802.3cy Ingress Noise Measurement Results

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802.3cy ingress noise measurement results

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Scope

- Ingress noise, coupling from external sources into the channel is one of the primary factors on SNR
- This presentation shows the ingress noise into an automotive STP link segment by means of antenna measurement (ALSE method) according to ISO 11452-2 (previous results in mueller_3ch_03_0518.pdf)
- Primary intent is to present data for differential and common mode ingress noise voltage at the MDI connector, for a normalized electrical field strength at different MDI connector shield termination implementations (typical cases of shield termination)
- Secondary aim is to provide a link between the adopted coupling- and screening attenuation baseline proposals and ingress noise (mueller_3cy_01_08_03_21.pdf)

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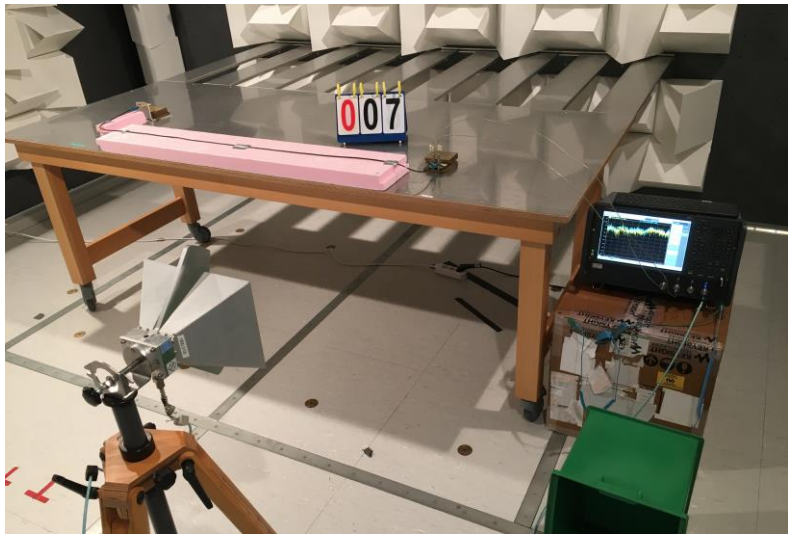
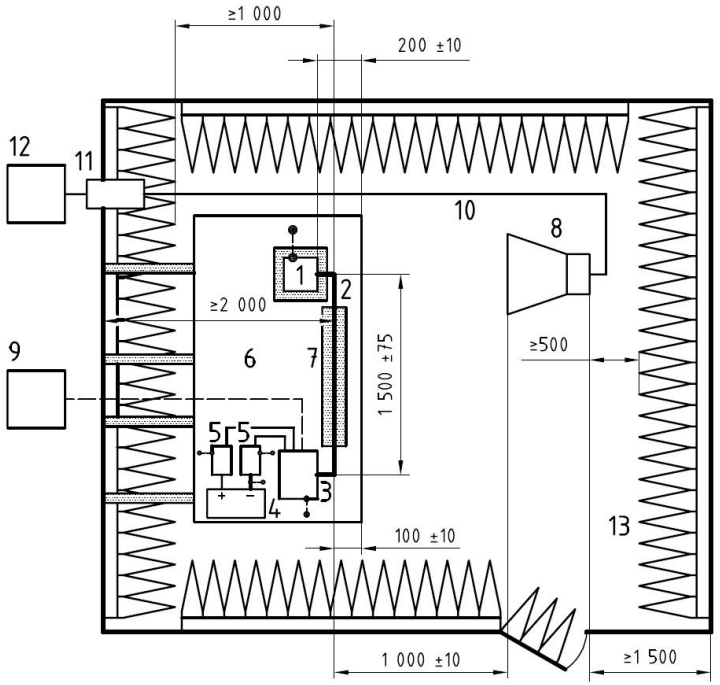
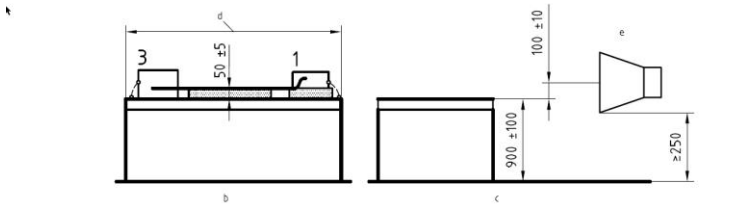
Measurement Setup

- Derived from ISO 11452-2 ALSE method
- Double ridge horn antennas directly pointing at the DUT
- Polarizations horizontal and vertical.
- Measurement with VNA to derive full s-parameter with transfer functions







Key

1 DUT (grounded locally if required in test plan)
2 test harness
3 load simulator (placement and ground: connection according to 7.5)
4 power supply (location optional)
5 artificial network (AN)
6 ground plane (bonded to shielded enclosure)
7 low relative permittivity support ($\varepsilon_r \leq 1{,}4$)
8 horn antenna
9 stimulation and monitoring system
10 high quality double-shielded coaxial cable (50 Ω)
11 bulkhead connector
12 RF signal generator and amplifier
13 RF absorber material

[a] Upper view (horizontal polarisation).
[b] Front view.
[c] Side view.
[d] See 7.1.
[e] Vertical polarization.

Figure 3 — Example test set-up for frequencies above 1 GHz — Horn antenna

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Measurement Setup

- Derived from ISO 11452-2 ALSE method
- Double ridge horn antennas directly pointing at the DUT
- Polarizations horizontal and vertical
- Measurement with VNA to derive full s-parameter with transfer functions
- Electrical field strength of 1 V/m between 1 GHz and 9 GHz, calibrated with generator and field probe and scaled to 100 V/m

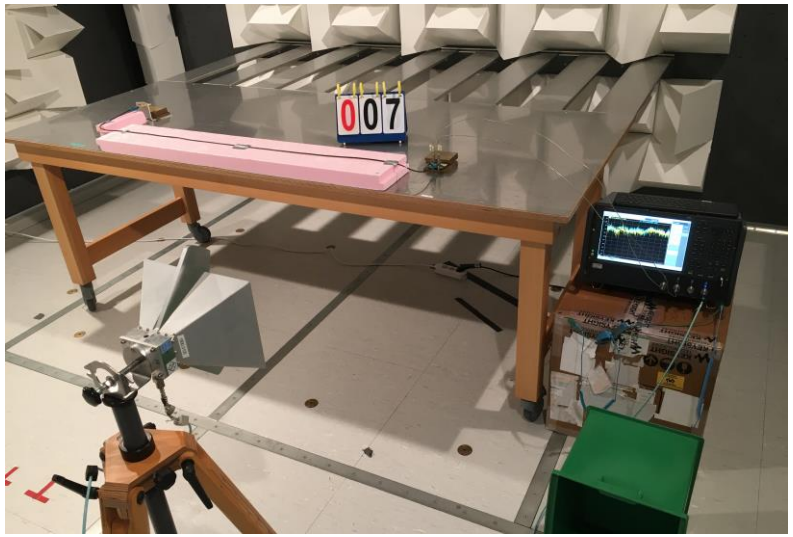
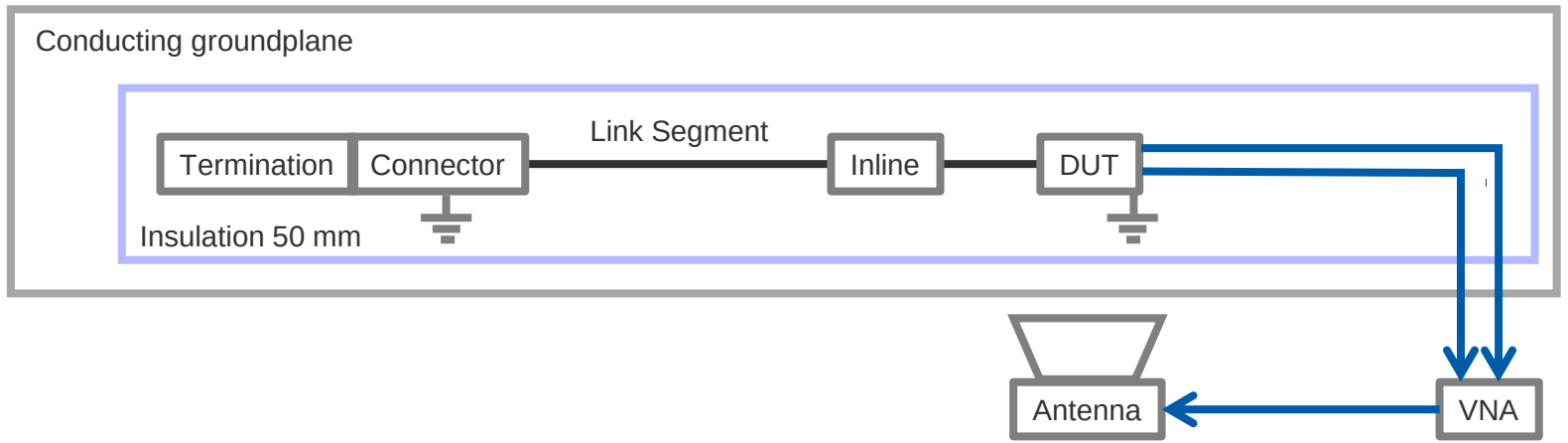


Table C.1 — Suggested test severity levels

Test severity level	Value V/m
I	25
II	50
III	75
IV	100
V	Specific value agreed between the users of this part of ISO 11452, if necessary



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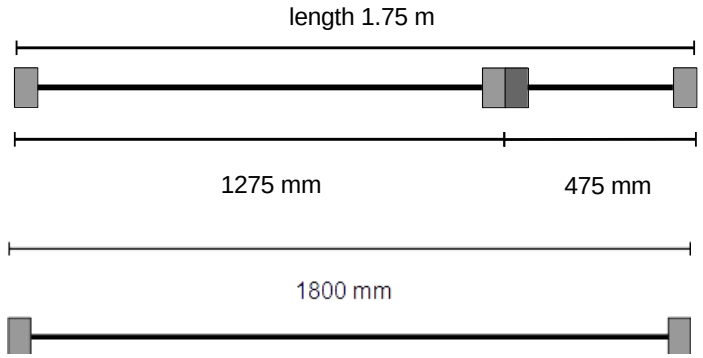
Measurement setup

Link segments under test:

- DUT 1 0.475 m + 1.275 m STP link segment, inline located at DUT side
- DUT 10 1.8 m STP cable assembly without inlines



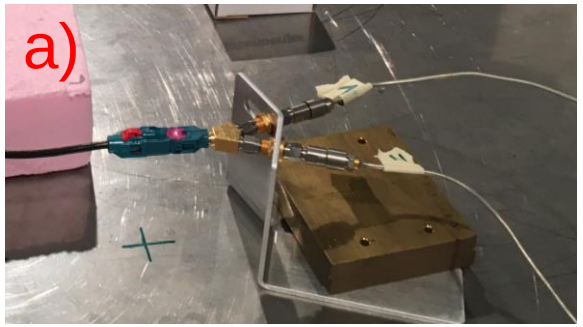
Shield termination scenarios:

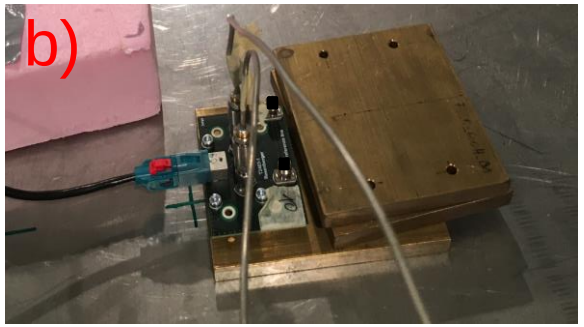
a) Ideally shielded test fixtures to reproduce perfect shield termination at the MDI with direct contact to shielded enclose.

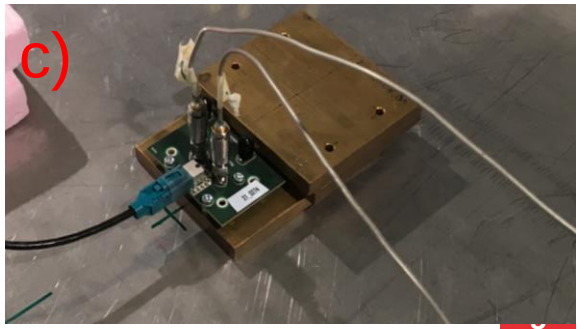
b) PCB test fixture with DC shield termination without shielded enclosure.

c) PCB test fixture with AC shield termination with high number of capacitors. Lower number of capacitors reduces complexity but also shield termination quality.

- Far end always ideally terminated like a)







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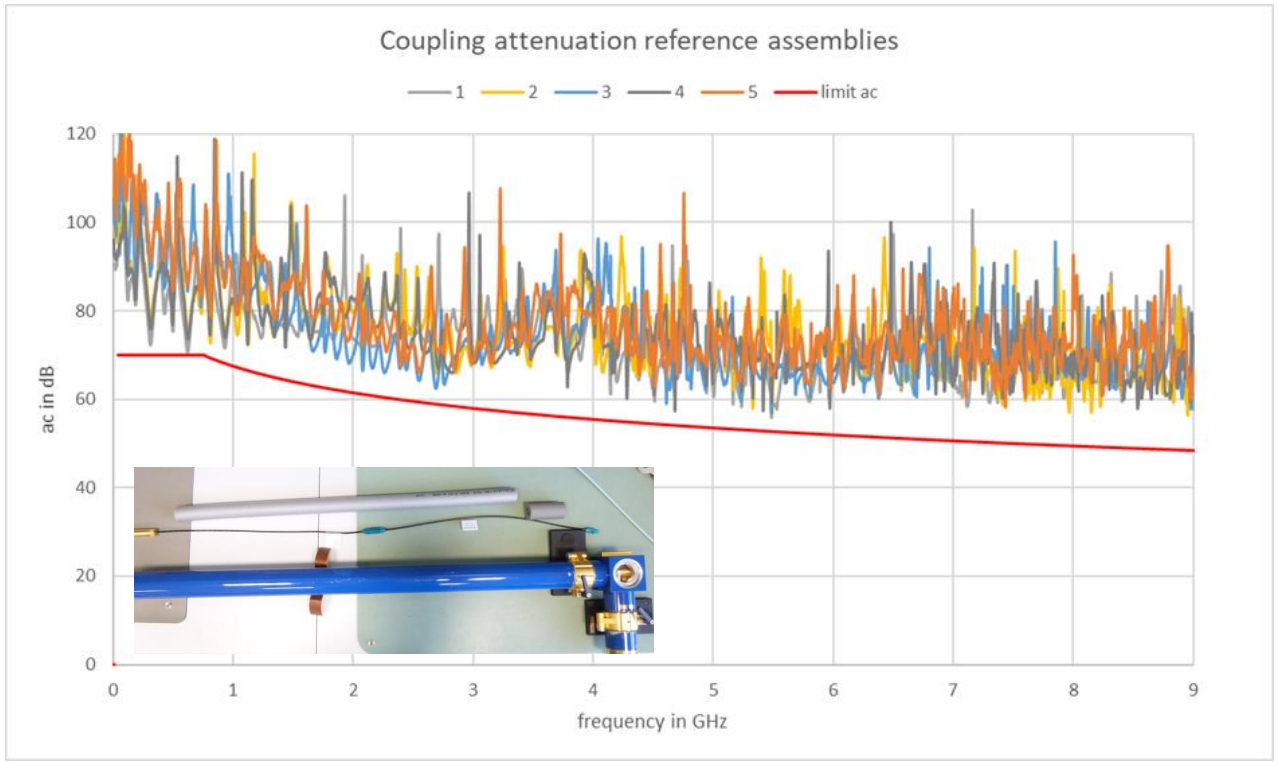
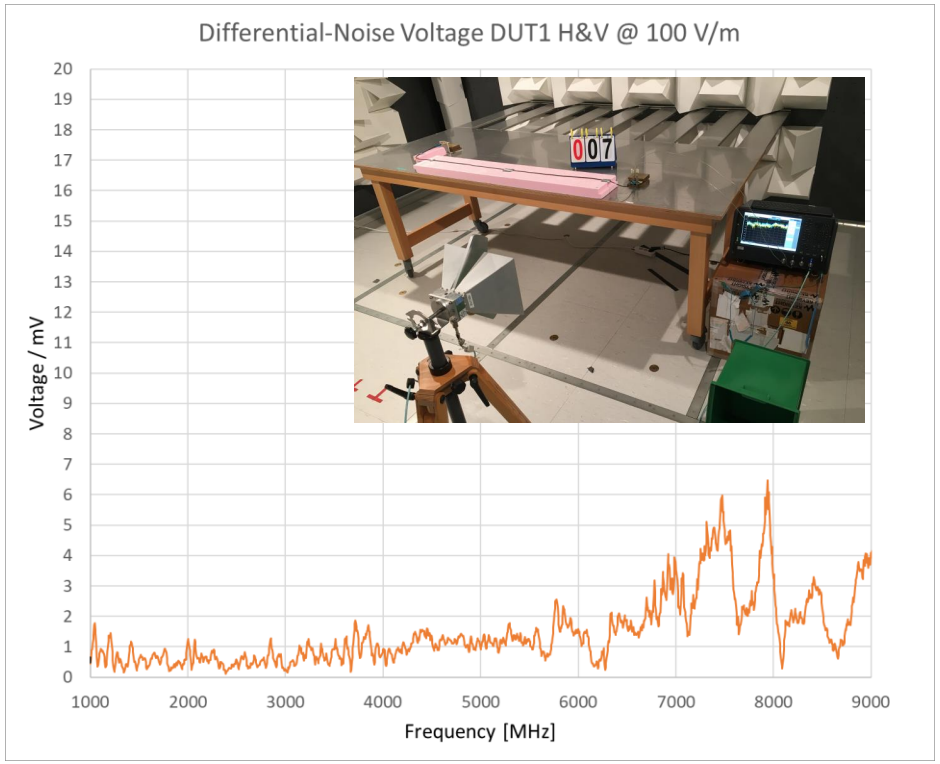
Measurement results

- Comparison of coupling attenuation vs. differential noise at 100 V/m
- Identical link segment as tested in the triaxial setup before (DUT1) with ideal shield termination a)
- Maximum ingress voltage with vertical and horizontal antenna polarization combined





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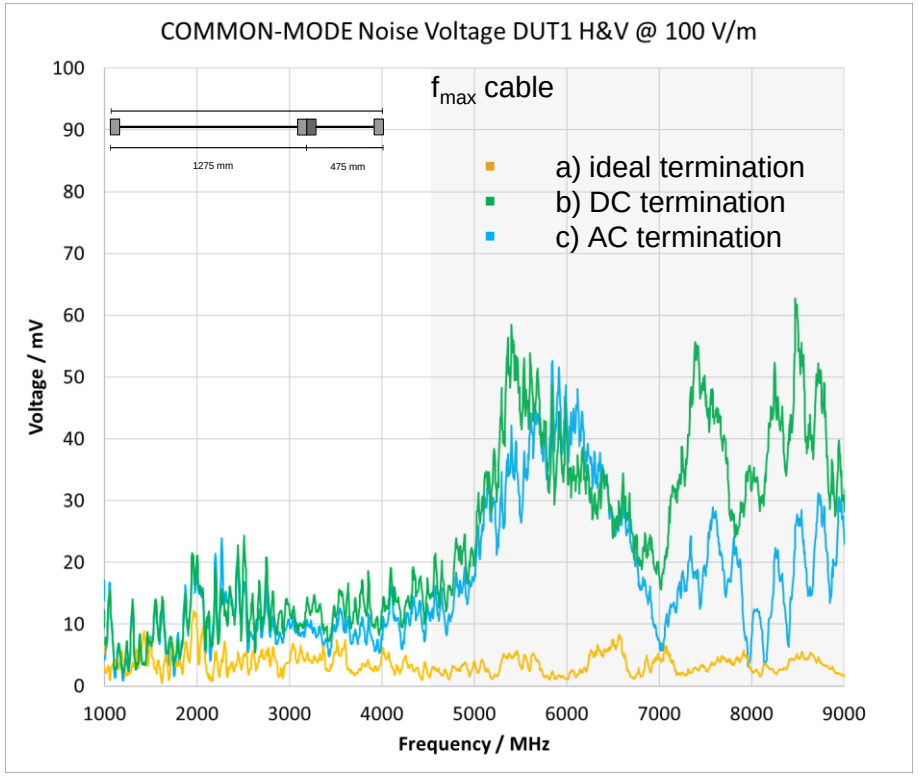
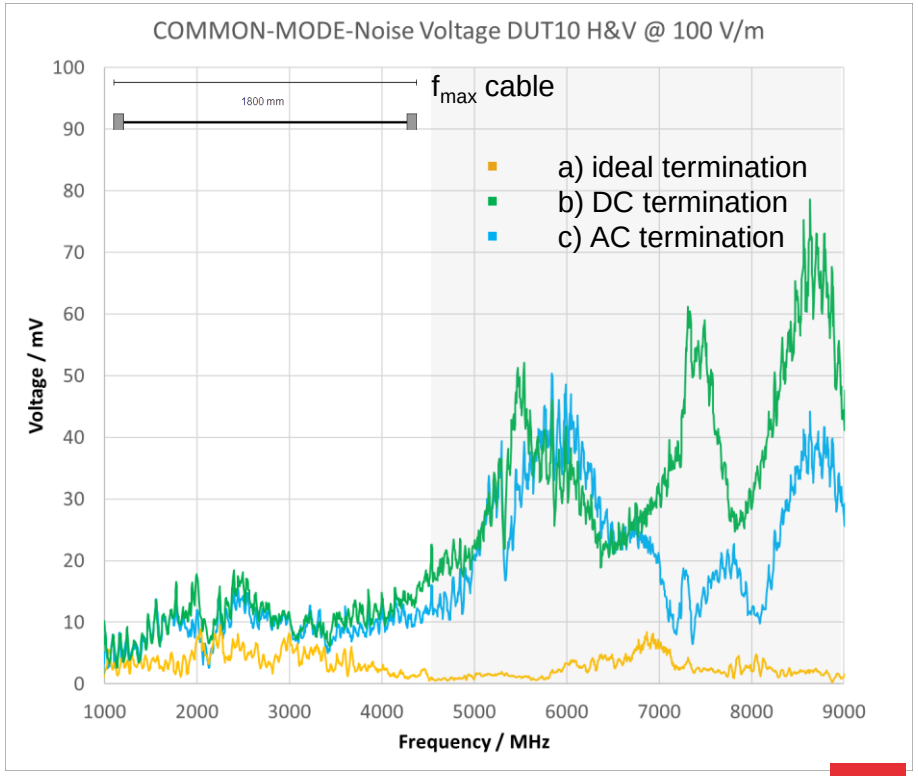
Measurement results

- Common mode ingress noise at 100 V/m below 80 mV between 1 GHz and 9 GHz
- Increase above 5 GHz due to finite screening of the PCB, potential influence of f_{max} of the cable due to increased mode conversion. Improvement with 9 GHz expected.
- Ideal termination much better than PCB due to contiguous shielding along the whole link (better screening beyond the connector interface on the device).
- Ideal termination represents best configuration achievable with the specific cable and connector type under test, using shielded enclosure and EMC sealed connector in practical application





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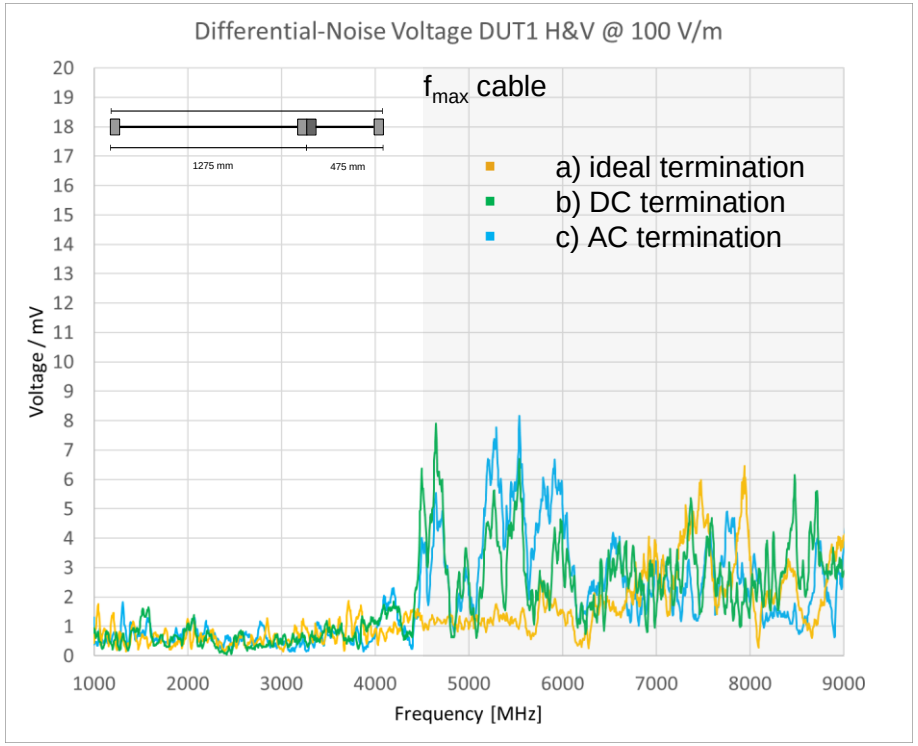
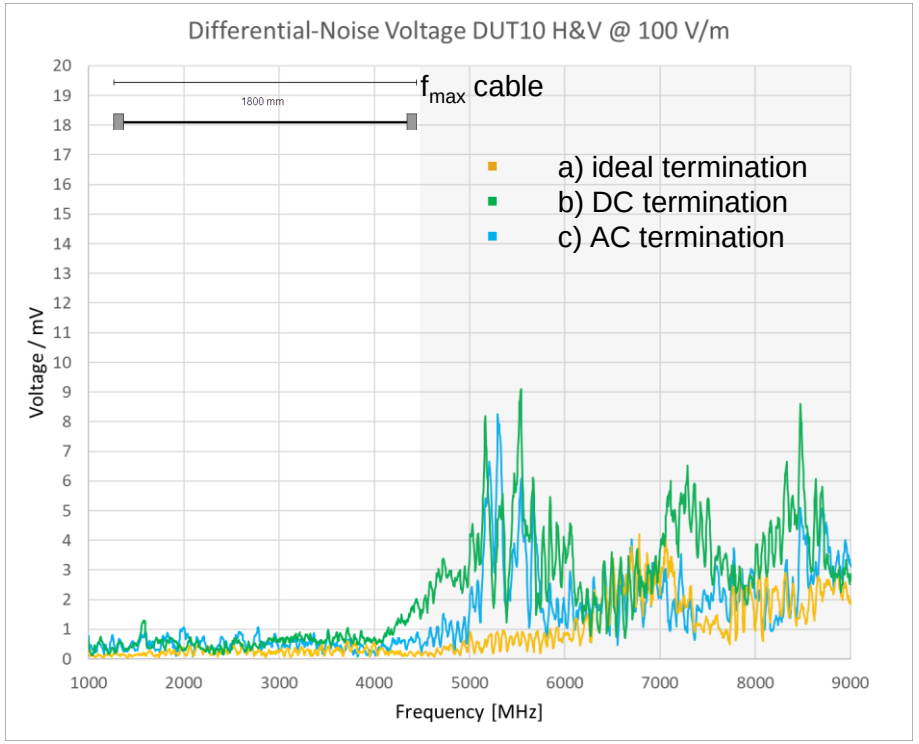
Measurement results

- Differential ingress noise at 100 V/m below 10 mV between 1 GHz and 9 GHz
- Ideal termination in overall better, but both PCB based terminations hold up quite well
- Comparable results for DC and AC terminations





802.3cy micro-reflexions measurement results

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Summary

- The link segment under test that passes the adopted coupling attenuation baseline proposal showed a differential noise of <10 mV common mode noise of <80 mV at 100 V/m between 1 GHz and 9 GHz in the presented measurement setup.
- Higher noise levels may occur at frequencies <1 GHz, when the cable assembly is in resonance at e.g. ½ the wavelength (not part of this presentation).
- The defined coupling attenuation baselines cover the link segment including the PCB header itself and its transition to the PCB. The quality of the shield termination implementation on the device affects the overall EMC performance of the subsystem. Factors include e.g. layout and routing of traces on the PCB, quality of AC shield termination, contact points to a shielded enclosure and external grounding of the ECU. These effects are considered as implementation and the designer of a device should consider them for EMC robust design.