149C.4 Channel return loss

The channel topology between TX function and RX function illustrated in Figure 149C–2 consists of the Tx function to MDI, the link segment, and the MDI to Rx function. The channel return loss can be modeled as a concatenation of the Tx function to MDI return loss, the link segment return loss, and the MDI to Rx function return loss.

Figure 149C–2—TX/RX function Channel Topology

149C.4.1 Tx/Rx function to MDI return loss

An example of an implementation of a Tx/Rx function to MDI topology is given in Figure 149C–3 and Figure 149C–4 with associated parameter values given in Table 149C–2. The implementation enables MDI return loss to be considered as a function of PHY termination impedances, PCB impedances, PCB trace lengths (insertion loss), external ESD clamp capacitances, and PoDL inductances. The MDI return loss specified in 149.8.2.1 was developed using the example implementation. .

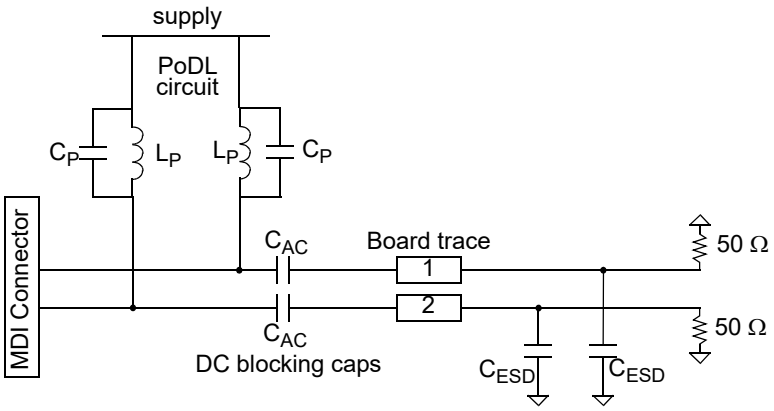

Figure 149C–3—Example implementation MDI to TX function

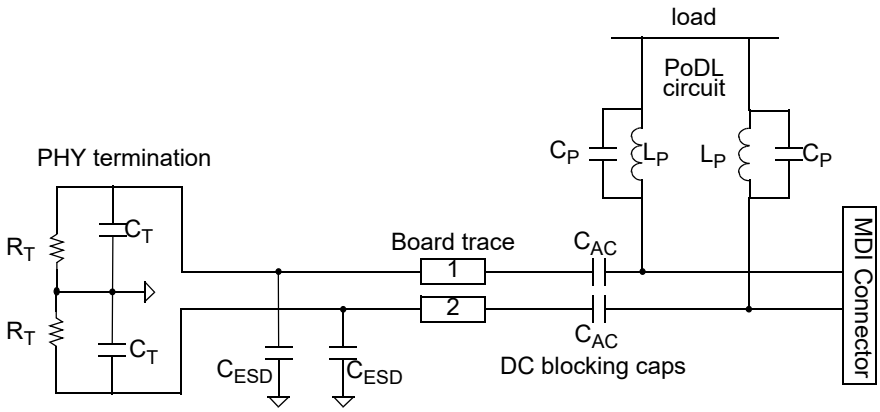

Figure 149C–4—Example implementation RX function to MDI

Table 149C–2—Analysis parameters and values

Element	unit	Minimum	Nominal	Max
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	—

149C.4.2 Link segment return loss

A link segment return loss can be modeled as a two-port ladder network, as shown in Figure 149C–5 with sections consisting of cable (Z_{cab}) and connector impedances (Z_{con}). The return loss is derived from the input impedance of the ladder network using Equation (149C–7). The input impedance is derived using Equation (149C–8) applied recursively to each section.

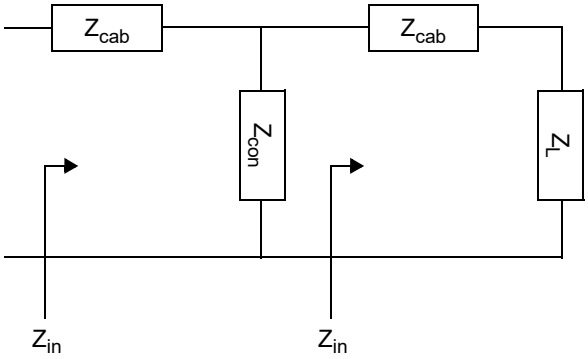

Figure 149C–5—Two–port ladder network

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

$$\Gamma = \frac{Z_{in} - Z_s}{Z_{in} + Z_s} \quad (149C–7)$$

$$Z_{in} = Z_o \frac{Z_L + Z_o \tanh\gamma l}{Z_o + Z_L \tanh\gamma l} \quad (149C–8)$$

where

Z_s is the source impedance
Z_o is the cable (Z_{cab}) or connector (Z_{con}) impedance
Z_L is the initial and recursive impedance
l is the length in m

$$\gamma = \alpha + j\beta$$

$$\alpha = \frac{Attenuation(\mathrm{dB}/m)}{20\log_{10}(e)}$$

$$\beta = \frac{\omega}{v}\ \text{radians/m}$$

149C.4.3 Channel return loss concatenation

The return loss for a channel can be modeled as a concatenation of the Tx function to MDI return loss, the link segment return loss, and the MDI to Rx function return loss using the method in 93A.1.2.1.