

ISL71840SEH

Total Dose Testing

TR010
Rev 0.00
June 30, 2015

Introduction

This document provides interim results of a low and high dose rate total dose test of the [ISL71840SEH](#) 16-channel analog multiplexer. The test was conducted in order to determine the sensitivity of the part to the total dose environment and to determine if any dose rate sensitivity exists. High dose rate testing under bias is complete through 150krad(Si) and the subsequent high temperature biased anneal while low dose rate testing under bias and with all pins grounded is at the intermediate 100krad(Si) downpoint.

Reference Documents

- MIL-STD-883 test method 1019
- [ISL71840SEH](#) datasheet.
- Standard Microcircuit Drawing (SMD) [5962-15219](#)

Part Description

The ISL71840SEH is a radiation hardened 16-channel analog multiplexer that is fabricated using Intersil's proprietary P6SOI (Silicon on Insulator) process to mitigate single-event effects and improve total ionizing dose performance. The part operates from a dual supply voltage ranging from $\pm 10.8V$ to $\pm 16.5V$ and has four address inputs and an ENABLE pin that can be driven with adjustable logic thresholds to select 1 of 16 available channels. An inactive channel is separated from an active channel by high impedance, which inhibits any interaction between them. The ISL71840SEH's low switch ON-resistance (r_{ON}) allows improved signal integrity and reduced power losses. The ISL71840SEH is also designed for cold sparing making it suitable for high reliability applications that have redundancy requirements. The part is designed to provide a high impedance to the analog source while in a powered OFF condition, making it easy to add additional backup devices without loading signal sources. The ISL71840SEH also incorporates input analog overvoltage protection up to $\pm 35V$, which will disable the switch to protect downstream devices. All inputs are Electrostatic Discharge (ESD) protected to 8kV Human Body Model (HBM). The ISL71840SEH is available in a 28 Ld flatpack or in die form and operates across the extended temperature range of $-55^{\circ}C$ to $+125^{\circ}C$.

As the ISL71840SEH is the third version of the part, a brief historical note may be in order. The first Intersil 16-channel multiplexer was the HS-1840RH. This part was built in an early dielectrically isolated metal gate CMOS process. The key to hardening a metal gate process at the time was the gate metal deposition, which must be performed using a flash evaporator. In the 1995 time frame this by then obsolete equipment became difficult to maintain and the metal gate process could no longer be supported. As a result the HS-1840RH was obsolete.

The HS-1840RH was followed by the HS-1840ARH, which was designed in the later RSG process and was developed in order to continue supplying this very popular part, which performs a key function in many space systems. As part of the redesign the HS-1840ARH gained some functionality made possible by the bipolar devices available in RSG, which the metal gate process did not support. Bipolar circuit blocks in the HS-1840ARH included the on-chip voltage reference, the digital input ESD network and the VDD and VSS ESD nets.

The ISL71840SEH is the subject of the present report and was designed as an updated version of the HS-1840ARH, with improvements in the switch ON-resistance and in cold sparing capabilities.

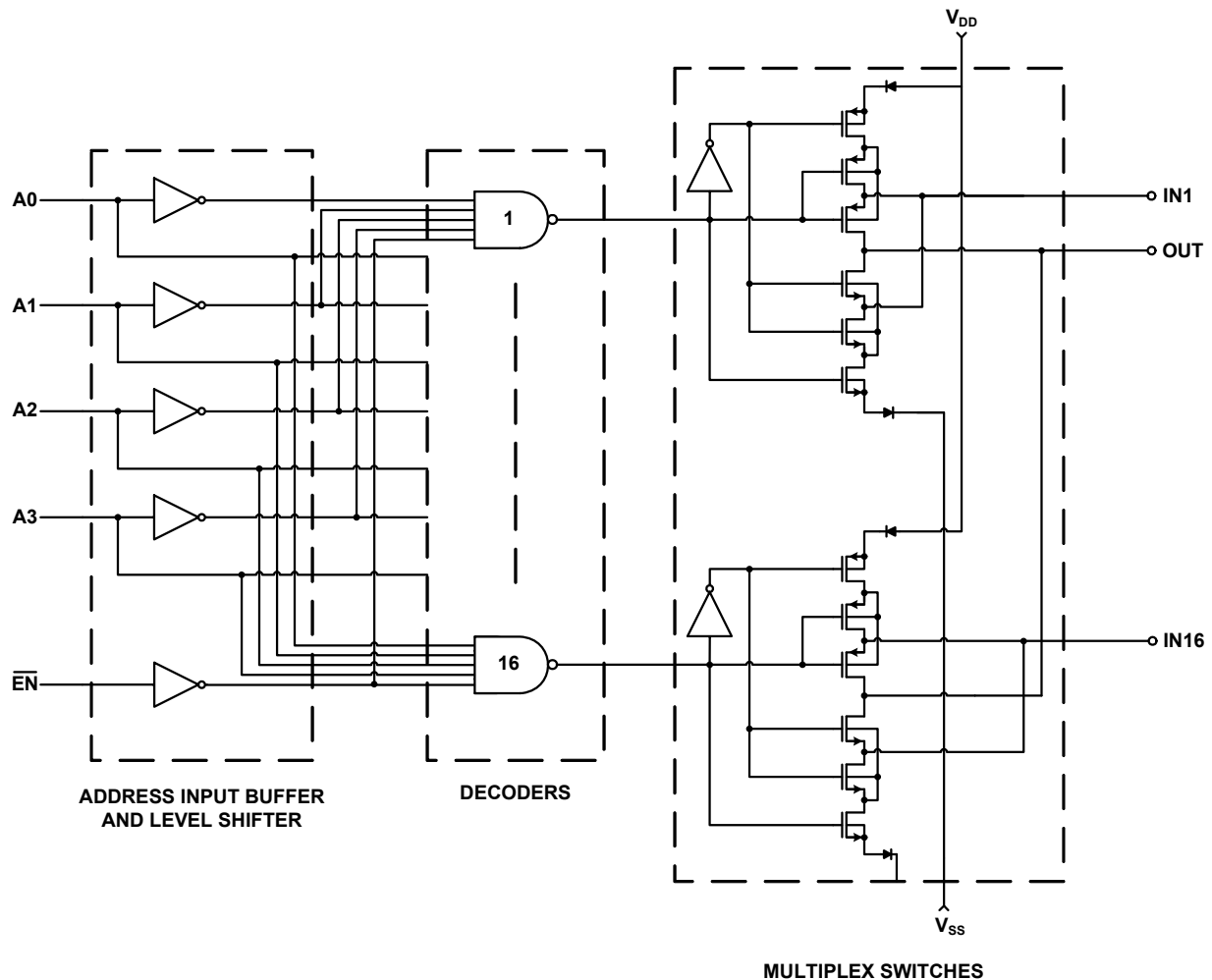


FIGURE 1. ISL71840SEH BLOCK DIAGRAM

Test Description

Irradiation Facilities

High dose rate testing was performed using a Gamma cell 220 ^{60}Co irradiator located in the Palm Bay, Florida Intersil facility. Low dose rate testing was performed using a Hopewell Designs N40 panoramic low dose rate ^{60}Co irradiator located in the same facility. The high dose rate irradiations were performed at $69.72\text{rad}(\text{Si})/\text{s}$ and the low dose rate work was performed at $0.0089\text{rad}(\text{Si})/\text{s}$ ($8.9\text{mrad}(\text{Si})/\text{s}$), both in accordance with MIL-STD-883 Method 1019. The low dose rate exposures used a PbAl box to shield the test board and devices under test against low energy secondary gamma radiation.

Test Fixturing

[Figure 2](#) on [page 3](#) shows the configuration and power supply sequencing used for biased irradiation.

233032-005-664

ISL71840 (HDR/LDR) Mask # 54252A01

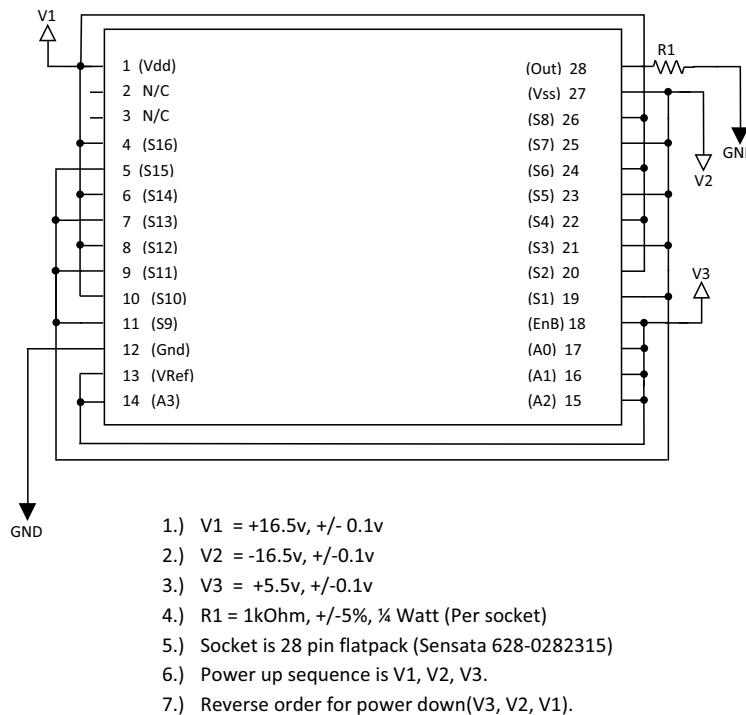


FIGURE 2. IRRADIATION BIAS CONFIGURATION AND POWER SUPPLY SEQUENCING FOR THE ISL71840SEH

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. 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 four samples irradiated at high dose rate under bias, four samples irradiated at low dose rate with all pins grounded and four samples irradiated at low dose rate under bias, (three control units were used).

Samples of the ISL71840SEH were drawn from development lot J67669 (wafers 1 and 2) as part of the routine wafer-by-wafer acceptance testing procedure and were packaged in the production hermetic 28-pin ceramic flatpack package outline K28.A. The samples were processed through the standard burn in cycle and were screened to the SMD 5962-15219 limits at room, low and high temperatures before irradiation.

Downpoints

Downpoints to date for the low dose rate tests were zero, 10krad(Si), 30krad(Si), 50krad(Si), 75krad(Si) and 100krad(Si). Downpoints for the high dose rate test were zero, 30krad(Si), 50krad(Si), 100krad(Si) and 150krad(Si). The high dose rate

samples were subjected to a high temperature biased anneal for 168 hours at 100 °C following irradiation. The low dose rate samples will be continued to 150krad(Si) and will then be subjected to the same anneal.

Results

Attributes Data

Testing at high dose rate under bias of the ISL71840SEH is complete and showed no reject devices after irradiation to 150krad(Si) or after the post-150krad(Si) irradiation anneal. Testing at low dose rate under bias and grounded is complete through 100krad(Si) and showed no reject devices after irradiation to that level. [Table 1 on page 4](#) summarizes the results.

TABLE 1. ISL71840SEH TOTAL DOSE TEST ATTRIBUTES DATA

DOSE RATE	BIAS	SAMPLE SIZE	DOWNPOINT	BIN 1	REJECTS
0.0089rad(Si)/s	Figure 2	4	Preirradiation	4	
			10krad(Si)	4	0
			30krad(Si)	4	0
			50krad(Si)	4	0
			75krad(Si)	4	0
			100krad(Si)	4	0
			150krad(Si)	Test in progress	Test in progress
			Anneal, 168 hours at 100 °C	Test in progress	Test in progress
0.0089rad(Si)/s	Grounded	4	Preirradiation	4	
			10krad(Si)	4	0
			30krad(Si)	4	0
			50krad(Si)	4	0
			75krad(Si)	4	0
			100krad(Si)	4	0
			150krad(Si)	Test in progress	Test in progress
			Anneal, 168 hours at 100 °C	Test in progress	Test in progress
69.72rad(Si)/s	Figure 2	4	Preirradiation	4	
			30krad(Si)	4	0
			50krad(Si)	4	0
			100krad(Si)	4	0
			150krad(Si)	4	0
			Anneal, 168 hours at 100 °C	4	0

NOTES:

1. Bin 1 indicates a device that passes all preirradiation specification limits.
2. The 168 hours anneal was performed at 100 °C using the bias configuration shown in [Figure 2](#).

Variables Data

The plots in [Figures 3](#) through [41](#) show data at all downpoints to date. The plots show the median of key parameters as a function of total dose for each of the four irradiation conditions. Many of the plots show the total dose response of the average of parameters such as ON resistance and the various leakage parameters for each of the 16 channels in order to facilitate the

interpretation of the results as well as managing the length of this report. All samples showed excellent stability over irradiation, with no observed dose rate sensitivity. See the conclusion on [page 25](#) for further discussion.

Variables Data Plots

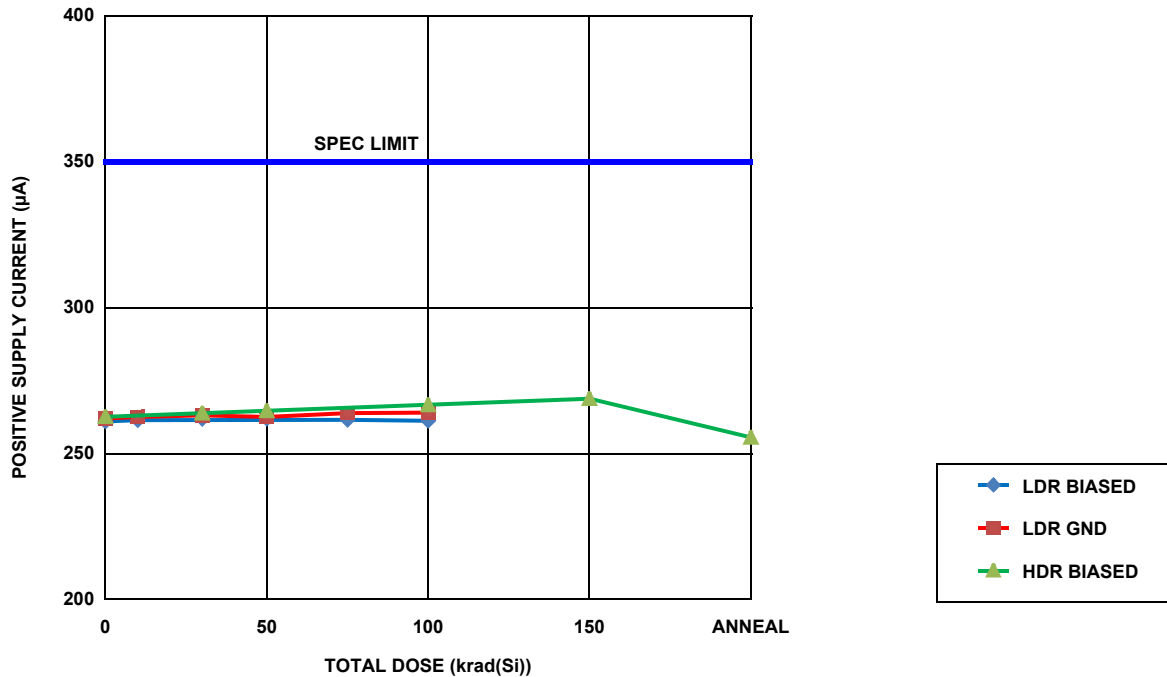


FIGURE 3. ISL71840SEH positive supply current as a function of total dose irradiation at high dose rate for the biased (per [Figure 2](#)) case and at low dose rate for the unbiased (all pins grounded) and the biased (per [Figure 2](#)) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 350µA maximum.

Variables Data Plots (Continued)

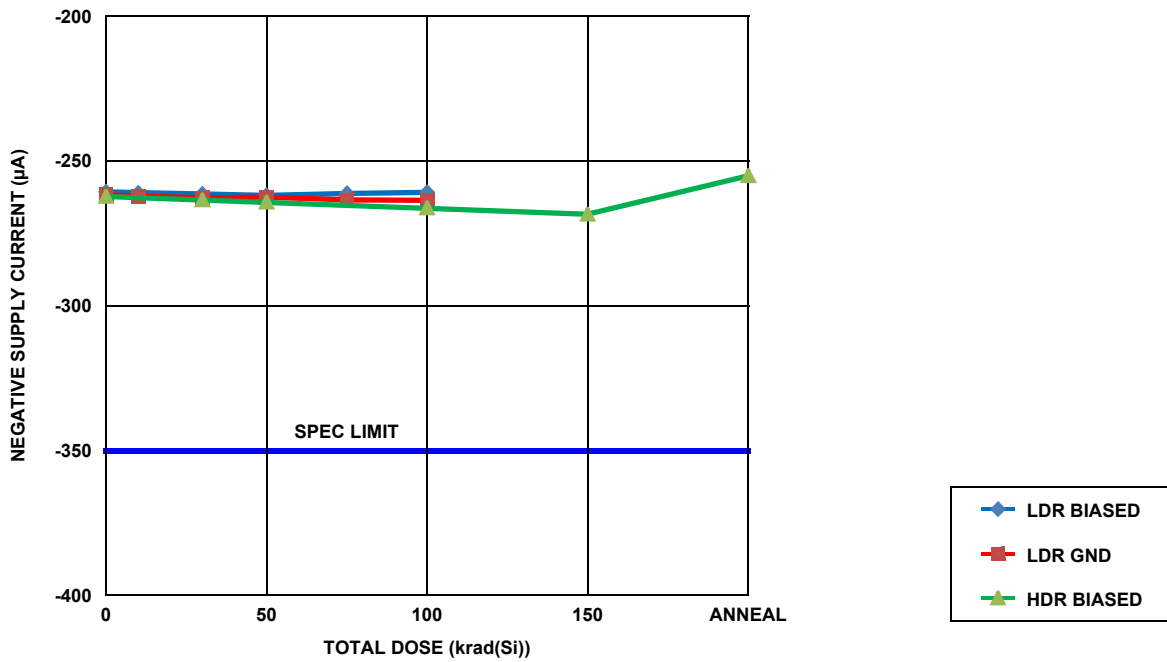


FIGURE 4. ISL71840SEH negative supply current as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is -350µA minimum.

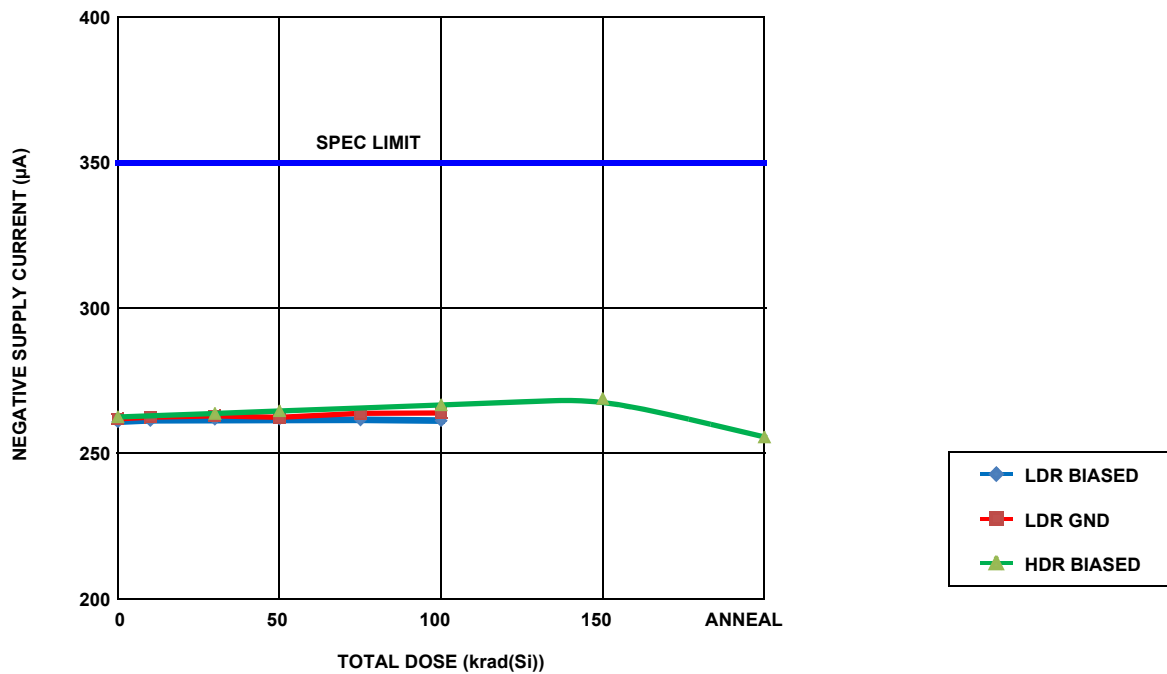


FIGURE 5. ISL71840SEH positive standby current as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 350µA maximum.

Variables Data Plots (Continued)

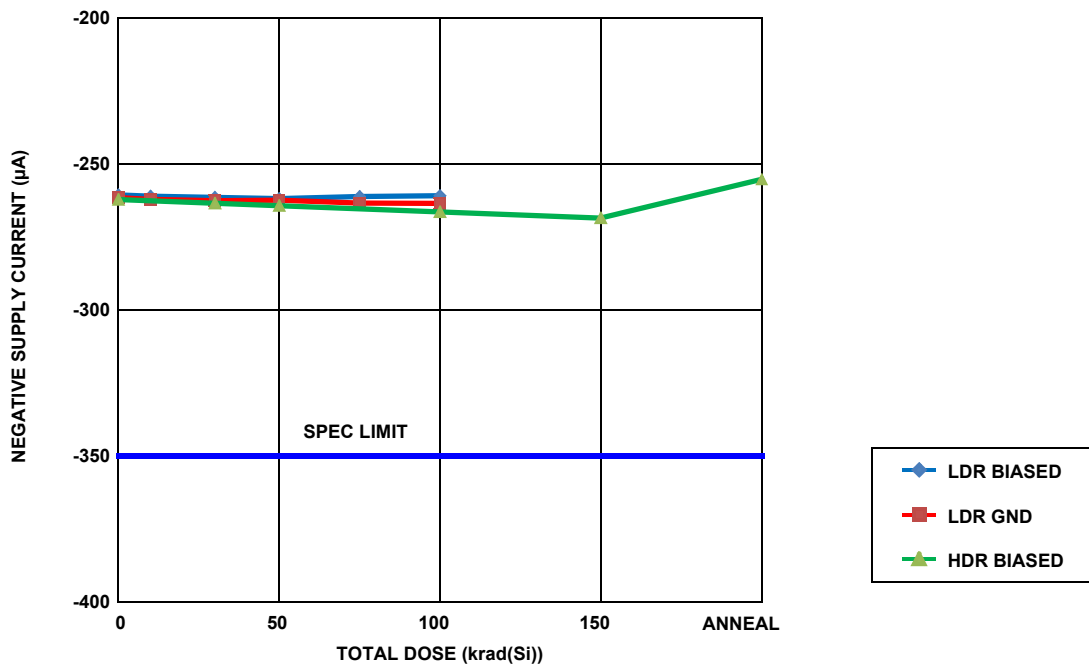


FIGURE 6. ISL71840SEH negative standby current as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is -350µA minimum.

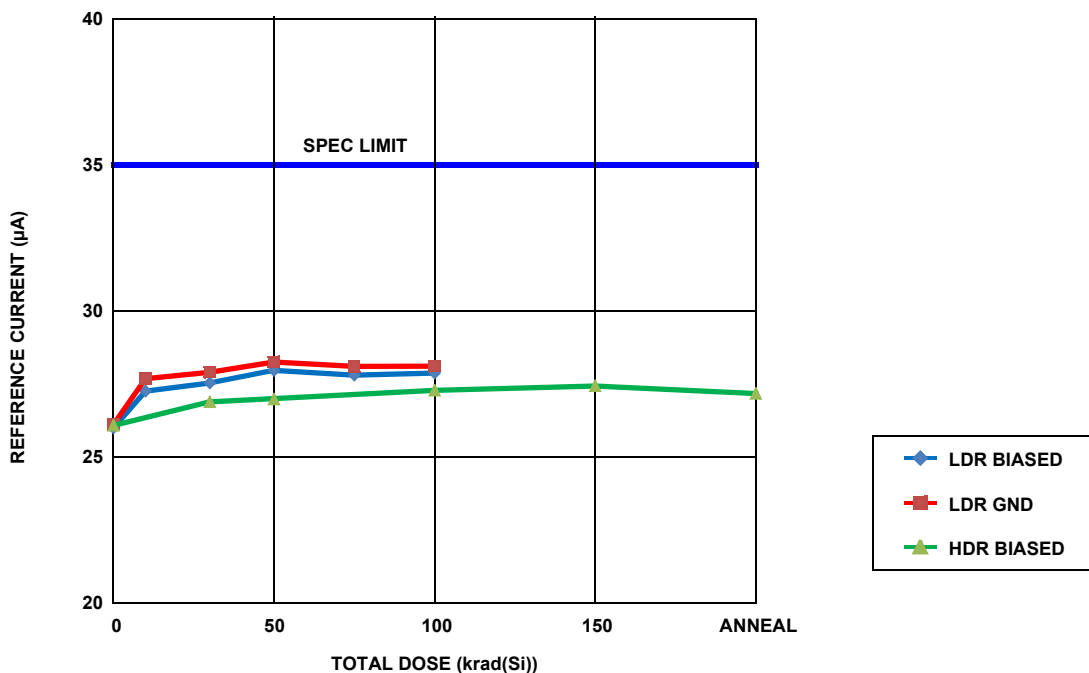


FIGURE 7. ISL71840SEH reference current as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 35µA maximum.

Variables Data Plots (Continued)

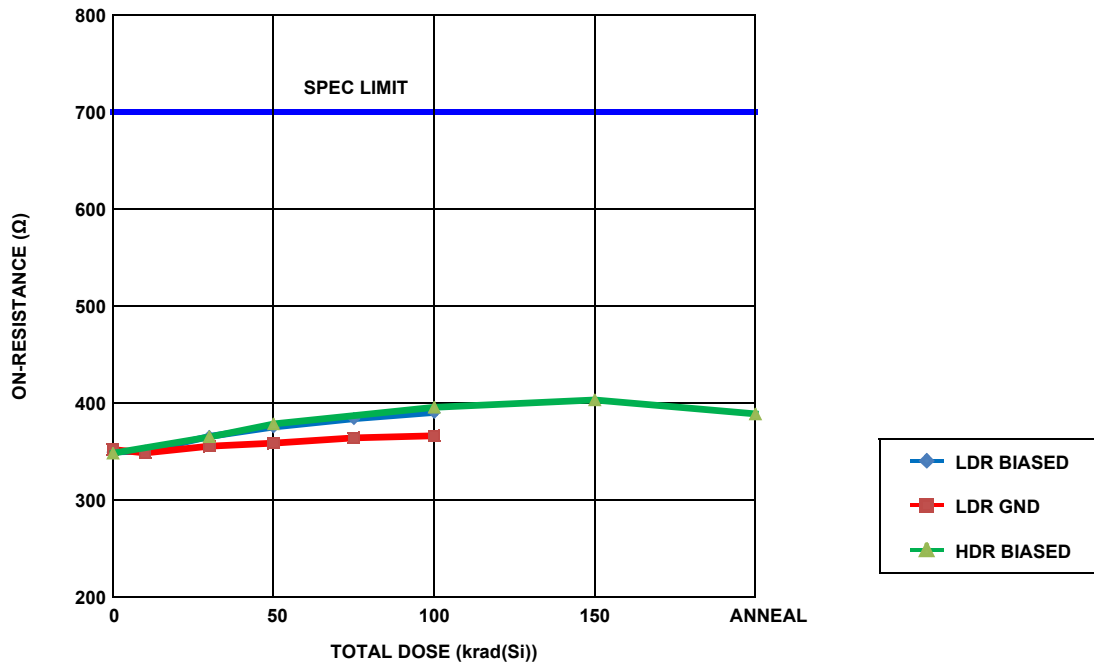


FIGURE 8. ISL71840SEH ON-resistance, average of all 16 channels, ±15V supplies, 1.0mA output current, 5V input voltage, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 700Ω maximum.

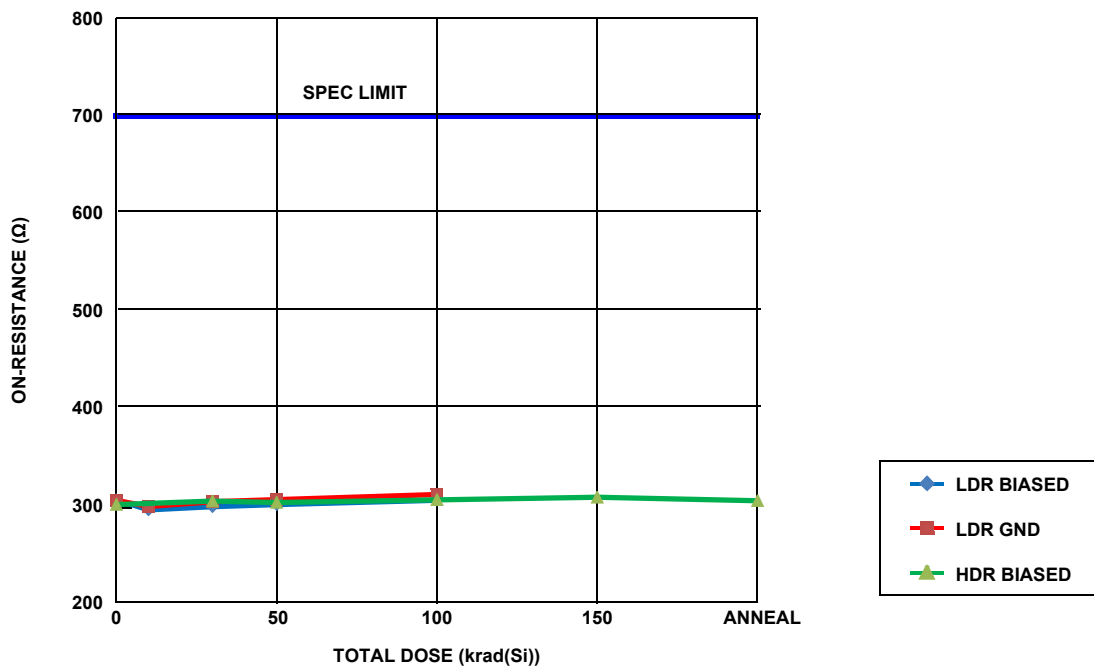


FIGURE 9. ISL71840SEH ON-resistance, average of all 16 channels, ±15V supplies, 1mA output current, -5V input voltage, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 700Ω maximum.

Variables Data Plots (Continued)

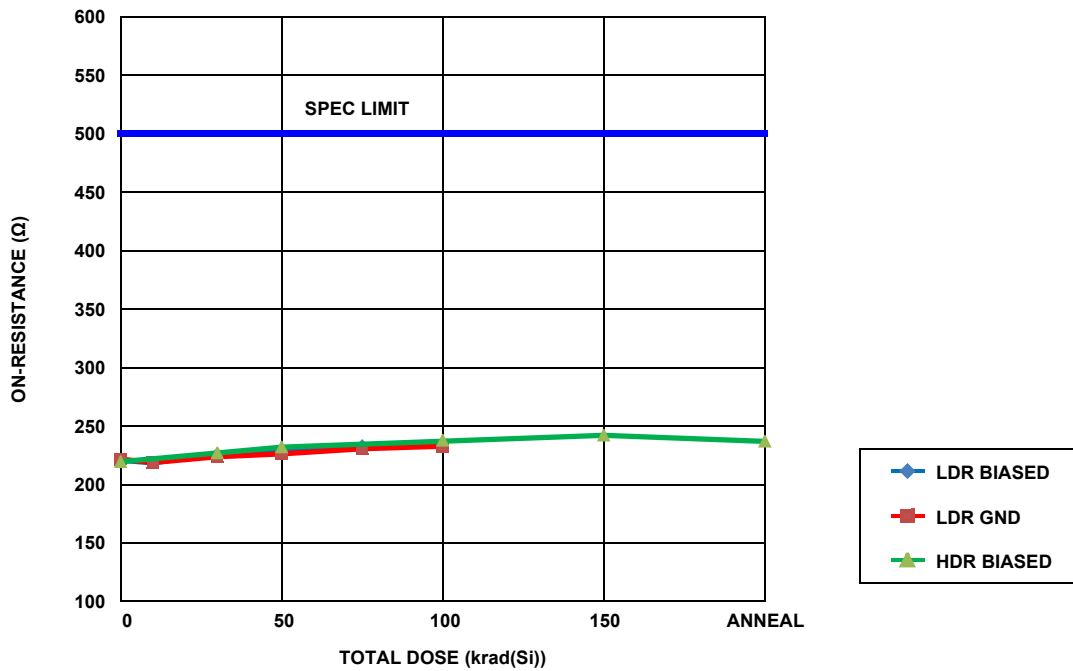


FIGURE 10. ISL71840SEH ON-resistance, average of all 16 channels, ±15V supplies, 1mA output current, 15V input voltage, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 500Ω maximum.

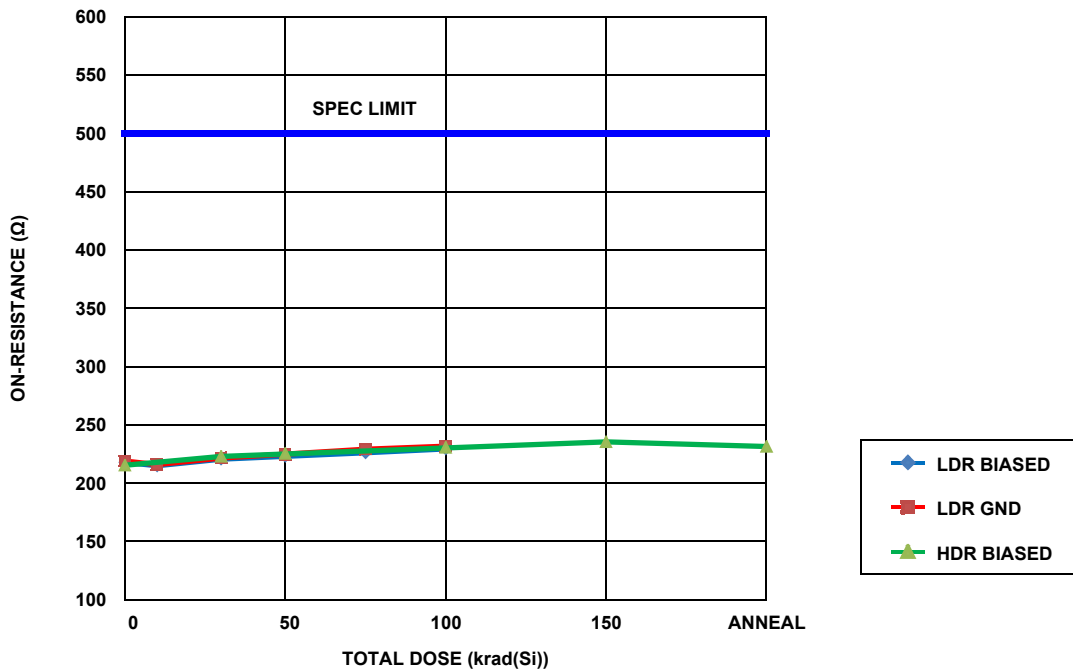


FIGURE 11. ISL71840SEH ON-resistance, average of all 16 channels, ±15V supplies, 1mA output current, -15V input voltage, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 500Ω maximum.

Variables Data Plots (Continued)

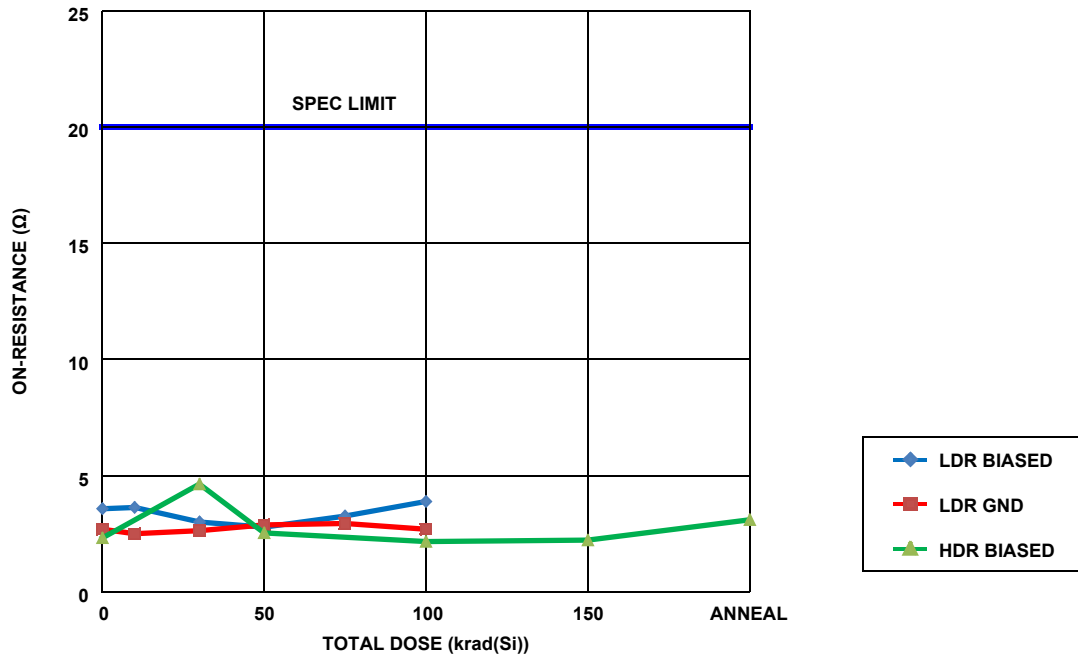


FIGURE 12. ISL71840SEH ON-resistance match, average of all 16 channels, ±15V supplies, -1mA output current, +5V input voltage, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 20Ω maximum.

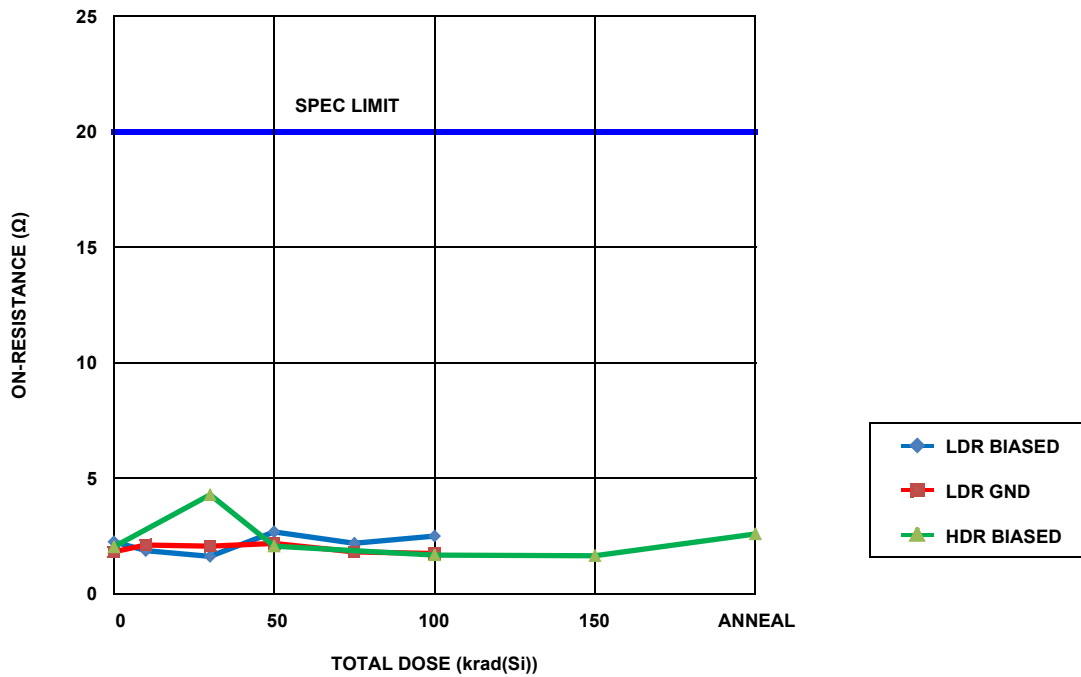


FIGURE 13. ISL71840SEH ON-resistance match, average of all 16 channels, ±15V supplies, -1mA output current, -5V input voltage, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 20Ω maximum.

Variables Data Plots (Continued)

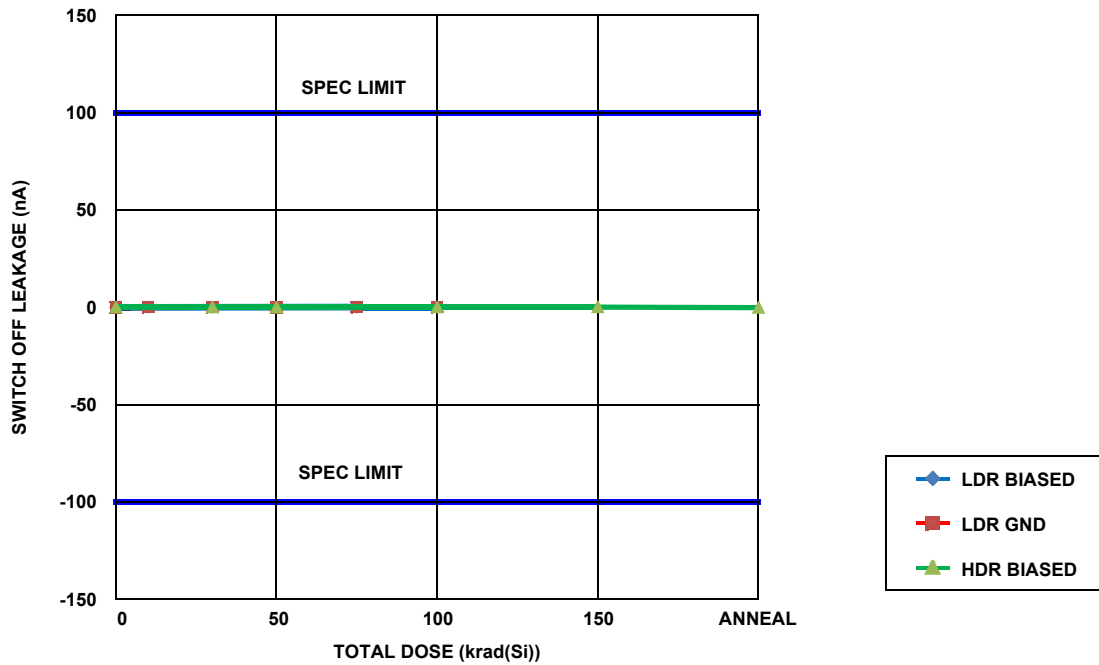


FIGURE 14. ISL71840SEH switch OFF leakage ($I_{S(OFF)}$) into the source of an unselected channel, average of all 16 channels, supply voltage $\pm 15V$, input voltage $+11.5V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are -100nA to 100nA .

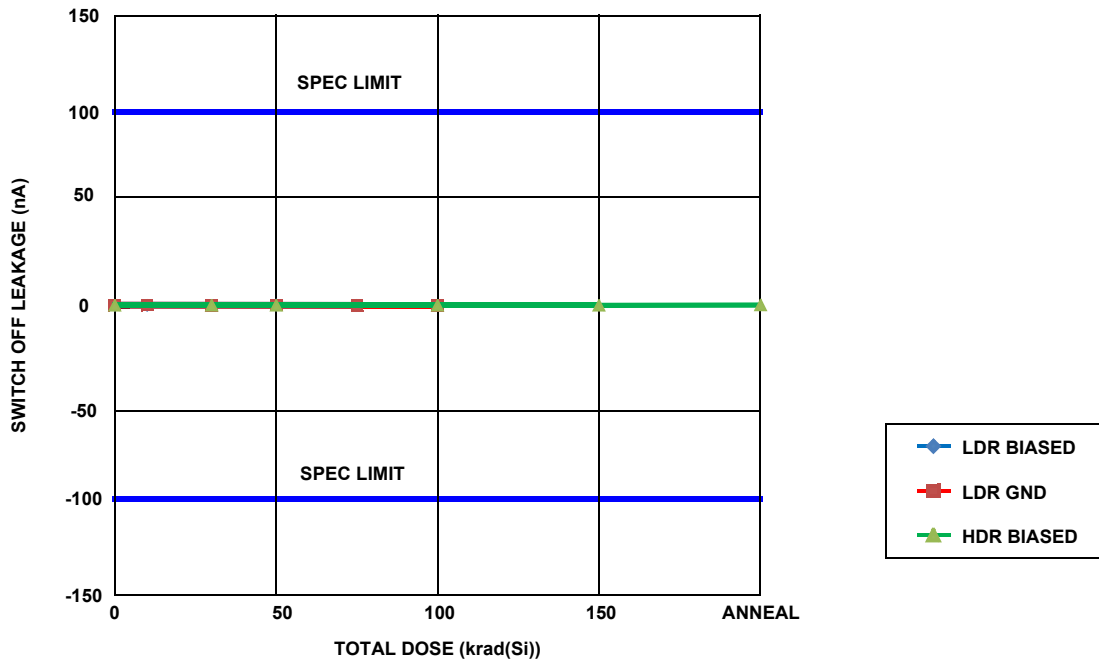


FIGURE 15. ISL71840SEH switch OFF leakage ($I_{S(OFF)}$) into the source of an unselected channel, average of all 16 channels, supply voltage $\pm 15V$, input voltage $-11.5V$ as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are -100nA to 100nA .

Variables Data Plots (Continued)

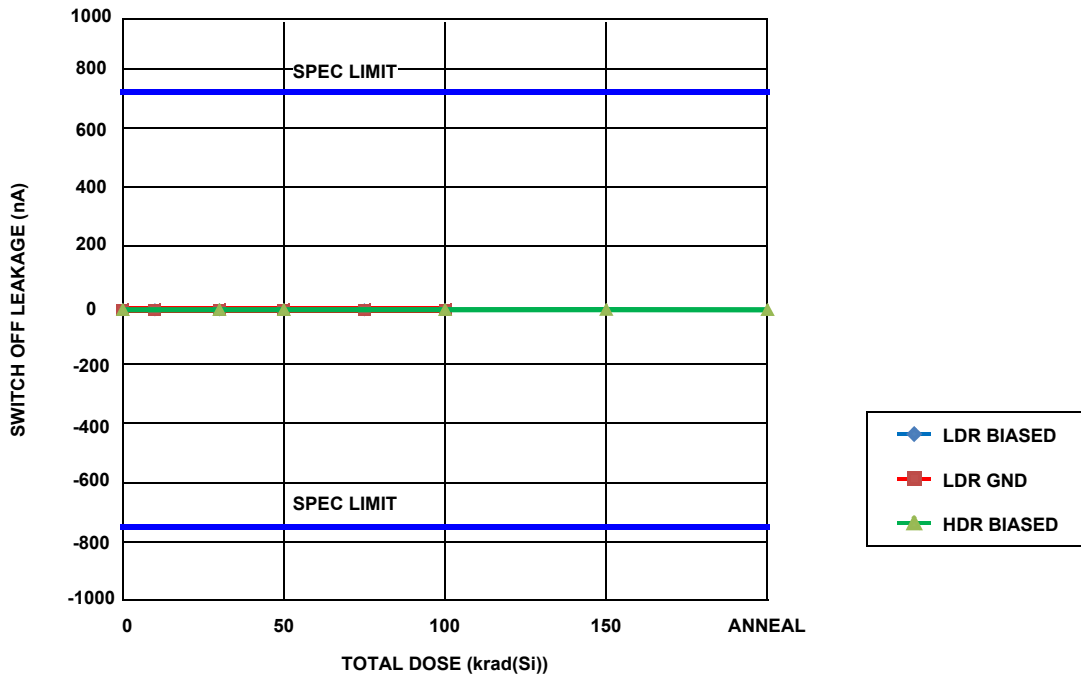


FIGURE 16. ISL71840SEH switch OFF leakage ($I_{S(OFF)}$) into the source of an unselected channel, average of all 16 channels, supply voltage $\pm 15V$, input overvoltage $+35V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are -750nA to $+750\text{nA}$.

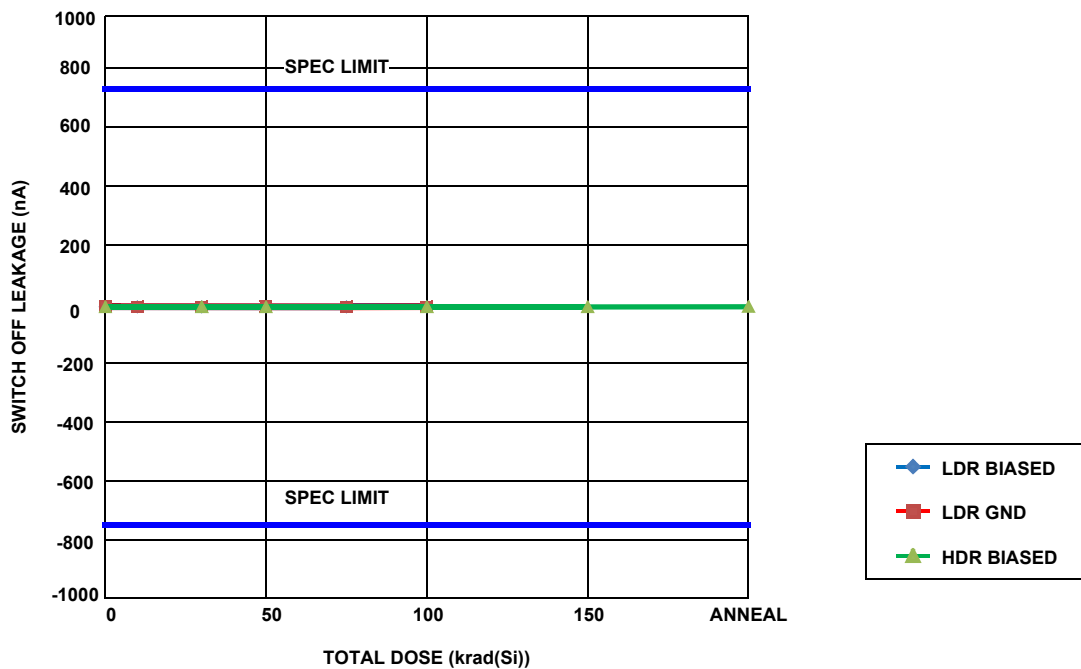


FIGURE 17. ISL71840SEH switch OFF leakage ($I_{S(OFF)}$) into the source of an unselected channel, average of all 16 channels, supply voltage $\pm 15V$, input overvoltage $-35V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are -750nA to $+750\text{nA}$.

Variables Data Plots (Continued)

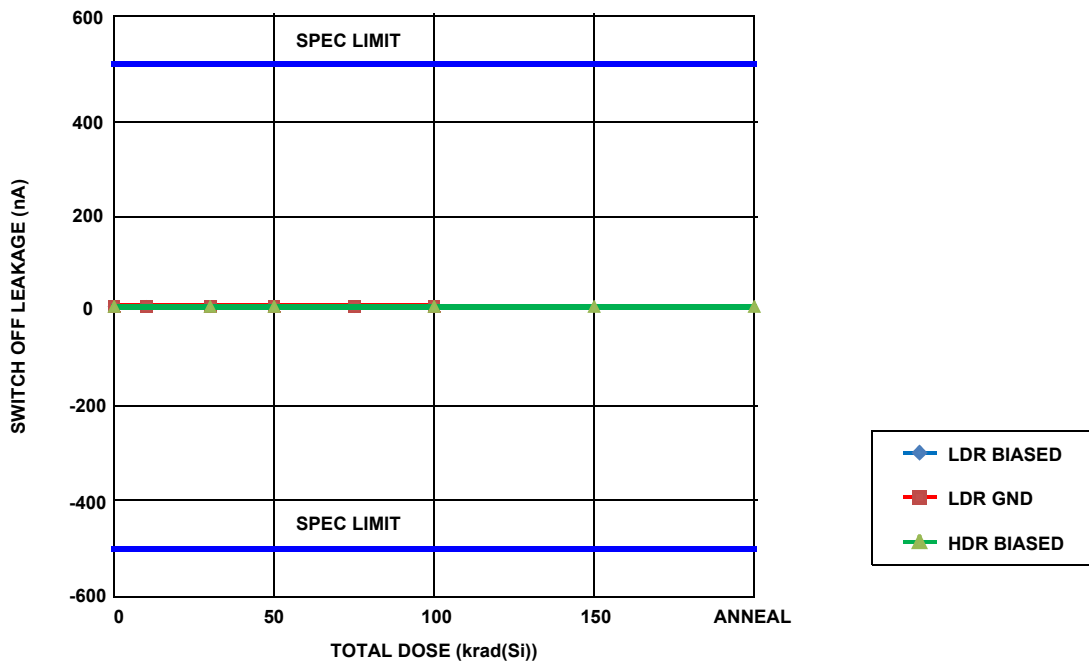


FIGURE 18. ISL71840SEH switch OFF leakage ($I_{D(OFF)}$) into the drain of an unselected channel, supply voltage $\pm 15V$, input overvoltage $+35V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was $0.0089rad(Si)/s$ and the high dose rate was $69.72rad(Si)/s$. Sample size for each of the three cells was 4. The postirradiation SMD limits are $-500nA$ to $+500nA$.

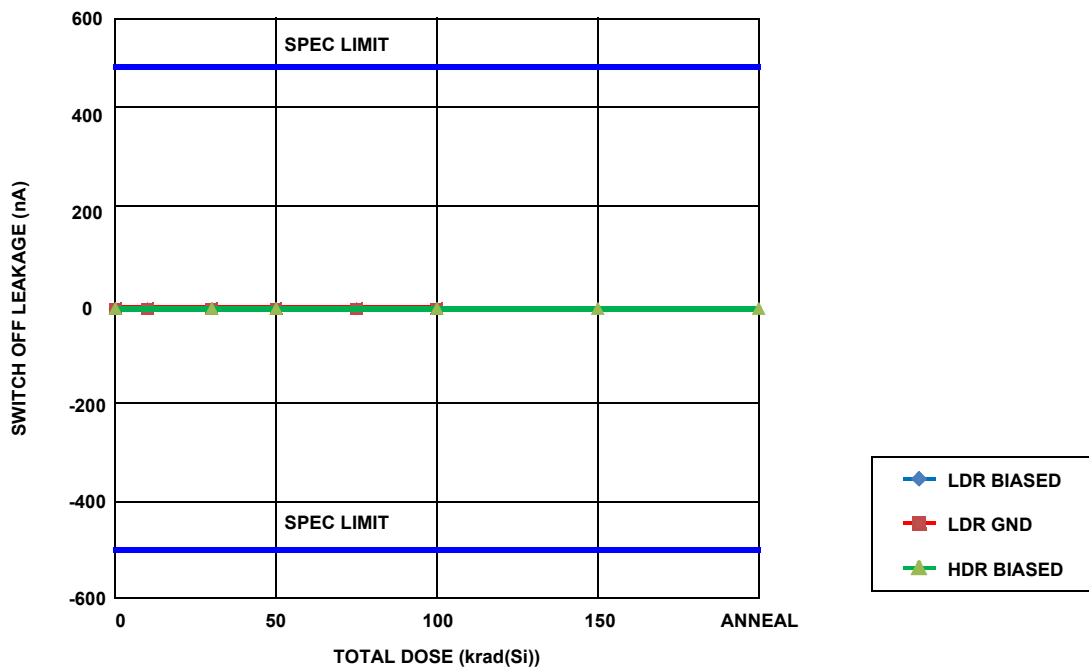


FIGURE 19. ISL71840SEH switch OFF leakage ($I_{D(OFF)}$) into the drain of an unselected channel, supply voltage $\pm 15V$, input overvoltage $-35V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was $0.0089rad(Si)/s$ and the high dose rate was $69.72rad(Si)/s$. Sample size for each of the three cells was 4. The postirradiation SMD limits are $-500nA$ to $+500nA$.

Variables Data Plots (Continued)

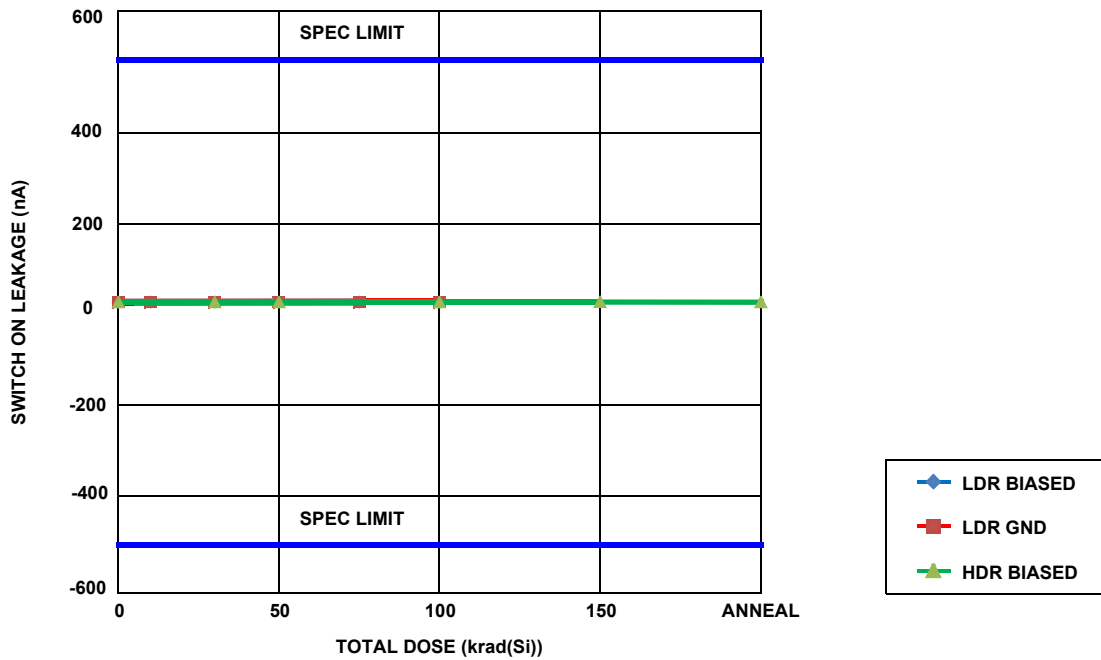


FIGURE 20. ISL71840SEH switch ON leakage ($I_{S(ON)}$) into the source of a selected channel, average of all 16 channels, supply voltage $\pm 15V$, input overvoltage $+35V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are -500nA to $+500\text{nA}$.

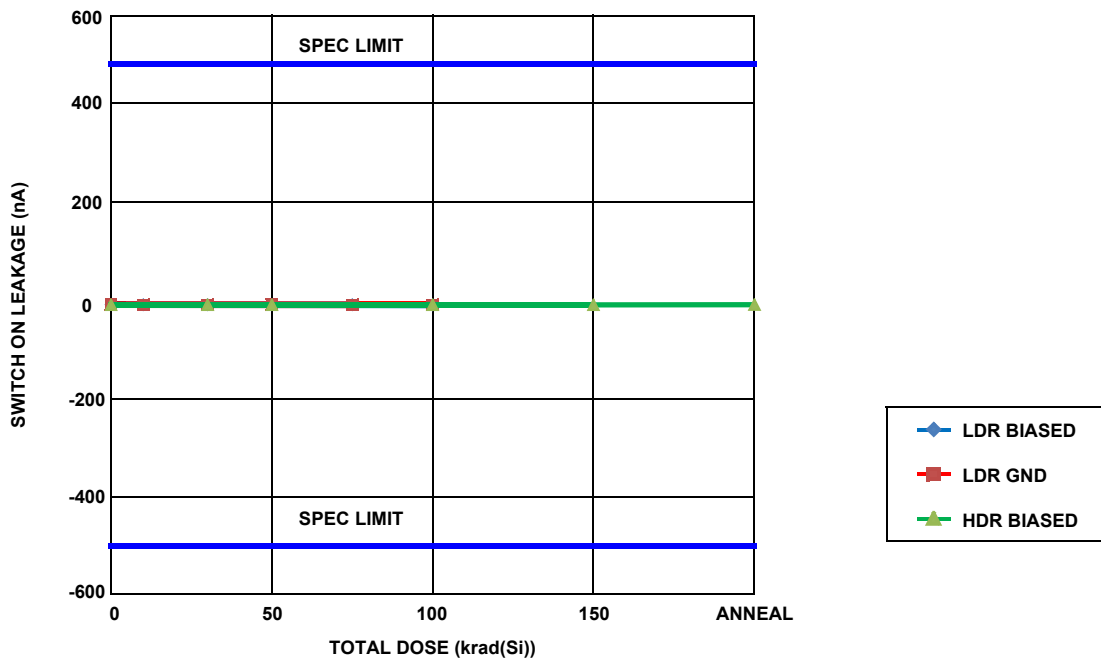


FIGURE 21. ISL71840SEH switch ON leakage ($I_{S(ON)}$) into the source of a selected channel, average of all 16 channels, supply voltage $\pm 15V$, input overvoltage $-35V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are -500nA to $+500\text{nA}$.

Variables Data Plots (Continued)

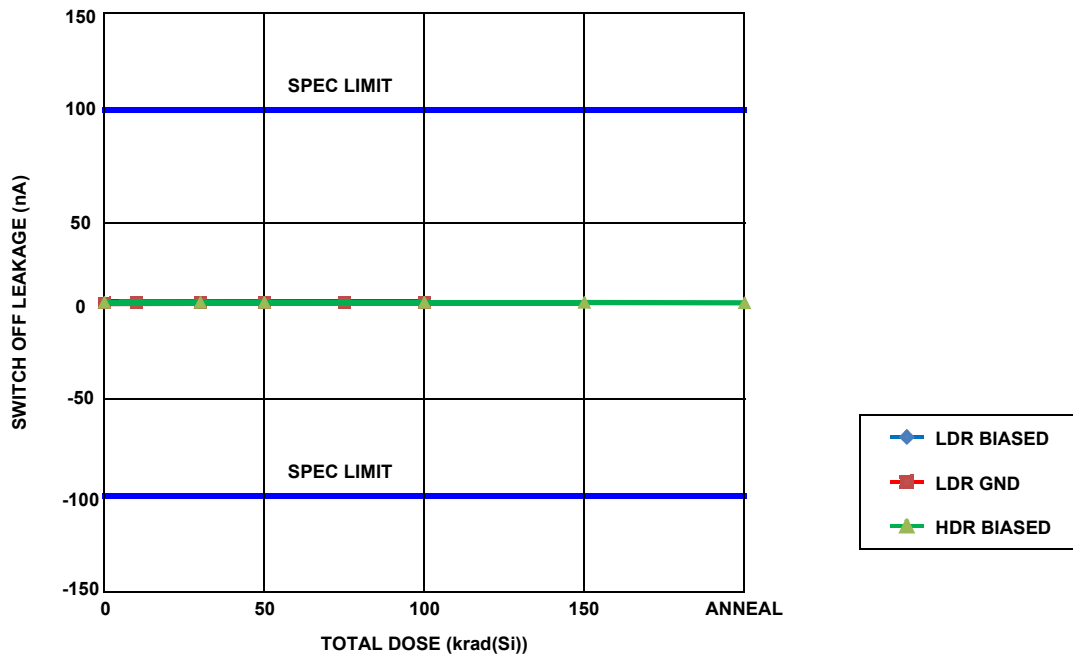


FIGURE 22. ISL71840SEH switch OFF leakage ($I_{S(OFF)}$) into the source of an unselected channel, average of all 16 channels, with supply, address and ENABLE pins open, input voltage +25V, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limits are -100nA to +100nA.

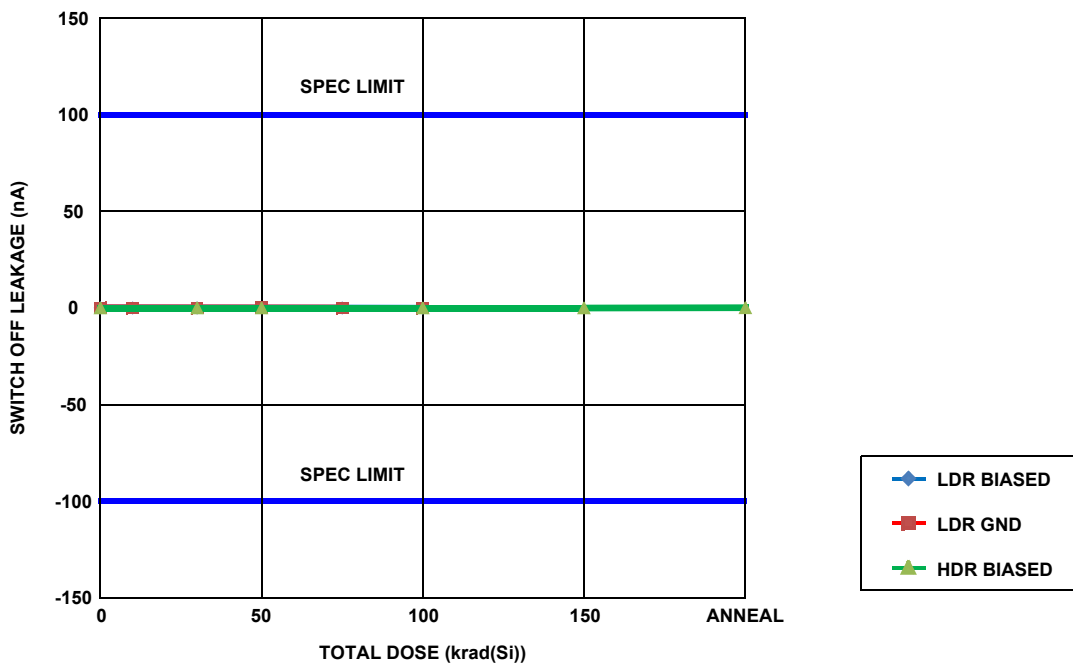


FIGURE 23. ISL71840SEH switch OFF leakage ($I_{S(OFF)}$) into the source of an unselected channel, average of all 16 channels, with supply, address and ENABLE pins open, input voltage -25V as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limits are -100nA to +100nA.

Variables Data Plots (Continued)

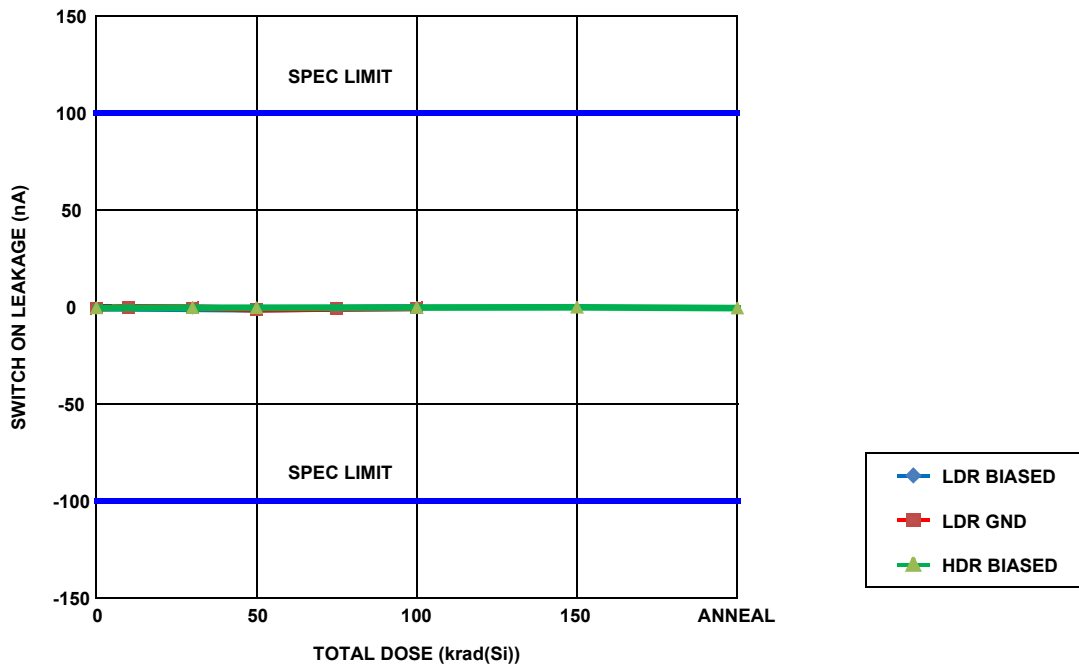


FIGURE 24. ISL71840SEH switch ON leakage ($I_{D(ON)}$) into the source and drain of a selected channel, average of all 16 channels, supply voltage $\pm 15V$, input and output voltage 10V, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limits are -100nA to +100nA.

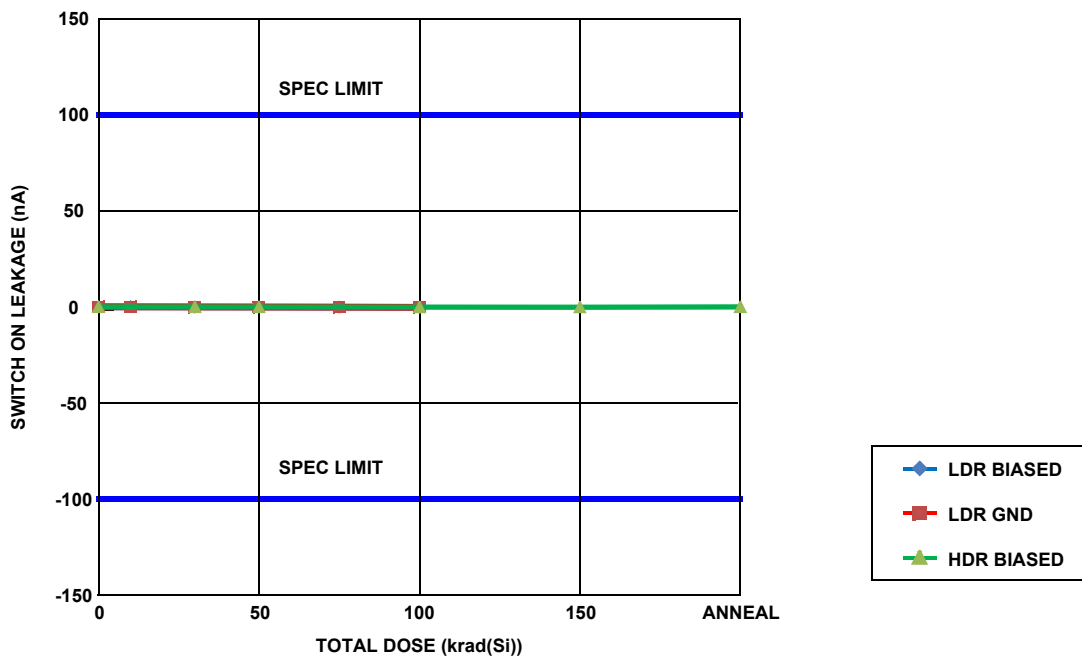


FIGURE 25. ISL71840SEH switch ON leakage ($I_{D(ON)}$) into the source and drain of a selected channel, average of all 16 channels, supply voltage $\pm 15V$, input and output voltage -10V, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limits are -100nA to +100nA.

Variables Data Plots (Continued)

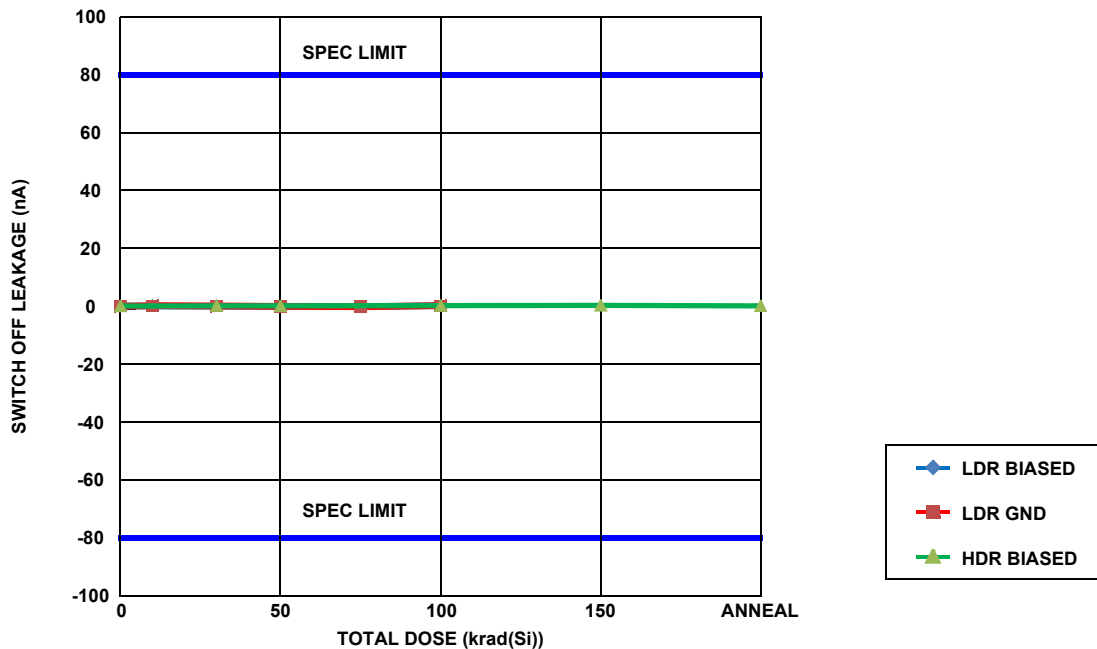


FIGURE 26. ISL71840SEH switch OFF leakage ($I_{D(OFF)}$) into the drain with the part disabled, supply voltage $\pm 15V$, output voltage $+10V$, input voltage $-10V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are -80nA to $+80\text{nA}$.

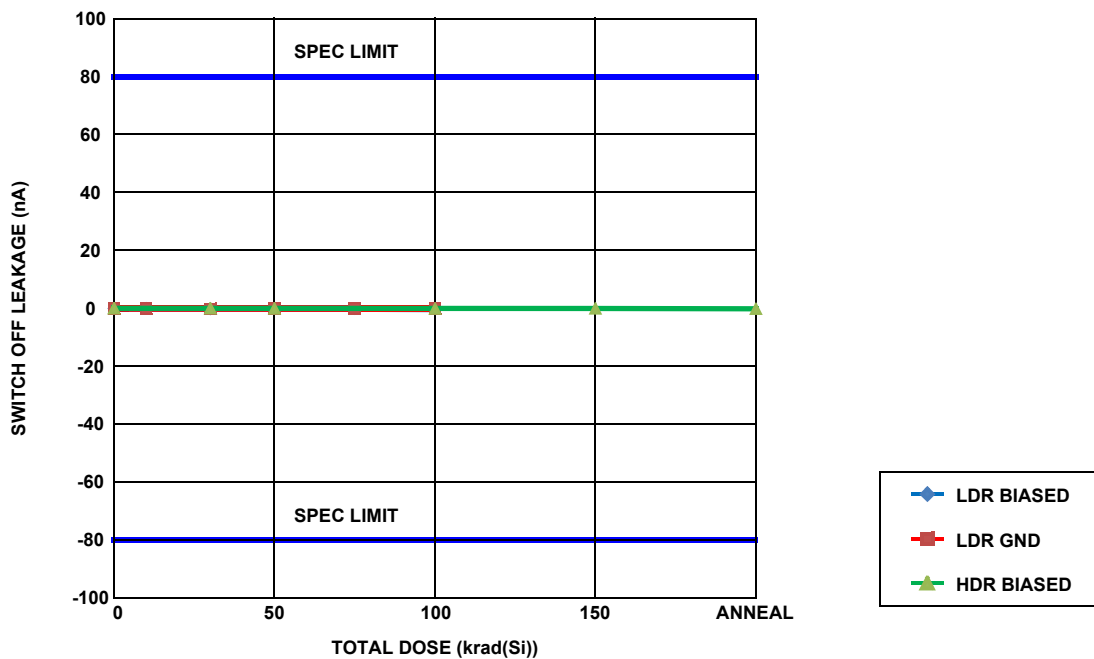


FIGURE 27. ISL71840SEH switch OFF leakage ($I_{D(OFF)}$) into the drain with the part disabled, supply voltage $\pm 15V$, output voltage $-10V$, input voltage $+10V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are -80nA to $+80\text{nA}$.

Variables Data Plots (Continued)

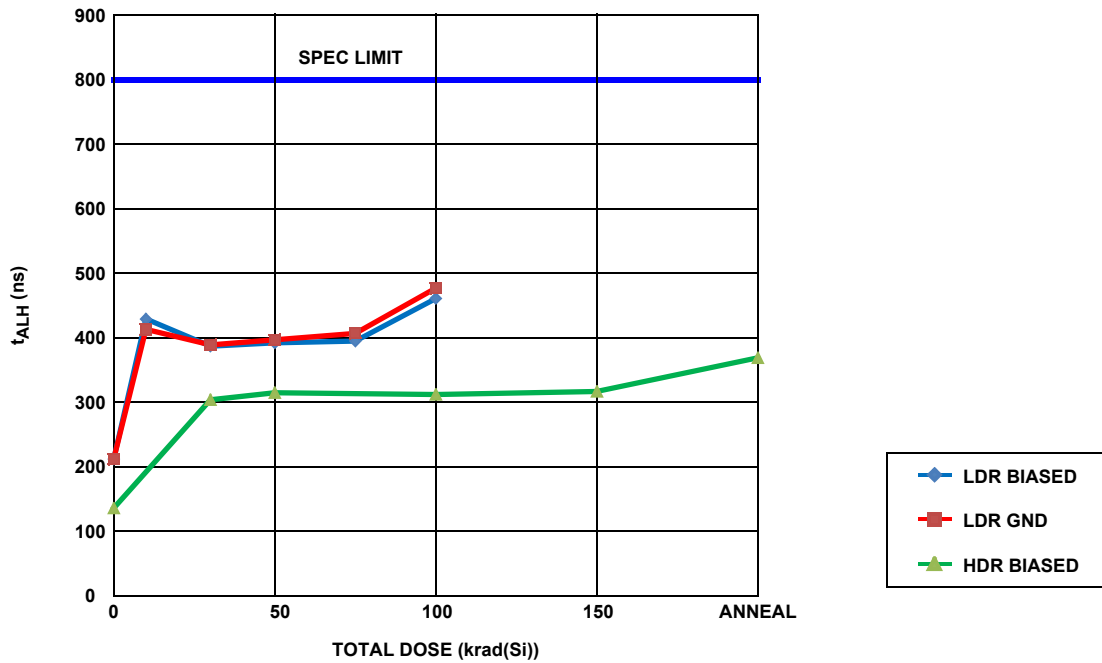


FIGURE 28. ISL71840SEH address to output access time, LOW-to-HIGH, supply voltage $\pm 15V$, as a function of total dose irradiation at high dose rate for the biased case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 800ns maximum.

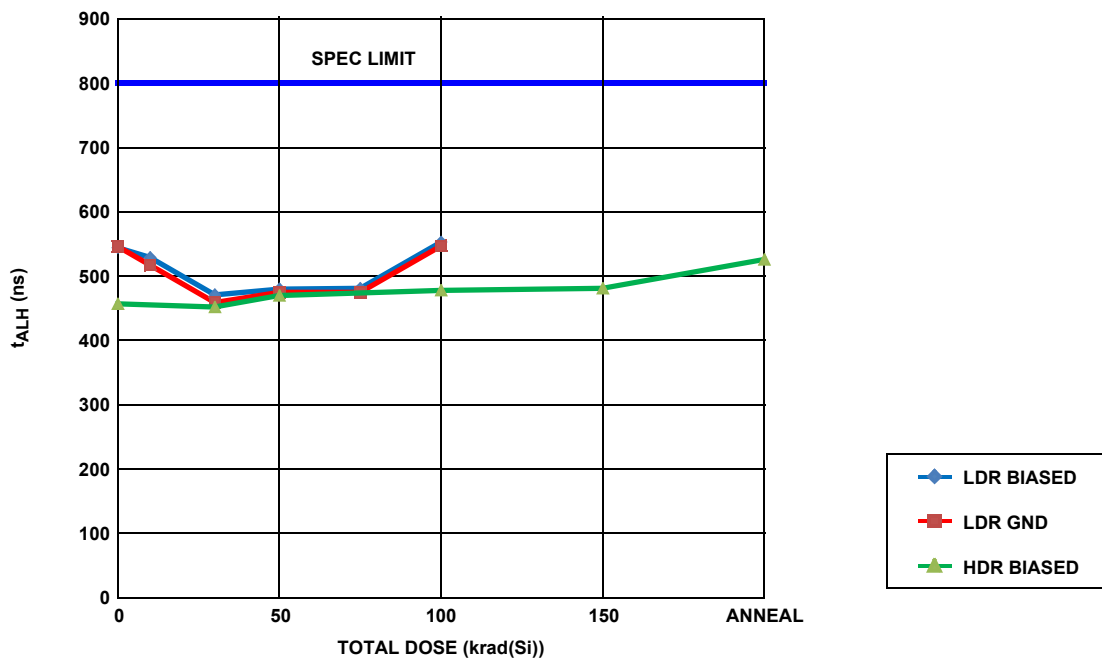


FIGURE 29. ISL71840SEH address to output access time, HIGH-to-LOW, supply voltage $\pm 15V$, as a function of total dose irradiation at high dose rate for the biased case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The post-irradiation SMD limit is 800ns maximum.

Variables Data Plots (Continued)

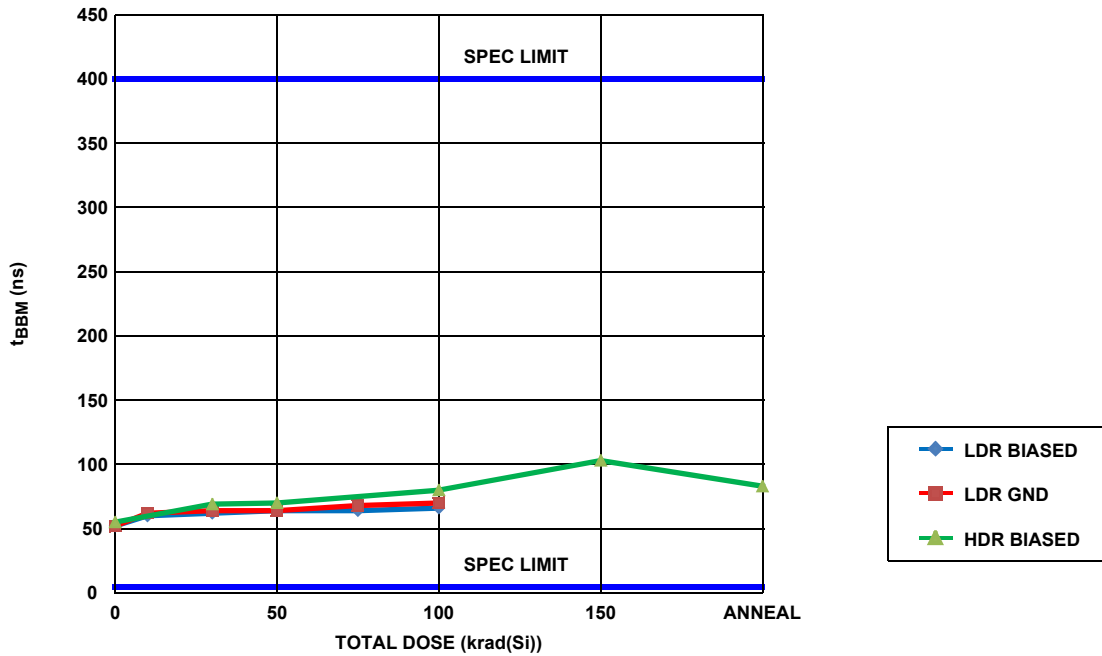


FIGURE 30. ISL71840SEH break-before-make time delay, supply voltage $\pm 15V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limits are 5ns to 400ns.

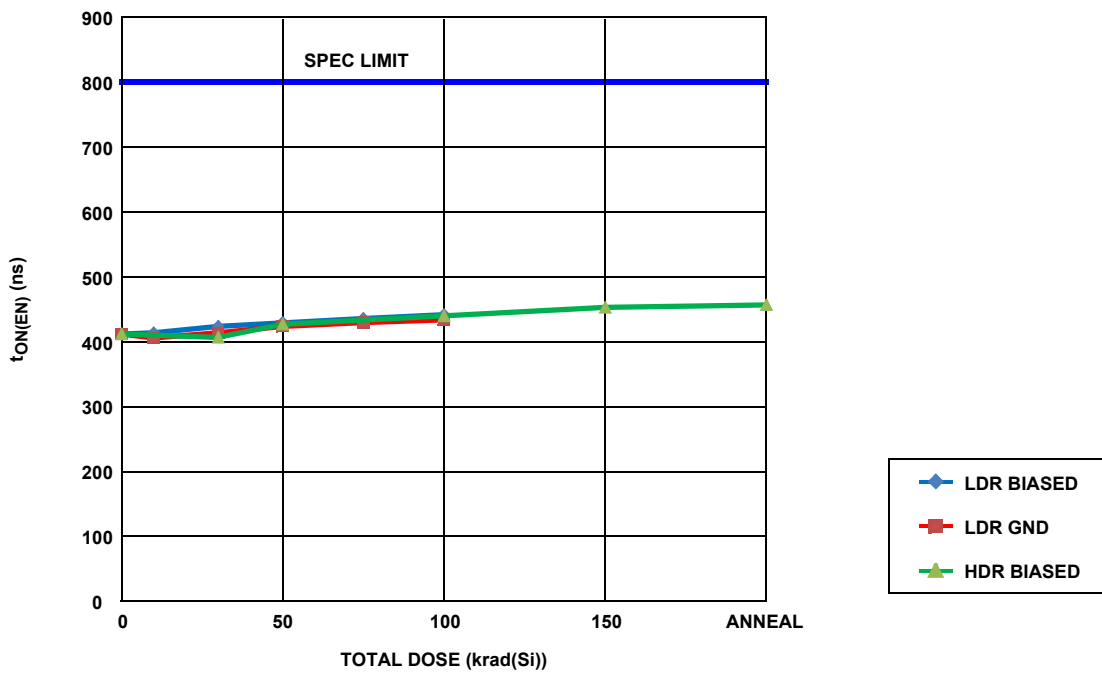


FIGURE 31. ISL71840SEH enable to output ON delay, supply voltage $\pm 15V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limit is 800ns maximum

Variables Data Plots (Continued)

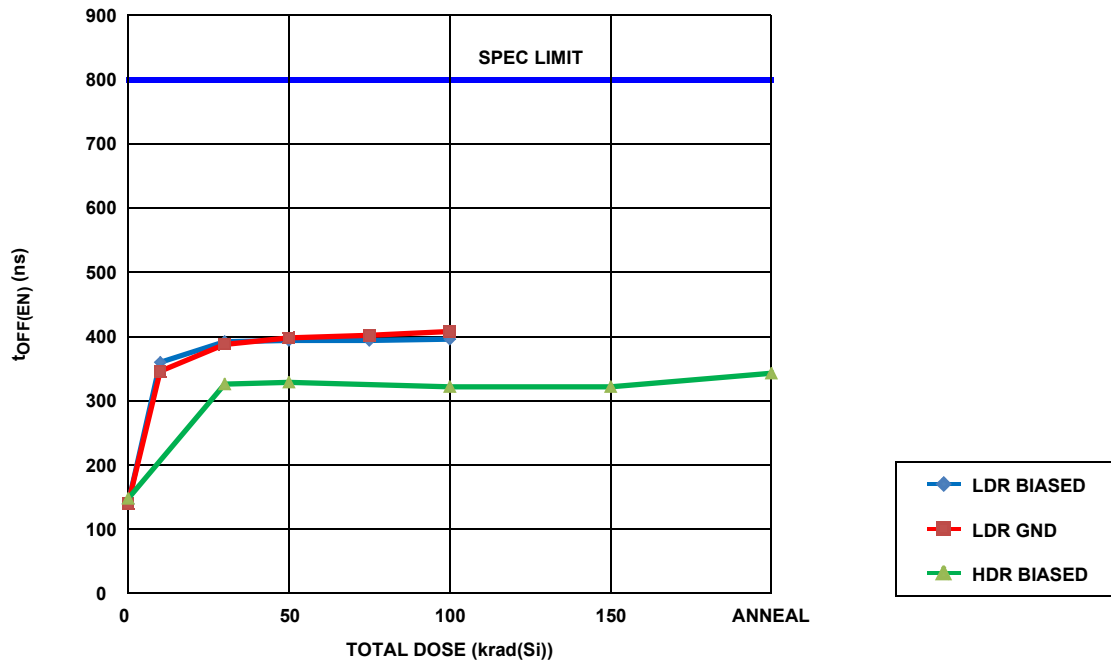


FIGURE 32. ISL71840SEH enable to output OFF delay, supply voltage $\pm 15V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 800ns maximum.

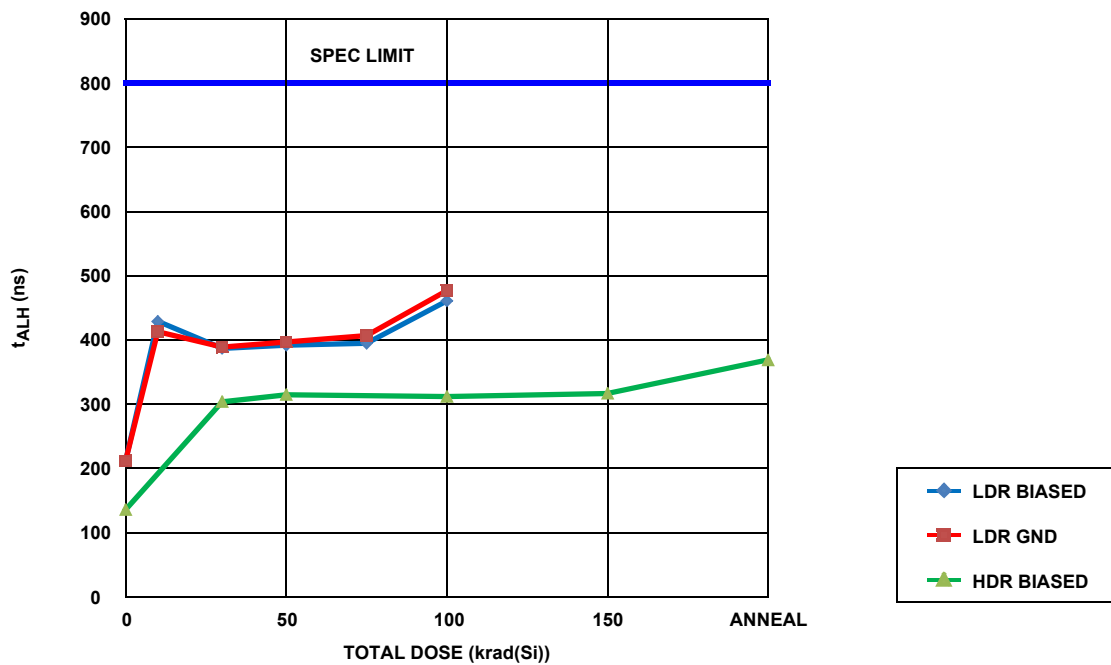


FIGURE 33. ISL71840SEH address to output access time, LOW-to-HIGH, supply voltage $\pm 12V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 800ns maximum.

Variables Data Plots (Continued)

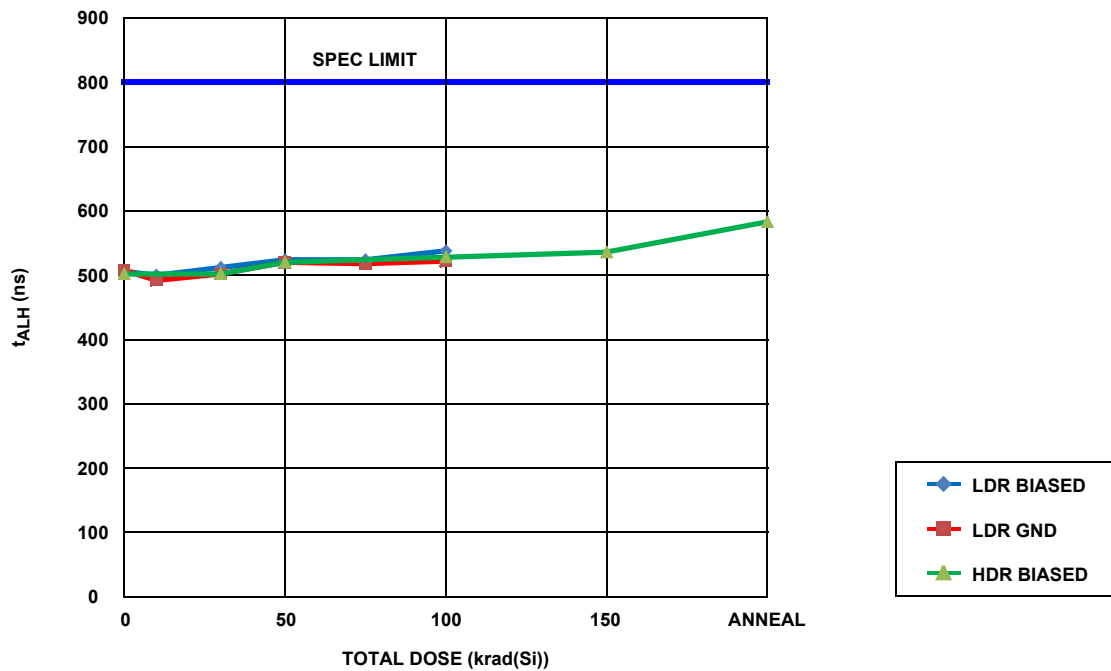


FIGURE 34. ISL71840SEH address to output access time, HIGH-to-LOW, supply voltage $\pm 12V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limit is 800ns maximum.

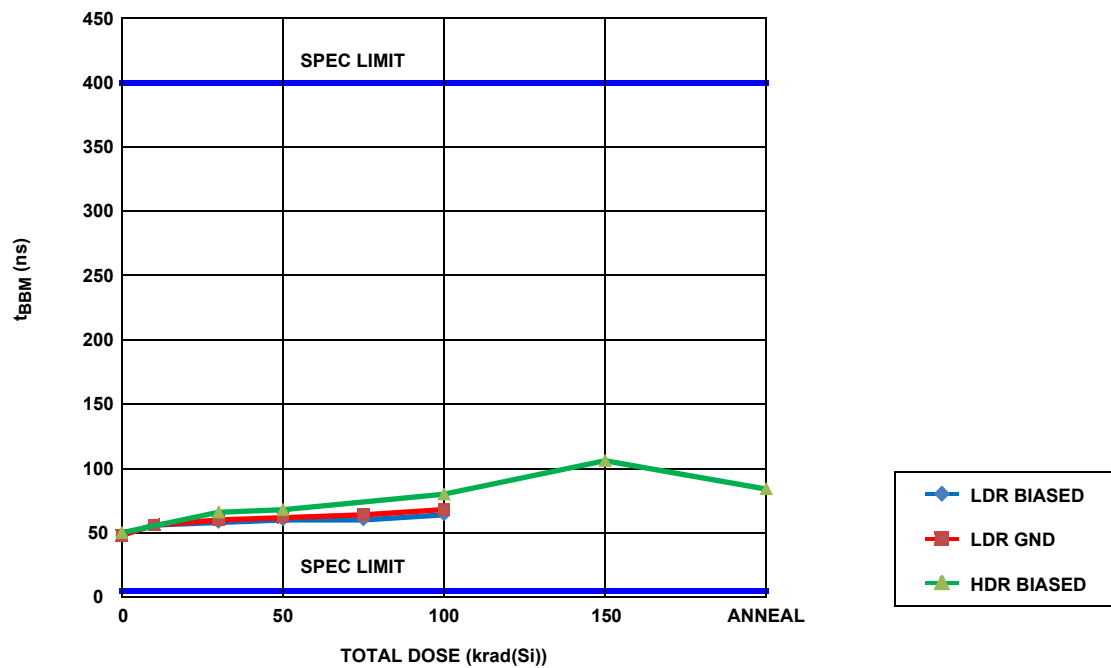


FIGURE 35. ISL71840SEH break-before-make time delay, supply voltage $\pm 12V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The post-irradiation SMD limits are 5ns to 400ns.

Variables Data Plots (Continued)

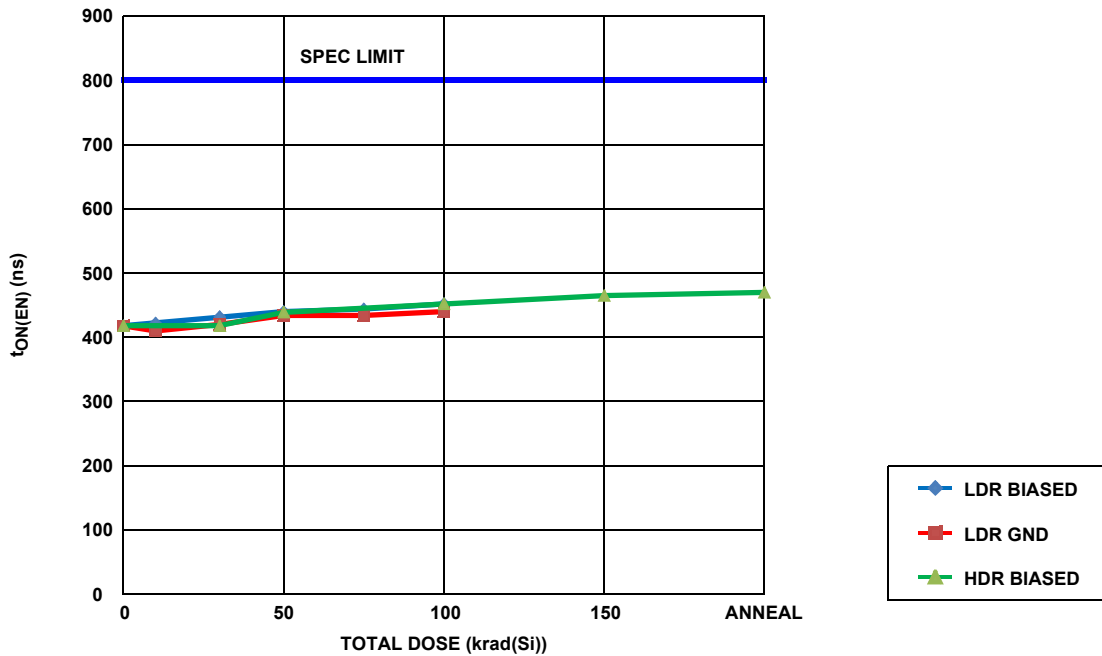


FIGURE 36. ISL71840SEH enable to output ON delay, supply voltage $\pm 12V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limit is 800ns maximum.

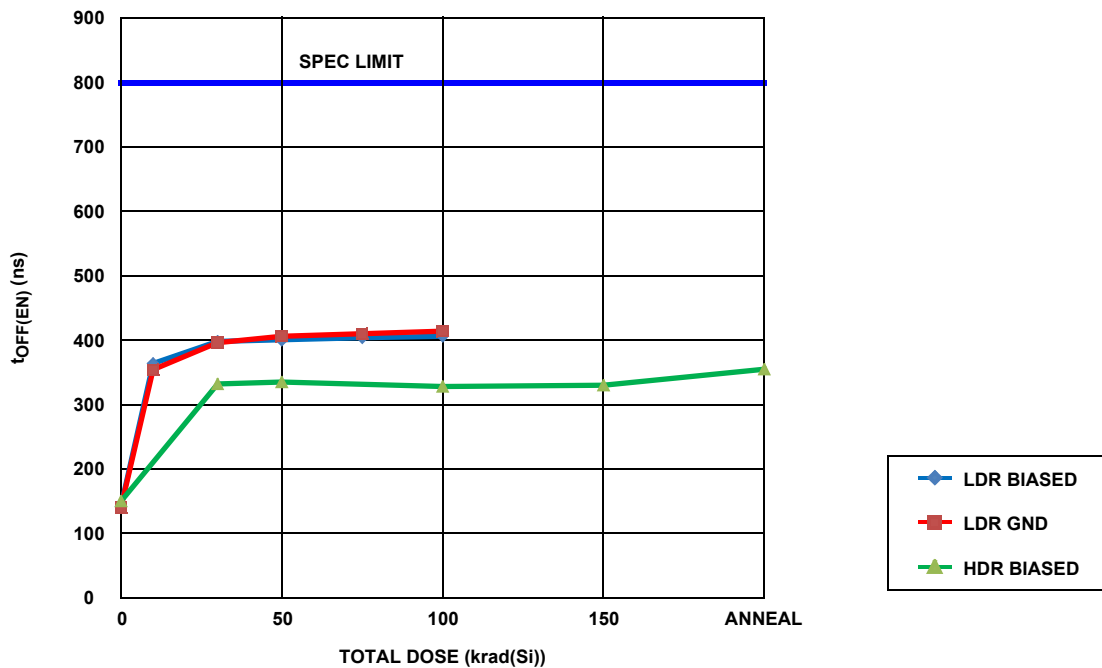


FIGURE 37. ISL71840SEH enable to output OFF delay, supply voltage $\pm 12V$, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s . Sample size for each of the three cells was 4. The postirradiation SMD limit is 800ns maximum.

Variables Data Plots (Continued)

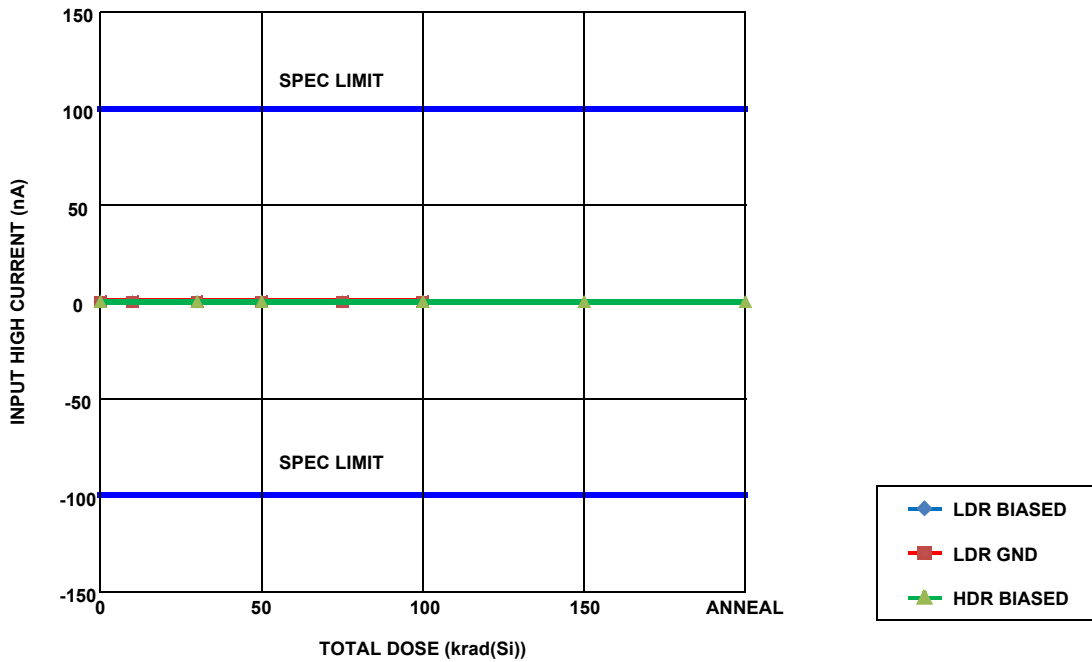


FIGURE 38. ISL71840SEH input HIGH current, average of four addresses and ENABLE, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limits are -100nA to 100nA.

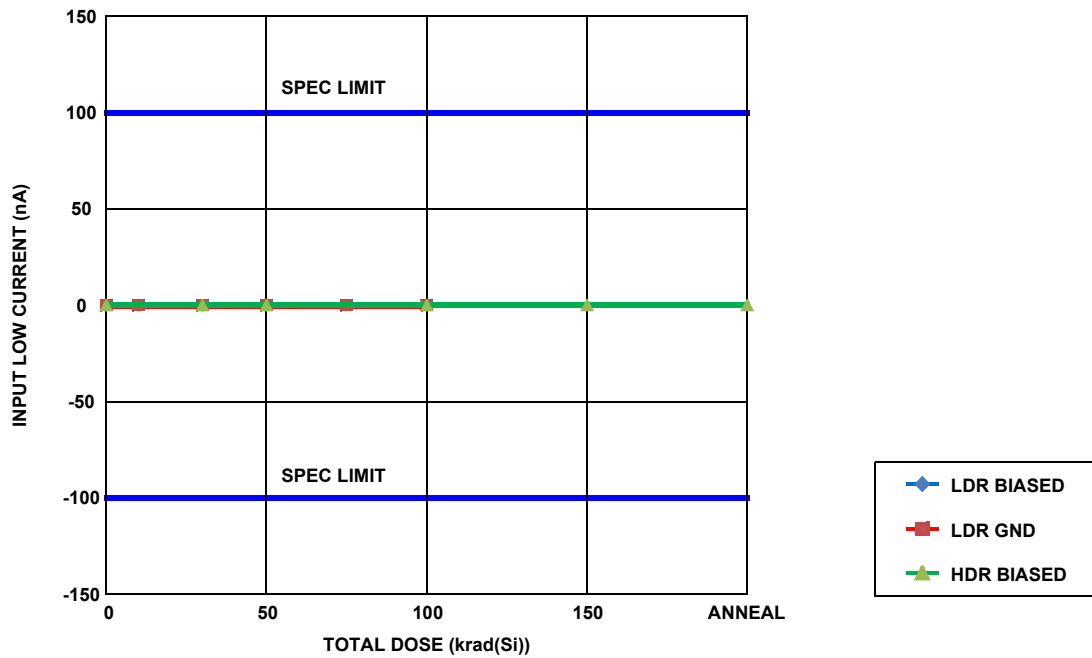


FIGURE 39. ISL71840SEH input LOW current, average of four addresses and ENABLE, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limits are -100nA to 100nA.

Variables Data Plots (Continued)

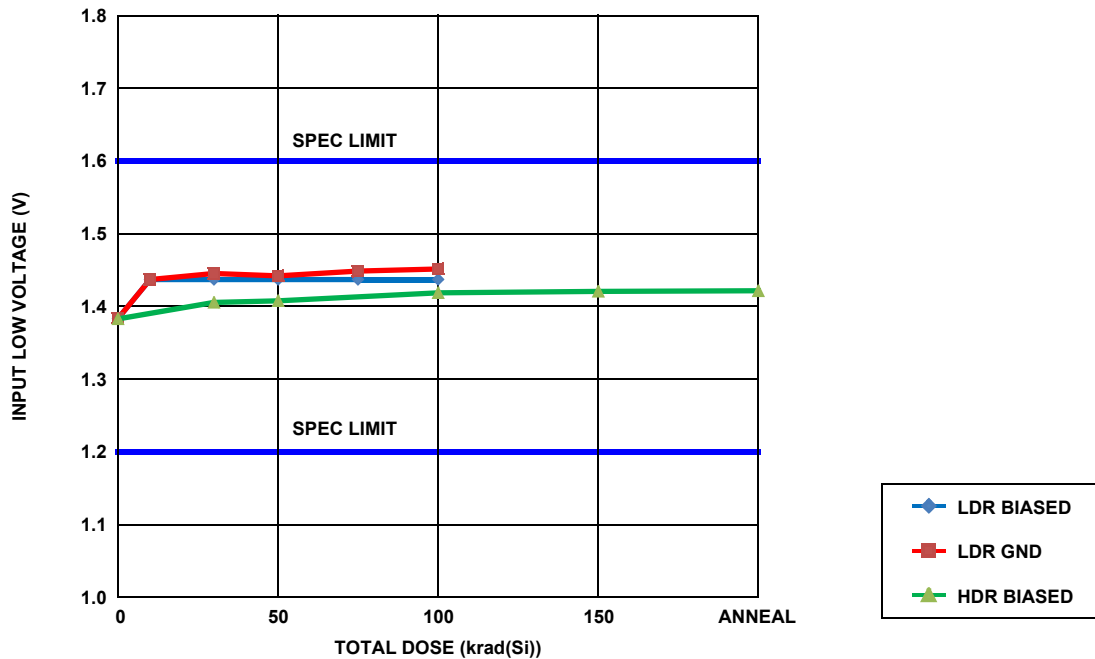


FIGURE 40. ISL71840SEH input LOW voltage, average of four addresses and ENABLE, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limits are 1.2V to 1.6V.

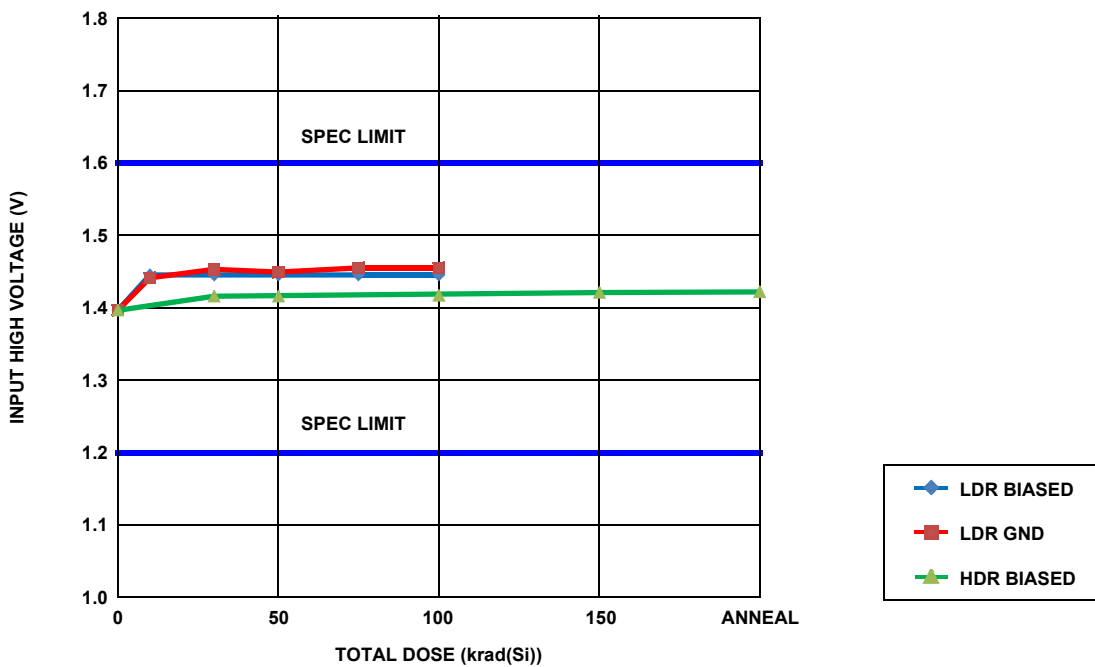


FIGURE 41. ISL71840SEH input HIGH voltage, average of four addresses and ENABLE, as a function of total dose irradiation at high dose rate for the biased (per Figure 2) case and at low dose rate for the unbiased (all pins grounded) and the biased (per Figure 2) cases. The low dose rate was 0.0089rad(Si)/s and the high dose rate was 69.72rad(Si)/s. Sample size for each of the three cells was 4. The postirradiation SMD limits are 1.2V to 1.6V.

Conclusion

This document reports interim results of a total dose test of the ISL71840SEH 16-channel analog multiplexer. Parts were tested at low dose rate underbiased and unbiased conditions and at high dose rate underbiased conditions as outlined in MIL-STD-883 Test Method 1019.7. The high dose rate samples were taken through 150krad(Si) and biased anneal; the low dose rate samples are at 100krad(Si) at this time and will be continued through 150krad(Si) and anneal.

ATE characterization testing at downpoints showed no rejects to the SMD Group A limits for biased irradiation at high dose rate and biased and grounded irradiation at low dose rate, with the high dose rate irradiations followed by a 100 hours biased anneal for 168 hours.

The attributes data is presented in [Table 1](#), while the variables data for selected parameters is presented in [Figures 3](#) through [41](#).

As a determinant of low dose rate sensitivity, MIL-STD-883 Test Method 1019.7 specifies that a delta_parameter calculation be performed for any parameters that exceed the Group A limits. These calculations were not required as there were no rejects against the Group A limits. Accordingly, the part is considered ELDRS insensitive up to 150krad(Si).

Similarly, no differences between biased and unbiased irradiation were noted, and the part is not considered bias sensitive.

TABLE 2. REPORTED PARAMETER

FIGURE	PARAMETER	LIMIT LOW	LIMIT HIGH	UNIT	NOTES
3	Positive Supply Current	-	350	μA	
4	Negative Supply Current	-350	-	μA	
5	Positive Standby Supply Current	-	350	μA	
6	Negative Standby Supply Current	-350	-	μA	
7	Supply Current Into VREF	-	35	μA	
8	Switch ON-resistance, Average	-	500	Ω	V _{IN} = 5V
9	Switch ON-resistance, Average	-	500	Ω	V _{IN} = -5V
10	Switch ON-resistance, Average	-	700	Ω	V _{IN} = 15V
11	Switch ON-resistance, Average	-	700	Ω	V _{IN} = -15V
12	ON-resistance match, Average	-	20	Ω	V _{IN} = 5V
13	ON-resistance Match, Average	-	20	Ω	V _{IN} = -5V
14	OFF Source Leakage, Average	-100	100	nA	V _{IN} = 11.5V
15	OFF Source Leakage, Average	-100	100	nA	V _{IN} = -11.5V
16	OFF Source Leakage, Average	-750	750	nA	35V overvoltage
17	OFF Source Leakage, Average	-750	750	nA	-35V overvoltage
18	OFF Drain Leakage, Average	-500	500	nA	Power off, 35V overvoltage
19	OFF Drain Leakage, Average	-500	500	nA	Power off, -35V overvoltage
20	ON Source Leakage, Average	-500	500	nA	35V overvoltage
21	ON Source Leakage, Average	-500	500	nA	-35V overvoltage
22	OFF Source Leakage, Average	-100	100	nA	Power off
23	OFF Source Leakage, Average	-100	100	nA	Power off
24	ON Drain Leakage, Average	-100	100	nA	Source and drain at 10V
25	ON Drain Leakage, Average	-100	100	nA	Source and drain at -10V
26	ON Source Leakage	-80	80	nA	Part disabled
27	ON Source Leakage	-80	80	nA	Part disabled
28	Access Time, LOW-to-HIGH	-	800	ns	±15V supplies
29	Access Time, HIGH-to-LOW	-	800	ns	±15V supplies
30	Break-before-make Time	5	400	ns	±15V supplies

TABLE 2. REPORTED PARAMETER (Continued)

FIGURE	PARAMETER	LIMIT LOW	LIMIT HIGH	UNIT	NOTES
31	Enable ON to Output Delay	-	800	ns	±15V supplies
32	Enable OFF to Output Delay	-	800	ns	±15V supplies
33	Access time, LOW-to-HIGH	-	800	ns	±12V supplies
34	Access time, HIGH-to-LOW	-	800	ns	±12V supplies
35	Break-before-make Time	5	400	ns	±12V supplies
36	Enable ON to Output Delay	-	800	ns	±12V supplies
37	Enable OFF to Output Delay	-	800	ns	±12V supplies
38	Input HIGH Current, Average	-100	100	nA	A0-A3 and ENABLE
39	Input LOW Current, Average	-100	100	nA	A0-A3 and ENABLE
40	Input LOW Voltage, Average	1.2	1.6	V	A0-A3 and ENABLE
41	Input HIGH Voltage, Average	1.2	1.6	V	A0-A3 and ENABLE

NOTE:

3. Limits are taken from Standard Microcircuit Drawing (SMD) [5962-15219](#).

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.
"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.
Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.
(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.
(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)



SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852-2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338