
ISL73040SEH

Total Dose Testing

TR061
Rev.0.00
Jan 15, 2018

Introduction

This report documents the results of low dose rate total dose testing and subsequent high temperature biased annealing of the [ISL73040SEH](#) GaN FET driver. The tests were conducted to provide an assessment of the total dose hardness of the part and to provide an estimate of bias or anneal sensitivity. Parts were irradiated under bias and with all pins grounded at low dose rate. The ISL73040SEH is rated at 75krad(Si) at 0.01rad(Si)/s and is acceptance tested on a wafer-by-wafer basis to its SMD limits.

Product Description

The ISL73040SEH is a low-side driver designed to drive enhancement mode Gallium Nitride (eGaN) power FET devices. The part operates over a supply voltage range from 4.5V to 13.2V and offers both inverting (INB) and non-inverting (IN) inputs to satisfy requirements for inverting and non-inverting gate drive with a single device. The ISL73040SEH supplies 4.5V gate drive voltage (V_{DRV}) that is generated using an internal regulator, which prevents the driven device's gate voltage exceeding its maximum gate-source rating. The gate drive voltage also features Undervoltage Lockout (UVLO) protection that ignores the inputs (IN/INB) and keeps OUTL turned on to ensure the GaN FET is in an OFF state whenever V_{DRV} is below the UVLO threshold. The inputs of the ISL73040SEH can withstand voltages up to 14.7V. The split outputs of the ISL73040SEH offer the flexibility to adjust the turn-on and turn-off speed independently by adding impedance in the turn-on and turn-off paths.

The ISL73040SEH operates across the -55°C to +125°C temperature range and is offered in an 8 Ld hermetically sealed ceramic Surface Mount Device (SMD) package or in die form. The part is implemented in the Renesas P6 power management and mixed signal process, a junction-isolated 5V BiCMOS flow with added high voltage DMOS devices. The fabrication process is QML certified and is in volume commercial production.

Related Literature

- MIL-STD-883 Test Method 1019.
- For a full list of related documents, visit our website
 - [ISL73040SEH](#) product page

1. Test Description

1.1 Irradiation Facilities

Low dose rate testing was performed at 0.01rad(Si)/s using the Renesas Palm Bay Hopewell Designs N40 panoramic gamma ray irradiator. Biased irradiation and annealing were performed on all samples following irradiation, using the [“Appendix” on page 15](#) bias configuration at +100°C for 168 hours in a small temperature chamber.

1.2 Test Fixturing

The [Appendix](#) shows the configuration used for biased irradiation.

1.3 Characterization Equipment and Procedures

All electrical testing was performed at room temperature outside the irradiator, using production Automated Test Equipment (ATE) with datalogging to SMD 5962-17233 limits at each downpoint.

1.4 Experimental Matrix

Irradiation was performed in accordance with the guidelines of MIL-STD-883 Test Method 1019. The experimental matrix consisted of 12 samples irradiated at low dose rate under bias, and 12 samples irradiated at low dose rate with all pins grounded. Three control units were used.

The ISL73040SEH samples were drawn from wafer lot 5VAFB. All samples were packaged in the hermetic 6mmx6mm 8 Ld surface mount package (package code J8.A). Samples were processed through the standard burn-in cycle before irradiation.

1.5 Downpoints

Downpoints for the tests were 0, 10, 30, 50, and 75krad(Si). All irradiations were followed by a 168-hour high temperature biased anneal at +100°C.

2. Test Results

2.1 Attributes Data

Table 1. ISL73040SEH Total Dose Test Attributes Data

Part	Dose Rate (rad(Si)/s)	Bias	Sample Size	Downpoint	Pass (Note 1)	Fail
ISL73040SEH	0.01	"Appendix" on page 15	12	Pre-irradiation	12	0
				10krad(Si)	12	0
				30krad(Si)	12	0
				50krad(Si)	12	0
				75krad(Si)	12	0
				Anneal	12	0
ISL73040SEH	0.01	Grounded	12	Pre-irradiation	12	
				10krad(Si)	12	0
				30krad(Si)	12	0
				50krad(Si)	12	0
				75krad(Si)	12	0
				Anneal	12	0

Note:

- 'Pass' indicates a sample that passes all pre- and post-irradiation SMD limits.

2.2 Critical Parameter Listing

[Table 2](#) lists 17 critical parameters that are considered indicative of part performance. These parameters are discussed in detail below, including the SMD parameter names for clarity, and are plotted in [Figures 1](#) through [17](#). All parametric limits are in accordance with the ISL73040SEH SMD pre- and post-irradiation limits, which are identical.

Table 2. Critical Parameters

Figure	Parameter	Limit Low	Limit High	Units	Notes
1	Quiescent Power Supply Current	-	2.5	mA	4.5V supply
		-	2.5	mA	13.2V supply
2	Operating Supply Current	-	13.0	mA	4.5V supply, 500kHz
		-	15.0	mA	13.2V supply, 500kHz
3	Output Voltage	4.29	-	V	4.5V supply
		4.34	4.71	V	13.2V supply
4	Input HIGH Level Threshold	-	2.0	V	4.5V supply
		-	2.0	V	13.2V supply
5	Input LOW Level Threshold	1.0	-	V	4.5V supply
		1.0	-	V	13.2V supply
6	Input B HIGH Level Threshold	-	2.0	V	4.5V supply
		-	2.0	V	13.2V supply
7	Input B LOW Level Threshold	1.0	-	V	4.5V supply
		1.0	-	V	13.2V supply

Table 2. Critical Parameters (Continued)

Figure	Parameter	Limit Low	Limit High	Units	Notes
8	Output Rise Time	21	90	ns	$C_L = 10,000\text{pF}$
9	Output Fall Time	16	50	ns	$C_L = 10,000\text{pF}$
10	Input to Output Turn-On Propagation Delay	15	65	ns	$C_L = 1,000\text{pF}$
11	Input to Output Turn-Off Propagation Delay	15	65	ns	$C_L = 1,000\text{pF}$
12	Input B to Output Turn-On Propagation Delay	15	65	ns	$C_L = 1,000\text{pF}$
13	Input B to Output Turn-Off Propagation Delay	15	65	ns	$C_L = 1,000\text{pF}$
14	Input to Output Propagation Delay Match	-8	8	ns	
15	Input B to Output Propagation Delay Match	-8	8	ns	
16	Driver Output Resistance	-	3.2	Ω	$I_{OUTH} = 45\text{mA}$
17	Driver Output Resistance	-	1.0	Ω	$OUTH = V_{DRV}$, $I_{OUTL} = -45\text{mA}$
		-	3.0	Ω	$OUTH = OUTL$, $I_{OUTL} = -45\text{mA}$

[Figure 1 on page 5](#) plots the quiescent power supply current (I_{DDQ}) for the 4.5V supply and 13.2V supply cases.

[Figure 2 on page 5](#) plots the operating power supply current (I_{DDO}) for the 4.5V supply and 13.2V supply cases.

[Figure 3 on page 6](#) plots the output voltage (V_{DRV}) for the 4.5V supply and 13.2V supply cases.

[Figure 4 on page 6](#) and [Figure 5 on page 7](#) plot the input HIGH and LOW (V_{IH} and V_{IL}) logic threshold voltages for the 4.5V supply and 13.2V supply cases.

[Figure 6 on page 7](#) and [Figure 7 on page 8](#) plot the input B HIGH and LOW (V_{IH} and V_{IL}) logic threshold voltages for the 4.5V supply and 13.2V supply cases.

[Figure 8 on page 8](#) and [Figure 9 on page 9](#) plot the 10% to 90% output rise and fall times (t_{RISE} and t_{FALL}) with a 10nF load capacitance.

[Figure 10 on page 9](#) and [Figure 11 on page 10](#) plot the input to output turn-on and turn-off propagation delays (t_{DON} and t_{DOFF}).

[Figure 12 on page 10](#) and [Figure 13 on page 11](#) plot the input B to output turn-on and turn-off propagation delays (t_{DON} and t_{DOFF}).

[Figure 14 on page 11](#) plots the input to output turn-on and turn-off propagation delay match (t_{DM}).

[Figure 15 on page 12](#) plots the input B to output turn-on and turn-off propagation delay match (t_{DM}).

[Figure 16 on page 12](#) plots the driver output resistance (r_{ONP}) with the HIGH output current at 45mA.

[Figure 17 on page 13](#) plots the driver output resistance (r_{ONN}) with the HIGH output at V_{DRV} and the HIGH output at the LOW output cases, both with the LOW output current at -45mA.

2.3 Critical Parameter Variables Data

The plots in [Figures 1](#) through [17](#) show the TID response of the critical parameters outlined in “[Critical Parameter Listing](#)” on [page 3](#). The figures plot the average only because the data was tightly grouped.

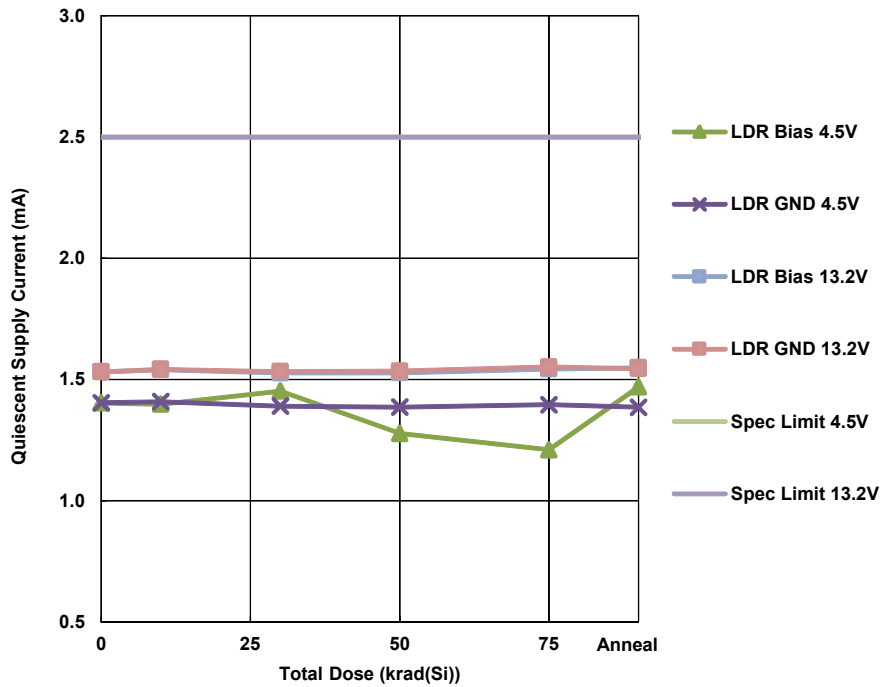


Figure 1. ISL73040SEH quiescent power supply current (I_{DDQ}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#) on page 15) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limit is 2.5mA maximum (4.5V supply and 13.2V supply).

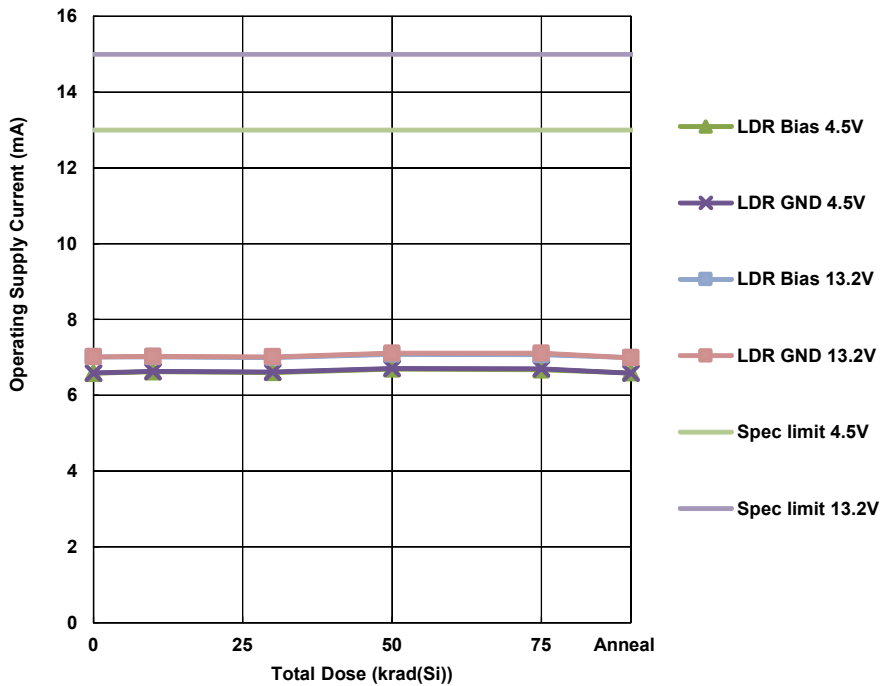


Figure 2. ISL73040SEH operating (500kHz) power supply current (I_{DDQ}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 13mA maximum (4.5V supply) and 15mA maximum (13.2V supply).

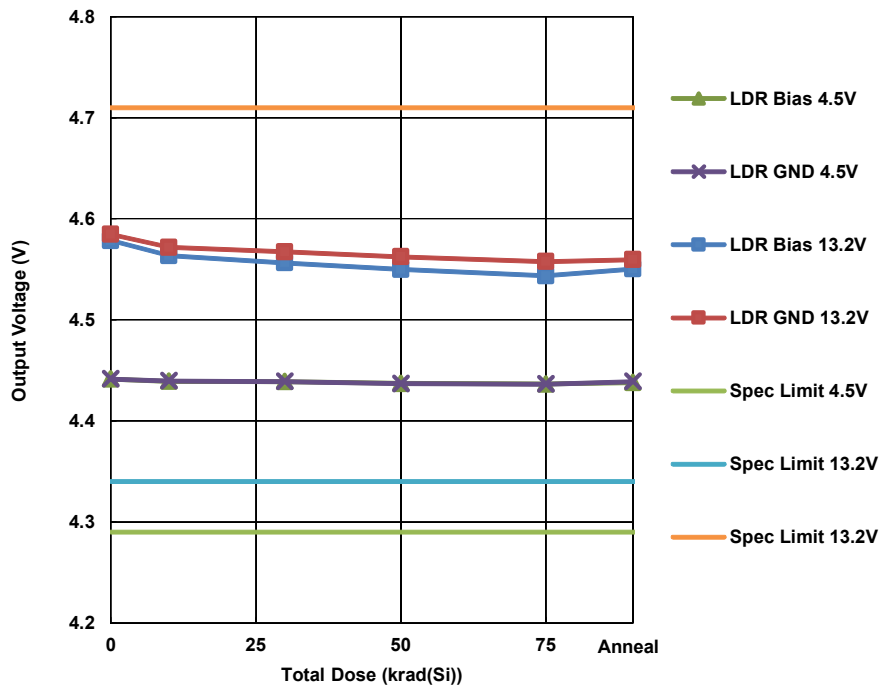


Figure 3. ISL73040SEH output voltage (V_{DRV}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 4.29V minimum (4.5V supply) and 4.34V to 4.71V (13.2V supply).

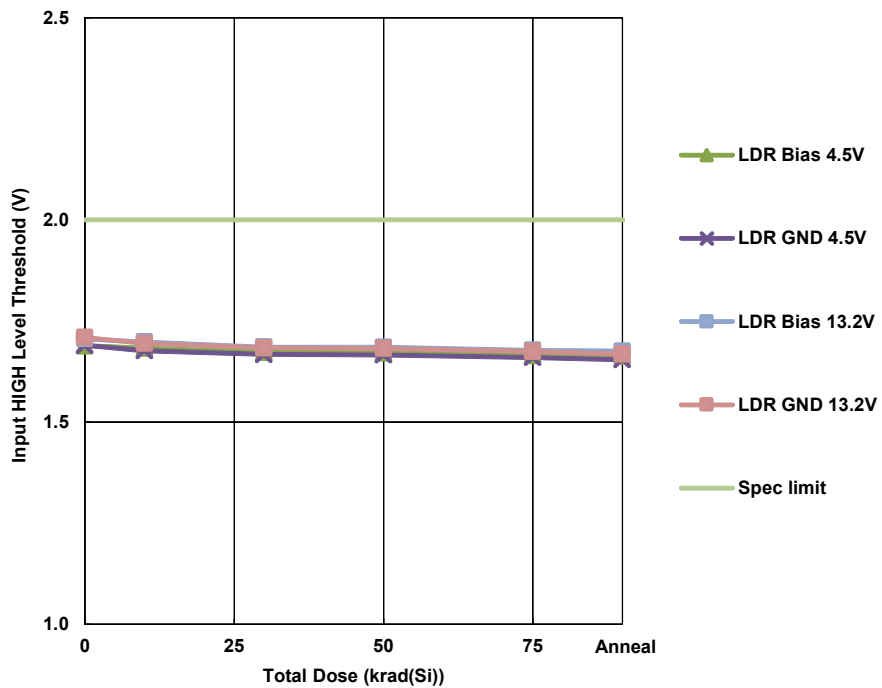


Figure 4. ISL73040SEH input HIGH level threshold (V_{IH}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limit is 2.0V maximum (4.5V supply and 13.2V supply).

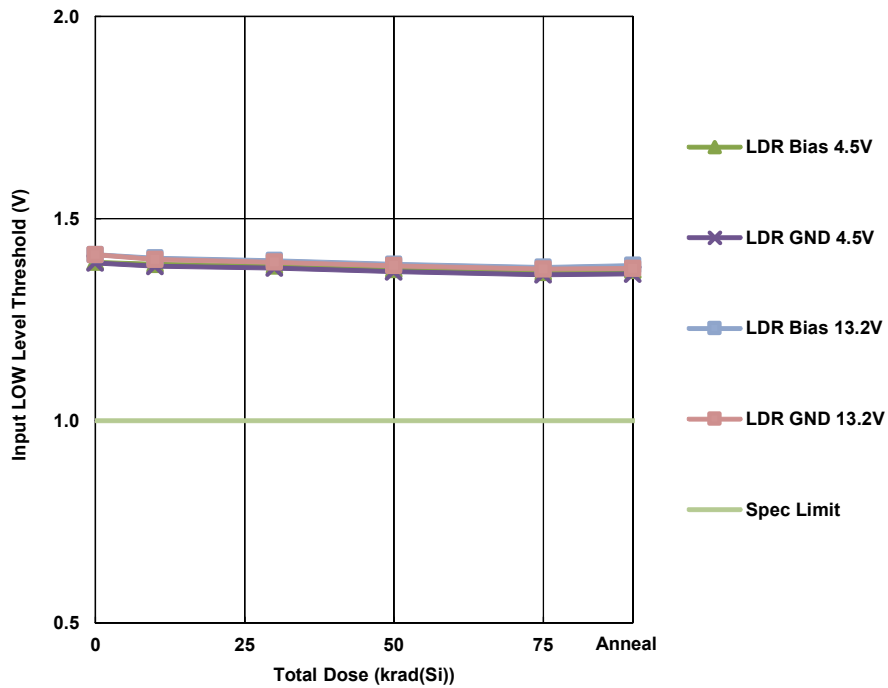


Figure 5. ISL73040SEH input LOW level threshold (V_{IL}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 1.0V minimum (4.5V supply and 13.2V supply).

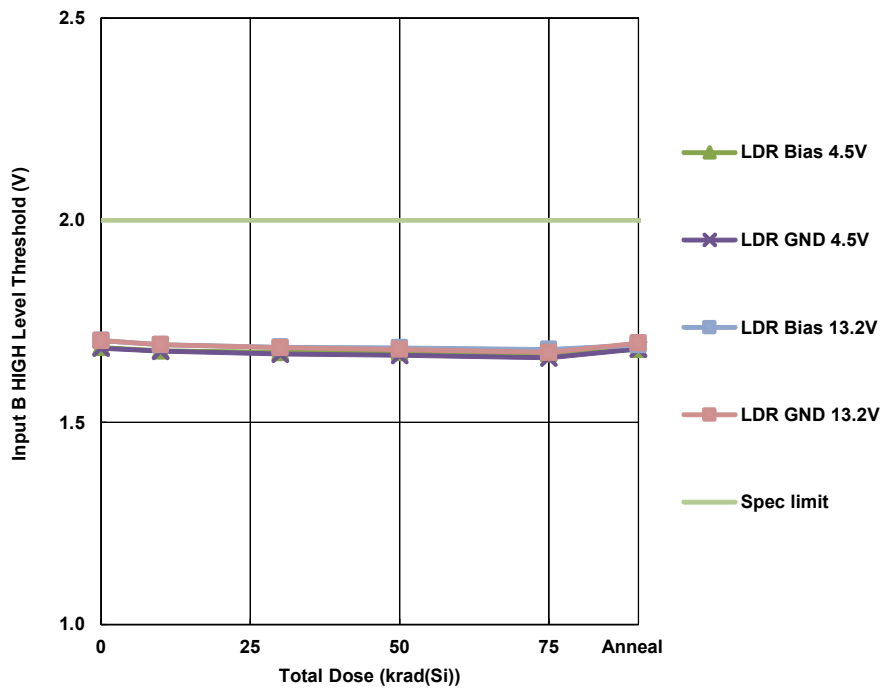


Figure 6. ISL73040SEH input B HIGH level threshold (V_{IH}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limit is 2.0V maximum (4.5V supply and 13.2V supply).

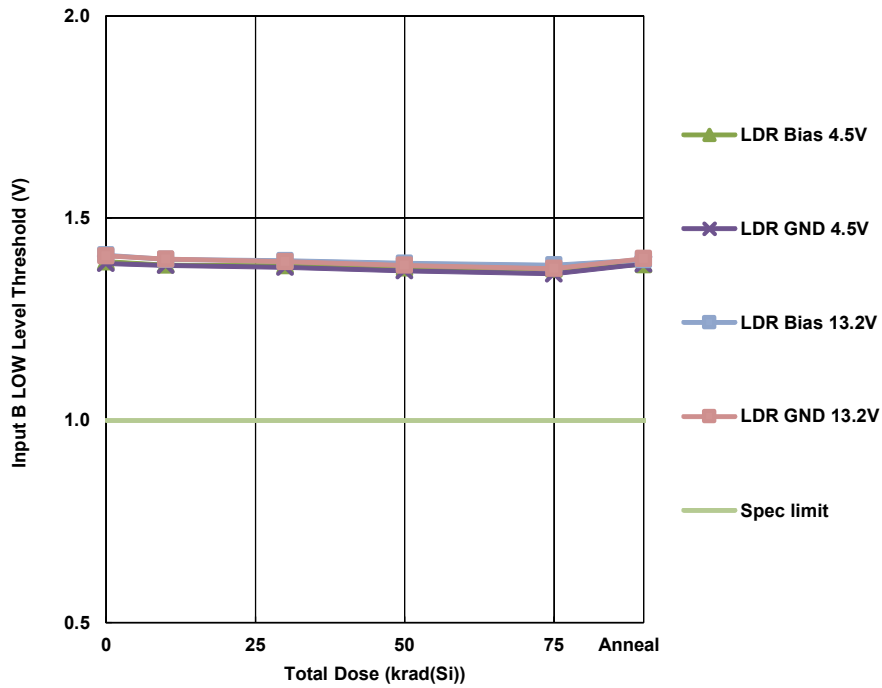


Figure 7. ISL73040SEH input B LOW level threshold (V_{IL}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limit is 1.0V minimum (4.5V supply and 13.2V supply).

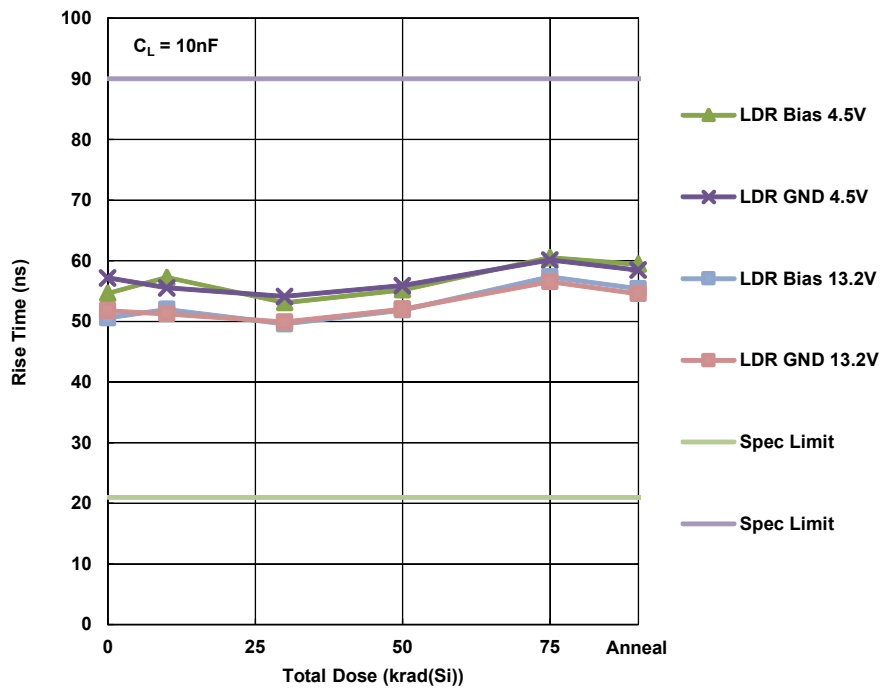


Figure 8. ISL73040SEH rise time (t_{RISE}) as a function of total dose irradiation, 10nF load capacitance, for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 21ns to 90ns.

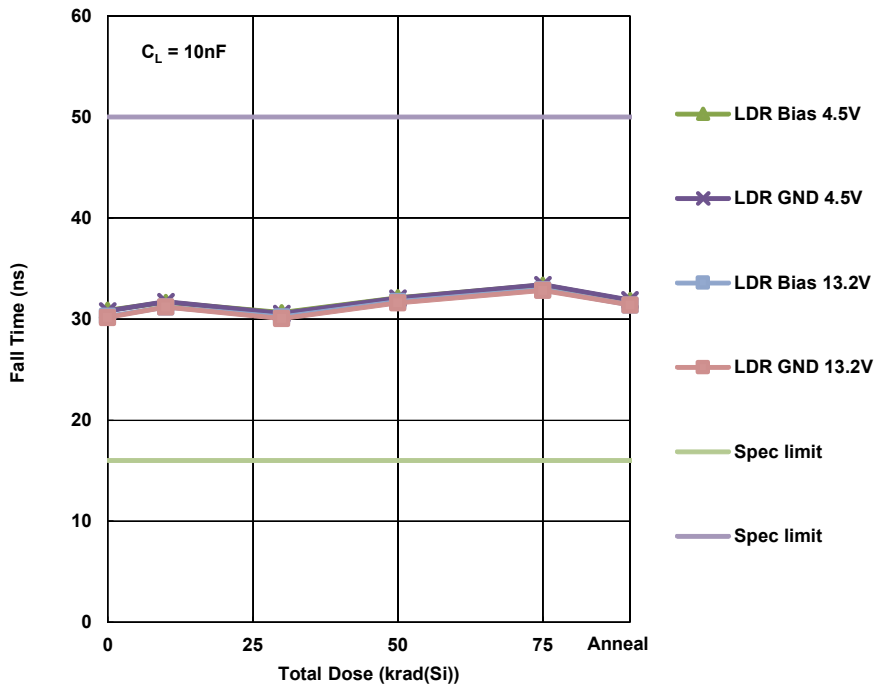


Figure 9. ISL73040SEH fall time (t_{FALL}) as a function of total dose irradiation, 10nF load capacitance, for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 16ns to 50ns.

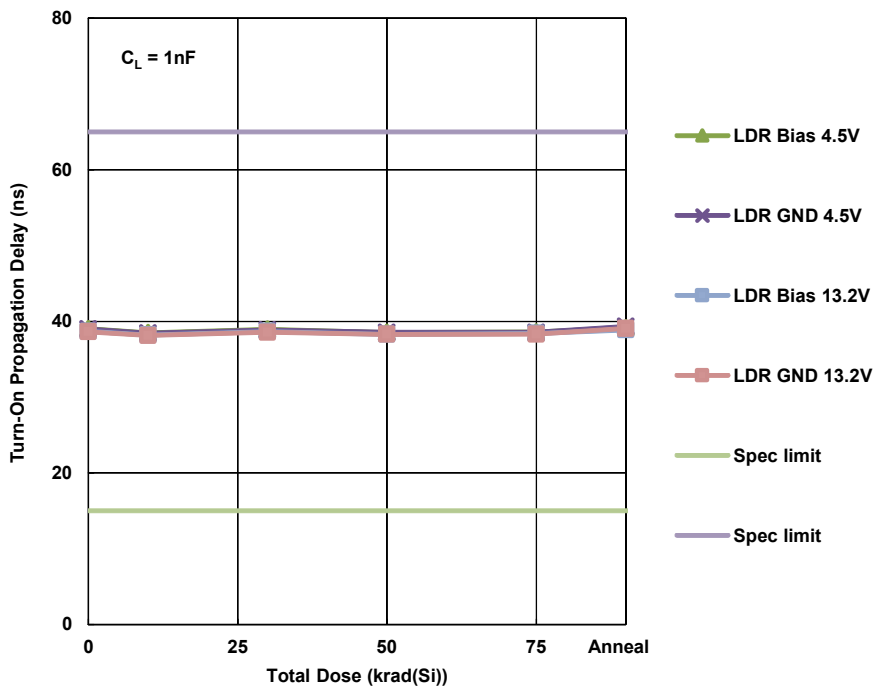


Figure 10. ISL73040SEH input to output turn-on propagation delay (t_{DON}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 15ns to 65ns.

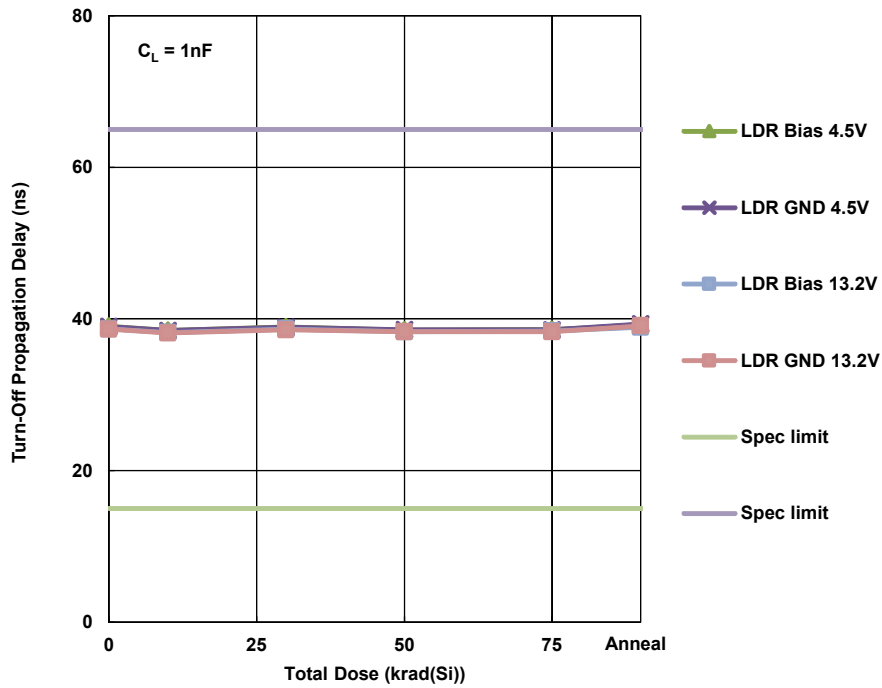


Figure 11. ISL73040SEH input to output turn-off propagation delay (t_{DOFF}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 15ns to 65ns.

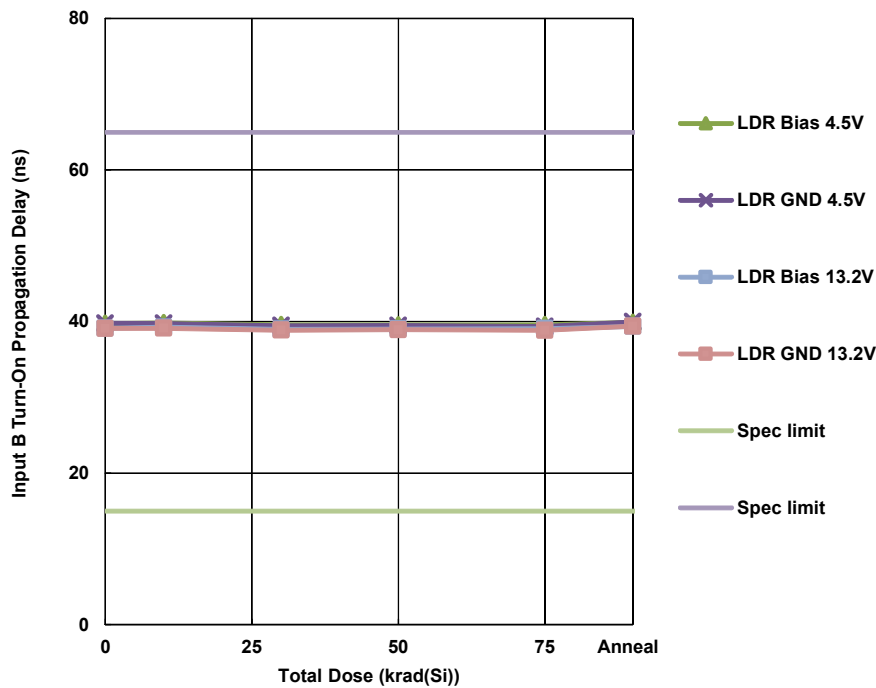


Figure 12. ISL73040SEH input B to output turn-on propagation delay (t_{DON}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 15ns to 65ns.

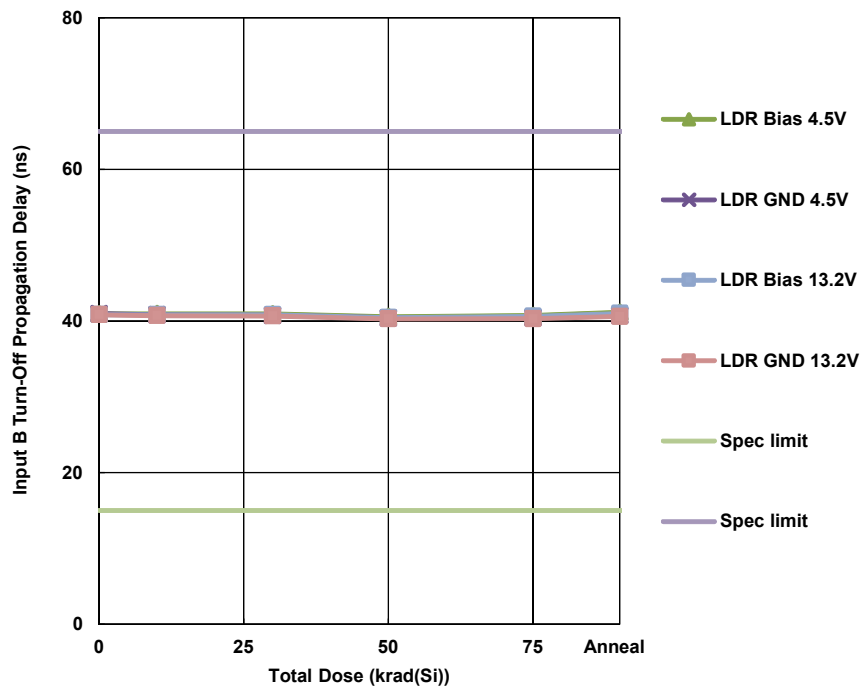


Figure 13. ISL73040SEH input B to output turn-off propagation delay (t_{DOFF}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 15ns to 65ns.

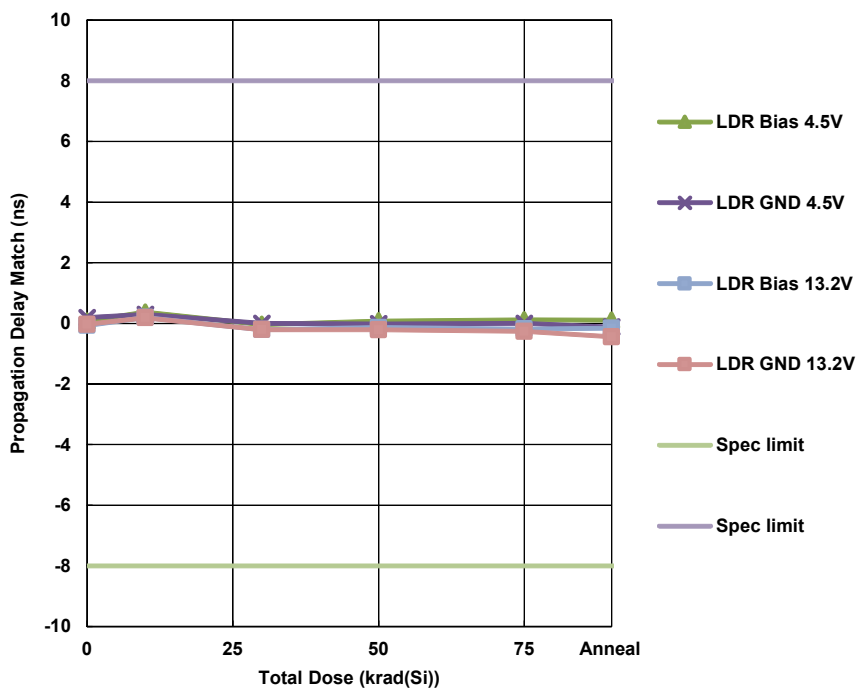


Figure 14. ISL73040SEH input to output propagation delay match (t_{DM}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are -8ns to 8ns.

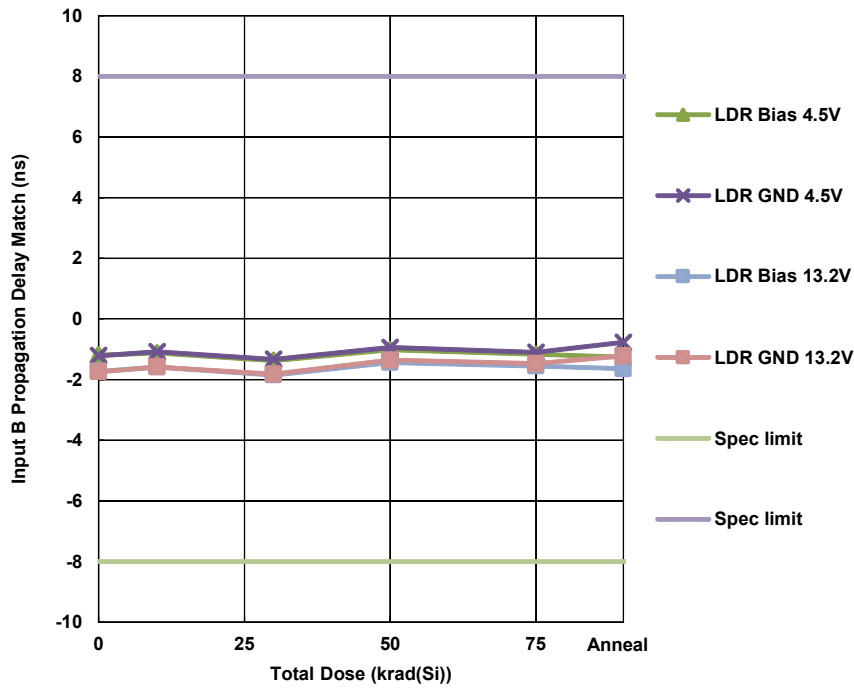


Figure 15. ISL73040SEH input B to output propagation delay match (t_{DM}), 4.5V and 13.2V supply, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are -8ns to 8ns.

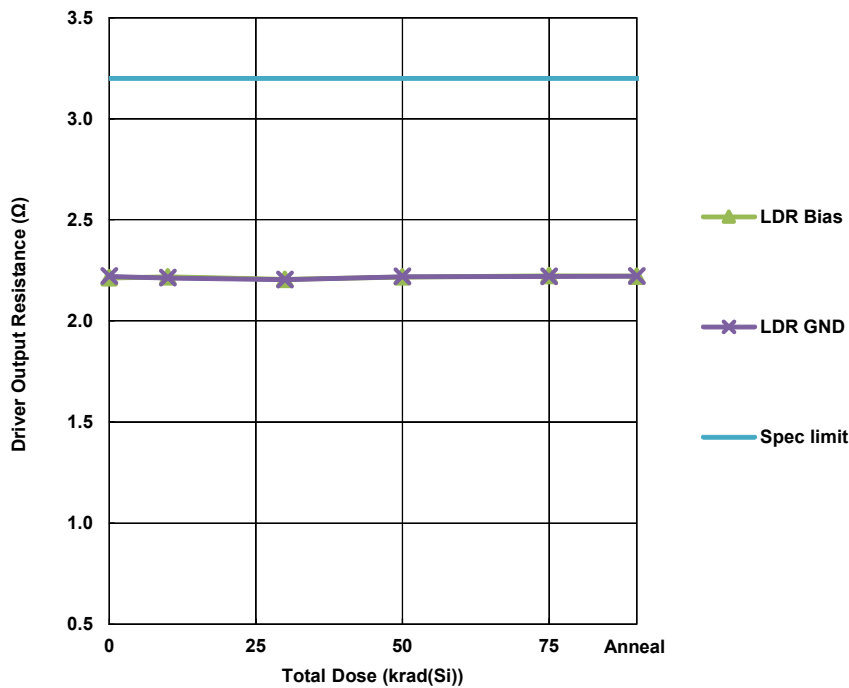


Figure 16. ISL73040SEH driver output resistance (r_{ONP}), output HIGH current 45mA, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s. The irradiations were followed by a +100°C 168-hour biased anneal. The sample size of all cells was 12. The SMD limit is 3.2Ω maximum.

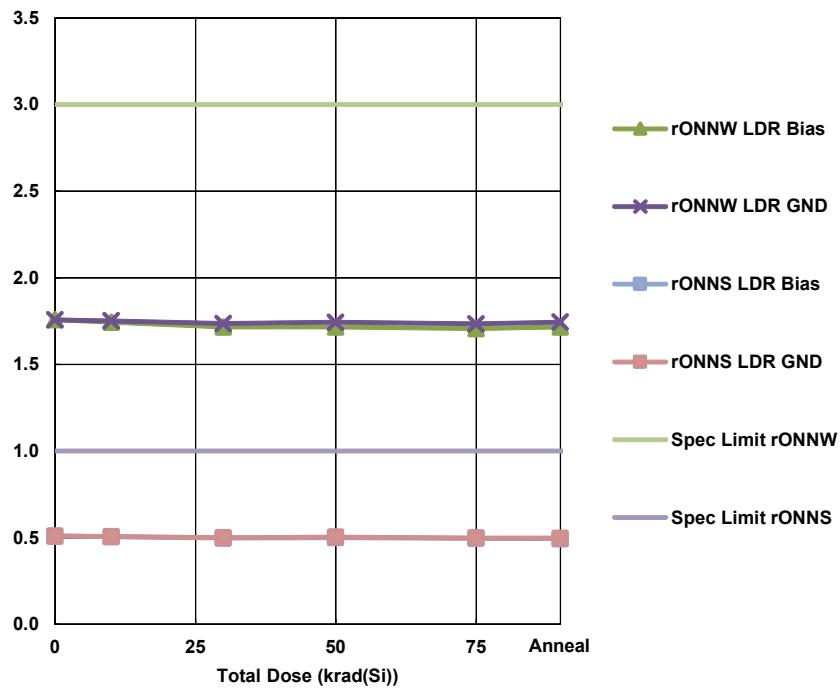


Figure 17. ISL73040SEH driver output resistance (r_{ONN}), output LOW current -45mA , HIGH output at V_{DRV} and at OUTL cases, as a function of total dose irradiation for the biased (per [Appendix](#)) and unbiased (all pins grounded) cases, plotting the average. The dose rate was 0.01rad(Si)/s . The irradiations were followed by a $+100^\circ\text{C}$ 168-hour biased anneal. The sample size of all cells was 12. The SMD limits are 1.0Ω maximum (OUTH = V_{DRV}) and 3.0Ω (OUTH = OUTL).

3. Discussion and Conclusion

The results of a low dose rate biased and grounded total dose test of the ISL73040SEH radiation tolerant low side GaN FET driver were reported. All irradiations were followed by a 168-hour anneal at +100°C under bias. [“Attributes Data” on page 3](#) summarizes the attributes data for the test. [“Critical Parameter Listing” on page 3](#) summarizes the 17 critical parameters for the part. Finally, [“Critical Parameter Variables Data” on page 4](#) provides plots of the total dose and anneal response for these critical parameters.

All parameters remained well within the SMD limits at all downpoints and showed no differences between biased and unbiased irradiation. This leads to the conclusion that the part is not bias sensitive.

4. Appendix

The ISL73040SEH uses the ISL70040SEH irradiation and anneal bias configuration, see [Figure 18](#).

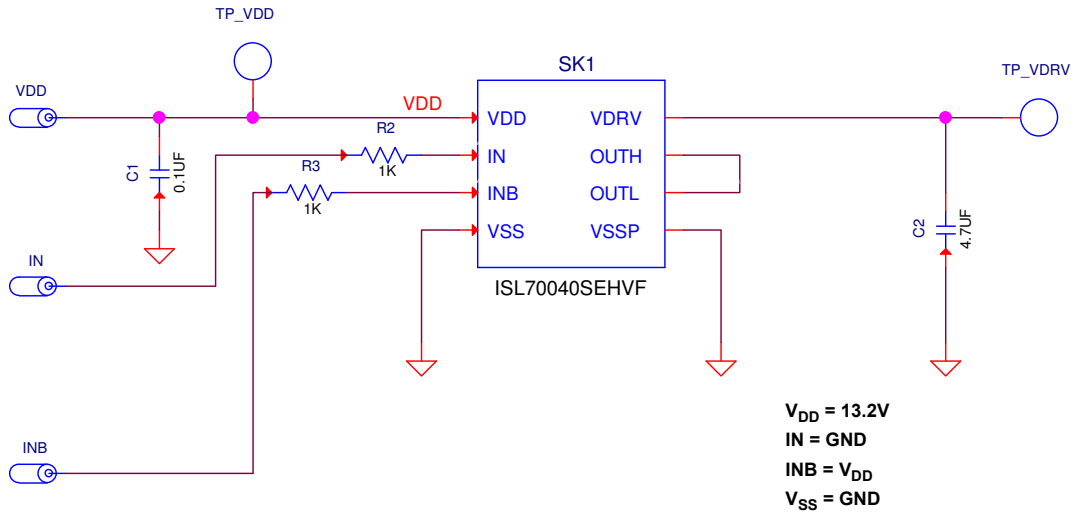


Figure 18. ISL73040SEH Irradiation and Anneal Bias Configuration

5. Revision History

Rev.	Date	Description
0.00	Jan 15, 2018	Initial release

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