White Paper
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TLK2711-SP Unpowered Receiver Stress Evaluation

In response to a customer inquiry Texas Instruments HiRel Products undertook an investigation of the TLK2711-SP space-rated 1.6-GBPS to 2.5-GBPS transceiver (DLA SMD 5962-0522101VXC) to evaluate the effects of additional stresses that are encountered due to signals driven on an unpowered receiver.

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1 Introduction

Per the TLK2711-SP data sheet (*SGLS307*) and the DLA Standard Microcircuit drawing 5962-05221 SMD, the absolute-maximum specification for the DINRXP and DINRXN pins is –0.35-V minimum to VDDA + 0.35-V maximum. In the case where the receiving TLK2711-SP is unpowered, this results in a VDDA of 0 V. The minimum and maximum voltage level that can be applied under this circumstance is therefore –0.35 V to +0.35 V. Exceeding this range will cause the electrostatic discharge (ESD) protection diodes within the device to begin conducting.

Due to the age of the wafer fabrication process and technology used to create this device, direct analysis of the reliability impact of exceeding the absolute-maximum range is not practical from a design perspective. Therefore a stress test was devised to evaluate possible changes in functionality, performance, and/or parametrics.

Previously a stress test was performed on multiple units to determine the maximum cumulative exposure of unpowered receiver to external inputs. Characterization was performed using maximum VOD, minimum frequency and typical VCM from recommended operating conditions for a twenty hour period. This characterization determined that the TLK2711-SP showed no performance degradation when an external powered transmitter (a transmitting DC coupled TLK2711-SP was used) sends a signal to an unpowered receiver for short periods of time. This is specified in the data sheet under *Absolute Maximum Ratings* as up to ten hours over the lifetime of the device. Some customers, however, were unable to meet this duration over the specified mission lifetime. Consequently an additional stress test was performed with extended durations.

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2 Methodology

Worst case conditions were determined to be DC coupling with slowest data frequency. This would conduct the highest current for longest duration. With respect to the device reliability, worst-case electromigration occurs with DC currents at high temperatures. Accordingly the following worst-case conditions were applied to units 101 through 103:

- DC coupled maximum VOD from 50-Ω source.
- DINRXP and DINRXN driven differentially with 700 mV to 1.8 V with 800-MHz clock (1.6Gbps equivalent).
- This results in a 1.25-V common mode with worst case 1100-mV VOD at 125°C.
- 125°C (maximum specified operating case temperature).
- Two units exposed to 240 hours, and one unit to extended duration of 1463 hours.

Three TLK2711-SP devices, labeled Unit-101 through Unit-103, and one control unit, labeled Unit-104, were characterized before and after the above stress conditions. Delta measurements were evaluated to determine if a shift occurred with respect to the receiver inputs. Table 1 shows the results of the parametric tests. Values are pre-post delta readings with a negative value indicating a decrease.

Table 1. Parametric Test Results(1)

Pin	Test	Unit-101	Unit-102	Unit-103	Unit-104	Unit
		Stress Duration = 240 hrs	Stress Duration = 240 hrs	Stress Duration = 1463 hrs	Stress Duration = 0 hrs	
RXN	Opens check	–3.98E–01	–4.06E–01	–4.26E–01	–3.55E–01	V
RXP	Opens check	–3.97E–01	–4.06E–01	–4.25E–01	–3.54E–01	V
RXN	Shorts check	2.89E–01	2.91E–01	2.84E–01	2.84E–01	V
RXP	Shorts check	2.90E–01	2.93E–01	2.85E–01	2.85E–01	V
RXN	Pin-to-pin check	1.86E–02	2.11E–02	2.49E–02	2.36E–02	V
RXP	Pin-to-pin check	1.20E–03	1.20E–03	–1.36E–03	–1.35E–03	V
RXN	Pin-to-pin leakage	1.43E–05	6.27E–06	1.43E–05	1.42E–05	A
RXP	Pin-to-pin leakage	–2.64E–06	–8.56E–06	–2.64E–06	–4.60E–06	A
RXN	IIH_IIL	–6.96E–06	–6.96E–06	3.49E–04	–6.96E–06	A
RXP	IIH_IIL	5.22E–06	5.22E–06	3.61E–04	7.20E–06	A
RXN	IIH_IIL	1.63E–05	2.63E–05	2.83E–05	2.83E–05	A
RXP	IIH_IIL	6.09E–06	1.27E–07	6.09E–06	4.10E–06	A

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The orange highlighted data points represent a slight increase of RXP and RXN leakage current in Unit-103. The post-stress leakages were still within device data sheet limits.

3 Summary

All units passed the full functional and parametric production test program post stress. Only Unit-103 that was exposed to 1463 hours of stress showed marginal increase in IIH/IIL pin leakage due to extended stress.

4 References

- *TLK2711-SP 1.6-Gbps to 2.5-Gbps Class V Transceiver* (SGLS307)
- DLA Standard Microcircuit drawing 5962-05221

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