EDGES Variation Project

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Tom Mozdzen

A study was performed to determine the effect of physical dimension variation upon the S11 parameter of the nominal EDGES antenna. Fig. 1 shows a 3D image of the antenna's shape. Several dimensions were varied by +/- 5% and +/- 10%. These dimensions are listed in table 1 and are illustrated in figs. 2-4. Only one parameter was varied at a time.

The tilt angle parameter needs a little explaining. The unconnected panels were left in their ideal position while the active panels were tilted either both up, one up and one down or both down. Each panel had its own tilt parameter, tilt1 and tilt2. The tilt angle was determined to be 4.4% for a 10% variation in the ideal height of 18.5" and a panel diagonal dimension of 24". A full 5x5 matrix of variation was conducted for these parameters and care had to be taken to make sure the port didn't become disconnected while "bending" the panels up and down.

Figs. 5 – 10 show the simulated results of the variations. For each of these graphs, the lowest numbered curve is the -10% variation while the highest numbered curve is the +10% variation. Each graph contains Curve 3, which is the configuration with nominal antenna dimensions.

The S11 response is most sensitive to two parameters: XY1 and z_height. XY1 has a big impact upon the frequency range and z_height affects the value of S11. However, as the value of z_height increases and the reflection coefficient decreases, the high end frequency response also decreases. The low end frequency response appears to be un affected.

The results of this study will be used to perform a principal component analysis where an optimal basis set will be found which will allow us to model the antenna with as few parameters as possible.

Parameter	-10%	-5%	Nominal	+5%	+10%
			(inches)		
t_rim	0.0288	0.0304	0.032	0.0336	0.0352
z_rim	0.495	0.5225	0.55	0.5775	0.605
xy1	10.8	11.4	12	12.6	13.2
xy2	4.78125	5.046875	5.3125	5.578125	5.84375
z_height	16.65	17.575	18.5	19.425	20.35
xymin	0.3375	0.35625	0.375	0.39375	0.4125
			(degrees)		
tilt1 (degrees)	-4.4	-2.2	0	2.2	4.4
tilt2 (degrees)	-4.4	-2.2	0	2.2	4.4

Table 1. Parameter Variations. Parameter t_rim is the thickness of the metal. The other parameters are illustrated in figures 2 – 4.
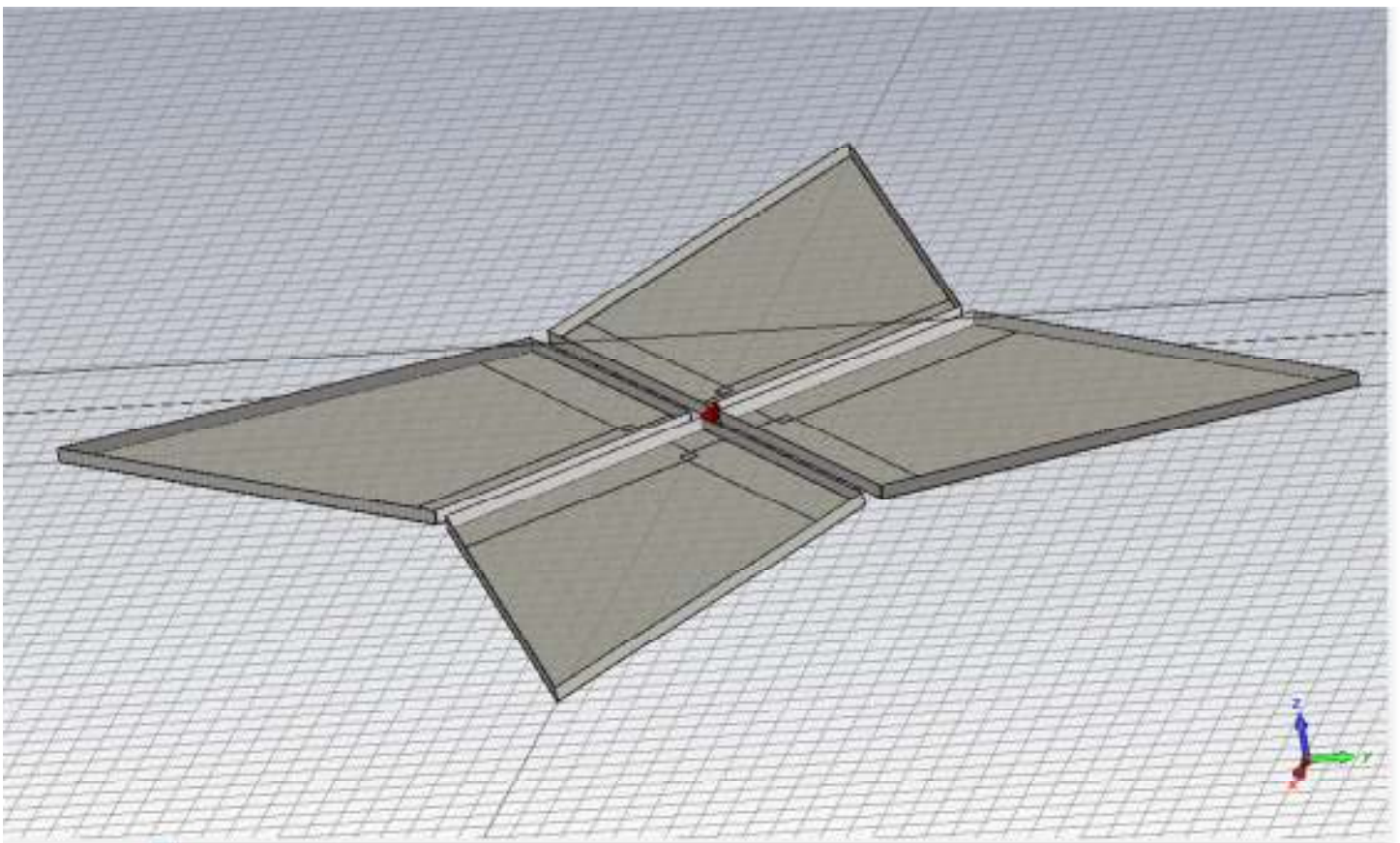
Figure 1. Picture of the EDGES Antenna
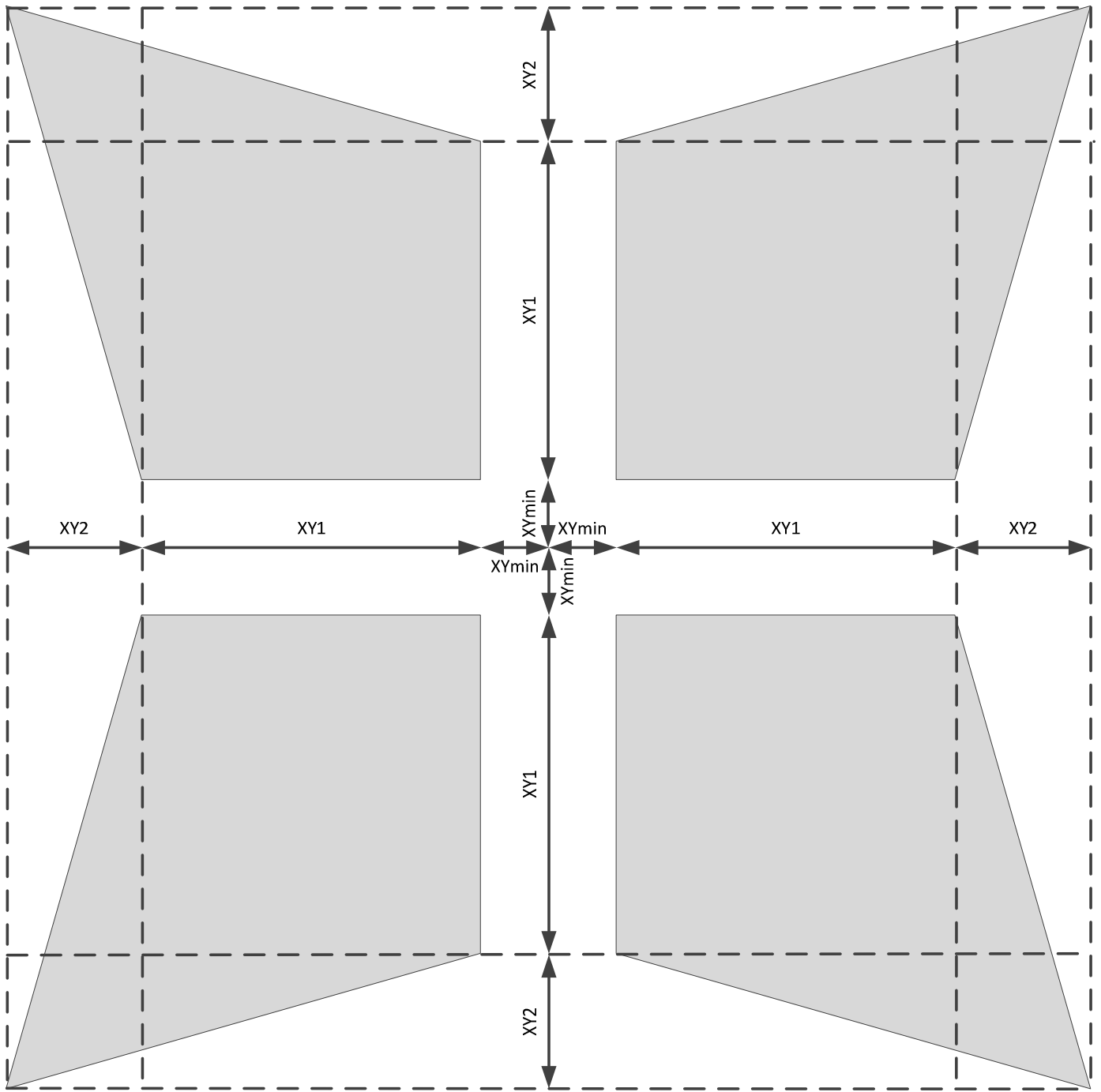
Figure 2. Face view showing the definitions of parameters XYmin, XY1, and XY2
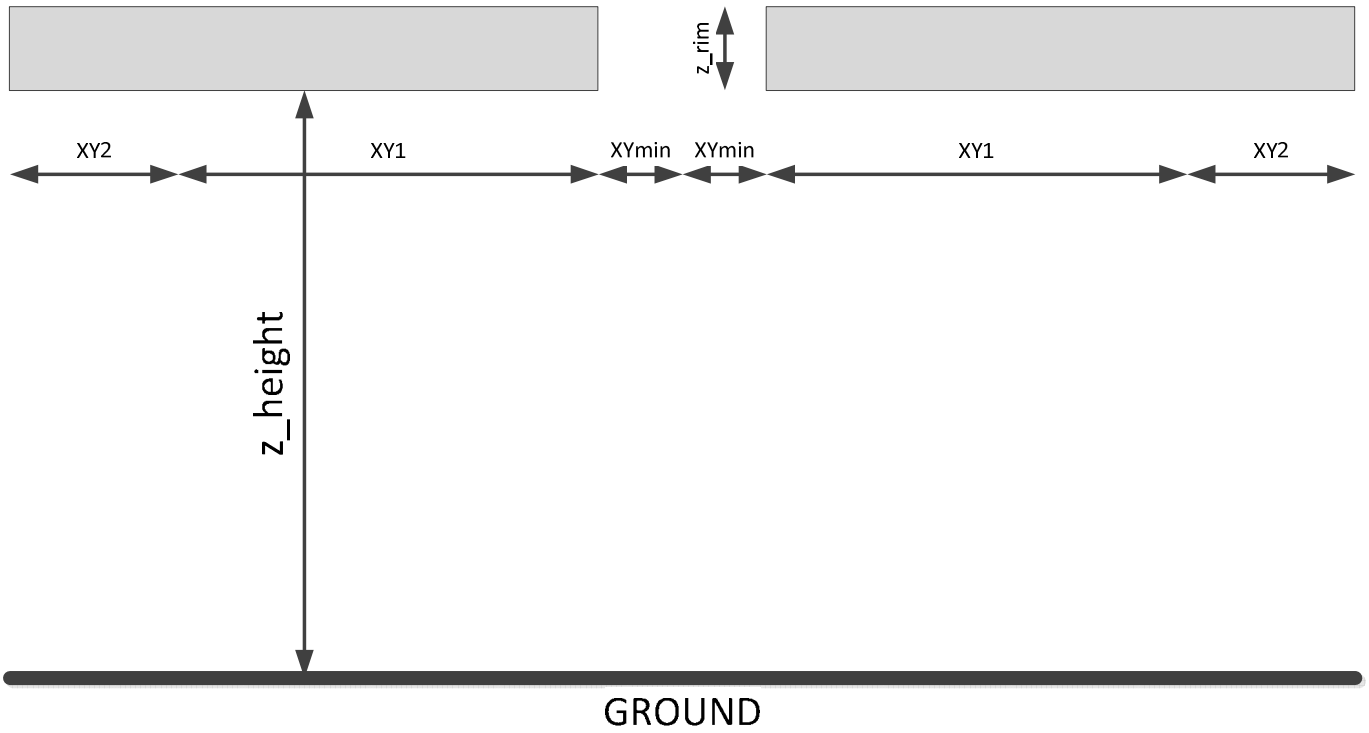
EDGES Side View

XY2   XY1   XYmin   XYmin   XY1   XY2

z_rim

z_height

GROUND

Figure 3. Side view showing the definitions of parameters z_height and z_rim

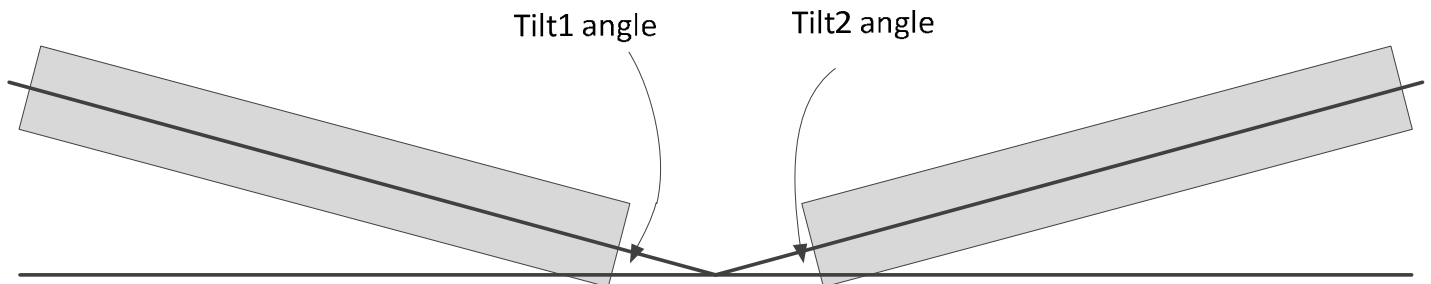# EDGES Side View
Showing Tilt Angles

Tilt1 angle   Tilt2 angle

Figure 4. Side view showing the definitions of tilt1 and tilt2
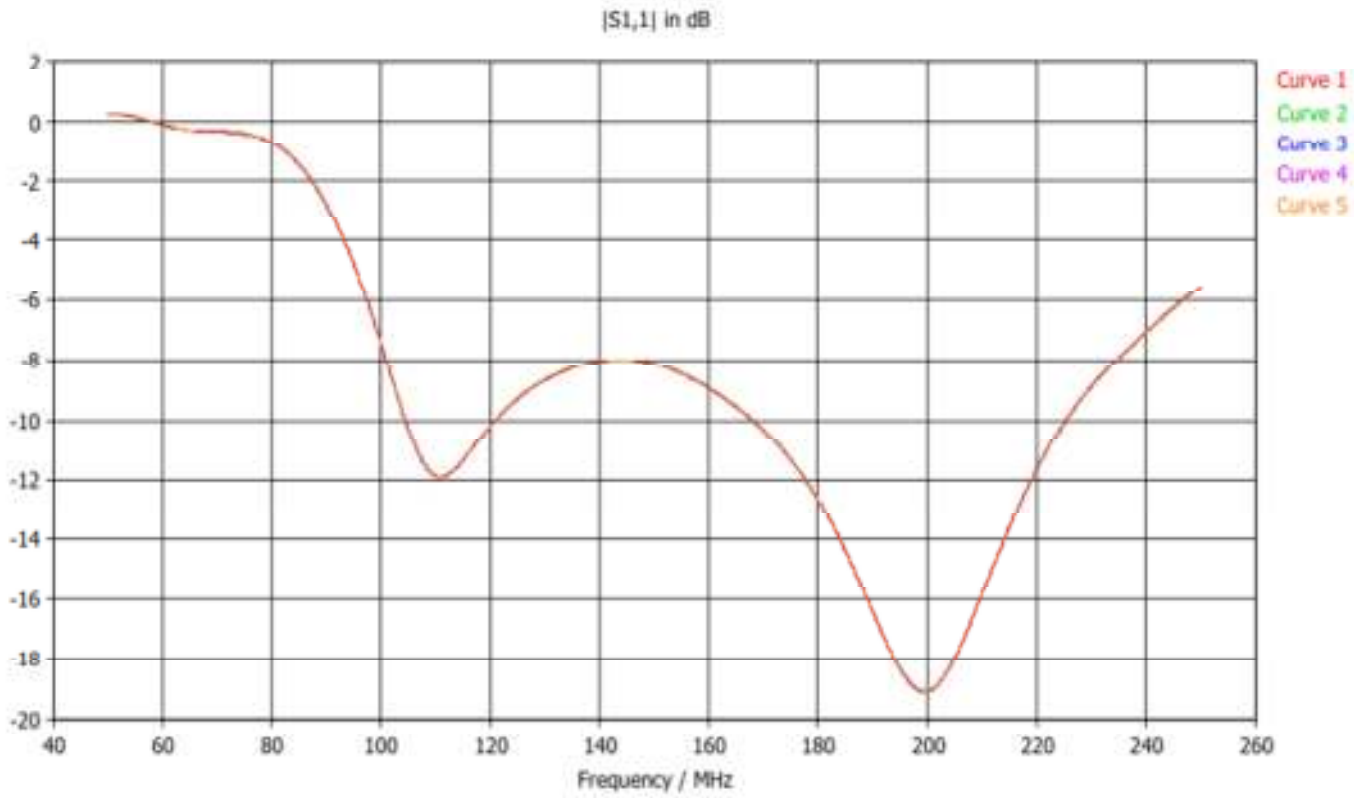
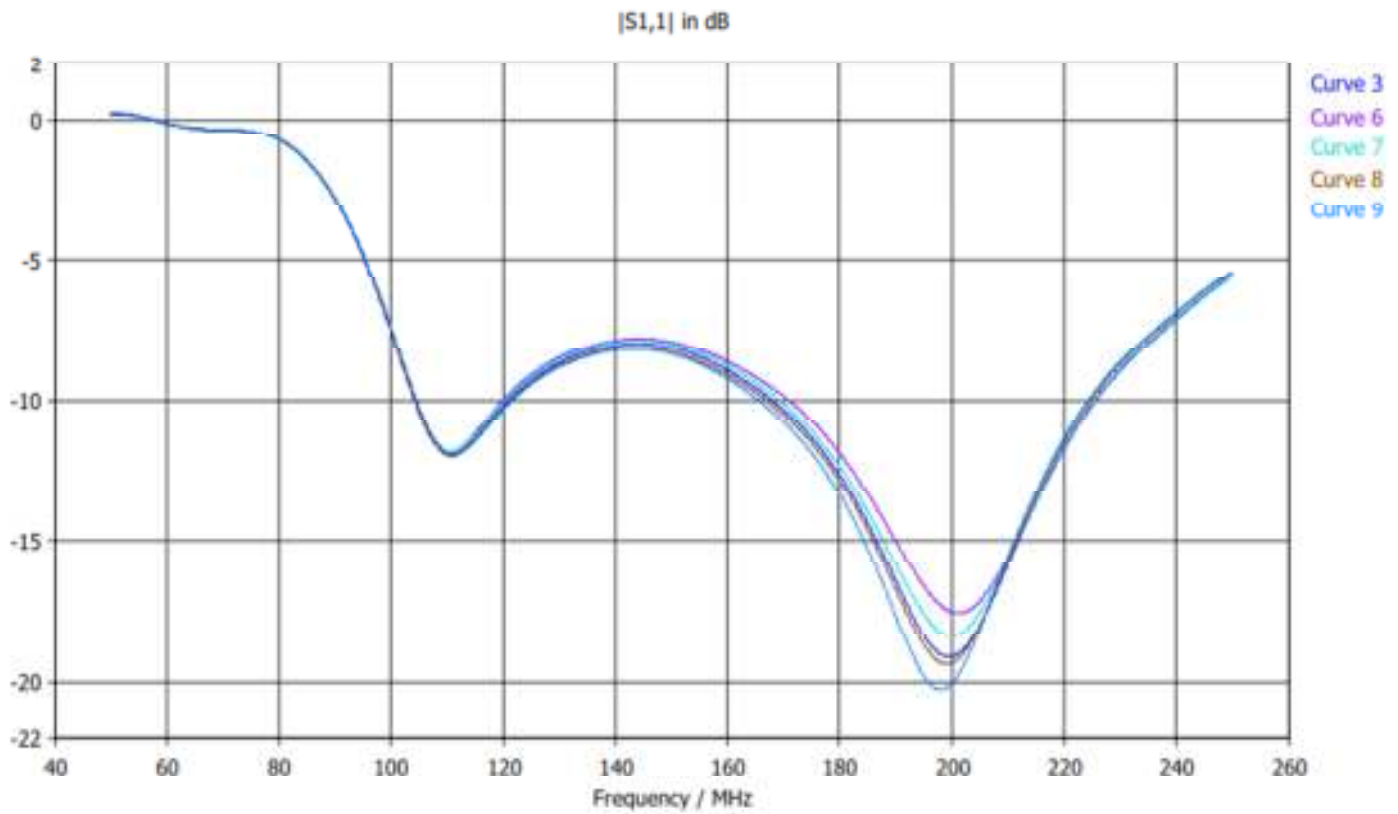Figure 5. Thickness variation – t_rim (Curve 1 is -10%, Curve 3 is nominal, and Curve 5 is +10%)

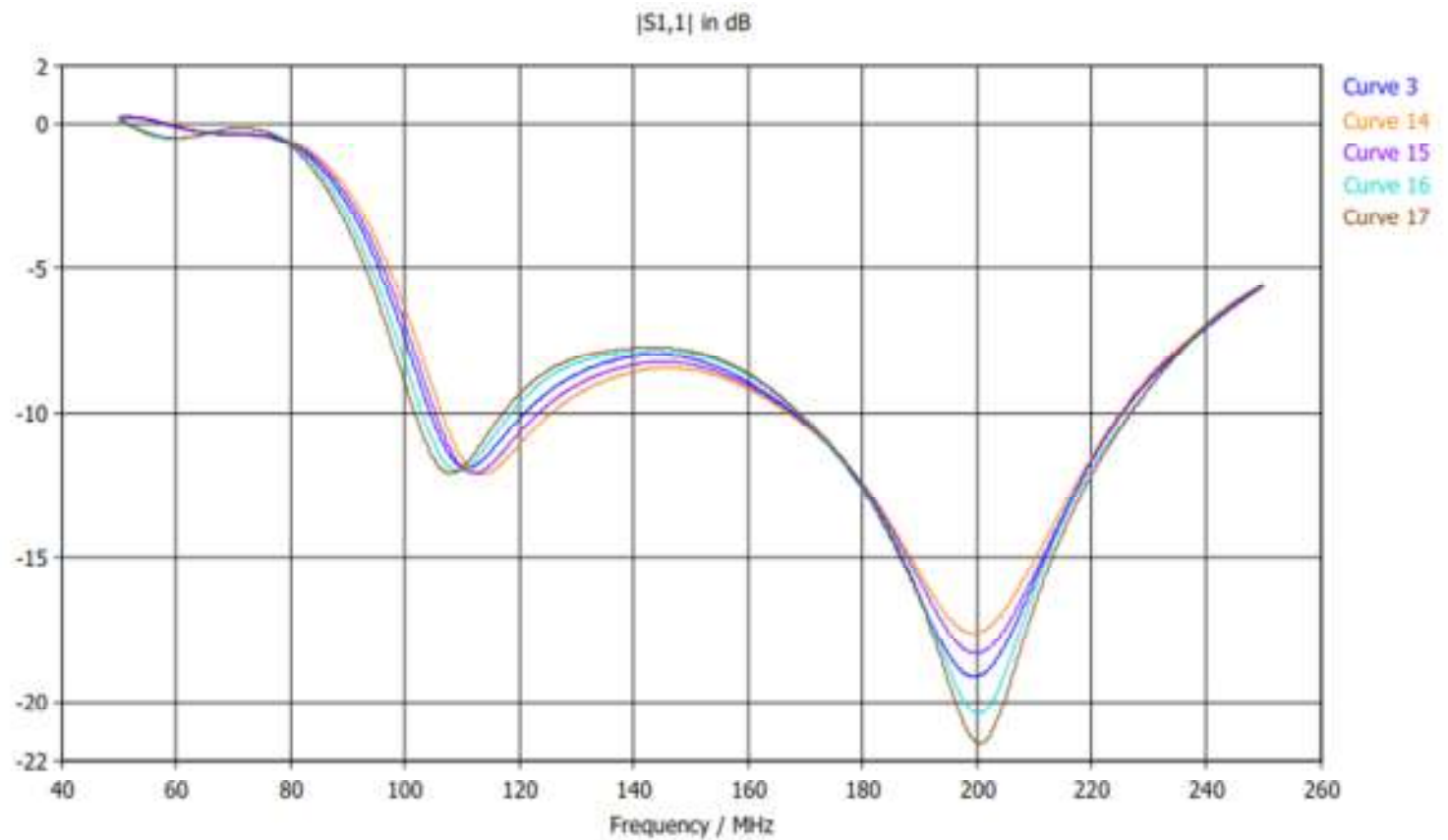Figure 6. Rim height variation – z_rim
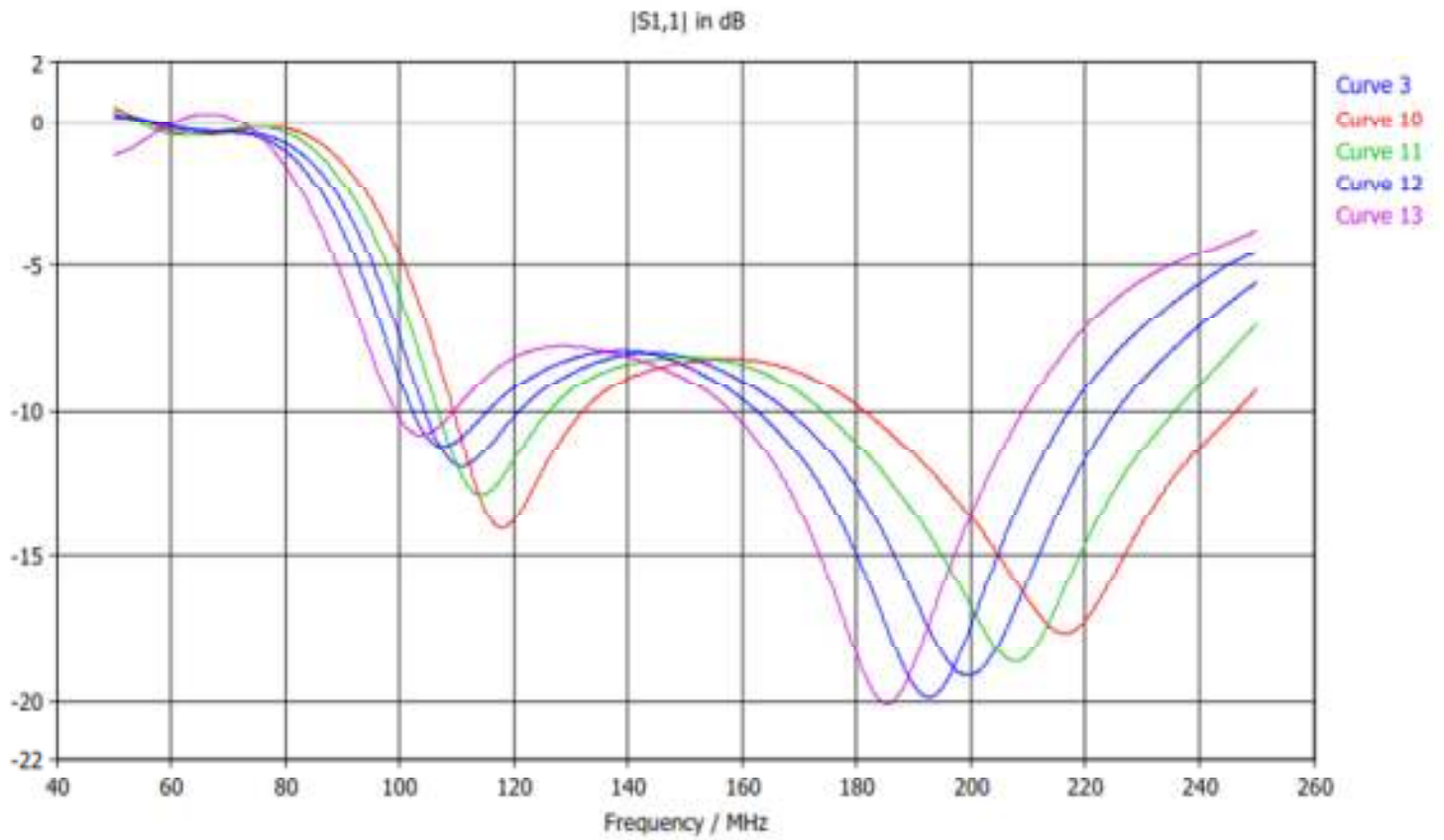
Figure 7. XY1 variation

Figure 8. XY2 variation

|S1,1| in dB

Curve 3
Curve 18
Curve 19
Curve 20
Curve 21

Frequency / MHz
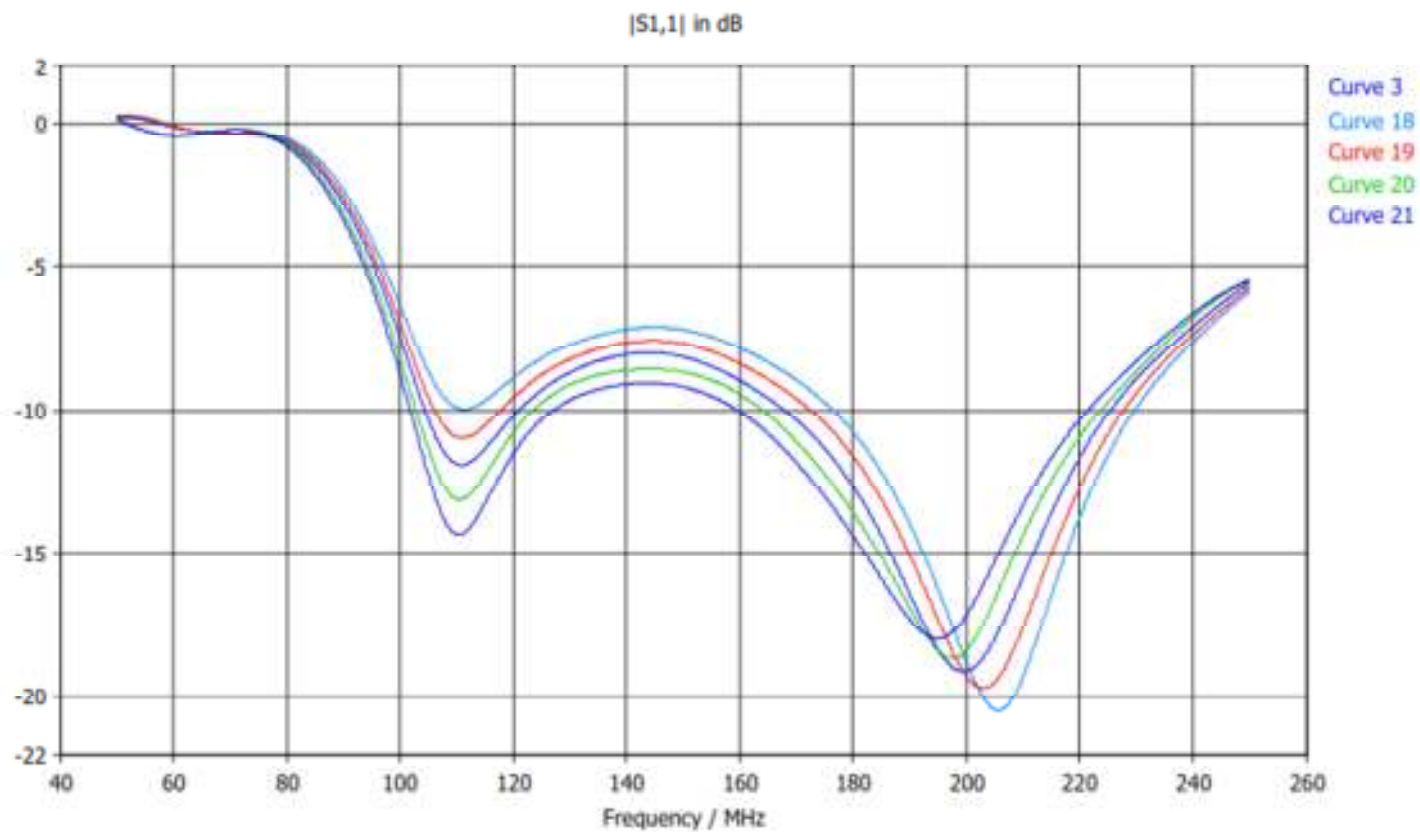
Figure 9. z_height variation

|S1,1| in dB

Curve 3
Curve 22
Curve 23
Curve 24
Curve 25

Frequency / MHz
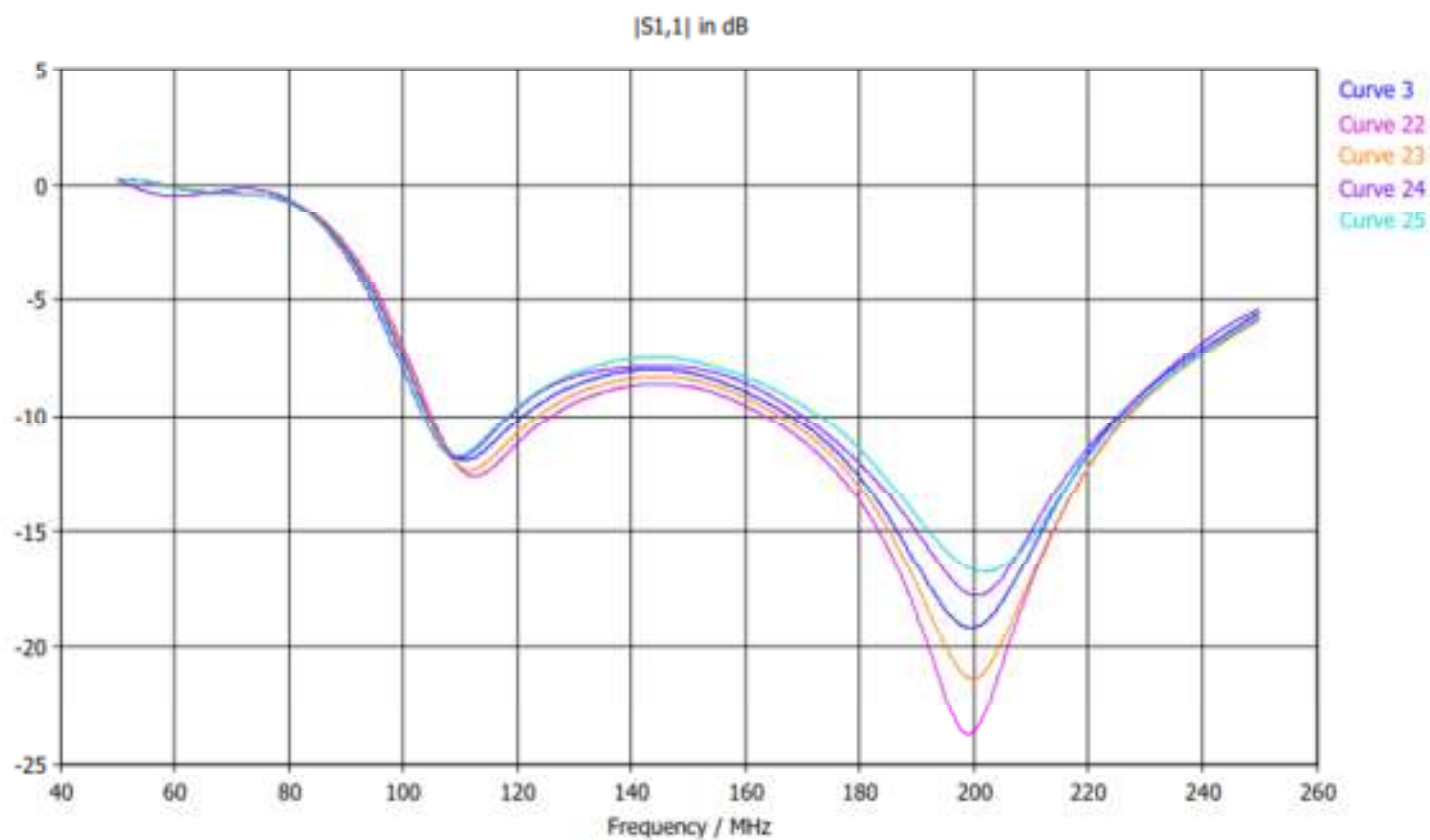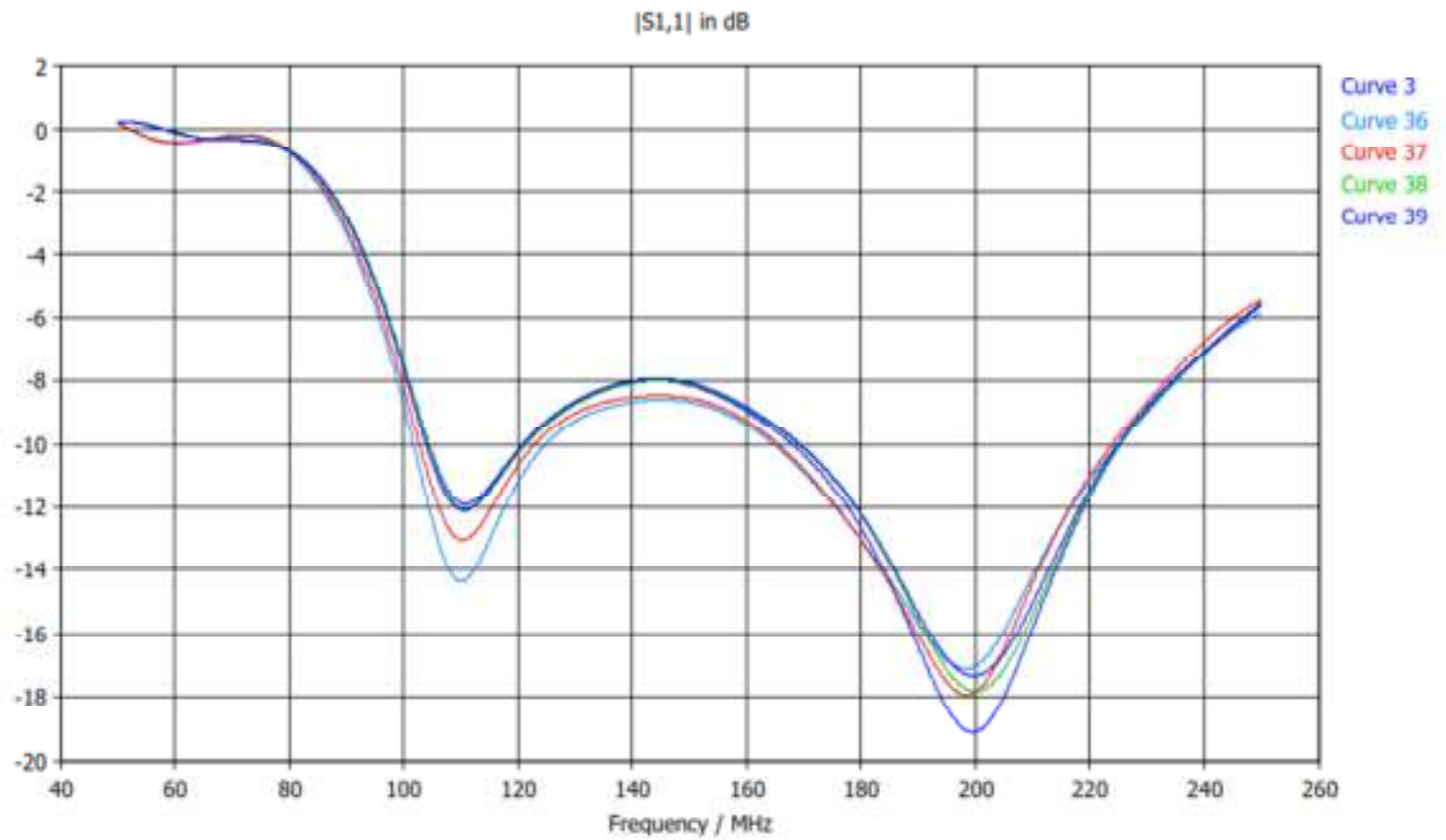
Figure 10. XYmin variation

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Figure 11. Wing angle variation – one tilted and the other held level
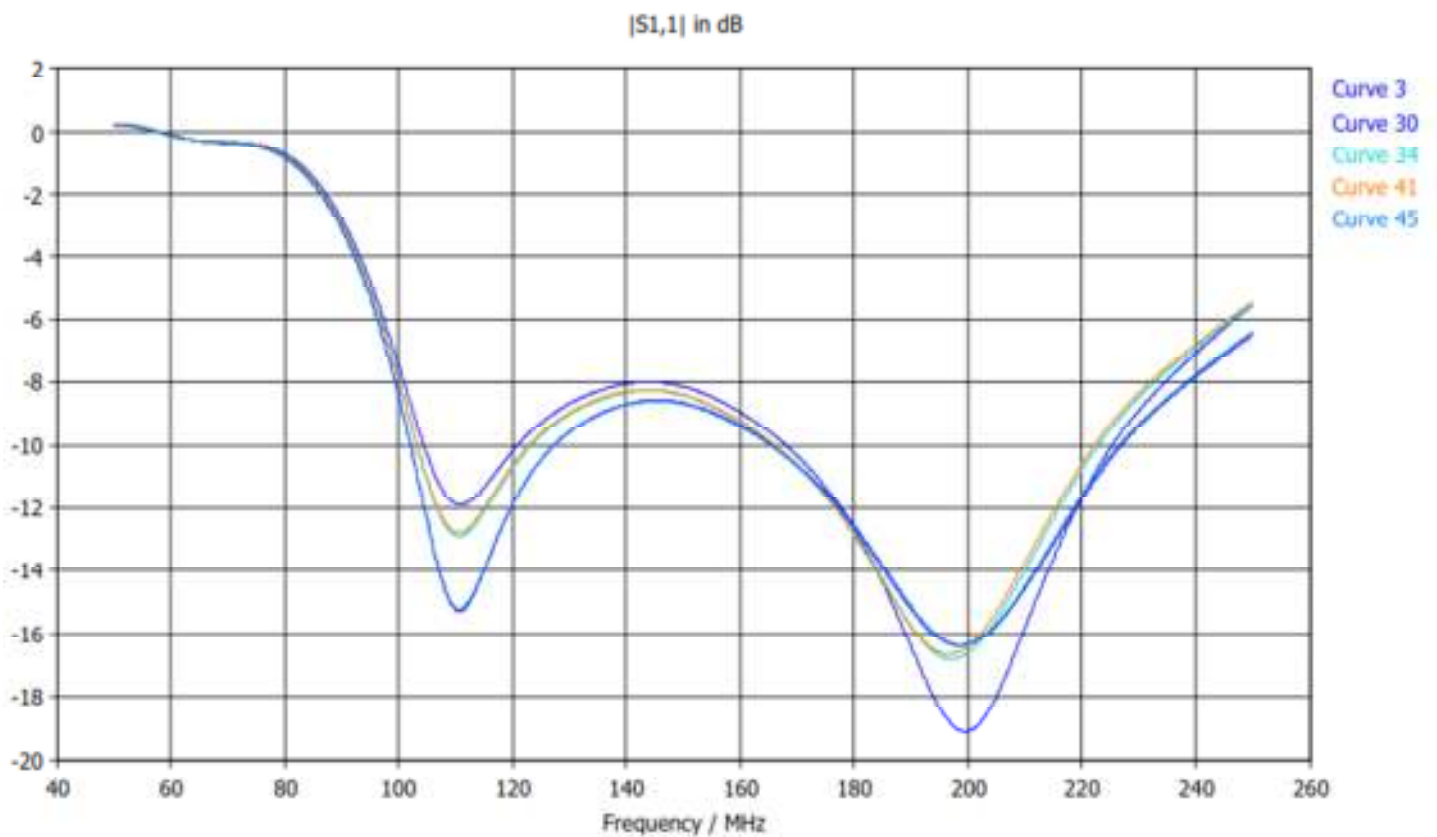

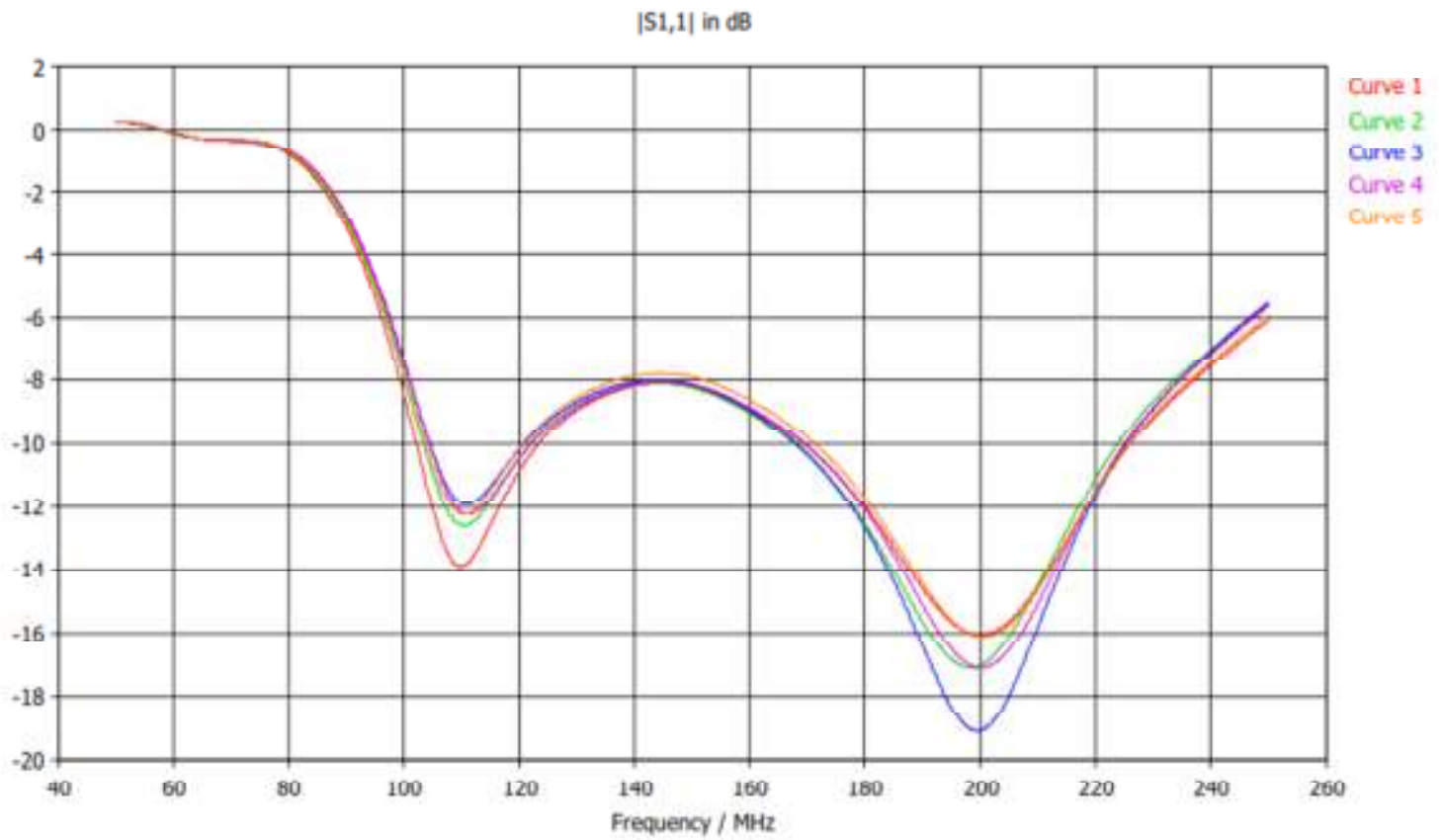Figure 12. Wing angle variation – one tilted up and the other tilted down equal amounts

Figure 13. Wing angle variation – both tilted by the same angle – both positive or both negative