL70617SEH negative output LOW output voltage with  $I_{OUT} = 7.5\text{mA}$  at  $\pm 18\text{V}$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 550mV maximum. The positive output LOW voltage (not shown) showed similar stability.

Variables Data Plots (Continued)

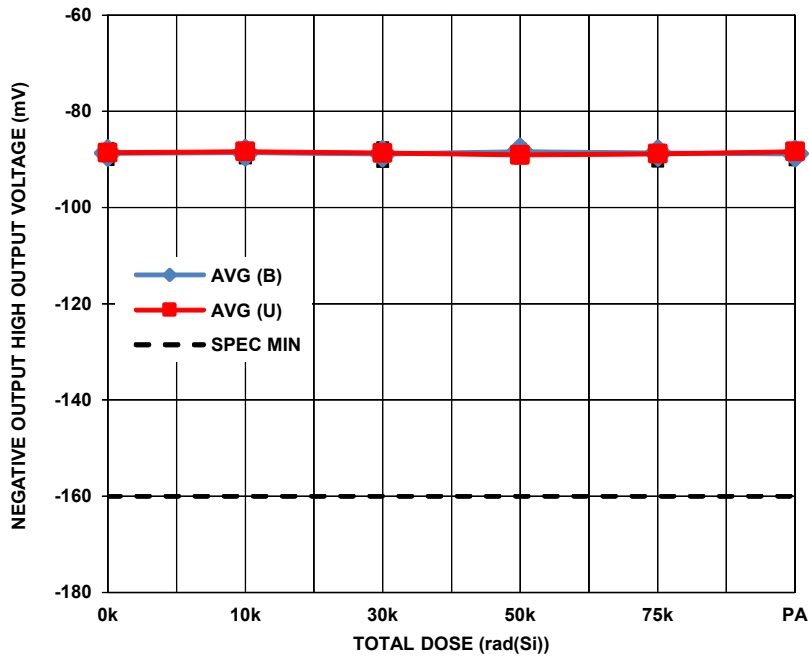


FIGURE 19. ISL70617SEH negative output HIGH output voltage with  $I_{OUT} = 0mA$  at  $\pm 18V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -160mV maximum. The positive output HIGH voltage (not shown) showed similar stability.

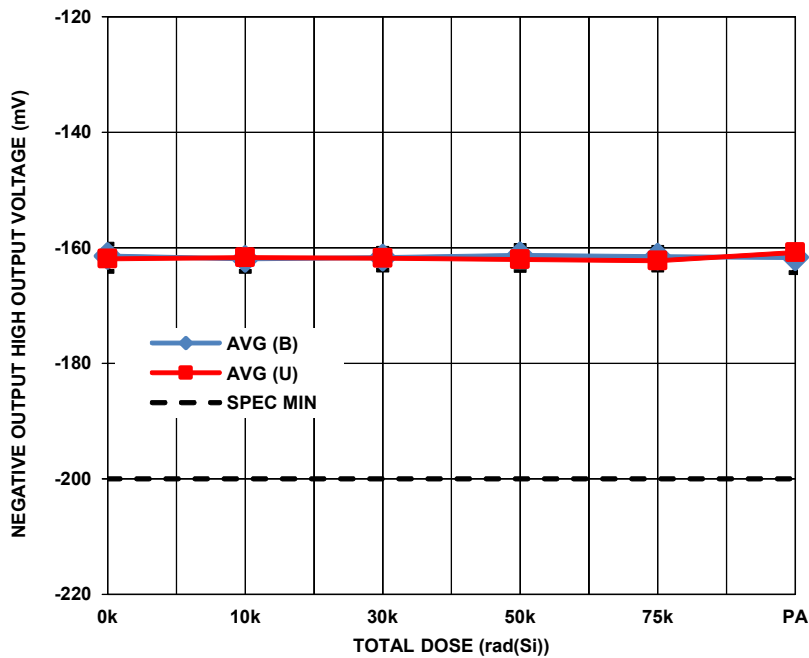


FIGURE 20. ISL70617SEH negative output HIGH output voltage with  $I_{OUT} = 1.5mA$  at  $\pm 18V$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -200mV maximum. The positive output HIGH voltage (not shown) showed similar stability.

Variables Data Plots (Continued)

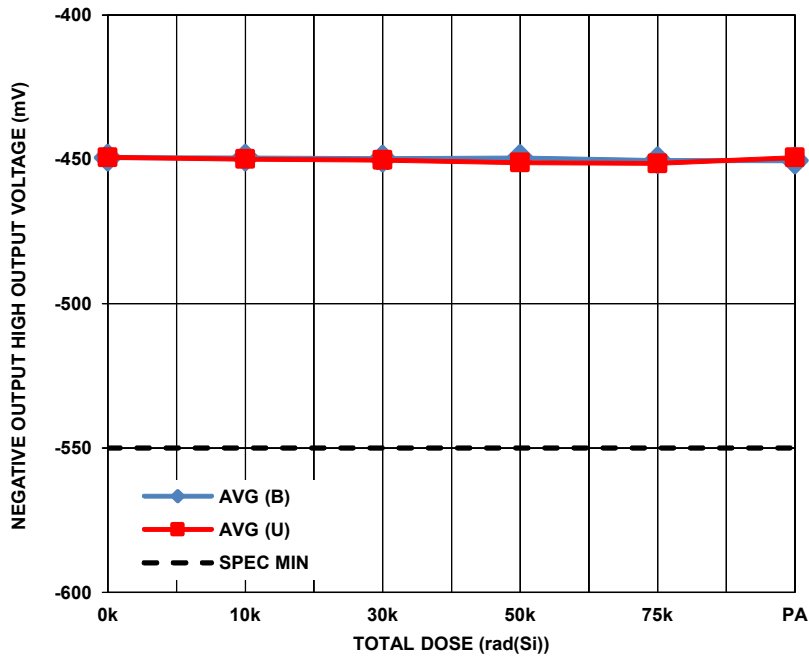


FIGURE 21. ISL70617SEH negative output HIGH output voltage with  $I_{OUT} = 7.5\text{mA}$  at  $\pm 18\text{V}$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -550mV maximum. The positive output HIGH voltage (not shown) showed similar stability.

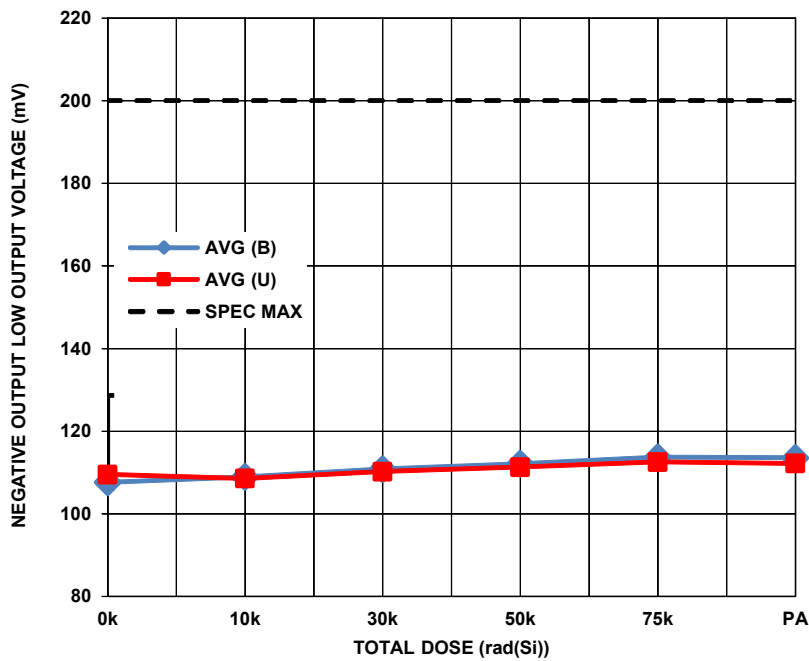


FIGURE 22. ISL70617SEH negative output LOW output voltage with  $I_{OUT} = 1.5\text{mA}$  at  $\pm 4\text{V}$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 200mV maximum.

Variables Data Plots (Continued)

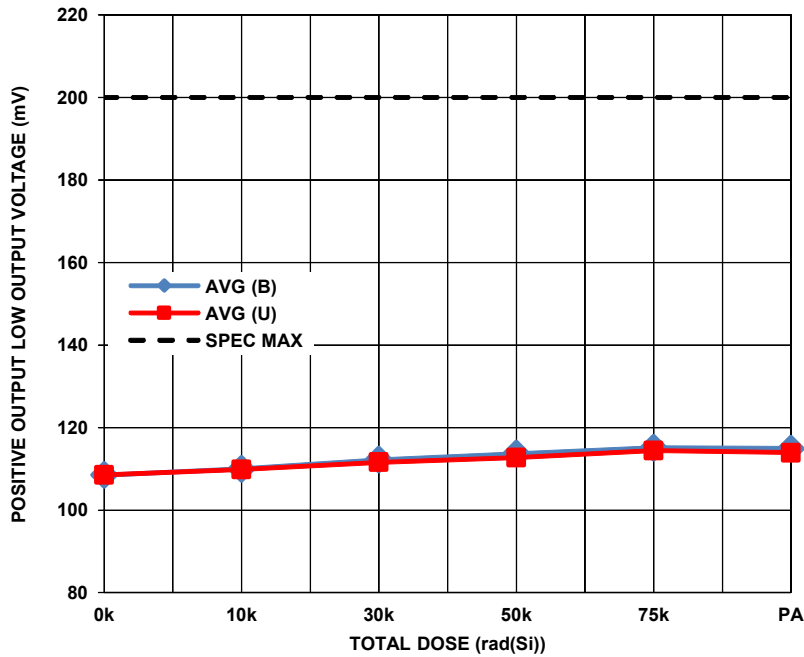


FIGURE 23. ISL70617SEH positive output LOW output voltage with  $I_{OUT} = 1.5\text{mA}$  at  $\pm 4\text{V}$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 200mV maximum.

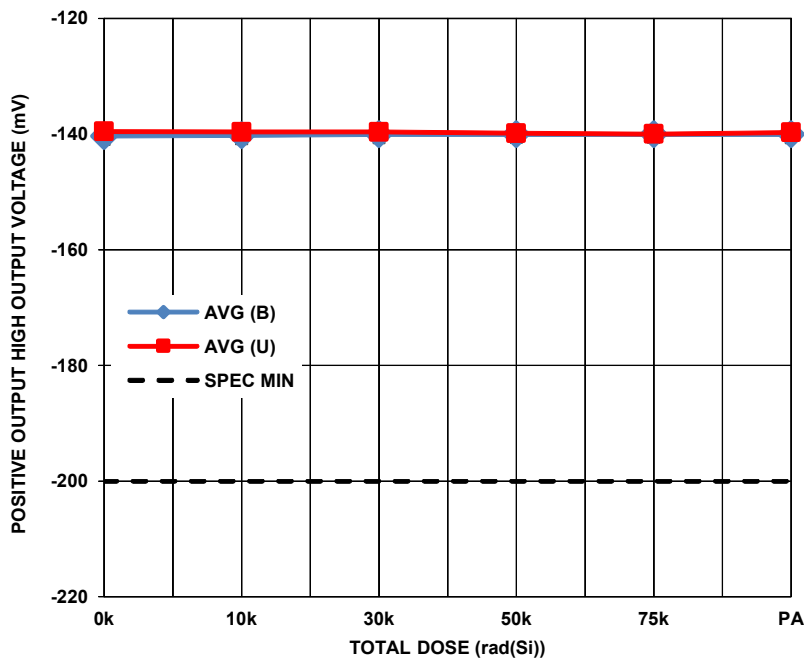


FIGURE 24. ISL70617SEH negative output HIGH output voltage with  $I_{OUT} = 1.5\text{mA}$  at  $\pm 4\text{V}$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -200mV minimum.



Variables Data Plots (Continued)

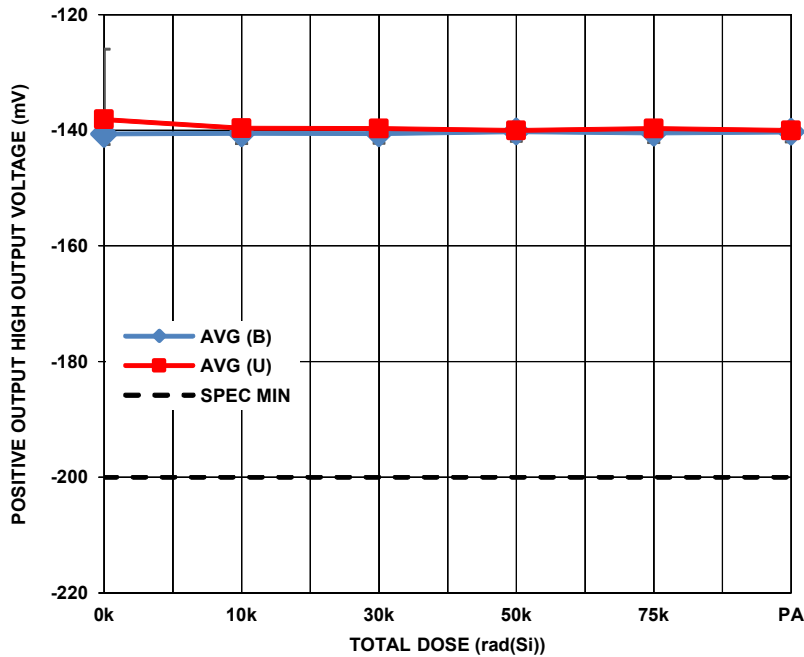


FIGURE 25. ISL70617SEH positive output HIGH output voltage with  $I_{OUT} = 1.5\text{mA}$  at  $\pm 4\text{V}$  supplies as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -200mV minimum.

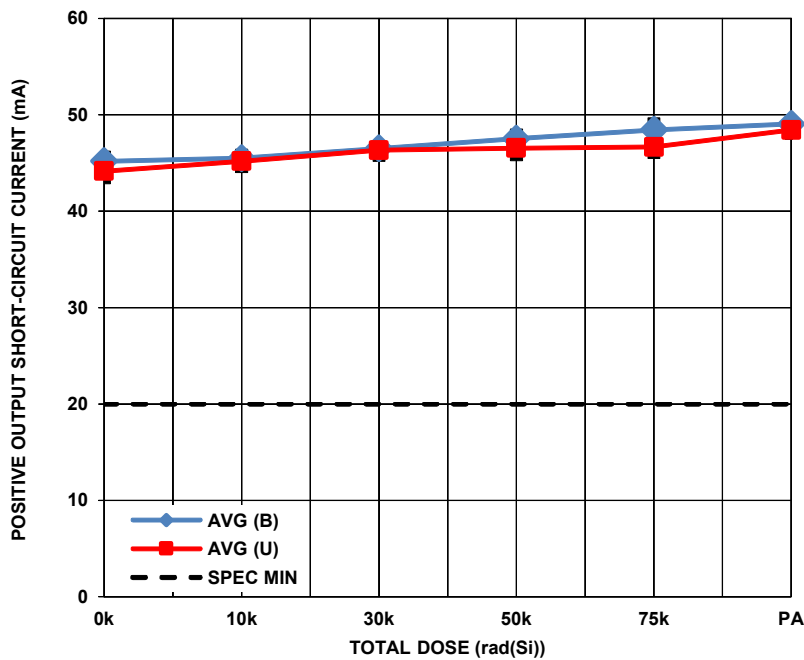


FIGURE 26. ISL70617SEH positive output short-circuit current, sinking, at  $\pm 18\text{V}$ , as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 20mA minimum.

Variables Data Plots (Continued)

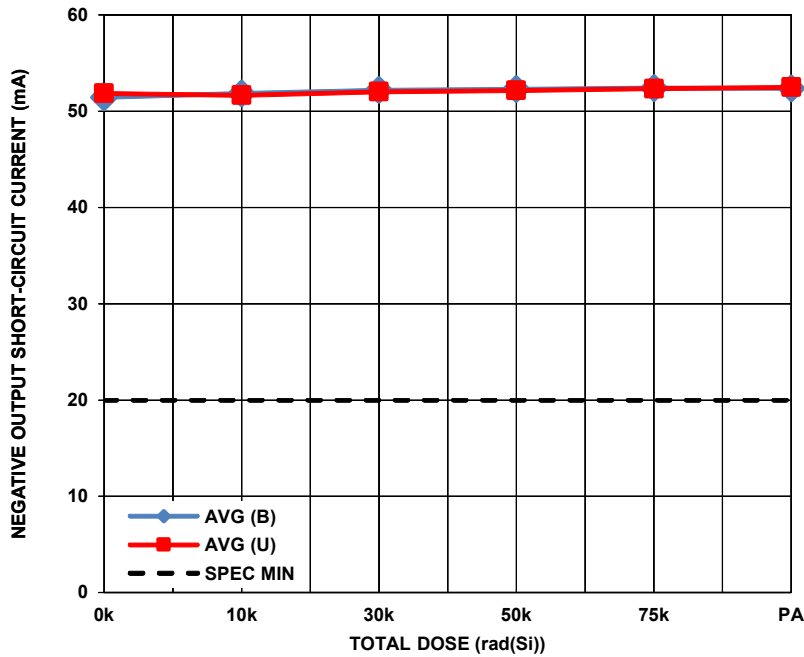


FIGURE 27. ISL70617SEH negative output short-circuit current, sinking, at  $\pm 18V$ , as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 20mA minimum.

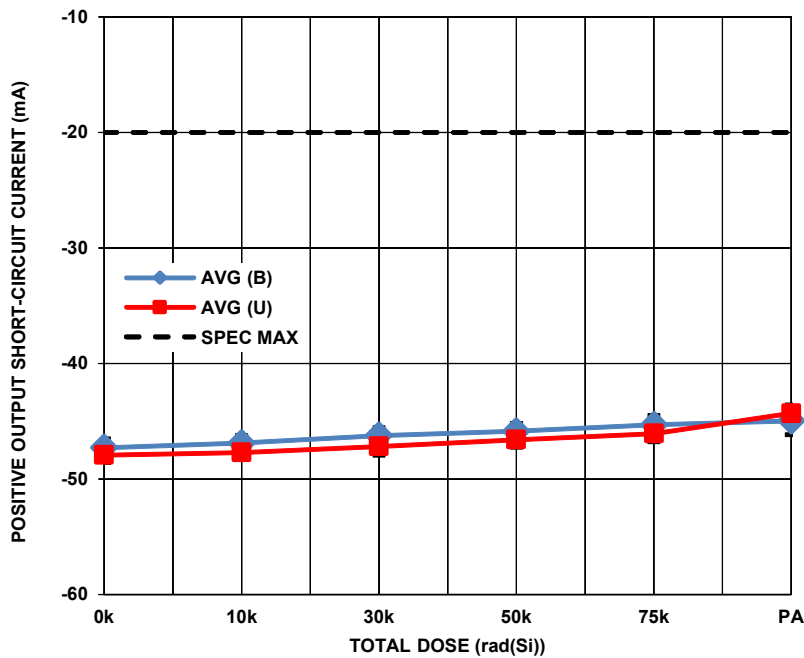


FIGURE 28. ISL70617SEH positive output short-circuit current, sourcing, at  $\pm 18V$ , as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -20mA maximum.

Variables Data Plots (Continued)

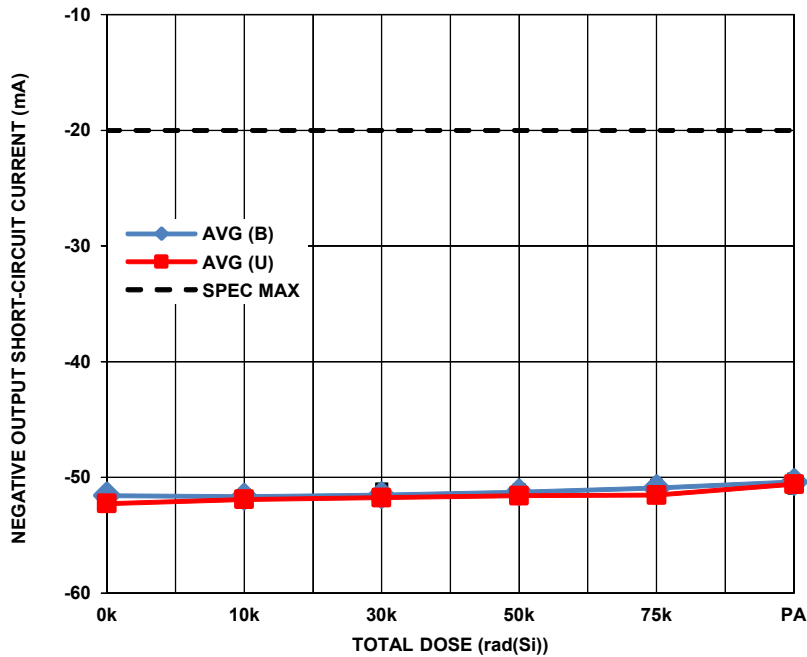


FIGURE 29. ISL70617SEH negative output short-circuit current, sourcing, at  $\pm 18V$ , as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -20mA maximum.

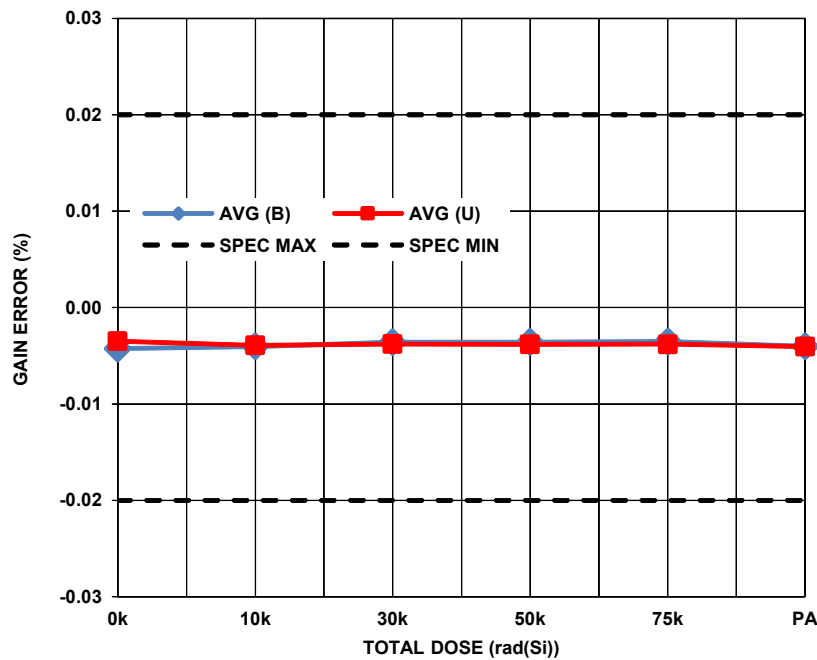


FIGURE 30. ISL70617SEH gain error at  $\pm 18V$ ,  $V_{OUT} = \pm 10V$ ,  $R_{FB} = 121k$ , Gain = 1, as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -0.02% to 0.02%.

Variables Data Plots (Continued)

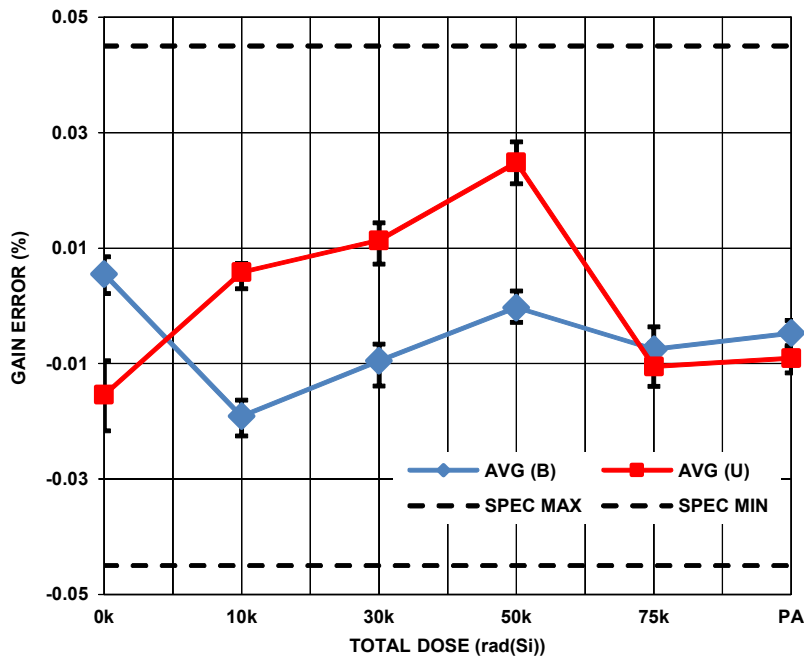


FIGURE 31. ISL70617SEH gain error at  $\pm 18V$ ,  $V_{OUT} = \pm 10V$ ,  $R_{FB} = 121k$ , Gain = 100, as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -0.045% to 0.045%.

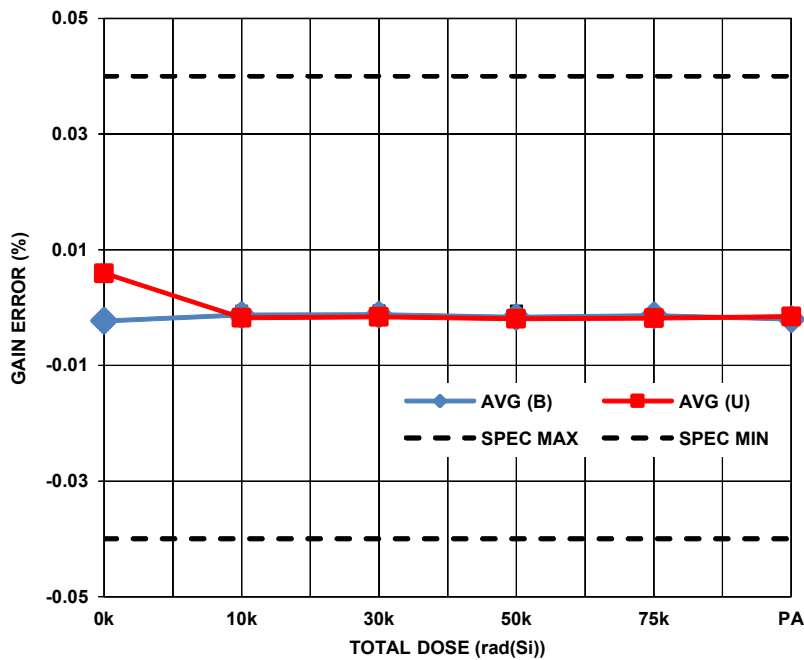


FIGURE 32. ISL70617SEH gain error at  $\pm 18V$ ,  $V_{OUT} = \pm 2.5V$ ,  $R_{FB} = 30.1k$ , Gain = 1, as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -0.04% to 0.04%.

Variables Data Plots (Continued)

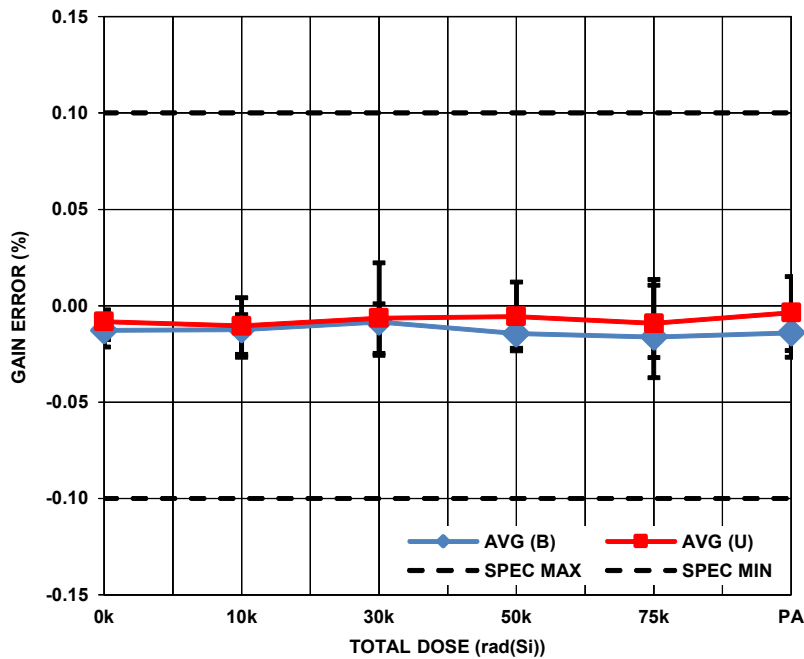


FIGURE 33. ISL70617SEH gain error with the input amplifier at  $\pm 4V$  and the output amplifier at  $\pm 1.5V$ ,  $V_{OUT} = \pm 0.1V$ ,  $R_{FB} = 121k$ , Gain = 1, as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -0.1% to 0.1%.

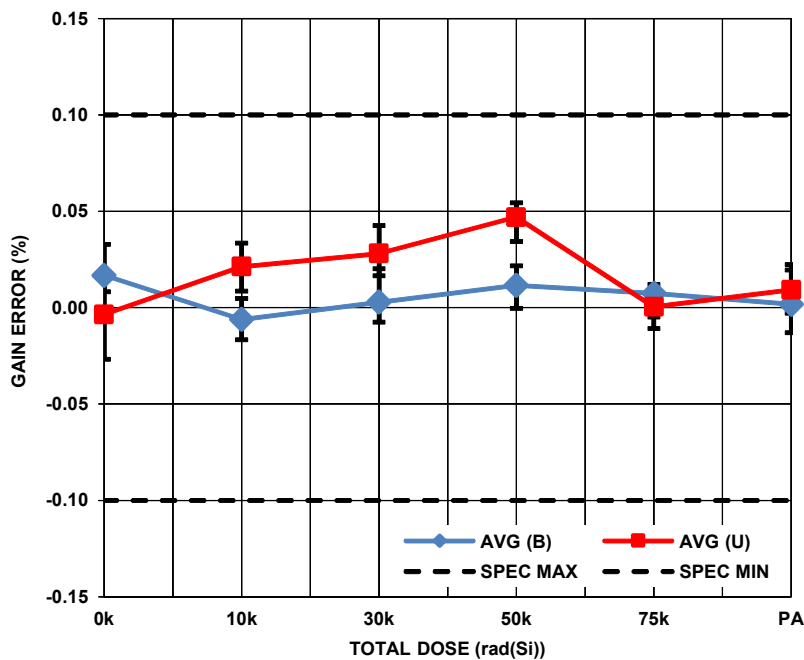


FIGURE 34. ISL70617SEH gain error with the input amplifier at  $\pm 4V$  and the output amplifier at  $\pm 1.5V$ ,  $V_{OUT} = \pm 1.25V$ ,  $R_{FB} = 121k$ , Gain = 100, as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -0.1% to 0.1%.

Variables Data Plots (Continued)

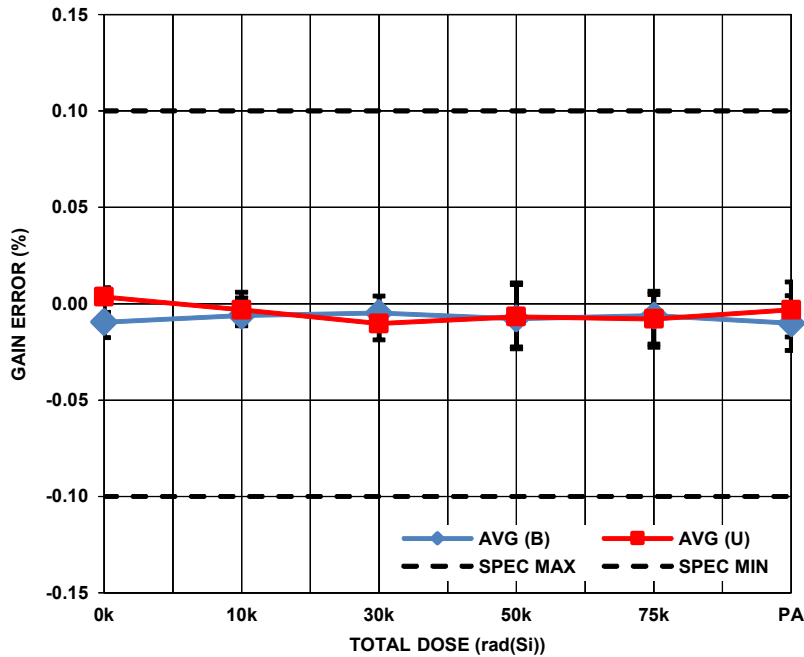


FIGURE 35. ISL70617SEH gain error with the input amplifier at  $\pm 4V$  and the output amplifier at  $\pm 1.5V$ ,  $V_{OUT} = \pm 0.1V$ ,  $R_{FB} = 30.1k$ , Gain = 1, as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -0.1% to 0.1%

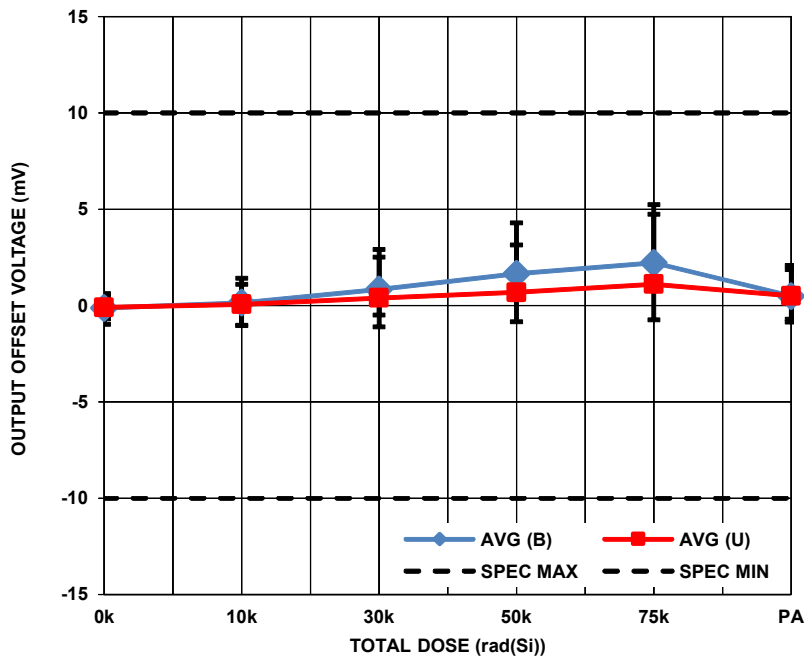


FIGURE 36. ISL70617SEH output offset voltage at  $\pm 18V$ ,  $R_{FB} = 30.1k$ , as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -10mV to 10mV.

Variables Data Plots (Continued)

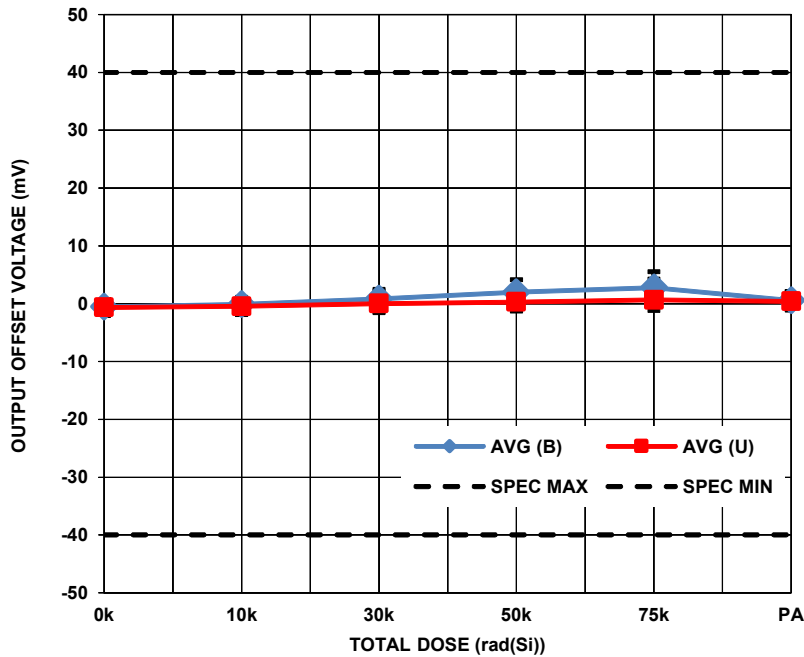


FIGURE 37. ISL70617SEH output offset voltage at  $\pm 18V$ ,  $R_{FB} = 121k$ , as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limits are -40mV to 40mV.

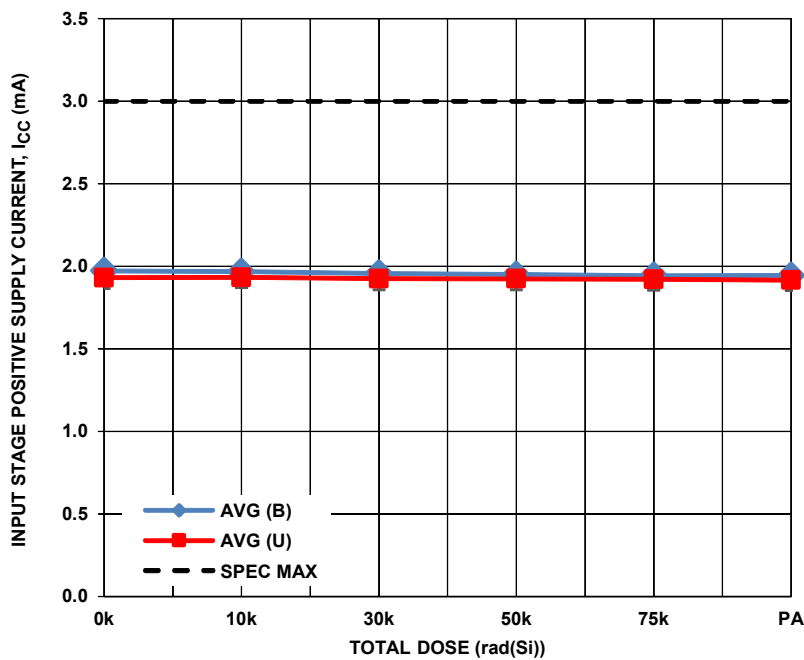


FIGURE 38. ISL70617SEH input stage positive supply current ( $I_{CC}$ ) at  $\pm 4V$ , as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 3.0mA maximum.

Variables Data Plots (Continued)

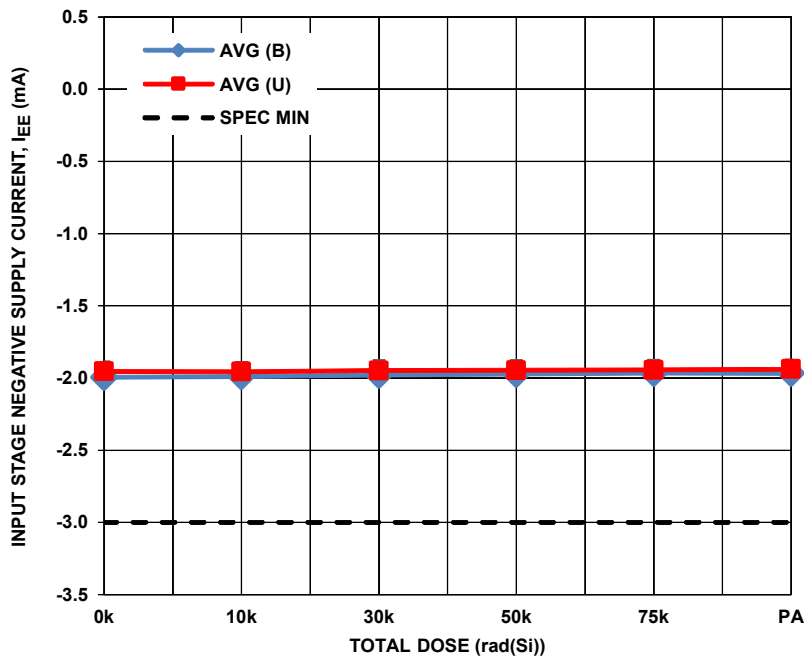


FIGURE 39. ISL70617SEH input stage negative supply current ( $I_{EE}$ ) at  $\pm 4V$ , as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -3.0mA minimum.

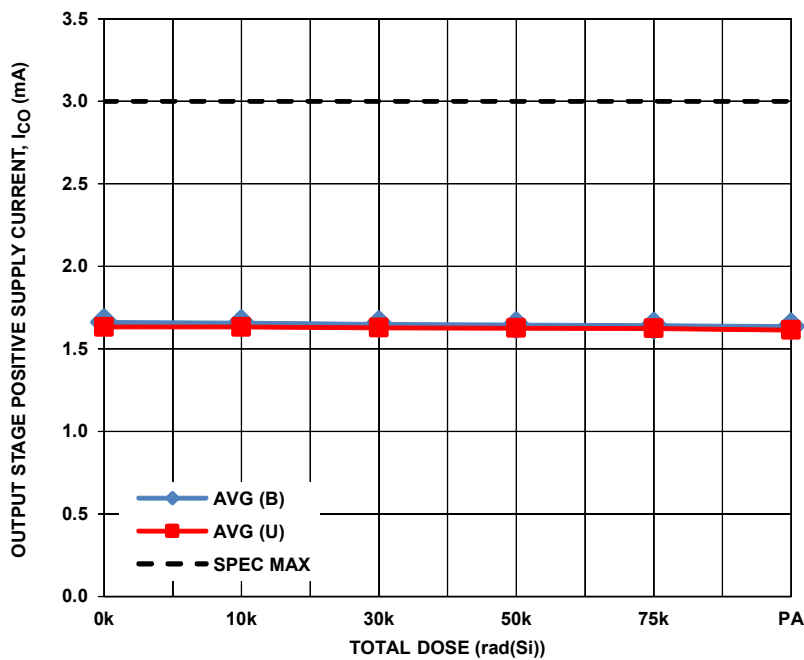


FIGURE 40. ISL70617SEH output stage positive supply current ( $I_{CO}$ ) at  $\pm 4V$ , as a function of low dose rate irradiation for the Biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 3.0mA maximum.



Variables Data Plots (Continued)

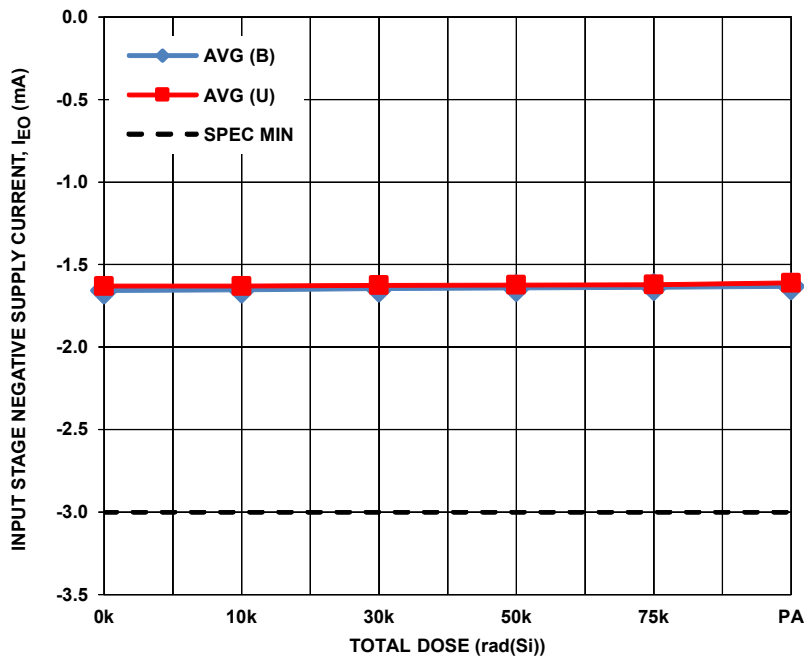


FIGURE 41. ISL70617SEH output stage negative supply current ( $I_{EO}$ ) at  $\pm 4V$ , as a function of low dose rate irradiation for the Biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -3.0mA minimum.

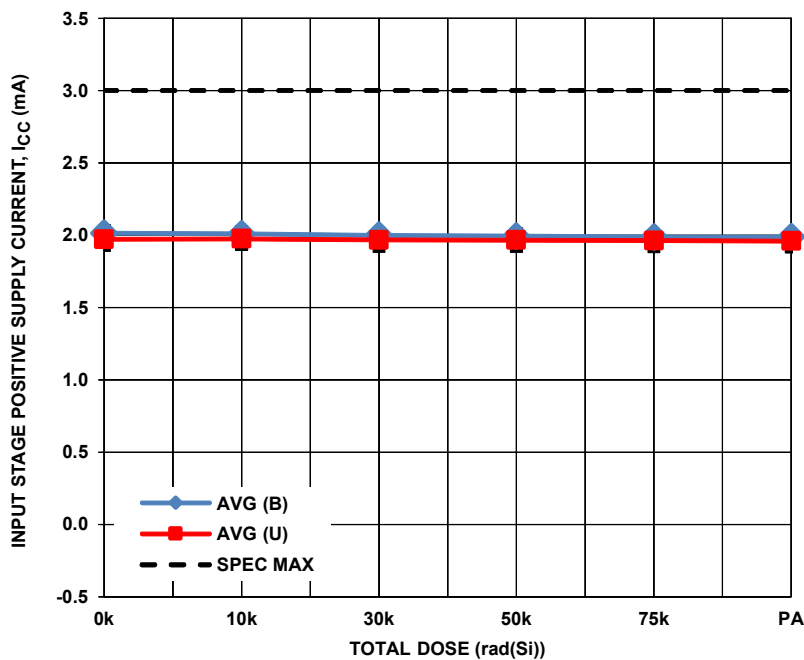


FIGURE 42. ISL70617SEH input stage positive supply current ( $I_{CC}$ ) at  $\pm 18V$ , as a function of low dose rate irradiation for the biased (B) (per Figure 1) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is 3.0mA maximum.

## Variables Data Plots (Continued)

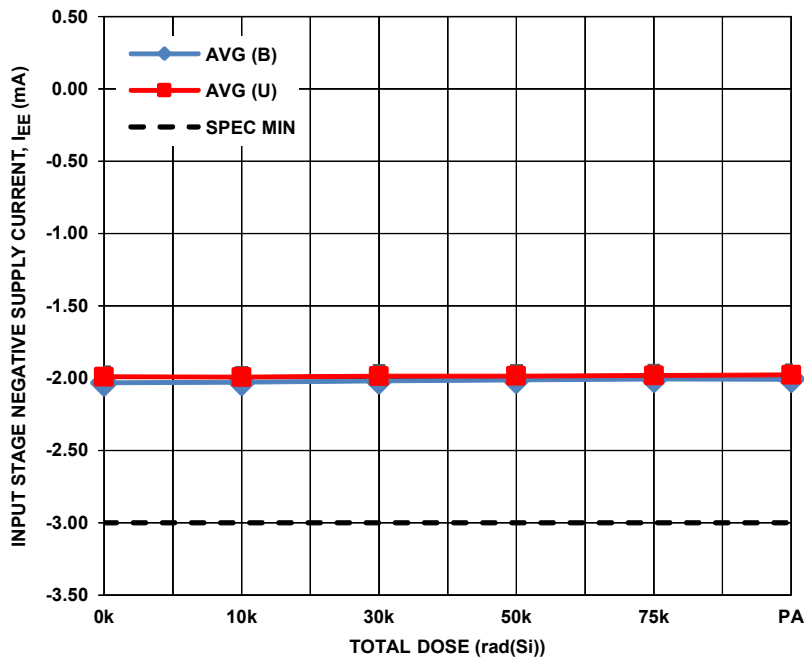


FIGURE 43. ISL70617SEH input stage negative supply current ( $I_{EE}$ ) at  $\pm 18V$ , as a function of low dose rate irradiation for the biased (B) (per [Figure 1](#)) and Unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is  $-3.0mA$  minimum.

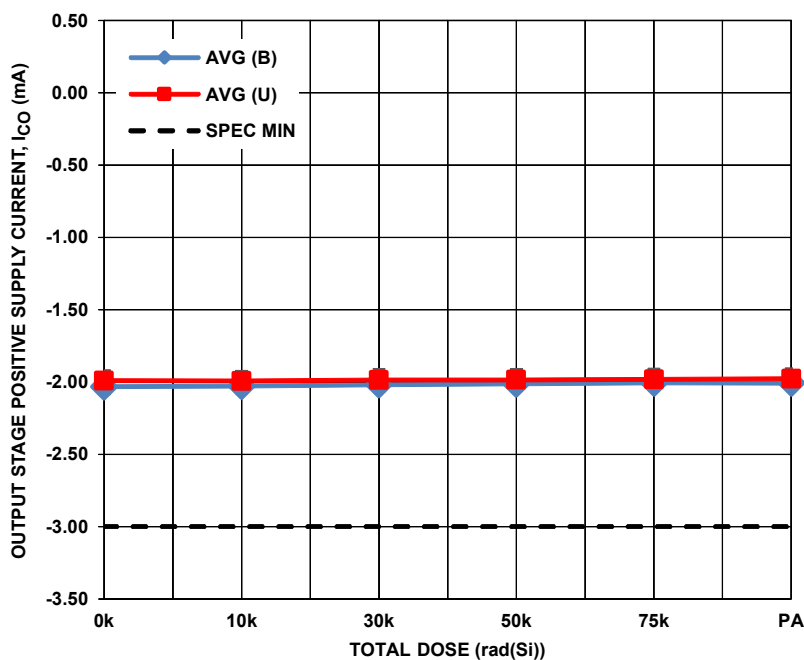


FIGURE 44. ISL70617SEH output stage positive supply current ( $I_{CO}$ ) at  $\pm 18V$ , as a function of low dose rate irradiation for the biased (B) (per [Figure 1](#)) and unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is  $3.0mA$  maximum.

Variables Data Plots (Continued)

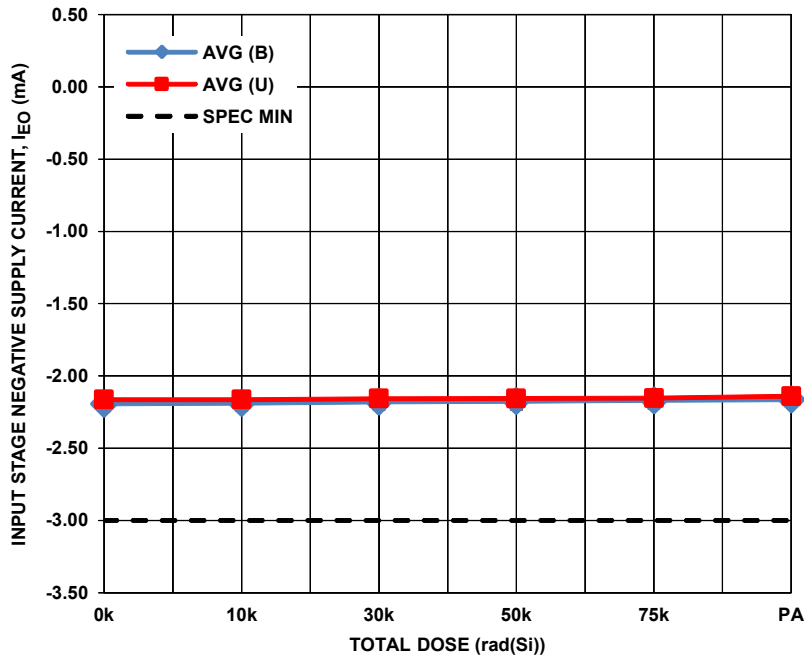


FIGURE 45. ISL70617SEH output stage negative supply current ( $I_{EO}$ ) at  $\pm 18V$ , as a function of low dose rate irradiation for the biased (B) (per [Figure 1](#)) and unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -3.0mA minimum.

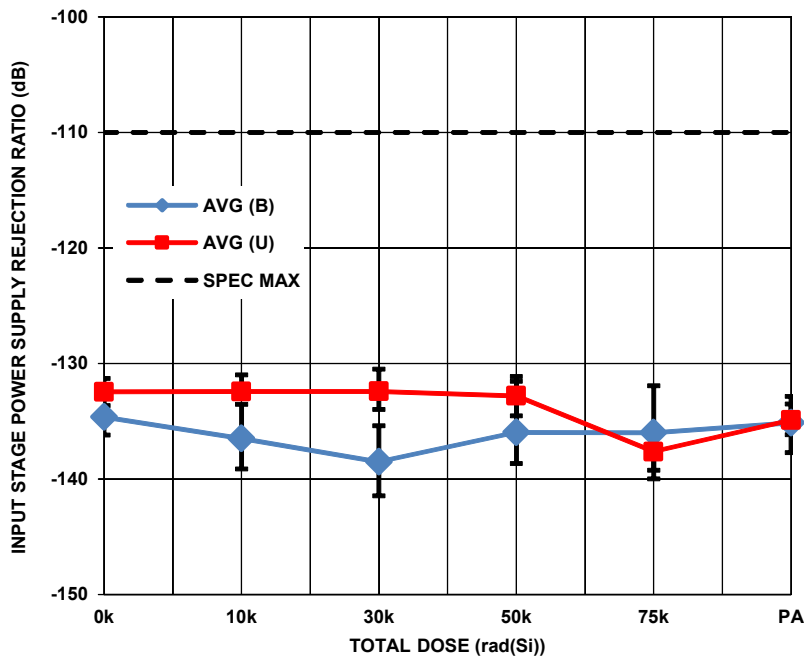


FIGURE 46. ISL70617SEH input stage power supply rejection ratio,  $\pm 4V$  to  $\pm 18V$ , as a function of low dose rate irradiation for the biased (B) (per [Figure 1](#)) and unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -110dB maximum.

## Variables Data Plots (Continued)

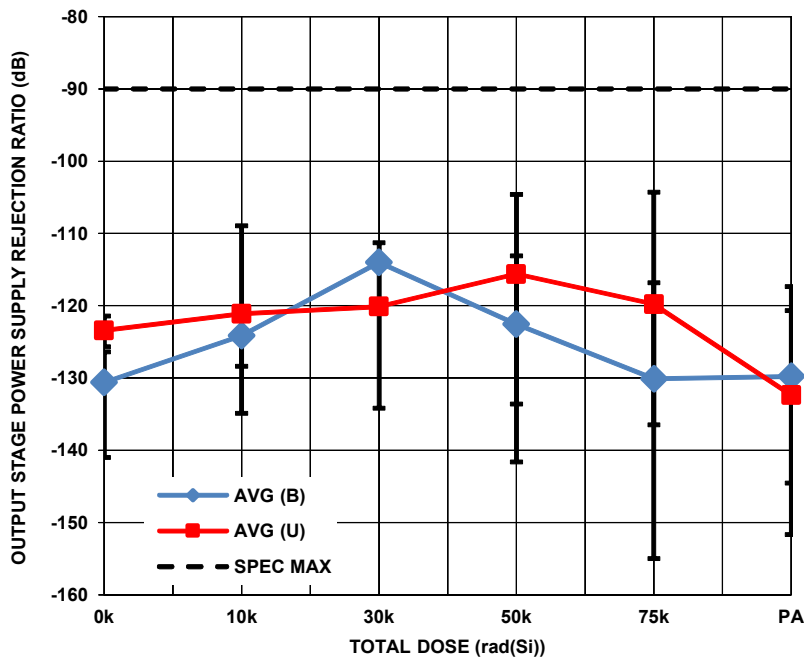


FIGURE 47. ISL70617SEH output stage power supply rejection ratio,  $\pm 1.5V$  to  $\pm 18V$ , as a function of low dose rate irradiation for the biased (B) (per [Figure 1](#)) and unbiased (U) (all pins grounded) cases. The error bars represent the minimum and maximum measured values. The post-irradiation SMD limit is -90dB maximum.

## Conclusion

This report documents the results of a Total Ionizing Dose (TID) test of the ISL70617SEH instrumentation amplifier. The test was conducted in order to determine the sensitivity of the parts to the low dose rate total dose environment as found in nearly all space applications. Parts were tested to 75krad(Si) at a low dose rate under biased and unbiased conditions and were then subjected to a high temperature biased anneal at  $+100^{\circ}C$  for 168 hours. ATE characterization testing showed no rejects to the SMD Group A parametric limits (indicated by a "Bin 1" category) after biased and grounded irradiation at low dose rate and after the 168 hours  $+100^{\circ}C$  biased anneal. Attributes data are presented in [Table 2 on page 4](#), while variables data are plotted in [Figures 2 through 47](#). No meaningful differences between biased and unbiased irradiation were noted, and the samples showed no significant response to the high temperature anneal.

TABLE 3. REPORTED PARAMETER

FIGURE	PARAMETER	LIMIT LOW	LIMIT HIGH	UNIT	NOTES
<a href="#">2</a>	Input Offset Voltage	-300	300	$\mu\text{V}$	$\pm 18\text{V}$
<a href="#">3</a>	Input Offset Voltage	-300	300	$\mu\text{V}$	$\pm 4\text{V}$
<a href="#">4</a>	Positive Input Bias Current	-25	25	nA	$\pm 18\text{V}$
<a href="#">5</a>	Negative Input Bias Current	-25	25	nA	$\pm 18\text{V}$
<a href="#">6</a>	Positive Input Bias Current	-25	25	nA	$\pm 5\text{V}$
<a href="#">7</a>	Negative Input Bias Current	-25	25	nA	$\pm 5\text{V}$
<a href="#">8</a>	Input Offset Current	-18.5	18.5	nA	$\pm 18\text{V}$
<a href="#">9</a>	Input Offset Current	-18.5	18.5	nA	$\pm 5\text{V}$
<a href="#">10</a>	Common-Mode Rejection Ratio	-	-120	dB	Gain = 100
<a href="#">11</a>	Common-Mode Rejection Ratio	-	-97	dB	Gain = 1
<a href="#">12</a>	Feedback Input Offset Voltage	-6000	6000	$\mu\text{V}$	$\pm 18\text{V}$
<a href="#">13</a>	Feedback Input Offset Voltage	-6000	6000	$\mu\text{V}$	$\pm 4\text{V}$
<a href="#">14</a>	Feedback Input Bias Current	-200	200	nA	$\pm 18\text{V}$
<a href="#">15</a>	Feedback Input Bias Current	-200	200	nA	$\pm 4\text{V}$
<a href="#">16</a>	Low Output Voltage	-	160	mV	$I_{\text{OUT}} = 0\text{mA}$
<a href="#">17</a>	Low Output Voltage	-	200	mV	$I_{\text{OUT}} = 1.5\text{mA}$
<a href="#">18</a>	Low Output Voltage	-	550	mV	$I_{\text{OUT}} = 7.5\text{mA}$
<a href="#">19</a>	High Output Voltage	-160	-	mV	$I_{\text{OUT}} = 0\text{mA}$
<a href="#">20</a>	High Output Voltage	-200	-	mV	$I_{\text{OUT}} = -1.5\text{mA}$
<a href="#">21</a>	High Output Voltage	-550	-	mV	$I_{\text{OUT}} = -7.5\text{mA}$
<a href="#">22</a>	Low Output Voltage	-	200	mV	$V_{\text{CC}} = 4\text{V}$ , $V_{\text{EE}} = -4\text{V}$ , $V_{\text{CO}} = 1.5\text{V}$ , $V_{\text{EO}} = -1.5\text{V}$ , $I_{\text{OUT}} = 1.5\text{mA}$
<a href="#">23</a>	Low Output Voltage	-	200	mV	
<a href="#">24</a>	High Output Voltage	-200	-	mV	
<a href="#">25</a>	High Output Voltage	-200	-	mV	
<a href="#">26</a>	Output Short-Circuit Current, Sinking	20	-	mA	$\pm 18\text{V}$ , Positive Output
<a href="#">27</a>	Output Short-Circuit Current, Sinking	20	-	mA	$\pm 18\text{V}$ , Negative Output
<a href="#">28</a>	Output Short-Circuit Current, Sourcing	-	-20	mA	$\pm 18\text{V}$ , Positive Output
<a href="#">29</a>	Output Short-Circuit Current, Sourcing	-	-20	mA	$\pm 18\text{V}$ , Negative Output
<a href="#">30</a>	Gain Error	-0.02	0.02	%	$V_{\text{OUT}} = \pm 10\text{V}$ , $R_{\text{FB}} = 121\text{k}$ , $G = 1$
<a href="#">31</a>	Gain Error	-0.045	0.045	%	$V_{\text{OUT}} = \pm 10\text{V}$ , $R_{\text{FB}} = 121\text{k}$ , $G = 100$
<a href="#">32</a>	Gain Error	-0.04	0.04	%	$V_{\text{OUT}} = \pm 2.5\text{V}$ , $R_{\text{FB}} = 30.1\text{k}$ , $G = 1$
<a href="#">33</a>	Gain Error, Low Supply Voltage	-0.1	0.1	%	$V_{\text{OUT}} = \pm 0.1\text{V}$ , $R_{\text{FB}} = 121\text{k}$ , $G = 1$
<a href="#">34</a>	Gain Error, Low Supply Voltage	-0.1	0.1	%	$V_{\text{OUT}} = \pm 1.25\text{V}$ , $R_{\text{FB}} = 121\text{k}$ , $G = 100$
<a href="#">35</a>	Gain Error, Low Supply Voltage	-0.1	0.1	%	$V_{\text{OUT}} = \pm 0.1\text{V}$ , $R_{\text{FB}} = 30.1\text{k}$ , $G = 1$
<a href="#">36</a>	Output Offset Voltage	-10	10	mV	$\pm 18\text{V}$ , $R_{\text{FB}} = 30.1\text{k}$
<a href="#">37</a>	Output Offset Voltage	-40	40	mV	$\pm 18\text{V}$ , $R_{\text{FB}} = 121\text{k}$
<a href="#">38</a>	Supply Current, $I_{\text{CC}}$	-	3.0	mA	$\pm 4\text{V}$
<a href="#">39</a>	Supply Current, $I_{\text{EE}}$	-3.0	-	mA	$\pm 4\text{V}$
<a href="#">40</a>	Supply Current, $I_{\text{CO}}$	-	3.0	mA	$\pm 4\text{V}$
<a href="#">41</a>	Supply Current, $I_{\text{EO}}$	-3.0	-	mA	$\pm 4\text{V}$

TABLE 3. REPORTED PARAMETER (Continued)

FIGURE	PARAMETER	LIMIT LOW	LIMIT HIGH	UNIT	NOTES
<a href="#">42</a>	Supply Current, $I_{CC}$	-	3.0	mA	$\pm 18V$
<a href="#">43</a>	Supply Current, $I_{EE}$	-3.0	-	mA	$\pm 18V$
<a href="#">44</a>	Supply Current, $I_{CO}$	-	3.0	mA	$\pm 18V$
<a href="#">45</a>	Supply Current, $I_{EO}$	-3.0	-	mA	$\pm 18V$
<a href="#">46</a>	Power Supply Rejection Ratio	-	-110	dB	Input Stage PSRR
<a href="#">47</a>	Power Supply Rejection Ratio	-	-90	dB	Output Stage PSRR

## NOTE:

- Limits are taken from Standard Microcircuit Drawing (SMD) 5962-15246.

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