



Channel Measurement Results RTPGE – Return Loss & Insertion Loss

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IEEE802.3bp Channel Definition Ad Hoc, Meeting 02MAY2013

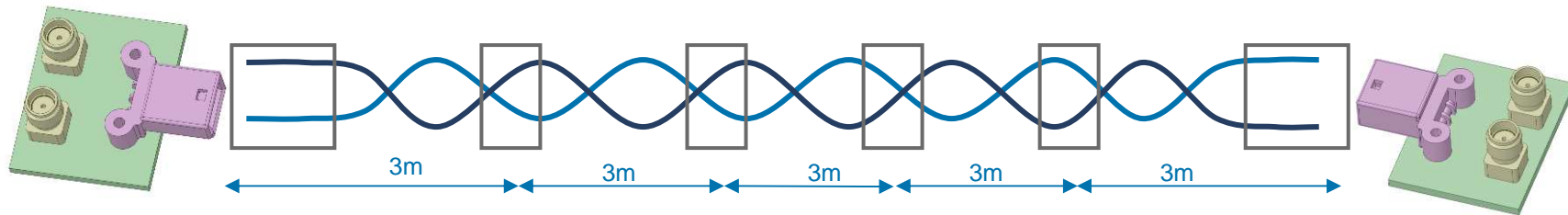
EVERY CONNECTION COUNTS



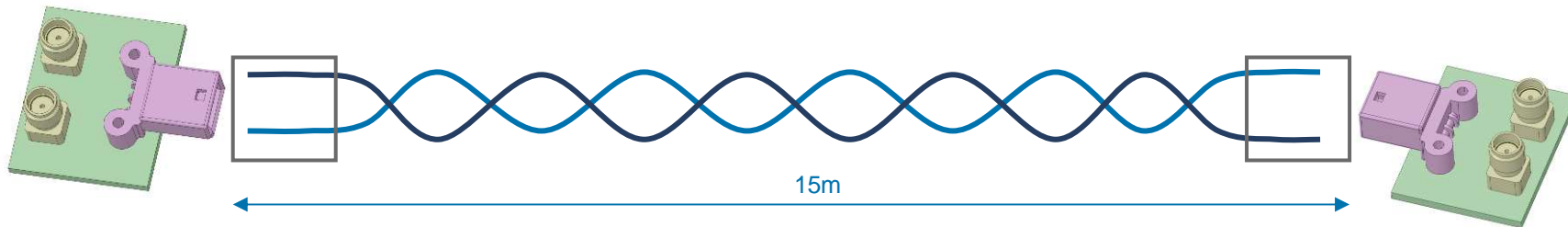
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Channel Configurations & Test Specimens

5x3m channel, includes 4 inline connectors:



1x15m channel:



Test Boards with SMA connectors used for NA connection

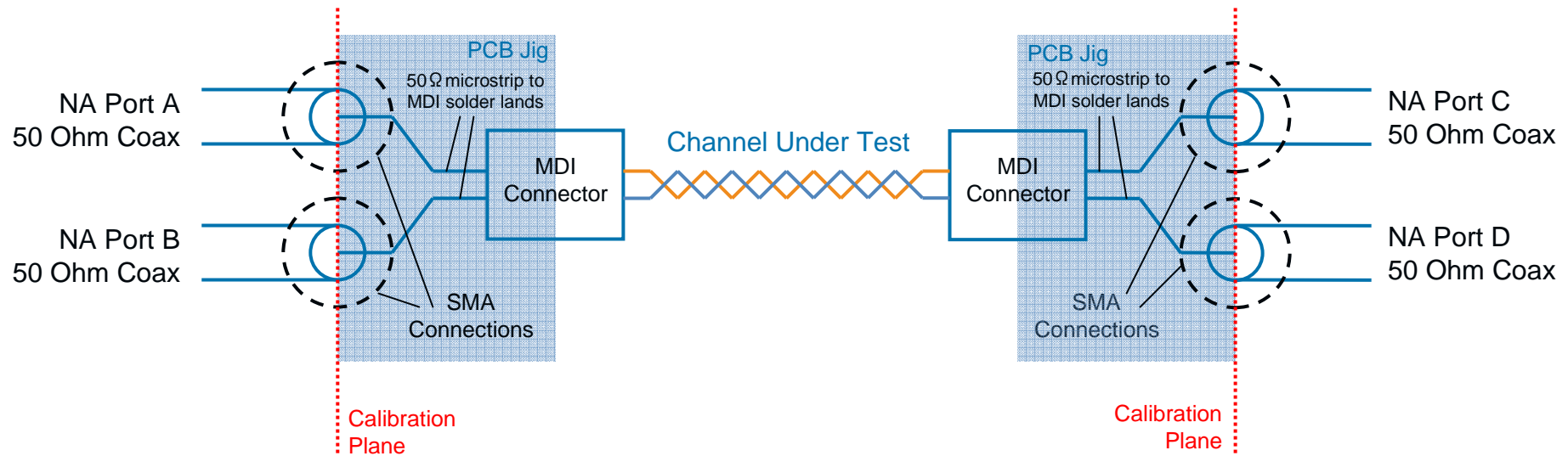
Connectors:	Connector "Con A":	2.54mm pitch size, 0.63mm ² pin size
	Connector "Con B":	1.8mm pitch size, 0.4x0.5mm ² pin size
Cables:	Cables "C1", "C2":	0.17mm ² , with and w/o jacket
	Cables "C3", "C4", "C5":	0.35mm ² , with and w/o jacket

Note:

The components (cables & connectors) were not specifically tailored for RTPGE. Future improvement possible ...

→ Total: 20 different channel samples with Automotive Cables

Measurement Setup



- 4 Port Measurement
- Calibration at SMA connectors using ECAL
- Calculation of Mixed Mode Parameters by NA
- $RL = -|S_{dd11}|$, $IL = -|S_{dd12}|$
- Measurements at 20° C

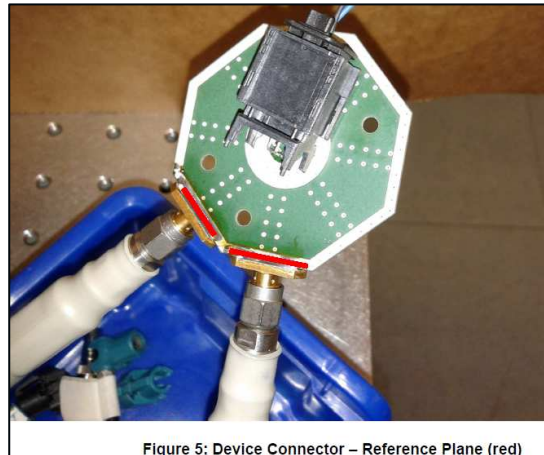


Figure 5: Device Connector – Reference Plane (red)

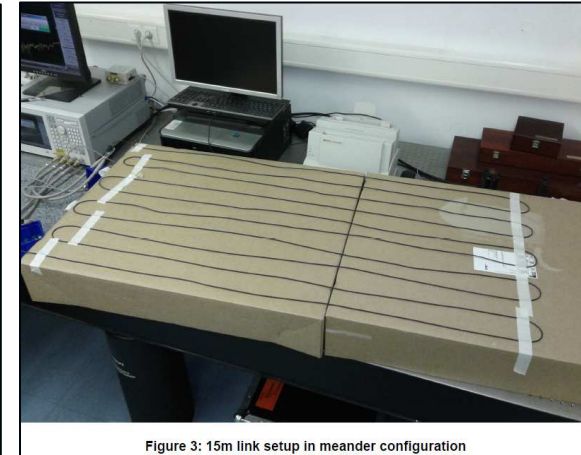
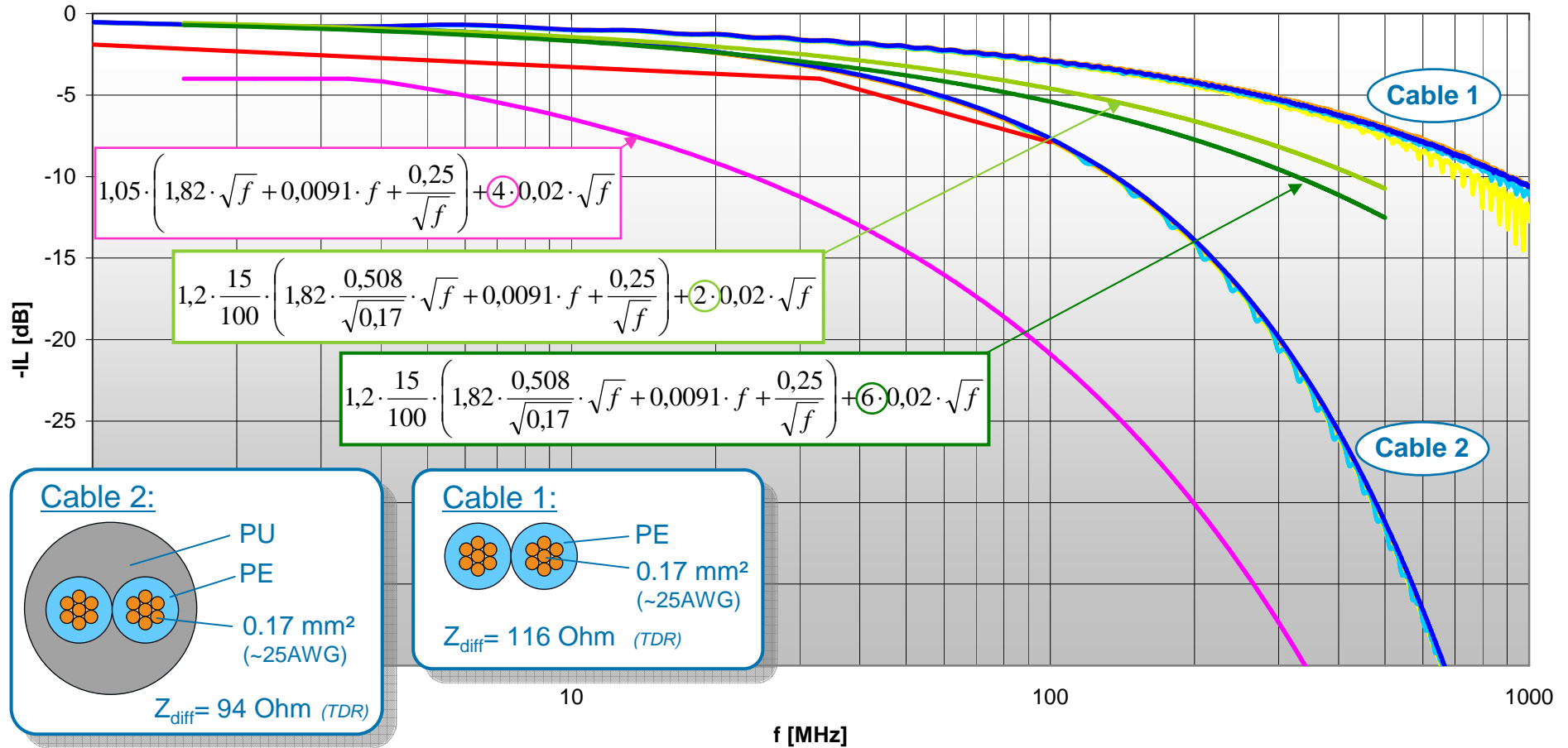
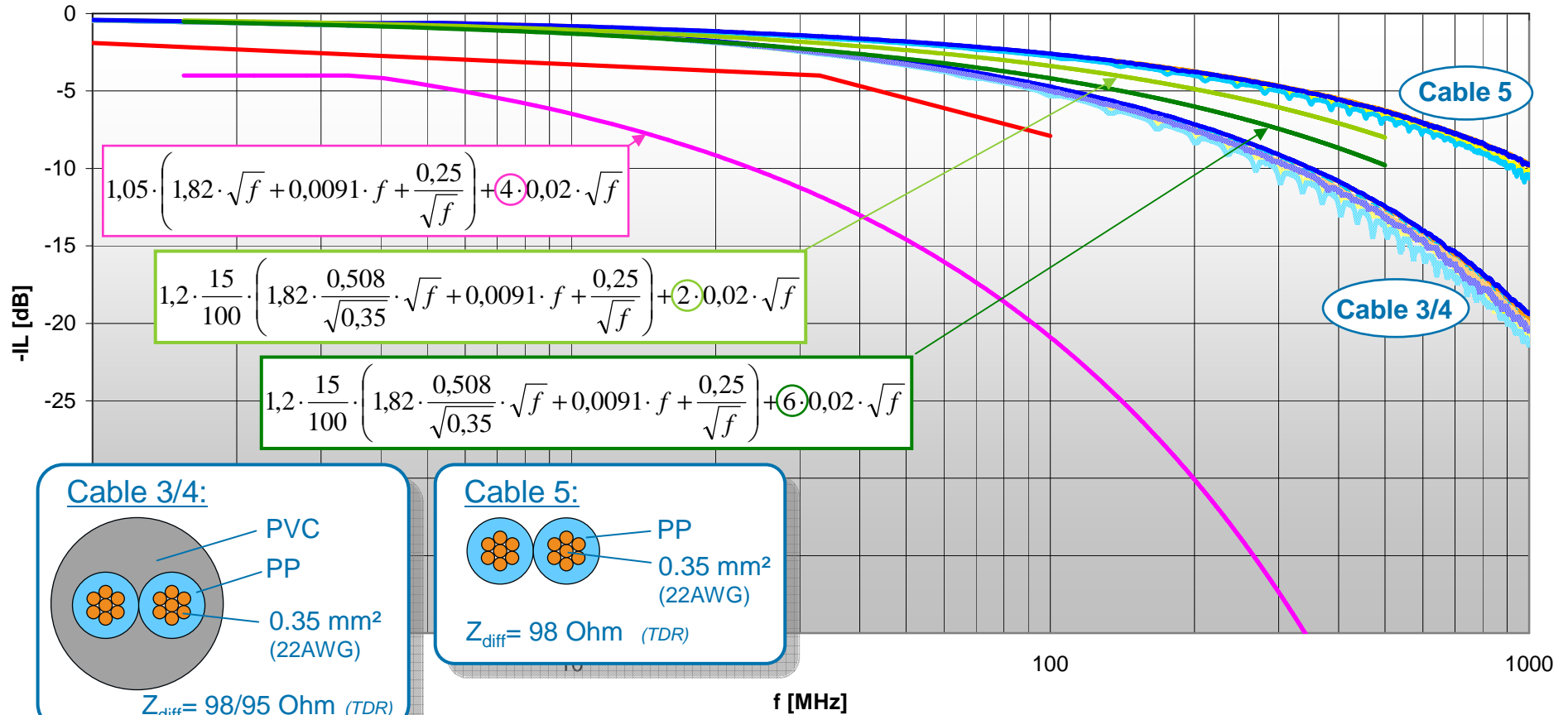


Figure 3: 15m link setup in meander configuration

Cable 1 & 2 (0.17mm²), Insertion Loss

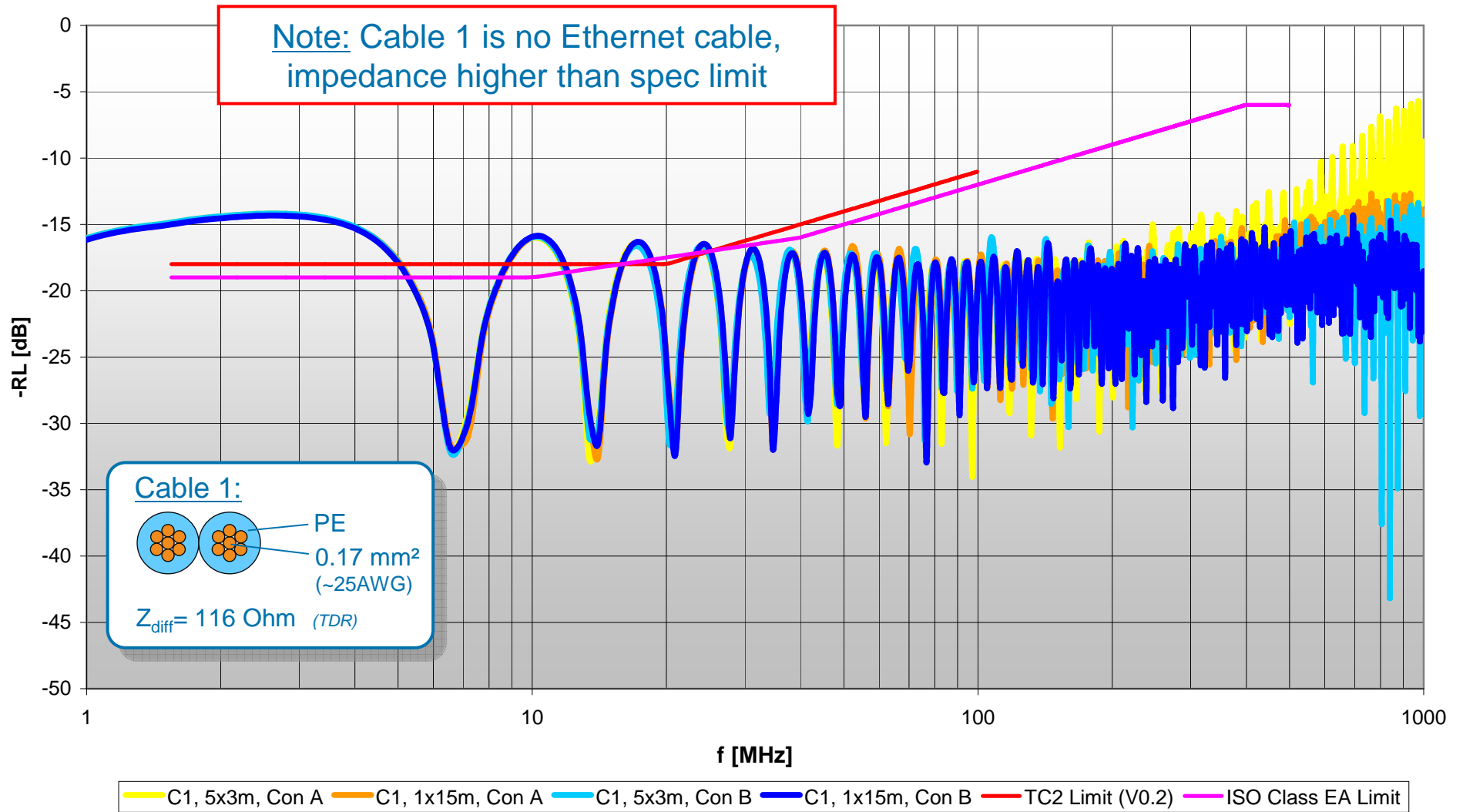


Cable 3/4/5 (0.35mm²), Insertion Loss

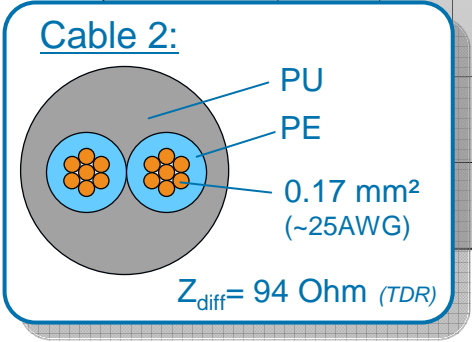
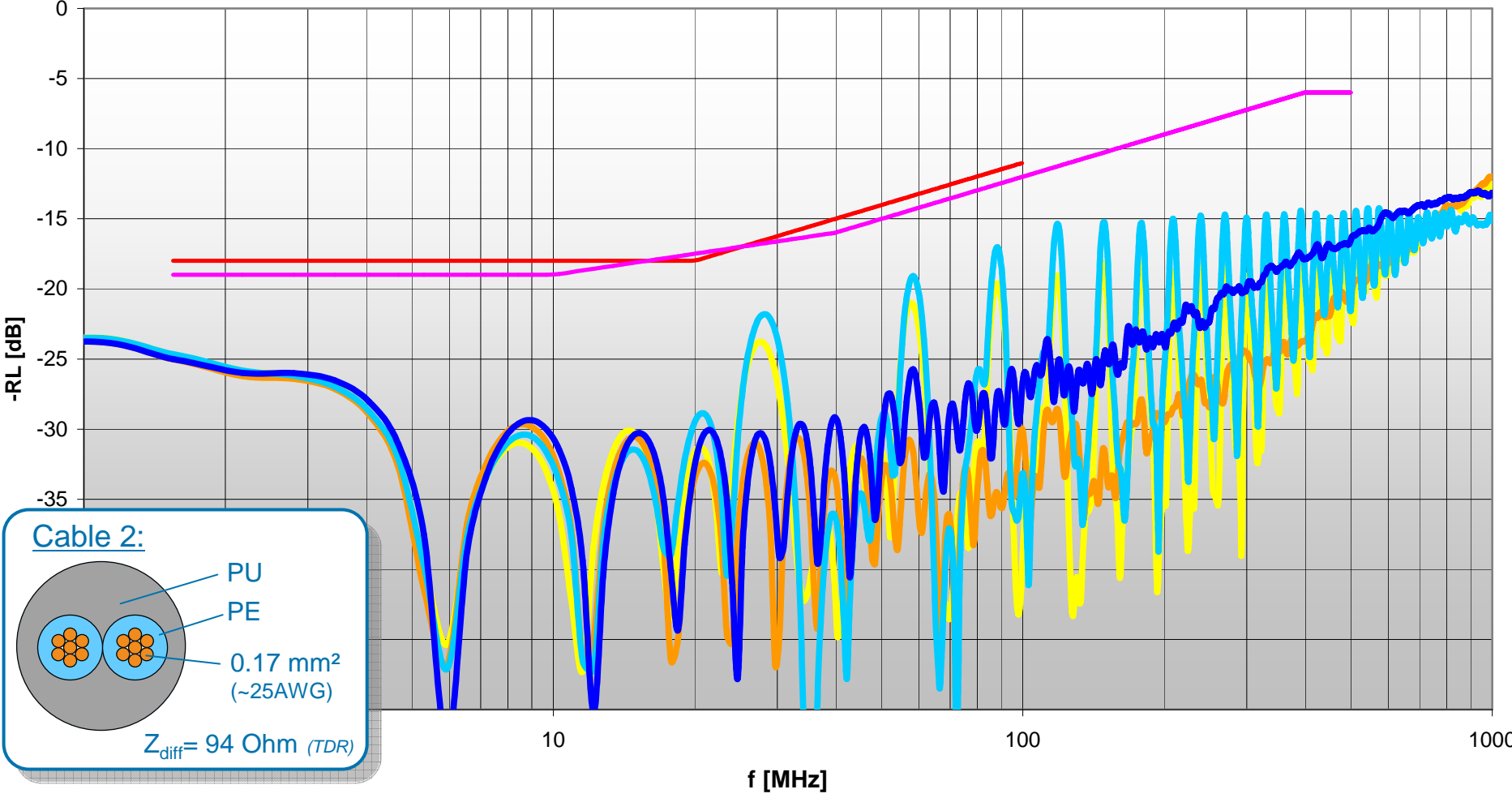


- | | | | |
|----------------------|--------------------|--|--|
| — C3, 5x3m, Con A | — C3, 1x15m, Con A | — C3, 5x3m, Con B | — C3, 1x15m, Con B |
| — C4, 5x3m, Con A | — C4, 1x15m, Con A | — C4, 5x3m, Con B | — C4, 1x15m, Con B |
| — C5, 5x3m, Con A | — C5, 1x15m, Con A | — C5, 5x3m, Con B | — C5, 1x15m, Con B |
| — ISO Class EA Limit | — BR Spec V1.2 | — TC3, 0.35mm ² , w/o Inliner | — TC3, 0.35mm ² , 4 Inliner |

Cable 1, Return Loss



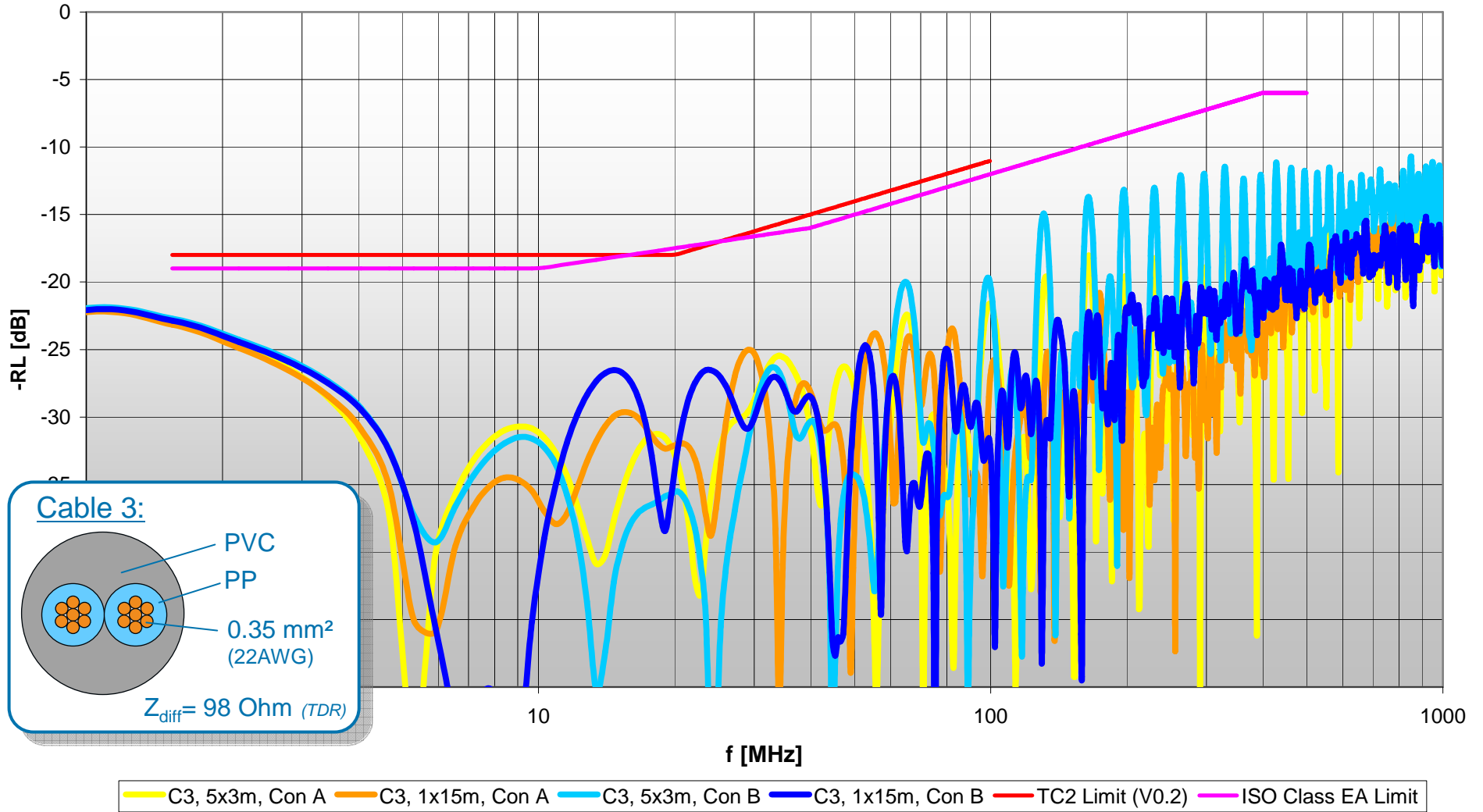
Cable 2, Return Loss



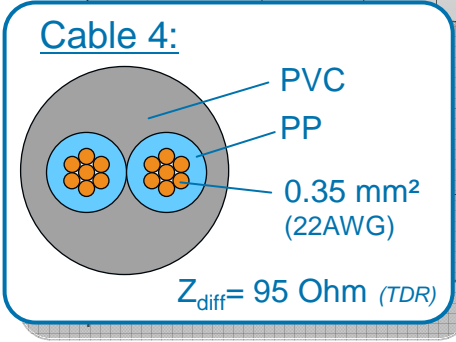
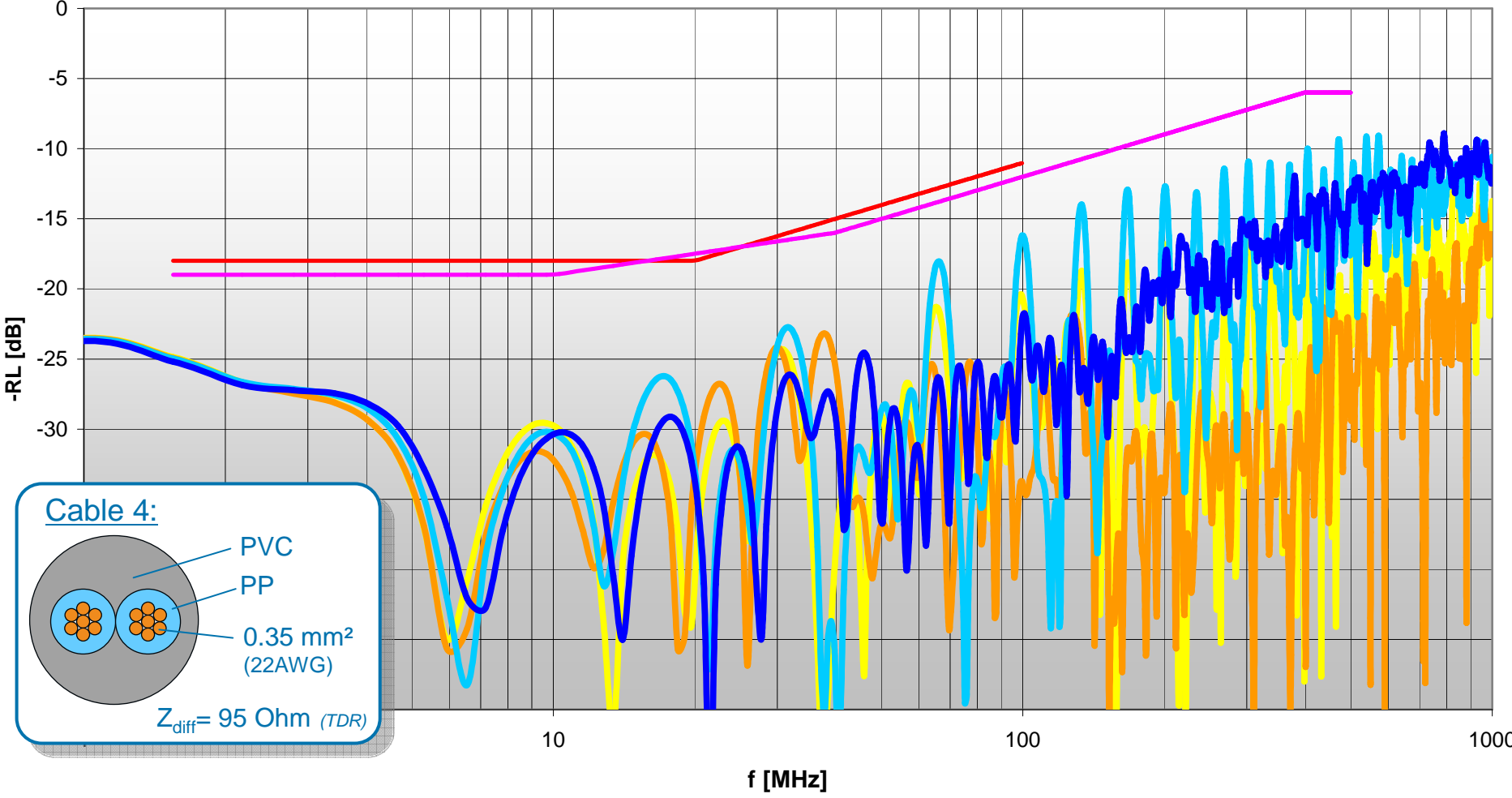
— C2, 5x3m, Con A — C2, 1x15m, Con A — C2, 5x3m, Con B — C2, 1x15m, Con B — TC2 Limit (V0.2) — ISO Class EA Limit



Cable 3, Return Loss

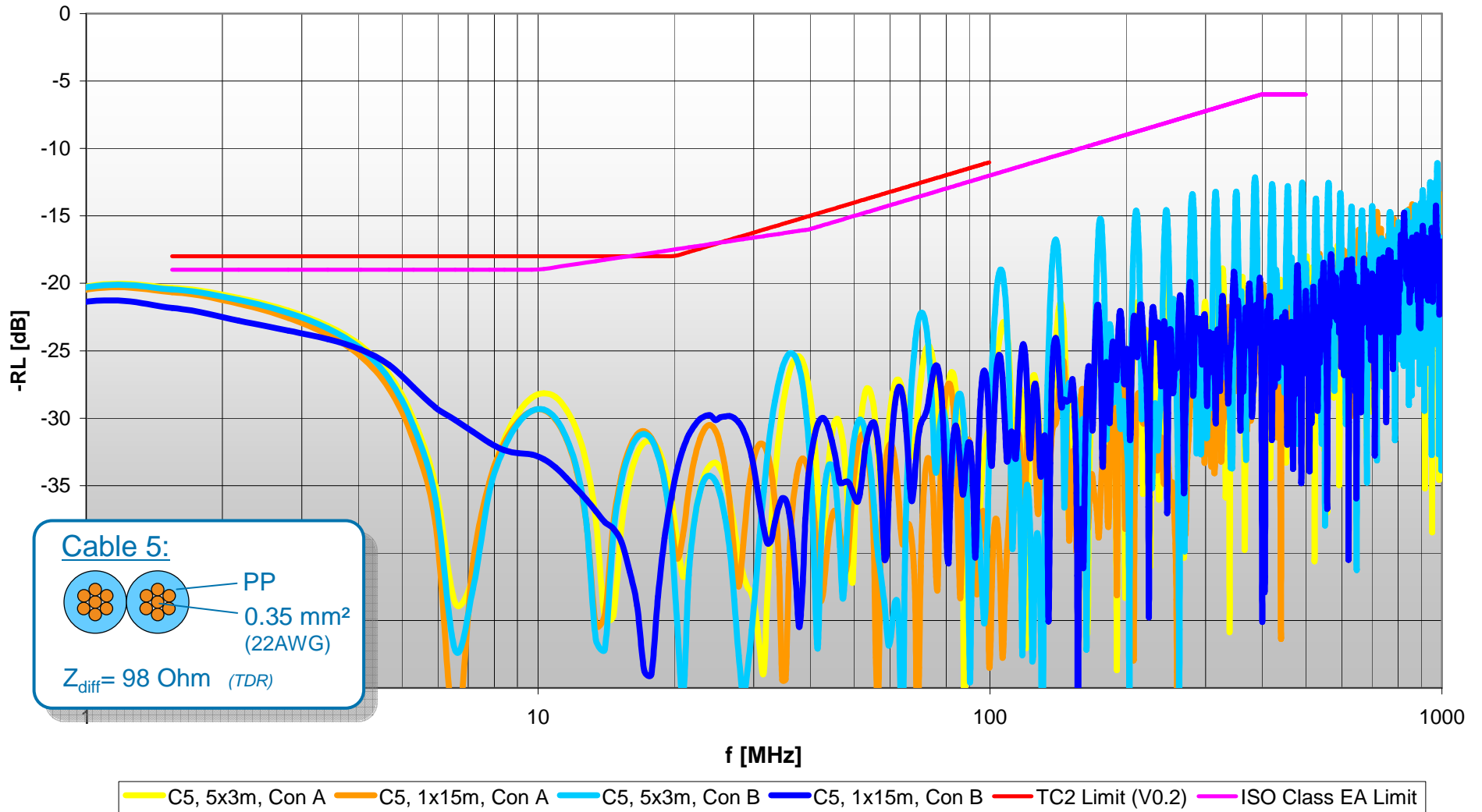


Cable 4, Return Loss



— C4, 5x3m, Con A
 — C4, 1x15m, Con A
 — C4, 5x3m, Con B
 — C4, 1x15m, Con B
 — TC2 Limit (V0.2)
 — ISO Class EA Limit

Cable 5, Return Loss



Conclusion

Insertion Loss:

- Channel insertion loss strongly depends on dielectric loss of cable jacket
- Connector impact to insertion loss small up to 500MHz
- BroadR-Reach limit and ISO 11801 Class EA limit met with each configuration
- Insertion loss models discussed in TC3 only met for cables w/o jacket

Return Loss:

- TC2 and ISO 11801 Class EA return loss limits met if nominal cable impedance is within specified limits
- Connector impact (inline connectors) to return loss visible but below proposed limit

→ Coefficients of insertion loss model should be adapted for automotive cable constructions with sufficient margin considering jackets and environmental variations, e.g. temperature/moisture.