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

PCB INSERTION LOSS MATERIAL COMPARISON

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Channel

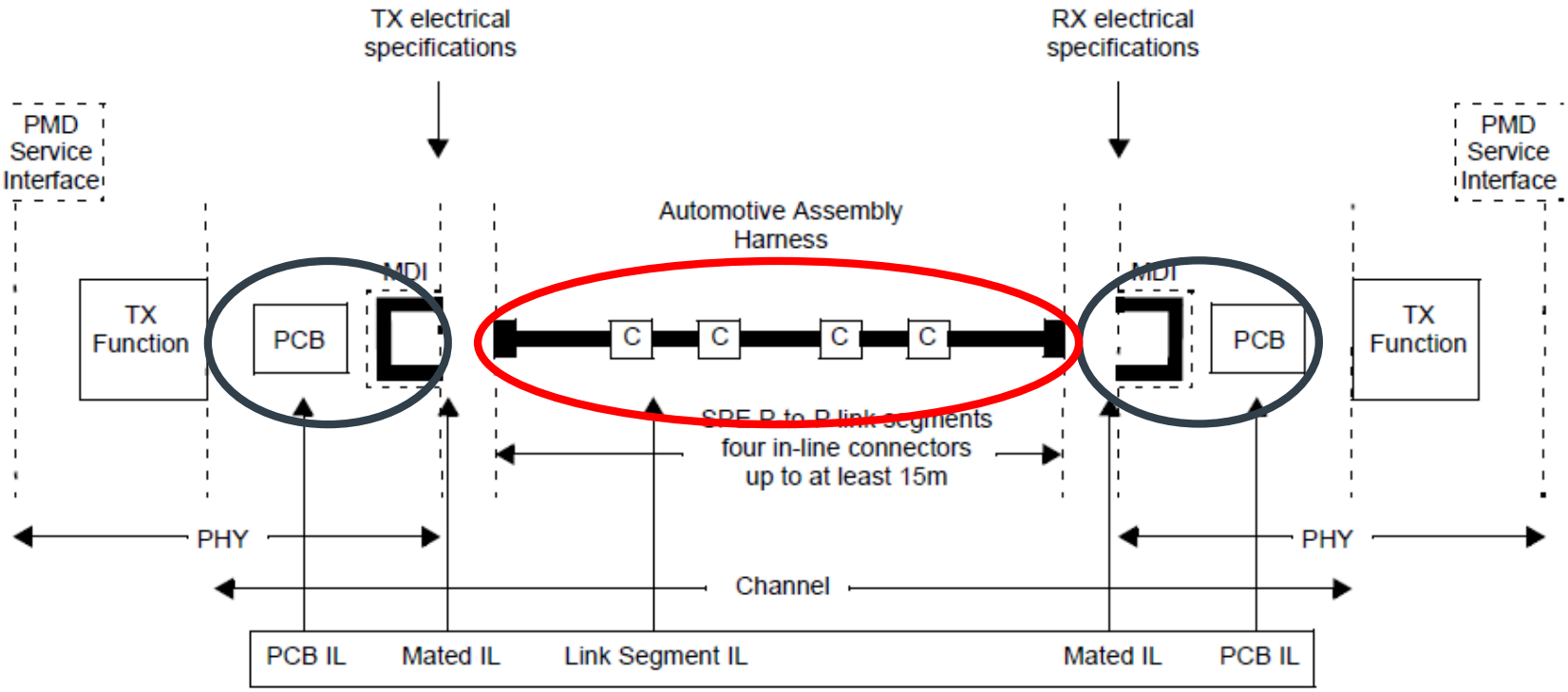

Figure 149C–1—Channel TX function to RX function

From 802.3ch TX/RX Annex

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Analysis Information

- The data shown is a 2D calculation of transmission line's insertion loss prepared using Polar Si9000 PCB Transmission Line Field Solver and verified with Advanced Design Systems (ADS). Via's and components (e.g., Connector) will better be modeled using 3D solver. This data only represents the PCB trace for the transmission line structure and PCB Stackups in slide 4 at room temperature.

- High Density Boards will have larger layer count and smaller layer-to-layer thickness and trace-to-trace spacing. Minimum layer thickness could be as low as 2mil for a core and 1.6mil for Prepreg. Based on the copper thickness the spacing between traces can go as low as 3mil. Both a standard and a high-density stack are evaluated.

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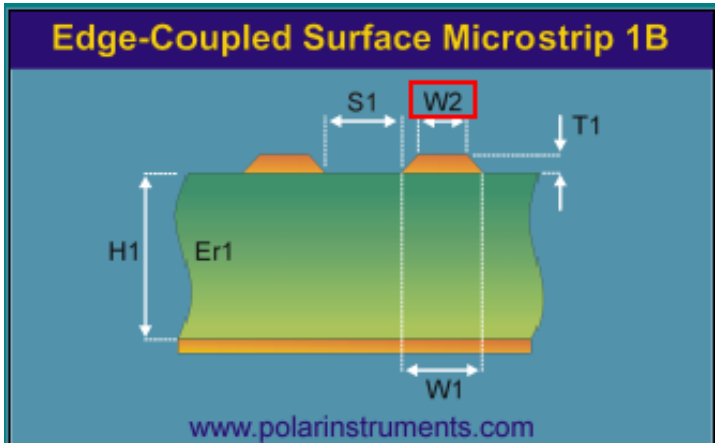
PCB-Differential Pair Structure



Standard Stack(Stackup1):
H1= 6.7mil
S1=5mil (tightly coupled)
T1=1.4mil
Er=Based on Material
Df = Based on Material
W1/W2=Determined based on impedance

High Density Stack(Stackup2):
H1= 4mil
S1=4mil (tightly coupled)
T1=1.2~2.1mil (used 1.4)
Er=Based on Material
Df = Based on Material
W1/W2=Determined based on impedance

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Structure Results

Material	Resin*	Er	Df	Stackup1** W1/W2 (mil)	Stackup 2** W1/W2 (mil)
370HR	-	4.04	0.021	7.8/6.8	4.9/3.9
FR408HR	-	3.68	0.0092	8.6/7.6	5.4/4.4
EM370(Z)/EM37B(Z)	50%	4.2	0.015	7.6/6.6	4.7/3.7
	70%	3.8	0.019	8.3/7.3	5.2/4.2
EM-526/EM-526(B)	50%	3.9	0.007	8.1/7.1	5/4
	70%	3.4	0.008	9.2/8.2	5.7/4.7
Megtron6	-	3.4	0.004	9.2/8.2	5.7/ 4.7
RO4000 Series	-	3.38	0.0027	9.3/8.3	5.8/4.8

*Materials with two or more entries indicates data sheets for these materials listed the Dielectric constant and dissipation factor different resin content.

**I put exact numbers from the tool, realistically, you can’t etch to that exact width so manufacturing will have its tolerances.

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Structure Insertion Loss Results @ 7031.25MHz

Material	Resin	IL dB/in	
	Resin	Stackup 1	Stackup 2
370HR	-	0.793	0.936
FR408HR	-	0.525	0.666
EM370(Z)/EM37B(Z)	50%	0.686	0.84
	70%	0.728	0.87
EM-526/EM-526(B)	50%	0.499	0.64
	70%	0.481	0.62
Megtron6	-	0.405	0.542
RO4000 Series	-	0.380	0.517

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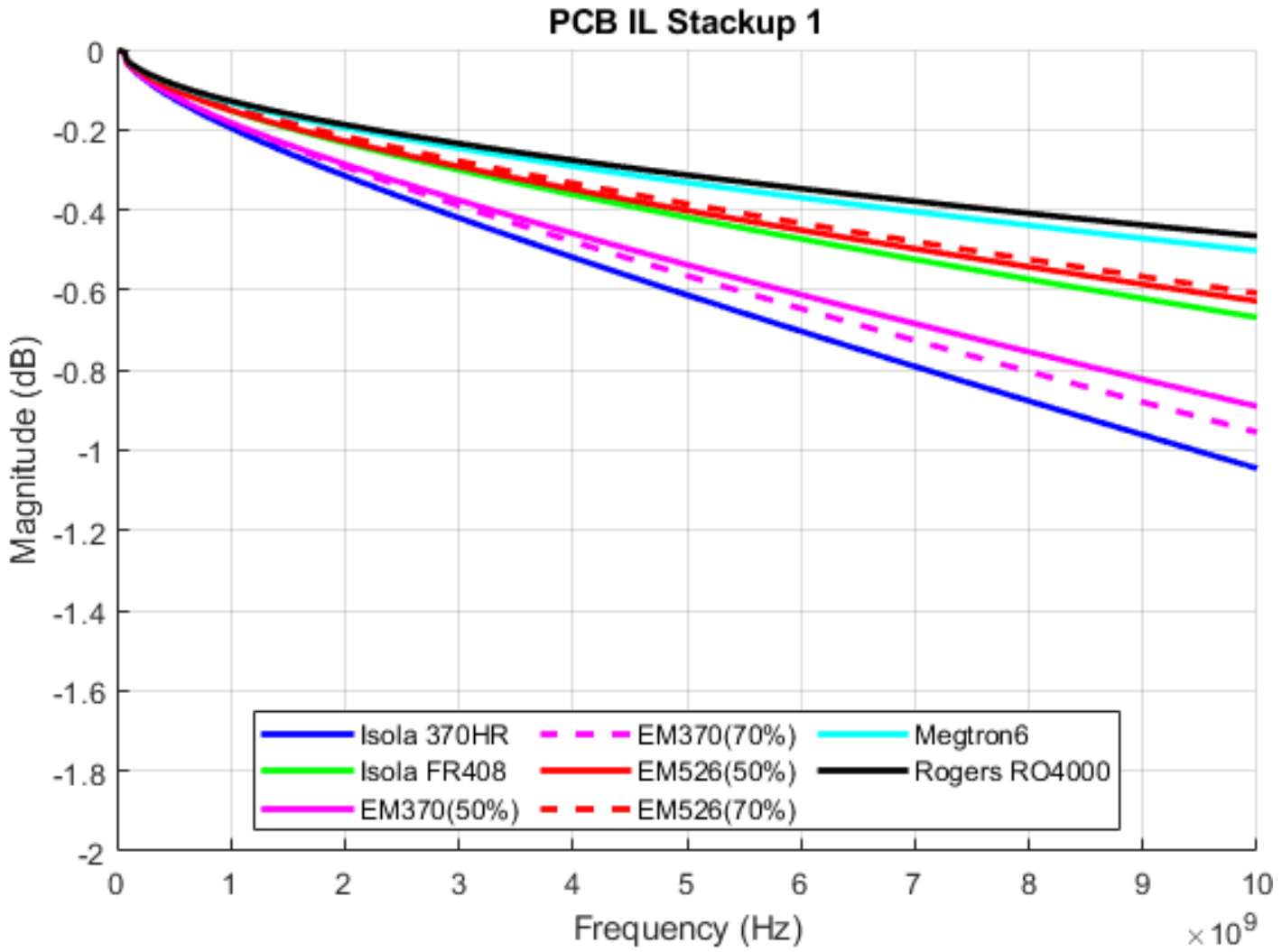
Stackup 1 Structure Insertion Loss Results Plot



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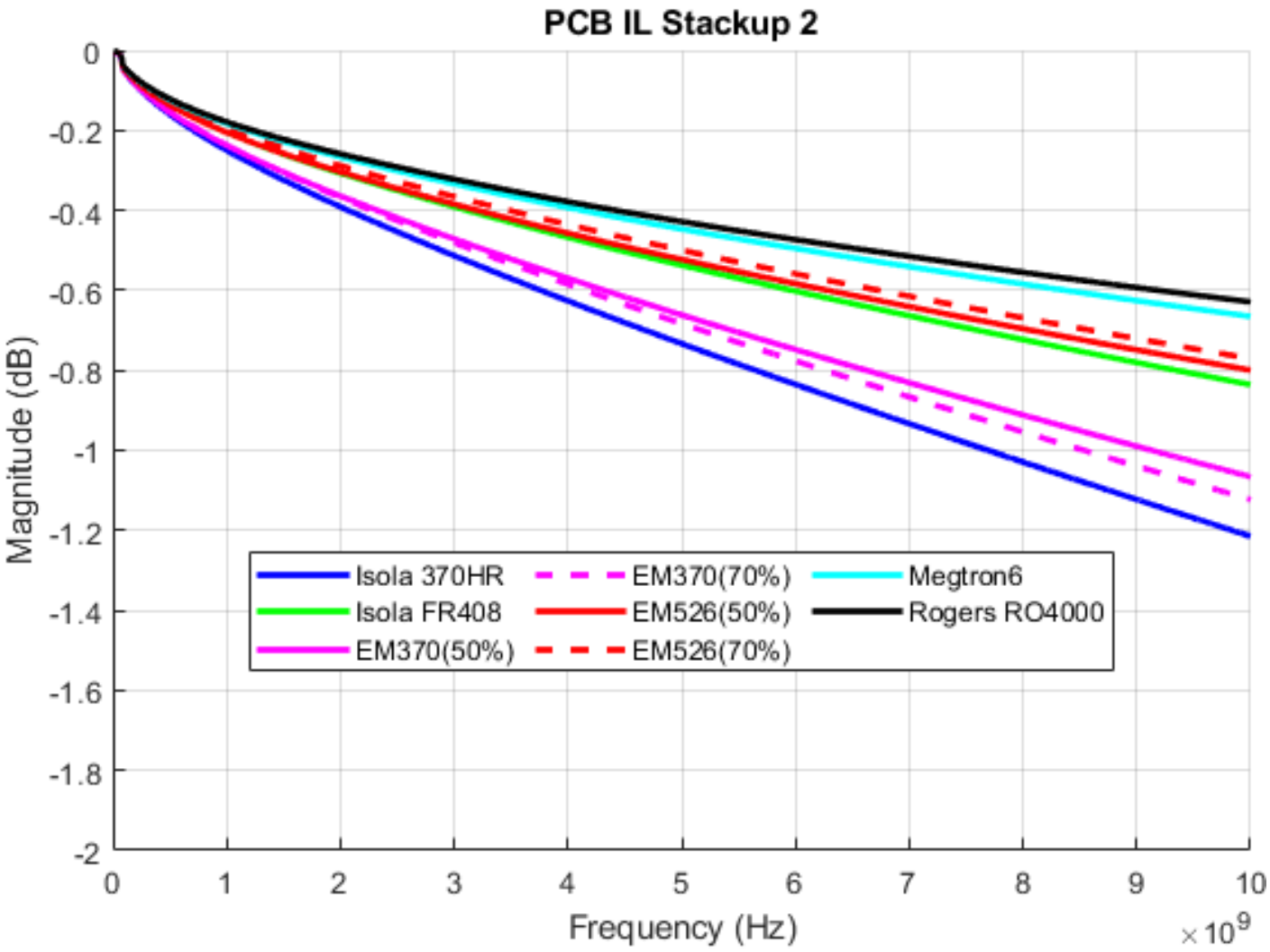
Stackup 2 Structure Insertion Loss Results Plot



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Summary Points

- Stripline and Coplanar Waveguide structures inherently have larger loss and will need to account for that variation.

- Need to consider loss for connector and possibly components

- *Covering every case is not feasible but determining and defining the maximum loss will drive the PCB stack up and transmission structure*.

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Thank you!

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