EFFECTS OF LUBRICATED CONTACTS

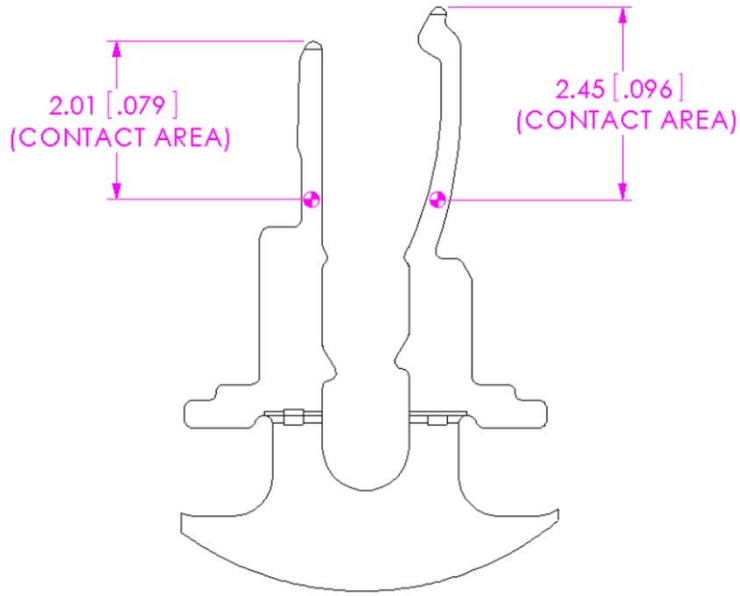
LSHM 10mm Stack Height Hermaphroditic

Effects of Lubricant on Contacts

- **Purpose: The purpose of this test is to determine the impact (if any) on electrical performance when using lubricant on the contacts of passive interconnects.**
- **Test Parameters**
  - Impedance, Insertion Loss, & Return Loss
- **Test Samples**
  - PCB-102612-TST Rev, LSHM-DV/LSHM-DV Test Board, Best Case
  - PCB-102612-TST Rev, LSHM-DV/LSHM-DV (samples lubricated) Test Board, Best Case
    - Test board traces were slightly altered in the lab, in order to align their impedance profiles. Details are included in the appendix.

Effects on Lubricant on Contacts

- Lubricant
  - Santolubes ACCL-53T [PPE (OS-138)] lubricant used
  - Lubricant selectively applied to contacts per following drawing:

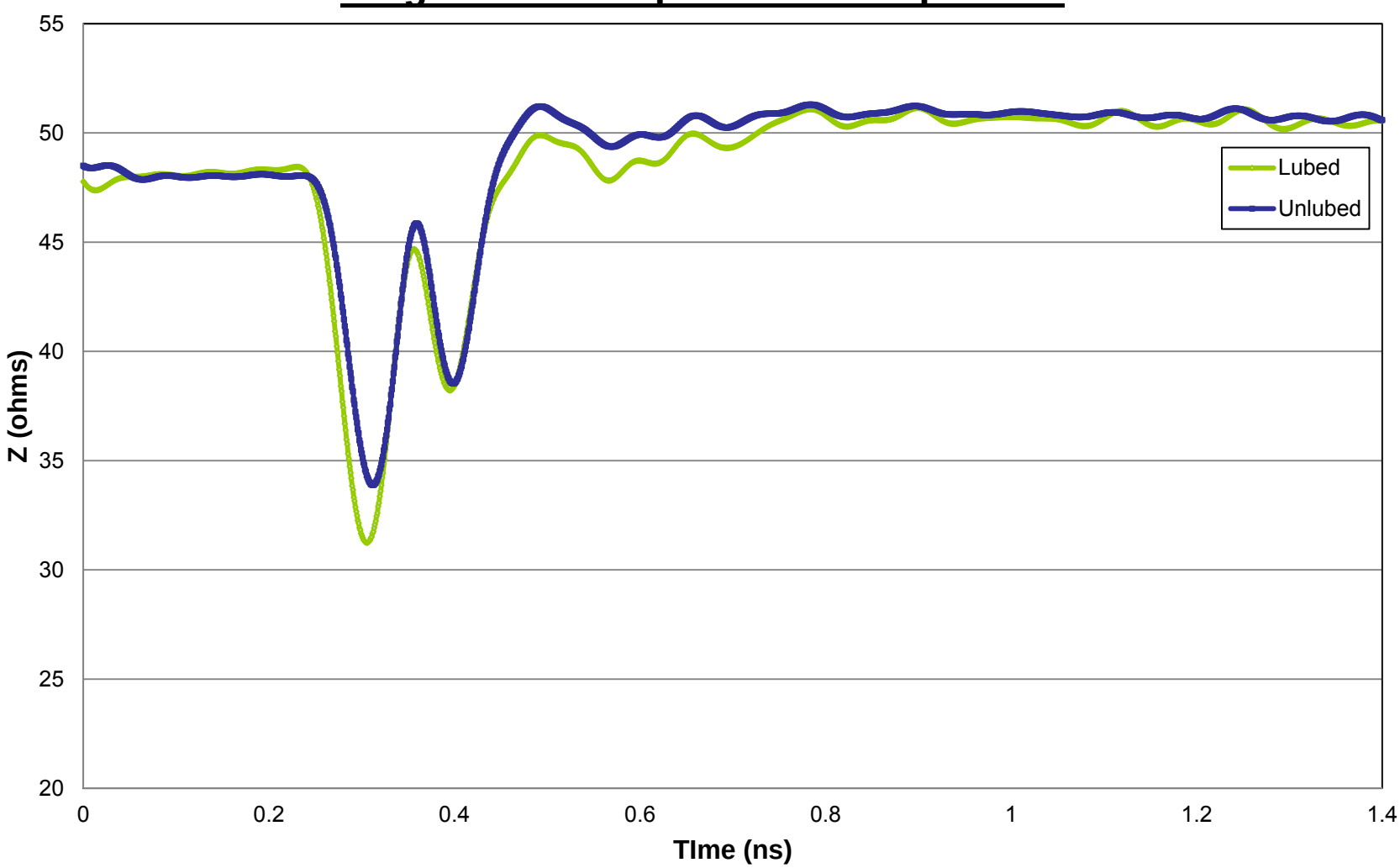


LSHM LUBRICANT LOCATION DETAIL
(LUBRICANT TO BE APPLIED IN CONTACT AREA)

Effects of Lubricant on Contacts

- **Scope**
  - Test 1 GSG and 1 GSSG configuration on a DUT with lubricated contacts
  - Test 1 GSG and 1 GSSG configuration on a DUT with standard non-lubricated contacts
  - Evaluate effects of the lubricant applied to the contacts

Effects of Lubricant on Contacts



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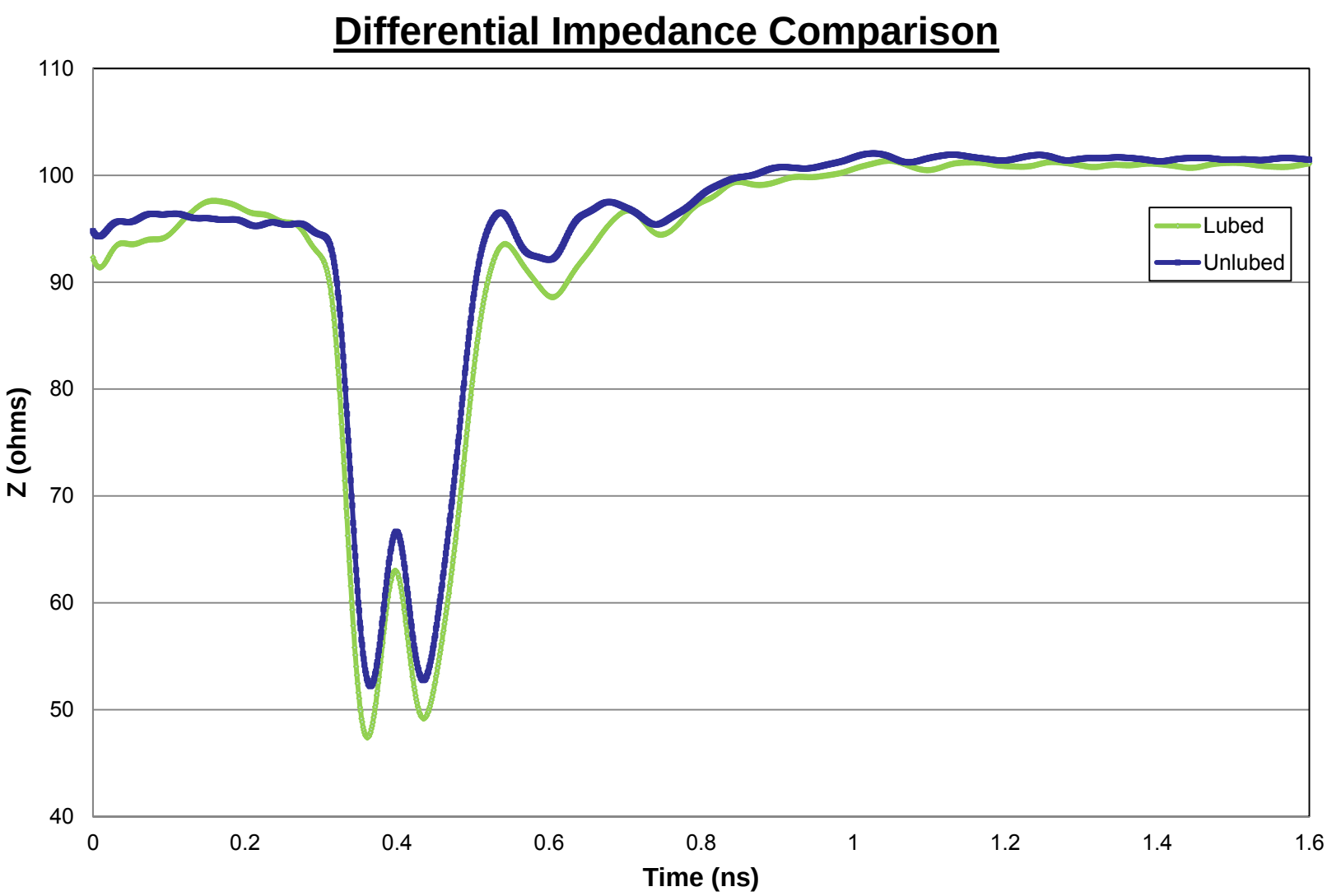
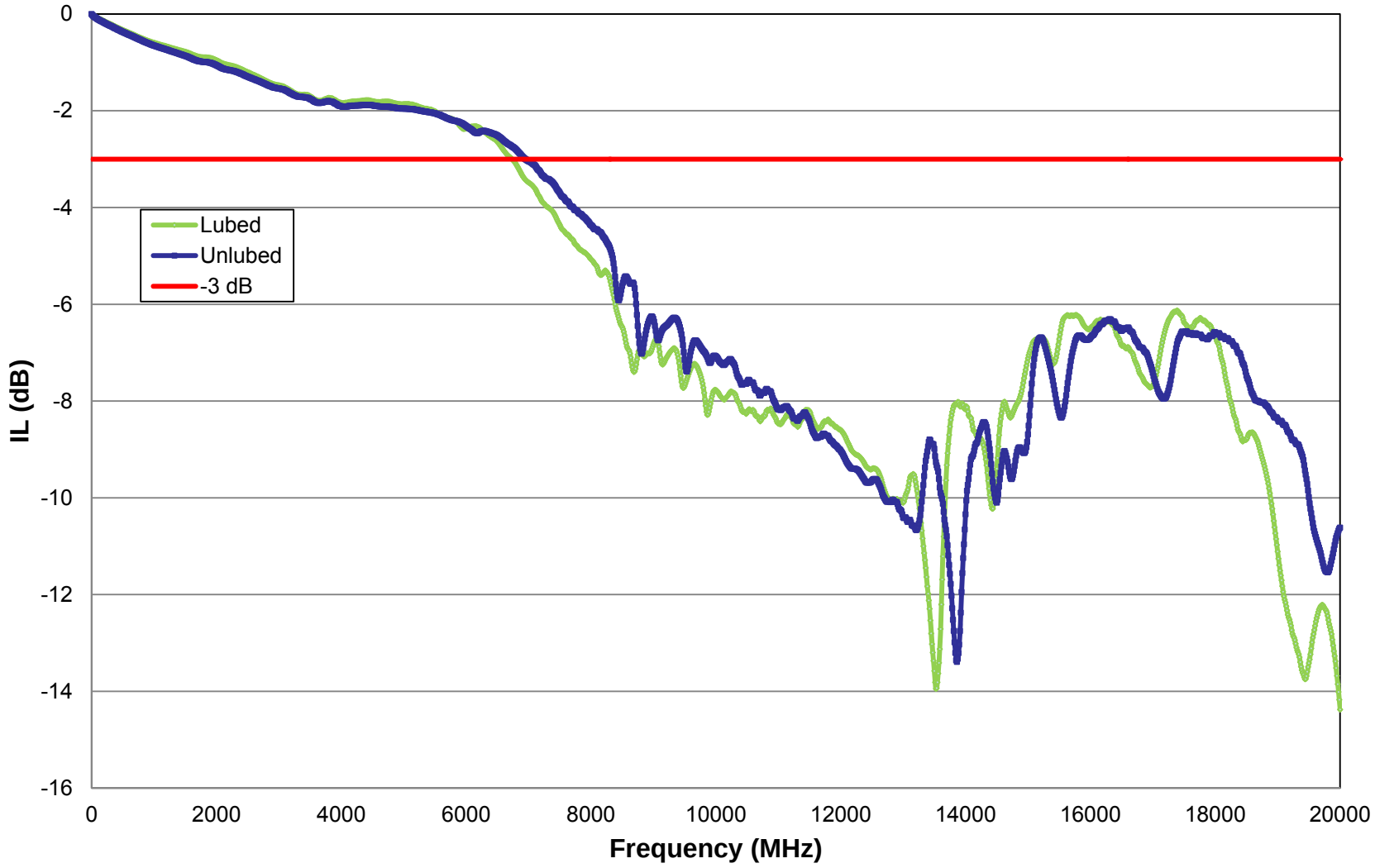


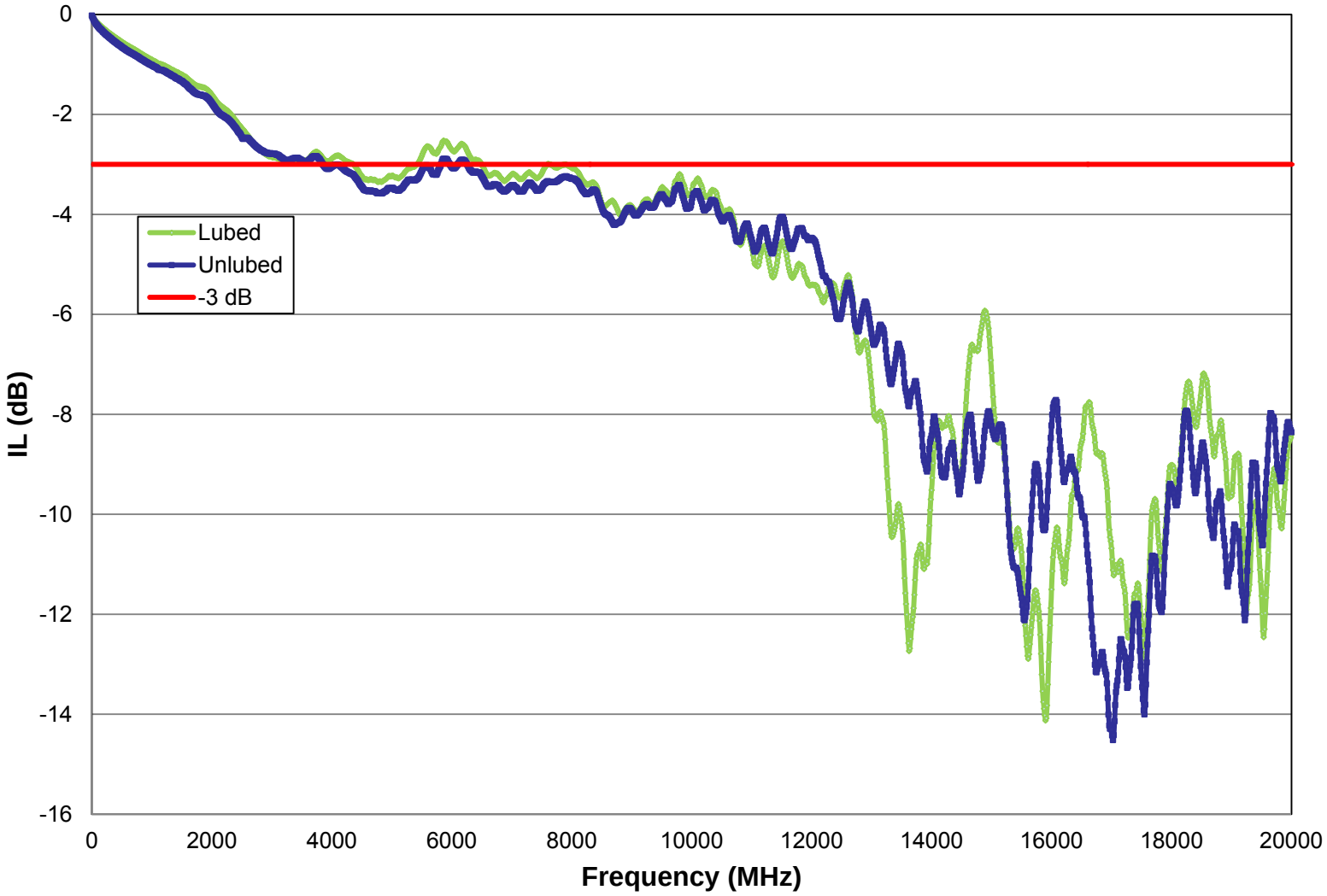
Effects of Lubricant on Contacts

Single Ended Insertion Loss Comparison



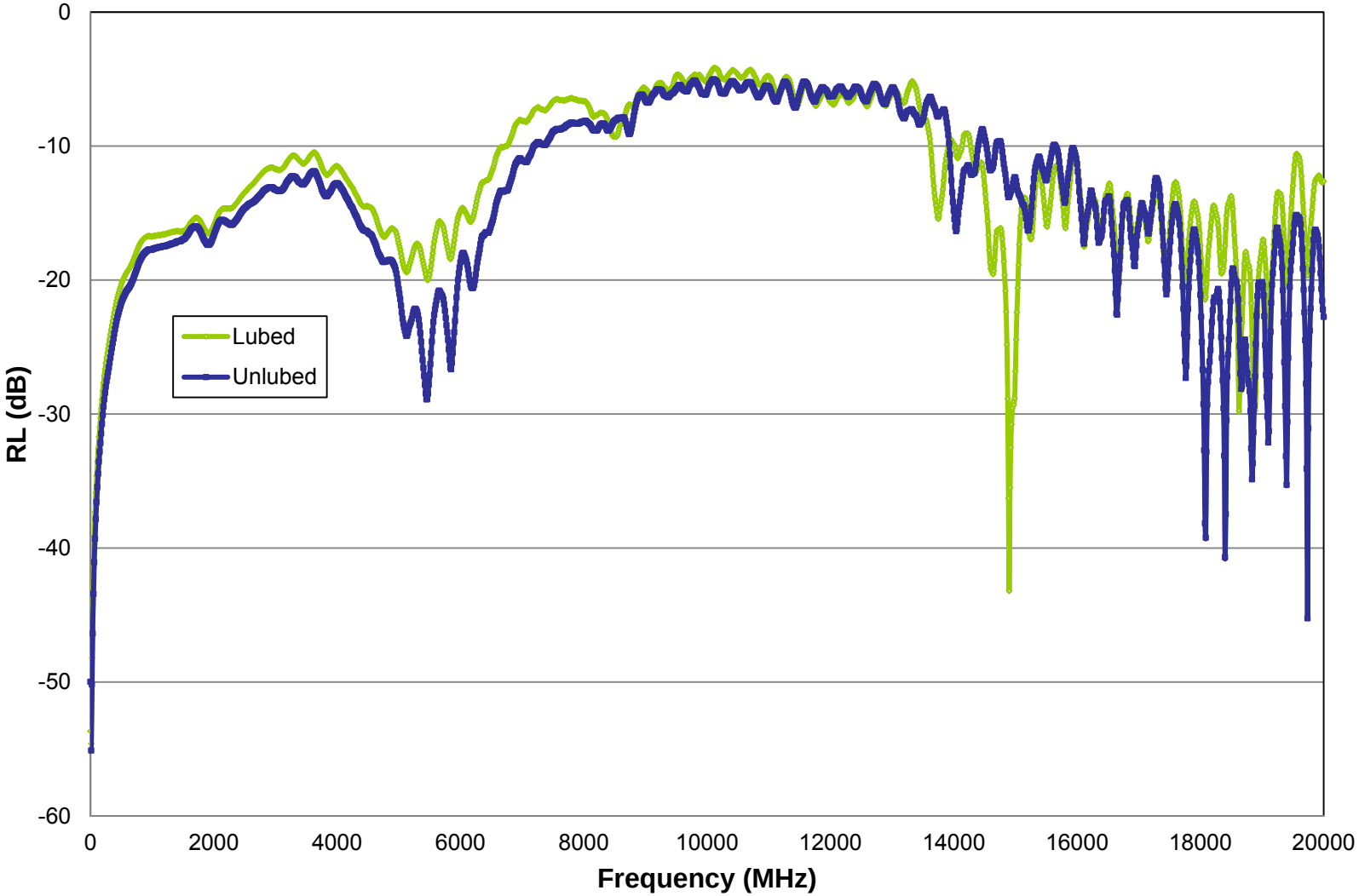
Effects of Lubricant on Contacts

Differential Insertion Loss Comparison

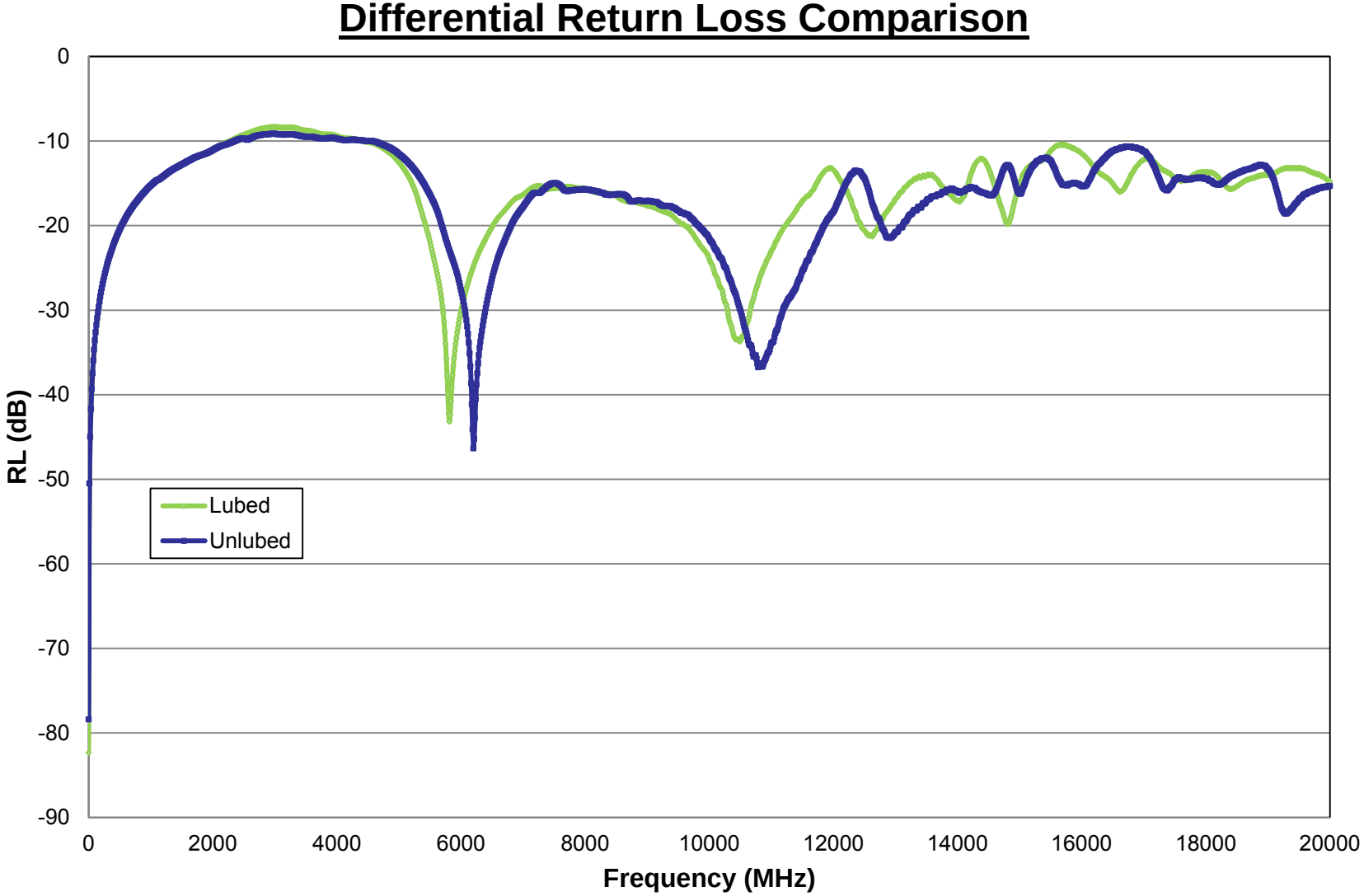


Effects of Lubricant on Contacts

Single Ended Return Loss Comparison



Effects of Lubricant on Contacts



Effects of Lubricant on Contacts

- **Results**
  - **DUT with Lubricated Contacts**
    - Average signal line impedance : single-ended, 48.4 Ω, differential, 95.2 Ω *(slides 4 & 5)*
      - Requirement: SE, 50Ω ±5%, diff, 100Ω ±5%,
    - Half Power (3dB) Point: single-ended, 6.737 GHz, differential, 2.275 GHz *(slides 6 & 7)*
    - Return Loss (10dB): single-ended, 6.738 GHz, differential, 1.150 GHz *(slides 8 & 9)*
    - Minimum Mated Connector Impedance: single-ended, 31.2 Ω, differential, 46.7 Ω *(slides 4 & 5)*
  - **DUT with Standard Non-Lubricated Contacts**
    - Average signal line impedance : single-ended, 48.6 Ω, differential, 95.4 Ω *(slides 4 & 5)*
      - Requirement: SE, 50Ω ±5%, diff, 100Ω ±5%,
    - Half Power (3dB) Point: single-ended, 6.950 GHz, differential, 2.450 GHz *(slides 6 & 7)*
    - Return Loss (10dB): single-ended, 7.187 GHz, differential, 1.500 GHz *(slides 8 & 9)*
    - Minimum Mated Connector Impedance: single-ended, 33.9 Ω, differential, 50.9 Ω *(slides 4 & 5)*

Effects of Lubricant on Contacts

- **Summary**
  - There are apparent signal integrity changes taking place within the DUT where the contacts have been coated with a lubricant. The most apparent change was the decrease in minimum impedance around the lubricated contact profiles. Impedance decreased 2.7 Ω for single-ended and 4.2 Ω for differential signals. Also decreasing were the frequency domain performance parameters. As an example single-ended half power point performance decreased by 213 MHz from 6950 MHz non-lubricated to 6737 MHz lubricated. Differential 10 dB return loss benchmark speed went from 1500 MHz to 1150 MHz. These decreasing performance speeds and impedance drops were consistent for the lubricated DUT throughout all the measurements, whether the applied signal was single-ended or differential.
- **Conclusion**
  - The application of a lubricant to the contacts will slightly degrade the electrical performance of the connector system. However the effects of the lubricant are felt to be **minimal** at best, when tested in an environment where PCB impedance and dielectric properties are well controlled.

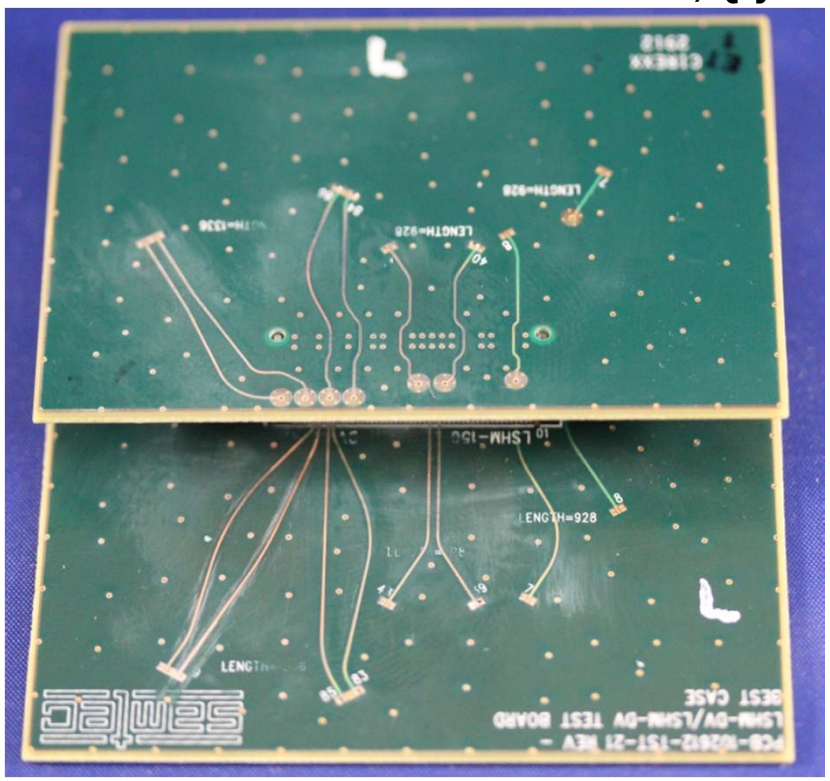
Appendix

- **Background on test boards issues**:
  - Initial 10 mm LSHM connector tests used two PCB vendors and compared measurements made approximately 8 months apart. Un-expectantly the results introduced variables from two different PCB vendors and differences in signal line impedance. It was felt both variables would be eliminated by using one vendor, therefore allowing a proper evaluation of the effects of a lubricant applied to the contacts. One vendor (Cirexx) was chosen. Unfortunately signal line impedances again varied, producing almost identical results as in the first test. Why signal line impedance varied from same vendor is unknown. It was decided to manually lower and raise signal line impedances by in-house modification.
- **Solution:**
  - Modify the signal line impedances on each board type, lubricated contacts or non-lubricated, to match within the Samtec impedance tolerance guidelines
    - Single-Ended: 50 Ω ± 5%, range; 47.5 Ω → 52.5 Ω
    - Differential: 100 Ω ± 5%, range; 95.0 Ω → 105.0 Ω

Effects of Lubricant on Contacts

Contacts Lubricated

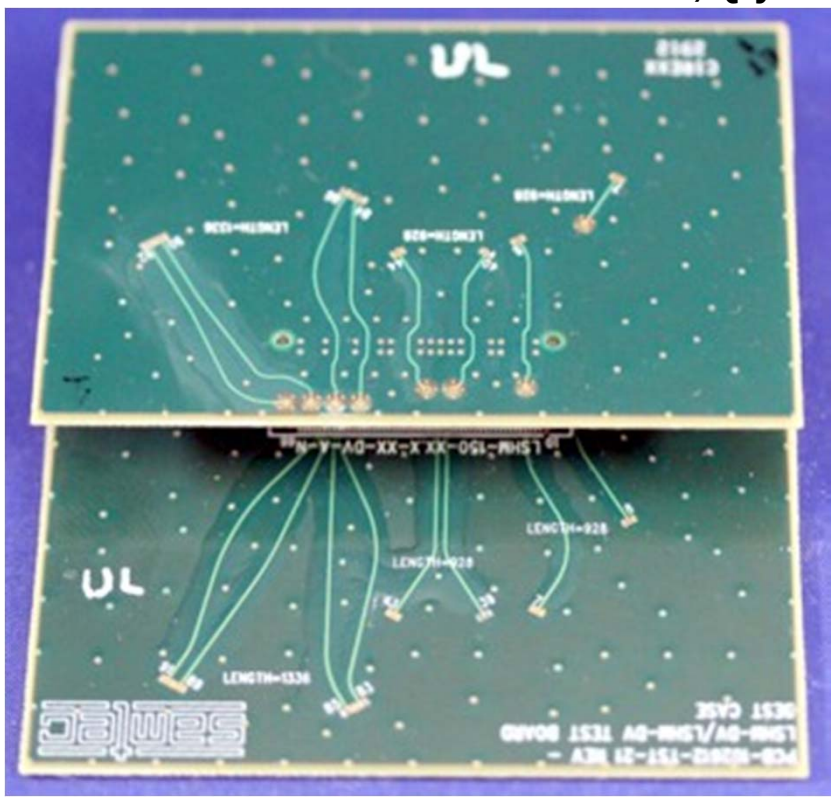
Connector P/N: **LSHM-150-06.0-L-DV-A, Qty. 1**
LSHM-150-04.0-L-DV-A, Qty. 1



- Increase Signal Line Impedance
  - Remove solder mask and sand signal line with P400 grit paper
- Initial Signal Line Impedance (mean)
  - Single-Ended = 47.5 Ω
    Differential = 93.1 Ω
- Final Signal Line Impedance (mean)
  - Single-Ended = 48.4 Ω
    Differential = 95.2 Ω
- Increased Impedance
  - Single-Ended = 0.9 Ω
  - Differential = 2.1 Ω

Effects of Lubricant on Contacts
Standard Contacts

Connector P/N: **LSHM-150-06.0-L-DV-A, Qty. 1**
LSHM-150-04.0-L-DV-A, Qty. 1



- Decrease Signal Line Impedance
  - Apply thick application of polyurethane (dK≈2.3) over signal lines
- Initial Signal Line Impedance (mean)
  - Single-Ended = 50.5 Ω
    Differential = 99.1 Ω
- Final Signal Line Impedance (mean)
  - Single-Ended = 48.6 Ω
    Differential = 95.4 Ω
- Increased Impedance
  - Single-Ended = 1.9 Ω
  - Differential = 3.7 Ω