gEEk® spEEk

Trace Corner Bends | Presenter: Scott McMorrow

INTRODUCTION

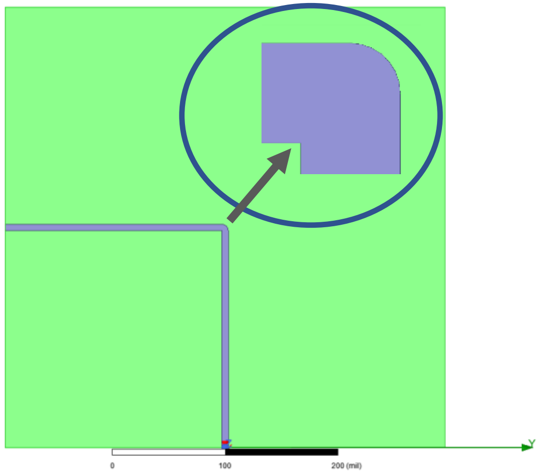
- Comprehensively look at trace 90 degree and 180 degree bend corner radius and the impact on TDR, Return loss, and signaling performance.
- 90 Degree Corners
- 180 Degree Corners
- Dual-180 Degree Serpentine
- Dual-180 Degree Differential Serpentine
- Recommendations for Test Boards
- Recommendations for Production Boards

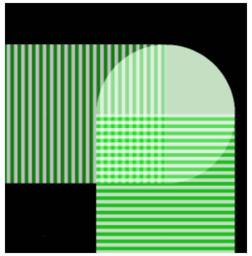
90 Degree Corner Bend Design

90 Degree Corner Radius Model (0.07 mm to 3 mm radius)

samtec gEEk® spEEk

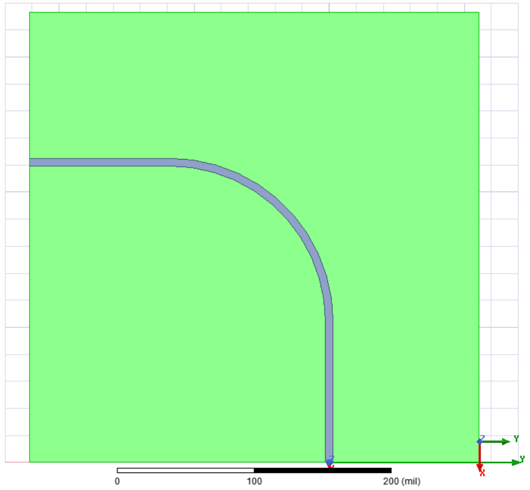
0.07 mm Radius





Cadence/Mentor
“standard”
corner

3 mm Radius

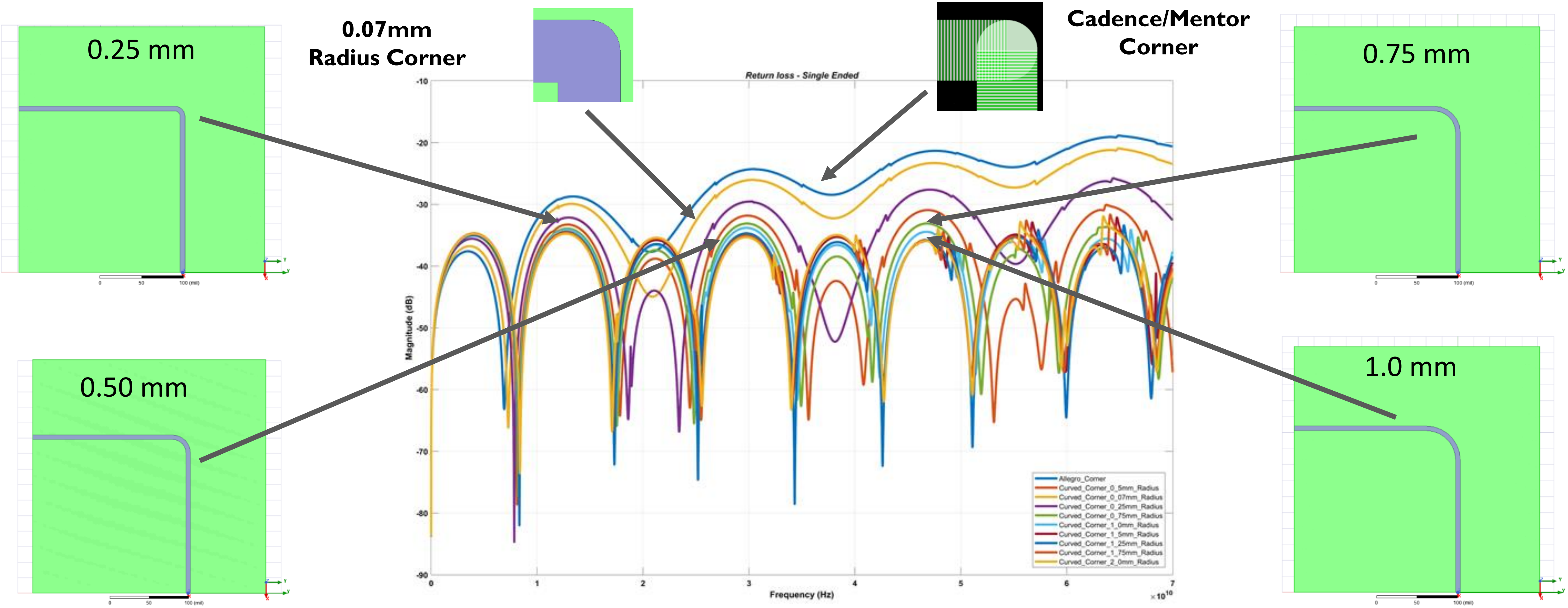


Corner radius swept from 0.07 to 3 mm
Trace length adjusted to 10 mm for constant loss
Stripline geometry
½ Oz Cu, 50 ohm
0.127 mm Core, 0.137 mm Prepreg

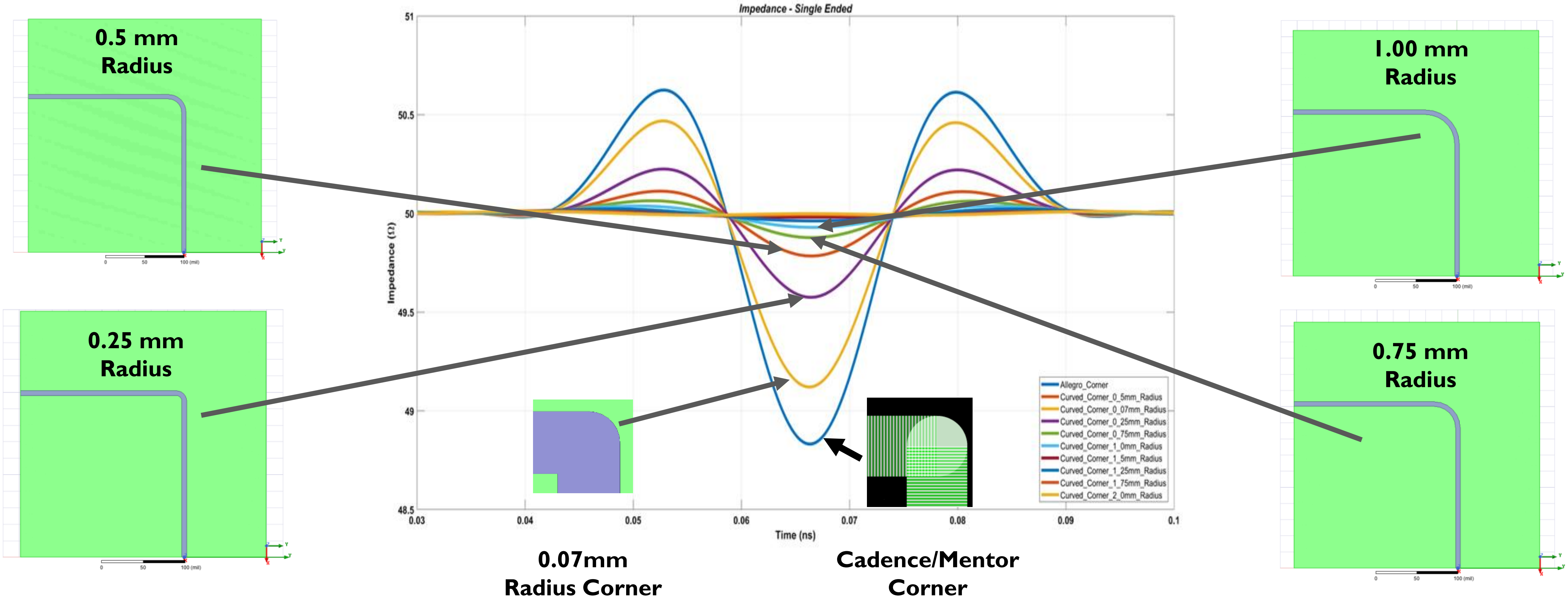
LayerName	Material	Thickness	
		mils	mm
P05	COPPER (0_5oz) VLP2	0.59	0.015
CORE03	I-TERA MT40 (2x1067) (72%) C	5	0.127
S06	COPPER (0_5oz) VLP2	0.59	0.015
DIEL03	I-TERA MT40 (2x1067) (76%) PP	5.39	0.137
P07	COPPER (0_5oz) VLP2	0.59	0.015

Return Loss vs 90 Degree Corner Radius

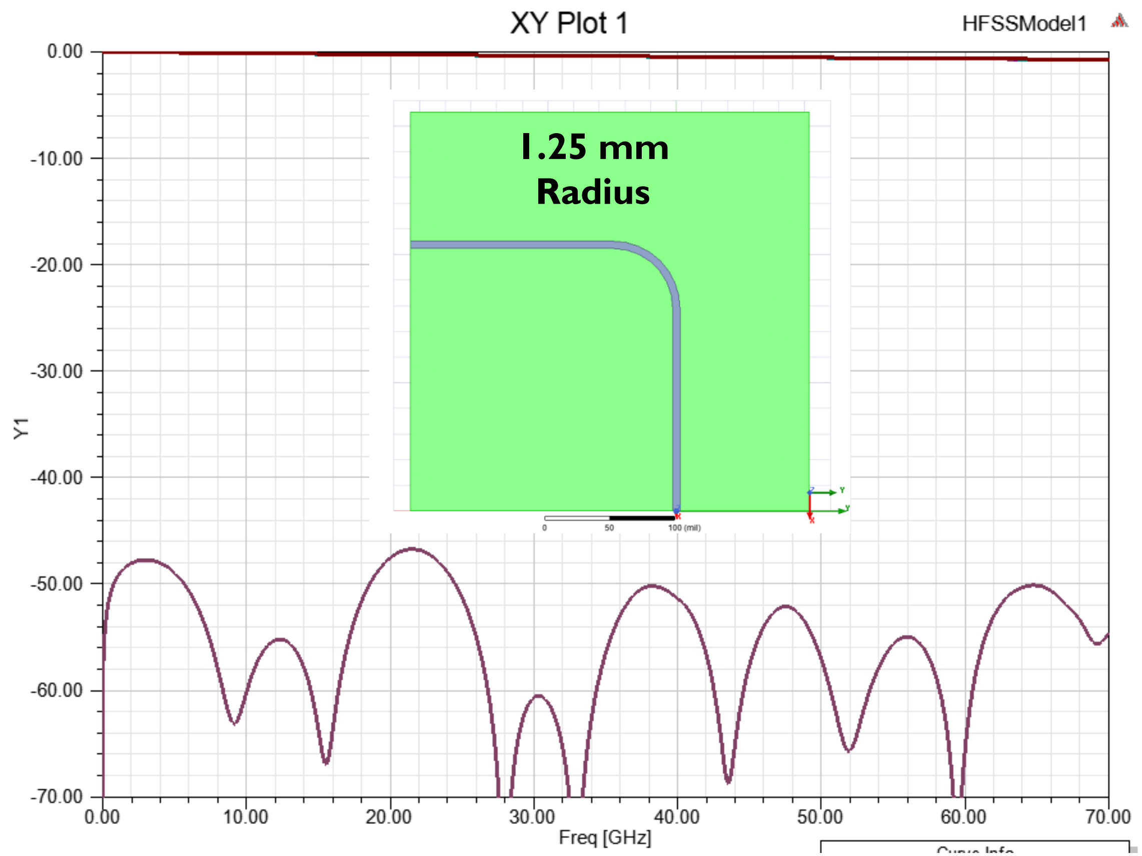
samtec
gEEk® spEEk

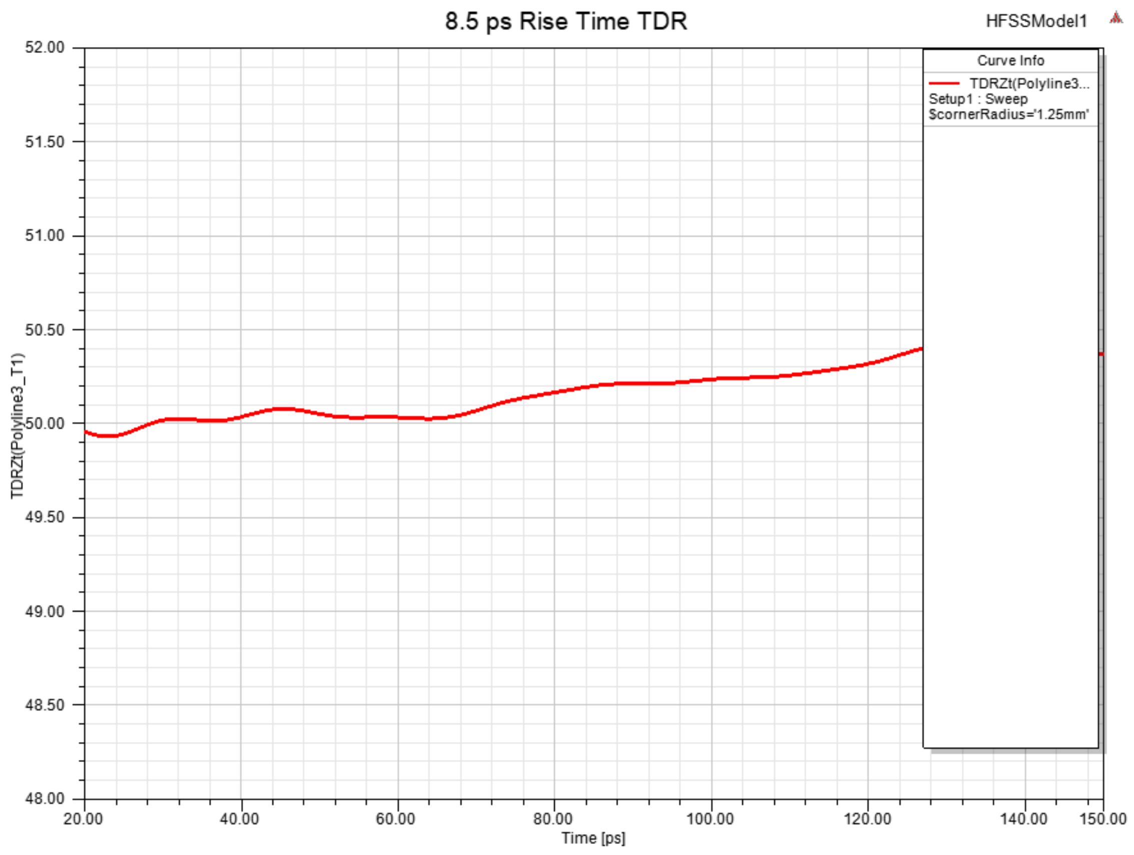


TDR @ 8.5 ps (10/90 %) vs 90 Degree Corner Radius (40 GHz Effective Bandwidth)

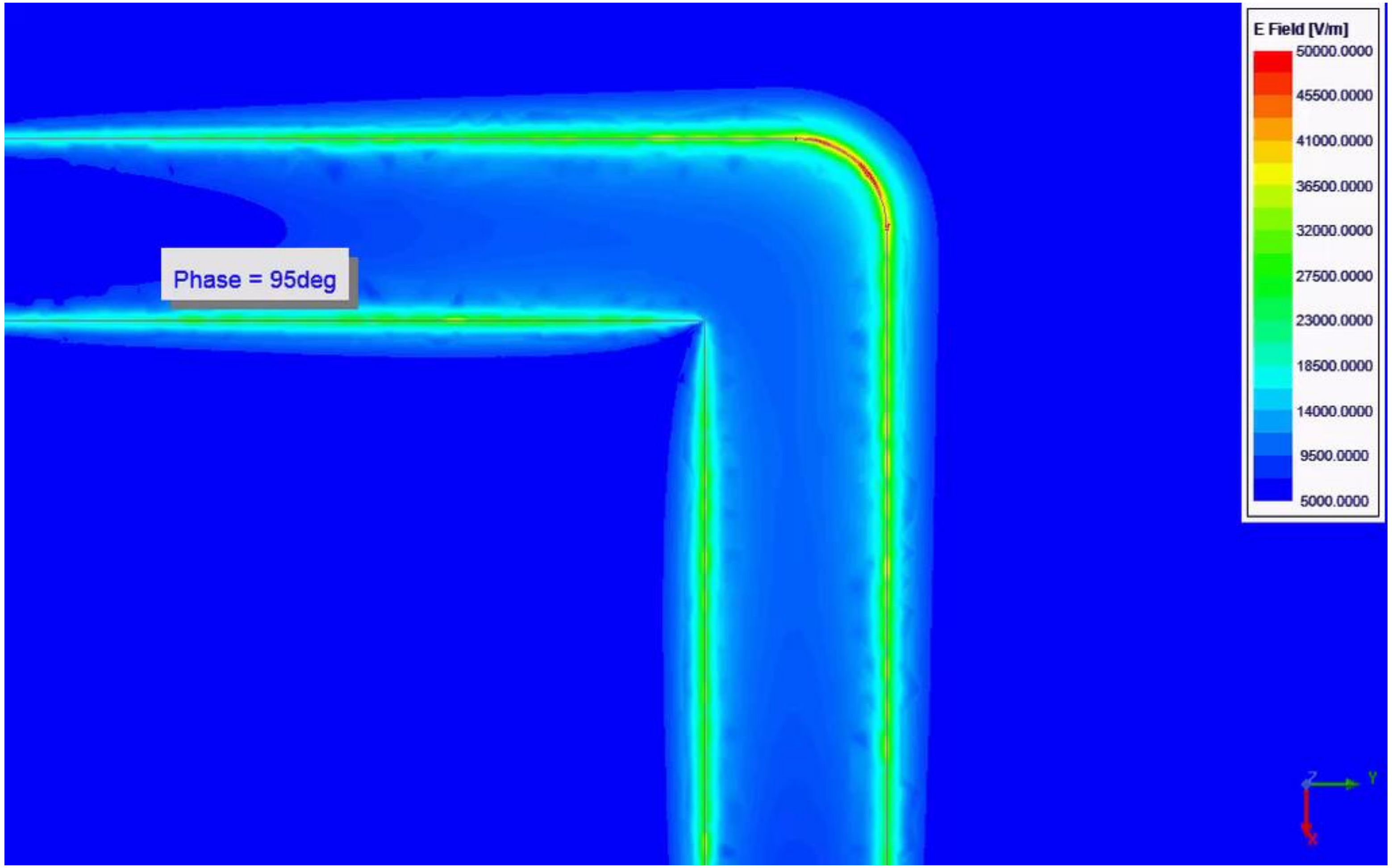


1.25 mm 90 Degree Corner Radius



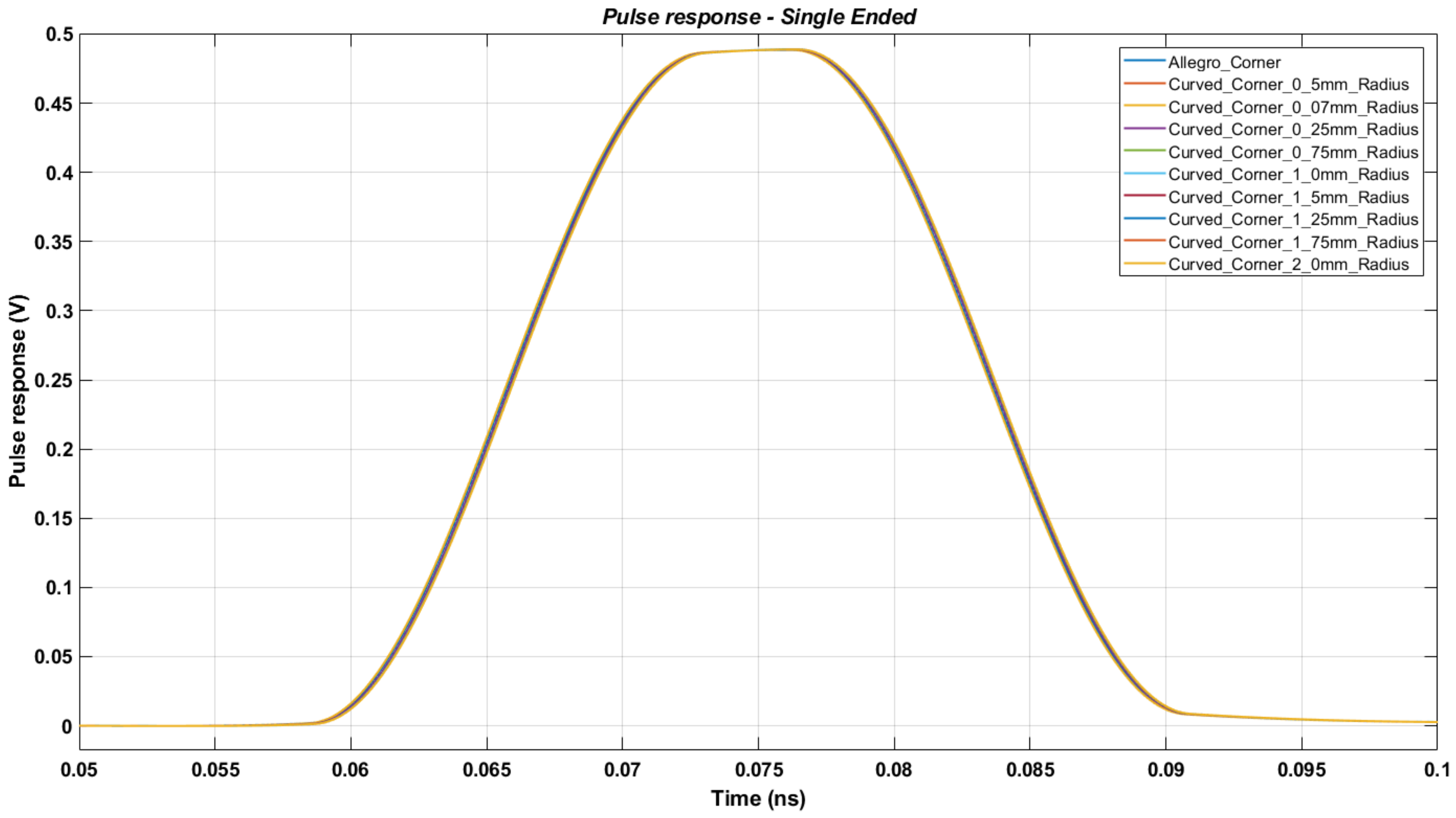


E-Field Plot @ 40 GHz

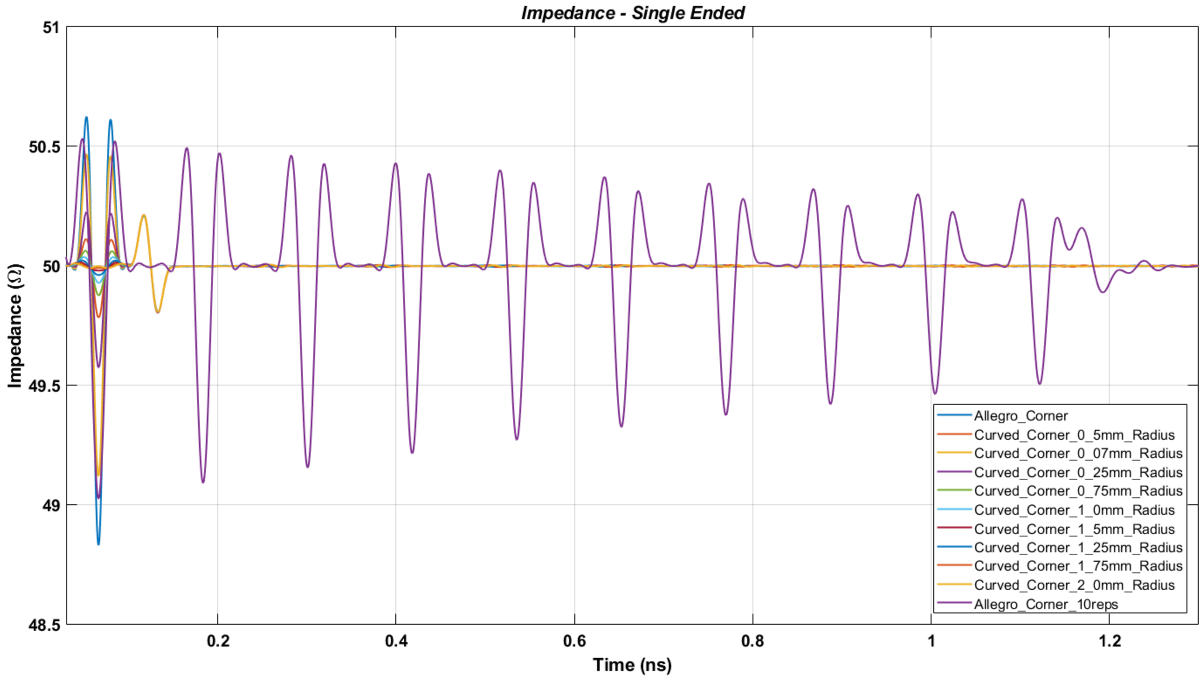


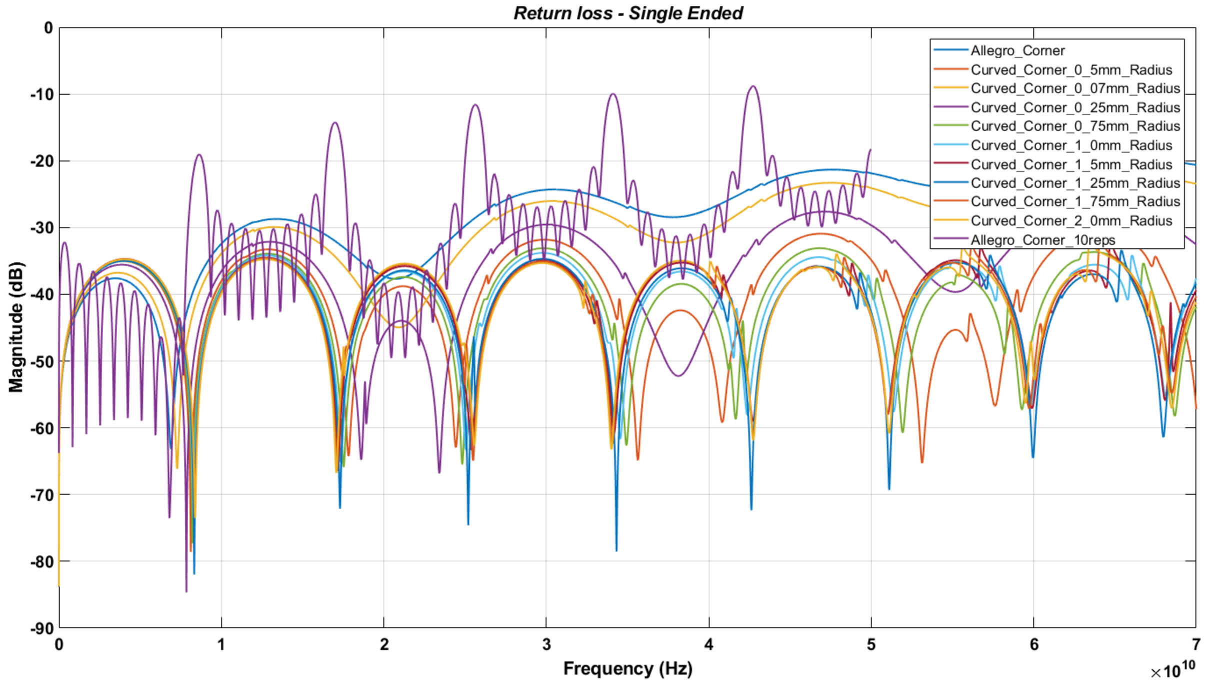
8.5 ps 10/90 % Pulse Response Single 90 Degree Corner

samtec gEEk® spEEk

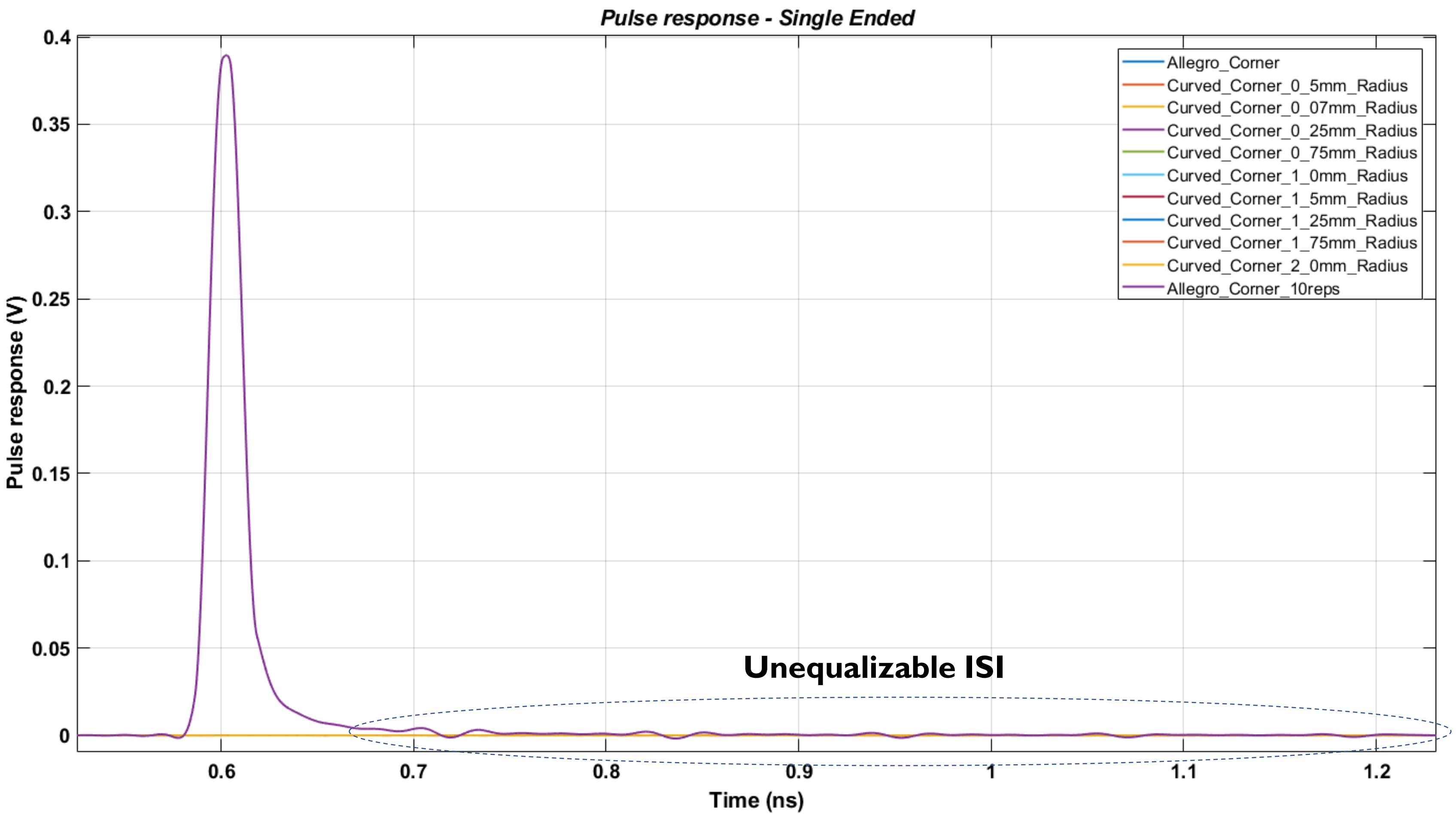


Repetitively Cascaded PCB Corners



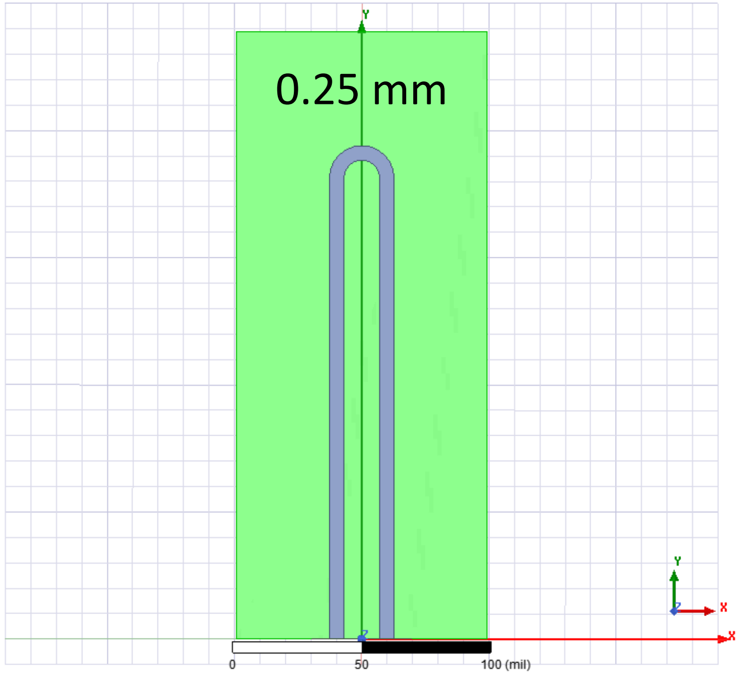


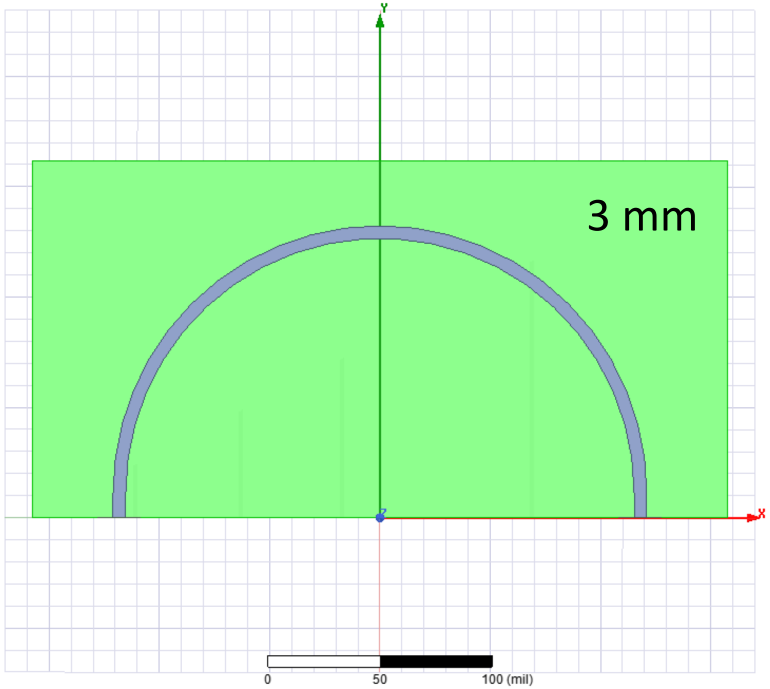
Repetitively Cascaded PCB Corners



180 Degree Corner Bend Design

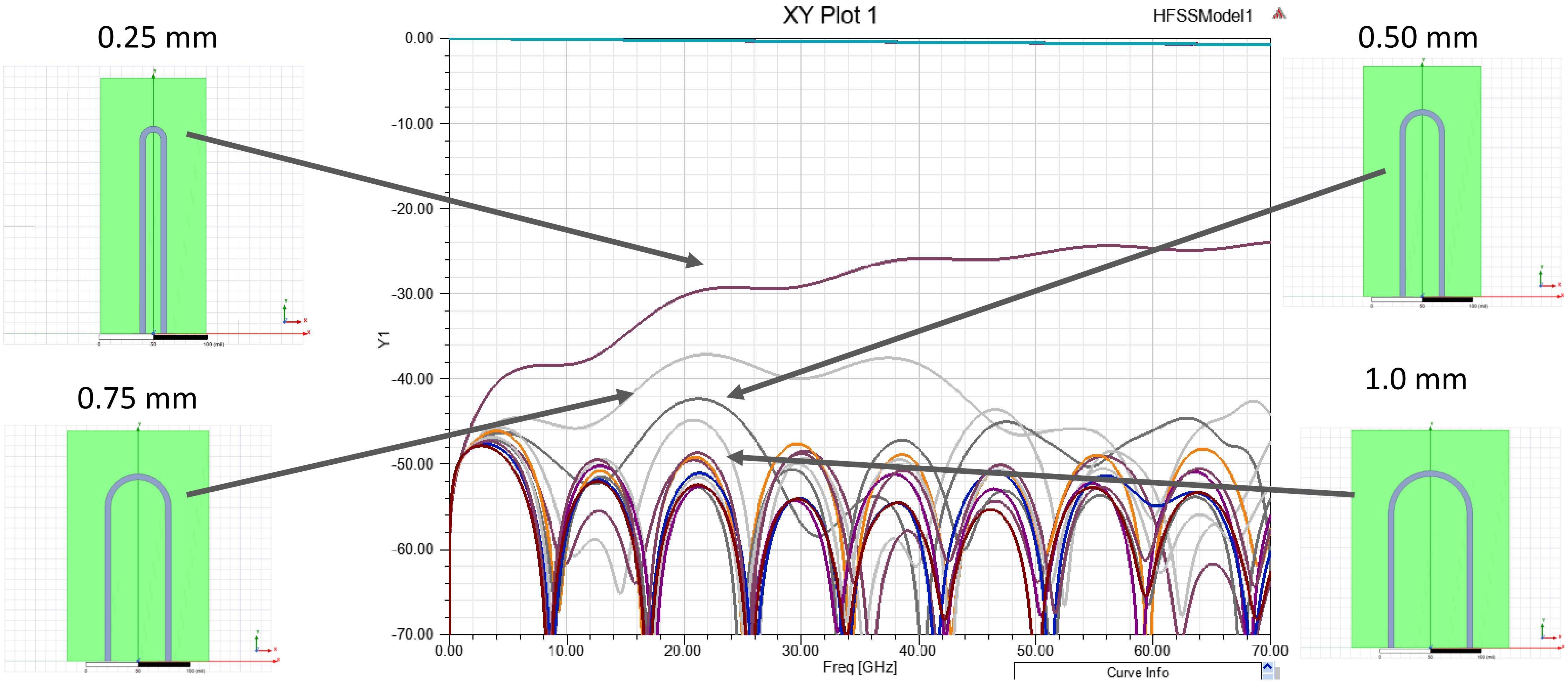
180 Degree Corner Radius Model (0.25 mm to 3 mm radius)





Corner radius swept from 0.25 to 3 mm in steps of 0.25 mm
Total trace length adjusted to 10 mm for constant loss
Stripline geometry
½ Oz Cu, 50 ohm
0.127 mm Core, 0.137 mm Prepreg

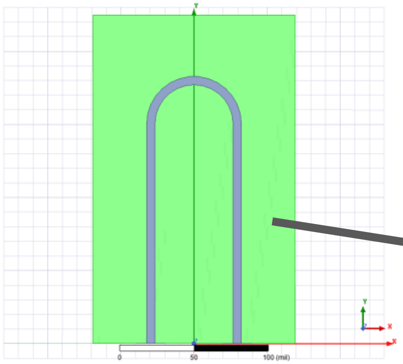
Return Loss vs 180 Degree Corner Radius



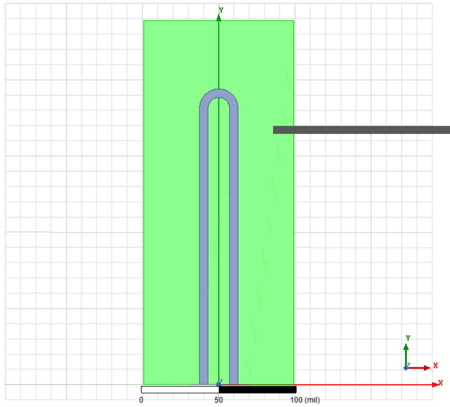
TDR @ 8.5 ps (10/90 %) vs 180 Degree Corner Radius

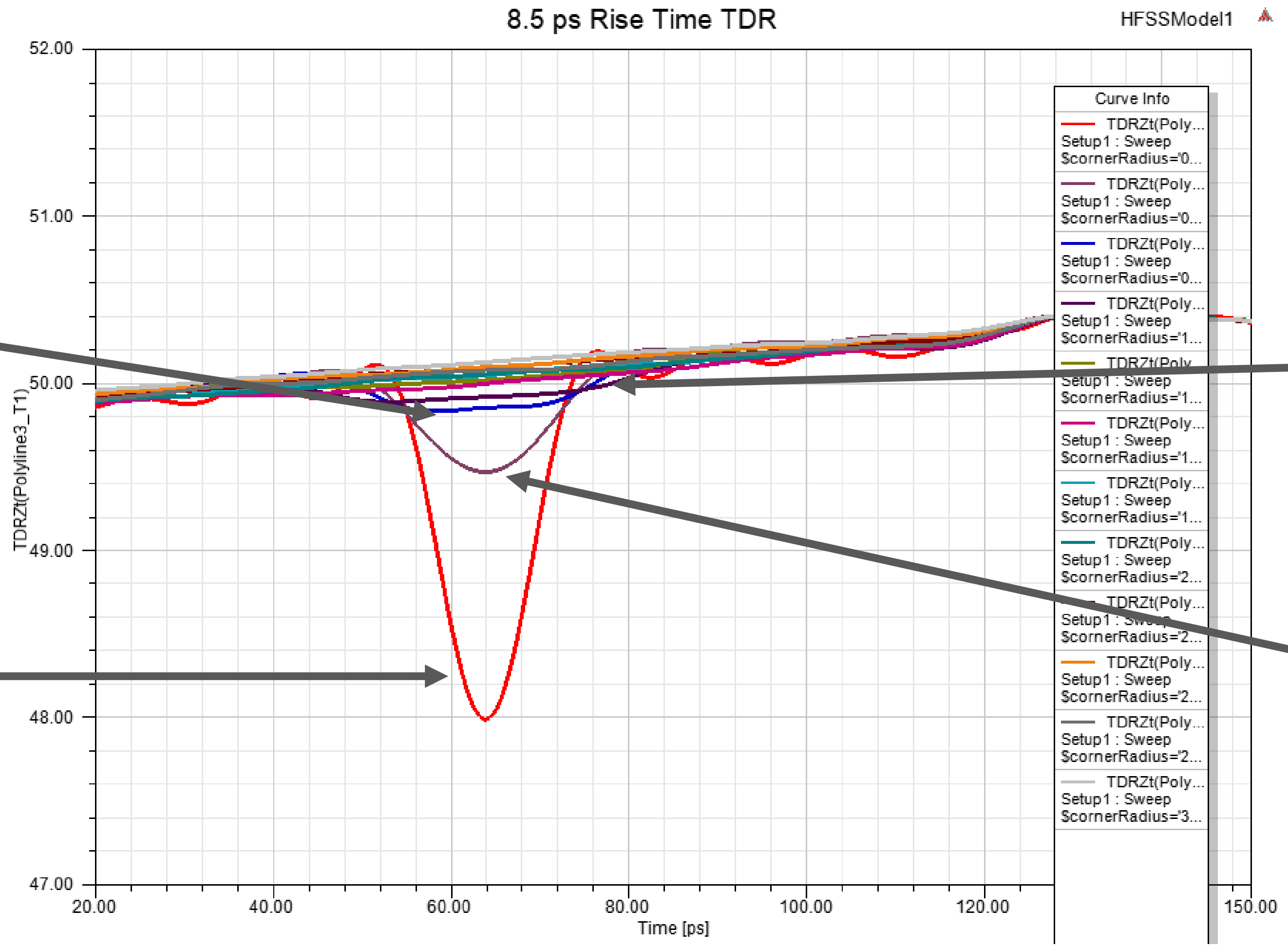
samtec gEEk® spEEk

0.75 mm

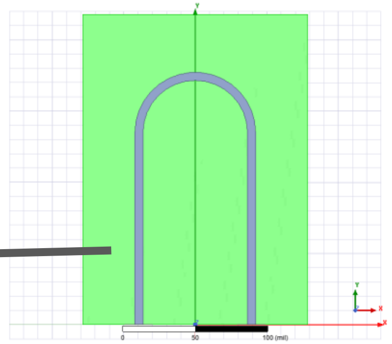


0.25 mm

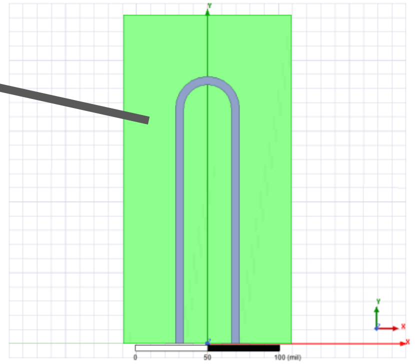




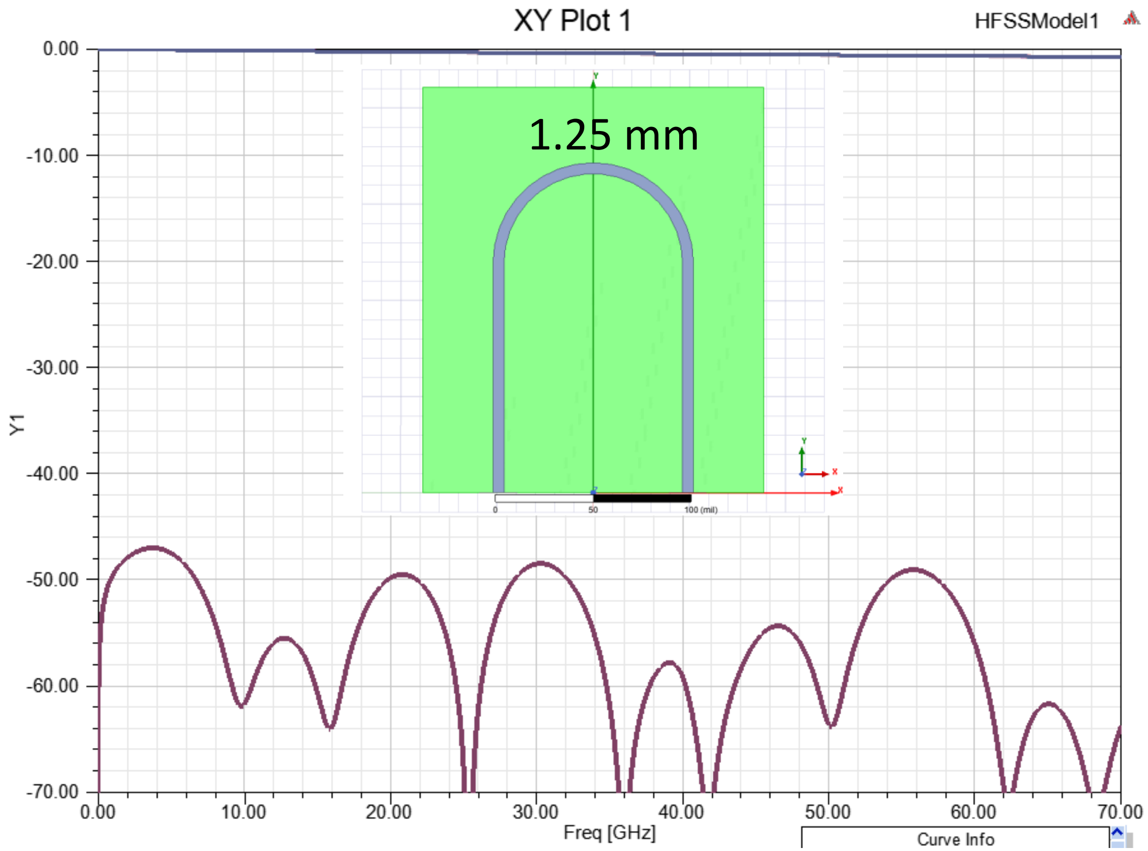
1.0 mm

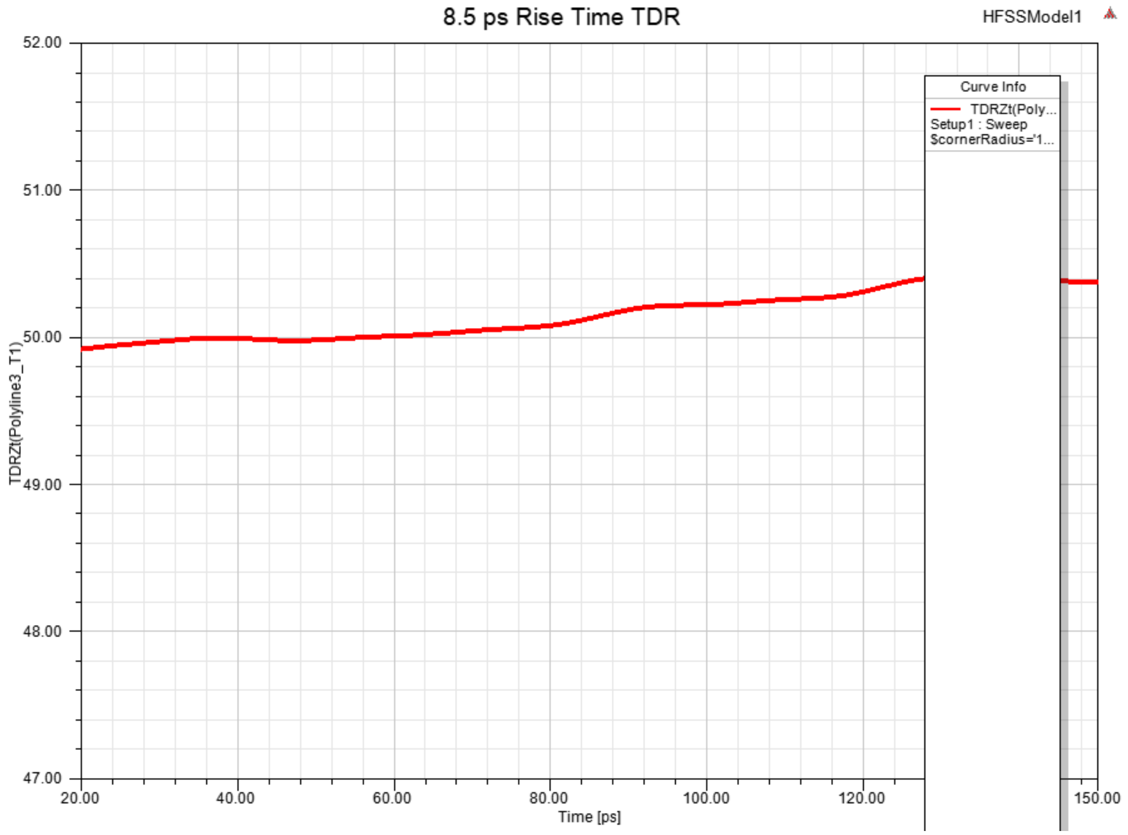


0.50 mm



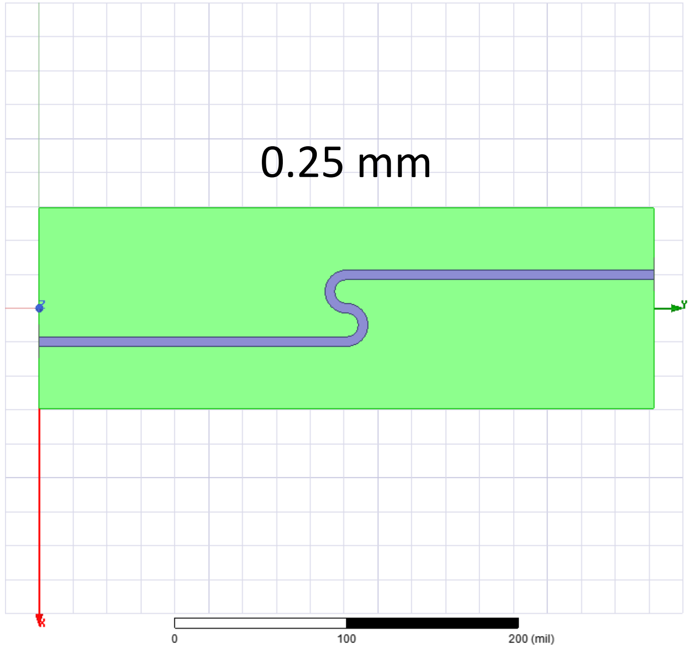
1.25 mm 180 Degree Corner Radius

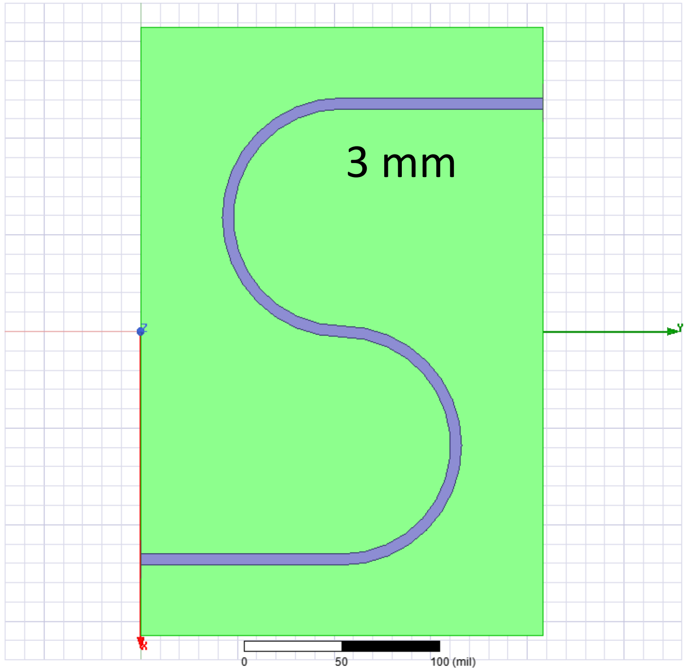




Dual 180 Degree Serpentine Design

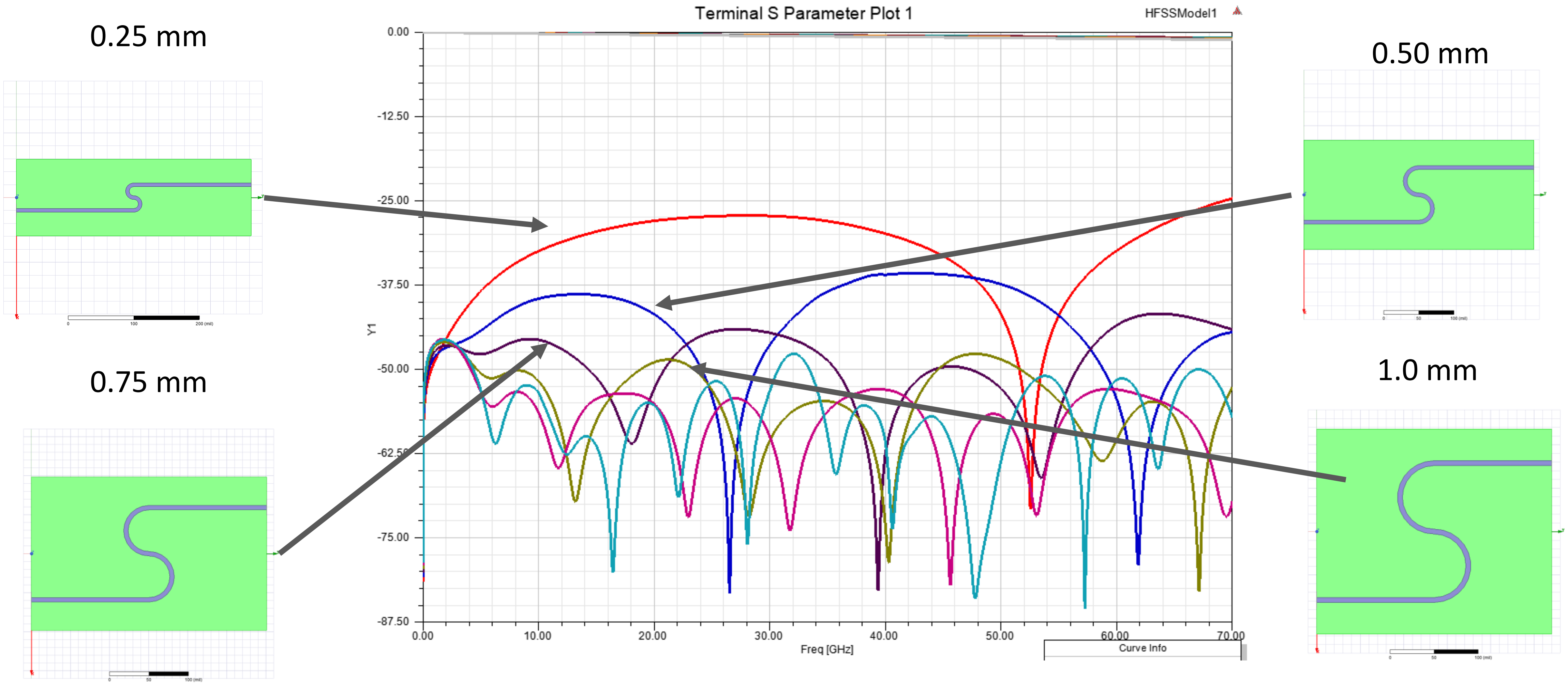
180 Degree Corner Radius Model (0.25 mm to 3 mm radius)



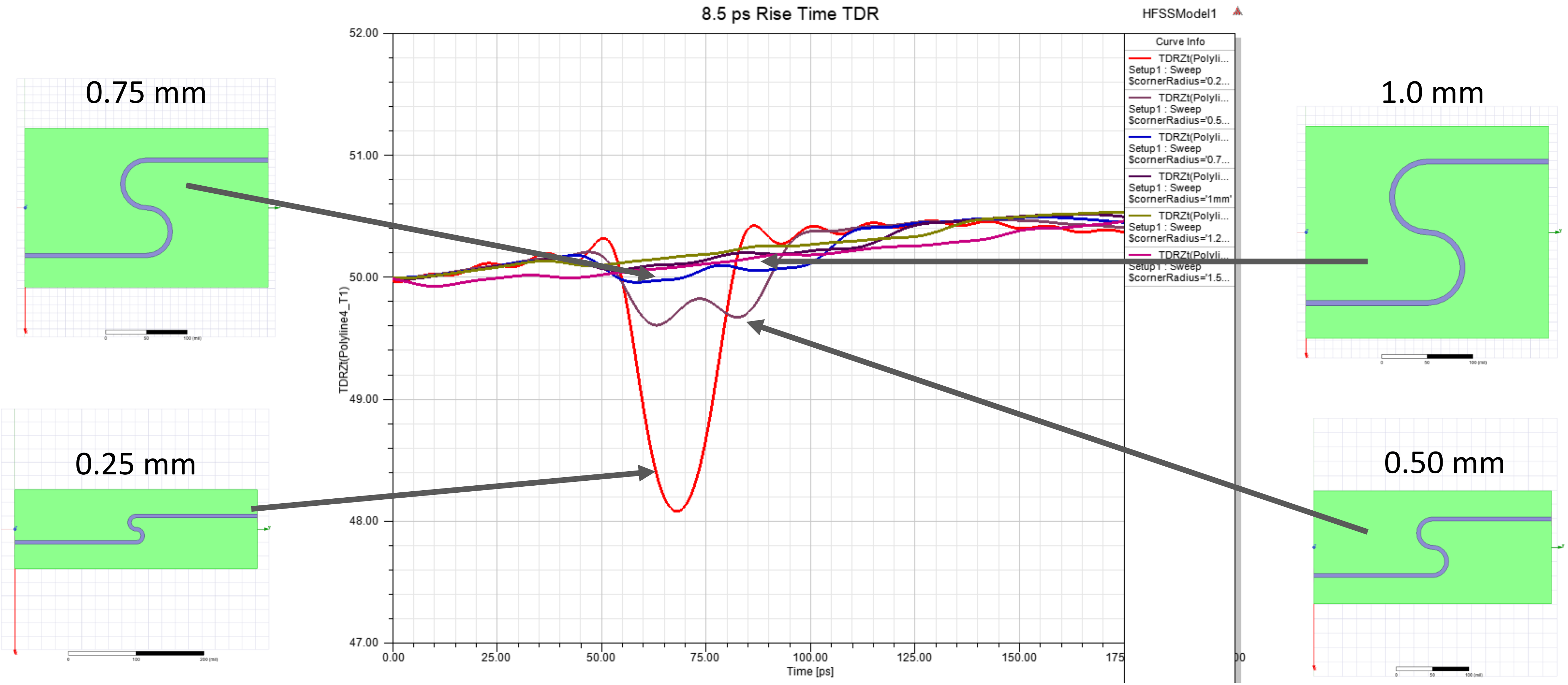


Corner radius swept from 0.25 to 1.5 mm in steps of 0.25 mm
Total trace length adjusted to 10 mm for constant loss
Stripline geometry
½ Oz Cu, 50 ohm
0.127 mm Core, 0.137 mm Prepreg

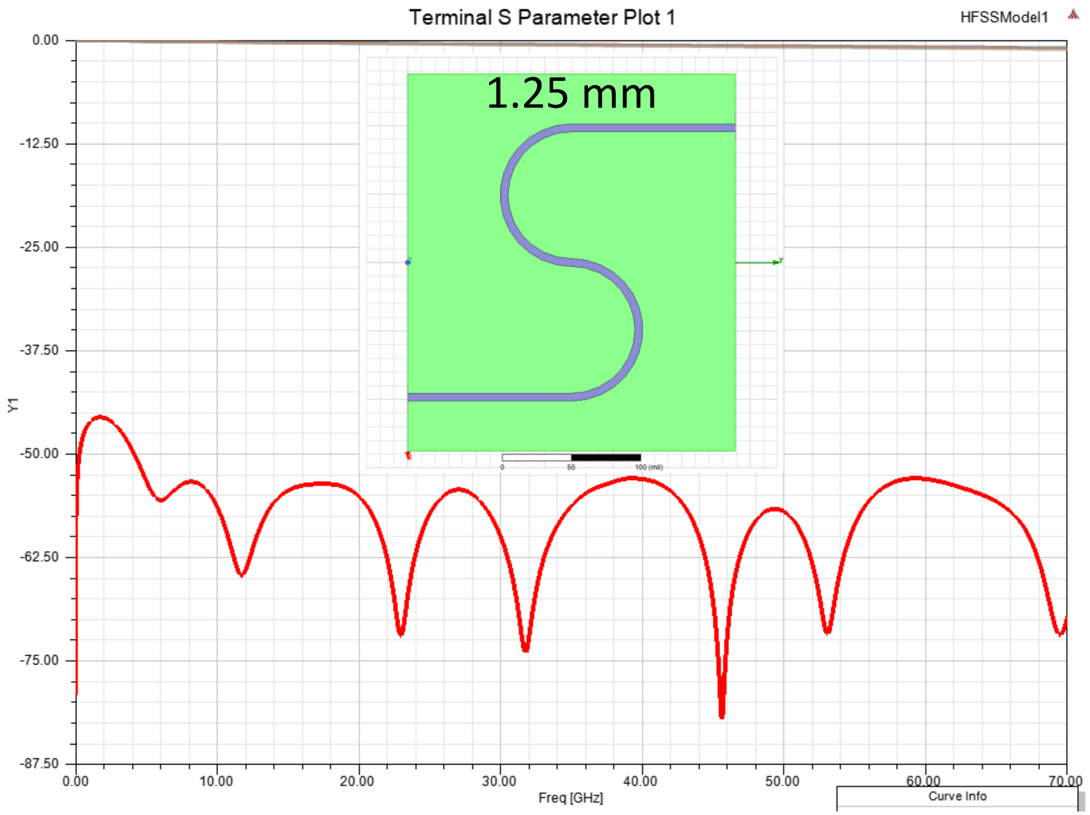
Return Loss vs 180 Degree Corner Radius

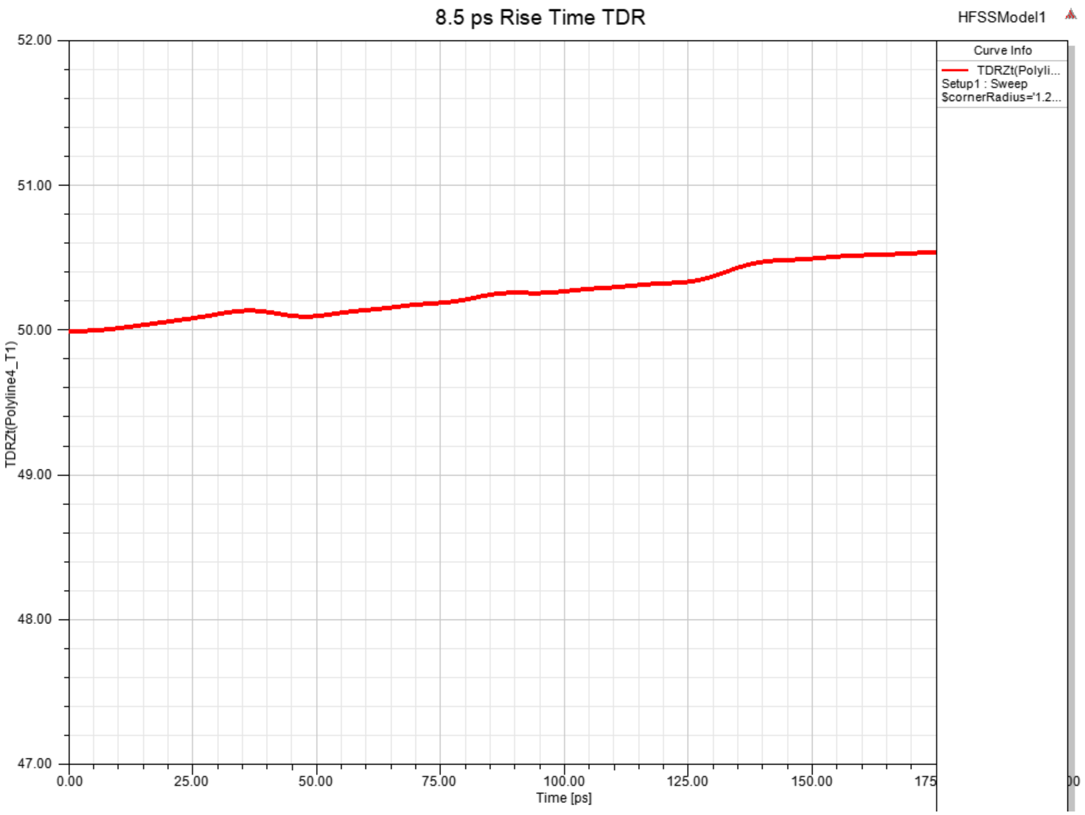


TDR @ 8.5 ps (10/90 %) vs 180 Degree Corner Radius



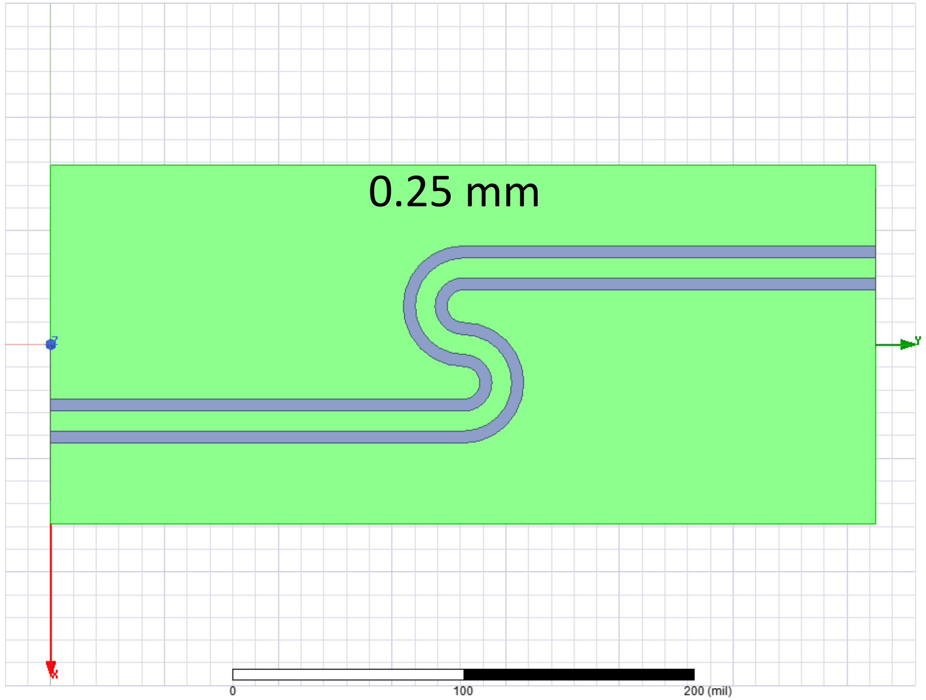
1.25 mm 180 Degree Corner Radius

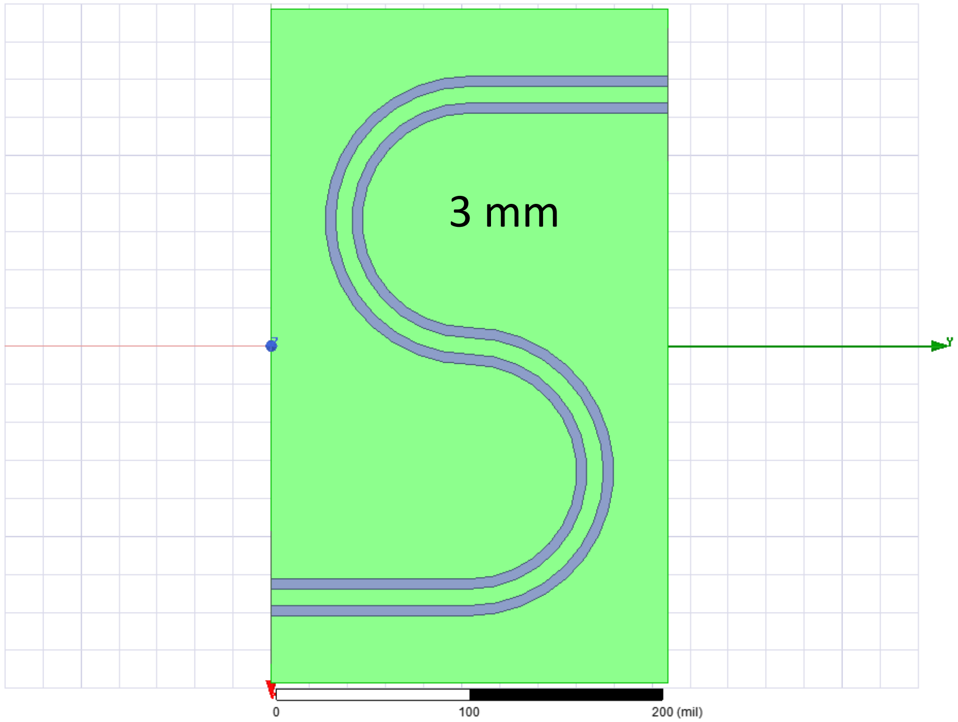




Dual 180 Degree Diff Serpentine Design

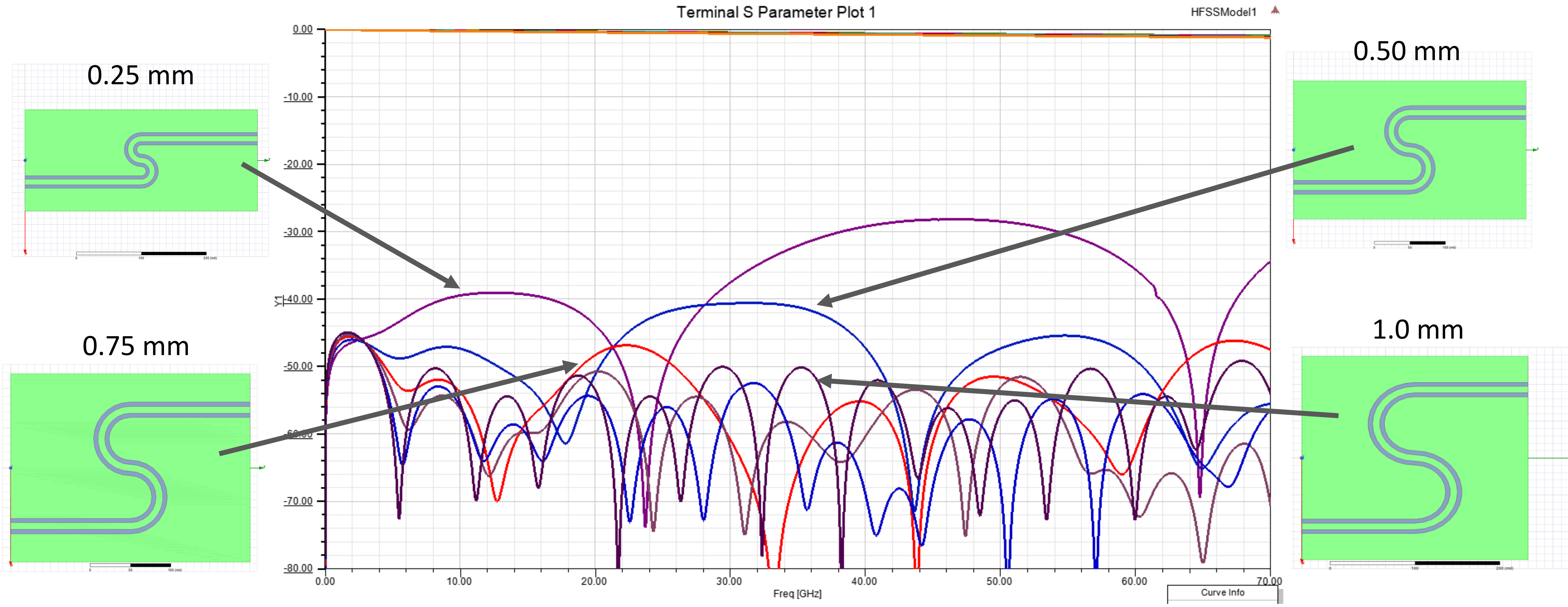
180 Degree Diff Serpentine Model (0.25 mm to 3 mm radius)



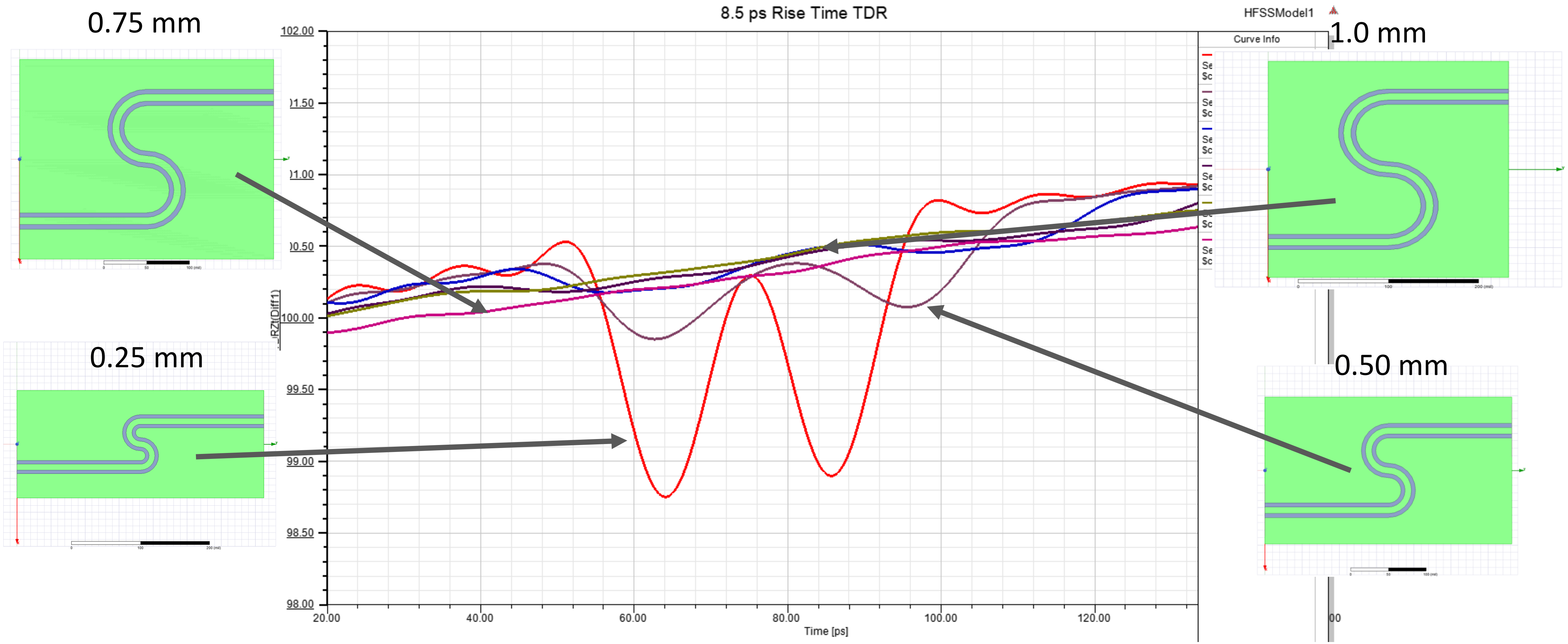


Corner radius swept from 0.25 to 1.5 mm in steps of 0.25 mm
Total trace length adjusted to 10 mm for constant loss
Stripline geometry
½ Oz Cu, 50 ohm
0.127 mm Core, 0.137 mm Prepreg

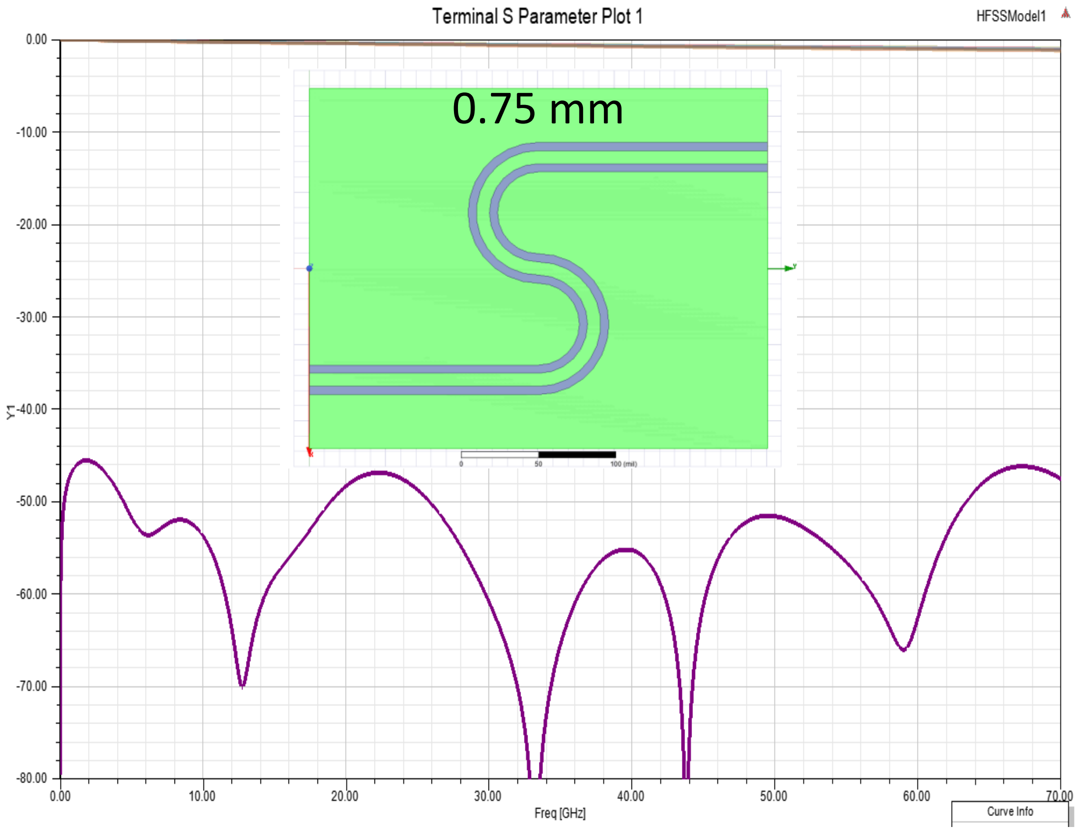
Return Loss vs 180 Degree Diff Inner Corner Radius

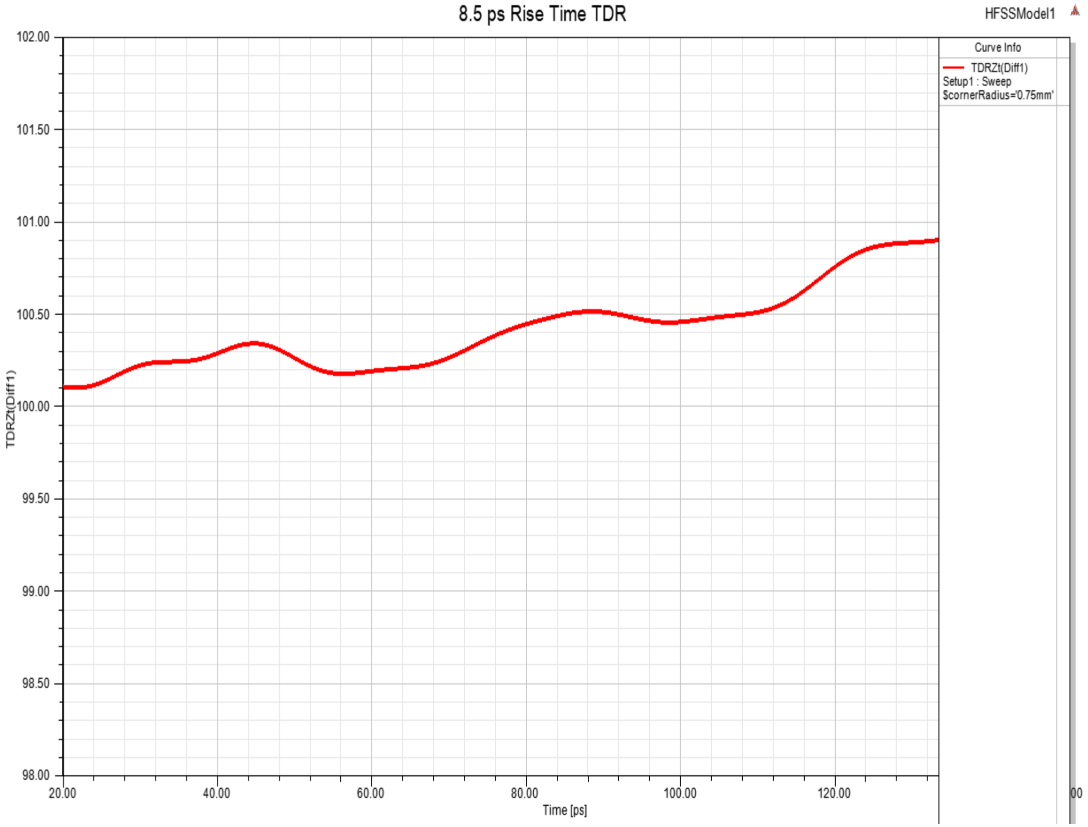


TDR @ 8.5 ps (10/90 %) vs 180 Degree Diff Inner Corner Radius



0.75 mm 180 Degree Diff Inner Corner Radius





Recommendations for Test Boards

	< 28 NRZ	28 NRZ / 56G PAM4	56G NRZ / 112G PAM4	112G NRZ / 224G PAM4/PAM6
Edge Rate (10%/90%)	< 12.5 ps	12.5 ps	8.5 ps	4.5 ps
Max Board Bandwidth	40 GHz	50 GHz	70 GHz	90 GHz
Single Ended Minimum Radius	0.75 mm	1 mm	1.25 mm	1.5 mm
Differential Minimum Radius	0.5 mm	0.75 mm	0.75 mm	1 mm

Minimum Radius scales linearly with Edge Rate / Frequency.

Recommendations for Production Boards

- For single-ended traces, individual corner bends have negligible performance impact when standard PCB corners are used.
  - Degradation is less than natural variation of the PCB in impedance and return loss.
  - However, limit the number of corners on a trace and guard against them being equally spaced, otherwise, unequalizable ISI will build up.
- For differential traces, differential coupling helps.
  - Degradation for a dual-serpentine is negligible.
  - Trace-to-trace crosstalk within the serpentine will determine spacing.

For information about Samtec's gEEk® spEEk presentations,
contact: **gEEkspEEk@samtec.com**

For Signal Integrity questions, contact: SIG@samtec.com

To view previous gEEk® spEEk webinar recordings,
go to **www.samtec.com/geekspeek**