

Signal Integrity & Balance Parameters on Unshielded Automotive Multi Pin Connectors

Preliminary Measurement Results

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Authors: Bert Bergner (bbergner@te.com), Jens Wülfing (jwuelfing@te.com)

Supporter: Mehmet Tazebay (mtazebay@broadcom.com)



Outline

- Objective & Current Status
- Signal integrity parameters (S_{dd}^*)
 - Test results, worst case simulation, limit discussion
 - Conclusion on signal integrity
- Balance parameters (S_{dc}^* , S_{cd}^*)
 - Different test setups & results, limit discussion
 - Conclusion

Objective & Current Status

Objective: Study suitability of unshielded multi-pin automotive standard connectors for RTPGE application

Current status: - Preliminary results for a 2 position (1 pair) inline connector only
(x-talk and x-conversion not included, MDI connectors not included)

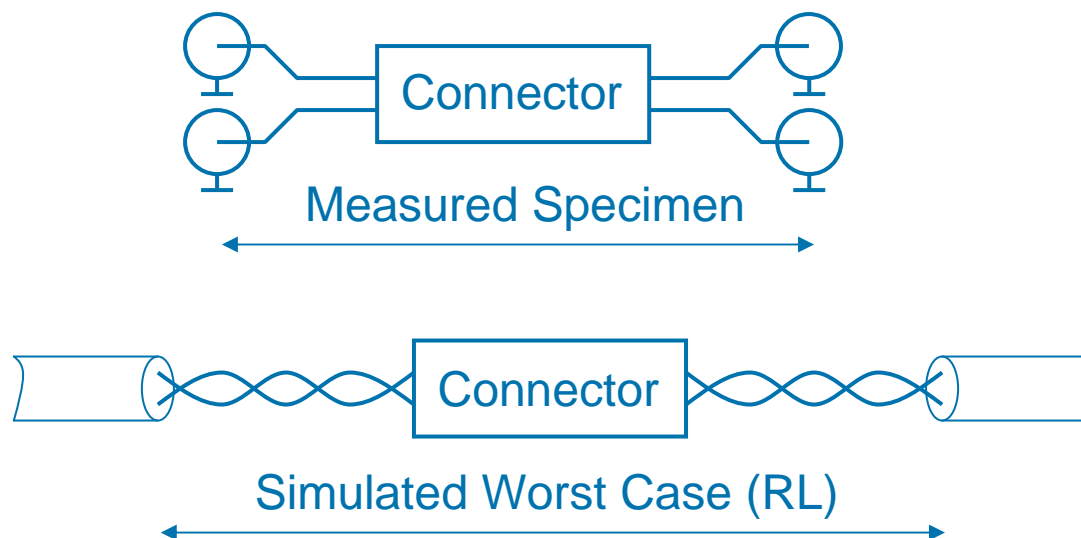
- Measurements based on mock-up test fixtures

Signal Integrity Measurements (Sdd11/Sdd12)

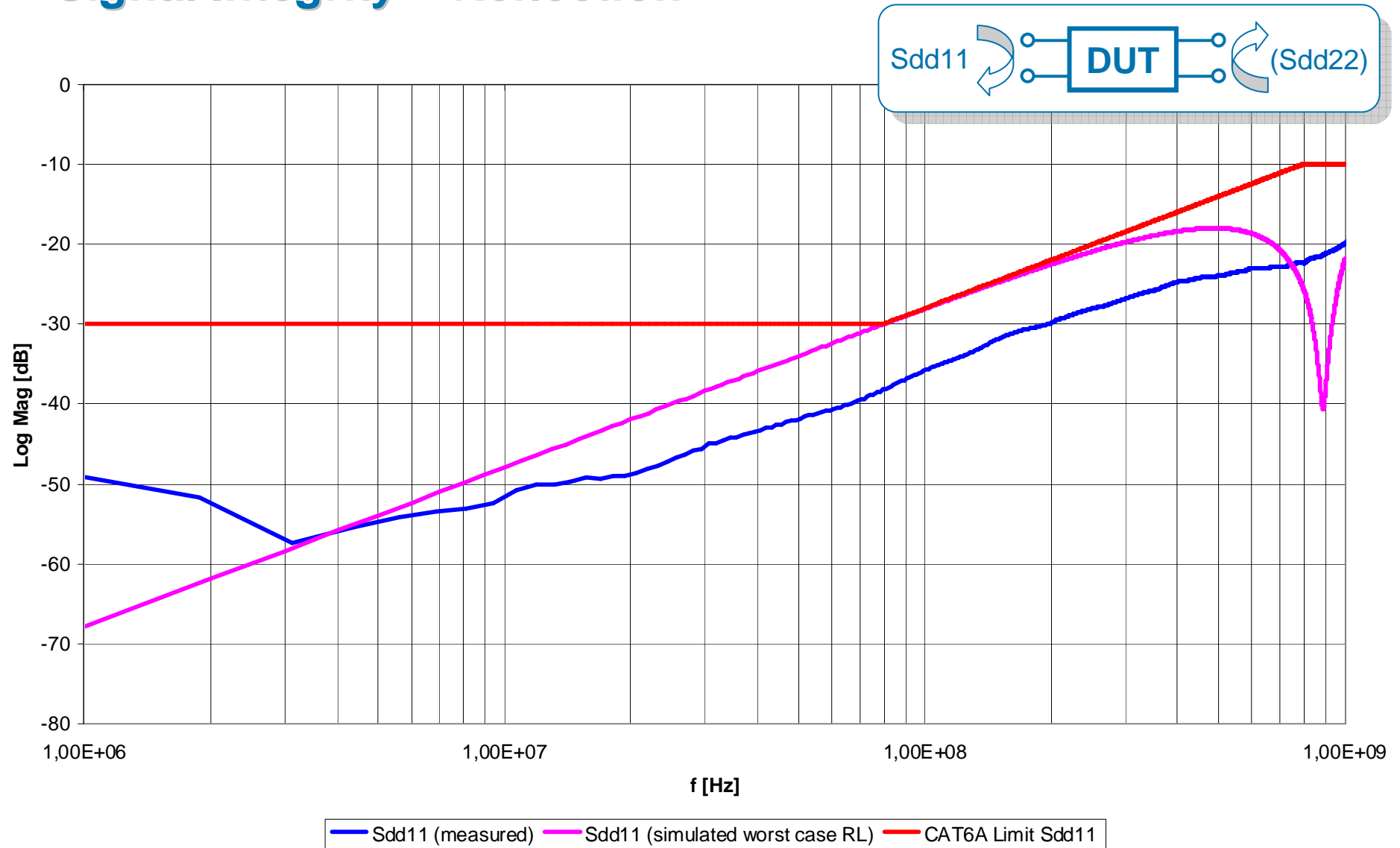
- Specimen: unshielded 2 pos. inline connector
- Impedance controlled short test fixture (adding 25mm travel length on each port)
- 3mm free wire length
- Calibration on SMA connectors, S4P single ended matrices captured
- Wire termination zone included in worst case simulation for Return Loss



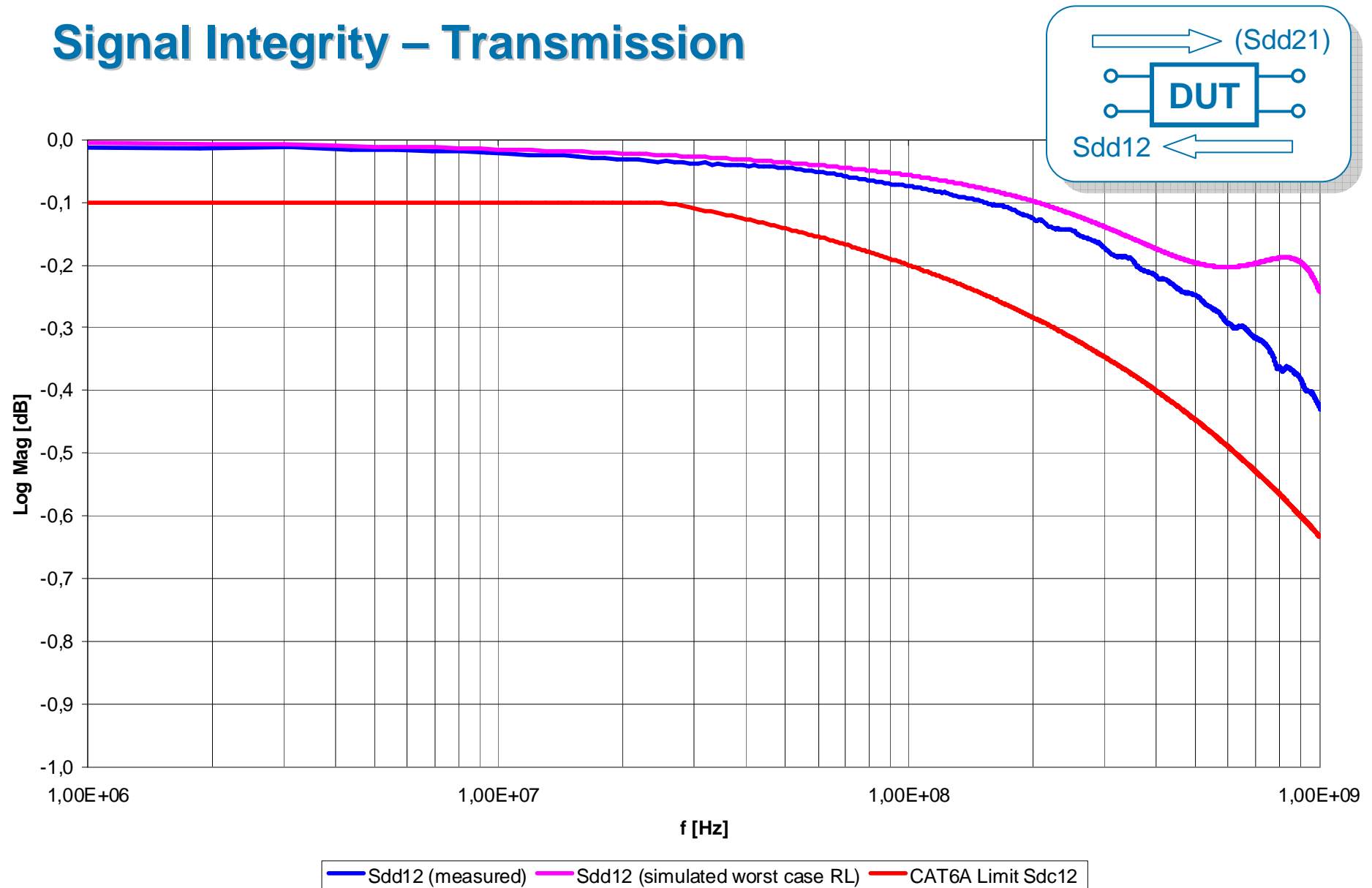
Test Setup



Signal Integrity – Reflection



Signal Integrity – Transmission

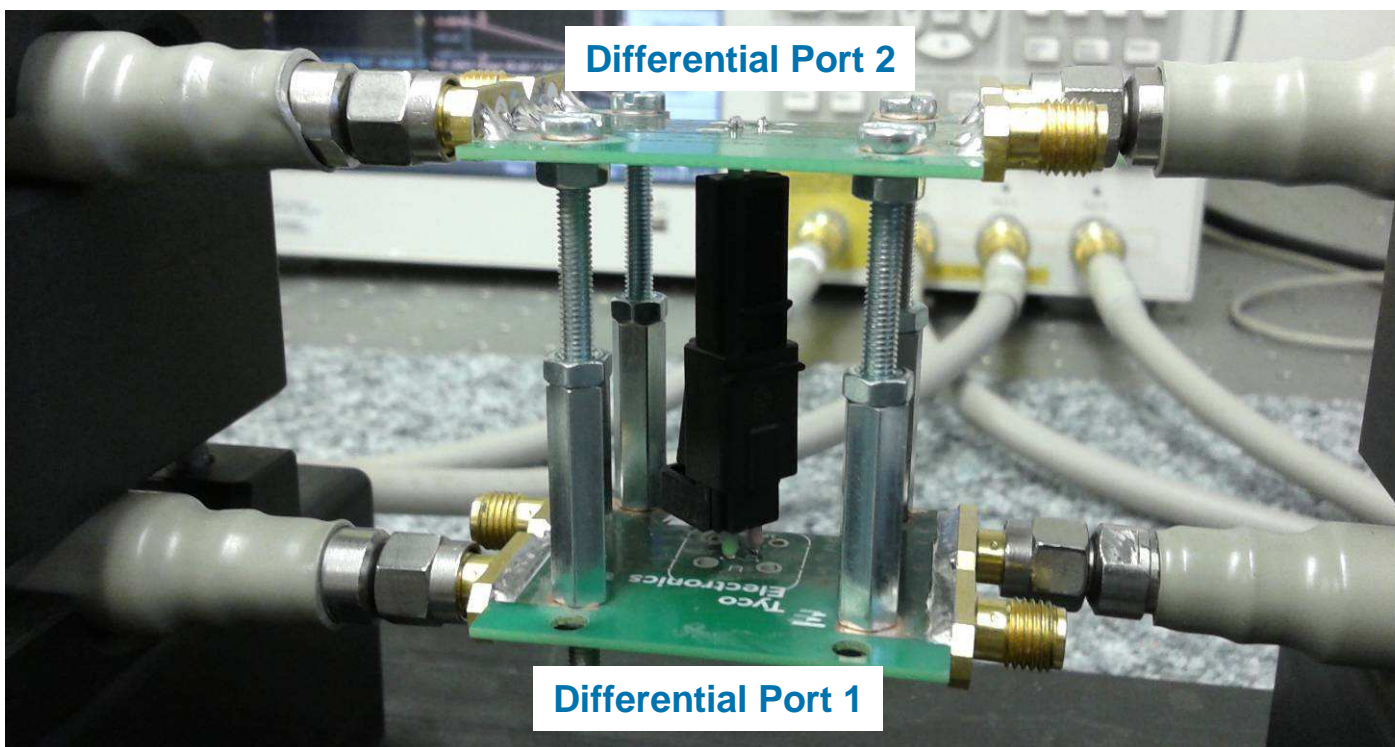


Conclusions on Signal Integrity Analysis

- IEC11801, Amend. 2 (2009) limits for CAT6_A feasible with tested specimen
- Worst case simulation demonstrates feasible margin for wire termination zone
- Wire termination zone should be included within the DUT model
- Proper test fixture or de-embedding methods recommended
- ToDo:
 - Tests for board connectors (MDI headers)
 - Include multi pair connectors to analyze x-talk

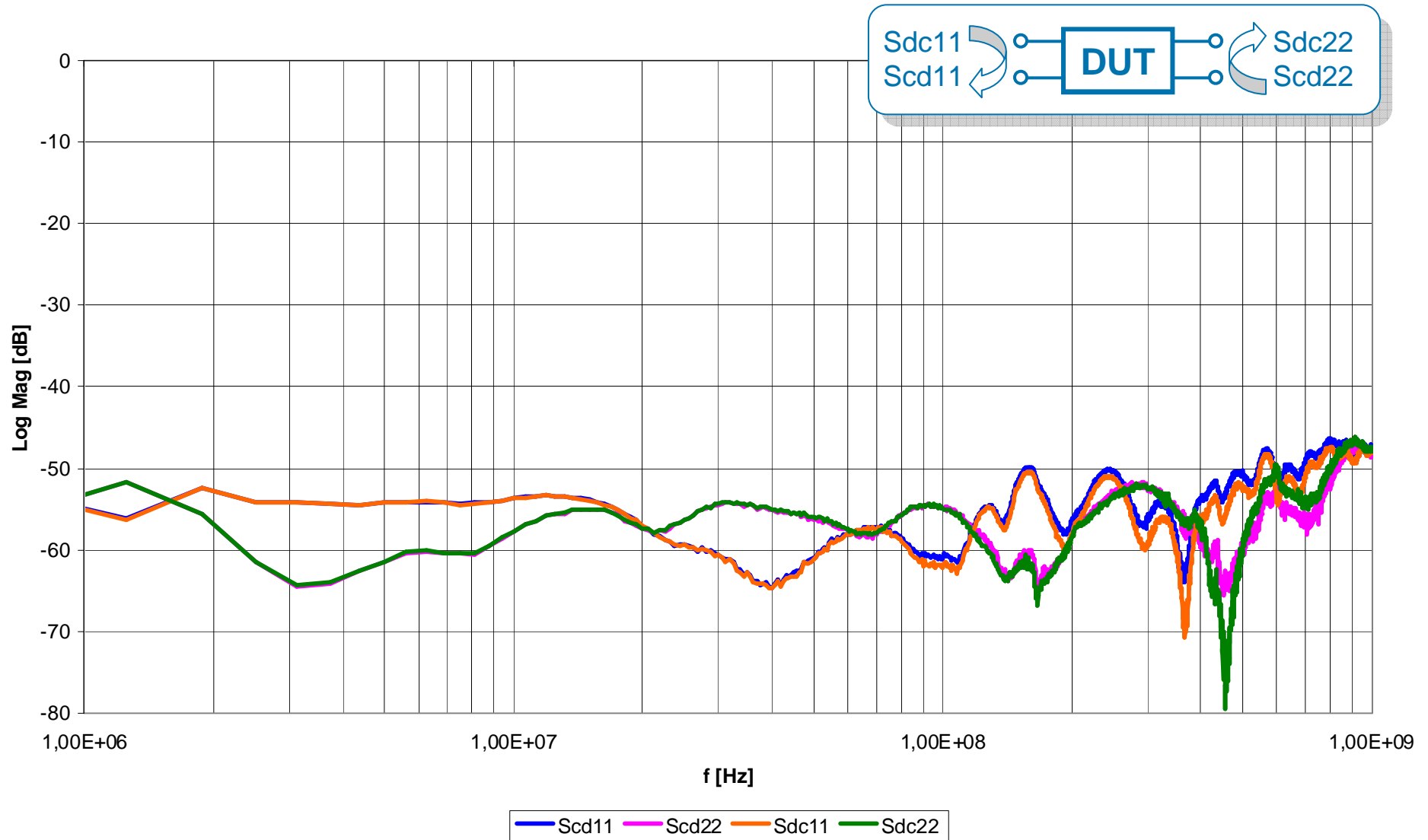
Test Setup 1 – Inline Connector w/o Cabling

- Calibration on SMA connectors, S4P single ended matrices captured
- Impedance controlled PCB traces up to the solder lands ensuring symmetric (balanced) signal launch into the DUT
- GND reference connection between the ports

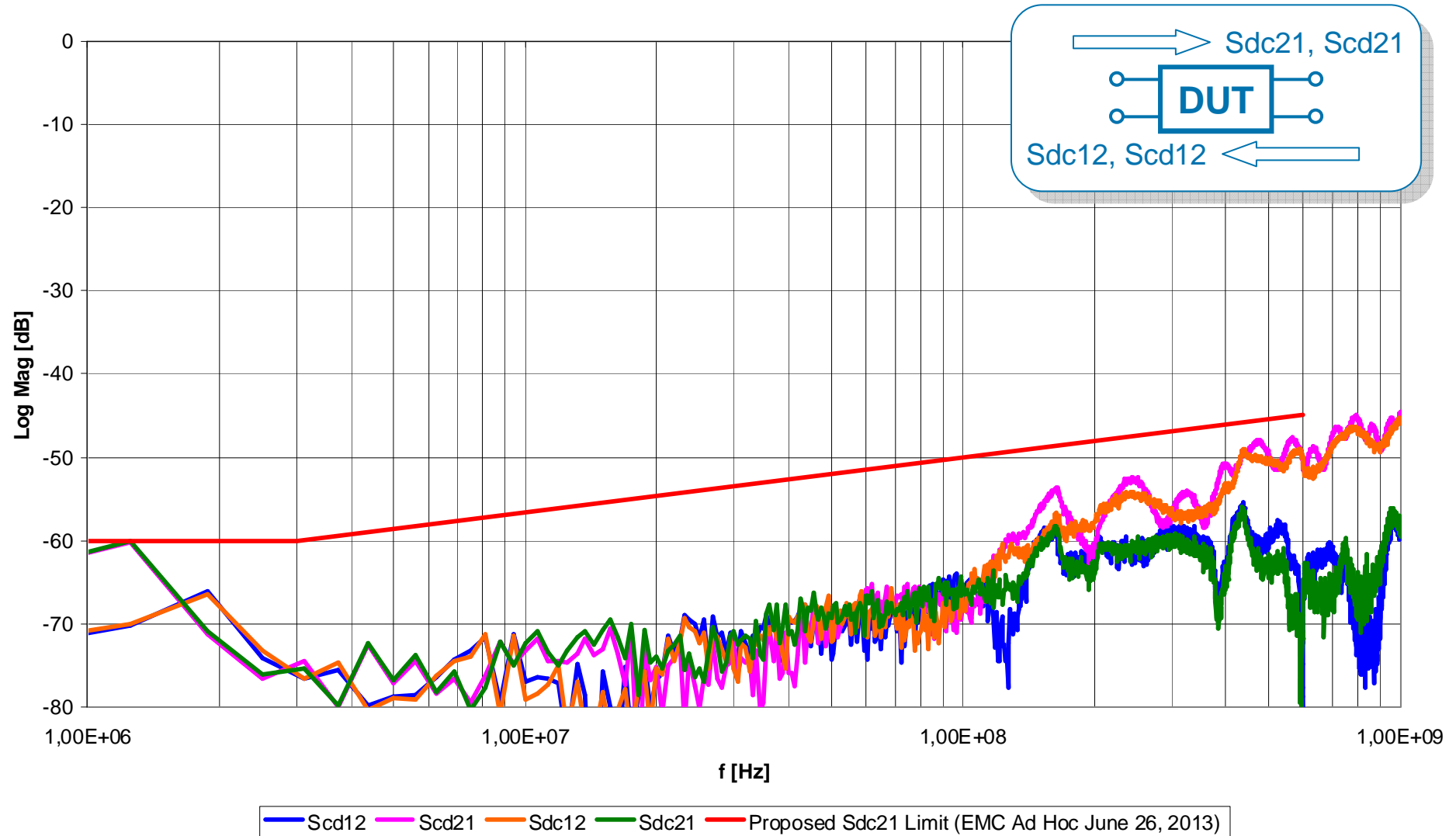


Test Setup 1

Test Setup 1 – Balance Results, Reflected Conversions

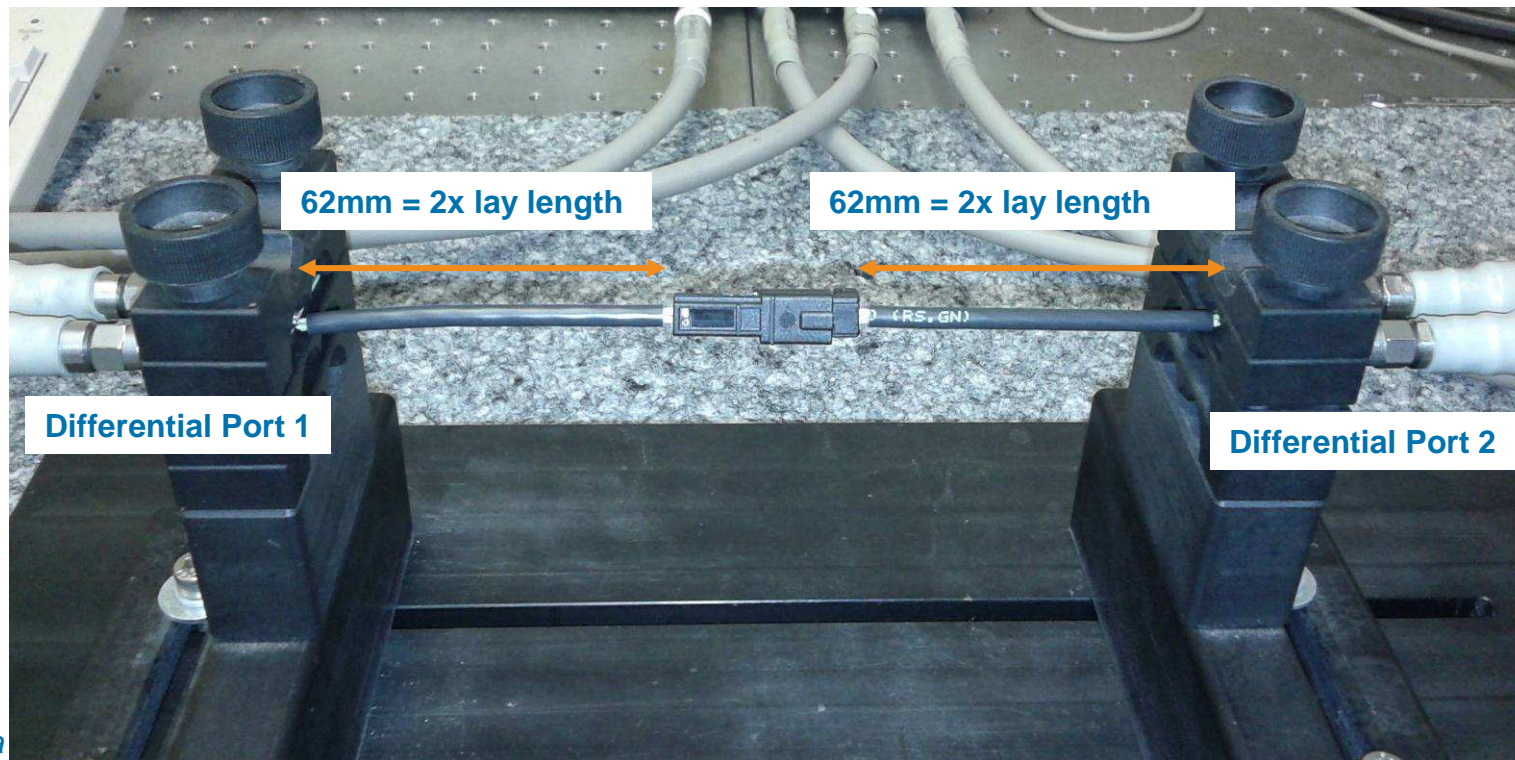


Test Setup 1 – Balance Results, Transmission Conversions



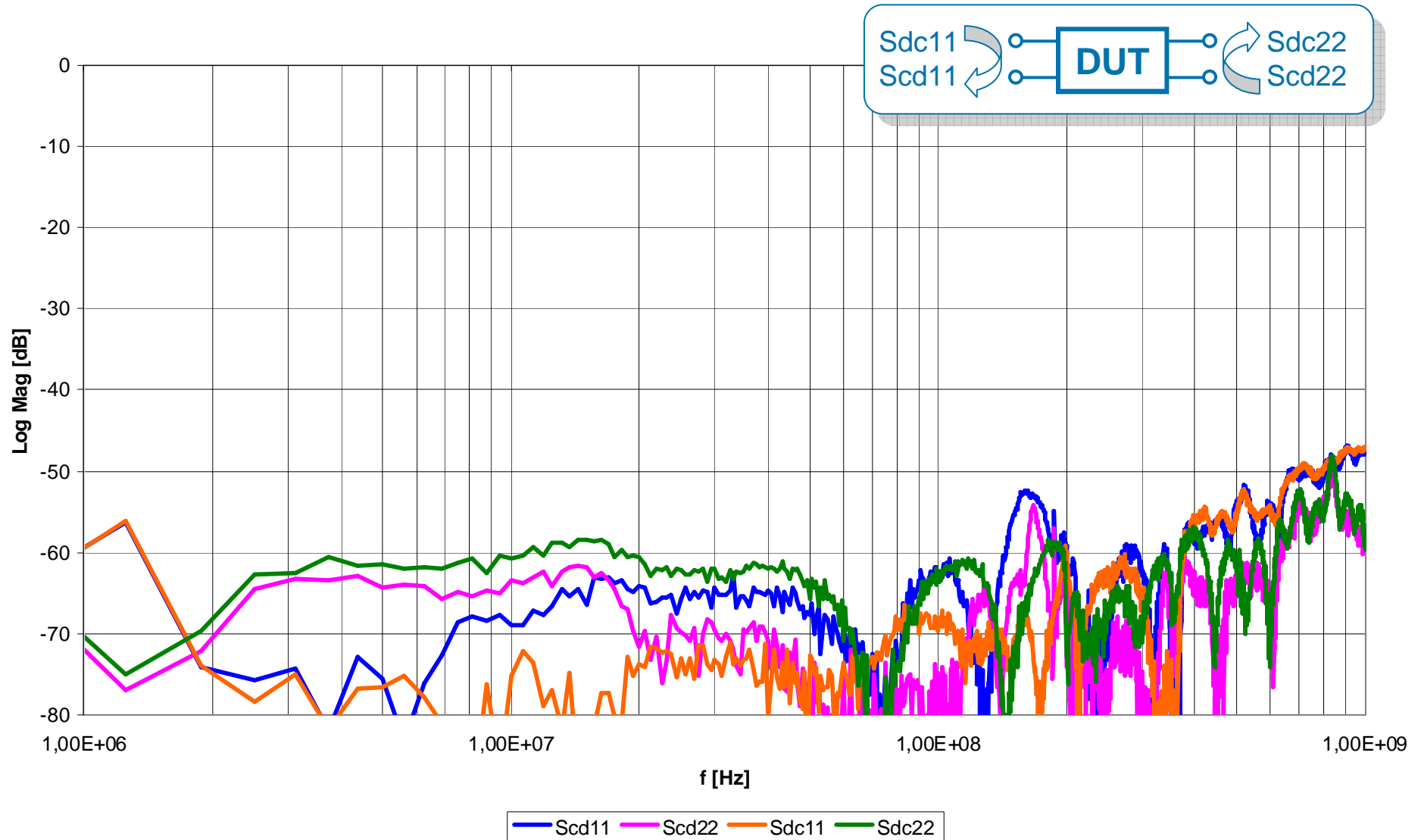
Test Setup 2a – Inline Connector with Short Cable

- Calibration on SMA connectors, S4P single ended matrices captured
- Impedance controlled PCB traces up to the solder lands ensuring symmetric (balanced) signal launch into the DUT
- Metal GND plane (table); no direct GND connection between differential ports

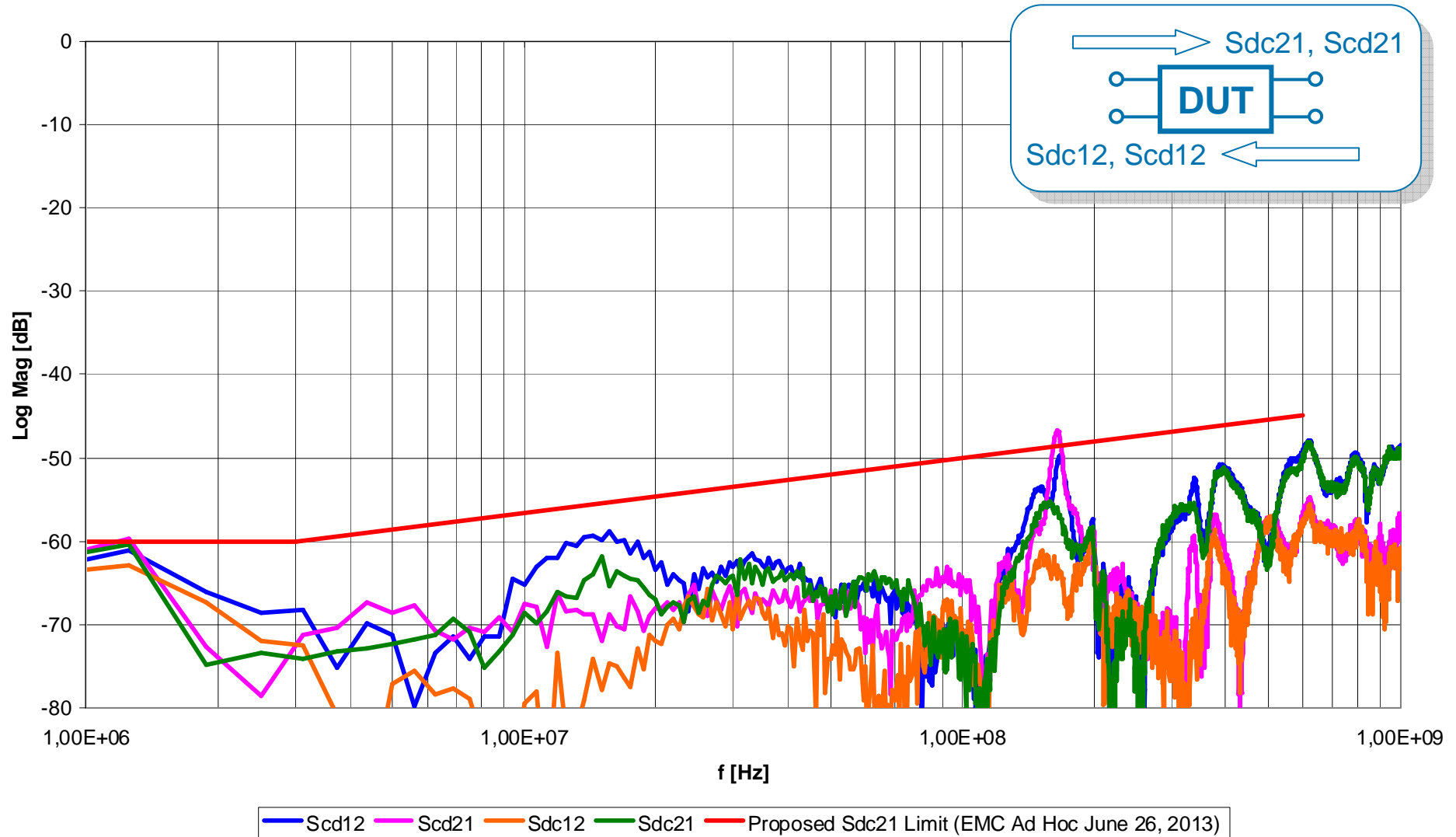


Test Setup 2a

Test Setup 2a – Balance Results, Reflected Conversions



Test Setup 2a – Balance Results, Transmission Conversions



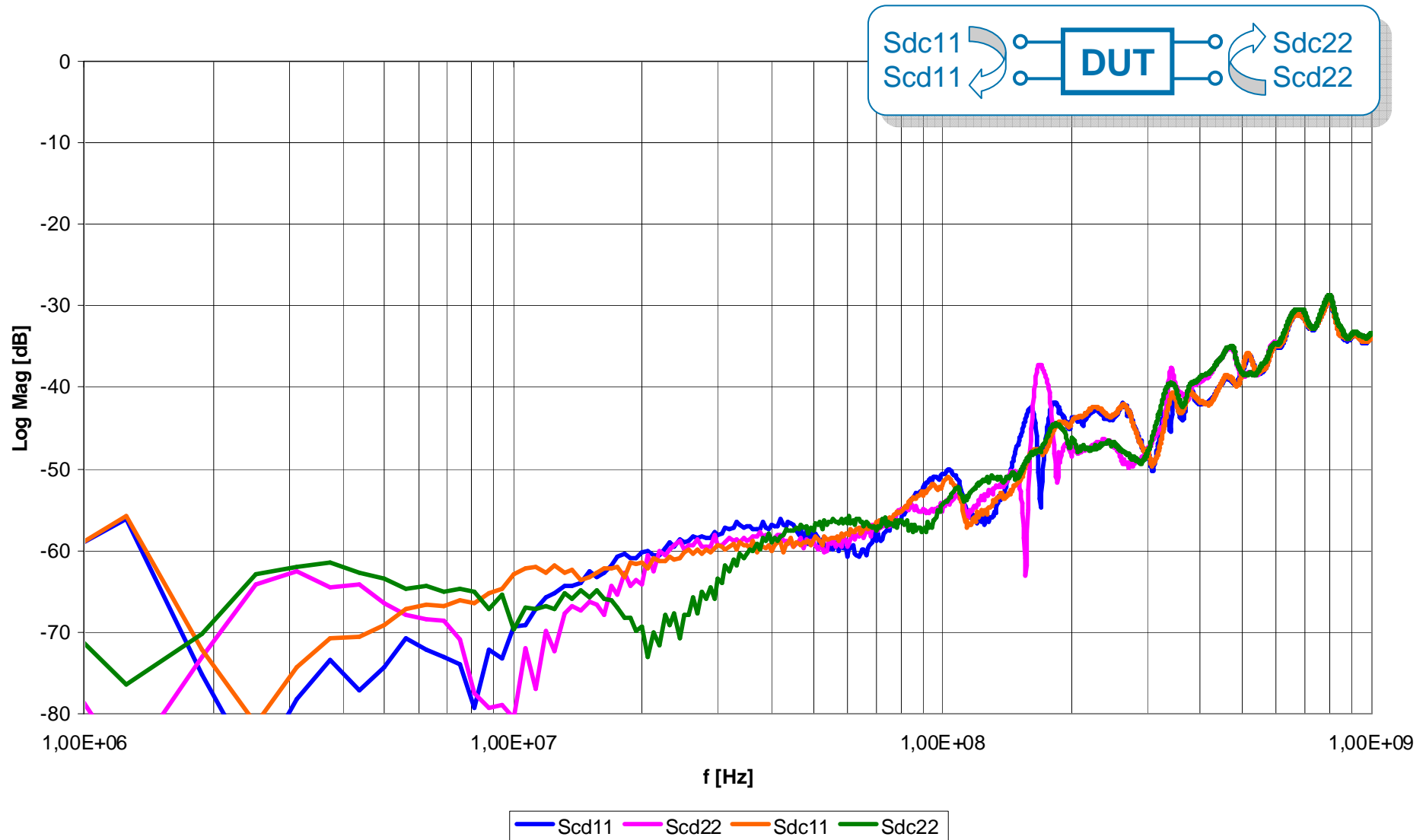
Test Setup 2b – Inline Connector with Short Cable & Asymmetric Floating Ground

- Calibration on SMA connectors, S4P single ended matrices captured
- Impedance controlled PCB traces up to the solder lands ensuring symmetric (balanced) signal launch into the DUT
- Metal GND plane (table); no direct GND connection between differential ports
- Floating GND plane touches connector side (90deg to contact plane)
- Same general setup as 2a

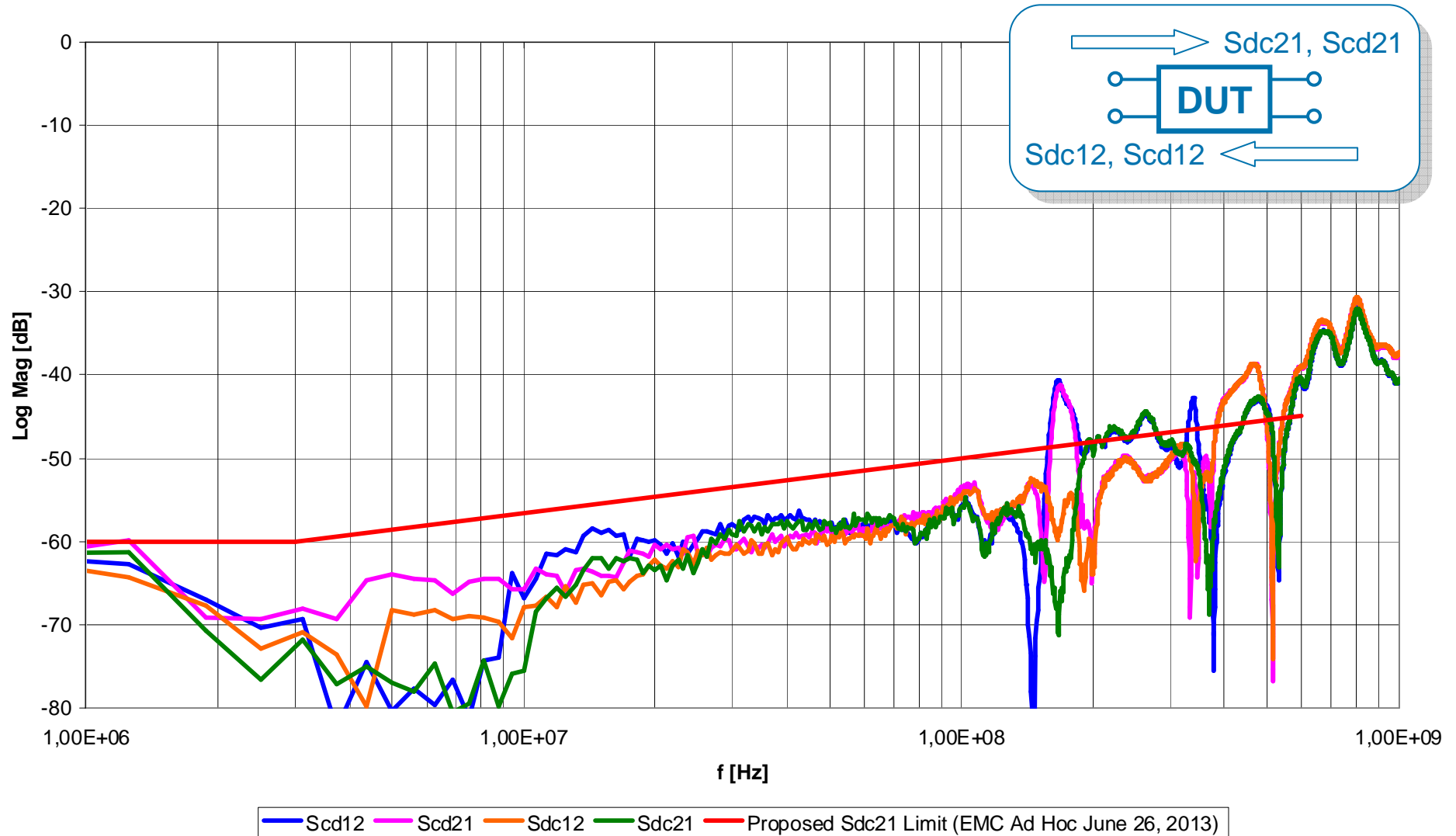


Test Setup 3a

Test Setup 2b – Balance Results, Reflected Conversions

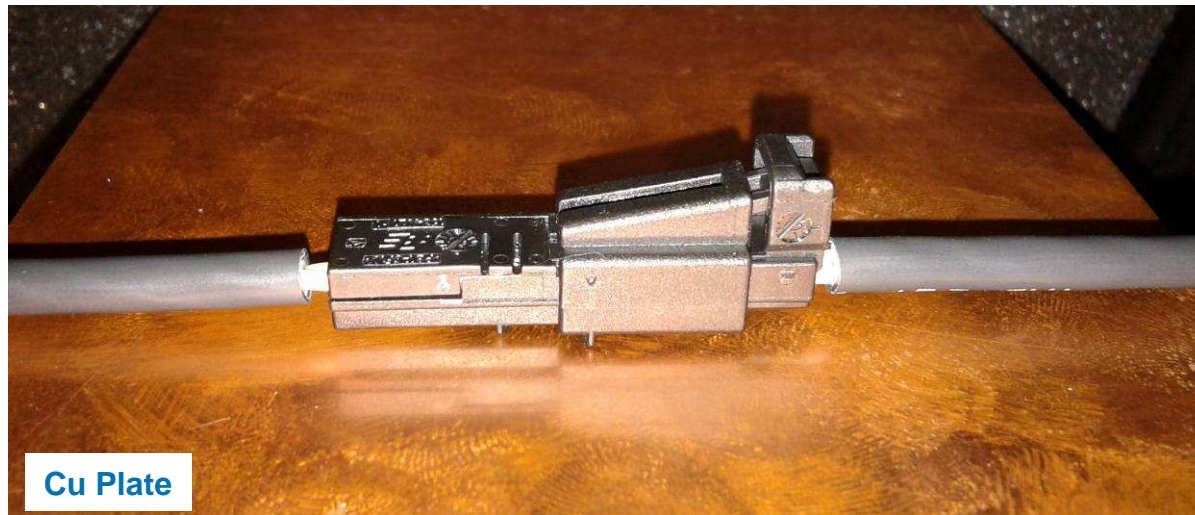


Test Setup 2b – Balance Results, Transmission Conversions



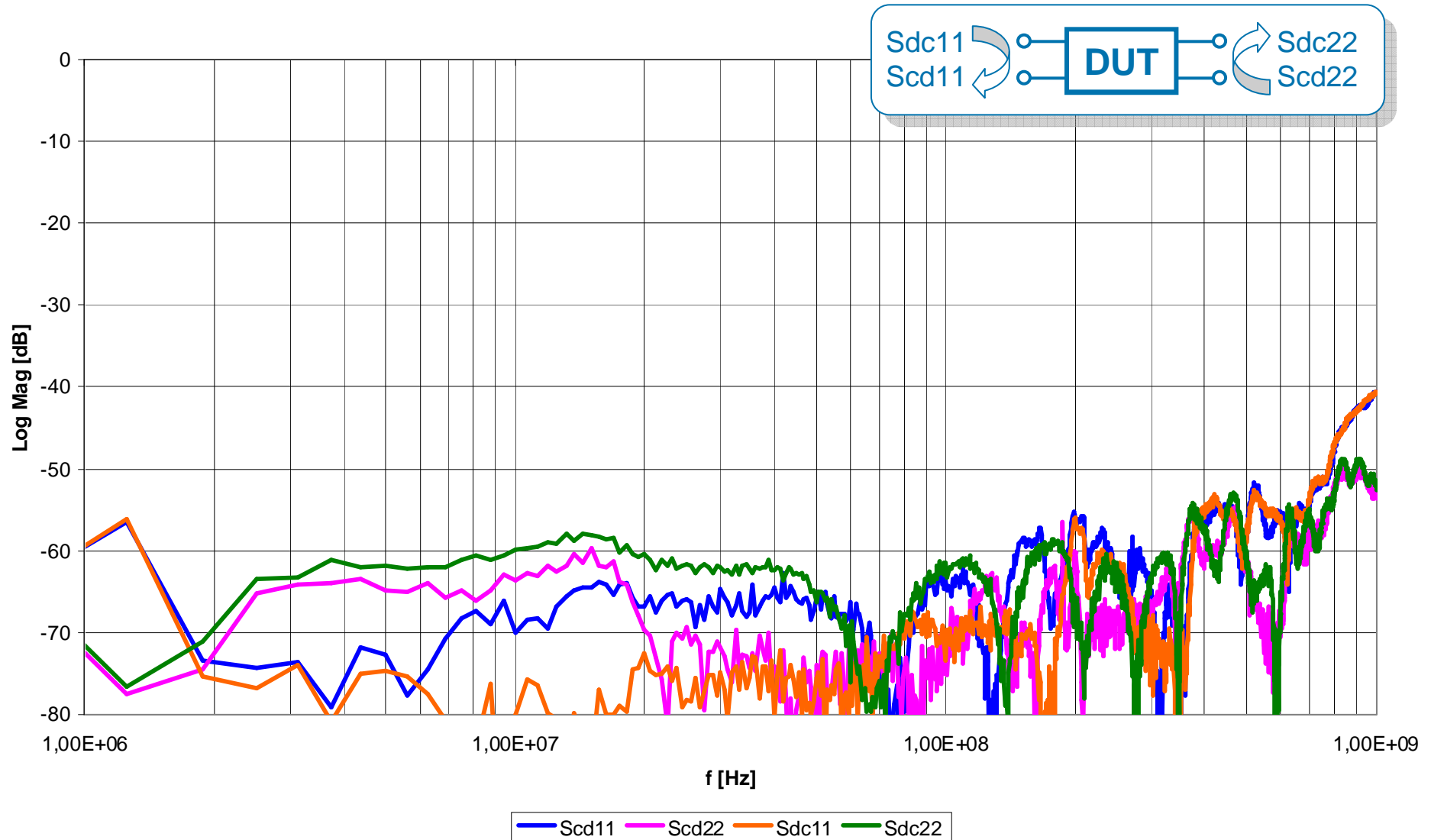
Test Setup 2c – Inline Connector with Short Cable & Symmetric Floating Ground

- Calibration on SMA connectors, S4P single ended matrices captured
- Impedance controlled PCB traces up to the solder lands ensuring symmetric (balanced) signal launch into the DUT
- Metal GND plane (table); no direct GND connection between differential ports
- Floating GND plane touches connector base (parallel to contact plane)
- Same general setup as 2a

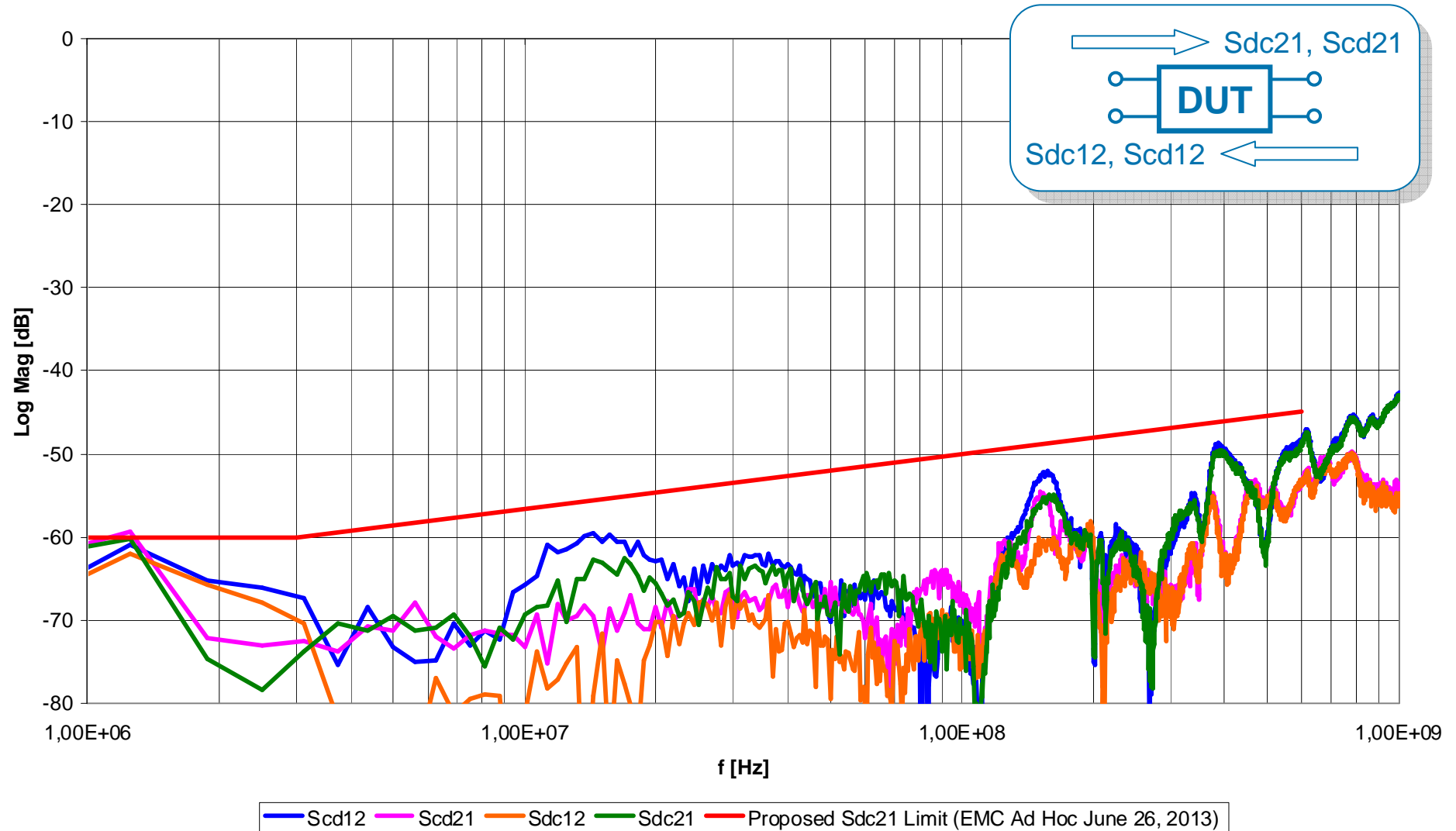


Test Setup 2c

Test Setup 2c – Balance Results, Reflected Conversions

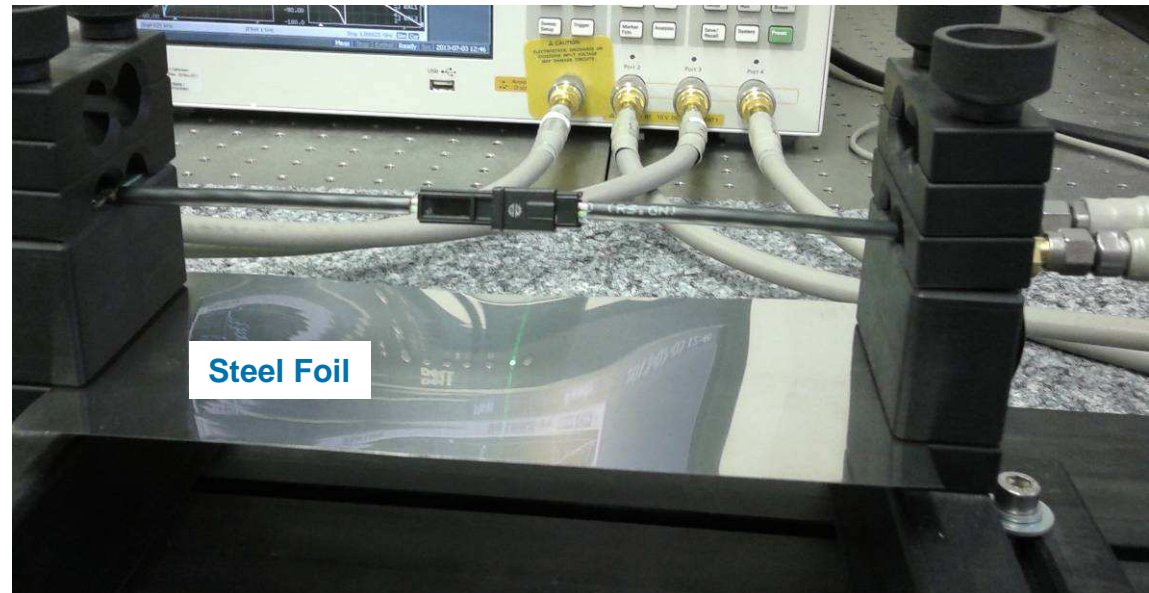


Test Setup 2c – Balance Results, Transmission Conversions



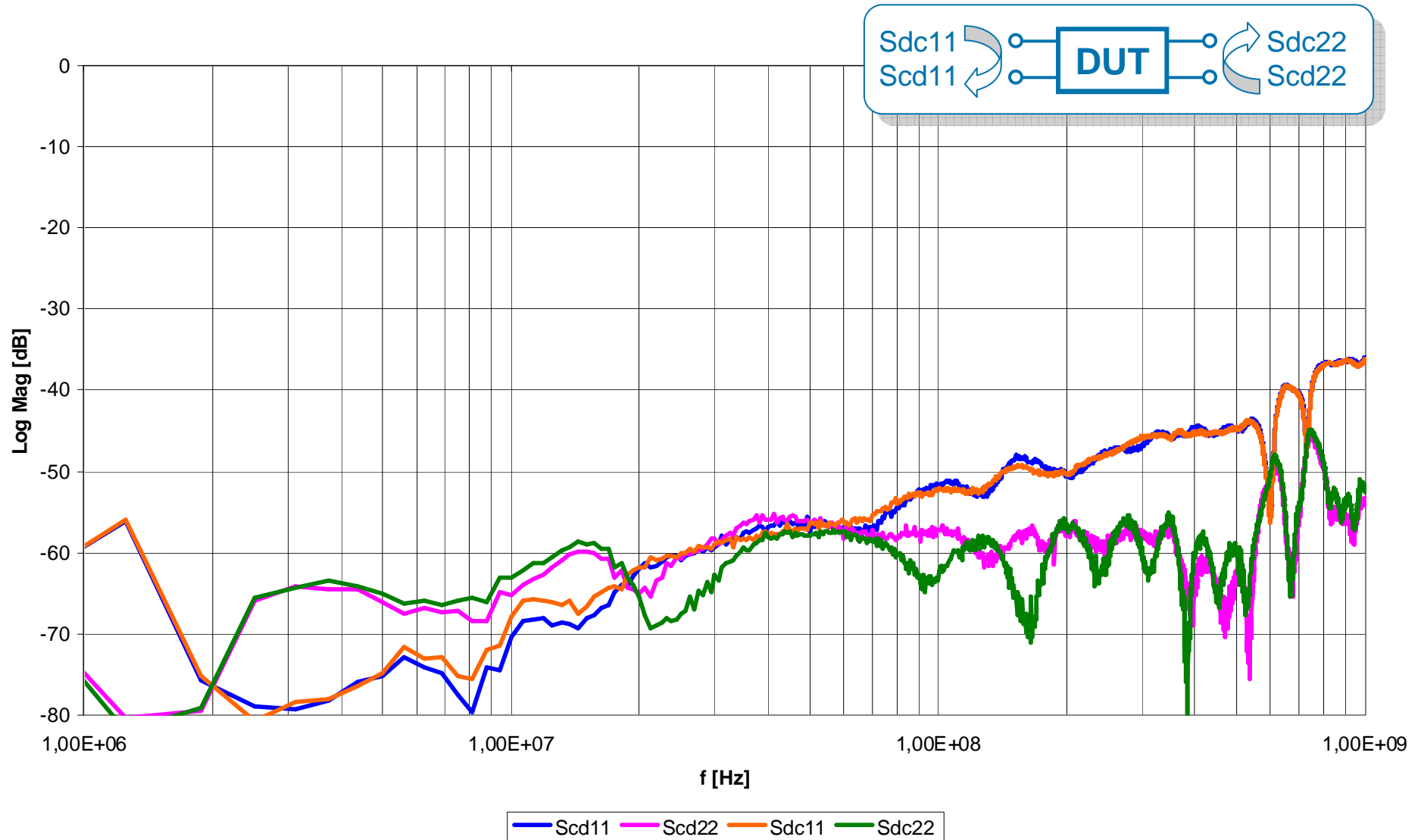
Test Setup 3 – Inline Connector with Short Cable & Ground Foil (not floating)

- Calibration on SMA connectors, S4P single ended matrices captured
- Impedance controlled PCB traces up to the solder lands ensuring symmetric (balanced) signal launch into the DUT
- Direct connected GND plane 30mm below DUT (basic construction similar to 2a)
- Asymmetric DUT orientation (ca. 80deg angle to contact plane)

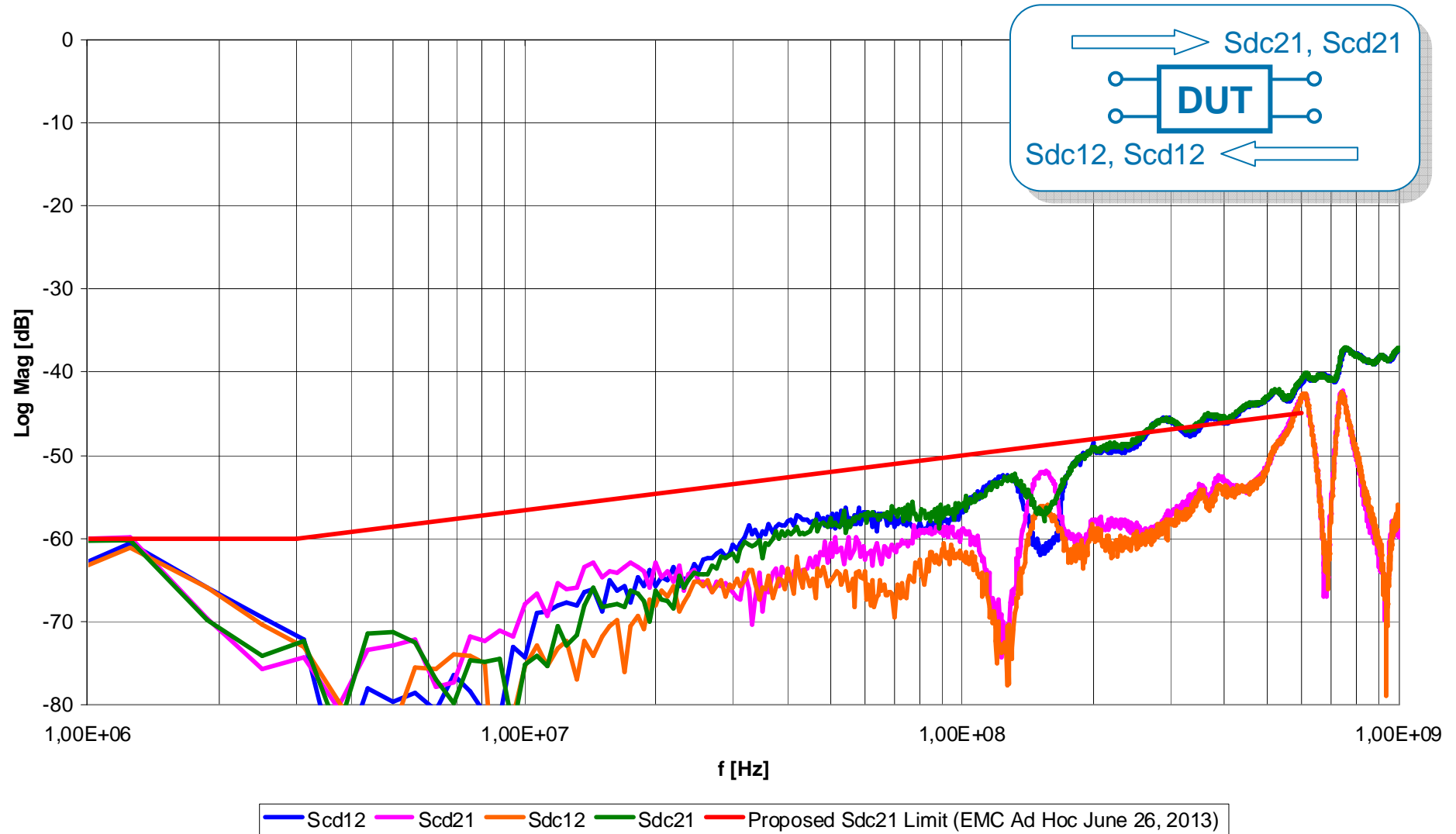


Test Setup 3

Test Setup 3 – Balance Results, Reflected Conversions



Test Setup 3 – Balance Results, Transmission Conversions



Conclusions on Balance Measurements

- Proposed limit is challenging for unshielded connectors
 - Contact system seems to provide sufficient symmetry as a baseline
 - proposed Sdc limit met with highly symmetric test arrangements
 - Surrounding metal has strong impact
 - limit definitions, connector designs & correlation to application need to be discussed
 - Test setup including reference ground requires high degree of symmetry
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- ToDo:
 - Tests for board connectors (MDI headers)
 - Include multi pair connectors to analyze x-conversion
 - Evaluation of suitable test setup arrangements