HS-26C31EH

Total Dose Testing

TR059
Rev.0.00
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Introduction

This report describes the results of Low Dose Rate (LDR) and High Dose Rate (HDR) total dose testing of the HS-26C31EH quad differential line driver. The data originated from routine production wafer-by-wafer acceptance testing of the part.

Two versions of the base HS-26C31 are available. The HS-26C31RH is acceptance tested on a wafer-by-wafer basis to 300krad(Si) at HDR only, as defined in MIL-STD-883 test method 1019 (50–300rad(Si)/s). The HS-26C31EH is acceptance tested on a wafer-by-wafer basis to 300krad(Si) at high dose rate and to 50krad(Si) at LDR, also as defined in MIL-STD-883 test method 1019 (0.01rad(Si)/s maximum). The HS-26C31RH and HS-26C31EH are identical parts and differ only in radiation lot acceptance testing (RLAT) procedures.

Product Description

The HS-26C31RH and HS-26C31EH are radiation hardened quad differential line drivers designed for digital data transmission over balanced lines in low voltage RS-422 protocol applications. The use of a CMOS process ensures low power consumption, high speed, and reliable operation in the most severe radiation environments. The HS-26C31RH and HS-26C31EH accept CMOS level inputs and convert them to differential outputs. Enable pins allow several devices to be connected to the same data source and addressed independently. These devices have unique outputs that revert to a high impedance state when the driver is disabled or powered down, maintaining signal integrity in multi-driver applications.

Specifications for Rad Hard QML devices are controlled by the Defense Logistics Agency, Land and Maritime (DLA). The SMD number listed in this report must be used when ordering. Detailed electrical specifications for these devices are contained in SMD 5962-96663.

Related Literature

- MIL-STD-883G test method 1019.7
- For a full list of related documents, visit our website
  - HS-26C31EH product page

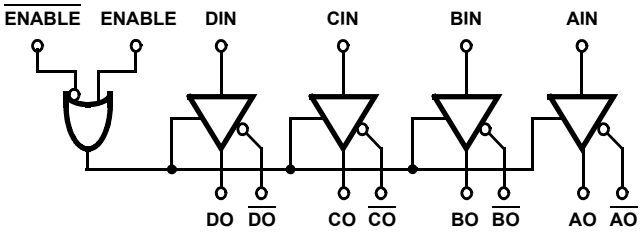

Figure 1. HS-26C31EH Block Diagram

1. Test Description

1.1 Irradiation Facilities

All data was derived from wafer acceptance testing results. HDR irradiation was performed using a Gammacell industry standard irradiator located in the Palm Bay, Florida Intersil facility. LDR irradiation was performed using the Intersil Palm Bay Hopewell Designs N40 panoramic irradiator located in the same facility. The HDR irradiations were performed at 55rad(Si)/s and the LDR irradiations were performed at 0.010rad(Si)/s.

1.2 Test Fixturing

Figure 2 shows the configuration used for biased irradiation.

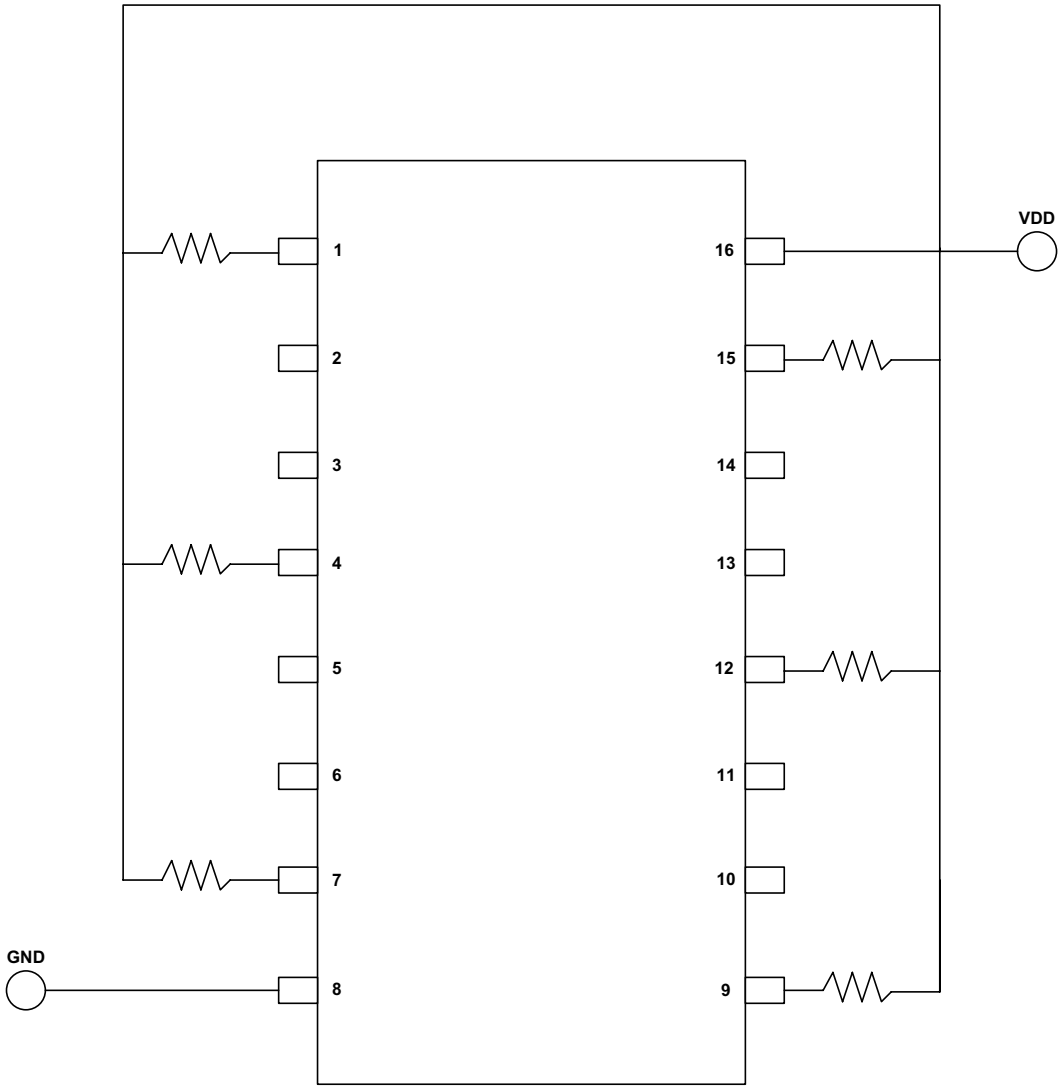

Figure 2. Irradiation Bias Configuration

Notes:

1. VDD = +5V ± 5%
2. GND = ground
3. All resistors are 47kΩ ± 5%
4. Use generic 16-pin universal board
5. Use patch labeled HS26C31

1.3 Characterization Equipment and Procedures

All electrical testing was performed outside the irradiator using the production Automated Test Equipment (ATE) with datalogging at each downpoint. Downpoint electrical testing was performed at room temperature.

1.4 Experimental Matrix

The experimental matrix consisted of 48 samples irradiated at HDR under bias, 20 samples irradiated at LDR with all pins grounded, and 20 samples irradiated at LDR under bias. All samples were part of the wafer-by-wafer acceptance testing procedure.

Samples of the HS-26C31EH die were drawn from production lot G2A0PEH and were packaged in the standard hermetic 16-Ld solder-sealed flatpack (CDFP4-F16) production package. Samples were processed through the standard burn-in cycle before irradiation, as required by MIL-STD-883, and were screened to the SMD 5962-96663 limits at room, high, and low temperatures before the test.

1.5 Downpoints

Downpoints were zero and 300krad(Si) for the HDR test. Downpoints were zero, 50krad(Si), 100krad(Si), and 150krad(Si) for the LDR test.

2. Results

2.1 Attributes Data

Testing of the HS-26C31EH at both dose rates showed no rejected devices after irradiation, screening to the SMD pre-irradiation and post-irradiation limits. The SMD specifies that the part will meet all pre-irradiation limits post-irradiation, that is, the pre-irradiation and post-irradiation limits are the same. Calculations to determine any LDR sensitivity were not required because no rejects occurred in the pre-irradiation Group A limits. Accordingly, the part is considered ELDRS-free up to 150krad(Si), and this conclusion is further supported by referring to the variables data plots in the Variables Data section. No bias sensitivity was noted in the LDR data.

Table 1. HS-26C31EH Total Dose Testing Attributes Data

Dose Rate	Bias	Sample Size	Downpoint	Bin 1 (Note 6)	Rejects
0.01rad(Si)/s	Figure 2	20	Pre-irradiation	20	
			50krad(Si)	20	0
			100krad(Si)	20	0
			150krad(Si)	20	0
0.01rad(Si)/s	Grounded	20	Pre-irradiation	20	
			50krad(Si)	20	0
			100krad(Si)	20	0
			150krad(Si)	20	
55rad(Si)/s	Figure 2	48	Pre-irradiation	48	
			300krad(Si)/s	48	

Note:

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

2.2 Variables Data

The plots in Figures 3 through 17 show data at all downpoints. Most of the plots show the response of all four channels of the parameter of interest as a function of total dose for each of the three irradiation conditions. Note that min/max error bars are not provided for this data because the distributions were tight enough to render this unnecessary. Note also that results are shown for the OUT outputs only; the corresponding data for the OUT_BAR outputs was so similar as to be indistinguishable and these plots were omitted for clarity. In nearly all cases the guardbanded ATE limits are shown instead of the SMD limits, because the ATE limits are used for the total dose acceptance tests. Both limits are given in the figure captions.

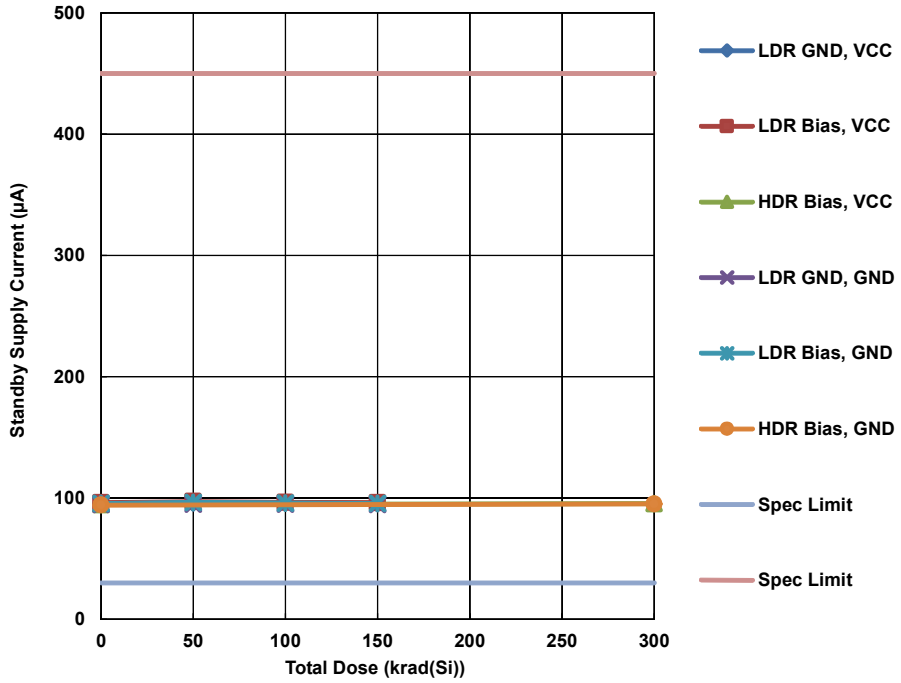

Figure 3. HS-26C31EH standby supply current, inputs at VCC or grounded, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limit is 500µA maximum; the internal ATE limits (shown) are 30µA to 450µA.

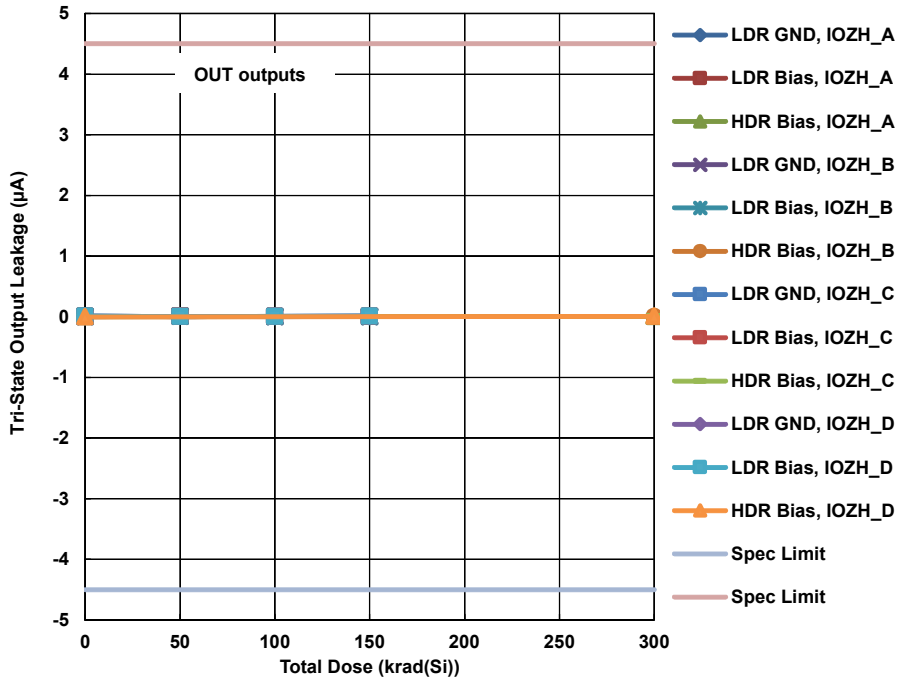

Figure 4. HS-26C31EH tristate output leakage, OUT outputs, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limits are -5µA to 5µA; the internal ATE limits (shown) are -4.5µA to 4.5µA.

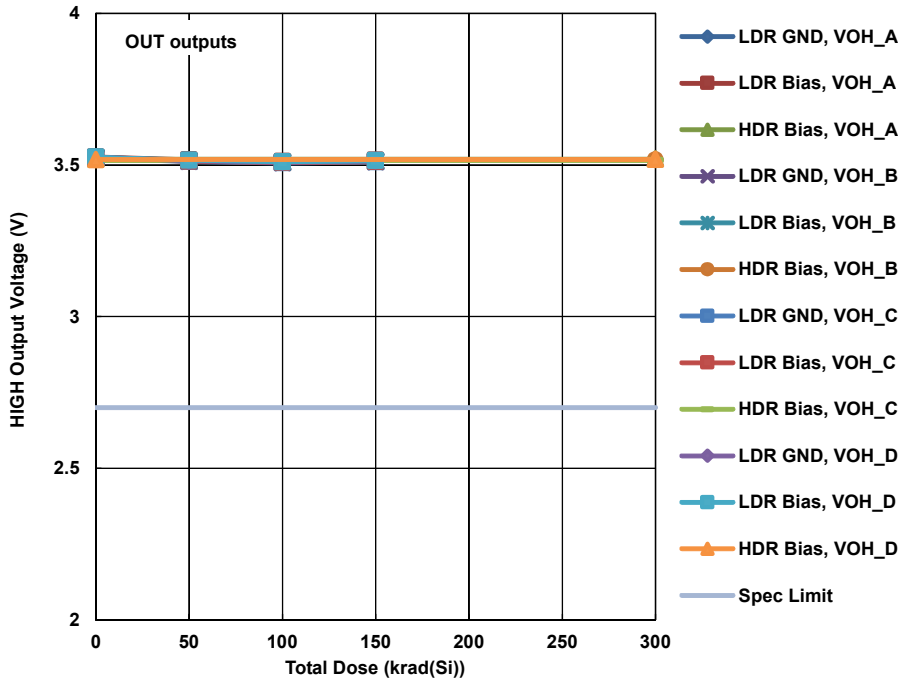

Figure 5. HS-26C31EH output HIGH voltage, OUT outputs, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limit is 2.5V minimum; the internal ATE limit (shown) is 2.7V minimum.

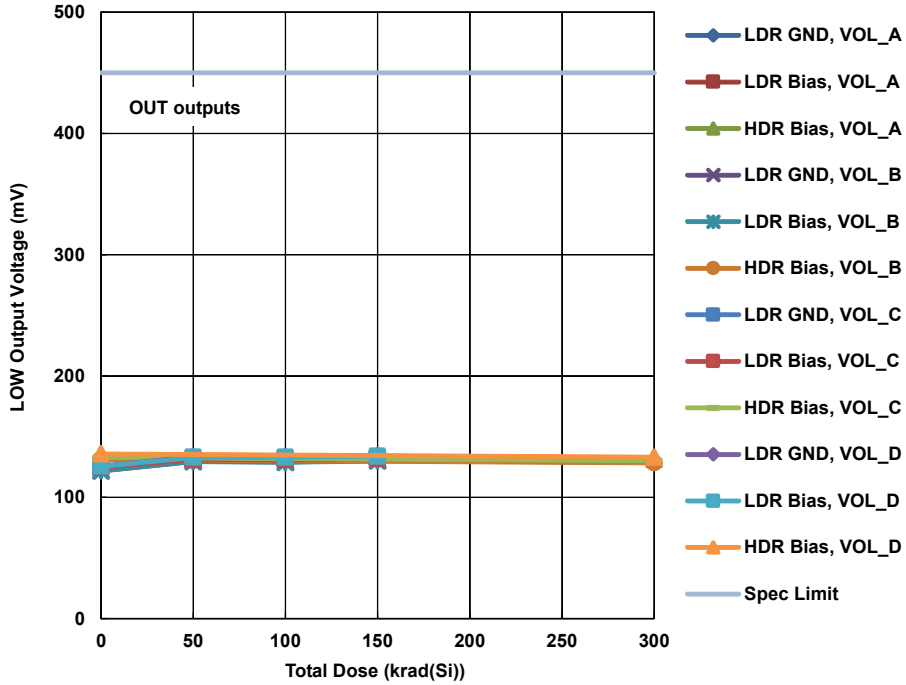

Figure 6. HS-26C31EH output LOW voltage, OUT outputs, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limit is 500mV maximum; the internal ATE limit (shown) is 450mV maximum.

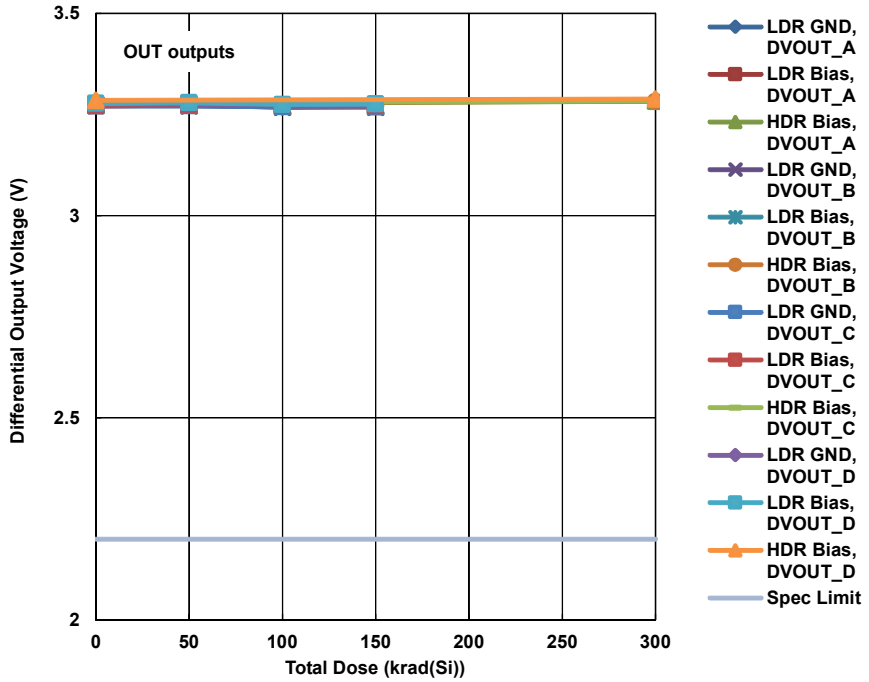

Figure 7. HS-26C31EH differential output voltage, OUT outputs, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limit is 2V minimum; the internal ATE limit (shown) is 2.2V minimum.

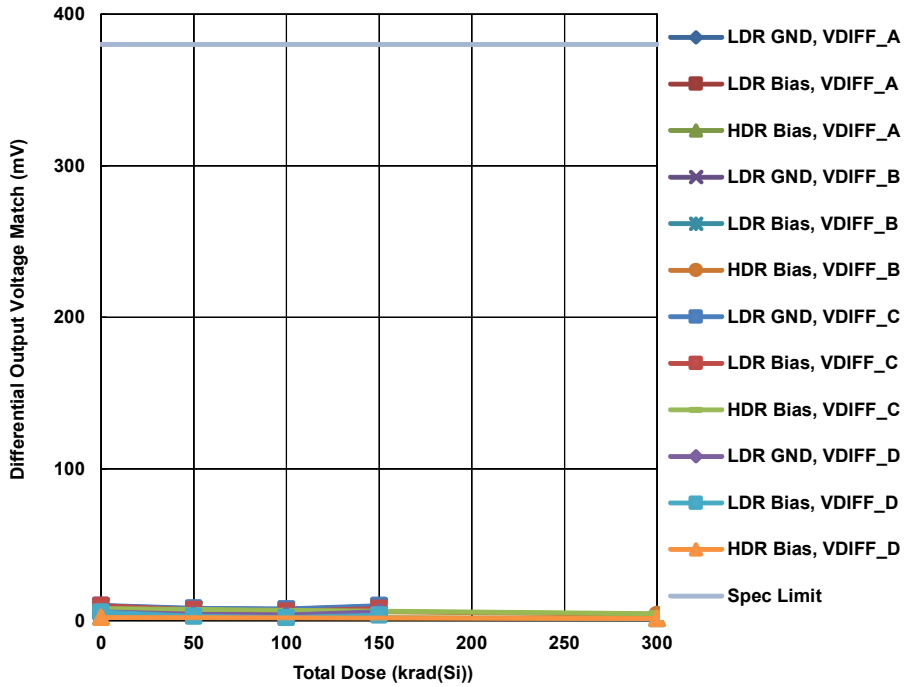

Figure 8. HS-26C31EH differential output voltage match, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes *for* the LDR cells were 20 each. The SMD limit is 400mV maximum; the internal ATE limit (shown) is 380mV maximum.

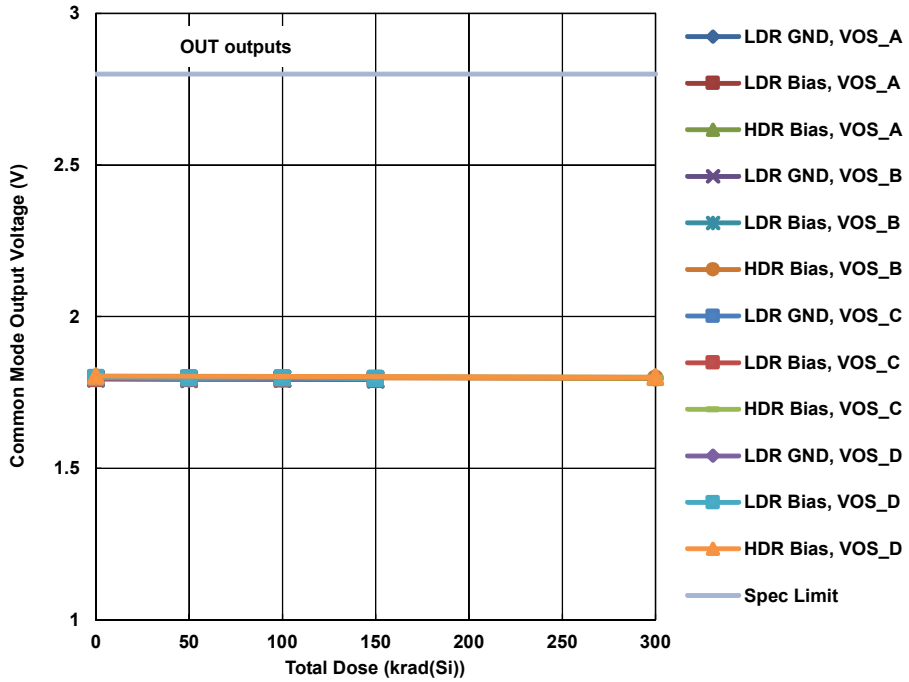

Figure 9. HS-26C31EH common mode output voltage, OUT outputs, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limit is 3V maximum; the internal ATE limit (shown) is 2.8V maximum.

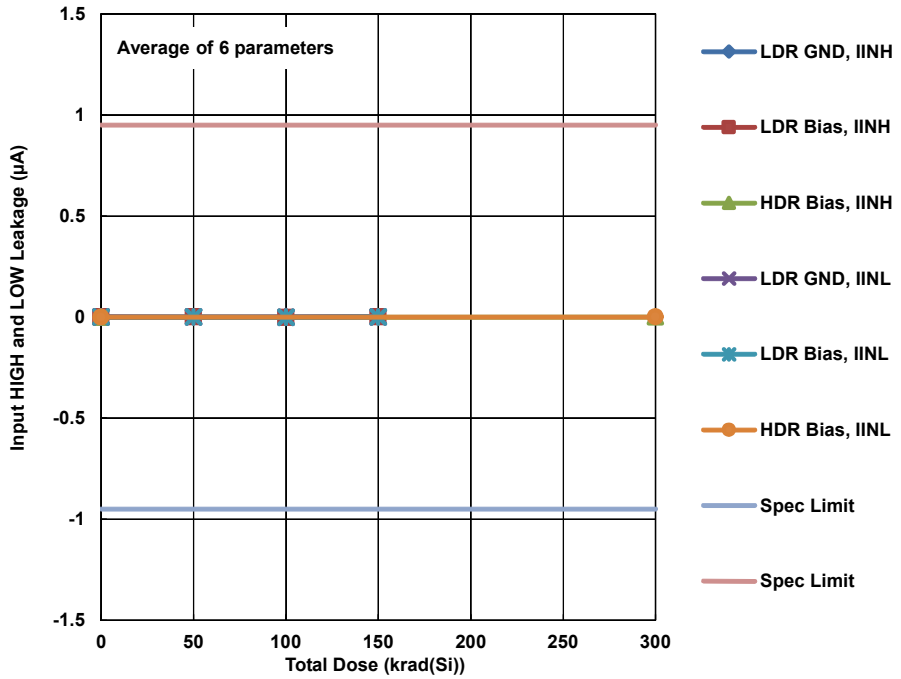

Figure 10. HS-26C31EH input HIGH and LOW leakage, average of channels A through D, ENABLE and ENABLE_BAR, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limits are -1.0µA to +1.0µA; the internal ATE limits (shown) are -0.95µA to +0.95µA.

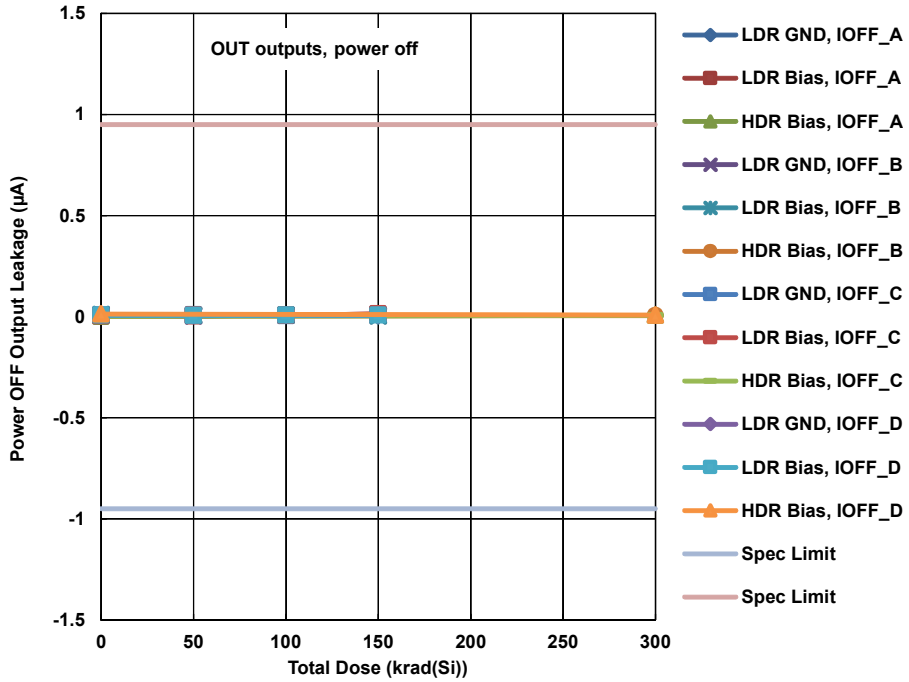

Figure 11. HS-26C31EH power OFF output leakage current, OUT outputs, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limits are -100µA to +100µA; the internal ATE limits (shown) are -95µA to +95µA.

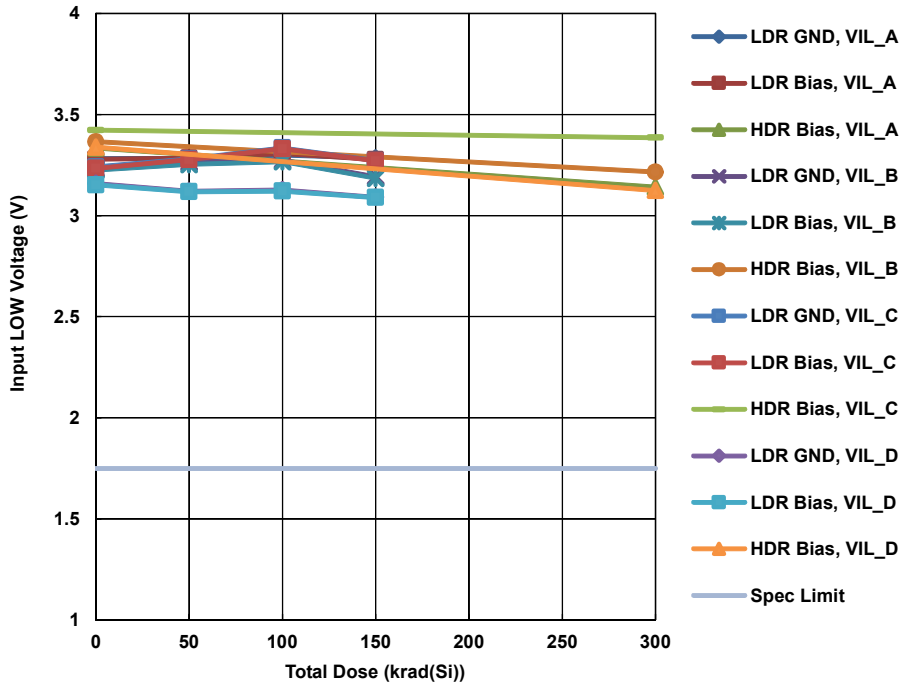

Figure 12. HS-26C31EH input LOW voltage, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limit is 1.75V minimum.

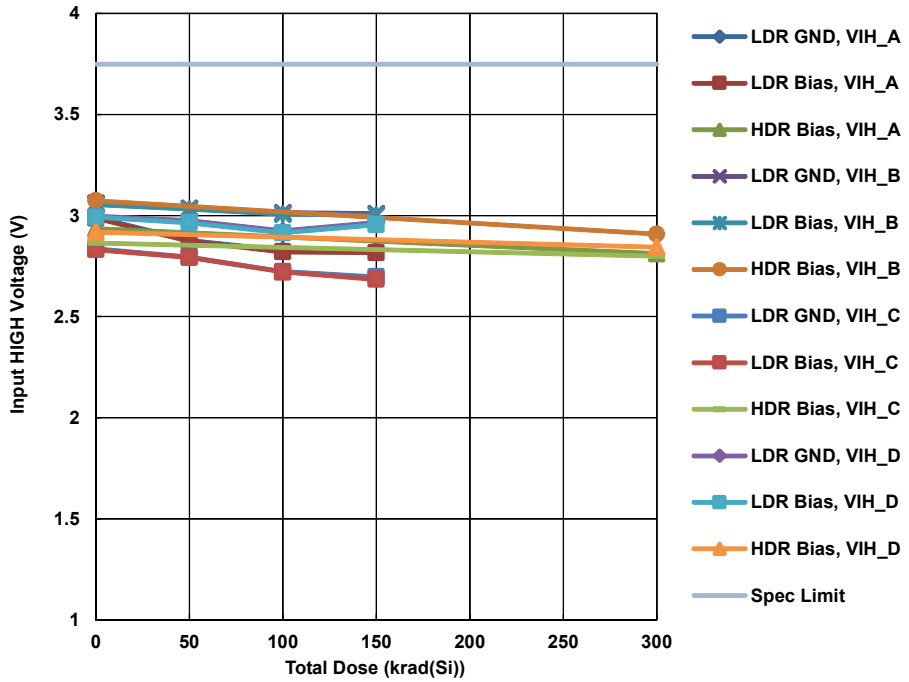

Figure 13. HS-26C31EH input HIGH voltage, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limit is 3.75V maximum.

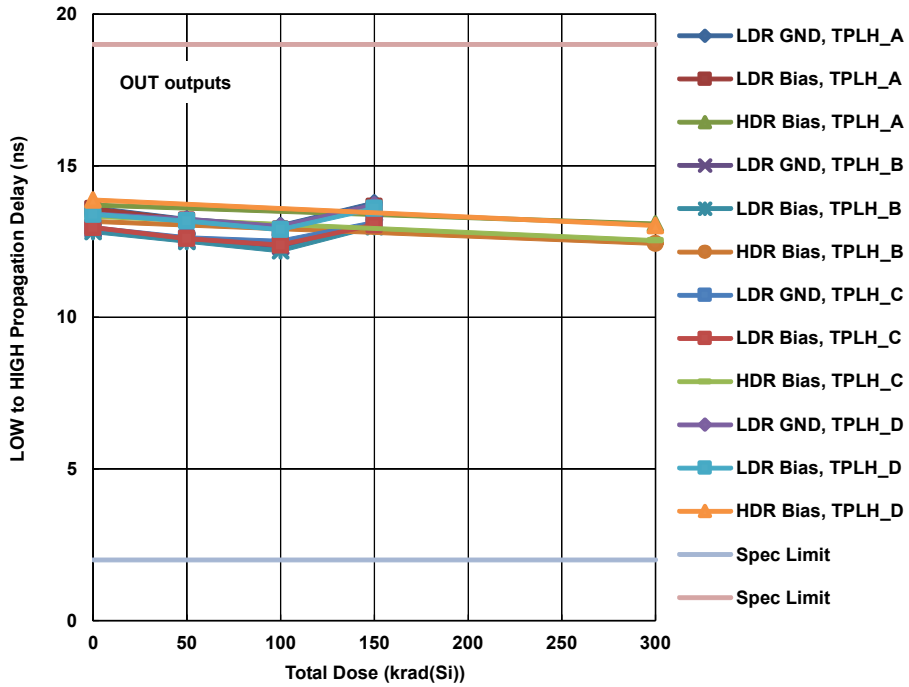

Figure 14. HS-26C31EH LOW to HIGH propagation delay, OUT outputs, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limits are 2ns to 22ns; the internal ATE limits (shown) are 2ns to 19ns.

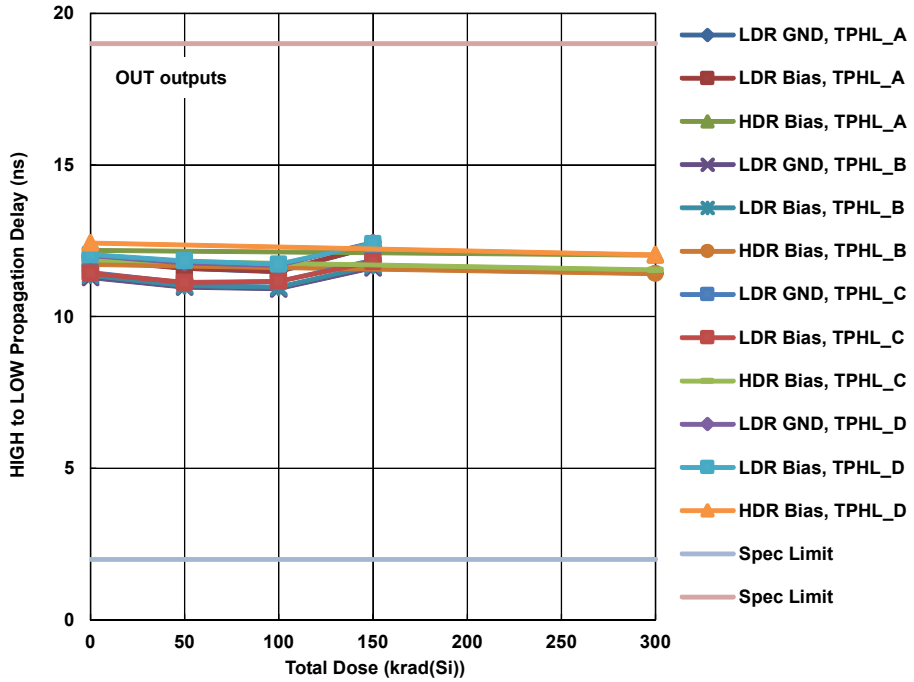

Figure 15. HS-26C31EH HIGH to LOW propagation delay, OUT outputs, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limits are 2ns to 22ns; the internal ATE limits (shown) are 2ns to 19ns.

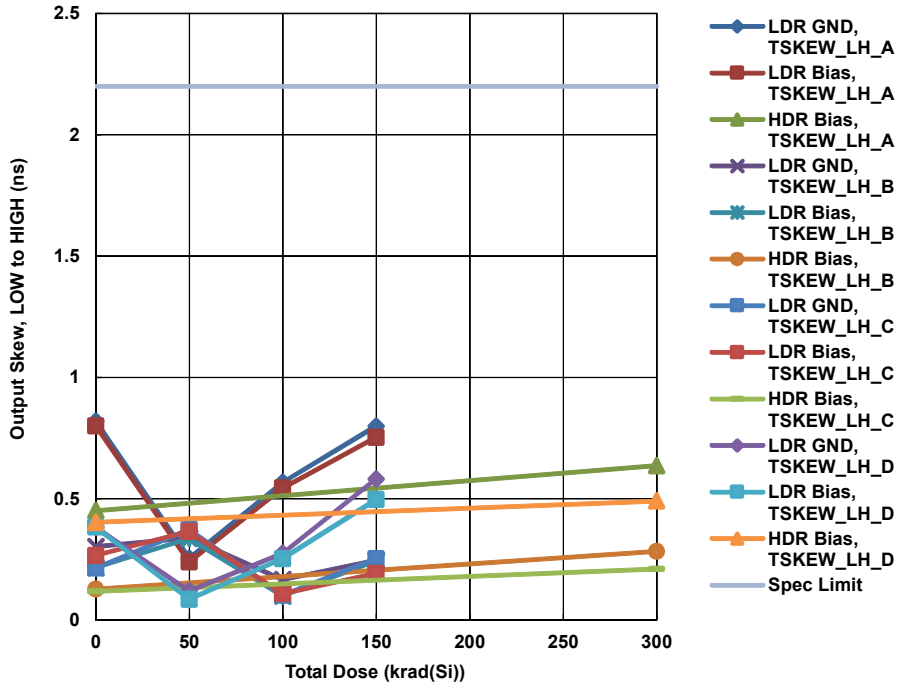

Figure 16. HS-26C31EH LOW to HIGH output skew, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. The SMD limit is 3ns maximum; the internal ATE limit (shown) is 2.2ns maximum.

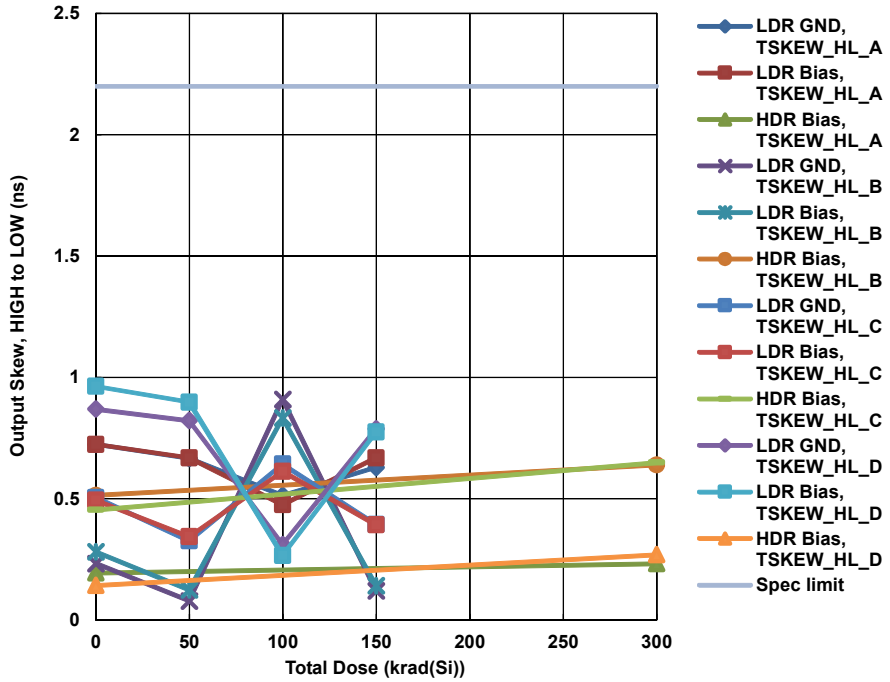

Figure 17. HS-26C31EH HIGH to LOW output skew, channels A through D, as a function of biased HDR total dose irradiation to 300krad(Si) and biased and unbiased (grounded) LDR irradiation to 150krad(Si). The sample size for the HDR cell was 48, while the sample sizes for the LDR cells were 20 each. SMD limit is 3ns maximum; the internal ATE limit (shown) is 2.2ns maximum.

3. Discussion and Conclusion

This report describes the results of total dose testing of the HS-26C31EH quad differential line driver. Parts were tested at LDR under biased and unbiased conditions and at HDR under biased conditions as part of routine production acceptance testing, to a total dose of 150krad(Si) (LDR) and 300krad(Si) (HDR). Testing at both dose rates showed zero rejected devices to either internal guardbanded ATE limits or the SMD pre-radiation limits, noting that the SMD pre-irradiation and post-radiation limits are the same for this part. The part is considered ELDRS-free, and no bias sensitivity was noted.

4. Appendices

4.1 Reported Parameters

Figure	Parameter	Limit, Low (Note 7)	Limit, High (Note 7)	Units	Notes
3	Standby Supply Current	-	450	µ	Inputs at VCC and ground
4	Tristate Output Leakage	-4.5	4.5	µA	OUT outputs
5	Output HIGH Voltage	2.7	-	V	OUT outputs
6	Output LOW Voltage	-	450	mV	OUT outputs
7	Differential Output Voltage	2.2	-	V	OUT outputs
8	Differential Output Voltage Match	-	380	mV	
9	Common Mode Output Voltage	-	2.8	V	OUT outputs
10	Input HIGH and LOW Leakage	-0.95	0.95	µA	
11	Power OFF Output Leakage	-95	95	µA	OUT outputs
12	Input LOW Voltage	1.75	-	V	
13	Input HIGH Voltage	-	3.75	V	
14	LOW to HIGH Propagation Delay	2	19	ns	OUT outputs
15	HIGH to LOW Propagation Delay	2	19	ns	OUT outputs
16	LOW to HIGH Output Skew		2.2	ns	
17	HIGH to LOW Output Skew		2.2	ns	

Note:

7. These limits are taken from Standard Microcircuit Drawing (SMD) 5962-96663, with additional guardbanding for some parameters.

5. Revision History

Rev.	Date	Description
0.00	Jan 8, 2018	Initial release

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