

BCI-Induced Noise Ingres to Coaxial MDI Test Method and Measured Levels

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Scope

- Describe a method suitable for measuring induced RF voltages in a coaxial channel under BCI-Immunity test conditions.
- Measure induced voltage at the PHY-pin location during BCI Immunity testing, using test jigs that emulate coaxial MDI.
- Present typical results.

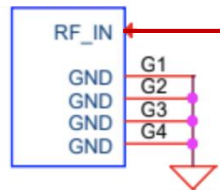
Test Conditions

BCI, substitution method, CW:

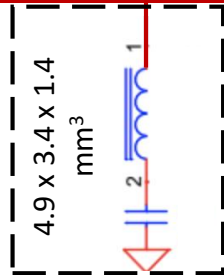
- 1 MHz – 400 MHz, 200mA.
- 2m, 6m, 10.5m RTK031-type of MDI cable assemblies.
- Two identical jigs connected to each end of the cable, emulate a coaxial channel between two PHYs.

Test Jigs

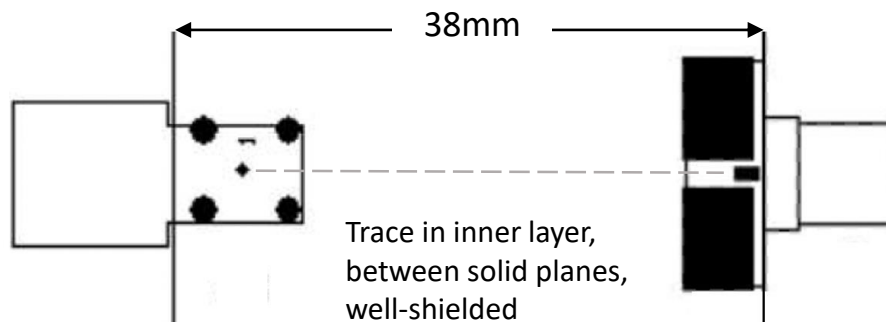
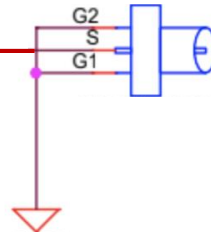
MDI Connector
Mini Coax



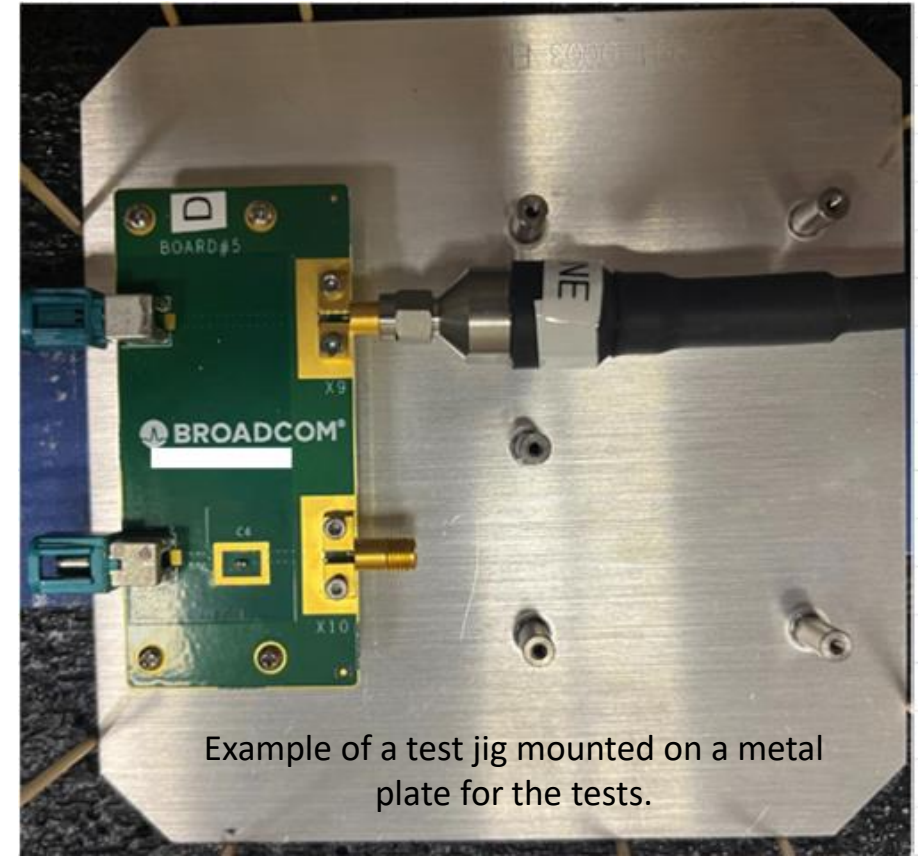
Optional
PoC
Inductor



SMA in place
of PHY

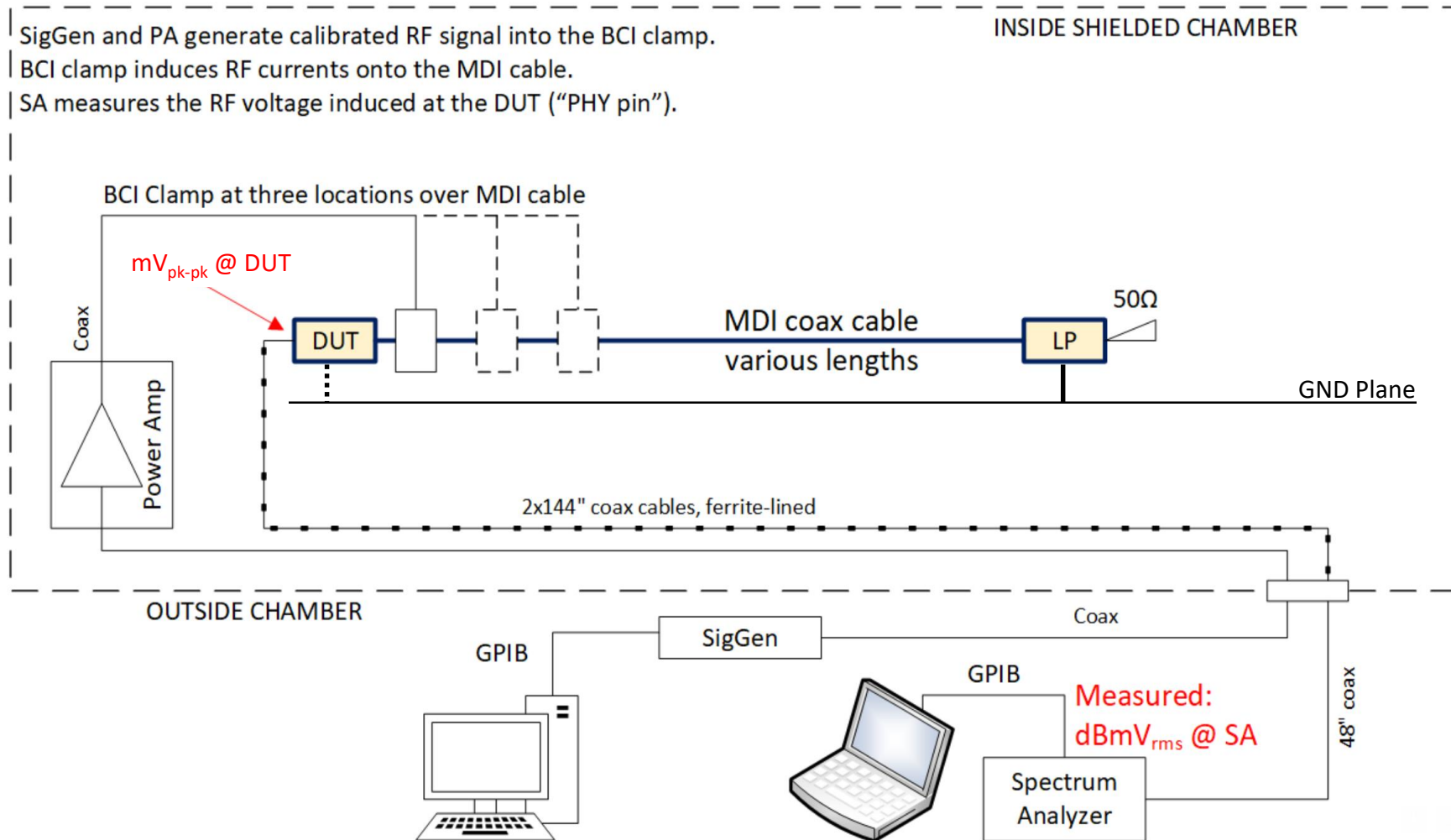


Two jigs, connected with the MDI cable,
represent a PHY-PHY channel.



Example of a test jig mounted on a metal plate for the tests.

BCI Setup

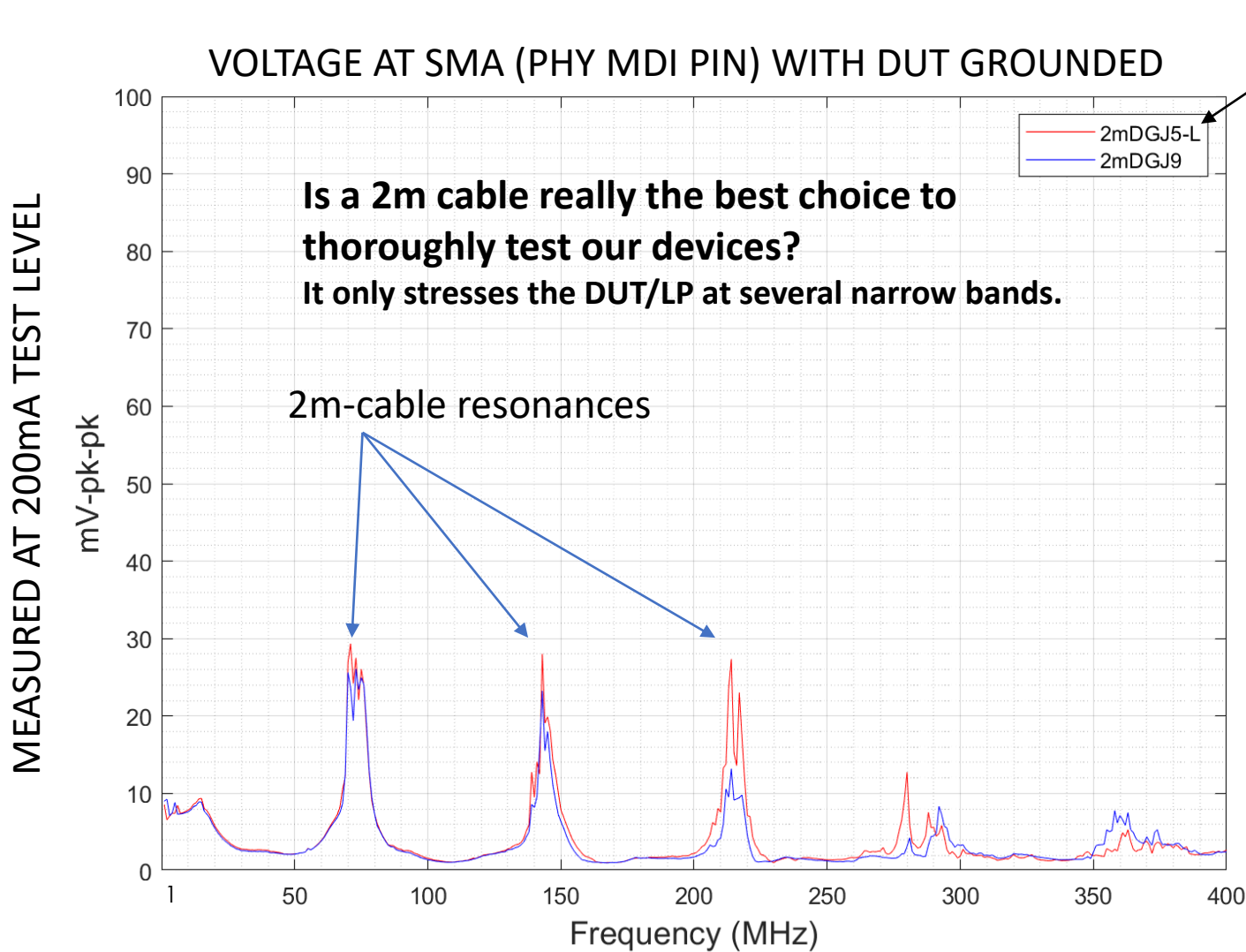


DUT and LP Conditions for BCI

During the BCI Noise Ingress measurements:

- LP (“Link Partner”) **always Grounded**, terminated with 50Ω @SMA.
- DUT either **Grounded or Floating**.
- DUT and LP connected with 2m, 6m or 10.5m of coax assemblies.
- Maximum of all three clamp locations presented for each test case.

2m-Cable, DUT GNDed

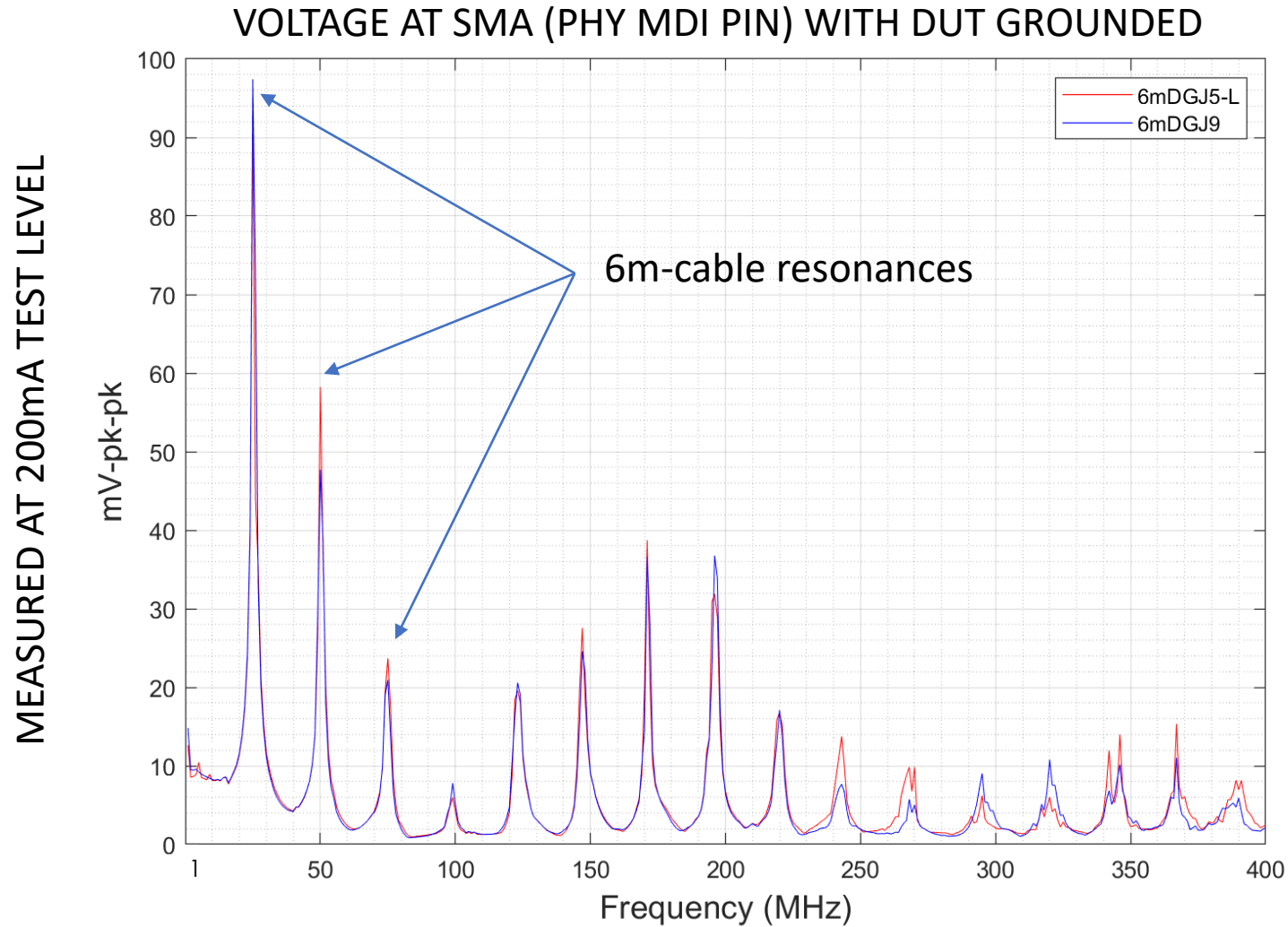


With inductor

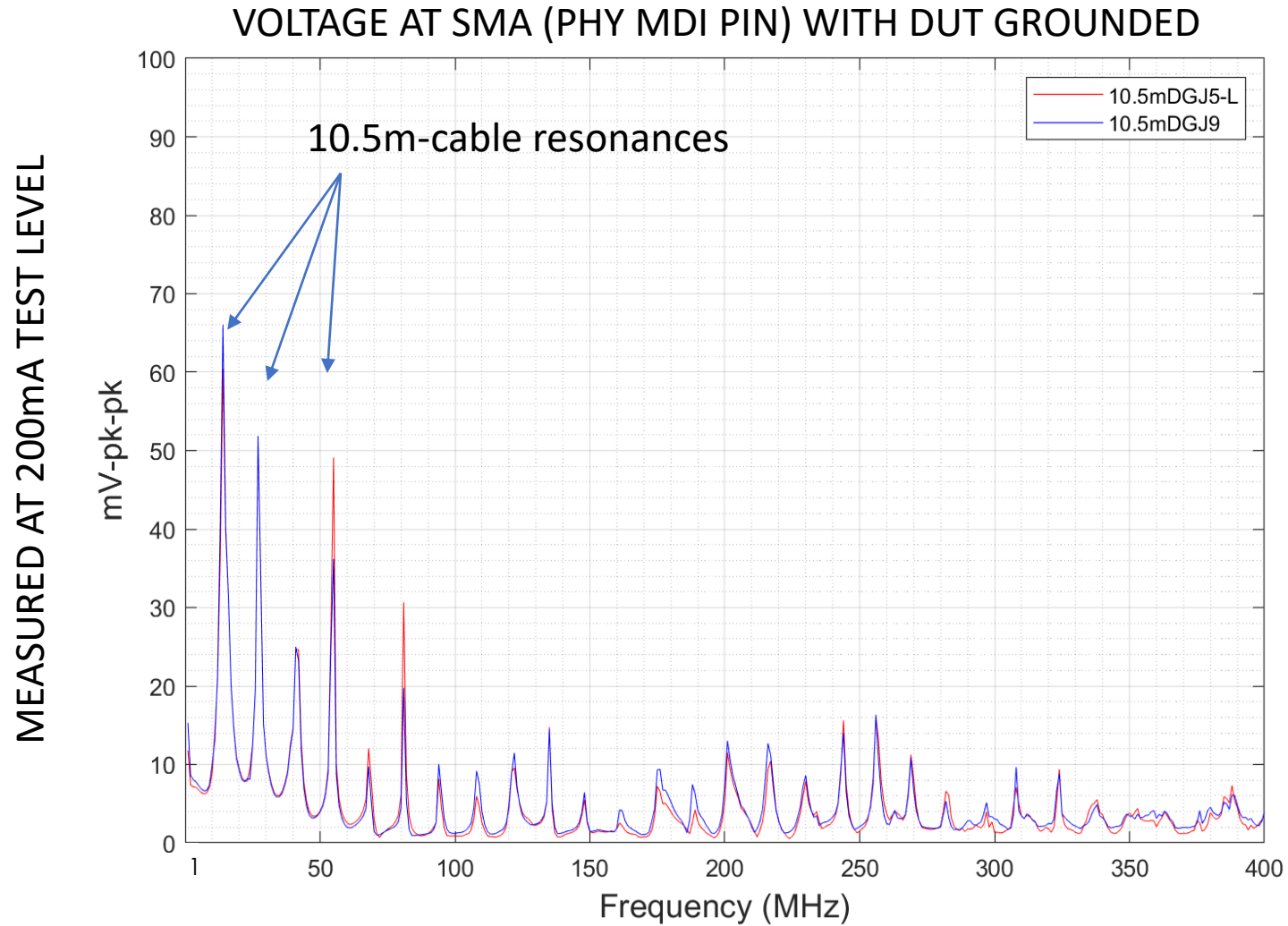
With both sides GNDed to the test bench, strong currents are induced on the shield at resonances.

TO SCALE TO 355mA TEST LEVEL
multiply by 1.78

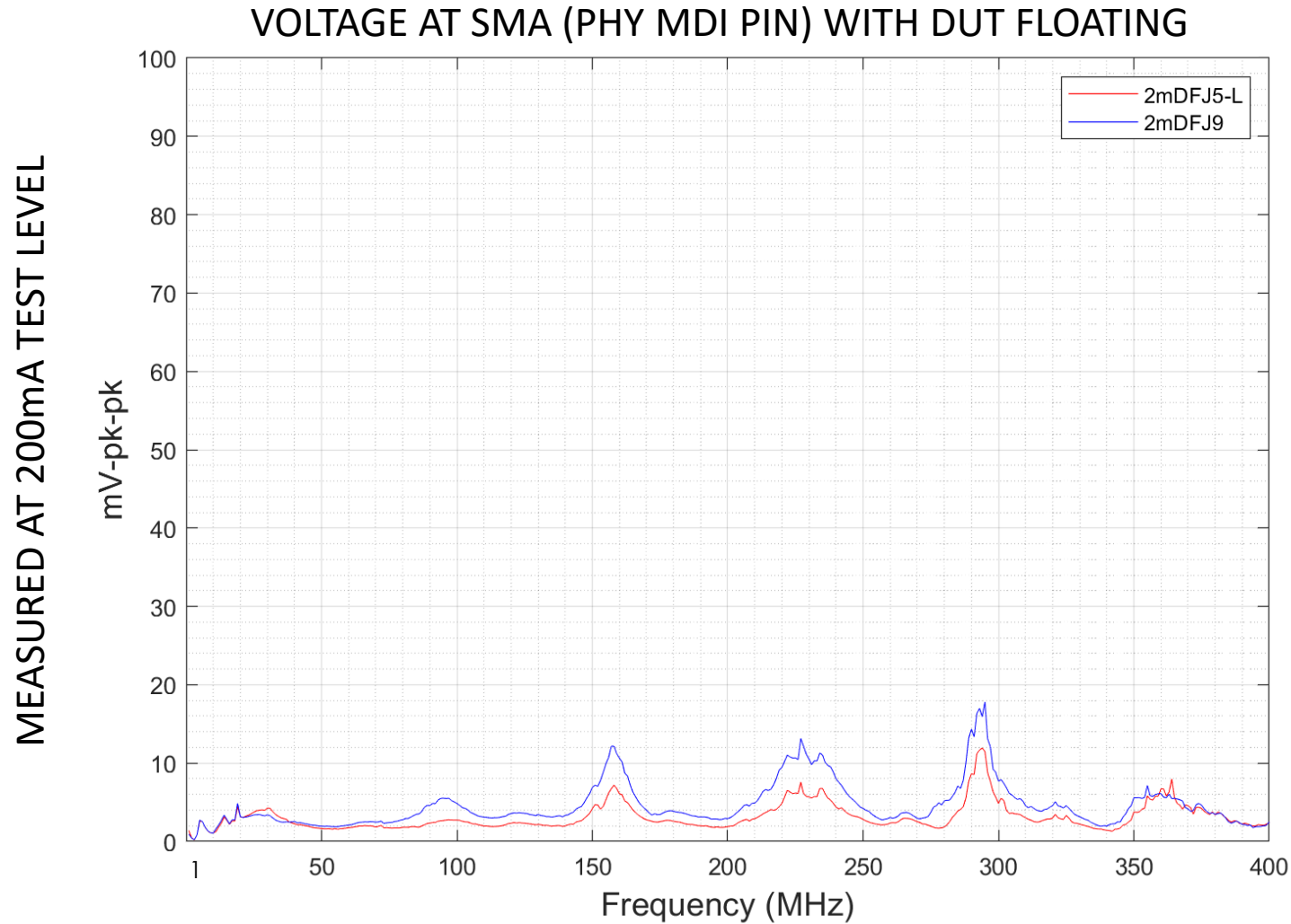
6m-Cable, DUT GNDed



10.5m-Cable, DUT GNDed

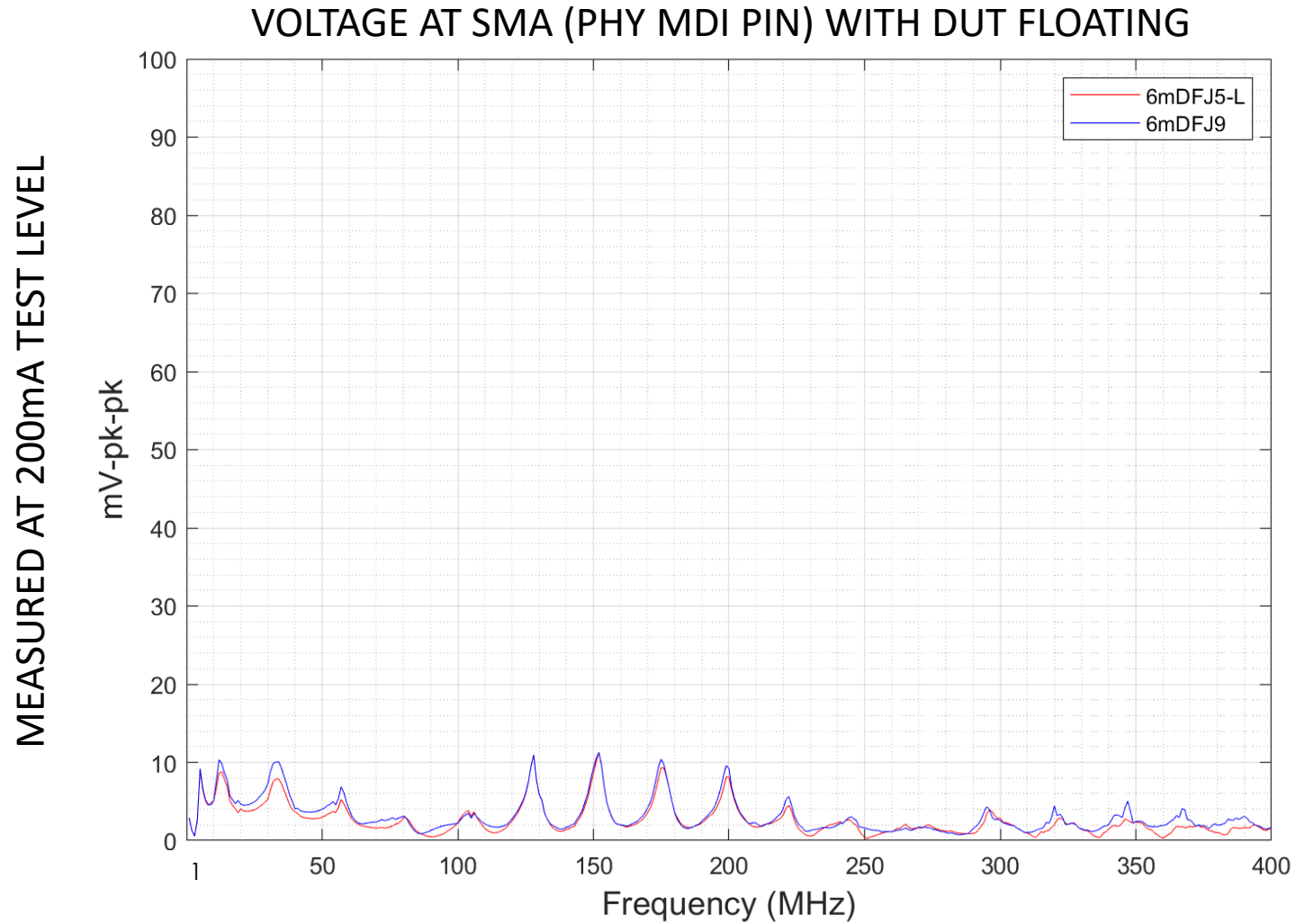


2m-Cable, DUT Floating

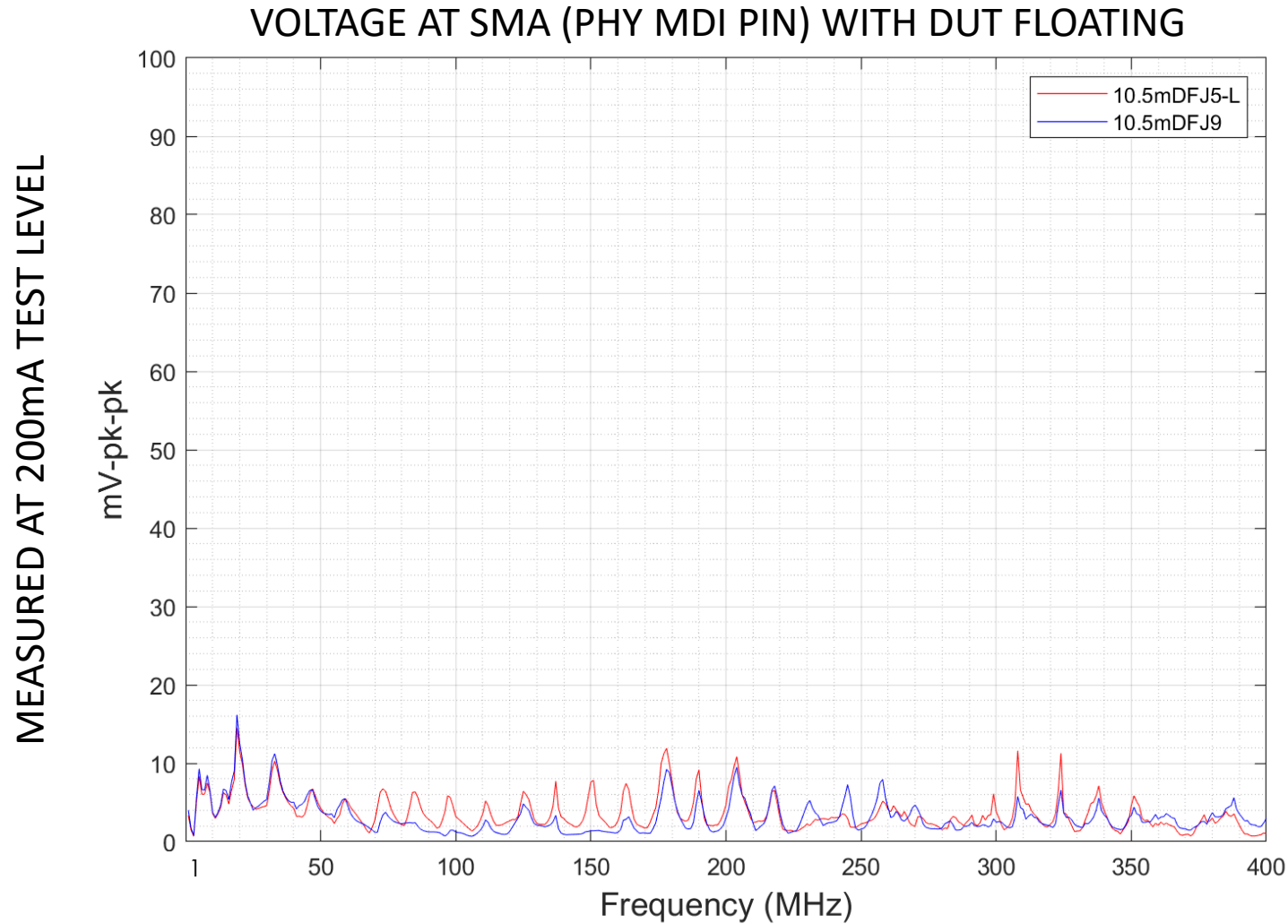


With one side Floating, induced currents on the shield are lower.

6m-Cable, DUT Floating



10.5m-Cable, DUT Floating



Summary Observations

- A method for characterization of coaxial channel under EMC test conditions is presented. A relation between the voltages at the PHY pin and external EMI can be accurately measured.
- Typical results for the BCI (200mA) on coaxial MDI are presented, and valid for the tested conditions. The presented levels are property of the channel (design) and not of the intended protocol. The design of the tested MDI is what can be expected in realistic applications.
- Response to coupled RFI is heavily affected by and depended on cable-resonances and their levels. Resonant frequencies depend on the length of the MDI cable and grounding conditions. A DUT can be stressed at the resonant frequencies and not stressed in between the resonances.
- Levels of coupled RFI also depend on the location of the BCI clamp in relation to the cable length and the wavelength of the injected frequency. Only three standard locations have been covered.
- The induced levels are lower when the DUT is floating relative to the GND plane on the bench.
- This method can be applied to characterize MDI vs. various EMC parameters and settings. It can be adapted for differential-pair MDI.

Conclusions

- The component-level tests are prerequisite for in-car testing. The BCI current level 200mA is considered in this study. However, some OEM requirements may go up to 355mA, in which case the presented results need to be scaled accordingly by a factor of 1.78.
- As shown, significant BCI-induced noise can be observed below 400MHz.
- The above observation indicates that there is an absolute need for certain level of signal processing and noise handling is required for both **camera-side receiver** as well as the ECU-side receiver. This fact is **independent of the modulation technique** used.
- The next study should consider radiated immunity, which includes higher frequencies.

Thank you!
Questions?