DC Blocking Capacitor Structures

IL & RL Plots

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Dell –Force10

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Objective

- Model and simulate DC blocking capacitor structures with the following variables:
  - 50mil via barrel, 126mil PCB stack, Nelco4000-13EP, differential stripline
    - 2 GND pinning vias; oval antipad
  - 70mil via barrel, 85mil PCB stack, Isola 370HR,differential stripline
    - 4 GND pinning vias; oval antipad

- Capacitor SMT pads are shorted with a short trace segment for the HFSS model

- Simulator
  - Ansoft HFSS 13
    - Sweep = 0 to 20Ghz
    - Nelco 4000-13EP: Dk =3.25; Df=0.01
    - Isola 370HR: Dk=3.4; Df=0.024
    - No surface roughness for copper
    - Lumped ports
  - Ansoft Designer
    - Sweep 0 to 20Ghz, 40Mhz frequency step

- Plot Insertion Loss and Return Loss
  - Insertion Loss: Depends predominantly on dielectric material & via barrel length
    - Varies from -0.41 dB to -1.3dB at 12.5 Ghz

  - Return Loss depends on antipad shape and number of GND pinning vias

Conclusions

•Insertion loss at 12.5GHz is -0.41dB for the Nelco4000-13EP board and -1.3dB for the 370HR board.

•The thickness of the PCB, stripline trace layer location and dielectric material have a big impact on the insertion loss of the DC blocking capacitor structure.

•One way to reduce insertion loss would be to place the DC blocking capacitors close to the receiver BGA and use microstrip traces to the BGA.

•Since there are no vias involved, placing the DC blocking capacitors in the connector will have much lower insertion loss.

126mil stack height, 50mil via barrel, Nelco4000-13EP: Trace In & Out Layer 9 with backdrill

FORCE10

Rev
Change Descr

Company: Force10 Networks
Contact:

Board Name: Next Gen PIC-Irene
Detail by: Umesh Chandra

Grain Direction: best cost
Board Size:

Layers	Specified Thickness	Layer Name Definition	Layer Type	Resin Content	Dk@10Ghz (adjusted)	Material Type	Impedance Differential	Impedance Line Width space	Impedance Differential	Impedance Line Width space	Impedance Single Ended	Impedance Line Width
	0.50	Mask					Target 100		Target 100		Target 50	
Top	1.65	Foil & Plating	num									
	0.55	Pads Only					100.20	5.50/9.00	98.14	3.50/4.625	49.64	7.25
	3.70					Nelco 4000-13 EP						
L02	1.20	GND1										
	4.00					Nelco 4000-13 EP						
L03	0.60	HS1					99.66	4.75/9.25	100.65	3.125/3.375	49.45	5.25
	6.30					Nelco 4000-13 EP						
L04	1.20	GND2										
Backdrill#8	4.00					Nelco 4000-13 EP						
L05	0.60	HS1					99.66	4.75/9.25	100.65	3.125/3.375	49.45	5.25
	6.30					Nelco 4000-13 EP						
L06	1.20	GND2										
Backdrill#7	4.00					Nelco 4000-13 EP						
L07	0.60	HS2					99.66	4.75/9.25	100.65	3.125/3.375	49.45	5.25
	6.30					Nelco 4000-13 EP						
L08	1.20	GND3										
Backdrill#6	4.00					Nelco 4000-13 EP						
L09	0.60	HS3					99.66	4.75/9.25	100.65	3.125/3.375	49.45	5.25
	6.30					Nelco 4000-13 EP						
L10	1.20	GND4										
Backdrill#5	4.00					Nelco 4000-13 EP						
L11	1.20	PWR1										
	5.20					Nelco 4000-13 EP						
L12	1.20	GND5										
Backdrill#4	4.00					Nelco 4000-13 EP						
L13	1.20	GND6										
	6.30					Nelco 4000-13 EP						
L14	0.60	HS4					99.66	4.75/9.25	100.65	3.125/3.375	49.45	5.25
	4.00					Nelco 4000-13 EP						
L15	1.20	GND8										
Backdrill#3	6.30					Nelco 4000-13 EP						
L16	0.60	HS4					99.66	4.75/9.25	100.65	3.125/3.375	49.45	5.25
	4.00					Nelco 4000-13 EP						
L17	1.20	GND8										
Backdrill#2	6.30					Nelco 4000-13 EP						
L18	0.60	HS5					99.66	4.75/9.25	100.65	3.125/3.375	49.45	5.25
	4.00					Nelco 4000-13 EP						
L19	1.20	GND9										
Backdrill#1	6.30					Nelco 4000-13 EP						
L20	0.60	HS6					99.66	4.75/9.25	100.65	3.125/3.375	49.45	5.25
	4.00					Nelco 4000-13 EP						
L21	1.20	GND10										
	3.70					Nelco 4000-13 EP						
	0.55	Pads Only					100.20	5.50/9.00	98.14	3.50/4.625	49.64	7.25
Bot	1.65	Foil & Plating	num									
	0.50	Mask										

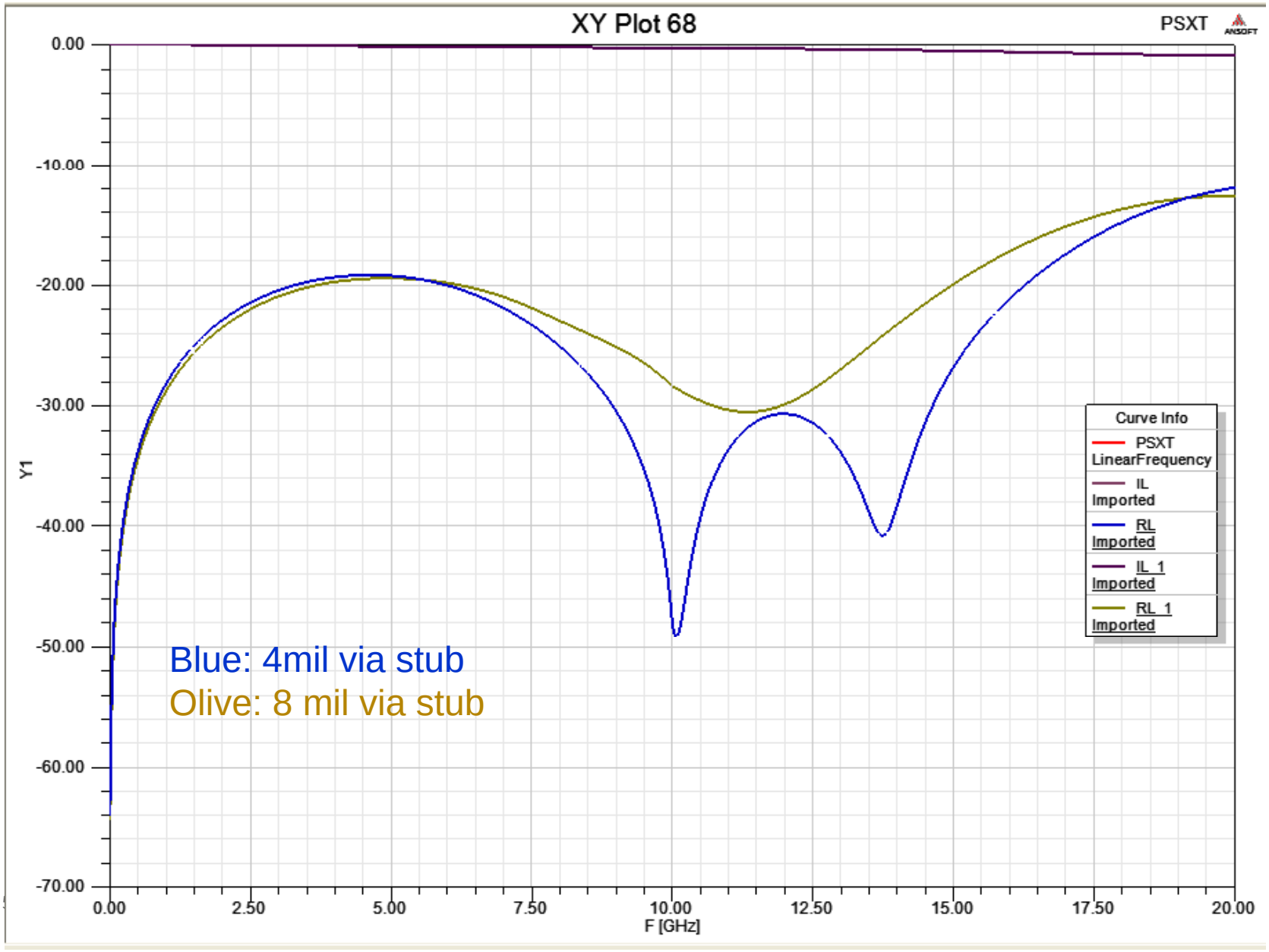
Total: 127.60 Est. Finish Thickness Over Plating & Mask
126.60 Est. Finish After Copper Plating
122.20 Est. Finish Thickness Dielectric
+8.0/-8.0 Finish Thickness Over Plating & Mask Tolerance

mm

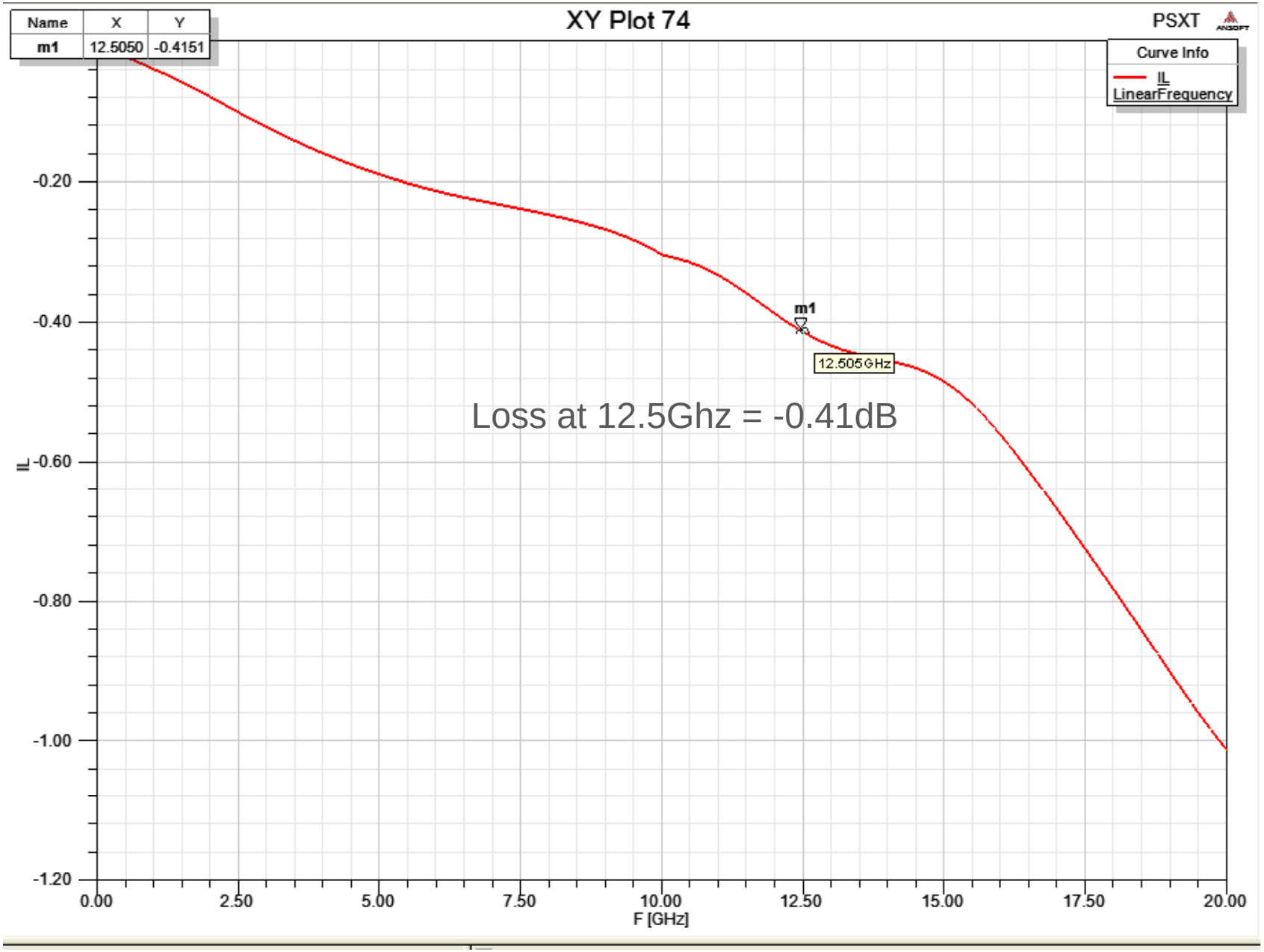
Notes:
1. Soldermask is conformal

DELL

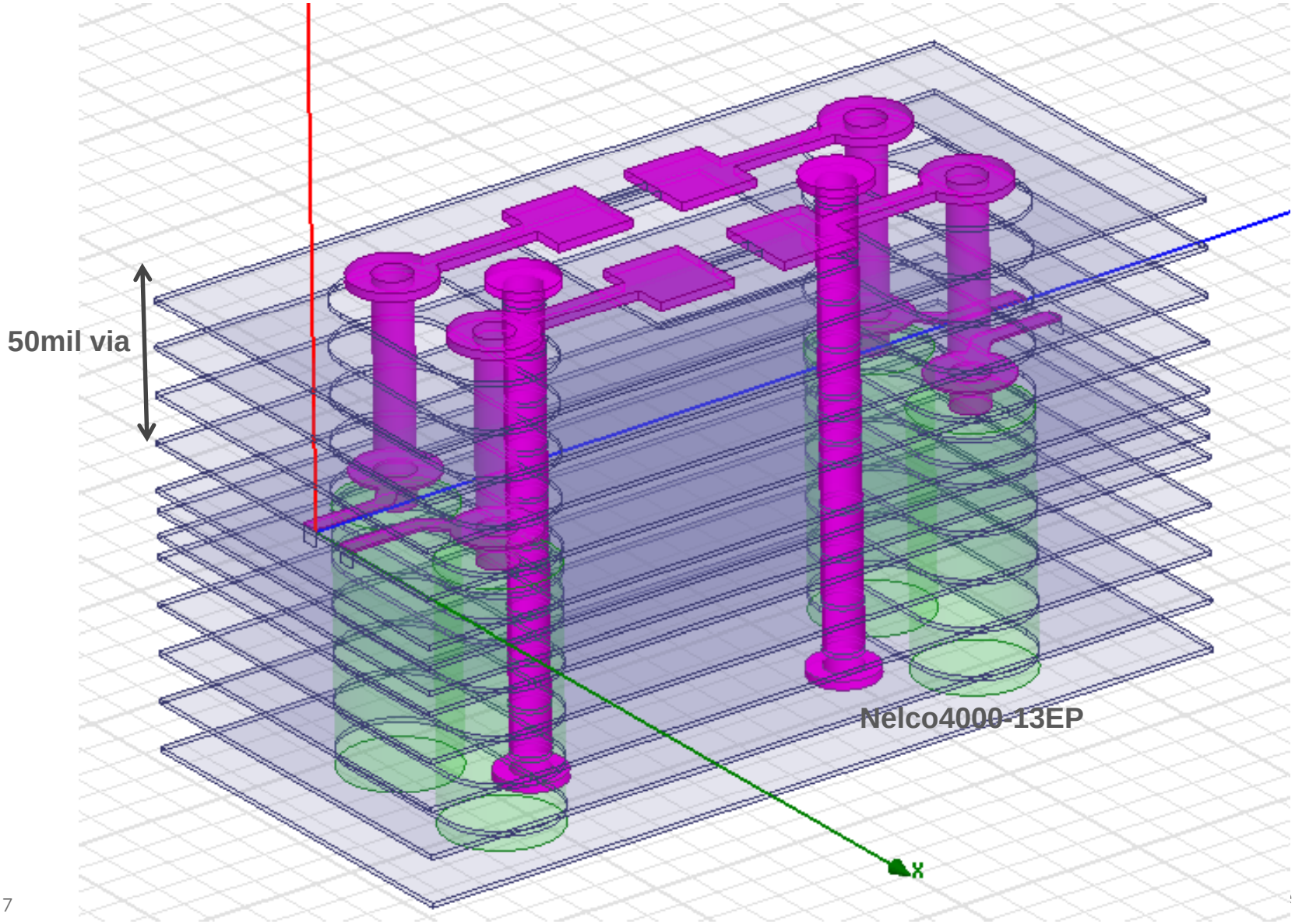
50mil via barrel, Nelco4000-13EP: Trace In & Out Layer 9 with backdrill



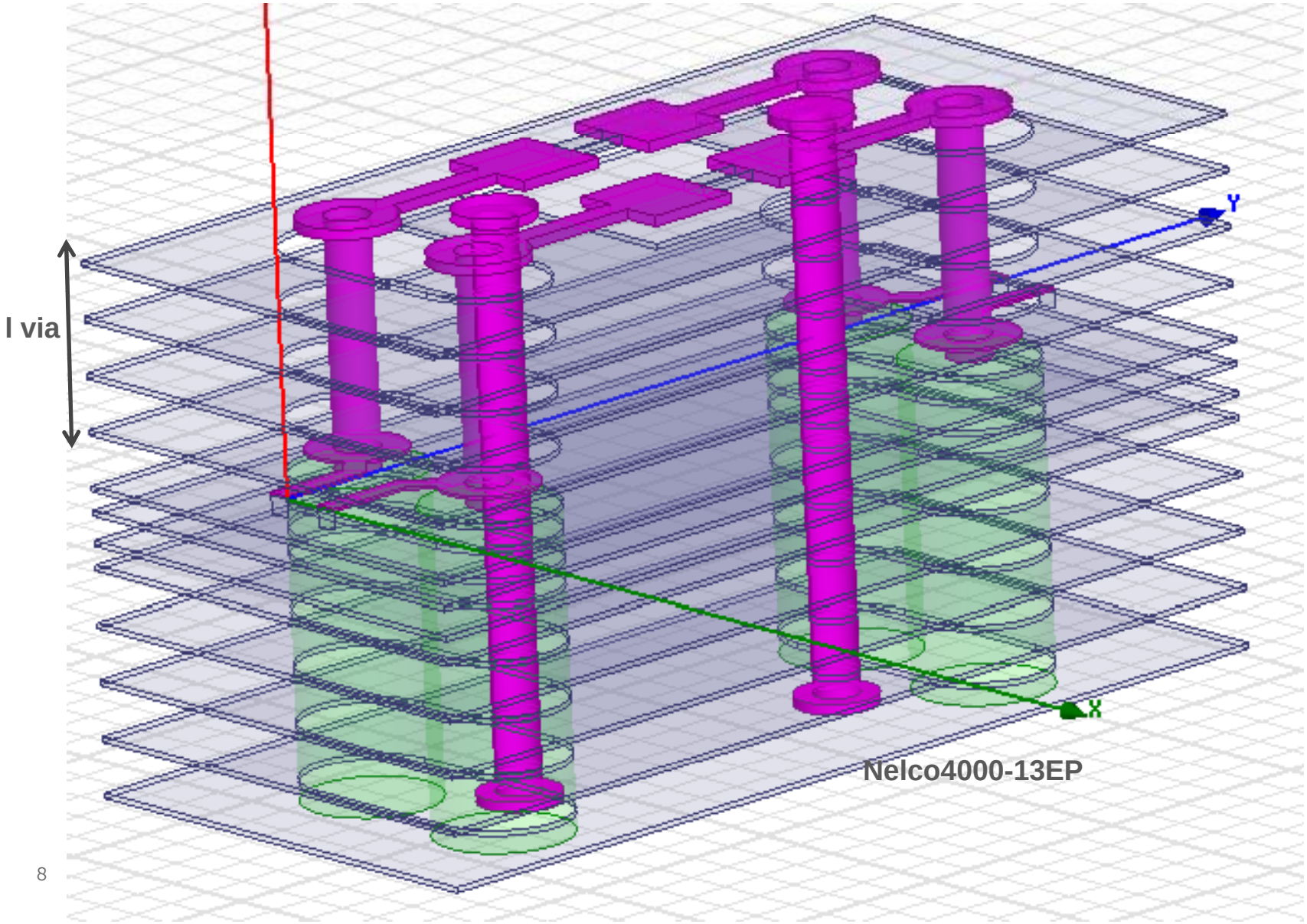
50mil via barrel, Nelco4000-13EP: Trace In & Out Layer 9 with backdrill



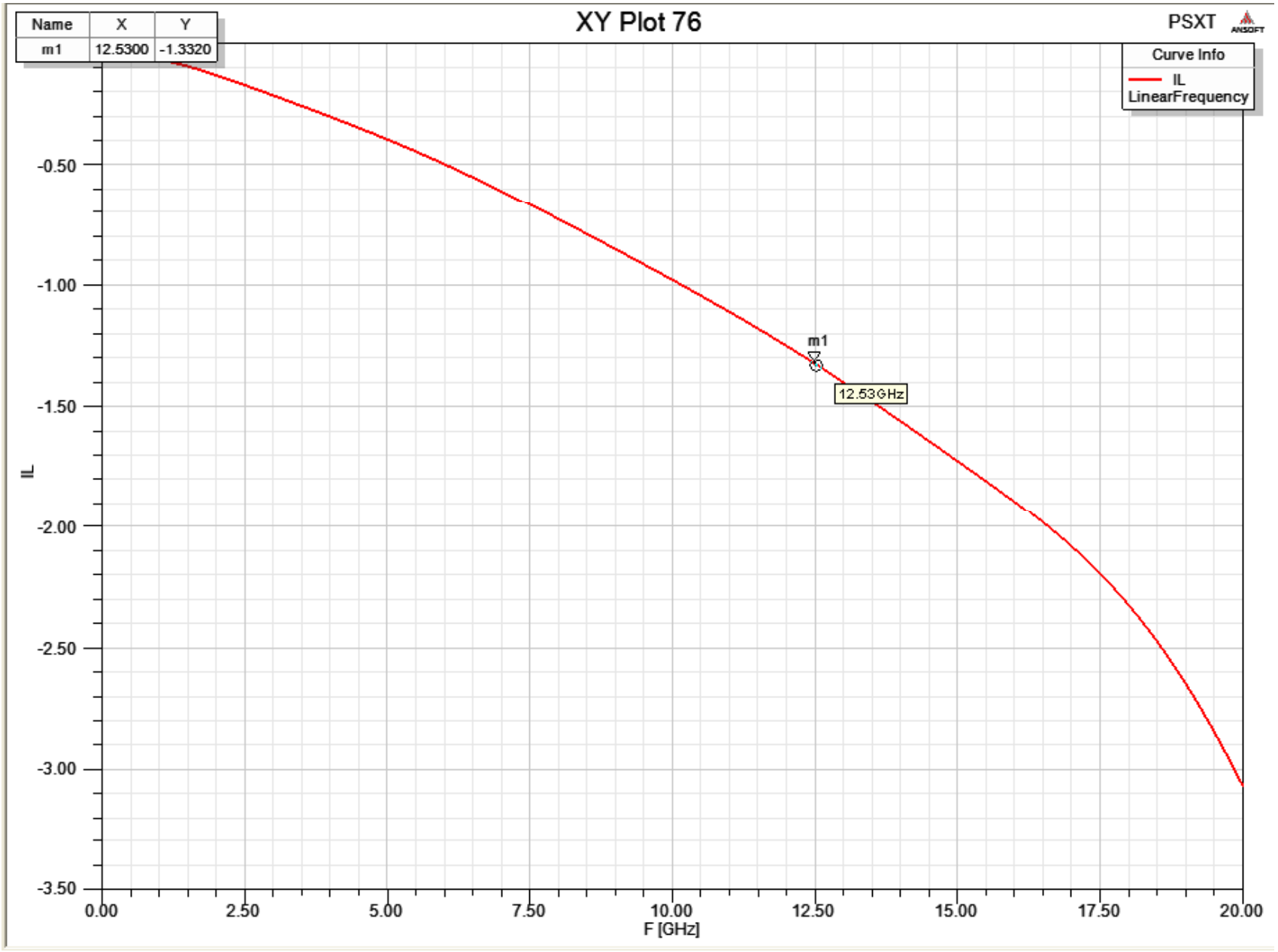
Case#1: 8mil via stub with backdrill: 2 pinning GND vias, with GND cutout under DC blocking capacitor pads, oval antipads around signal vias



Case#2: 4mil via stub with backdrill: 2 pinning GND vias, with GND cutout under DC blocking capacitor pads, oval antipads around signal vias



85mil stack height, 70mil via barrel, 370HR



85mil stack height, 70mil via barrel, 370HR