149.7.1.4 Coupling Attenuation

In order to limit the noise at the receiver as well as emissions, the 2.5G/5G/10GBASE-T1link segment shall meet the coupling attenuation values determined by using Equation (149-26). The coupling attenuation is tested as specified in IEC 62153-4-7 using triaxial tube-in-tube method. Additional coupling attenuation test methodologies are defined in Annex 149A.

$$\text{Coupling attenuation (f)} \geq \begin{pmatrix} 70 & 30 \leq f < 750 \\ 50 - 20\log({}^{f}/_{7500} & 750 \leq f \leq 4000 * S \end{pmatrix} \quad \text{(dB)} \qquad (149\text{-}26)$$

where

f — is the frequency in MHz; $30 \leq f \leq 4000 * S$

The coupling attenuation is illustrated in Figure 149–31.

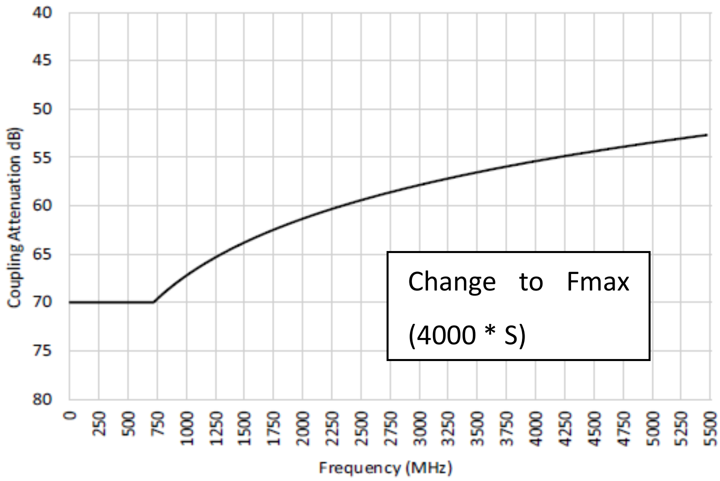

Figure 149-31: Coupling attenuation calculated using equation (149-26)

149.8.2.2 MDI coupling attenuation

149.7.1.5 Screening Attenuation

The minimum screening attenuation for a link segment is 45 dB for all frequencies between 30 MHz and Fmax MHz. Screening attenuation is tested as specified in IEC 62153-4-7 using triaxial tube-in-tube method. Additional screening attenuation test methodologies are defined in Annex 149A.

Annex 149A

(normative)

Coupling- and screening attenuation test methodology

149A.1 Introduction

This annex describes the test methodologies that shall be used to measure 2.5GBASE-T1, 5GBASE-T1 and 10GBASE-T1 link segment coupling- and screening attenuation specified in 149.7.1.4 and 149.7.1.5.

149A.2 General test conditions

Coupling- and screening attenuation are the main parameters for a shielded differential link segment to define its alien crosstalk and EMC properties. Coupling- and screening attenuation are tested as specified in IEC 62153-4-7 using triaxial tube-in-tube method.

The usable frequency range of the setup may be limited by the dimensions of the triaxial measurement equipment, as higher order modes may occur. IEC 62153-4-7 provides additional information on how to suppress higher order modes in order not to falsify the measurement result.

Measurements shall be performed at 23°C ± 5°C relative humidity 25% to 75%.

149A.3 Reference cable assembly

The reference cable assembly is intended to be a simplified representation of the components, that are used within a wiring harness, which are cable, PCB connectors, and inline connectors. This also ensures that connectors and cable are matched in terms of balance and shielding, to reach sufficient coupling- and screening attenuation.

This topology serves as common reference to compare link segments made of different components. It also allows to compare the results of different test houses.

The reference cable assembly has got a nominal length of 1.75 m, including one inline connector and one PCB connector with termination as shown in Figure 149A-1.

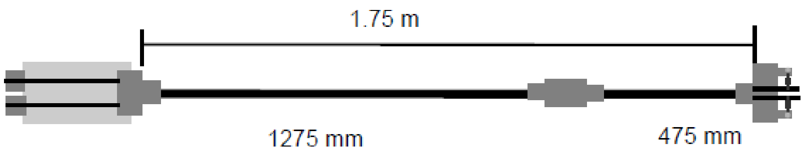

Figure 149A-1: Coupling- and screening attenuation reference cable assembly

149A.4 Measurement setup

Figure 149A-2 shows the reference cable assembly within the triaxial tube-in-tube measurement setup. Additional to the nominal lengths some length tolerances are allowed. The overall assembly length shall be between 1650 mm and 1800 mm. The exposed cable length within the triaxial tube shall be between 900 mm and 1000 mm. Therefore, the remaining cable length from the measurement fixture to the triaxial tube is between 650 mm and 900 mm. This allows easy handling while keeping the influence of the feeding cable section on insertion loss and balance low.

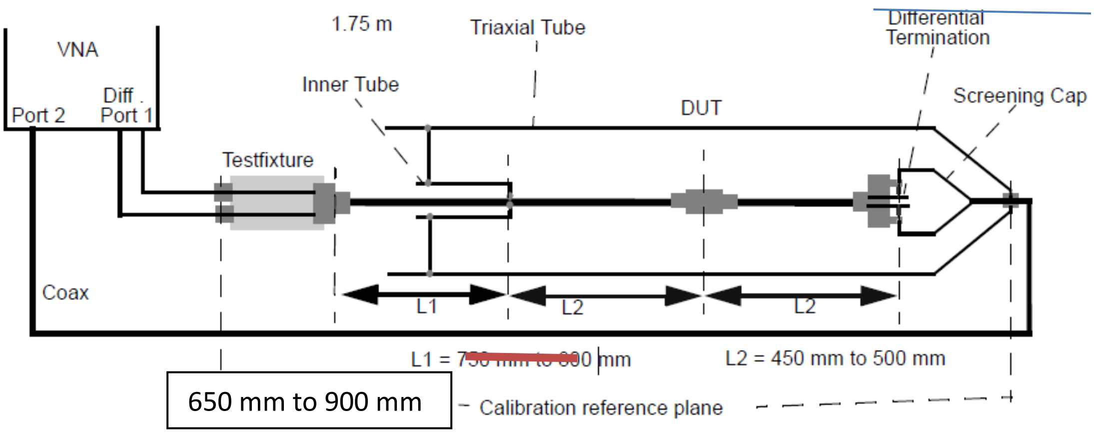

Figure 149A-2: Coupling- and screening attenuation cable assembly measurement setup

A 3-port vector network analyzer (VNA) measurement setup shall be used without baluns. Two ports of the VNA act as generator and the third port is used as single-ended receiver. For coupling attenuation measurements, the generator port-pair is operated in differential mode. For screening attenuation measurements, the generator port-pair is operated in common mode.

The measurement set-up shall be optimised with respect to balance. This includes VNA, accurate and well-balanced testfixture and terminations designs, and using phase stable coaxial cables.

The termination shall be nominal 100 Ω in differential mode and 25 Ω in common mode. The requirements on the single ended termination of every conductor of the differential pair are 50 Ω ± 1 % against ground. The two resistors of the differential pair shall be matched against each other with a tolerance of ±0.1 Ω at DC. The resistors need to be suitable for RF applications in the frequency range under test.

The measurement shall include the transition from the MDI connector to the PCB. Therefore, the termination resistors shall be placed between the signal conductors and ground of a termination housing or equivalent termination fixture as shown in Figure 149A-3. Placing the termination resistors inside the connector, in order to omit the transition to the PCB is not allowed. The termination housing shall be shielded and cover the termination resistors and any signal conductors sticking on the bottom of the PCB.

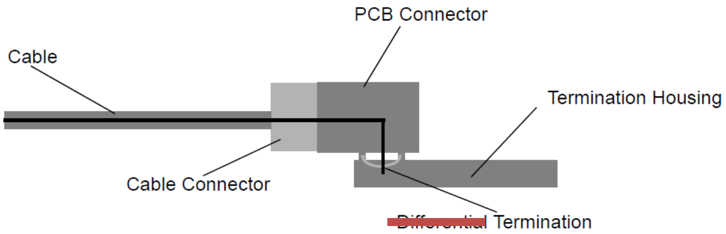

Figure 149A-3: MDI connector and termination

For connectors that provide additional shield contact from the connector housing to a shielded enclosure, the reference plane at the MDI connector side may be set at the point, where the EMC seal is attached. In this case, the connector housing and the transition to the PCB should not be part of the measurement but within the shield cap referenced in Figure 149A-4.

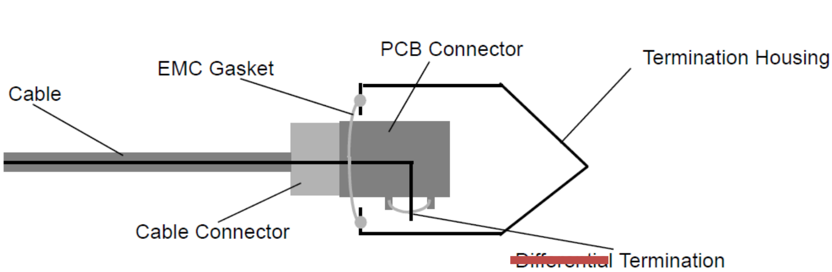

Figure 149A-4: MDI connector with EMC gasket and termination