CHANNEL REQUIREMENTS

IEEE 802.3CY – BEYOND 10G ELECTRICAL AUTOMOTIVE ETHERNET PHY TF

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OVERALL CHANNEL

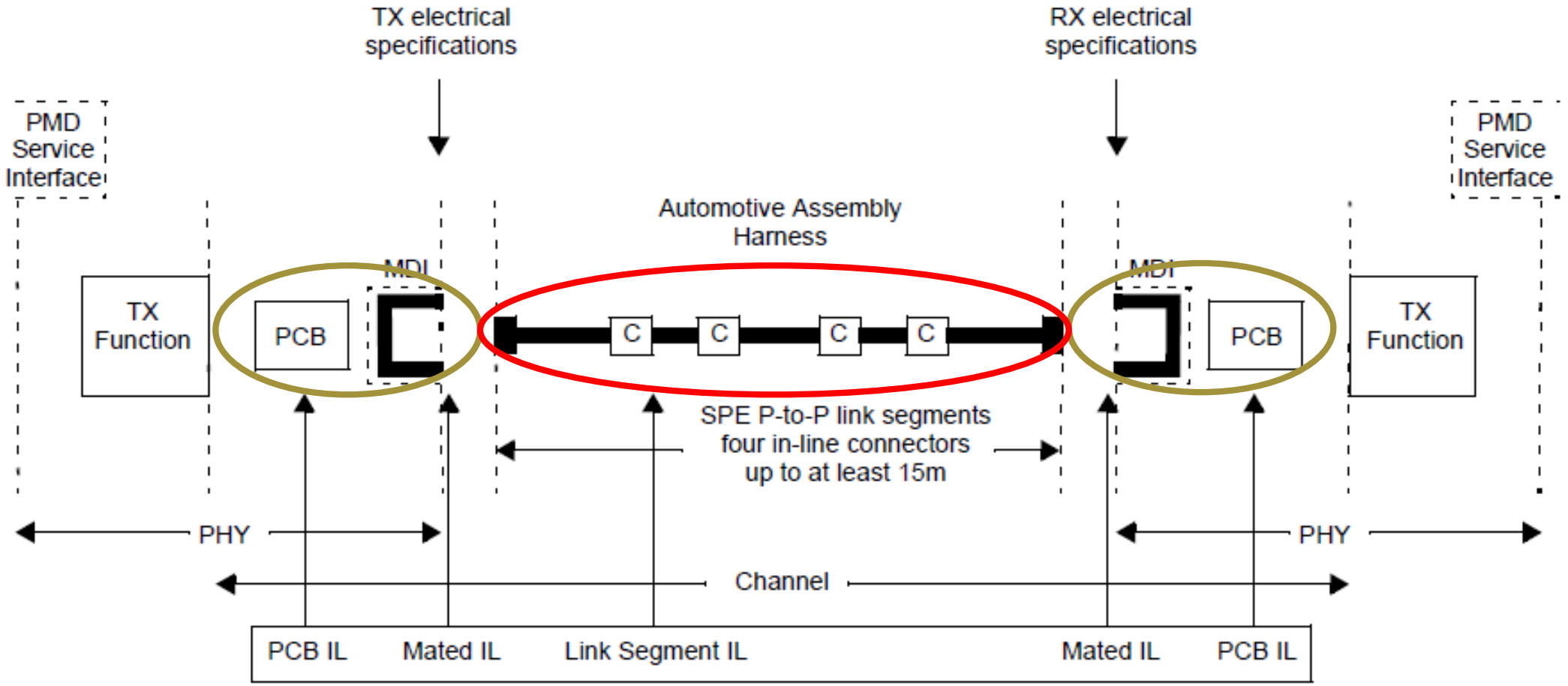
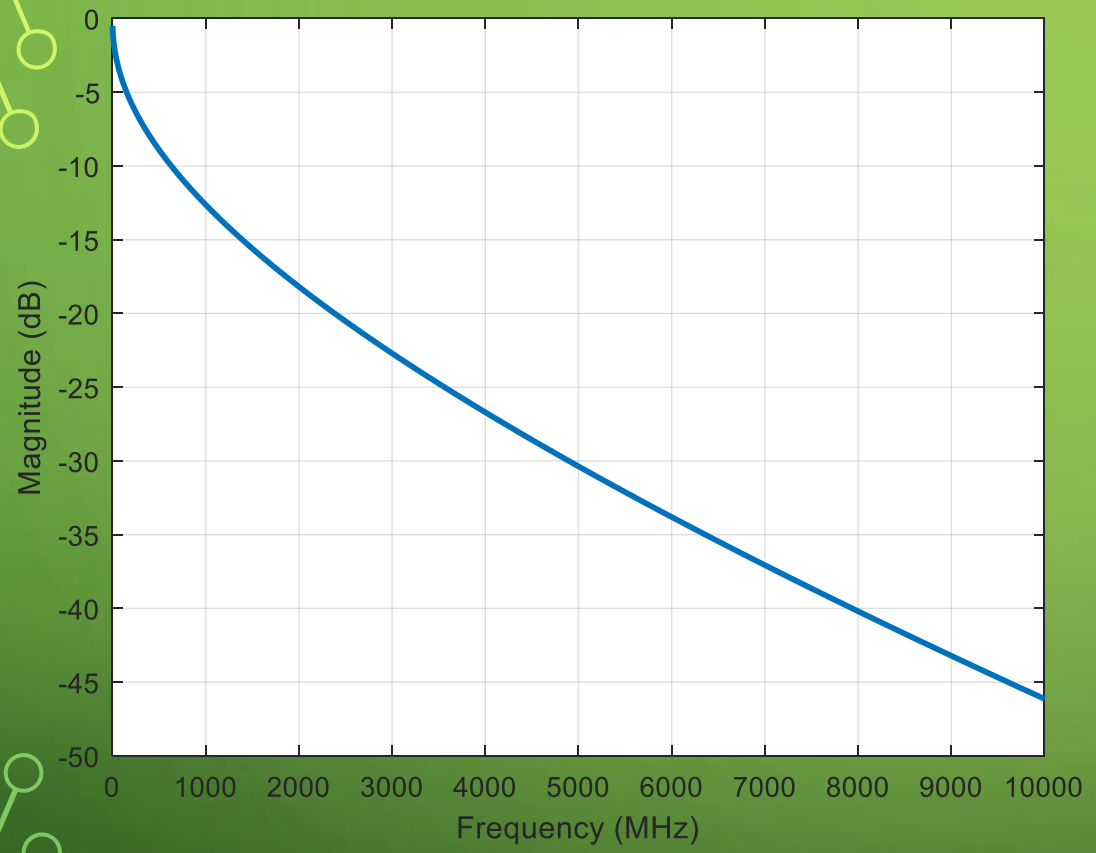


Figure 149C–1—Channel TX function to RX function

From 802.3ch TX/RX Annex

LINK SEGMENT

$$IL_{LinkSegment} = 1.3333 * 10^{-4} f + 0.0453 * f^{0.45}\ dB/m$$



Using the link segment (plug to plug) limit from IEEE802.3ch, we determine the per m loss and extrapolate for 11m length out to 10GHz.

Assuming PAM4 as in 802.3ch, the bandwidth for 25Gbps is

f = 7031.25 MHz = 2.5*2812.5 MHz

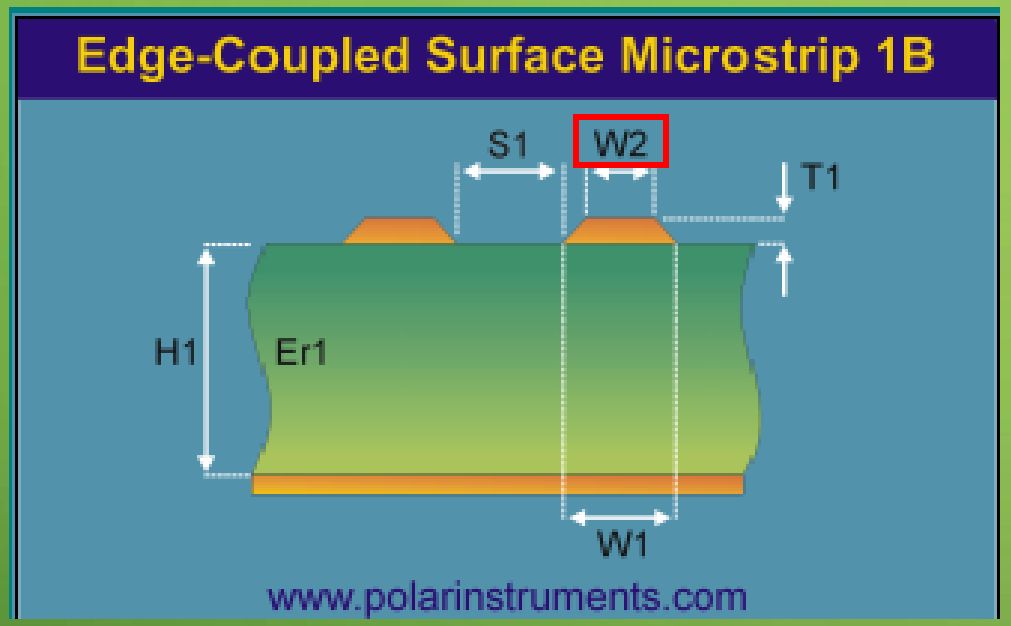
IL @ 7031.25 MHz= 3.3786 dB/m

IL @ 7031.25 MHz for 11m is -37.1644 dB

IL @ 10 GHz = 4.1937 dB/m

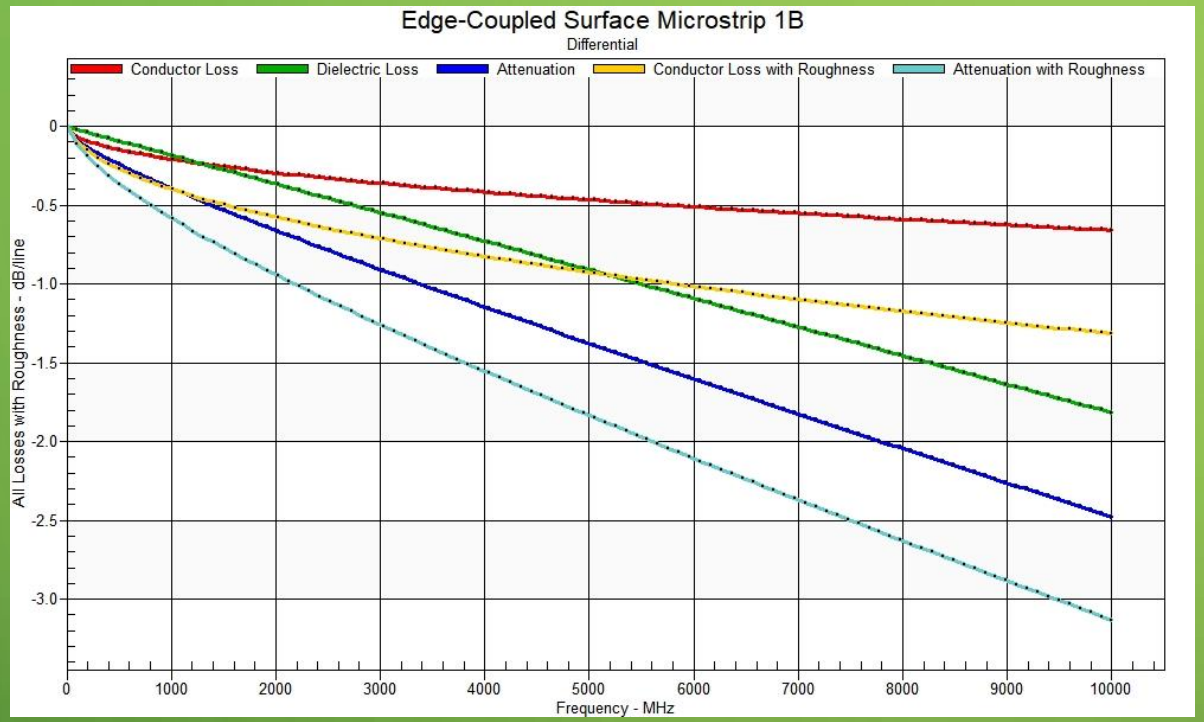
IL @ 10 GHz for 11m is -46.13 dB

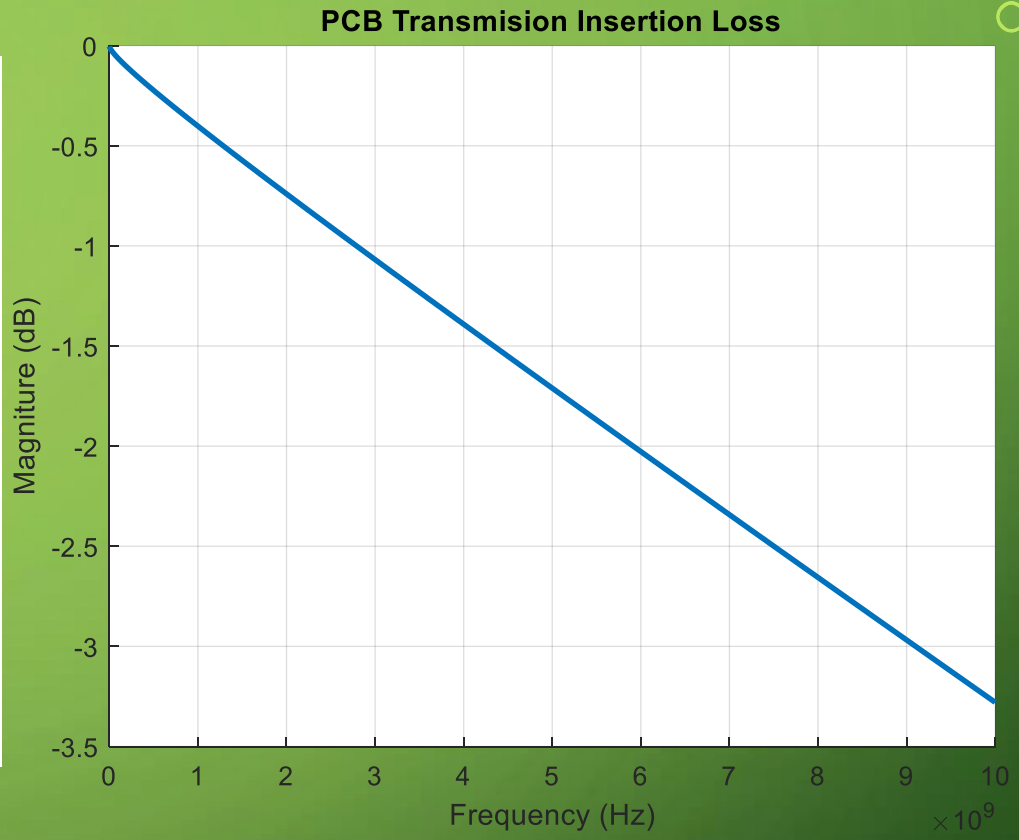
PCB – DIFFERENTIAL PAIR STRUCTURE



H1= 6.7mil
S1=5mil (tightly coupled)
T1=1.4mil
Er1=Based on Material
Losstangent = Based on Material
W1/W2=Determined based on impedance

PCB LOSS – ISOLA 370HR



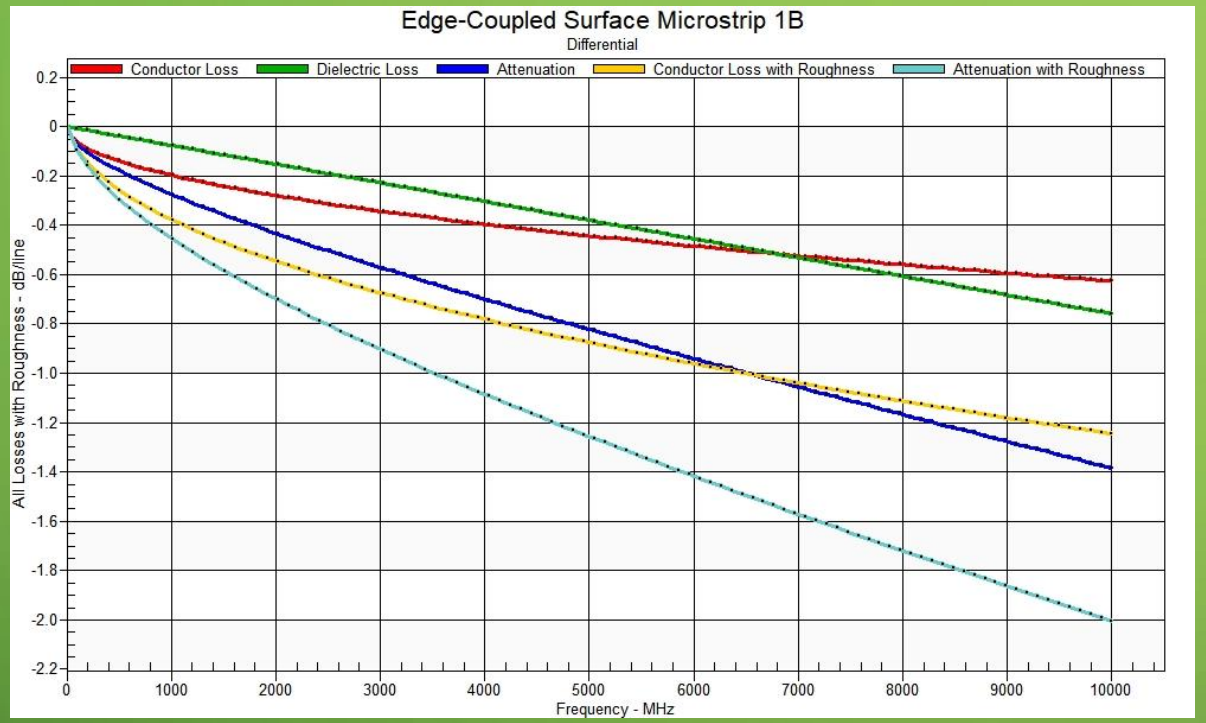


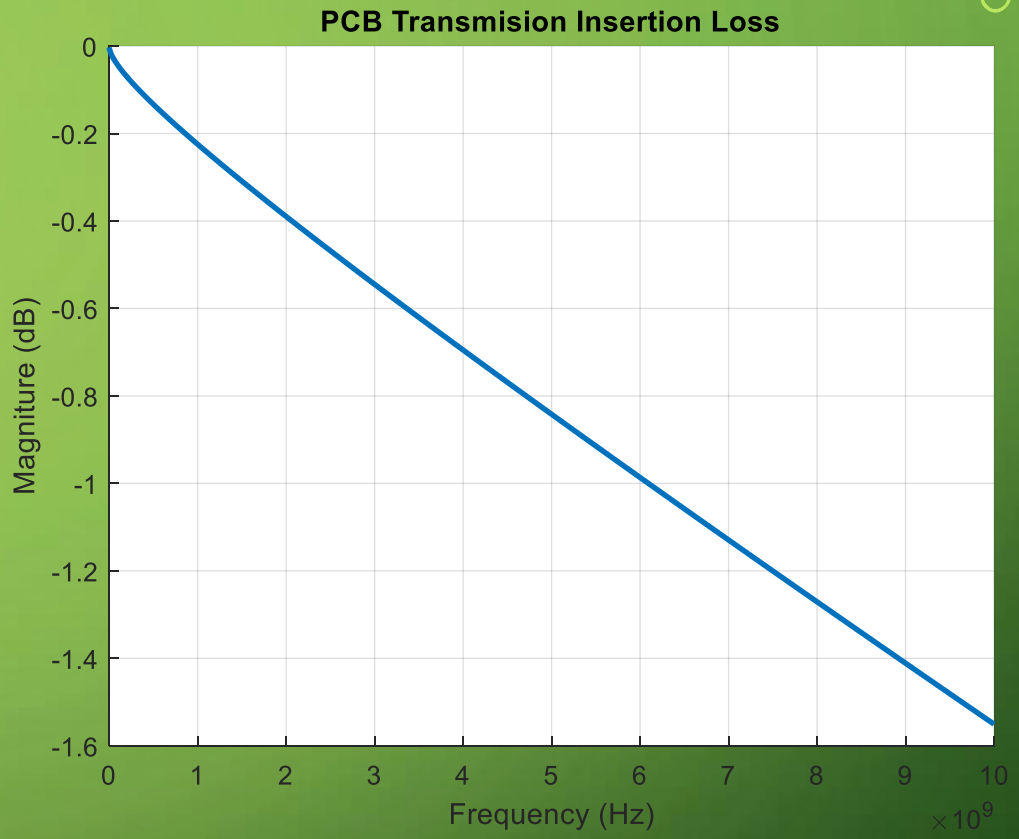
Er1= 4.04
Losstangent = 0.021
W1/W2 = 8/7 mil (trapezoidal)

IL @ 7031.25 MHz = 0.793 dB/in (25.4mm)
IL @ 7031.25 MHz for 3in(76.2mm) is -2.379 dB
IL @ 10 GHz = 1.1 dB/in (25.4mm)
IL @ 10 GHz for 3in(76.2mm) is -3.3 dB

$$IL_{PCB}^{370HR} = 0.036\sqrt{f} + 0.0979f\ dB/in$$

PCB LOSS – ISOLA FR480HR





Er1= 3.68

Losstangent = 0.0092

W1/W2 = 8.6/7.6 mil (trapezoidal)

IL @ 7031.25 MHz = 0.525 dB/in (25.4mm)

IL @ 7031.25 MHz for 3in(76.2mm) is -1.576 dB

IL @ 10 GHz = 0.668 dB/in (25.4mm)

IL @ 10 GHz for 3in(76.2mm) is -2.004 dB

$$IL_{PCB}^{FR408HR} = 0.0339\sqrt{f} + 0.0409f\ dB/in$$

PROPOSED TOTAL CHANNEL INSERTION LOSS

$$IL_{Channel} = 2 * IL_{PCB} + 2 * IL_{MDI} + IL_{LinkSegment}$$

$$IL_{LinkSegment} = 1.3333 * 10^{-4} f + 0.0453 * f^{0.45}\ dB/m$$

$$IL_{PCB}^{370HR} = 0.036\sqrt{f} + 0.0979 f\ dB/in$$

$$IL_{MDI} = 0.1\sqrt{f(GHz)}$$

$$@7031.25\ MHz, \qquad IL_{Channel} = (2 * -2.38) + (2 * -0.27) + (-37.16) = -42.46\ dB$$

$$@10\ GHz, \qquad IL_{Channel} = (2 * -3.3) + (2 * -0.32) + (-46.13) = -53.37\ dB$$

VNA SETUP

Parameter	Value
Fstart	1 MHz
Fstop	10 GHz (required) or 15 GHz (preferred)
Sweep Type	Linear
Step Size	1 MHz
Output power	-10dBm
IF bandwidth	≤10 kHz (lower IF bandwidth provides a lower noise floor)
Port reference Impedance(Single Ended)	50Ω
Port reference Impedance (Differential Mode)	100Ω
Port reference Impedance (Common Mode)	25Ω
Data calibration kit	Use E-Cal or kit
Averaging Function	Deactivated
Smoothing Function	Deactivated
Logical Differential Port 1	Ports 1 and 3
Logical Differential Port 2	Ports 2 and 4
Touchstone File	Version 1 (.s4p single ended data)
Data format	Real + Imaginary (preferred) or Magnitude/Phase

INTERFACE BOARDS

Connector suppliers already have PCB interface boards designed to measure their connectors. When these boards are used to measure the cable assembly. We need to have

1. Interface board details
    a) Trace length
    b) PCB Stackup
    c) Total loss
2. Link Segment analysis should include
    a) Interface boards (do not de-embedded the traces on the board)
    b) Should be 11 m

SUMMARY & QUESTIONS

1. It is important to incorporate the PCB loss as part of the overall channel loss budget.
    a) Only two PCB materials were investigated due to the nature of this protocol requiring better PCB material.
    b) What maximum loss should be allocated for the PCB?
    c) Different PCB structures, such as stripline or coplanar waveguide will yield different losses. It is critical to set a loss budget.
2. What is a good design target for the overall IL channel budget?
3. Can we achieve 11m and what is the use case for 11m?
    a) Camera application only?
    b) Can this length be only for coax?

THANK YOU