Tx Function to Rx Function Channel Updates and Link Segment Baseline Considerations

Chris DiMinico, (MC Communications/PHY-SI LLC/Panduit/SenTekse)

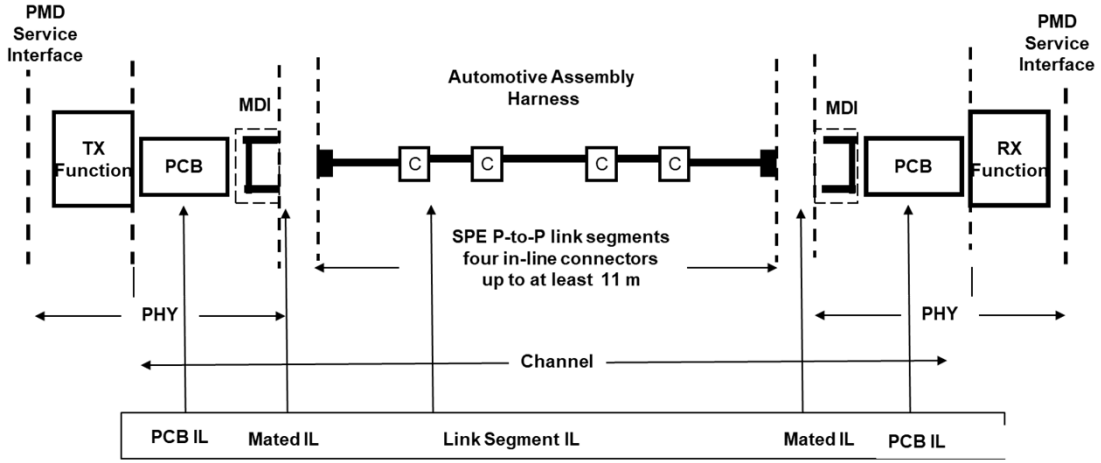
January 2021

Purpose

- Tx Function to Rx Function Channel Updates
- Link Segment Baseline Considerations

Tx Function to Rx function channel IL

- **Tx Function to Rx function channel IL proposal**



$$IL_{Channel} \leq 2 \cdot \mathrm{IL}_{\mathrm{PCB}(76.2mm)} + 2 \cdot \mathrm{IL}_{\mathrm{MDI}} + \mathrm{IL}_{\mathrm{Linksegment}} \quad (\mathrm{dB})$$

$$IL_{PCB(76.2mm)} \leq \left(0.0071 \cdot \sqrt{f/2.5 \cdot 10\text{^}3} + 0.0045 \cdot f/2.5 \cdot 10\text{^}3\right) \cdot 76.2 \ (\mathrm{dB})$$

$$IL_{Linksegment} \leq 0.002\left(\frac{\mathrm{f}}{2.5}\right) + 0.68\left(\frac{\mathrm{f}}{2.5}\right)^{0.45} \quad (\mathrm{dB})$$

$$IL_{MDI} \leq 0.1\sqrt{\frac{f}{2.5 \cdot 10\text{^}3}} \quad (\mathrm{dB})$$

https://www.ieee802.org/3/cy/public/adhoc/diminico_3cy_01a_1_5_21.pdf

PHY	MBd	Bandwidth (GHz)	PCBILdb/76.2mm	IL Link Segment	IL MDI	IL Channel Max
25GBASE-T1	14062.25	7031.25	1.8717	29.8688	0.168	33.948

Protocol implementation conformance statements (PICS)

- Clause requirement “shall’s” are listed in conformance statements.

- Physical Media Attachment (PMA) clause requirements (PICS)
  - Test Modes
  - Transmitter electrical specifications
  - Receiver electrical specifications

- Link Segment (PICS)
  - Link transmission parameters

- MDI (PICS)
  - Automotive mechanical interface to the shielded balanced cabling is a 2-pin connector with a shield.
  - Automotive MDI mechanical not specified

MDI – Medium Dependent Interface- RL

- **802.3ch 2.5/5/10GBASE-T1 - MDI connector - mechanical**
  - **The mechanical interface to the shielded balanced cabling is a 2-pin connector with a shield.**
- **802.3ch 2.5/5/10GBASE-T1 - MDI connector – electrical**
  - **Return Loss**

149.8.2.1 MDI return loss

$$MDI\_Return\_Loss(f) \le \begin{cases} 20 - 20\left(\log_{10}\frac{10}{f}\right) & 1 \le f < 10 \\ 20 & 10 \le f < 280S \\ 20 - 10\log_{10}(f/(280S)) & 280S \le f < 2800S \\ 10 - 16\log_{10}(f/(2800S)) & 2800S \le f \le F_{max} \end{cases} \quad \text{(dB)}$$

where

f is the frequency in MHz.

For 2.5GBASE-T1, 5GBASE-T1, and 10GBASE-T1, the maximum applicable frequency for the MDI return loss is 4000 × *S* MHz.

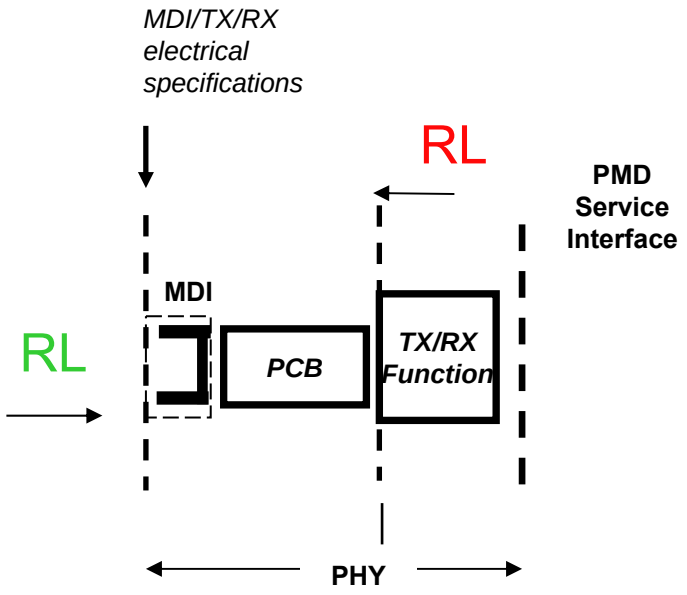


Table 149–1—Scaling parameter

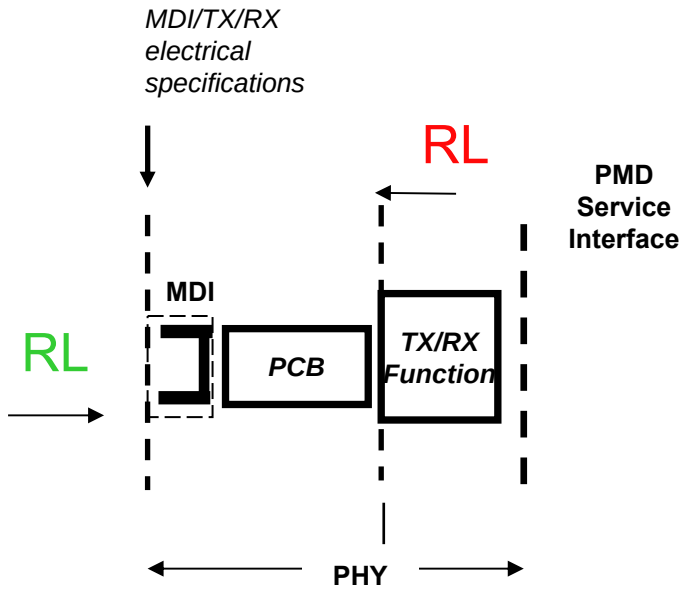
PHY type	*S*
10GBASE-T1	1
5GBASE-T1	0.5
2.5GBASE-T1	0.25

MDI – Medium Dependent Interface- RL

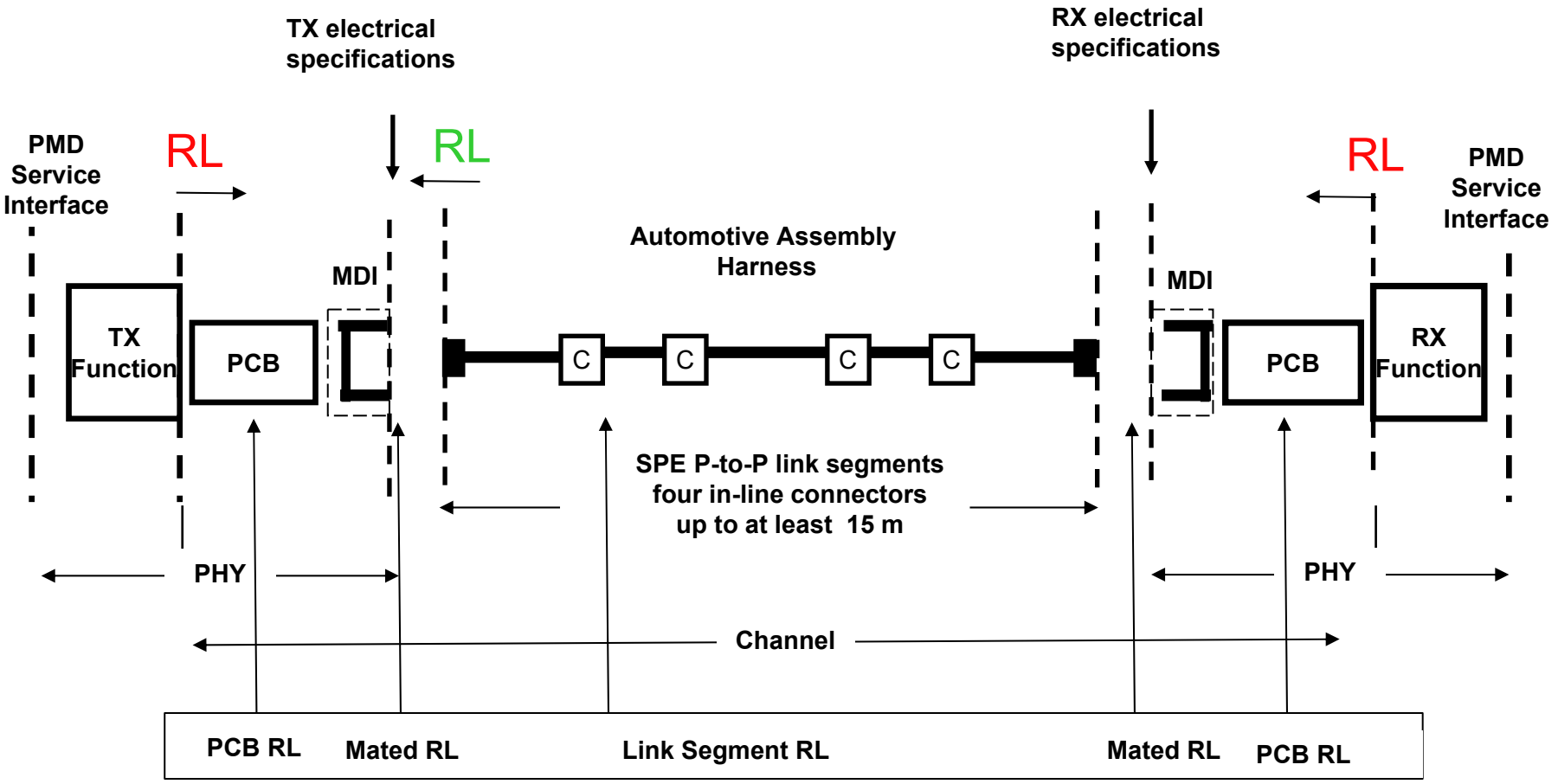
149.11 Protocol implementation conformance statement (PICS) proforma for Clause 149, Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer, and baseband medium, type 2.5GBASE-T1, 5GBASE-T1, and 10GBASE-T1[6]

149.11.4.6 MDI specifications

Item	Feature	Subclause	Value/Comment	Status	Support
MDI1	The electrical requirements specified in 149.5.2 and 149.5.3 shall be met when the PHY is connected to the MDI connector mated with a specified connector to a shielded balanced pair of conductors.	149.8.2		M	Yes [ ]
MDI2	Return loss	149.8.2.1	See Equation (149–27)	M	Yes [ ]



Tx Function to Rx function channel Return Loss



Tx Function to Rx function channel considerations

Annex 149C - IEEE Std 802.3ch-2020

149C.4 Channel return loss

Figure 149C–2—Tx/Rx function channel topology

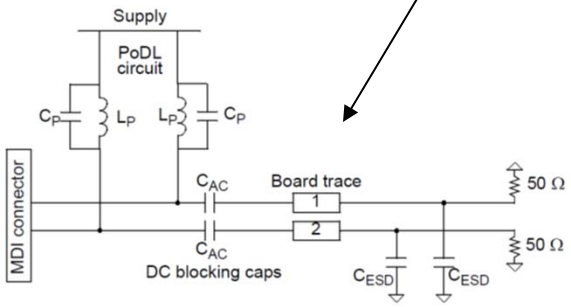


Figure 149C–3—Example implementation MDI to Tx function

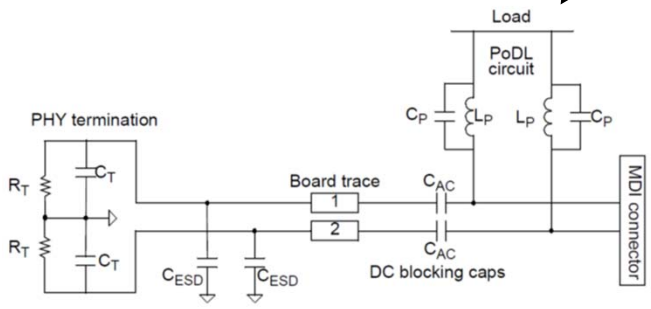


Figure 149C–4—Example implementation Rx function to MDI

149C.4.2 Link segment return loss

$$RL = 20\log_{10}|\Gamma|$$

$$\Gamma = \frac{Z_{in} - Z_s}{Z_{in} + Z_s}$$

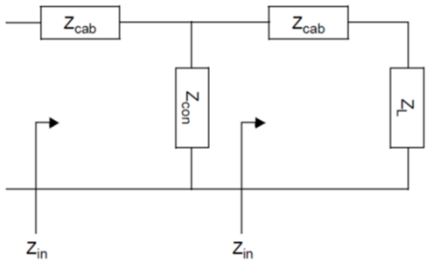
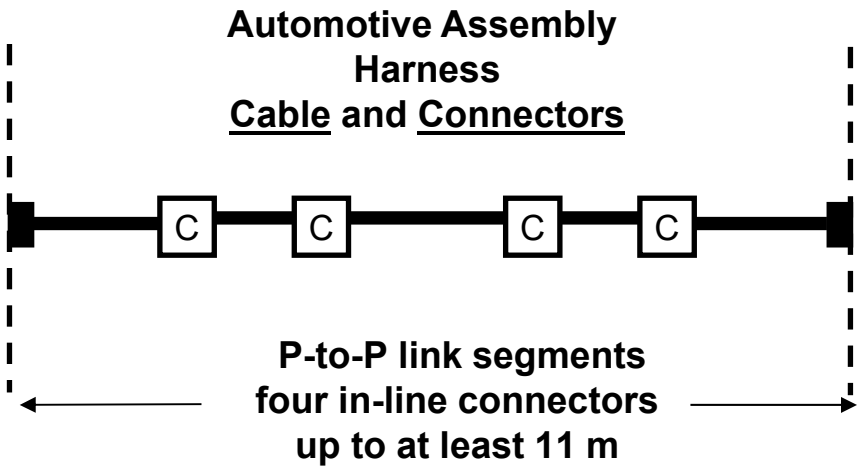


Figure 149C–5—Two–port ladder network

Table 149C–2—Analysis parameters and values

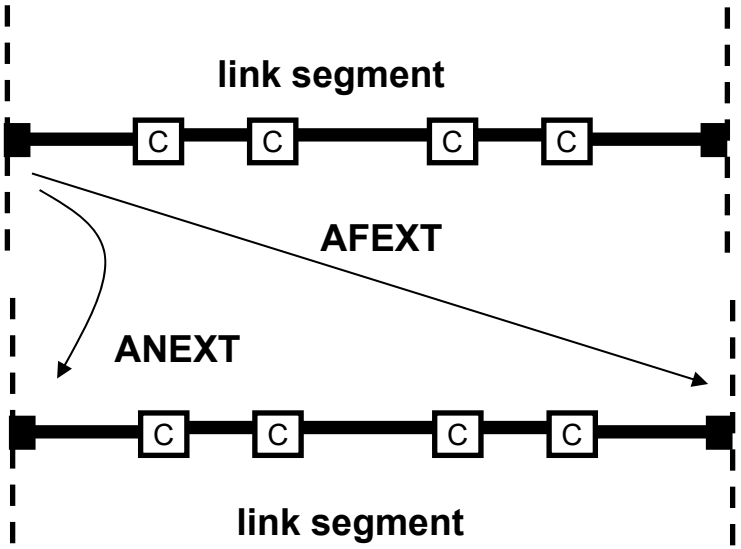
Element	Unit	Minimum	Nominal	Maximum
R_T	Ω	45	50	55
Z_O	Ω	45	50	55
C_T	pF	—	0.1	—
L_P	µH	—	4.7	—
C_P	pF	—	0.18	—
C_{ESD}	pF	—	0.4	—
C_{AC}	nF	—	10	—

Link Segment Baseline Parameters – 802.3cy



- Link Segment transmission parameters (up to at least 11 m)
  - Characteristic impedance (100 ohms)
  - Insertion loss (TBD) – .001 GHz ≤ f ≤ 10 GHz (TBD)
  - Return loss (TBD) - .001 MHz ≤ f ≤ 10 GHz (TBD)
    - Residual Return Loss
  - Shielding Effectiveness (TBD) - .001 GHz ≤ f ≤ 10 GHz (TBD)
  - Maximum Link Delay (TBD) - .001 GHz ≤ f ≤ 10 GHz (TBD)
  - Coupling Attenuation (UTP?)

Coupling parameters between link segments – 802.3cy



PSAACR-F - For multi-disturber AFEXT power summation of AFEXT relative to receive signal

PSANEXT - For multi-disturber ANEXT power summation of ANEXT

- Coupling parameters between link segments
  - Power sum alien near-end crosstalk (PSANEXT) -(TBD) - .001 GHz ≤ f ≤ 10 GHz
  - Power sum alien attenuation to crosstalk ratio far-end (PSAACR-F) - (TBD) - .001 GHz ≤ f ≤ 10 GHz

Summary

- Tx Function to Rx Function Channel Updates
- Link Segment Baseline Considerations