IEEE 802.3dg Task Force

PSANEXT, PSAACR-F and RL Proposal

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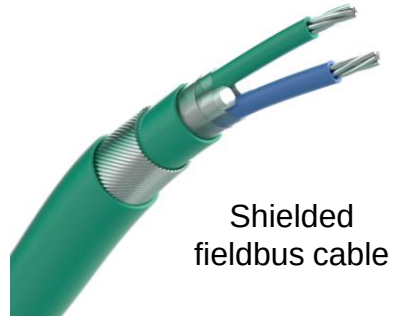
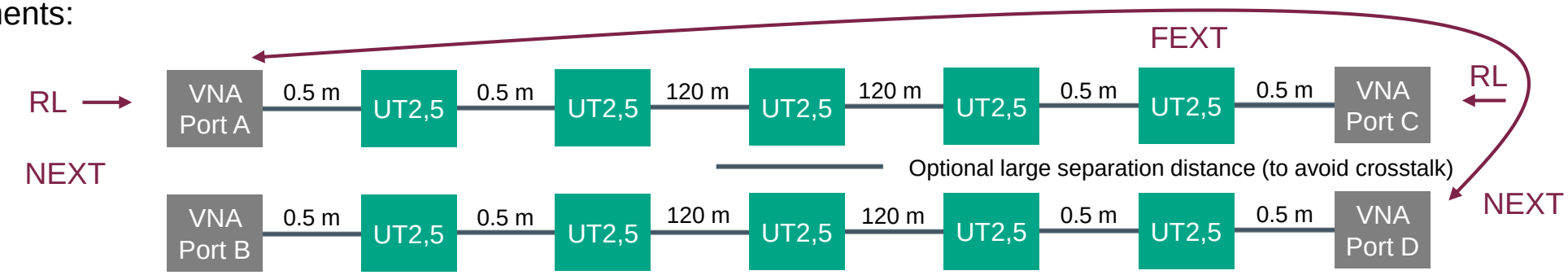
Link Segments

- Different neighbored link segments (with 120 m and 240 m length) with Phoenix Contact UT2,5 terminal blocks have been measured at room temperature related to crosstalk, insertion and return loss.
- The 0.5 m cable segments are using fine stranded **shielded** AWG18 fieldbus cables, the 120 m cable segments are using **shielded** AWG18/7 fieldbus cables.
- Two identical link segments running in parallel have been created to measure the crosstalk.
- For the measurements the AEM MMVNA-100 has been used. This VNA provides 4 differential ports (A, B, C, D) for the measurement of the following link segments:

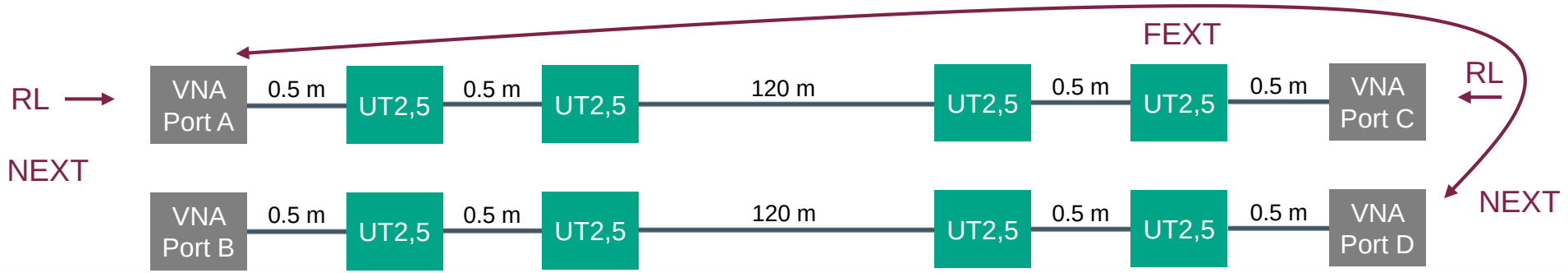


Shielded fieldbus cable

5 terminal blocks (240 m):

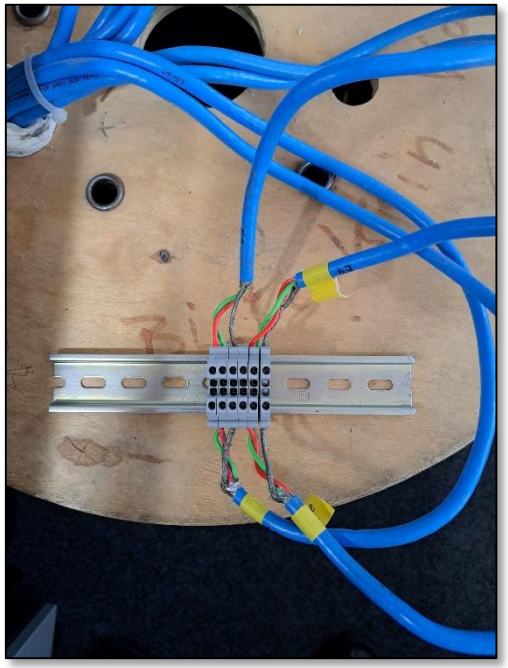
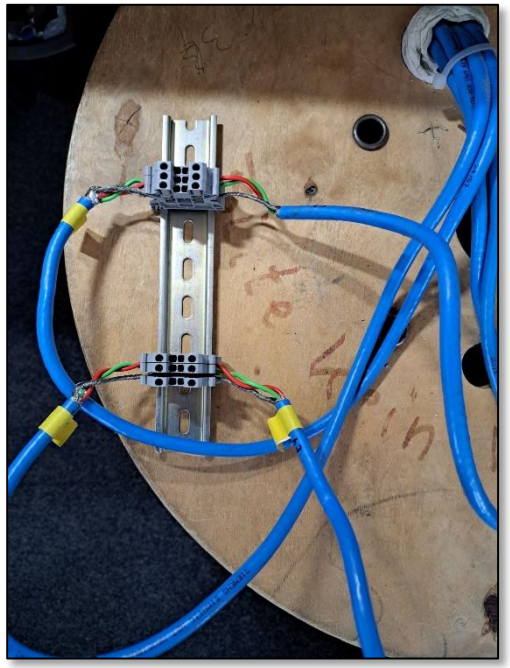
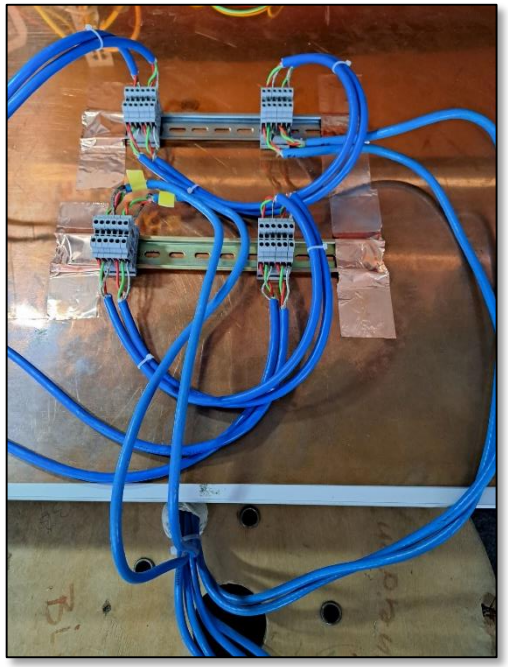


4 terminal blocks (120 m):

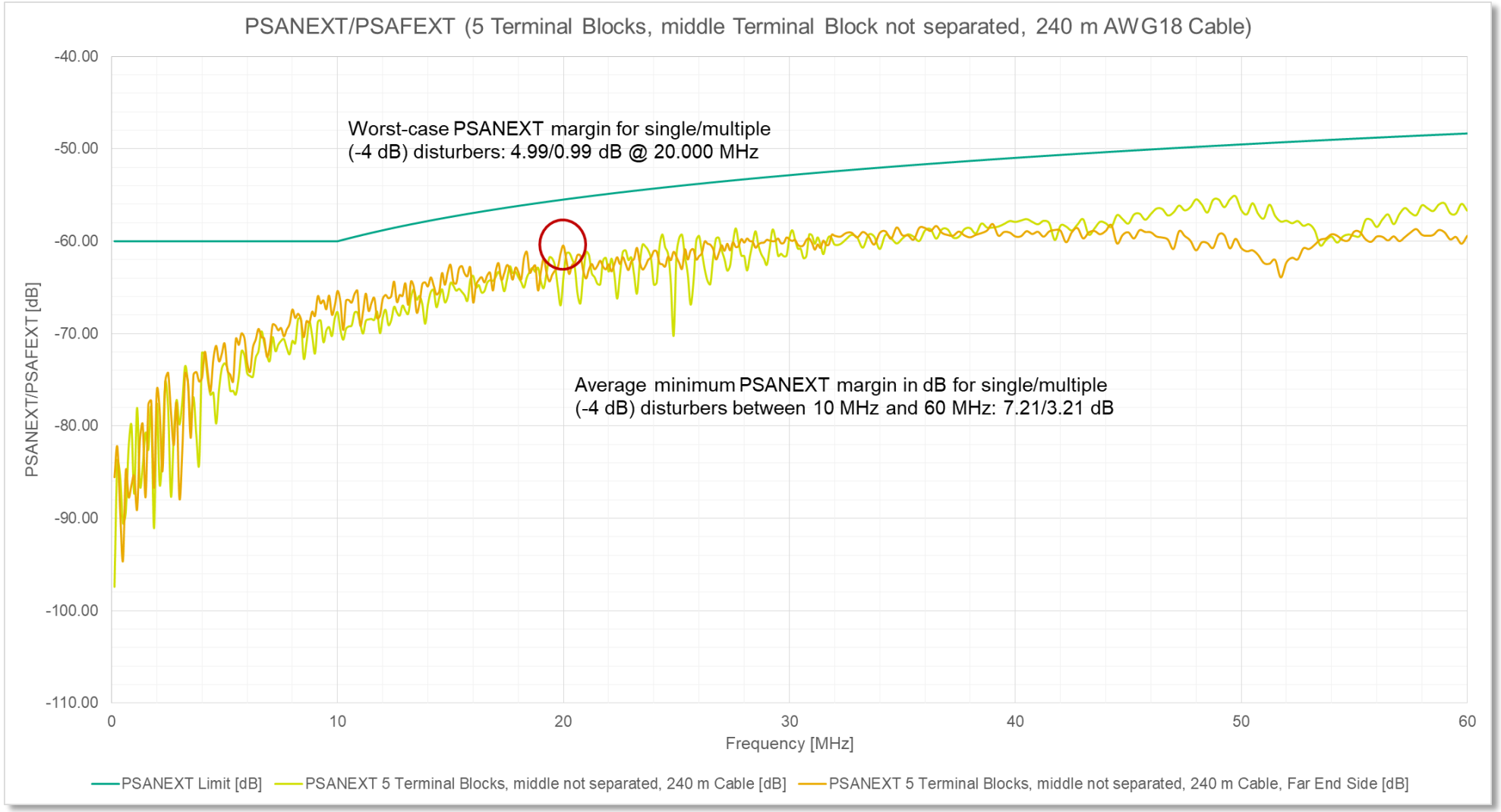


Measurement Setup

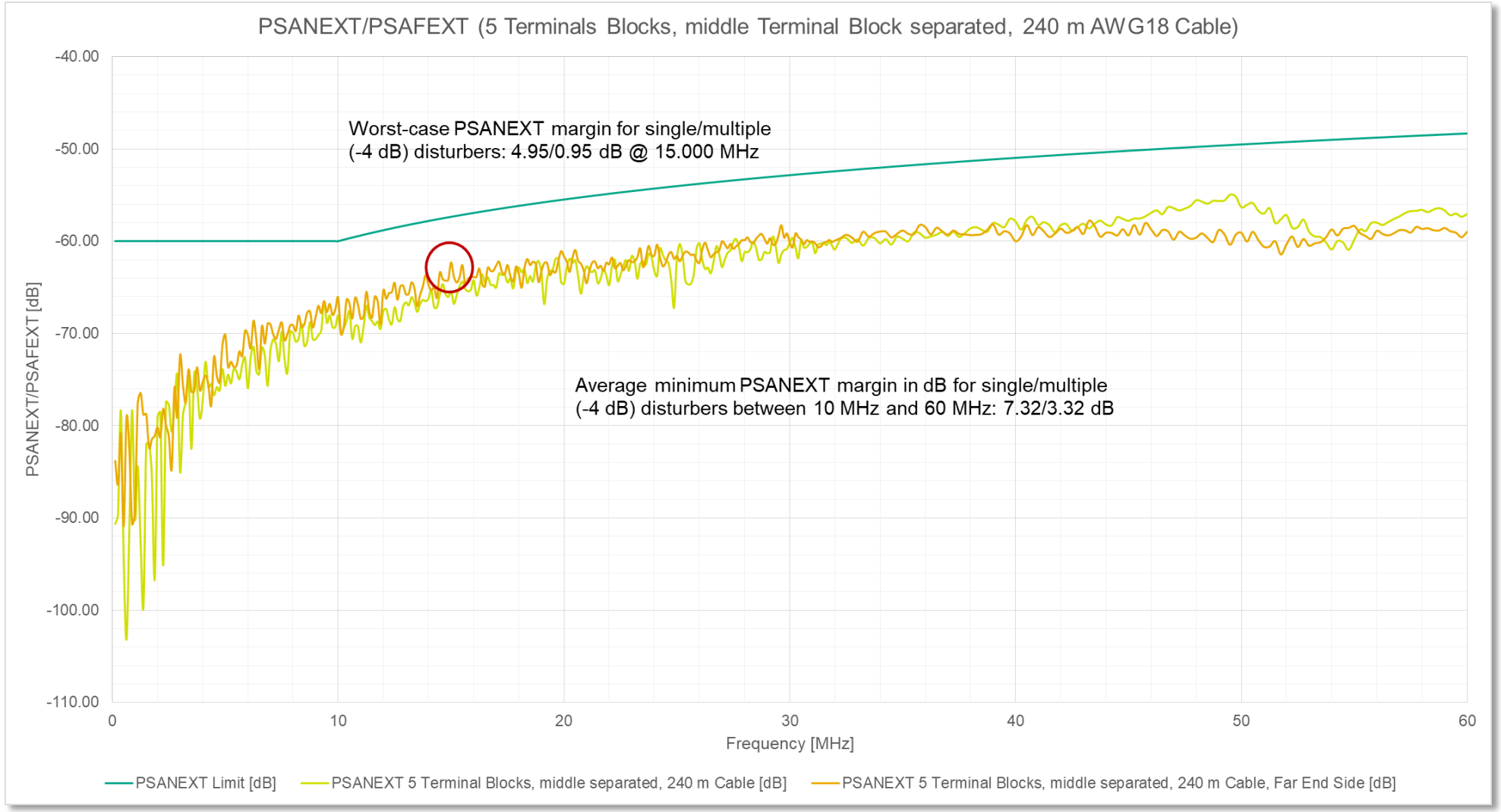
- The following pictures show an example of the measurement setup with the DIN rails, keeping the terminal blocks, taped to the copper plate.
- The 4 x 120 cable segments are placed on a cable drum, bundled and running in parallel.
- For the 240 m link segment for one measurement the middle terminal blocks are placed close to each other, for a second measurement they have been separated to reduce the influence of the middle terminal blocks to the overall crosstalk (simulation of one common 240 m cable segment instead of 2 x 120 m related to crosstalk).

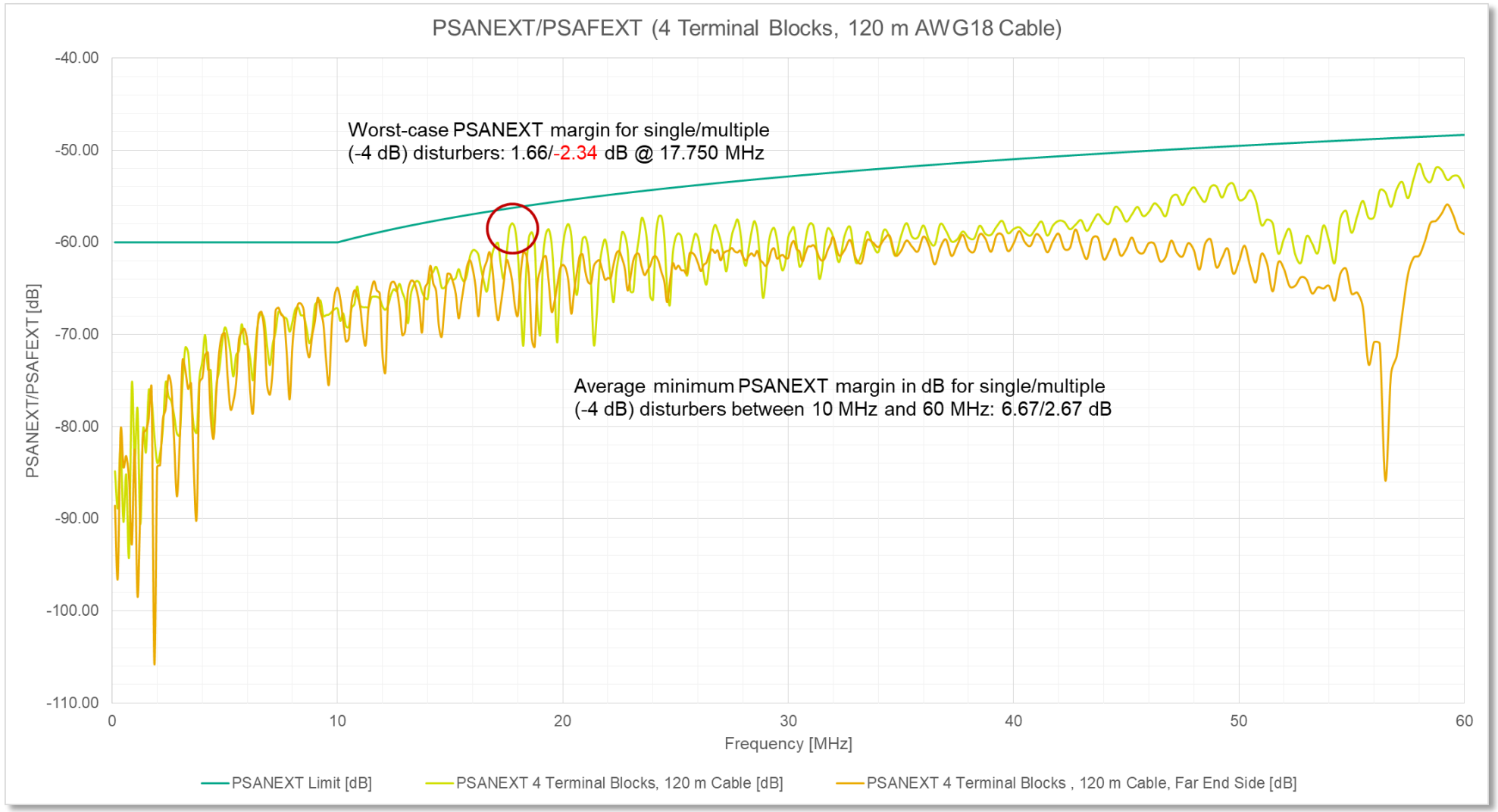
PSANEXT 5 TBs, middle not separated, 240 m AWG18 Cable



PSANEXT 5 TBs, middle separated, 240 m AWG18 Cable



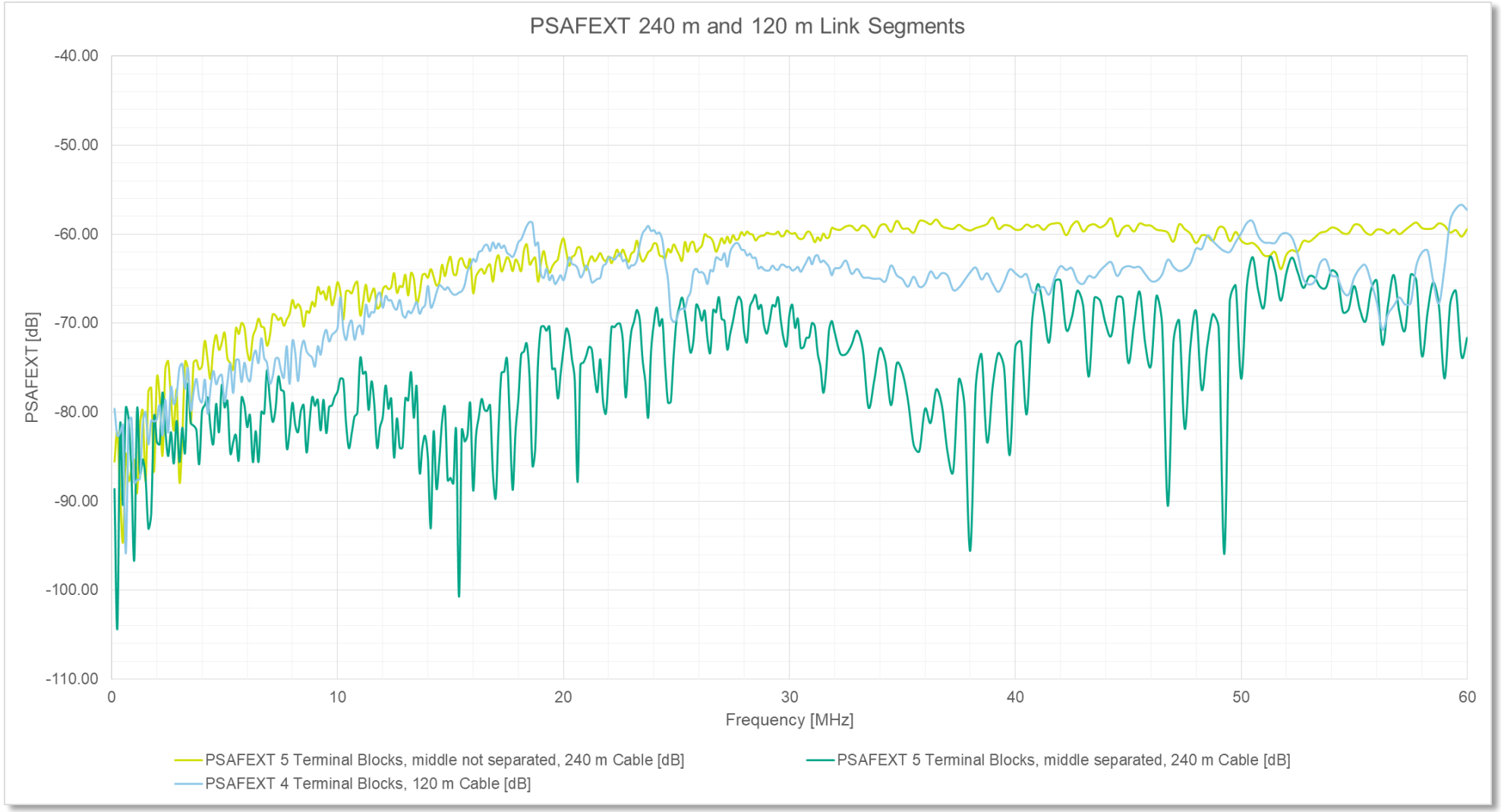
PSANEXT 4 Terminal Blocks, 120 m AWG18 Cable



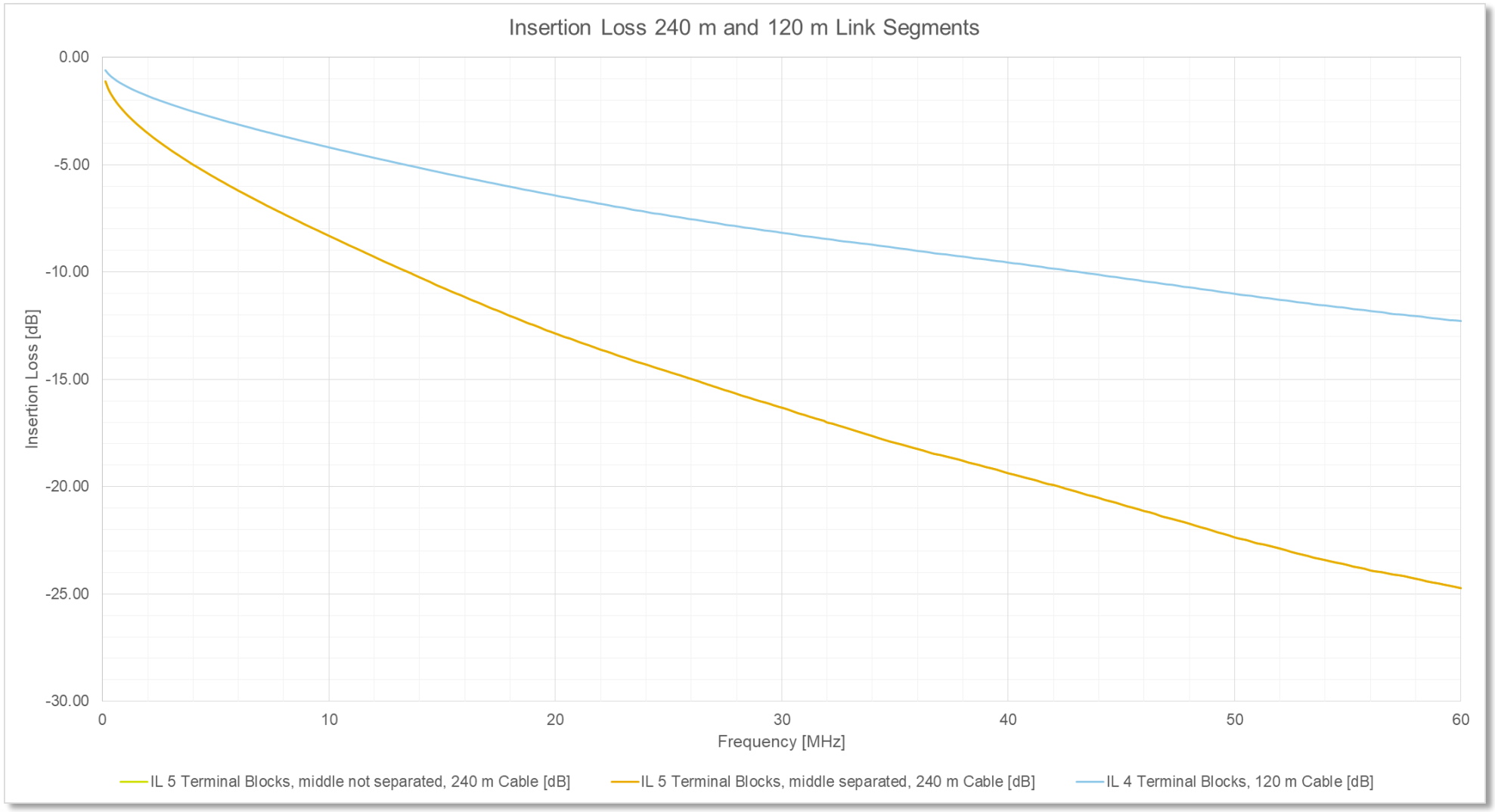
PSANEXT Measurements

- All inline terminal blocks are placed next to each other without separation.
- The curves on the previous slides show the PSANEXT measurements of two neighbored link segments.
- In a real installation there are likely disturbing link segments on both sides of the victim.
- Assuming that these neighbored link segments use scrambled 100BASE-T1L data streams, 3 dB need to be added to the measured values (adding of power values).
- It seems to be reasonable to add 1 dB further (4 dB in total), as in practice, also the link segment inline terminals which are not directly neighbored to the victim lead to some additional crosstalk.
- Taking these assumptions into account the two 240 m link segments stay below the PSANEXT limit line, while the 120 m link segment slightly fails, as a lower insertion loss potentially leads to larger resonances in the crosstalk coupling.
- Nevertheless, only at a few frequencies the limit is exceeded, the average minimum margin from both NEXT measurements between 10 MHz and 60 MHz is still 2.67 dB.
- Also adding a separating element can help to bring down the crosstalk by about 6 dB, if necessary.

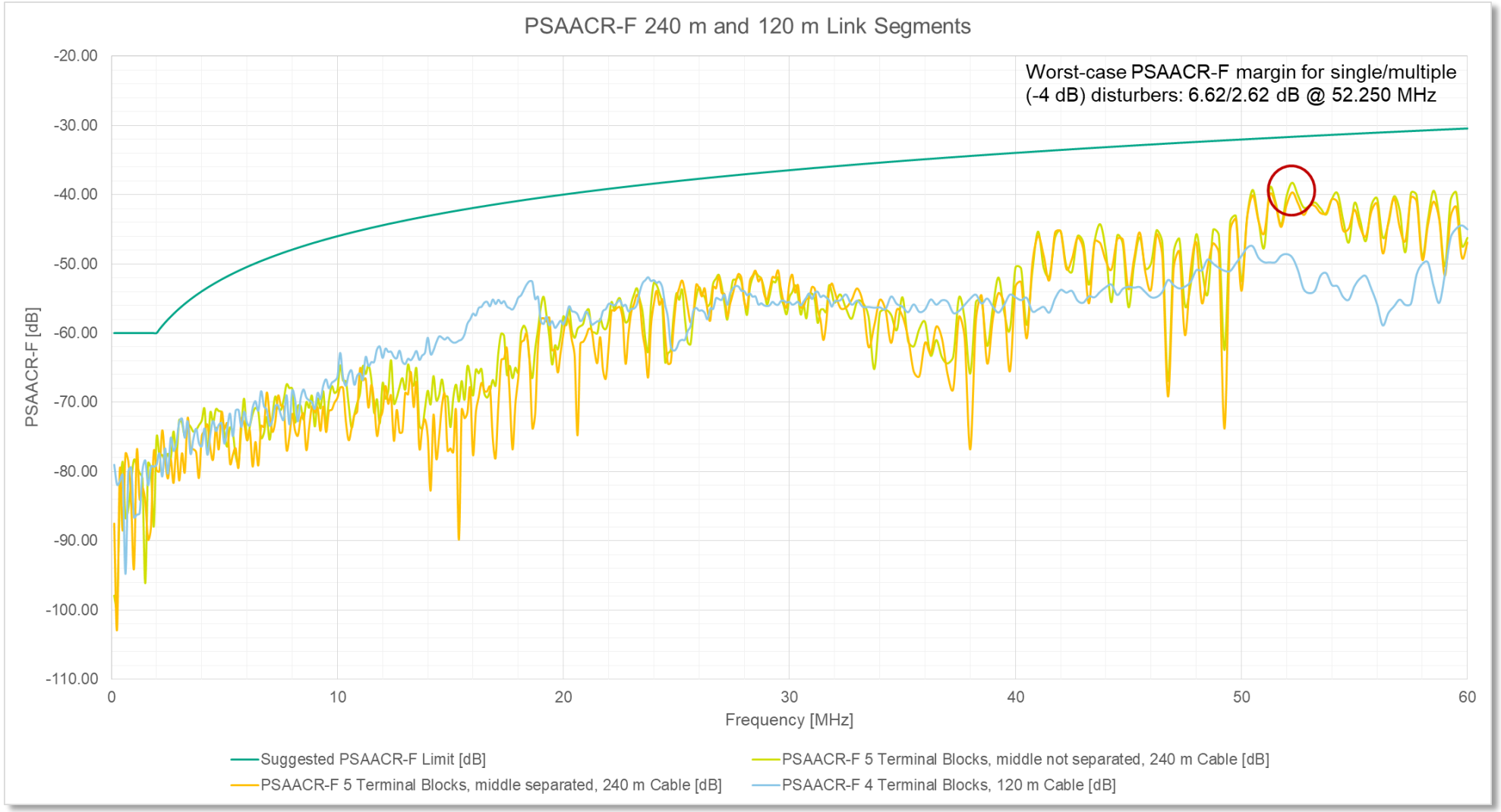
PSAFEXT 240 m and 120 m Link Segments



Insertion Loss 240 m and 120 m Link Segments



PSAACR-F 240 m and 120 m Link Segments



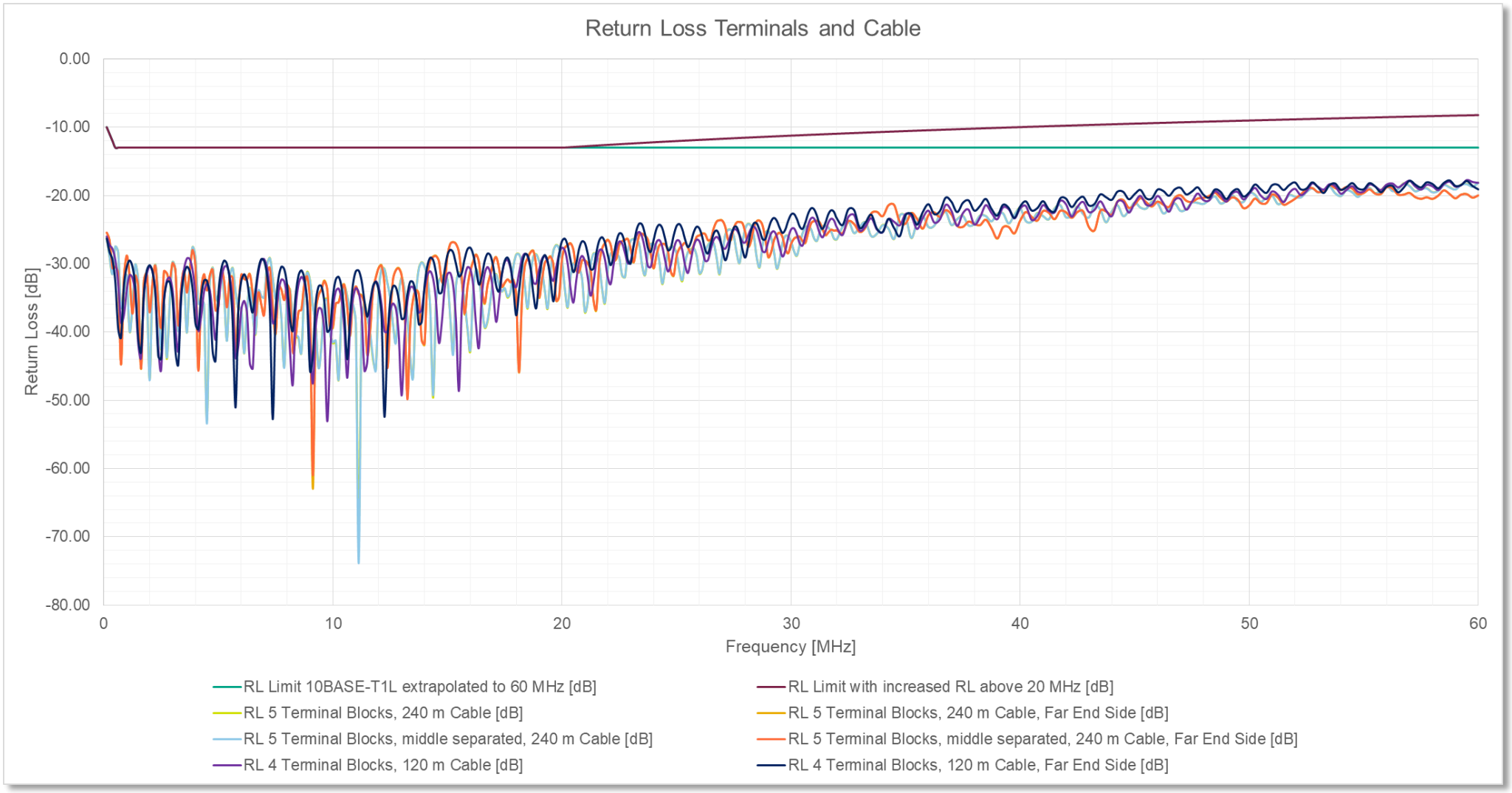
PSAACR-F Measurements

- All inline terminal blocks are placed next to each other without separation.
- The curves on the previous slide show the PSAACR-F measurements of two neighbored link segments.
- In a real installation there are likely disturbing link segments on both sides of the victim.
- Assuming that these neighbored link segments use scrambled 100BASE-T1L data streams, 3 dB need to be added to the measured values (adding of power values).
- It seems to be reasonable to add 1 dB further (4 dB in total), as in practice, also the link segment inline terminals which are not directly neighbored to the victim lead to some additional crosstalk.
- Based on the measurements the following PSAACR-F limit is suggested:

$$PSAACR - F\ [dB] = \begin{cases} 60 & for\ f < 2\ MHz \\ 46 - 20 \times log_{10}\left(\frac{f}{10}\right) & for\ 2\ MHz\ \leq f \leq 60\ MHz \end{cases}$$

- The worst-case margin of the measurements shows about 2.6 dB to the suggested limit.

Return Loss Measurements



Return Loss Measurements

- The return loss measurements show an (expected) increase in return loss above about 20 MHz.
- The overall return loss shows a margin of about 9.5 dB to the originally suggested limit line (dark red), which allows an increase in return loss above 20 MHz, similar as e.g. for 1000BASE-T.
- The margin for the revised flat return loss limit line (dark green) is significantly lower (only about 4.7 dB margin).
- It is important to mention, that the used 4 x 120 m cables have characteristic impedance of about 95 Ω.
- As we allow to use cables with a characteristic impedance between 80 Ω and 120 Ω and also might have some variation in the characteristic impedance between separate cable segments, it seems to be reasonable to stay with the original return loss limit, which increases above 20 MHz:

$$RL[dB] = \begin{cases} 9 + 8 \cdot f & for\ 0.1\ MHz \leq f < 0.5\ MHz \\ 13 & for\ 0.5\ MHz \leq f < 20\ MHz \\ 13 - 10 \cdot LOG_{10}\left(\frac{f}{20}\right) & for\ 20\ MHz \leq f \leq 60\ MHz \end{cases}$$

Summary

- Suggested limit for PSANEXT:

$$PSANEXT\ [dB] = \begin{cases} 60 & for\ f < 10\ MHz \\ 60 - 15 \times log_{10}\left(\frac{f}{10}\right) & for\ 10\ MHz \le f \le 60\ MHz \end{cases}$$

- Suggested limit for PSAACR-F:

$$PSAACR - F\ [dB] = \begin{cases} 60 & for\ f < 2\ MHz \\ 46 - 20 \times log_{10}\left(\frac{f}{10}\right) & for\ 2\ MHz \le f \le 60\ MHz \end{cases}$$

- Suggested limit for Return Loss:

$$RL[dB] = \begin{cases} 9 + 8 \cdot f & for\ 0.1\ MHz \le f < 0.5\ MHz \\ 13 & for\ 0.5\ MHz \le f < 20\ MHz \\ 13 - 10 \cdot LOG_{10}\left(\frac{f}{20}\right) & for\ 20\ MHz \le f \le 60\ MHz \end{cases}$$

Thank you!