ISL73847SEH

LDR Test Results of the ISL73847SEH Radiation Hardened Single/Dual Phase Current Mode PWM Controller

Introduction

This report documents the results of low dose rate (LDR) total dose testing of the ISL73847SEH, a synchronous buck controller that can operate as a single or dual phase controller. The testing was conducted to provide an assessment of the total dose hardness of the parts and to determine any bias sensitivity. Parts were irradiated under bias and with all pins grounded at LDR to 100krad(Si) with an anneal. The ISL73847SEH is rated at 75krad(Si) at LDR (0.01rad(Si)/s) and is acceptance tested on a wafer-by-wafer basis to the datasheet limits.

Product Description

The ISL73847SEH is a synchronous buck controller that can operate as a single or dual phase controller. It is intended to work with the ISL73041SEH (half bridge GaN FET driver) to generate point-of-load voltage rails for commercial space applications.

It accepts an input voltage range of 4.5V to 19V with an output switching frequency that is programmable between 250kHz and 1.5MHz with a single external resistor. The output can regulate a voltage upwards of 600mV and is limited on the top end by the minimum off-time and selected switching frequency.

The wide input voltage range makes it a suitable power supply option for a high current FPGA core and other general purpose power solutions. The ISL73847SEH uses current mode modulation, which simplifies loop compensation and provides excellent power supply rejection. Additionally, the output is remotely sensed to compensate for any voltage drop in the load conditions. All of this put together results in a robust power supply solution that requires minimal components while achieving high power density.

The ISL73847SEH also features a tri-level output that provides excellent protection against faults by driving a mid-scale voltage to signal the power stage to enter a Hi-Z condition.

The ISL73847SEH is available in a 24 Ld hermetically sealed Ceramic Dual Flatpack (CDFP) package or in die form. The package and pinout configuration for the ISL73847SEH is shown in Figure 1 and the pin descriptions are shown in Table 1.

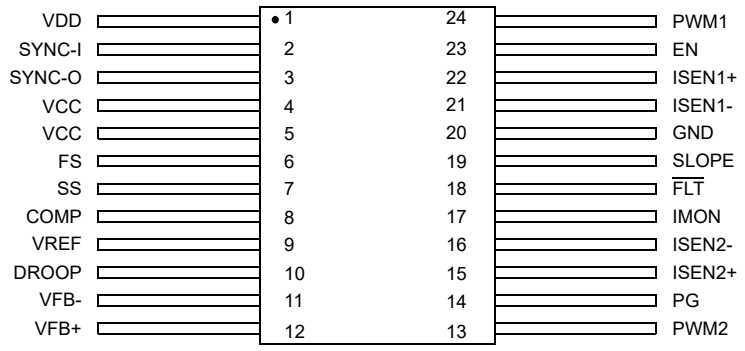


Figure 1. ISL73847SEH Pinout Configuration

Table 1. ISL73847SEH Pin Descriptions

Pin Number	Pin Name	Description
1	VDD	The power supply input to the IC. The voltage range on this pin is 4.5V to 19V.
2	SYNC-I	This pin is an input that accepts 2x the required output switching frequency (regardless of single or dual phase). Internally the IC divides the clock down to get two clocks 180° from each other for each phase. *Note:* This pin has an internal pull down, leave it floating if SYNC function is not needed.
3	SYNC-O	This pin can output either 1x or 2x the output switching frequency depending on the loading present on the pin during power up (before soft-start). When outputting 1x, the SYNC-O is 180° out of phase with phase 1 clock. The 2x SYNC-O output is in phase with the SYNC-I. 100kΩ to VCC: SYNC-O outputs 1x output switching frequency. 100kΩ to GND: SYNC-O outputs 2x output switching frequency.
4	VCC	Output of internal LDO for analog circuity, short this pin to pin 5.
5	VCC	Output of internal LDO for analog circuity, short this pin to pin 4.
6	FS	This pin sets the frequency for the internal oscillator between 1MHz and 3MHz. This sets the output between 0.5 MHz and 1.5MHz for each phase. When FS is tied to VCC, the oscillator switching frequency (f_{OSC}) is 1MHz, a resistor between FS and GND adjusts the frequency between 1MHz and 3 MHz. If SYNC-I is being used to sync to an external clock, FS needs to be set to a frequency 15% less than the external clock. Equation 2 in the datasheet can be used to find what resistor is needed for a given frequency.
7	SS	This is the soft-start pin, connect a ceramic capacitor from SS to GND to set the soft-start ramp. The soft-start time is adjustable between 2ms and 200ms. Equation 18 in the datasheet shows the relationship between the soft-start capacitor and soft-start time.
8	COMP	Output of error amplifier, connect a resistor and capacitor to ground for compensation adjustment.
9	VREF	Output for the internal voltage reference. Insert a resistor between VREF and DROOP to enable droop regulation.
10	DROOP	This pin is a current mirrored version of the output of the current sense amp output (sum of both phases). This output can be tied to the VREF pin through a resistor to enable droop regulation. The voltage created by the mirrored current and the resistor between VREF and DROOP sets the droop level.
11	VFB-	This pin is the negative input for differential voltage feedback.
12	VFB+	This pin is the positive input for differential voltage feedback.
13	PWM2	This pin is the PWM output for the secondary phase. Needs 100kΩ to GND.
14	PG	This pin is the power good indicator. It is an open-drain output, limit the sink current through this pin to below 7.2mA.
15	ISEN2+	This pin is the positive input for the secondary phase current sense amplifier.
16	ISEN2-	This pin is the negative input for the secondary phase current sense amplifier.
17	IMON	This pin outputs the summed outputs of the current sense amplifiers for telemetry purposes.
18	$\overline{FLT}$	This pin sequences the startup between the ISL73847SEH and the ISL73041SEH. On the ISL73847SEH, this pin operates as a bi-directional I/O during power up (before soft-start) and as an input while switching (during and after soft-start). A logic low on this pin indicates that either the ISL73847SEH or ISL73041SEH has encountered a fault or is not ready to start switching. A logic high indicates that there is no faults for either device.
19	SLOPE	This pin adjusts the slope compensation of the ISL73847SEH. Place a resistor in the range of 25Ωk to 100Ωk to adjust slope compensation.
20	GND	This is the ground reference for the ISL73847SEH. This pin is tied to the package seal ring (lid)
21	ISEN1-	This pin is the negative input for the primary phase current sense amplifier.

Table 1. ISL73847SEH Pin Descriptions

Pin Number	Pin Name	Description
22	ISEN1+	This pin is the positive input for the primary phase current sense amplifier.
23	EN	This pin is the chip enable for the ISL73847SEH.
24	PWM1	This pin is the PWM output for the primary phase. Needs 100kΩ to GND.
-	Lid	The lid is electrically connected to pin 20 (GND).

Contents

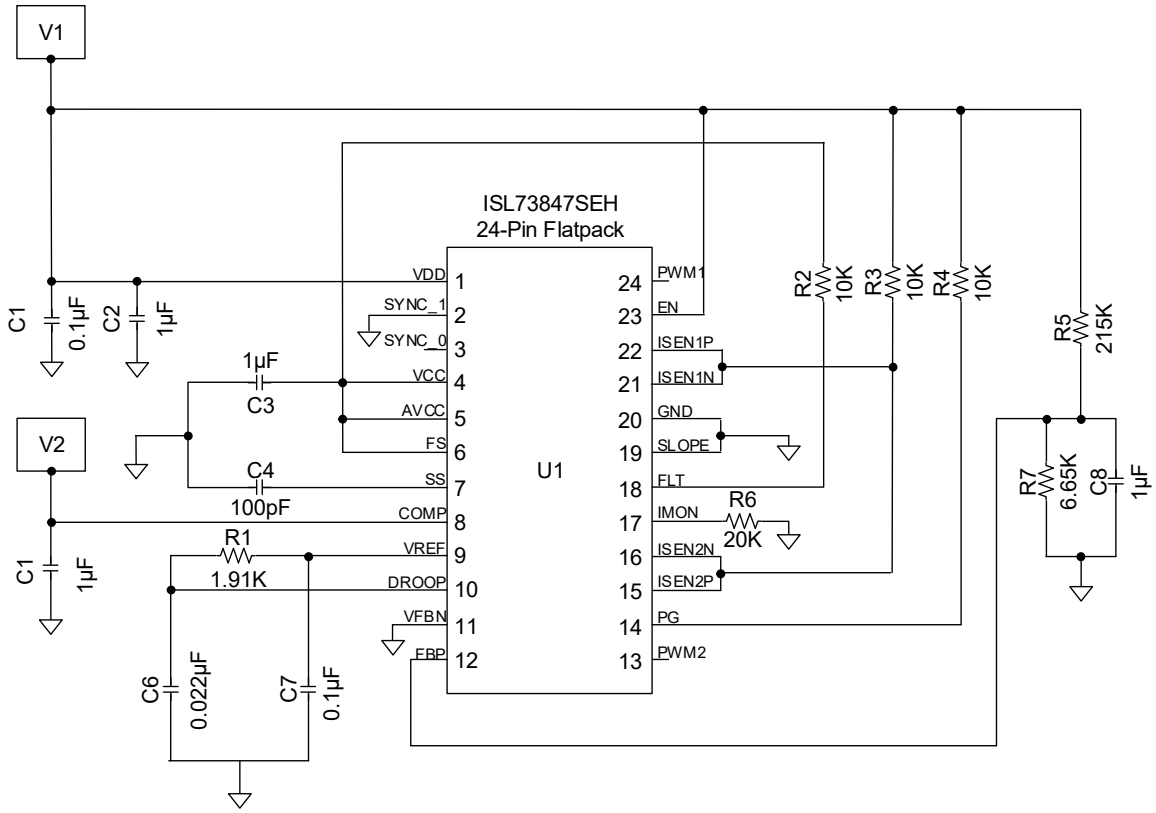
1. Test Description

1.1 Irradiation Facilities

LDR testing was performed at 0.01rad(Si)/s using the Renesas Palm Bay Hopewell Designs N40 panoramic irradiator. PbAl spectrum hardening filters were used to shield the test board and devices under test against low energy secondary gamma radiation. Half of the samples were biased, and half had all pins grounded during irradiation.

1.2 Test Fixturing

Figure 2 shows the configuration and voltages used for biased irradiation.



Note: VCC1 = V1 = 20V; VCC2 = V2 = 1.5V

Figure 2. ISL73847SEH TID Bias Schematic and Bias Voltages

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 down-point.

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 and 10 samples irradiated at LDR with all pins grounded. All parts were also subjected to a 168 hour, 100°C biased anneal. Three control units were used. The ISL73847SEH samples were from wafer lot V6C763.

1.5 Downpoints

Downpoints for the LDR tests were 0, 10, 30, 50, 75, 100krad(Si), and Post-Anneal (PA).

2. Test Results

2.1 Attributes Data

LDR testing of the ISL73847SEH is complete. All tested parameters passed the datasheet limits. Table 2 summarizes the results.

Table 2. ISL73847SEH Total Dose Test Attributes Data

Dose Rate (rad(Si)/s)	Bias	Sample Size	Downpoint	Pass[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
			100krad(Si)	8	2
			Post-Anneal	10	0
0.01	Grounded	10	Pre-irradiation	10	
			10krad(Si)	10	0
			30krad(Si)	10	0
			50krad(Si)	10	0
			75krad(Si)	10	0
			100krad(Si)	8	2
			Post-Anneal	10	0

1. A Pass indicates a sample that passes all datasheet limits.

2.2 Key Parameter Variables Data

The plots in Figure 3 through Figure 75 illustrate the LDR response of the selected parameters shown in Table 3 in the Appendix. 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, plus a 168 hour 100°C anneal. That downpoint is shown as PA (Post-Anneal) on the graphs. 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 because of their values compared to the scale of the graph.

Each Current Sense Amp on the ISL73847SEH has triple redundancy for improved SEE tolerance and therefore has three current-sense measurements. These are shown as LA, LB, LC (Low Side) in Figure 39 through Figure 42 and HA, HB, HC (High Side) in Figure 43 through Figure 50.

The exposed parts passed all parameters up to the TID acceptance level of 75krad(Si); however, there were some parametric failures at the final TID characterization exposure level of 100krad(Si). The LDO dropout voltage, shown in Figure 6, had a biased part measurement slightly exceed the 250mA limit (251.7mA). In addition, another part that was grounded during exposure, slightly failed the -4.5mV (-4.53mV) minimum limit on a high-side offset voltage test, which can be seen in Figure 43. All parameters passed after the 168 hour biased anneal.

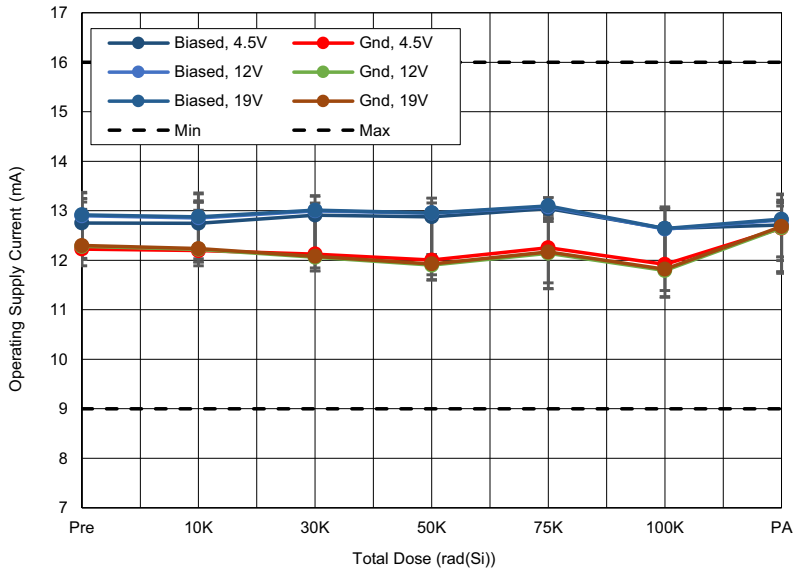


Figure 3. ISL73847SEH operating supply current (I_{DDO}) at V_{DD} = 4.5V, 12V and 19V; EN = 3.3V; f_{SW} = 500kHz and C_L=100pF, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 9mA minimum and 16mA maximum.

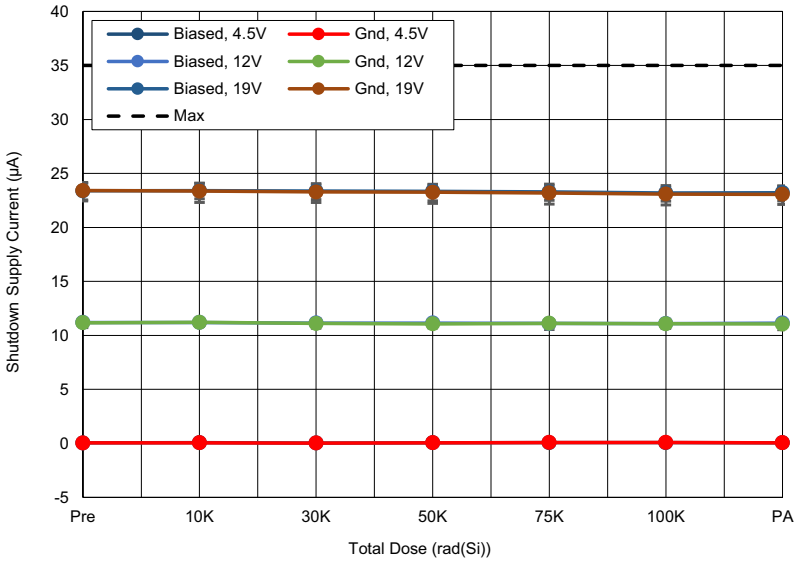


Figure 4. ISL73847SEH shutdown supply current (I_{DDSD}) at V_{DD} = 4.5V, 12V and 19V; EN = GND, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limit is 35µA maximum.

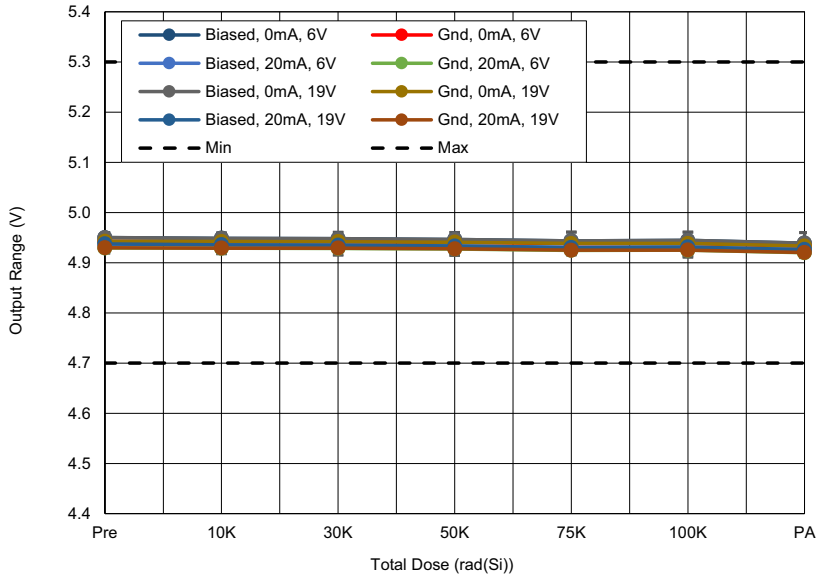


Figure 5. ISL73847SEH LDO output voltage range (V_{CC}) at V_{DD} = 6V and 19V; I_{OUT} = 0mA and 20mA, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 4.7V minimum and 5.3V maximum.

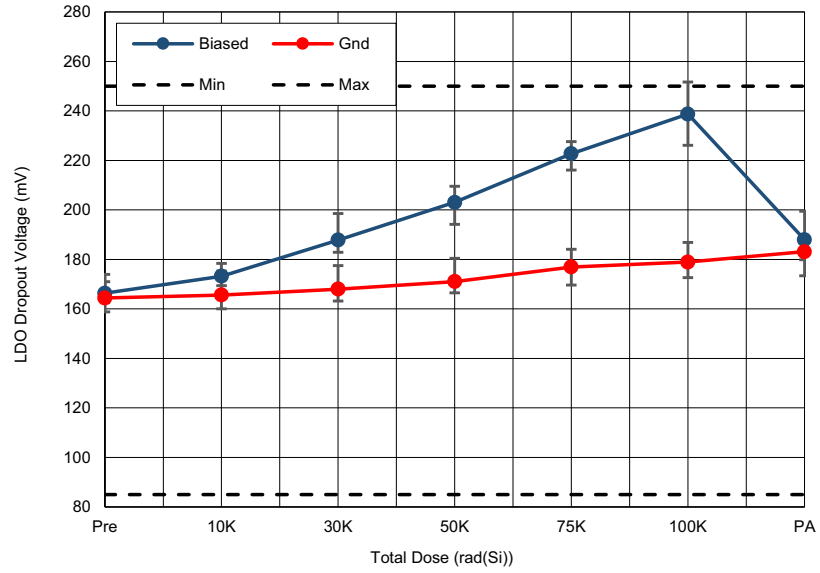


Figure 6. ISL73847SEH LDO dropout voltage (VCC_{DO}) at V_{DD} = 4.5V; I_{OUT} = 50mA, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 85mV minimum and 250mV maximum.

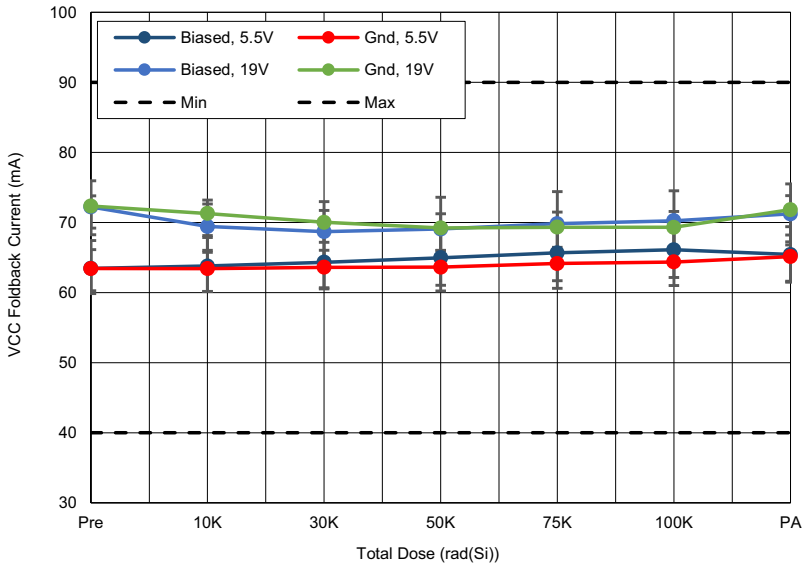


Figure 7. ISL73847SEH VCC foldback current (I_{CC-SC}) at V_{DD} = 5.5V and 19V; V_{CC} = 0V; EN = 1.6V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 40mA minimum and 90mA maximum.

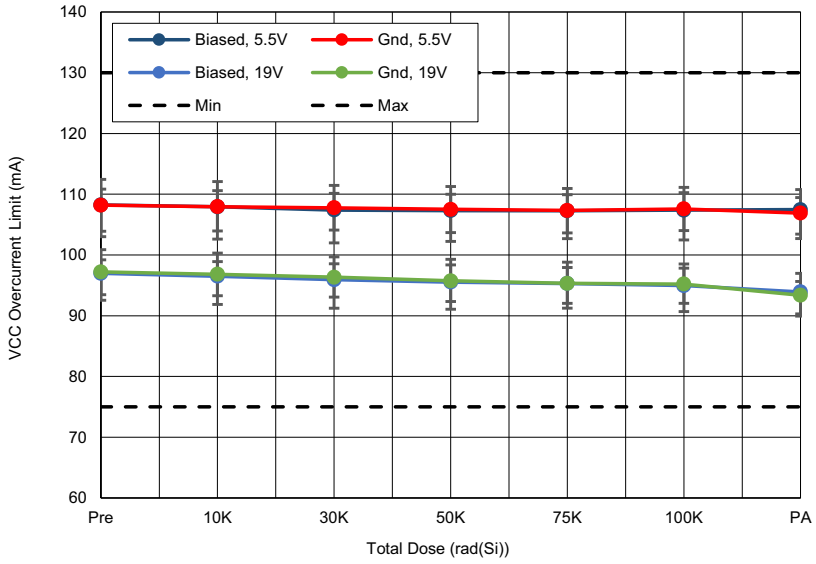


Figure 8. ISL73847SEH VCC overcurrent limit (I_{CC-CL}) at V_{DD} = 5.5V and 19V; V_{CC} = 4.5V; EN = 1.6V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 75mA minimum and 130mA maximum.

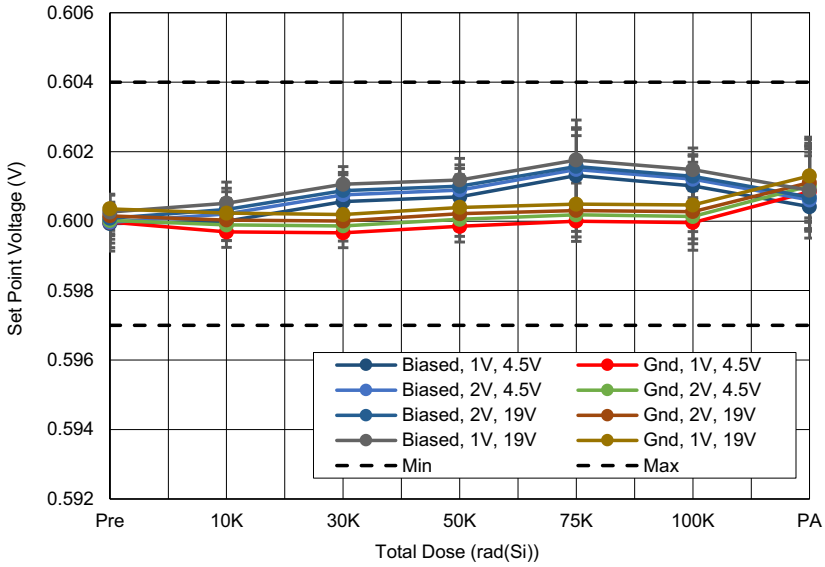


Figure 9. ISL73847SEH set point voltage (V_{FB+}), at V_{DD} = 4.5V and 19V; V_{REF} = V_{DROOP} = 1V and 2V; V_{SEN1} = V_{SEN2} = 0mV, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.597V minimum and 0.604V maximum.

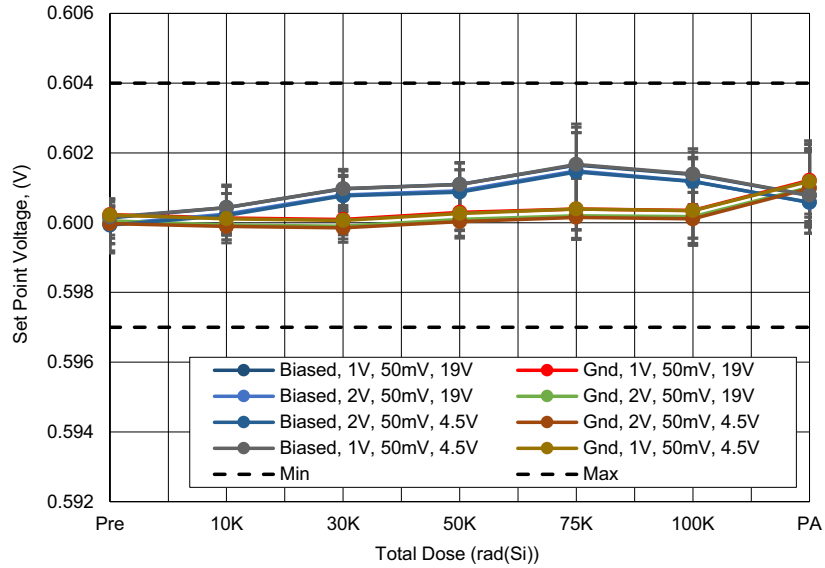


Figure 10. ISL73847SEH set point voltage (V_{FB+}) at V_{DD} = 4.5V and 19V; V_{REF} = V_{DROOP} = 1V and 2V; V_{SEN1} = V_{SEN2} = 50mV, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.597V minimum and 0.604V maximum.

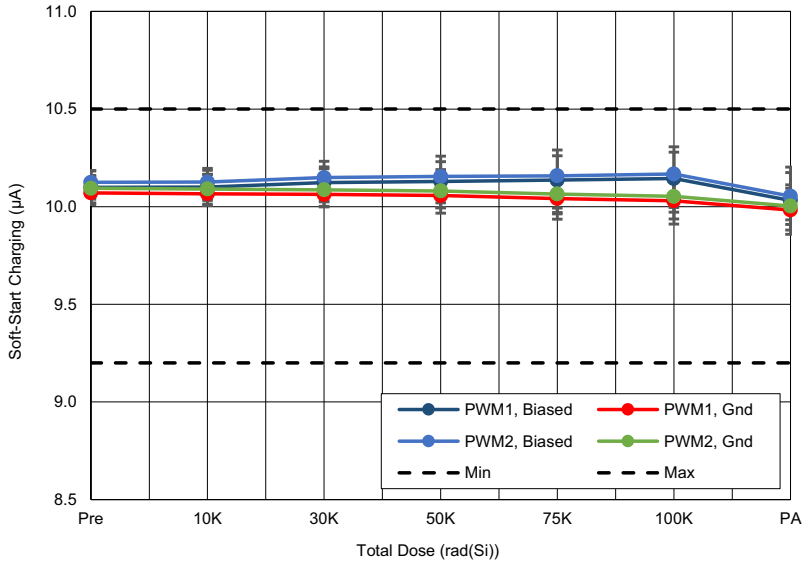


Figure 11. ISL73847SEH soft-start sourcing current ($I_{SOFTSTART}$) at VDD = 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 9.2µA minimum and 10.5µA maximum.

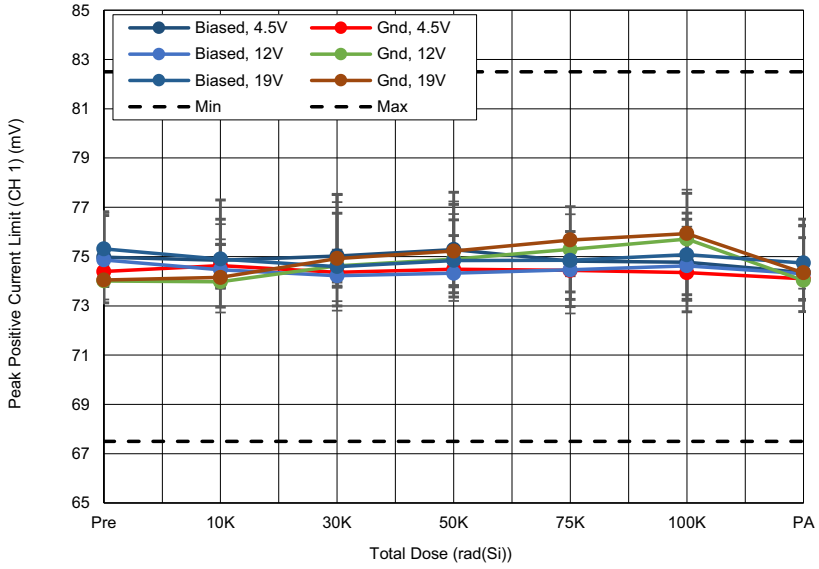


Figure 12. ISL73847SEH Channel 1 peak positive current limit (V_{PCL}) with V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 67.5mV minimum and 82.5mV maximum.

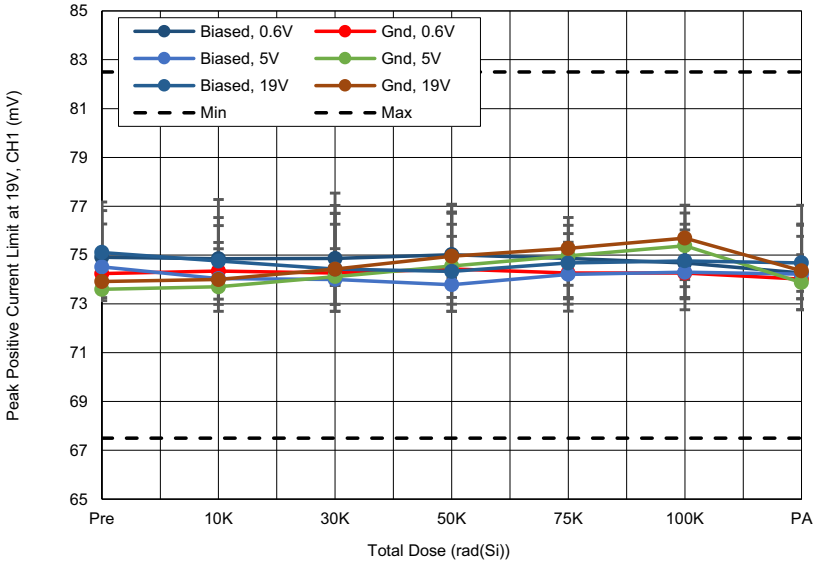


Figure 13. ISL73847SEH Channel 1 peak positive current limit (V_{PCL}) with V_{DD} = 19V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 67.5mV minimum and 82.5mV maximum.

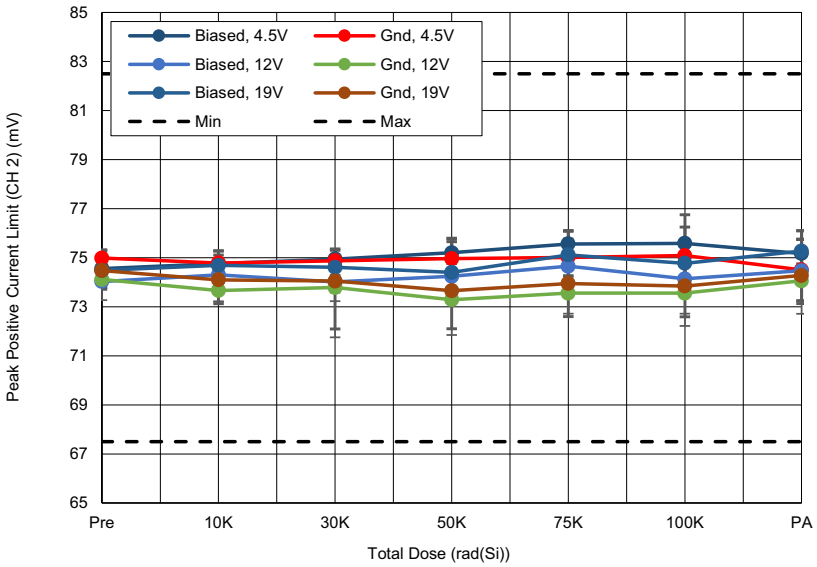


Figure 14. ISL73847SEH Channel 2 peak positive current limit (V_{PCL}) with V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 67.5mV minimum and 82.5mV maximum.

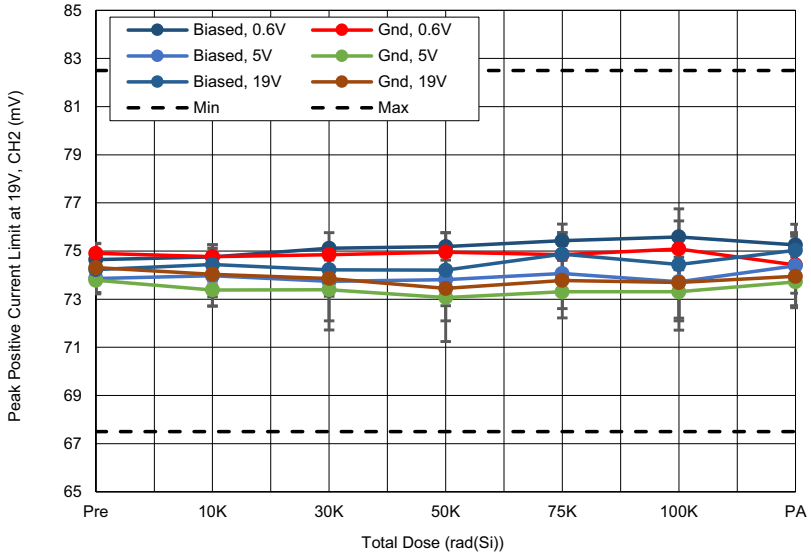


Figure 15. ISL73847SEH Channel 2 peak positive current limit (V_{PCL}) with V_{DD} = 19V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 67.5mV minimum and 82.5mV maximum.

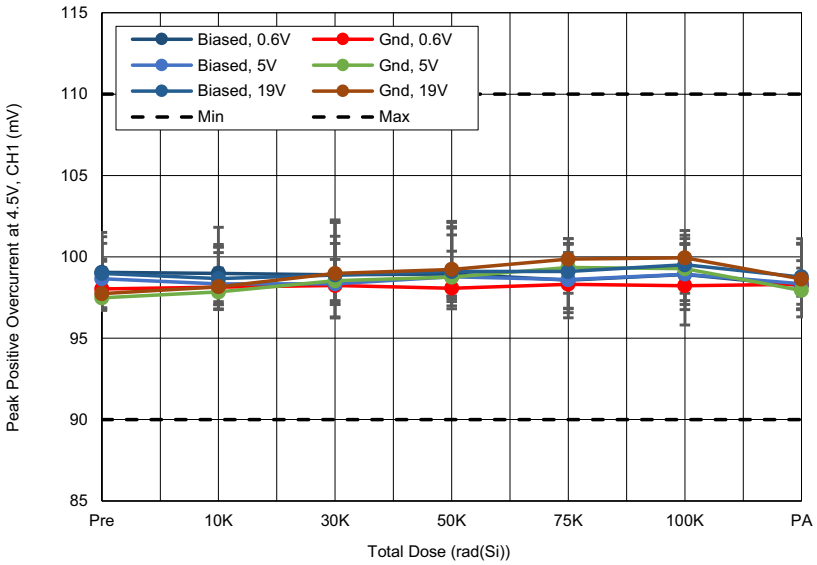


Figure 16. ISL73847SEH Channel 1 peak positive overcurrent (V_{POC}) with V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 90mV minimum and 110mV maximum.

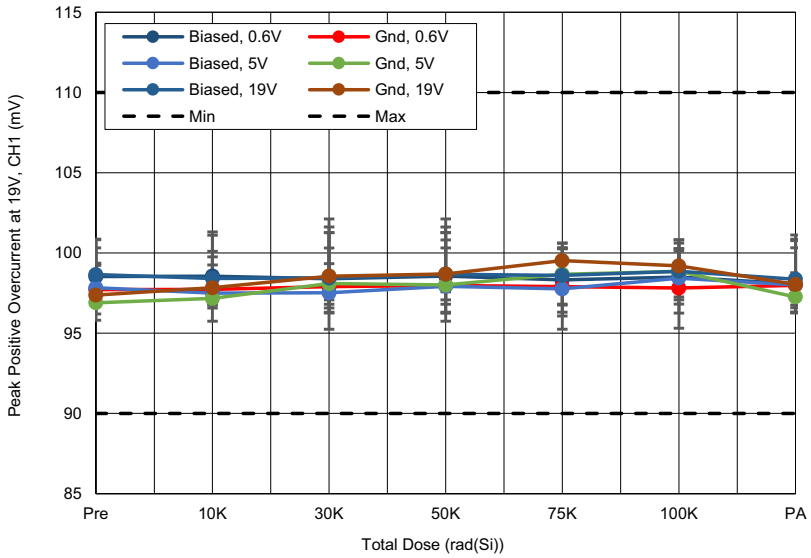


Figure 17. ISL73847SEH Channel 1 peak positive overcurrent (V_{POC}) with V_{DD} = 19V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 90mV minimum and 110mV maximum.

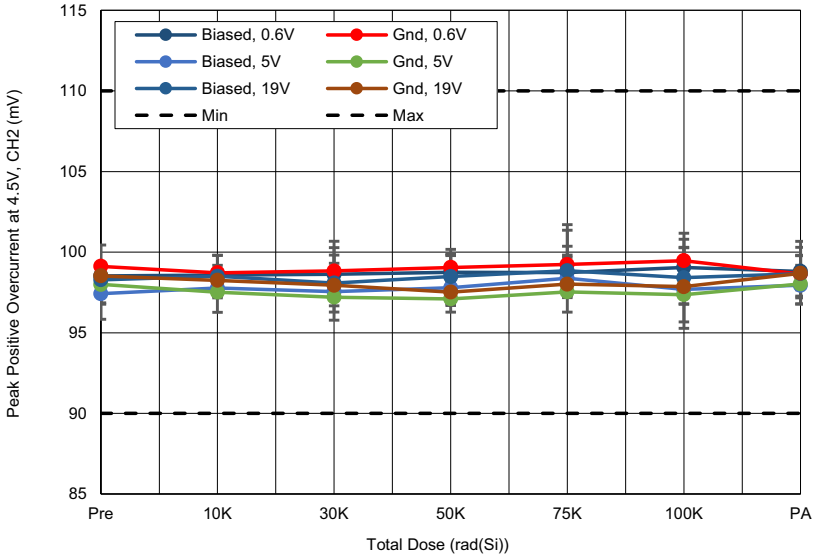


Figure 18. ISL73847SEH Channel 2 peak positive overcurrent (V_{POC}) with V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 90mV minimum and 110mV maximum.

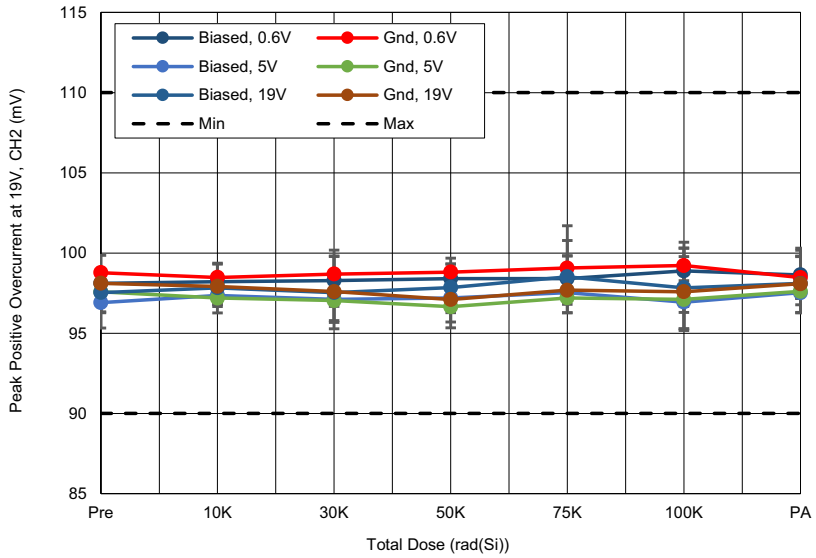


Figure 19. ISL73847SEH Channel 2 peak positive overcurrent (V_{POC}) with V_{DD} = 19V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 90mV minimum and 110mV maximum.

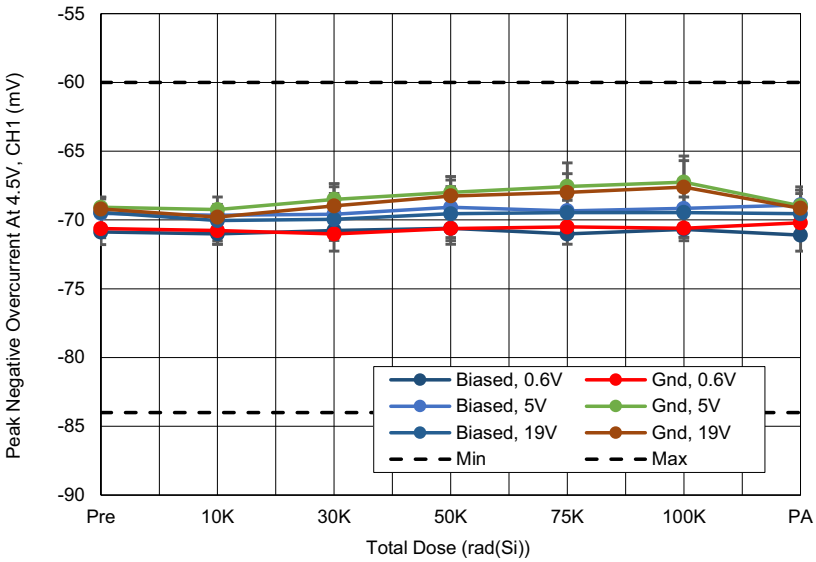


Figure 20. ISL73847SEH Channel 1 peak negative overcurrent (V_{NOC}) with V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -84mV minimum and -60mV maximum.

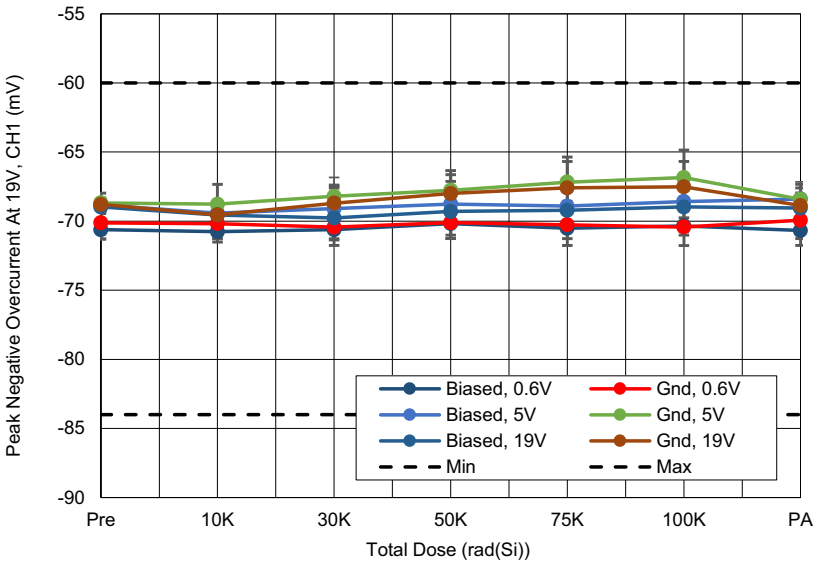


Figure 21. ISL73847SEH Channel 1 peak negative overcurrent (V_{NOC}) with V_{DD} = 19V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -84mV minimum and -60mV maximum.

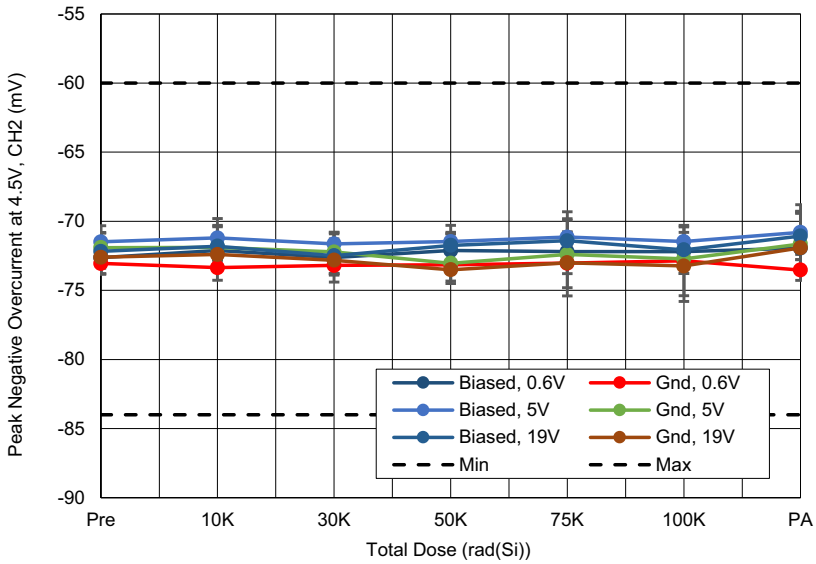


Figure 22. ISL73847SEH Channel 2 peak negative overcurrent (V_{NOC}) with V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -84mV minimum and -60mV maximum.

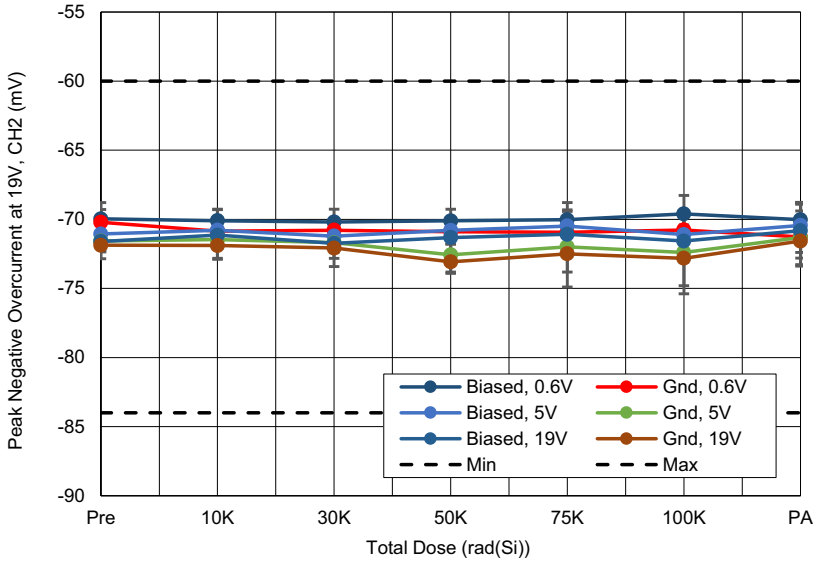


Figure 23. ISL73847SEH Channel 2 peak negative overcurrent (V_{NOC}) with V_{DD} = 19V; V_{CM} = 0.6V, 5.0V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -84mV minimum and -60mV maximum.

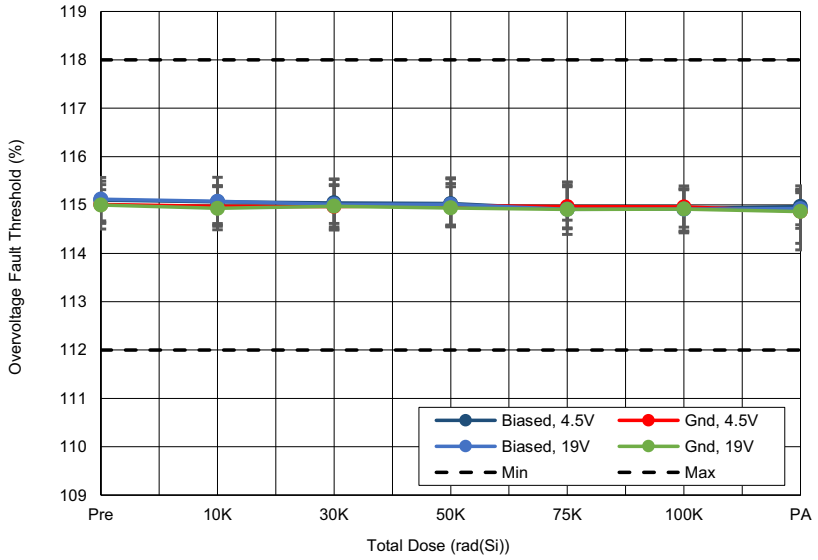


Figure 24. ISL73847SEH overvoltage fault threshold ($V_{FB, OV}$) with V_{DD} = 4.5V and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 112% minimum and 118% maximum.

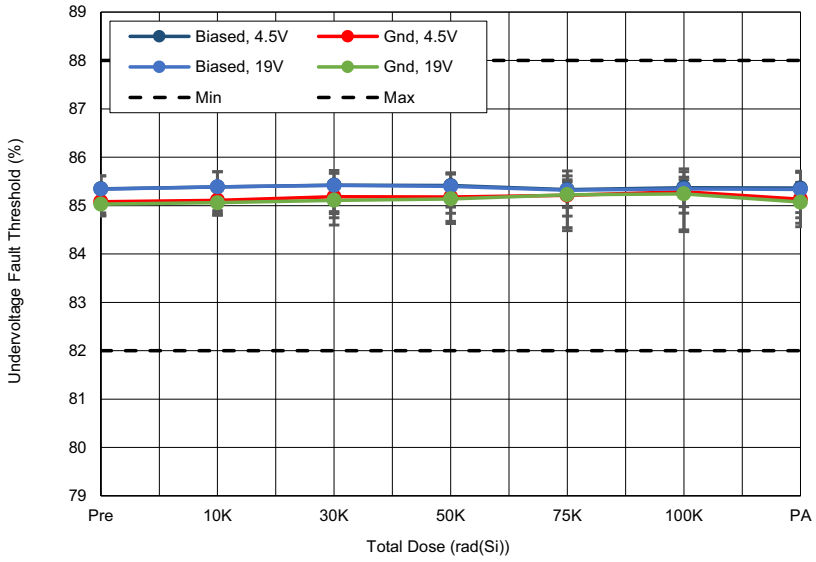


Figure 25. ISL73847SEH undervoltage fault threshold ($V_{FB, UV}$) with V_{DD} = 4.5V and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 82% minimum and 88% maximum.

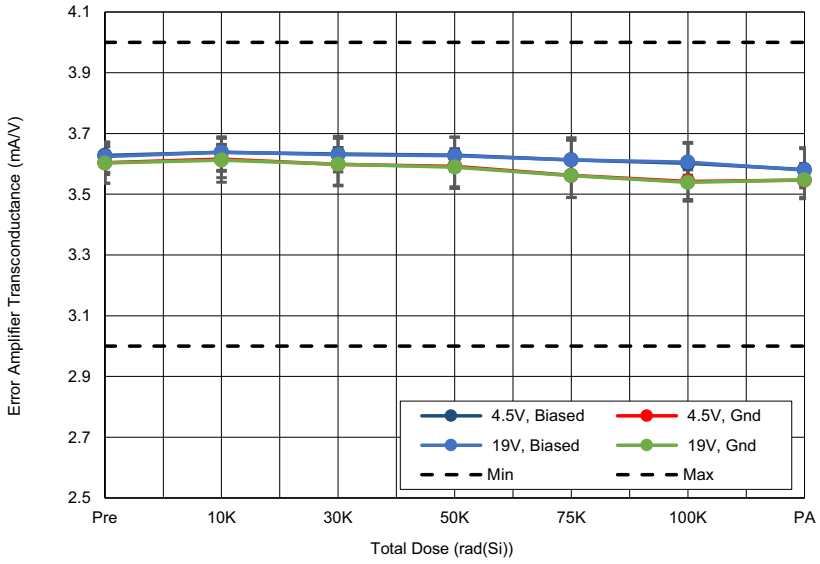


Figure 26. ISL73847SEH error amplifier transconductance (g_{m-EA}) with V_{DD} = 4.5V and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 3mA/V minimum and 4mA/V maximum.

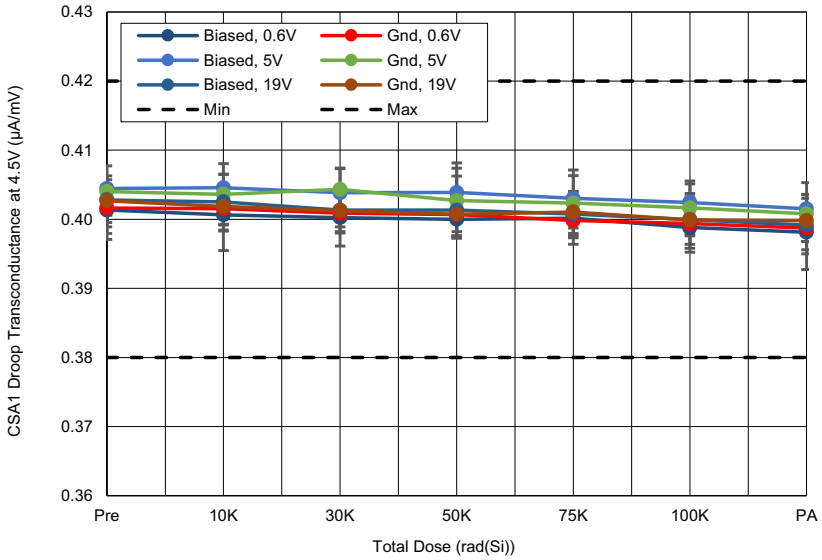


Figure 27. ISL73847SEH CSA1 droop transconductance ($g_{m(CSA, DRP)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.38µA/mV minimum and 0.42µA/mV maximum.

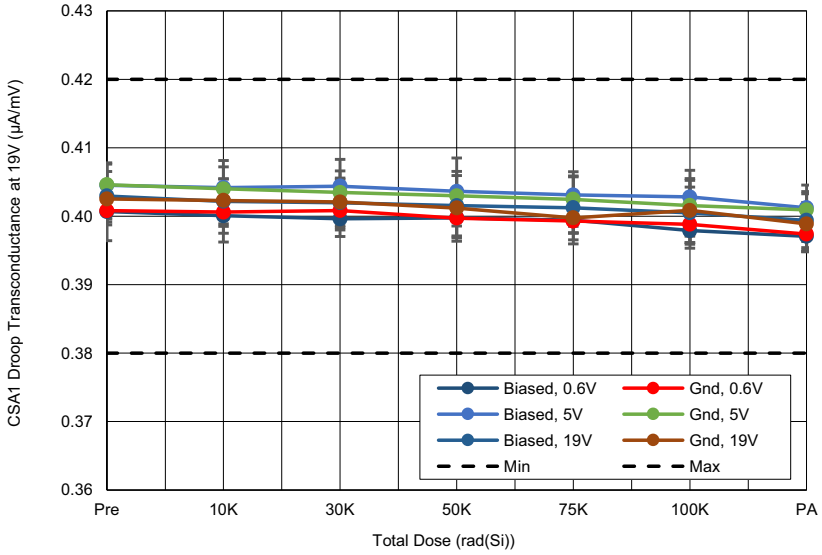


Figure 28. ISL73847SEH CSA1 droop transconductance ($g_{m(CSA,DRP)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.38µA/mV minimum and 0.42µA/mV maximum.

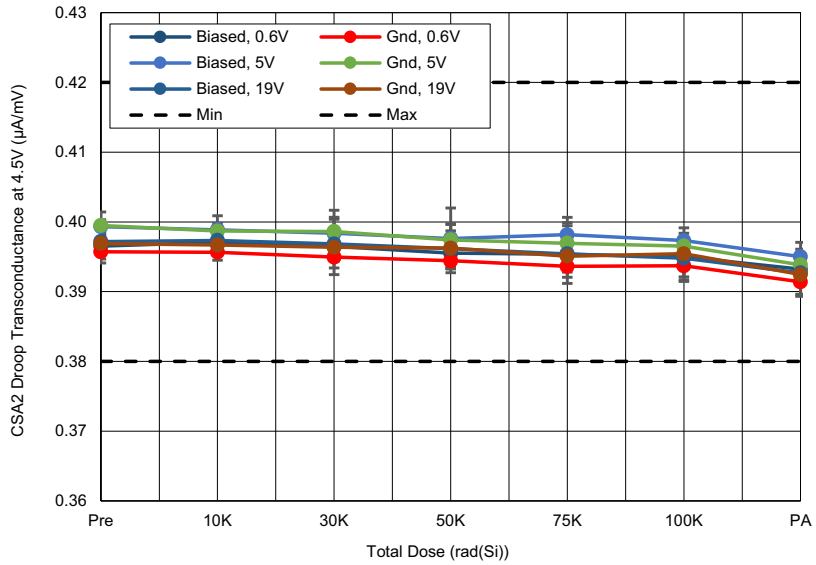


Figure 29. ISL73847SEH CSA2 droop transconductance ($g_{m(CSA,DRP)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.38µA/mV minimum and 0.42µA/mV maximum.

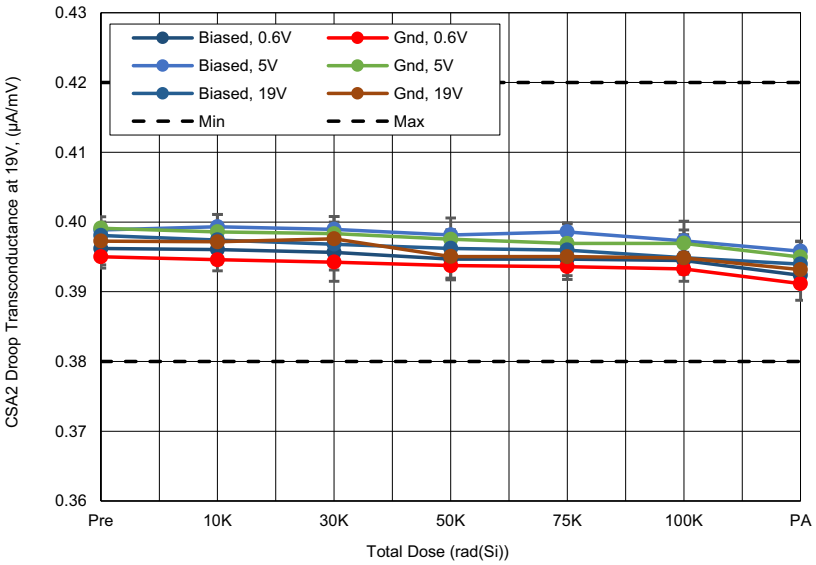


Figure 30. ISL73847SEH CSA2 droop transconductance ($g_{m(CSA,DRP)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.38µA/mV minimum and 0.42µA/mV maximum.

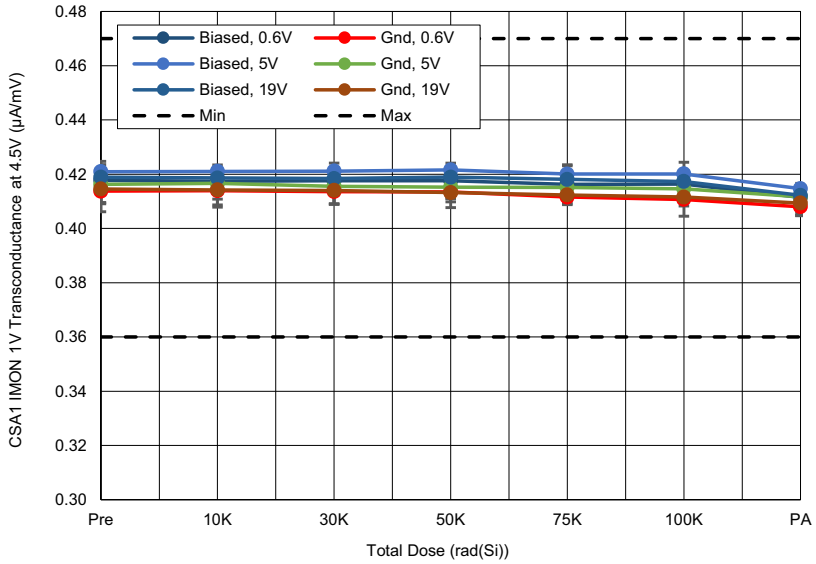


Figure 31. ISL73847SEH CSA1 IMON 1V transconductance ($g_{m(CSA, IMON)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.36µA/mV minimum and 0.47µA/mV maximum.

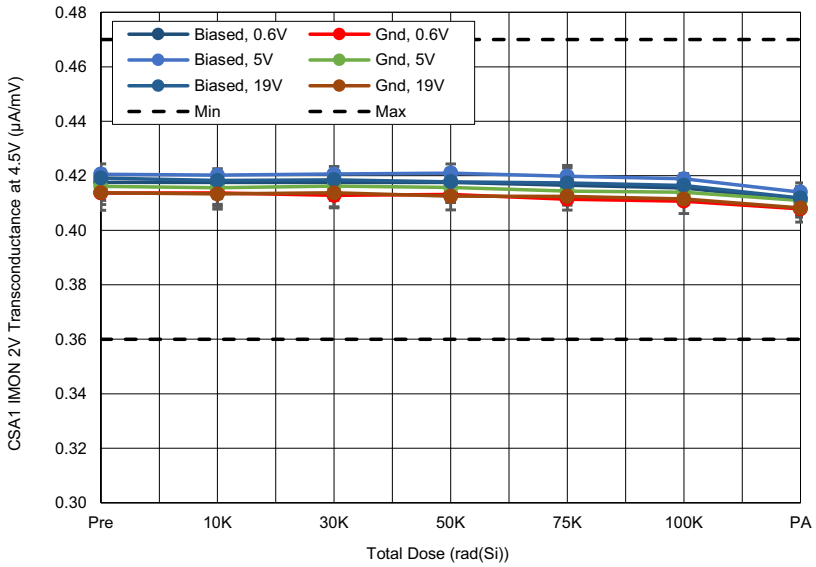


Figure 32. ISL73847SEH CSA1 IMON 2V transconductance ($g_{m(CSA, IMON)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.36µA/mV minimum and 0.47µA/mV maximum.

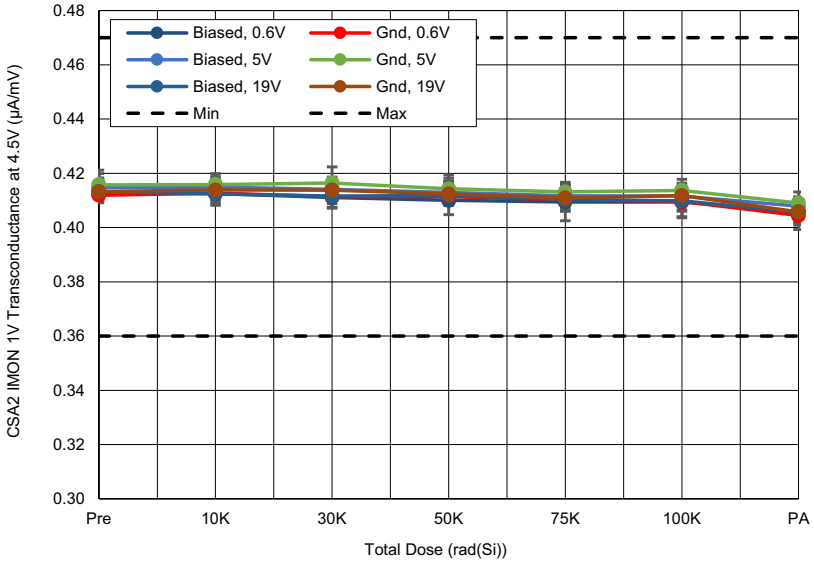


Figure 33. ISL73847SEH CSA2 IMON 1V transconductance ($g_{m(CSA, IMON)}$) with V_{DD} = 4.5V; $V_{(ISEN+,SEN-)}$ = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.36µA/mV minimum and 0.47µA/mV maximum.

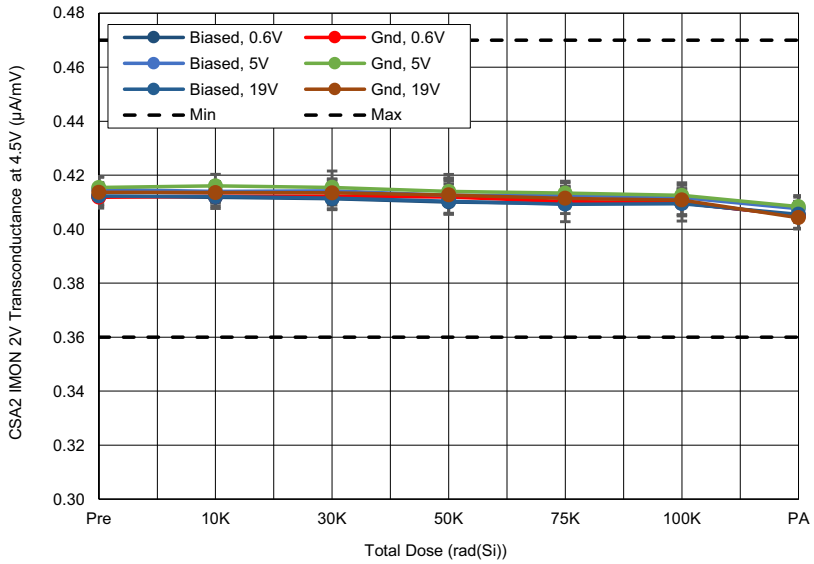


Figure 34. ISL73847SEH CSA2 IMON 2V transconductance ($g_{m(CSA, IMON)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.36µA/mV minimum and 0.47µA/mV maximum.

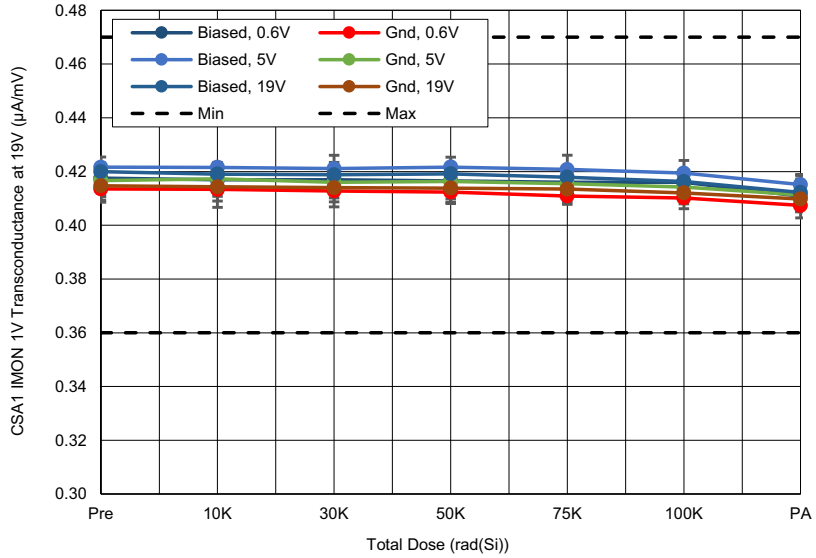


Figure 35. ISL73847SEH CSA1 IMON 1V transconductance ($g_{m(CSA, IMON)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.36µA/mV minimum and 0.47µA/mV maximum.

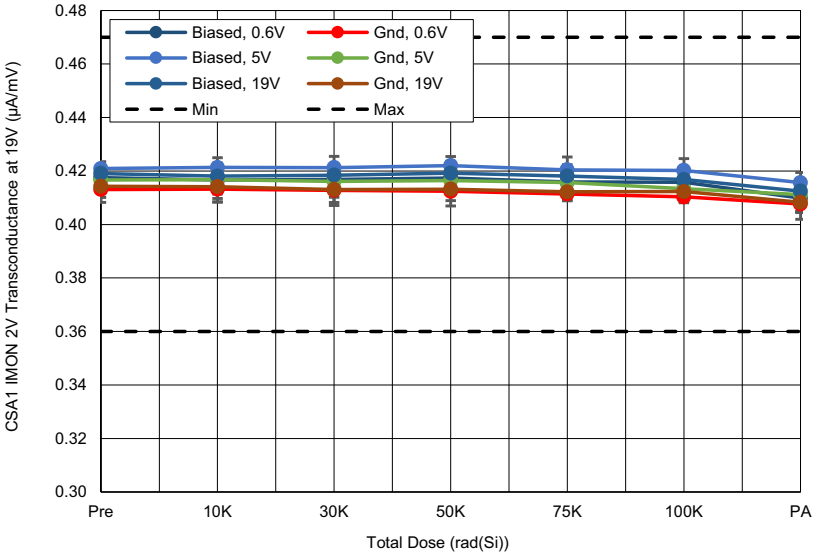


Figure 36. ISL73847SEH CSA1 IMON 2V transconductance ($g_{m(CSA,IMON)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.36µA/mV minimum and 0.47µA/mV maximum.

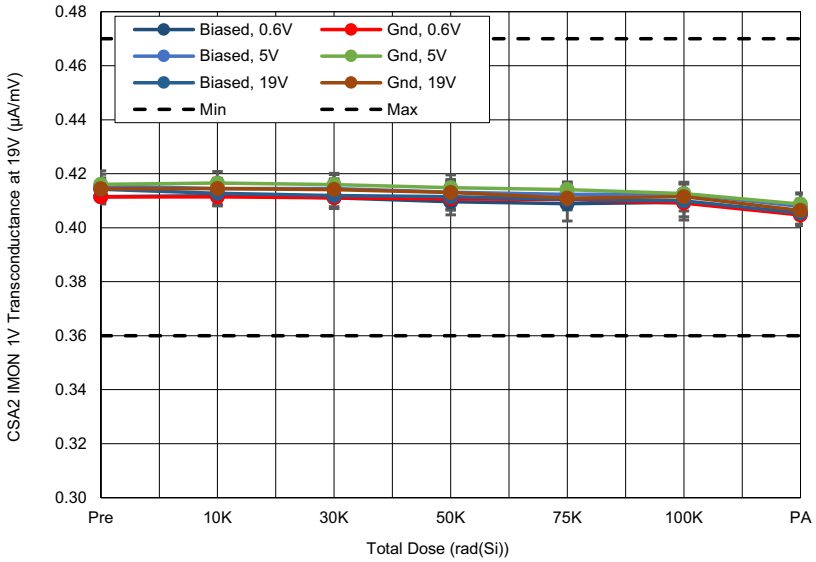


Figure 37. ISL73847SEH CSA2 IMON 1V transconductance ($g_{m(CSA,IMON)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.36µA/mV minimum and 0.47µA/mV maximum.

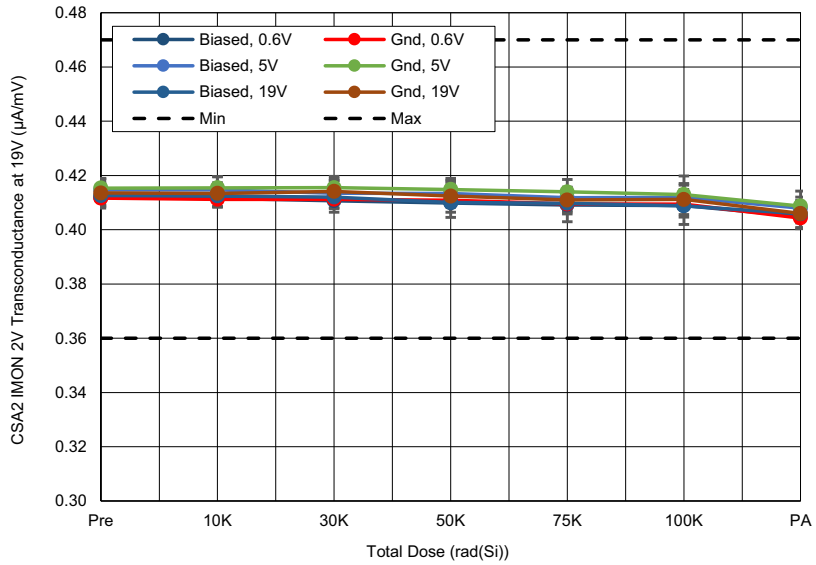


Figure 38. ISL73847SEH CSA2 IMON 2V transconductance ($g_{m(CSA,IMON)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV and 50mV, V_{CM} = 0.6V, 5.0V, and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.36µA/mV minimum and 0.47µA/mV maximum.

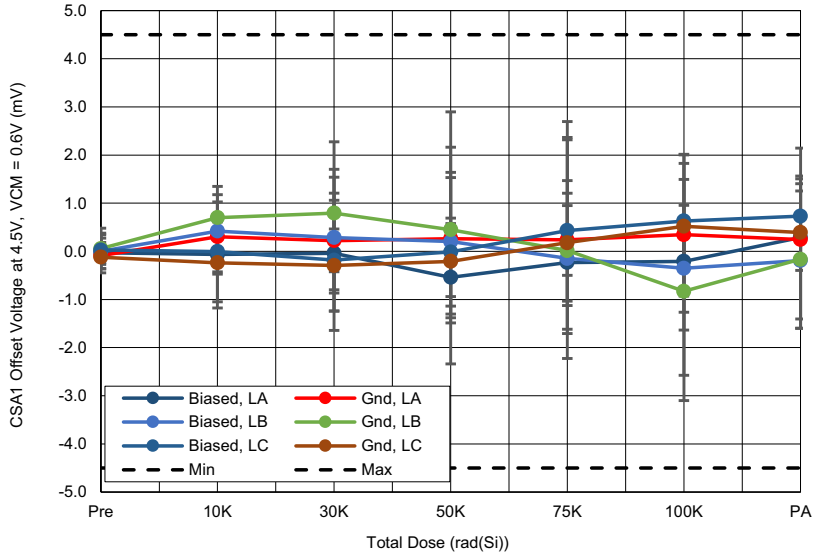


Figure 39. ISL73847SEH CSA1 (LA, LB, LC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 0.6V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

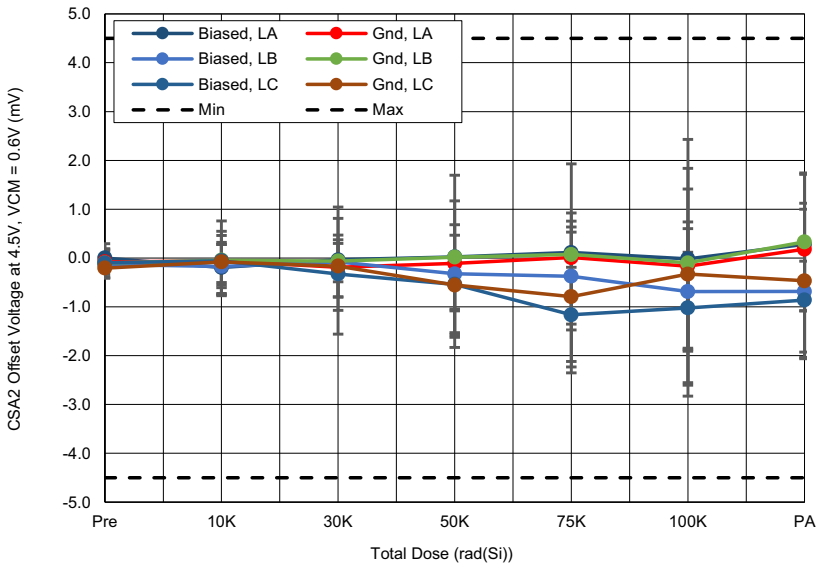


Figure 40. ISL73847SEH CSA2 (LA, LB, LC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 0.6V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

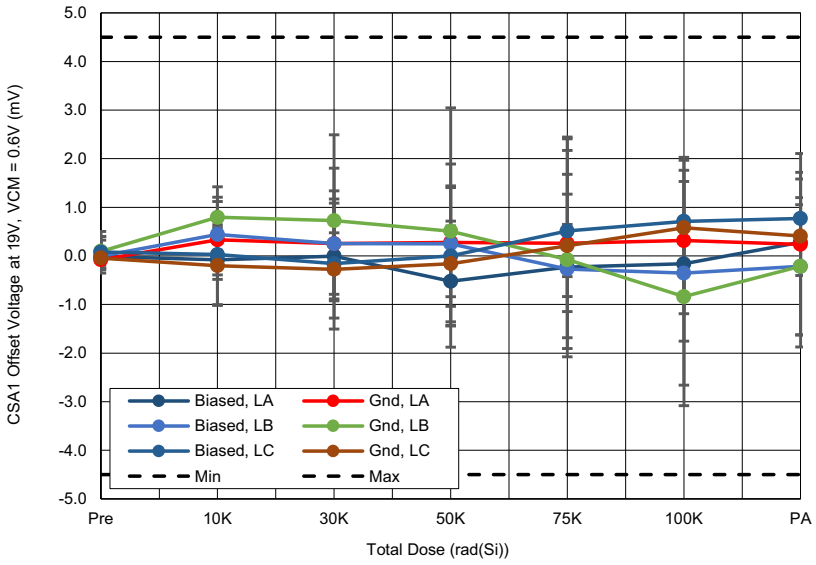


Figure 41. ISL73847SEH CSA1 (LA, LB, LC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 0.6V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

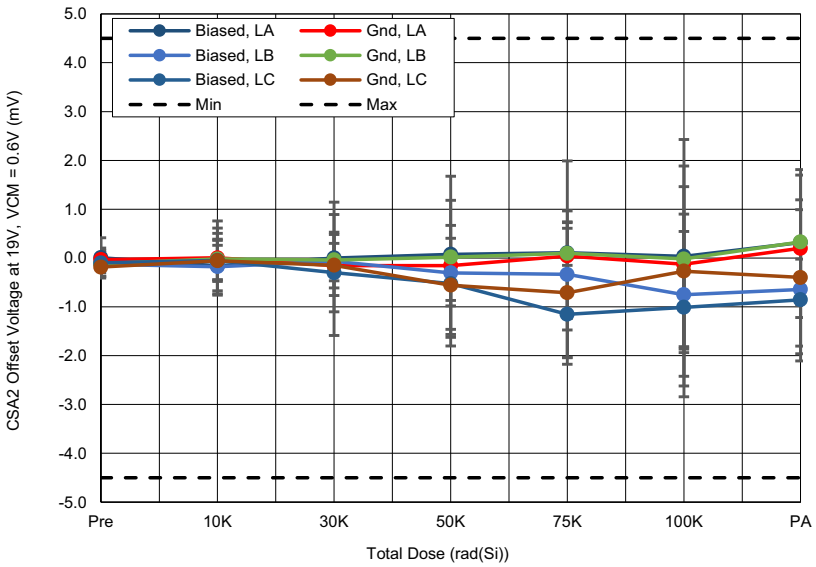


Figure 42. ISL73847SEH CSA2 (LA, LB, LC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 0.6V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

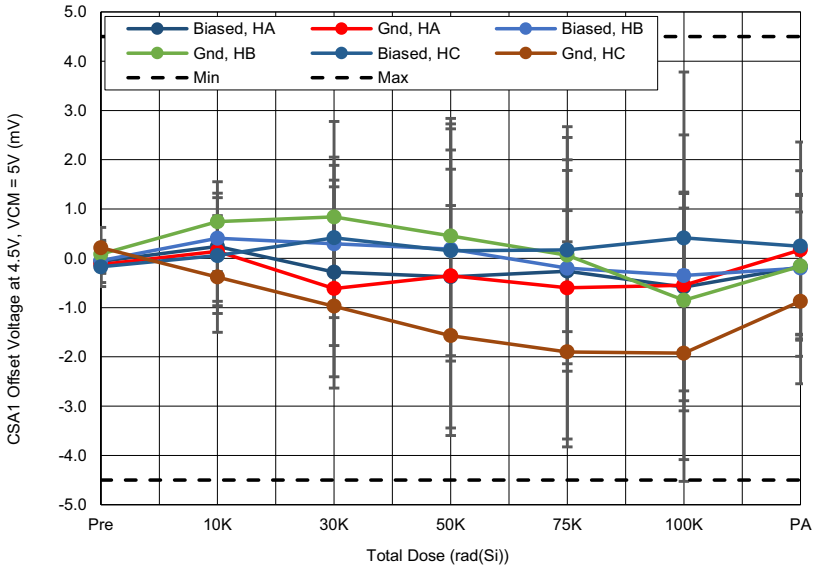


Figure 43. ISL73847SEH CSA1 (HA, HB, HC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 5V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

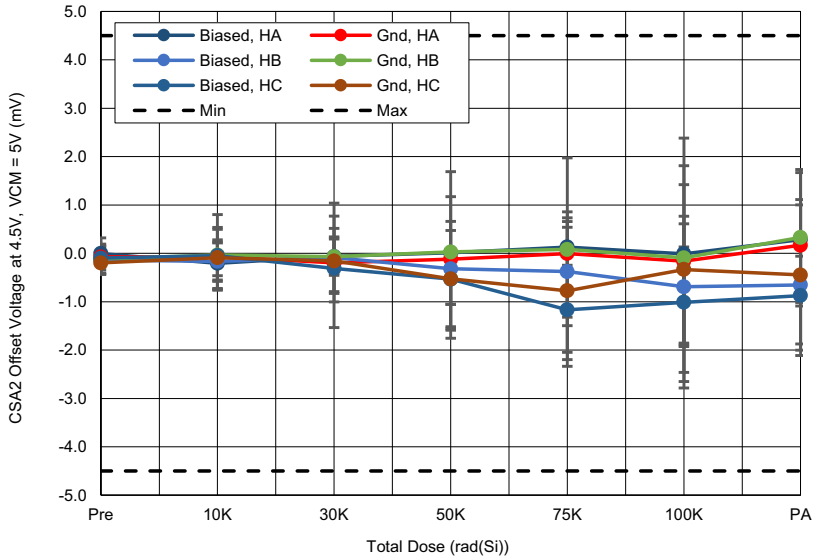


Figure 44. ISL73847SEH CSA2 (HA, HB, HC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 5V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

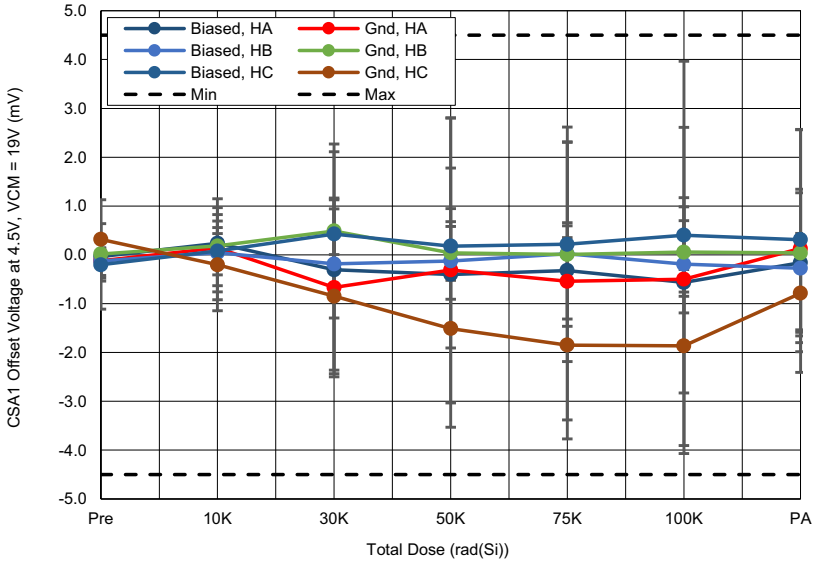


Figure 45. ISL73847SEH CSA1 (HA, HB, HC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 5V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

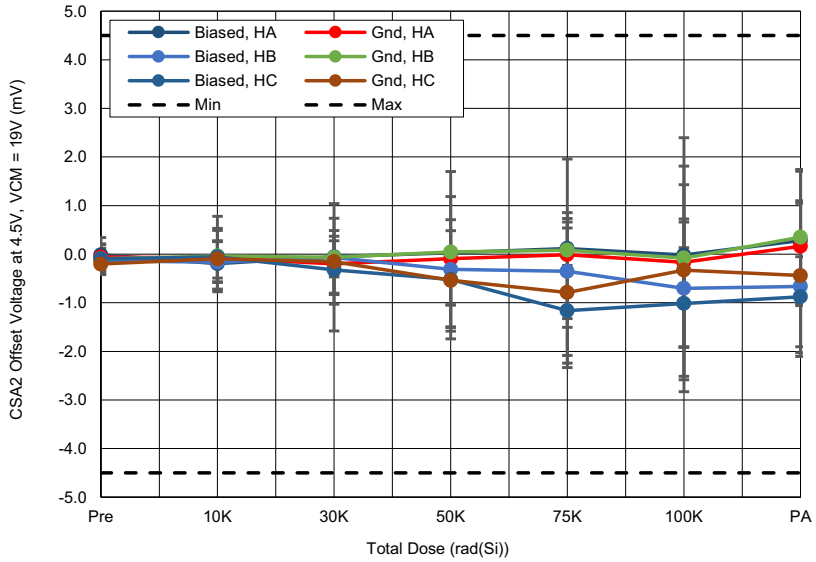


Figure 46. ISL73847SEH CSA2 (HA, HB, HC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 5V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

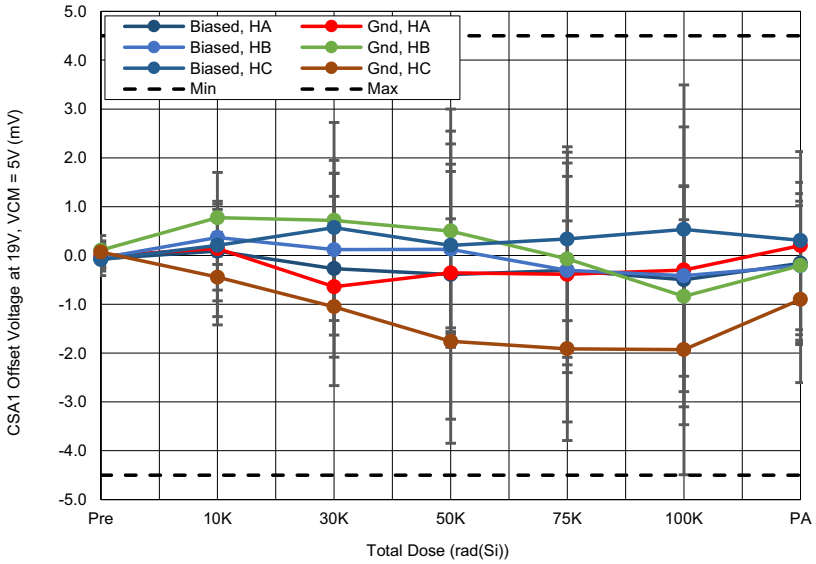


Figure 47. ISL73847SEH CSA1 (HA, HB, HC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 4.5V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

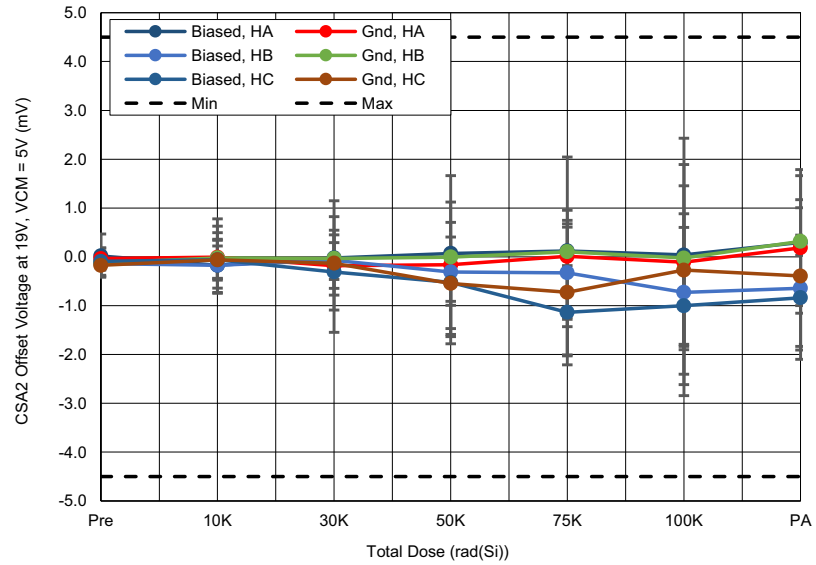


Figure 48. ISL73847SEH CSA2 (HA, HB, HC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 4.5V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

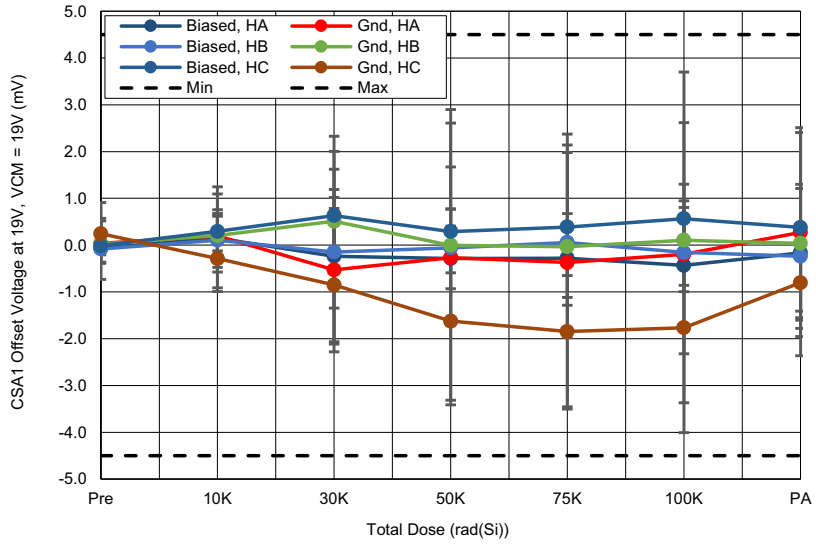


Figure 49. ISL73847SEH CSA1 (HA, HB, HC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 19V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

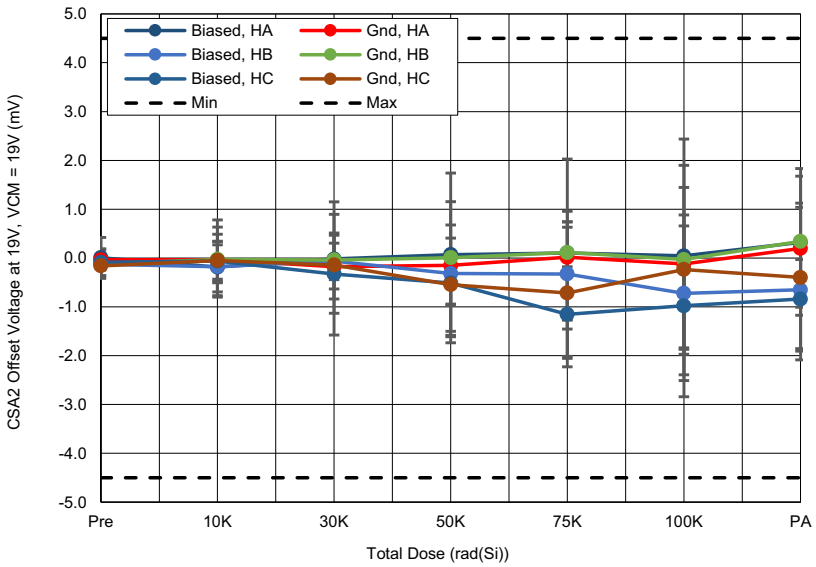


Figure 50. ISL73847SEH CSA2 (HA, HB, HC) offset voltage ($V_{OS(CSA)}$) with V_{DD} = 19V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are -4.5mV minimum and 4.5mV maximum.

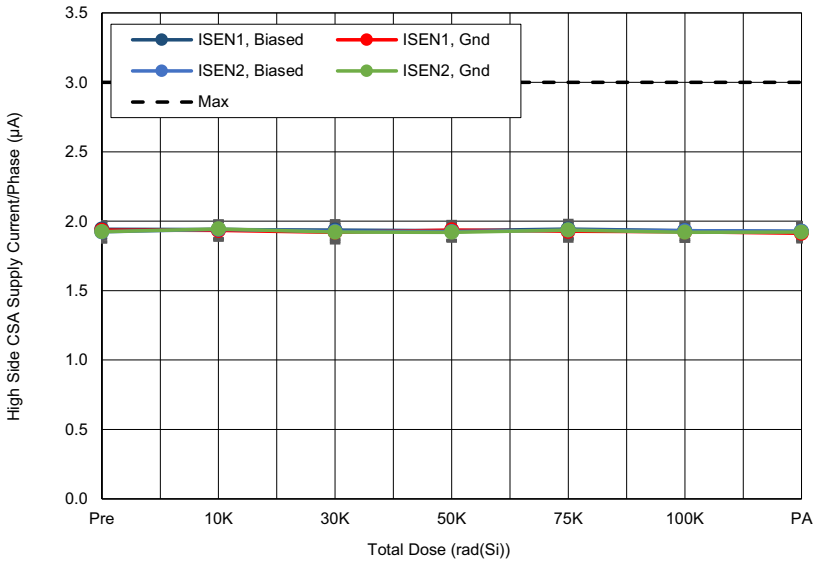


Figure 51. ISL73847SEH high-side CSA supply current per phase (I_{CSA}) with V_{DD} = 19V, EN = 3.3V, V_{CM} = 2.7V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limit is 3µA maximum.

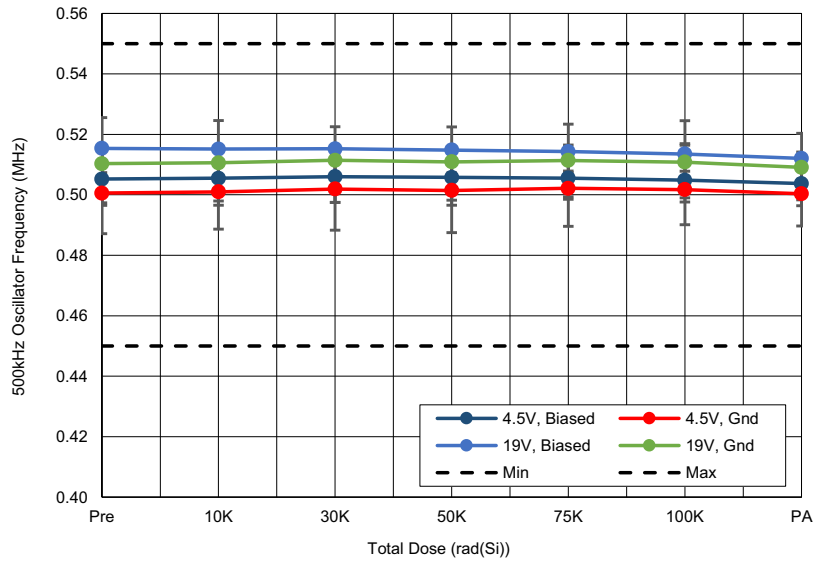


Figure 52. ISL73847SEH frequency range for 500kHz Oscillator ($f_{OSC-0.5M}$) with V_{DD} = 4.5V and 19V; R_{FS} = 205kΩ; EN = 3.3V; R_{SYNC-O} = 100kΩ to GND, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.45MHz minimum and 0.55MHz maximum.

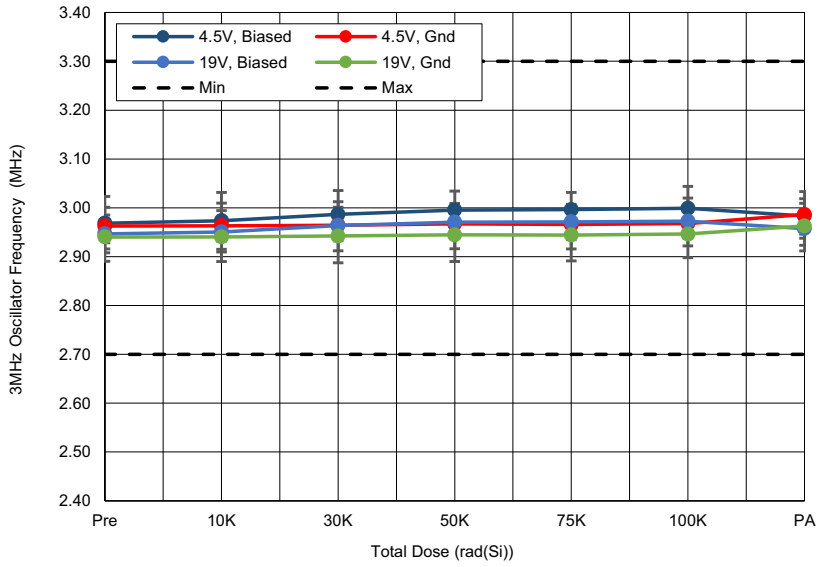


Figure 53. ISL73847SEH frequency range for 3MHz Oscillator (f_{OSC-3M}) with V_{DD} = 4.5V and 19V; R_{FS} = 16.7kΩ; EN = 3.3V; R_{SYNC-O} = 100kΩ to GND, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 2.7MHz minimum and 3.3MHz maximum.

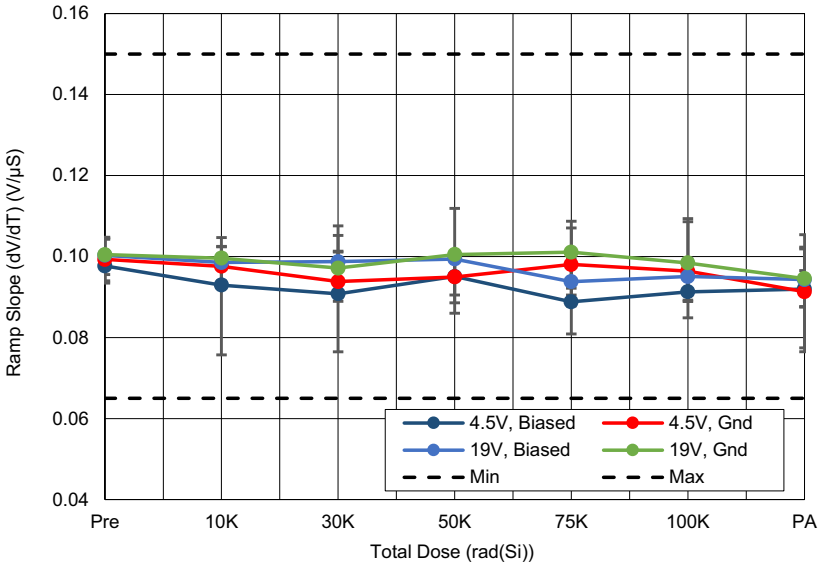


Figure 54. ISL73847SEH slope generator ramp slope ($V_{RAMP-SLOPE}$) with V_{DD} = 4.5V and 19V; f_{SW} = 500kHz; V_{SLOPE} = 0.4V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.065V/µs minimum and 0.15V/µs maximum.

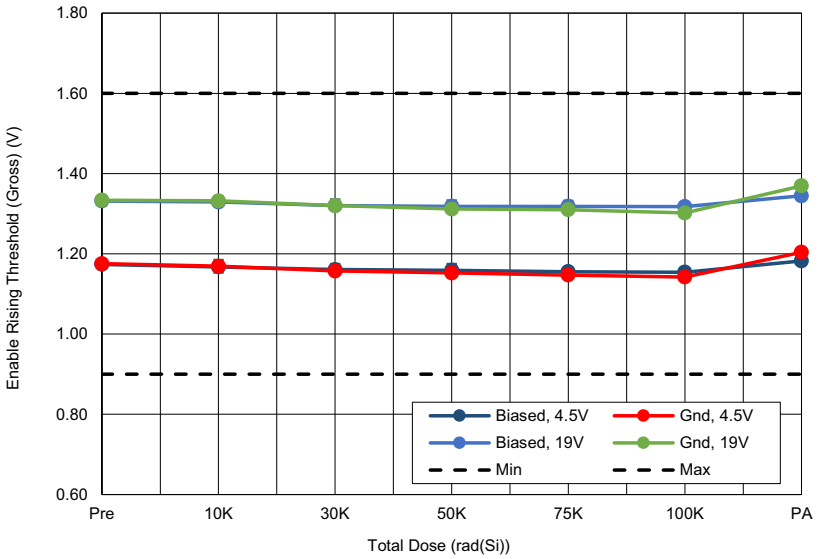


Figure 55. ISL73847SEH rising enable threshold (Gross) ($V_{IH-EN-G}$) with V_{DD} = 4.5V and 19V; FS = V_{CC}, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.9V minimum and 1.6V maximum.

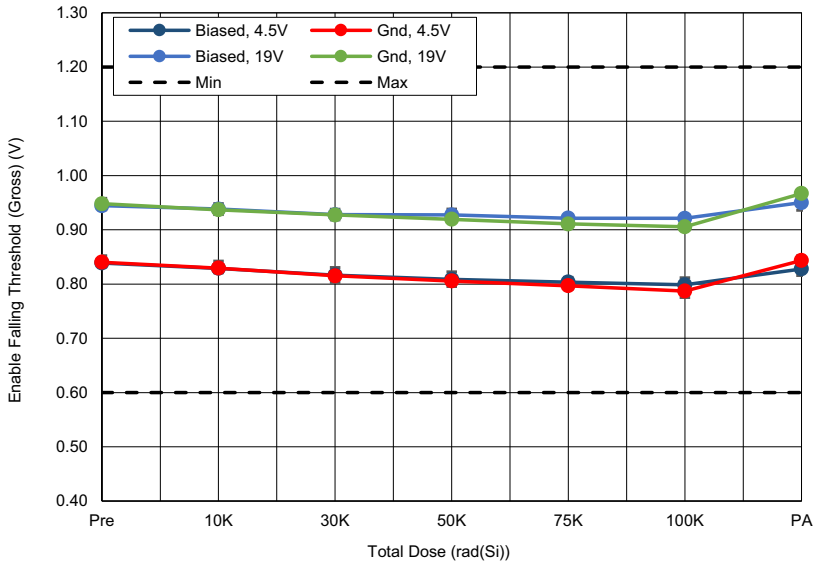


Figure 56. ISL73847SEH falling enable threshold (Gross) ($V_{IL-EN-G}$) with V_{DD} = 4.5V and 19V; FS = V_{CC}, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 0.6V minimum and 1.2V maximum.

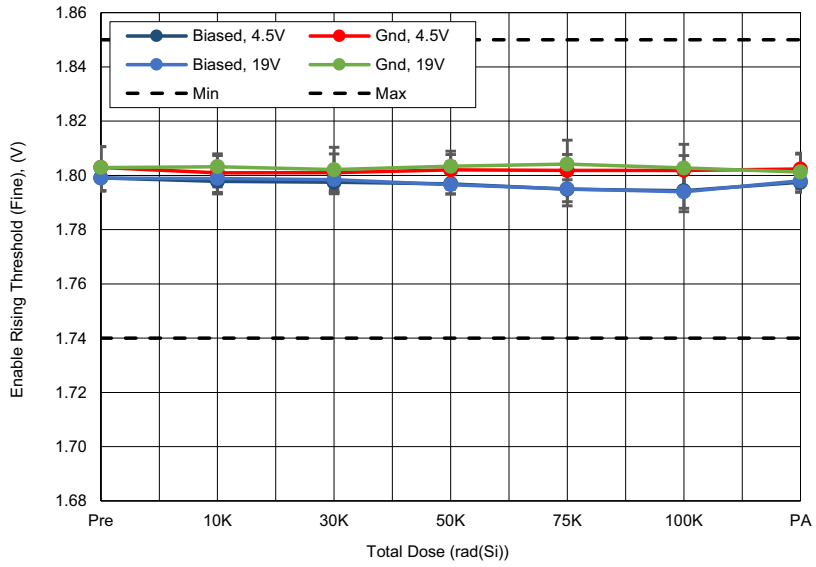


Figure 57. ISL73847SEH rising enable threshold (Fine) ($V_{IH-EN-F}$) with V_{DD} = 4.5V and 19V; FS = V_{CC}, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 1.74V minimum and 1.85V maximum.

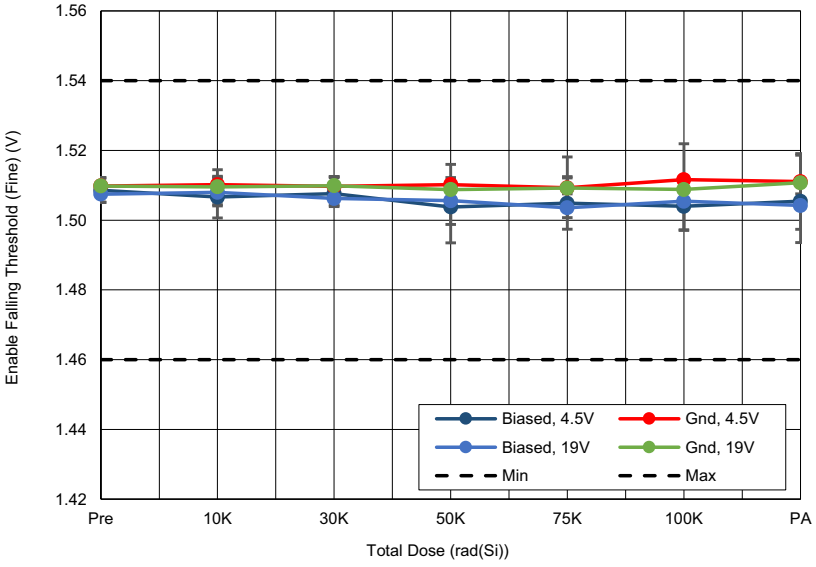


Figure 58. ISL73847SEH falling enable threshold (Fine) ($V_{IL-EN-F}$) with V_{DD} = 4.5V and 19V; FS = V_{CC}, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 1.46V minimum and 1.54V maximum.

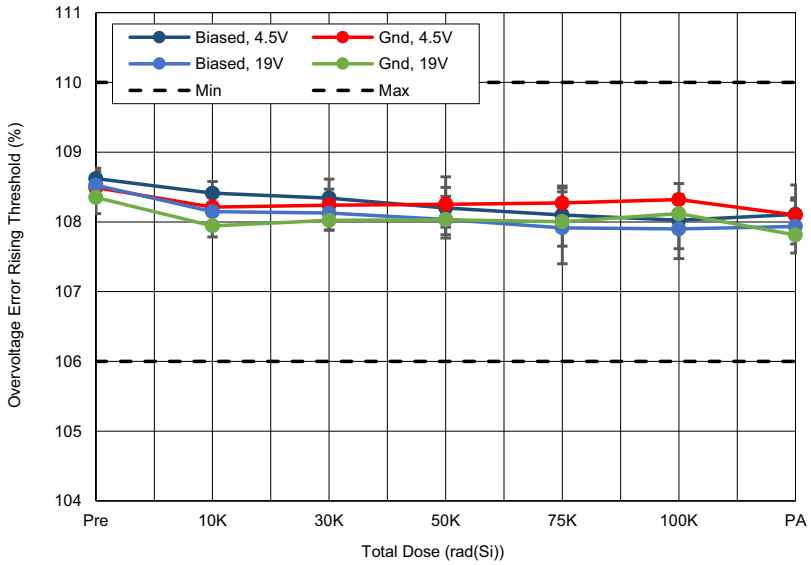


Figure 59. ISL73847SEH overvoltage error threshold rising (V_{OVH}) with V_{DD} = 4.5V and 19V; EN = 3.3V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 106% minimum and 110% maximum.

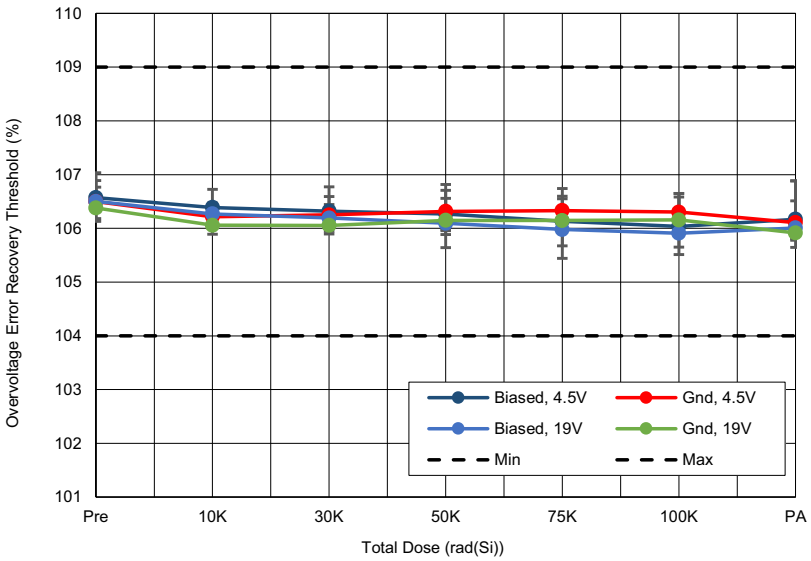


Figure 60. ISL73847SEH overvoltage error threshold recovery (V_{OVL}) with V_{DD} = 4.5V and 19V; EN = 3.3V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 104% minimum and 109% maximum.

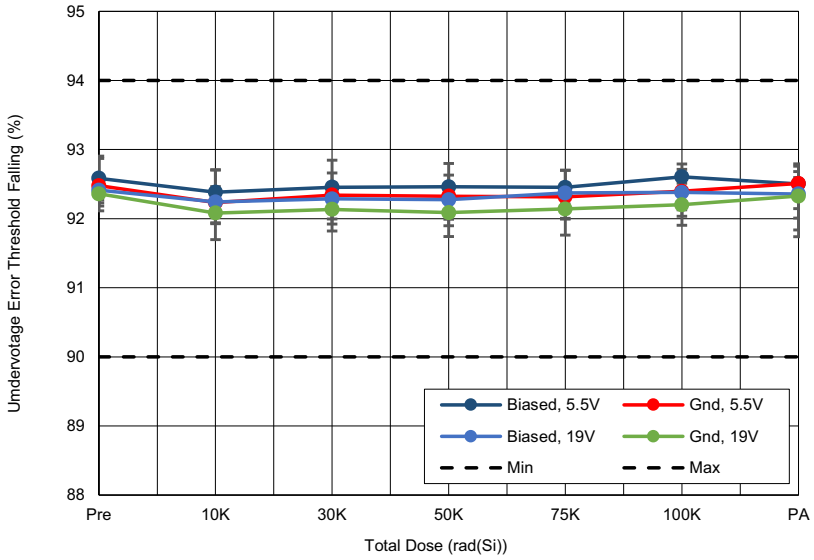


Figure 61. ISL73847SEH undervoltage error threshold (V_{UVL}) with V_{DD} = 4.5V and 19V; EN = 3.3V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 90% minimum and 94% maximum.

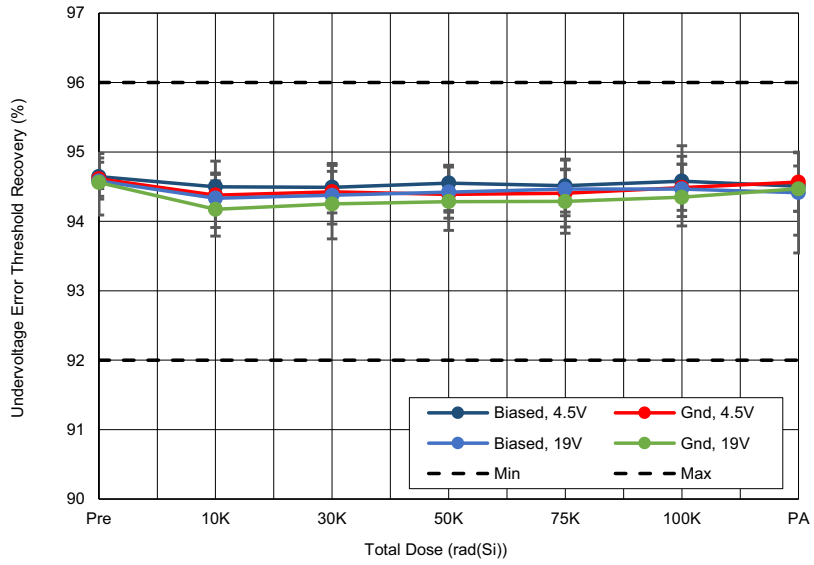


Figure 62. ISL73847SEH undervoltage error threshold recovery (V_{UVH}) with V_{DD} = 4.5V and 19V; EN = 3.3V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 92% minimum and 96% maximum.

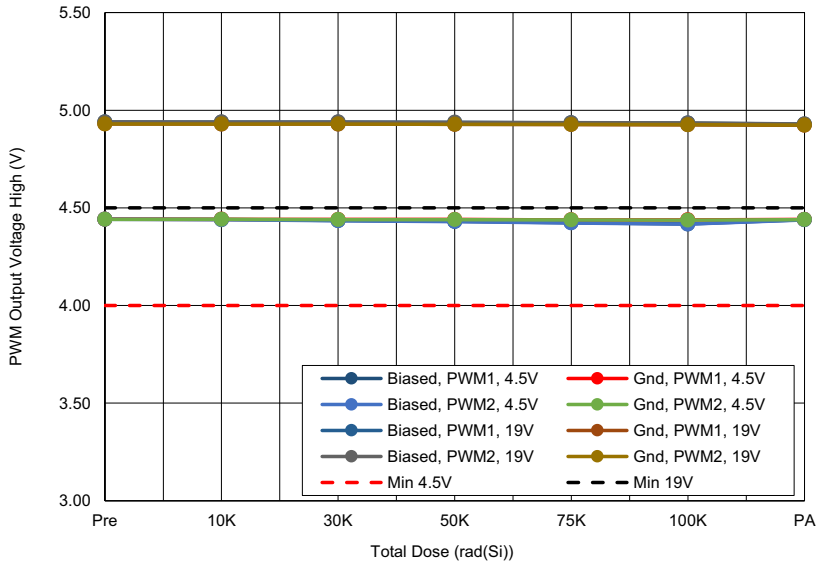


Figure 63. ISL73847SEH PWM output voltage high (V_{OH}) with V_{DD} = 4.5V and 19V; I_{PWM} = -500µA as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 4V minimum for V_{DD} = 4.5V and 4.5V minimum for V_{DD} = 19V.

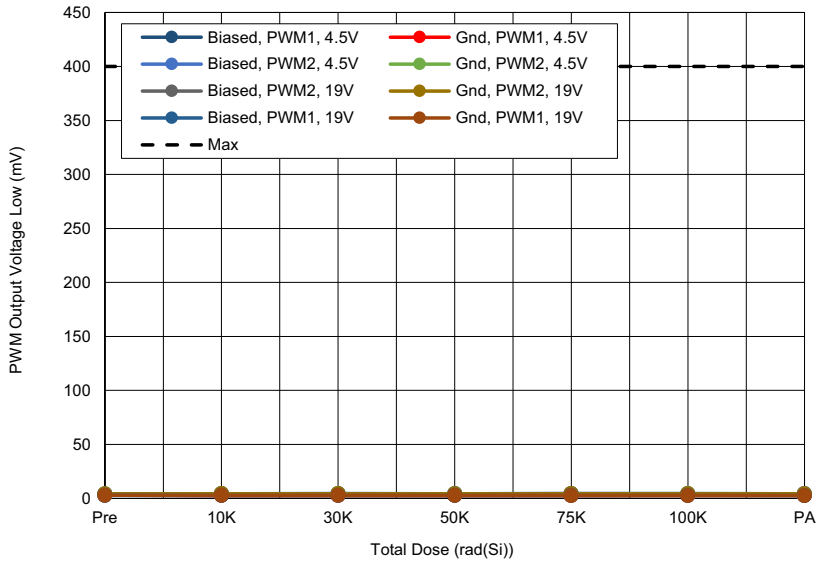


Figure 64. ISL73847SEH PWM output voltage low (V_{OL}) with V_{DD} = 4.5V and 19V; I_{PWM} = +500µA as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limit is 400mV maximum.

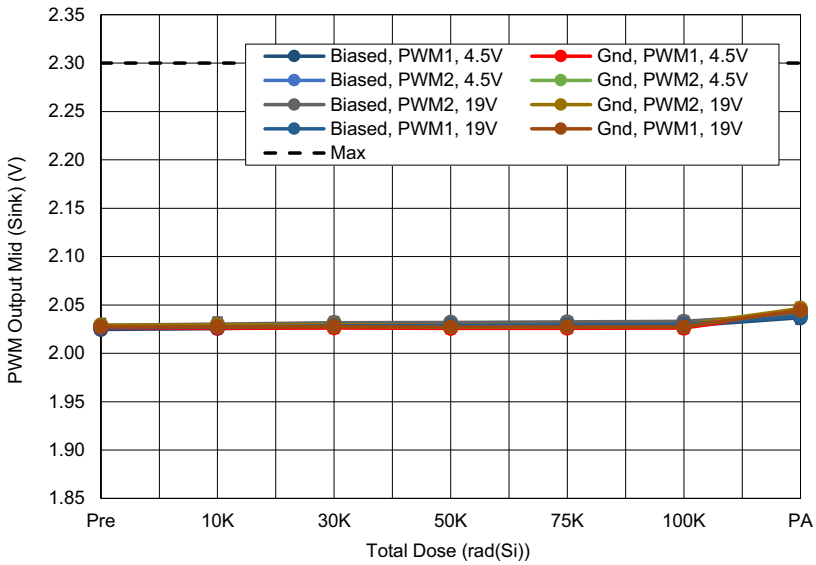


Figure 65. ISL73847SEH PWM output voltage mid sink (V_{OZ}) with V_{DD} = 4.5V and 19V; I_{PWM} = -100µA, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limit is 2.3V maximum.

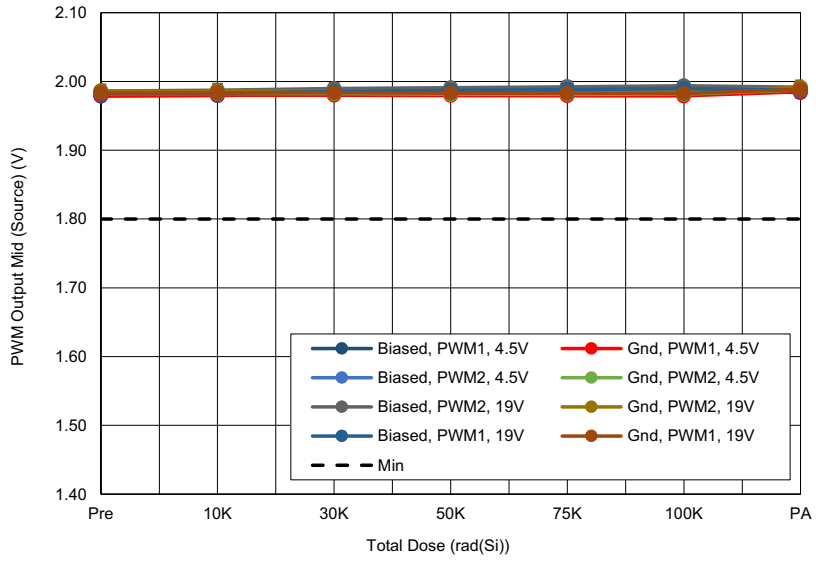


Figure 66. ISL73847SEH PWM output voltage mid source (V_{OZ}) with V_{DD} = 4.5V and 19V; I_{PWM} = +100µA, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limit is 1.8V minimum.

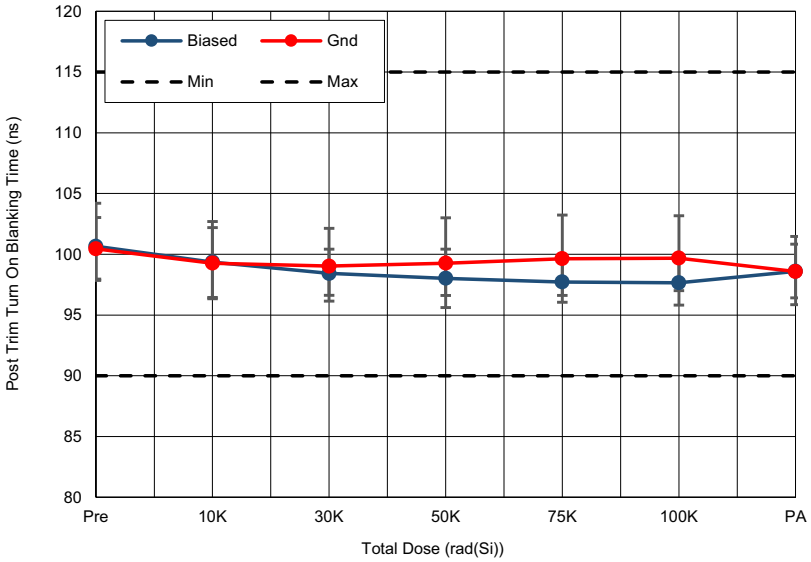


Figure 67. ISL73847SEH post trim turn on blanking time ($t_{MINONBLK}$) as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 90ns minimum and 115ns maximum.

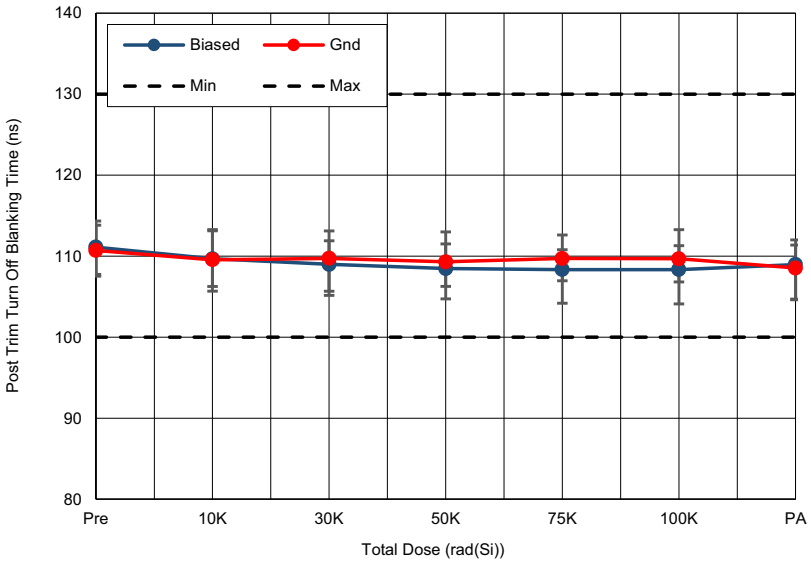


Figure 68. ISL73847SEH post trim turn off blanking time ($t_{MINOFFBLK}$) as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 100ns minimum and 130ns maximum.

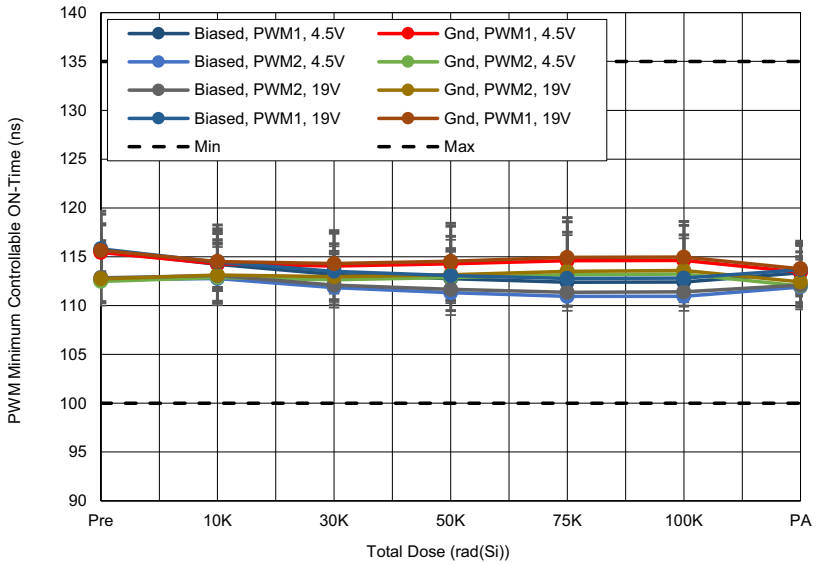


Figure 69. ISL73847SEH PWM minimum controllable ON-time ($t_{MINCTRLON}$) with V_{DD} = 4.5V and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 100ns minimum and 135ns maximum.

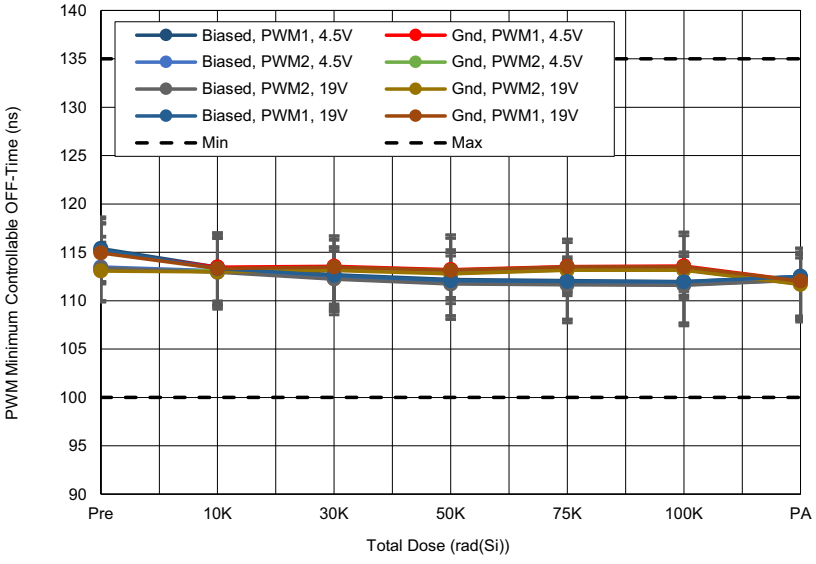


Figure 70. ISL73847SEH PWM minimum controllable OFF-time ($t_{MINCTRLOFF}$) with V_{DD} = 4.5V and 19V, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 100ns minimum and 135ns maximum.

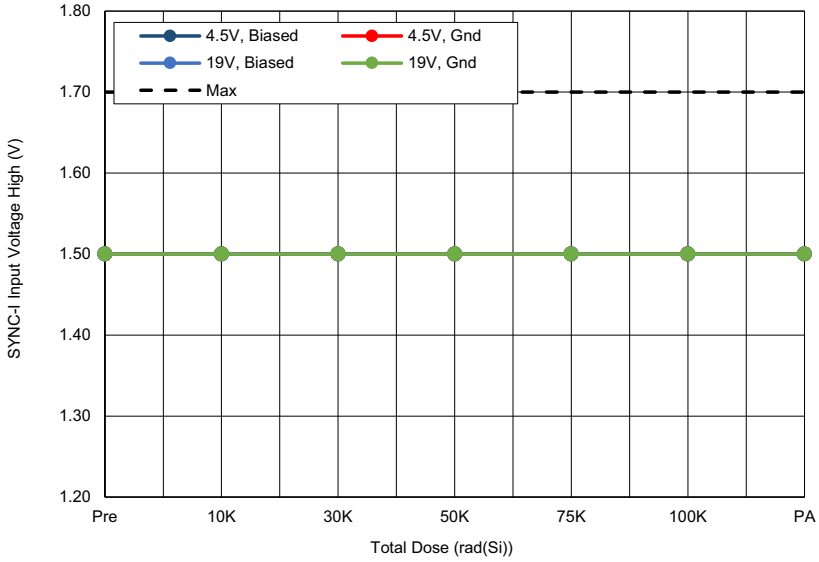


Figure 71. ISL73847SEH SYNC-I input voltage high (V_{SYNCH}) with V_{DD} = 4.5V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limit is 1.7V maximum.

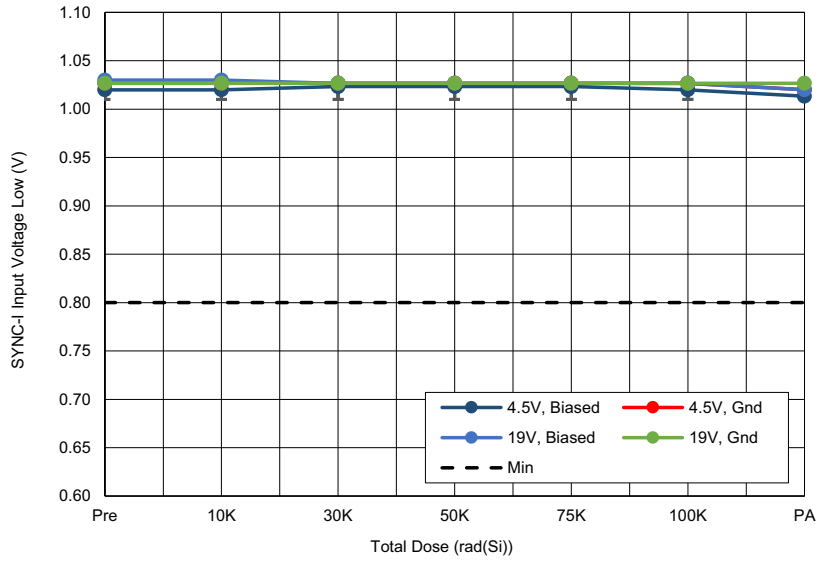


Figure 72. ISL73847SEH SYNC-I input voltage low (V_{SYNCL}) with V_{DD} = 4.5V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limit is 0.8V minimum.

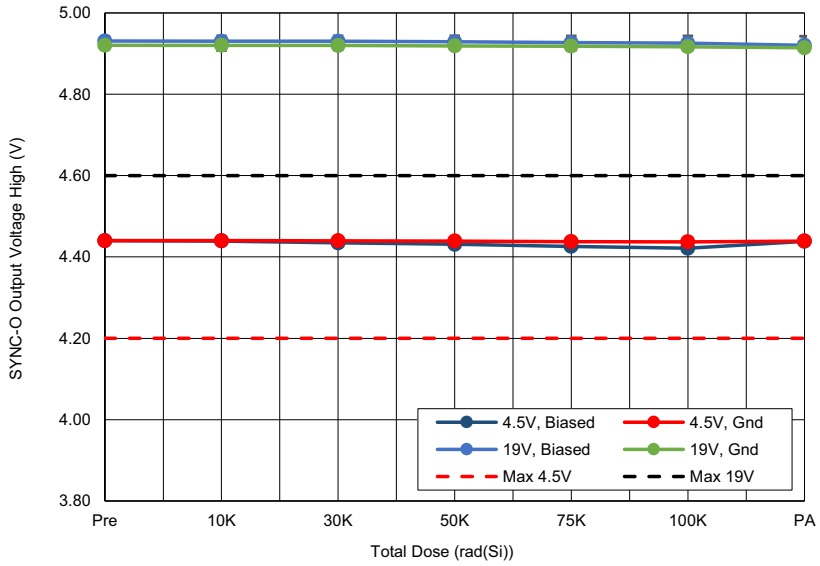


Figure 73. ISL73847SEH SYNC-O output voltage high ($V_{SYNC-OH}$) with V_{DD} = 4.5V and 19V; I_{SYNC-O} = -500µA, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 4.2V minimum for V_{DD} = 4.5V and 4.6V minimum for V_{DD} = 19V.

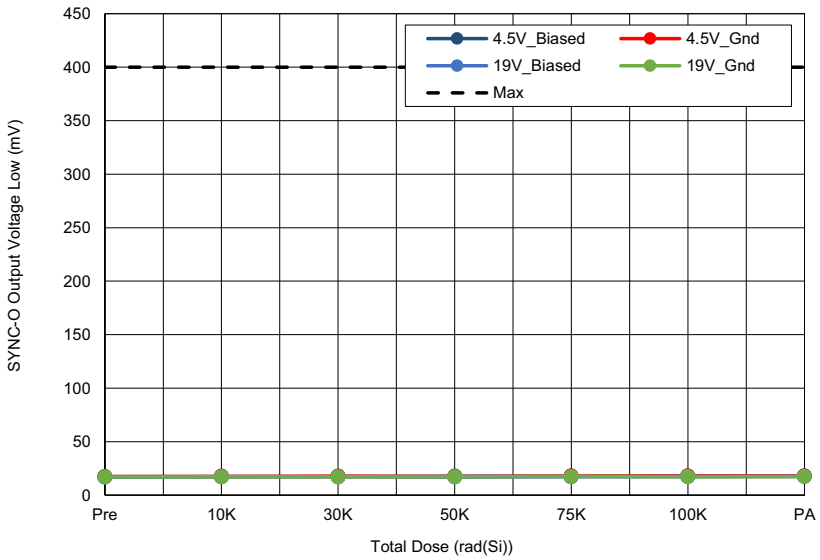


Figure 74. ISL73847SEH SYNC-O output voltage low ($V_{SYNC-OL}$) with V_{DD} = 4.5V and 19V; I_{SYNC-O} = +500µA, as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limit is 400mV maximum.

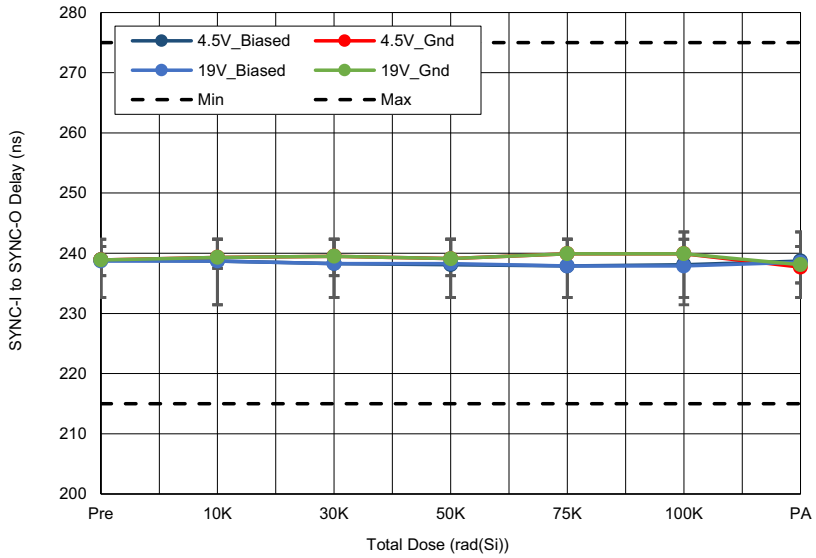


Figure 75. ISL73847SEH SYNC-I to SYNC-O delay ($t_{SYNC-DLY}$) with V_{DD} = 4.5V and 19V as a function of LDR irradiation and anneal for biased and grounded configurations. The error bars (if visible) represent the minimum and maximum measured values. The post-irradiation datasheet limits are 215ns minimum and 275ns maximum.

3. Discussion and Conclusion

We report the results of LDR total dose testing of critical, selected parameters of the ISL73847SEH synchronous buck controller. Attributes Data summarizes the attributes data for the test and Key Parameter Variables Data provides plots of the total dose response for the selected parameters.

All tested datasheet parameters passed at all downpoints up to and including the datasheet guaranteed level of 75krad(Si); however, there were some parametric failures at 100krad(Si). A biased unit slightly exceeded the LDO dropout voltage of 250mV, measuring 251.7mA, as shown in Figure 6.

Another part that was grounded during exposure, slightly failed the minimum limit on a high-side offset voltage test (-4.53mV versus -4.5mV). This can be seen in Figure 43. The part passed after annealing. Both units remained fully functional.

The LDO dropout voltage measurements in Figure 6 also showed a bias sensitivity between the biased and grounded parts with the biased parts exhibiting a steeper slope in the increase over radiation to 100krad(Si). The biased measurements and grounded measurements were similar after annealing.

The Set Point Voltage measurements in Figure 9 and Figure 10 appear to show some bias dependence, but that is due to the scale of the vertical axis, as there is less than a 2mV difference in the biased and unbiased measurements.

4. Revision History

Revision	Date	Description
1.01	Oct 23, 2023	Updated Figures 9, 10, 20, 21, 22, 23, 54, and 65.
1.00	Oct 18, 2022	Initial release.

Appendix: Reported Parameters

Table 3 below lists the datasheet parameters that are considered indicative of part performance. These parameters are plotted in Figure 3 through Figure 75. All limits are taken from the ISL73847SEH datasheet, which may also have more details on test conditions.

Table 3. ISL73847SEH Datasheet Total Dose Parameters (T_A = 25°C)

Fig.	Parameter	Symbol	Conditions	Low Limit	High Limit	Unit
3	Operating Supply Current	I_{DDO}	V_{DD} = 4.5V, 12V, 19V, EN = 3.3V, f_{SW} = 500kHz, C_L = 100pF	9	16	mA
4	Shutdown Supply Current	I_{DDSD}	V_{DD} = 4.5V, 12V, 19V, EN = GND	-	35	µA
5	Output Voltage Range	VCC	V_{DD} = 6V, 19V, I_{OUT} = 0mA, 20mA	4.7	5.3	V
6	Dropout Voltage	VCC_{DO}	V_{DD} = 4.5V, I_{OUT} = 50mA	85	250	mV
7	V_{CC} Foldback Current	I_{CC-SC}	V_{DD} = 5.5V, 19V, V_{CC} = 0V, EN = 1.6V	40	90	mA
8	V_{CC} Overcurrent Limit	I_{CC-CL}	V_{DD} = 5.5V, 19V, V_{CC} = 4.5V, EN = 1.6V	75	130	mA
9	Voltage Set Point	V_{FB+}	V_{REF} = V_{DROOP}, V_{SEN1} = V_{SEN2} = 0mV	0.597	0.604	V
10			V_{REF} = V_{DROOP}, V_{SEN1} = V_{SEN2} = 50mV			
11	Soft-Start Sourcing Current	$I_{SOFTSTART}$	V_{DD} = 19V	9.2	10.5	µA
12	Peak Positive Current Limit (Channel 1)	V_{PCL}	V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V, 19V	67.5	82.5	mV
13			V_{DD} = 19V; V_{CM} = 0.6V, 5.0V, 19V			
14	Peak Positive Current Limit (Channel 2)		V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V, 19V			
15			V_{DD} = 19V; V_{CM} = 0.6V, 5.0V, 19V			
16	Peak Positive Overcurrent (Channel 1)	V_{POC}	V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V, 19V	90	110	mV
17			V_{DD} = 19V; V_{CM} = 0.6V, 5.0V, 19V			
18	Peak Positive Overcurrent (Channel 2)		V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V, 19V			
19			V_{DD} = 19V; V_{CM} = 0.6V, 5.0V, 19V			
20	Peak Negative Overcurrent (Channel 1)	V_{NOC}	V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V, 19V	-84	-60	mV
21			V_{DD} = 19V; V_{CM} = 0.6V, 5.0V, 19V			
22	Peak Negative Overcurrent (Channel 2)		V_{DD} = 4.5V; V_{CM} = 0.6V, 5.0V, 19V			
23			V_{DD} = 19V; V_{CM} = 0.6V, 5.0V, 19V			
24	Overvoltage Threshold	$V_{(FB, OV)}$	V_{DD} = 4.5V, 19V	112	118	%
25	Undervoltage Threshold	$V_{(FB, UV)}$	V_{DD} = 4.5V, 19V	82	88	%
26	Error Amplifier Transconductance	g_{m-EA}	V_{DD} = 4.5V, 19V	3	4	mA/V

Table 3. ISL73847SEH Datasheet Total Dose Parameters (T_A = 25°C)

Fig.	Parameter	Symbol	Conditions	Low Limit	High Limit	Unit
27	Droop Transconductance (CSA1)	$g_{m(CSA, DRP)}$	V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 10mV, 50mV, V_{CM} = 0.6V, 5.0V, 19V	0.38	0.42	µA/mV
28			V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV, 50mV, V_{CM} = 0.6V, 5.0V, 19V			
29	Droop Transconductance (CSA2)		V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 10mV, 50mV, V_{CM} = 0.6V, 5.0V, 19V			
30			V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV, 50mV, V_{CM} = 0.6V, 5.0V, 19V			
31	IMON Transconductance (CSA1, 1V)	$g_{m(CSA, IMON)}$	V_{DD} = 4.5V; V(I_{SEN+}, I_{SEN-}) = 10mV, 50mV, V_{CM} = 0.6V, 5.0V, 19V	0.36	0.47	µA/mV
32	IMON Transconductance (CSA1, 2V)					
33	IMON Transconductance (CSA2, 1V)					
34	IMON Transconductance (CSA2, 2V)					
35	IMON Transconductance (CSA1, 1V)	$g_{m(CSA, IMON)}$	V_{DD} = 19V; V(I_{SEN+}, I_{SEN-}) = 10mV, 50mV, V_{CM} = 0.6V, 5.0V, 19V	0.36	0.47	µA/mV
36	IMON Transconductance (CSA1, 2V)					
37	IMON Transconductance (CSA2, 1V)					
38	IMON Transconductance (CSA2, 2V)					
39	Offset Voltage (CSA1)	$V_{OS(CSA)}$ (Low Side)	V_{DD} = 4.5V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 0.6V	-4.5	4.5	mV
40	Offset Voltage (CSA2)					
41	Offset Voltage (CSA1)		V_{DD} = 19V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 0.6V			
42	Offset Voltage (CSA2)					
43	Offset Voltage (CSA1)	$V_{OS(CSA)}$ (High Side)	V_{DD} = 4.5V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 5V	-4.5	4.5	mV
44	Offset Voltage (CSA2)					
45	Offset Voltage (CSA1)		V_{DD} = 19V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 5V			
46	Offset Voltage (CSA2)					
47	Offset Voltage (CSA1)		V_{DD} = 4.5V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 19V			
48	Offset Voltage (CSA2)					
49	Offset Voltage (CSA1)		V_{DD} = 19V, V(I_{SEN+}, I_{SEN-}) = 0mV, V_{CM} = 19V			
50	Offset Voltage (CSA2)					

Table 3. ISL73847SEH Datasheet Total Dose Parameters (T_A = 25°C)

Fig.	Parameter	Symbol	Conditions	Low Limit	High Limit	Unit
51	HS CSA Supply Current per Phase (Current into ISENx- pin)	I_{CSA}	V_{DD} = 19V; EN = 3.3V; V_{CM} = 2.7V		3	µA
52	Oscillator Frequency Range	$f_{OSC-0.5M}$	V_{DD} = 4.5V, 19V, R_{FS} = 205kΩ, EN = 3.3V, R_{SYNC-O} = 100kΩ to GND	0.45	0.55	MHz
53		f_{OSC-3M}	V_{DD} = 4.5V, 19V, R_{FS} = 16.7kΩ, EN = 3.3V, R_{SYNC-O} =100kΩ to GND	2.70	3.30	MHz
54	Ramp Slope	$V_{RAMP-SLOPE}$	V_{DD} = 4.5V, 19V, f_{SW} = 500kHz, V_{SLOPE} = 0.4V	0.065	0.15	V/µs
55	Rising Enable Threshold (Gross)	$V_{IH-EN-G}$	V_{DD} = 4.5V, 19V, FS = V_{CC}	0.9	1.6	V
56	Falling Enable Threshold (Gross)	$V_{IL-EN-G}$	V_{DD} = 4.5V, 19V, FS = V_{CC}	0.6	1.2	V
57	Rising Enable Threshold (Fine)	$V_{IH-EN-F}$	V_{DD} = 4.5V, 19V, FS = V_{CC}	1.74	1.85	V
58	Falling Enable Threshold (Fine)	$V_{IL-EN-F}$	V_{DD} = 4.5V, 19V, FS = V_{CC}	1.46	1.54	V
59	Overvoltage Error Threshold	V_{OVH}	V_{DD} = 4.5V, 19V, EN = 3.3V	106	110	%
60	Overvoltage Error Threshold Recovery	V_{OVL}	V_{DD} = 4.5V, 19V, EN = 3.3V	104	109	%
61	Undervoltage Error Threshold	V_{UVL}	V_{DD} = 4.5V, 19V, EN = 3.3V	90	94	%
62	Undervoltage Error Threshold Recovery	V_{UVH}	V_{DD} = 4.5V, 19V, EN = 3.3V	92	96	%
63	PWM Output High	V_{OH}	V_{DD} = 4.5V, I_{PWM} = -500µA	4.0	-	V
			V_{DD} = 19V, I_{PWM} = -500µA	4.5	-	V
64	PWM Output Low	V_{OL}	V_{DD} = 4.5V, 19V, and I_{PWM} = +500µA	-	0.4	V
65	PWM Output Mid Sink	V_{OZ}	V_{DD} = 4.5V, 19V, and I_{PWM} = -100µA	-	2.3	V
66	PWM Output Mid Source		V_{DD} = 4.5V, 19V, and I_{PWM} = +100µA	1.8	-	V
67	Turn-On Blanking Time	$t_{MINONBLK}$		90	115	ns
68	Turn-Off Blanking Time	$t_{MINOFFBLK}$		100	130	ns
69	Minimum Controllable ON-Time	$t_{MINCTRLON}$	V_{DD} = 4.5V, 19V	100	135	ns
70	Minimum Controllable OFF-Time	$t_{MINCTRLOFF}$	V_{DD} = 4.5V, 19V	100	135	ns
71	SYNC-I Input Voltage High	V_{SYNCH}	V_{DD} = 4.5V, 19V	-	1.7	V
72	SYNC-I Input Voltage Low	V_{SYNCL}	V_{DD} = 4.5V, 19V	0.8	-	V
73	SYNC-O Output Voltage High	$V_{SYNC-OH}$	V_{DD} = 4.5V, I_{SYNC-O} = -500µA	4.2	-	V
			V_{DD} = 19V, I_{SYNC-O} = -500µA	4.6	-	

Table 3. ISL73847SEH Datasheet Total Dose Parameters (T_A = 25°C)

Fig.	Parameter	Symbol	Conditions	Low Limit	High Limit	Unit
74	SYNC-O Output Voltage Low	$V_{SYNC-OL}$	I_{SYNC-O} = +500µA	-	0.4	V
75	SYNC-I to SYNC-O Delay	$t_{SYNC-DLY}$	50% of SYNC-I to 50% of SYNC-O	215	275	ns

Related Information

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

- ISL73847SEH device page
- MIL-STD-883 Test Method 1019

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use o any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.0 Mar 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan

www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:

www.renesas.com/contact/

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.