1000BASE-T1 Type B Alien Cross Talk Limits

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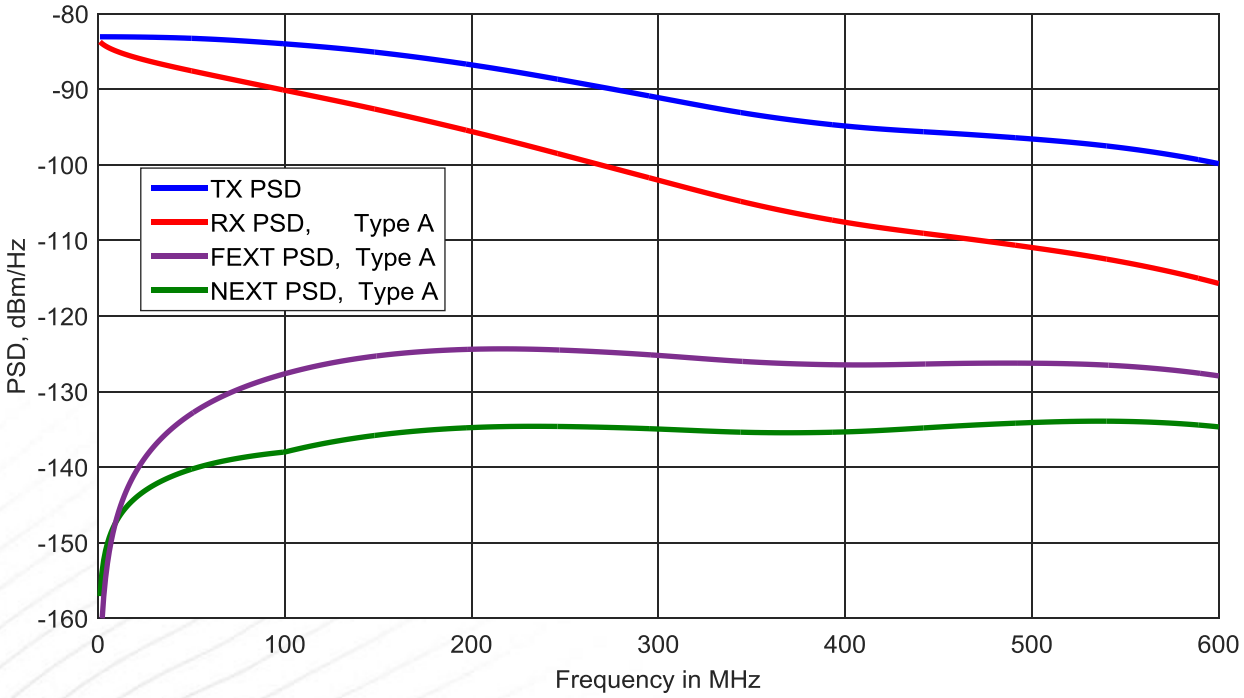
Objective

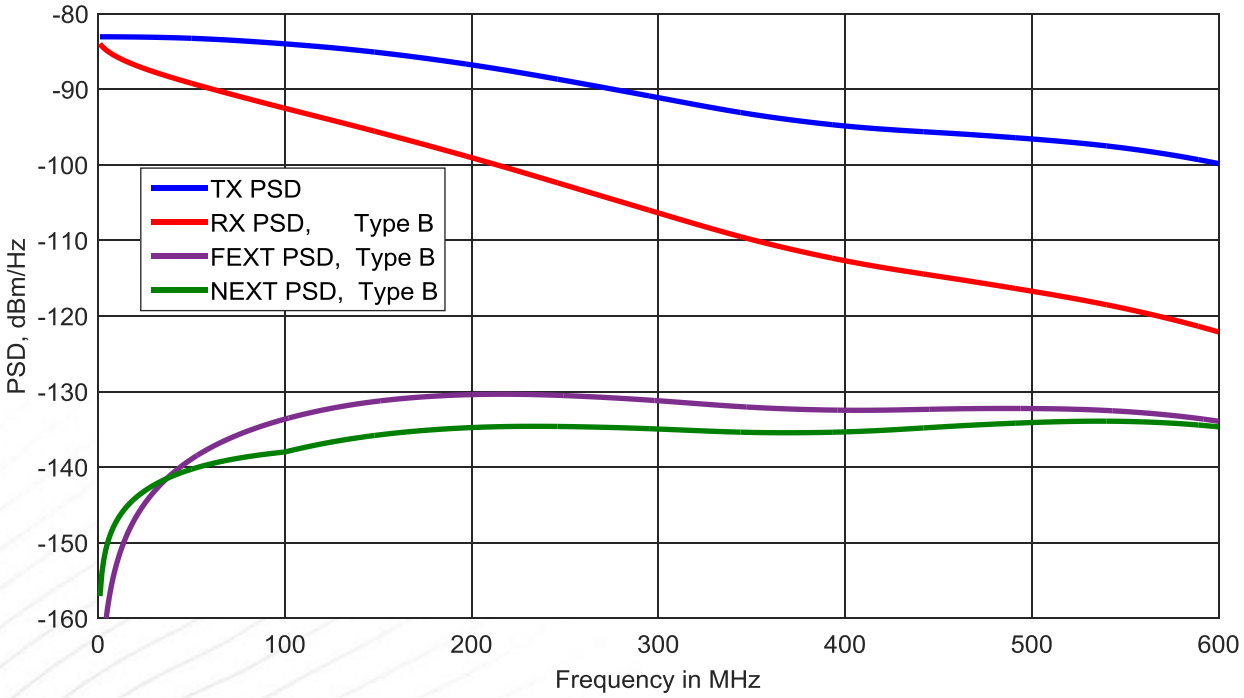
- IEEE 802.3bp has adopted category 6A screened twisted-pair cabling specified in TIA-1005-A Telecommunication Infrastructure Standard for Industrial Premises.
- Alien cross talk limits are not defined for category 6A in TIA-1005-A, the limits are defined in IEEE 802.3 clause 55.
- Clause 55 alien cross talk limits are set to achieve BER objectives. The same limits apply to both unshielded and screened cables of types E1, E2 and E3, although some may have better cross talk performance and therefore provide for higher noise margin.
- Likewise, new alien cross talk limits are suggested for 1000BASE-T1 type B cables to achieve BER objectives.

Type A signal and cross talk spectrum



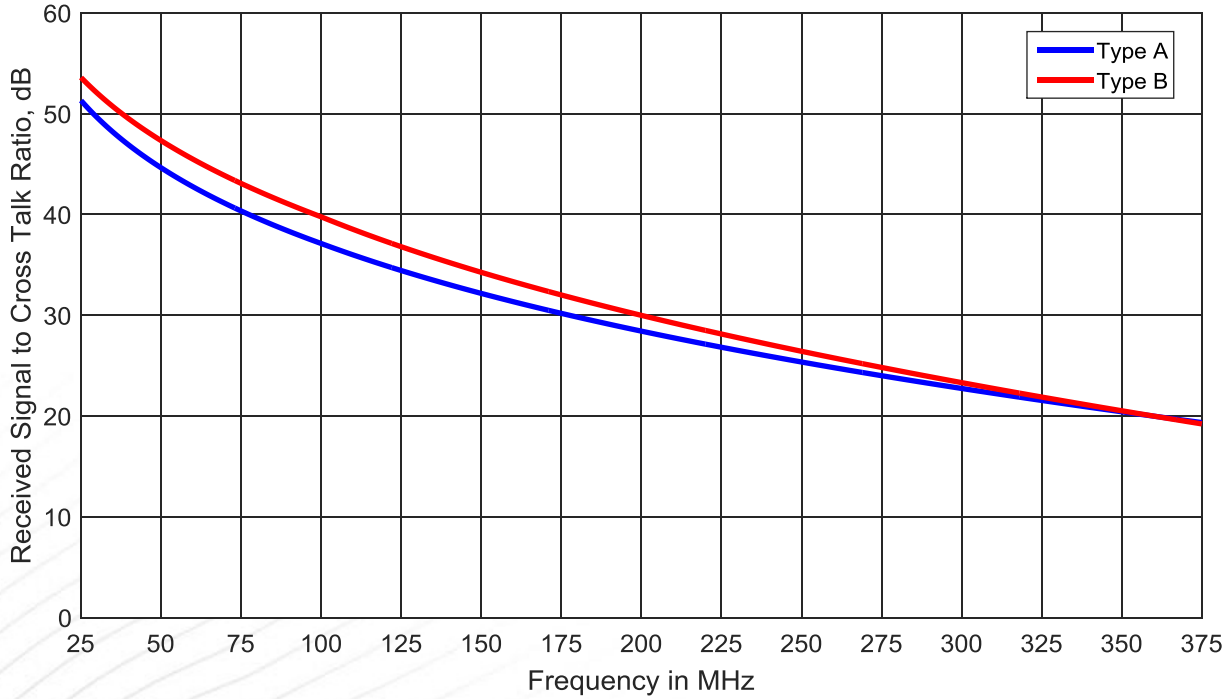
- Plots shown are based on IEEE P802.3bp 1000BASE-T1 PHY.
- TX PSD satisfies (97-14) and (97-15) PSD limits.
- RX PSD scales TX PSD with type A insertion loss limit of (97-16).
- FEXT PSD scales TX PSD with type A PSAACRF limit of (97-24) assuming zero insertion loss for alien links for worst case.
- NEXT PSD scales TX PSD with type A PSANEXT limit of (97-22).

Type B signal and new proposed cross talk spectrum



- Plots shown are based on IEEE P802.3bp 1000BASE-T1 PHY.
- TX PSD satisfies (97-14) and (97-15) PSD limits.
- RX PSD scales TX PSD with type B insertion loss limit of (97-19).
- FEXT PSD scales TX PSD with 6dB higher loss than type A PSAACRF limit of (97-24).
- NEXT PSD scales TX PSD with same type A PSANEXT limit of (97-22).

Received signal to cross talk ratio, types A & B comparison



- With the new proposed limits for type B alien cross talk, the signal to cross talk ratio is larger than that of type A.
- Geometric mean of received signal to alien cross talk noise ratio is about 30dB.

BER performance

- MMSE analysis and full system simulation for type A cables show more than 12dB additional noise margin to 10^{-10} BER point with Gaussian noise models. 1000BASE-T1 PAM3 modulation and the strong RS FEC code help to get such a large margin (requiring only14dB SNR for 10^{-10} BER).
- MMSE analysis and full system simulation for type B cables assuming the new proposed alien cross talk limits show performance exceeding that of type A.

Noise Environment

- Type A channels are designed for automotive environment with noise levels of as much as 100V/m or more.
- Type B channels are meant for industrial applications with maximum of 10V/m radio noise immunity for class E3 cables.
- Type B noise environment is less severe than type A which allows cables with more relaxed requirements.

Summary

- It is suggested that alien cross talk limits (PSANEXT and PSAACRF) for type B cables are updated based on BER performance. The new suggested limit for PSANEXT of type B is same as that of type A. For PSAACRF of type B, same limit as type A with additional 6dB margin is suggested.
- The new suggested alien cross talk limit results in noise margin equal or exceeding that of type A.