Farfield Vertical Gain Component at the Horizon with and without a Shield

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The vertical component of the beam gain in the direction of the horizon was investigated by means of CST simulations. Figure 1 is a 3D view of the gain. Note that Phi=0 is aligned with the antenna's excitation axis, x', and theta=0 is aligned with the z' axis. Phi=0 points in the direction of the top plate capacitor stub. Figure 2 is the temperature view of the gain. Figure 3 is a 3D view of the gain in the theta direction and Figure 4 is a side view.

The gain at the horizon of the vertical field is the theta component evaluated at theta = 90 degrees. The maximum values of this component were recorded at every 10 MHz from 120 MHz to 180 MHz for the two cases of using a shield around the balun vs not using a shield. The differences in maximum gain (maximum as found at any value of phi) are plotted in Figure 5.

As can be seen in Figures 6 and 7, the maximum gain occurs at either phi=0 or phi=180 degrees. A typical gain value at the horizon is in the -25 to -30 dB range. The peak total gain ranges from +8.5 dB at 120 MHz and decreases gradually to +8.0 dB at 180 MHz. The use of the shield does help bring the vertical component of the gain down by at least 2 dB and up to 4 dB as can be seen in Figure 8.

For certain frequencies, the peak occurred at a phi value of 0 degrees without the shield but at 180 degrees with the shield. This case is shown in Figures 9 and 10. In other cases, both maximums occurred at phi = 0 degrees as can be seen in Figures 11 and 12.

The conclusion is that the shield does help reduce the vertical gain in the direction of the horizon. Relative to the maximum gain at the zenith (~ 8 dB), the vertical gain at the horizon is down between 33 and 38 dB, with the shield making a difference between 2 and 4 dB depending upon the frequency of interest.

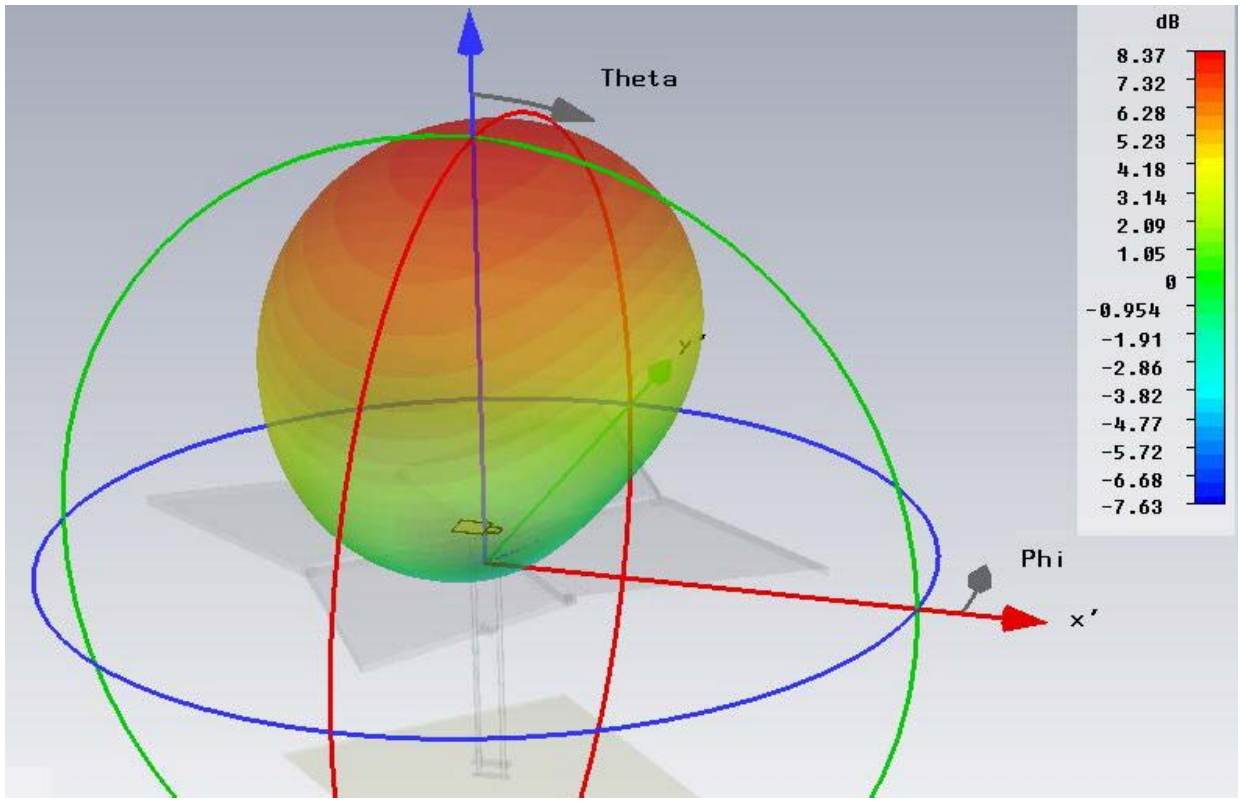

Figure 1. Gain at 140 MHz without a shield. Note the placement of Phi=0 and Theta=0.

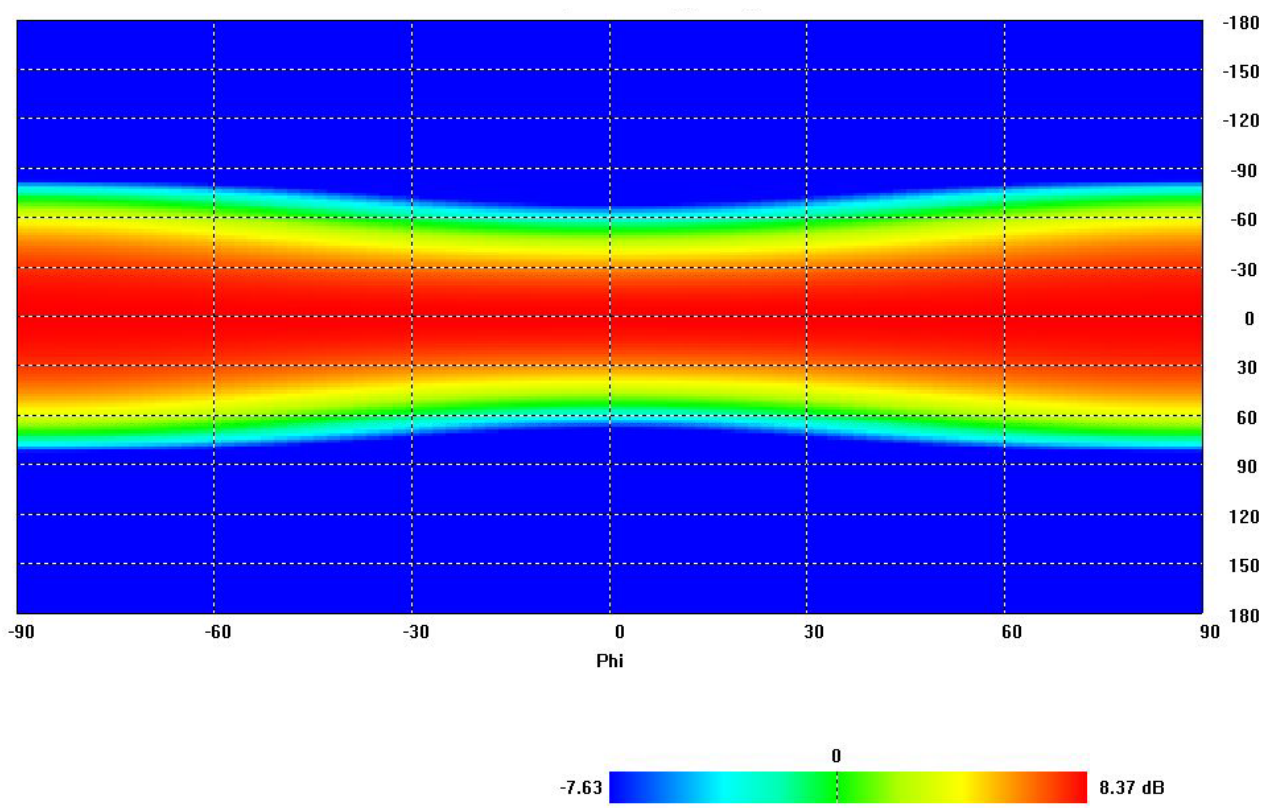

Figure 2. 2D Plot of the gain at 140 MHz without a shield.

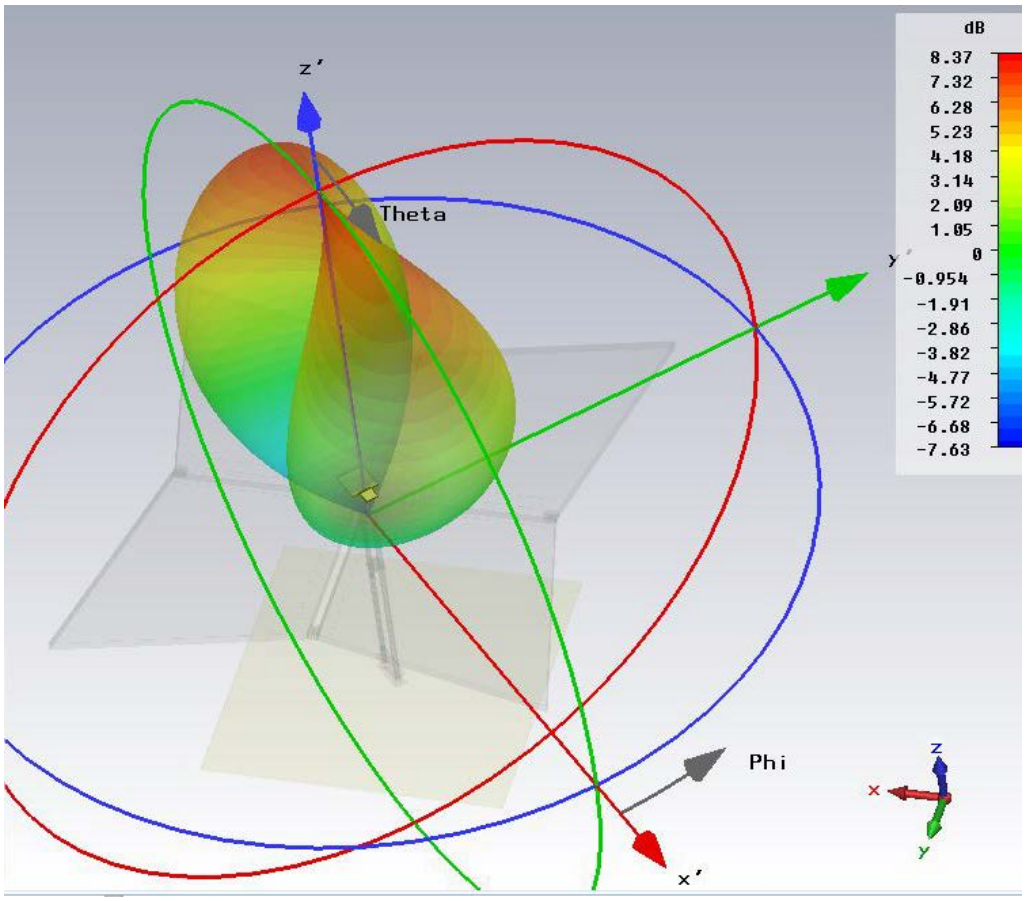

Figure 3. The theta component of the gain. Note the location of Phi=0 and Theta=0.

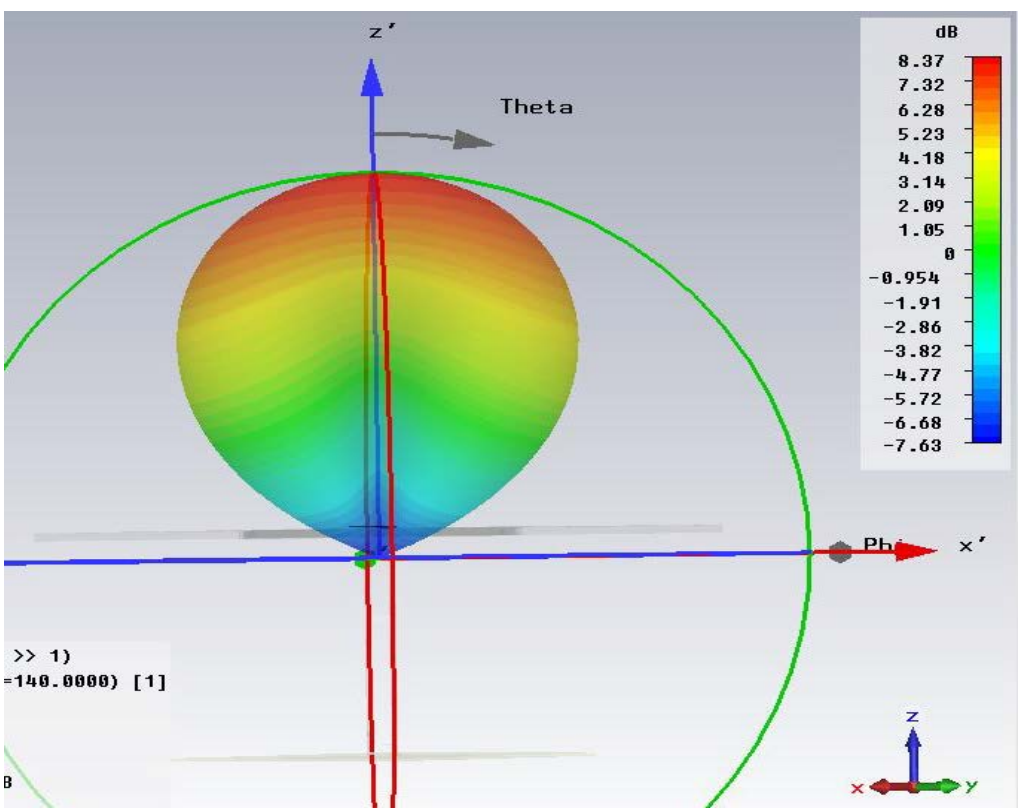

Figure 4. Side view of the theta gain.

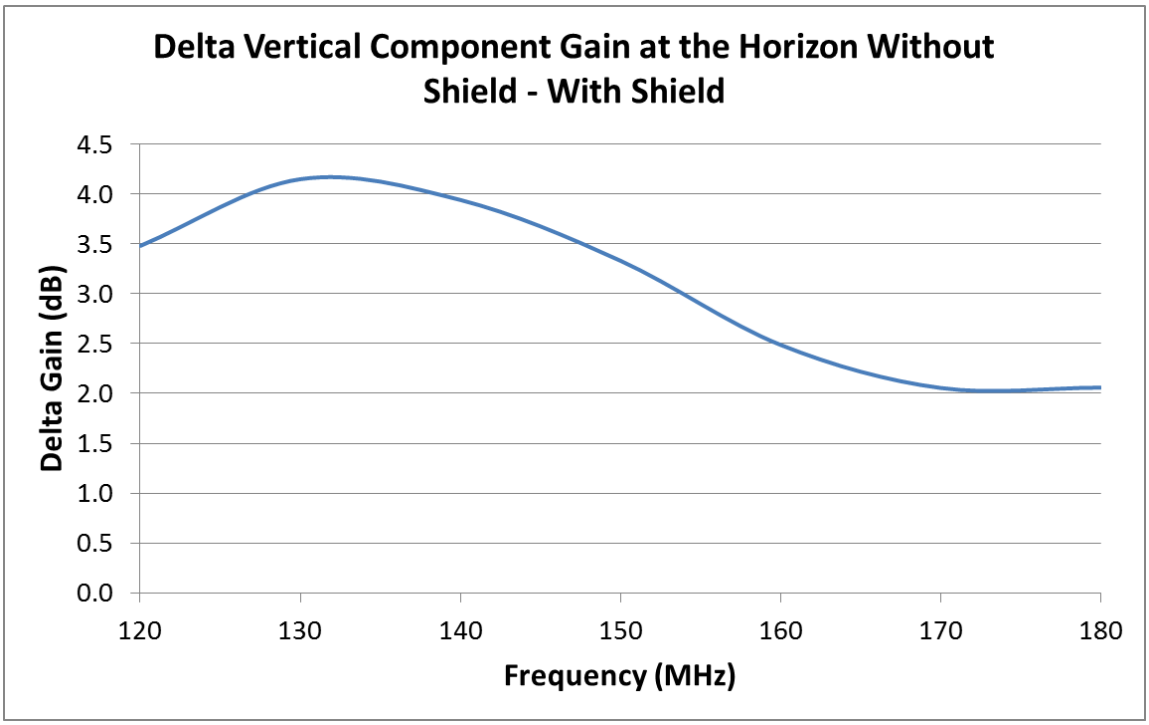

Figure 5. The Gain difference in dB of the theta component between 120 MHz and 180 MHz. Phi value for which the maximum occurs may not always be the same. It may switch between phi=0 and phi=180.

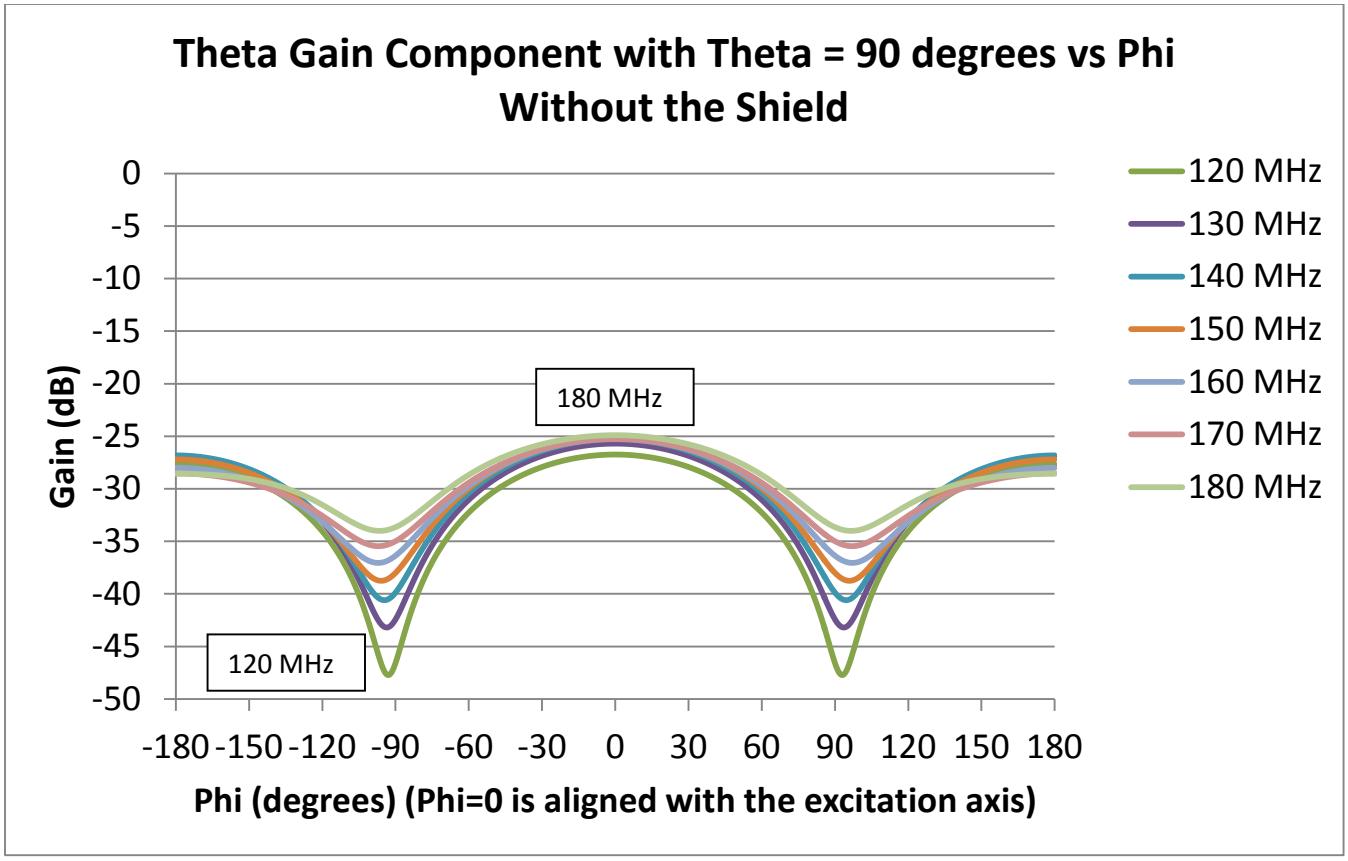

Figure 6. Vertical theta component of the farfield horizon gain vs phi for theta=90 without a shield. The maximum occurs at phi=0.

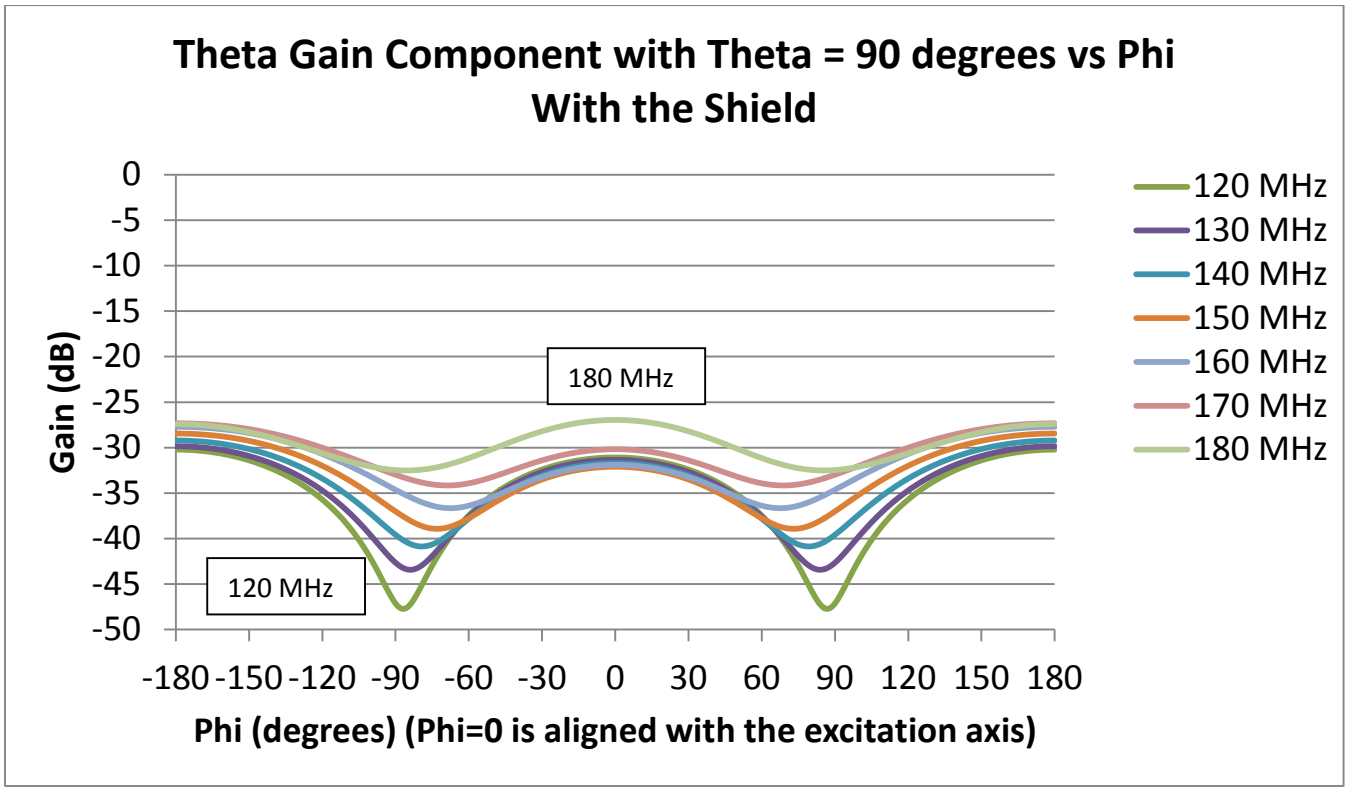

Figure 7. Theta component of farfield gain vs phi for theta=90 degrees with a shield. Note that the maximum is now at phi=180 for most of the frequencies.

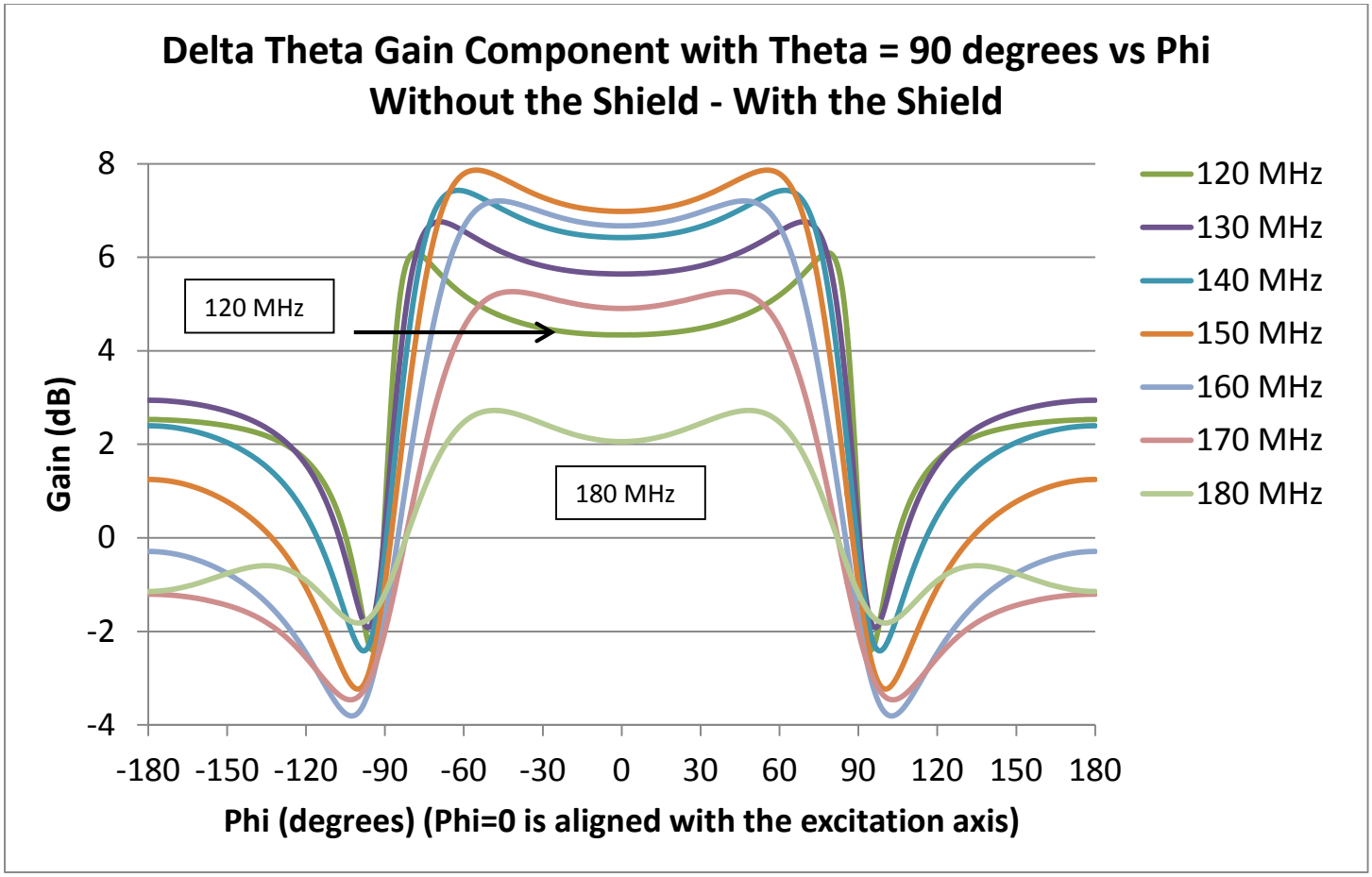

Figure 8. Theta component of farfield gain vs Phi for theta=90 degrees at 140 MHz without a shield. Note that the maximum delta is not always positioned at phi=0. Also note that the difference

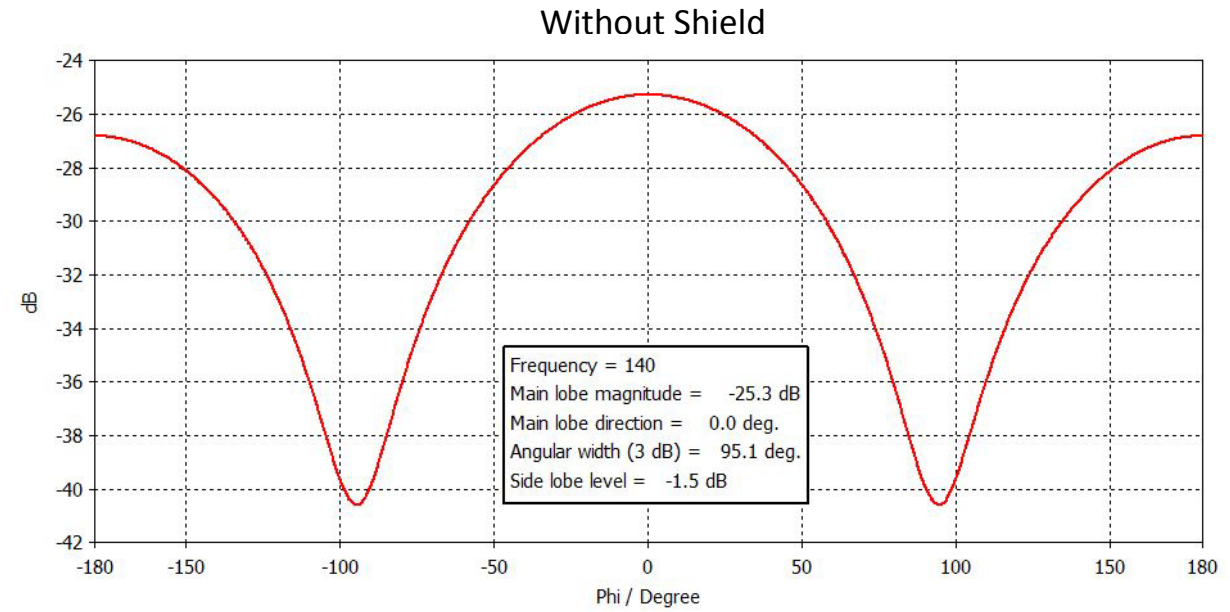

Figure 9. Theta component of farfield gain vs Phi for theta=90 degrees at 140 MHz without a shield. Note that the maximum is at Phi = 0 degrees for the unshielded case, but at 180 degrees for the shielded case.

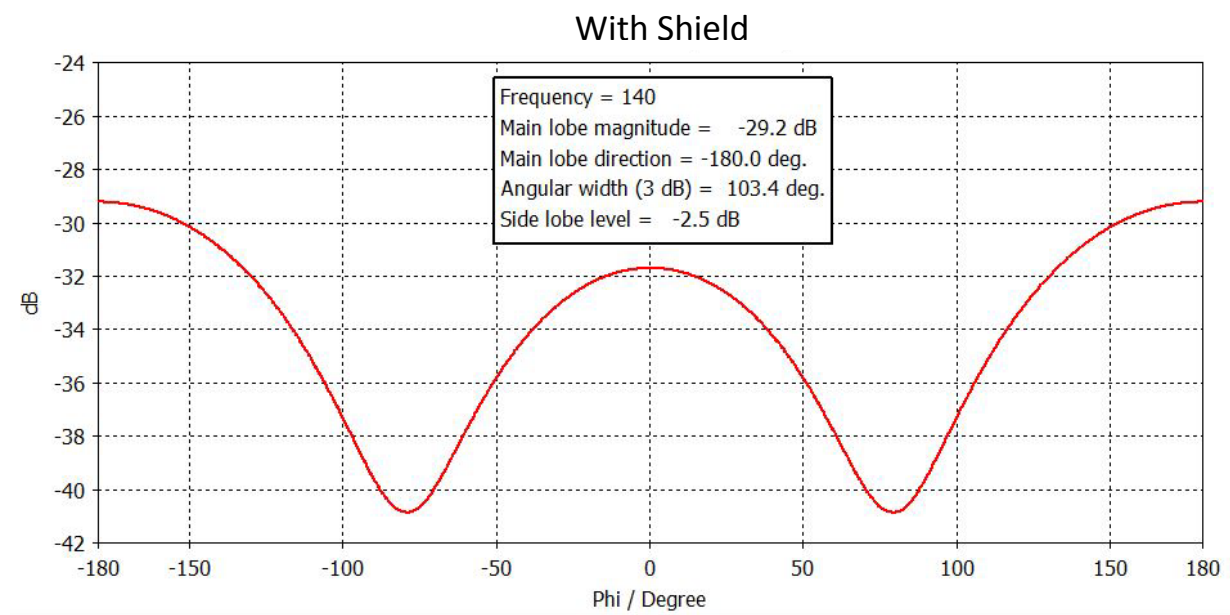

Figure 10. Theta component of farfield gain vs Phi for theta=90 degrees at 140 MHz with a shield. Note that the maximum is at Phi = 0 degrees for the unshielded case, but at 180 degrees for the shielded case.

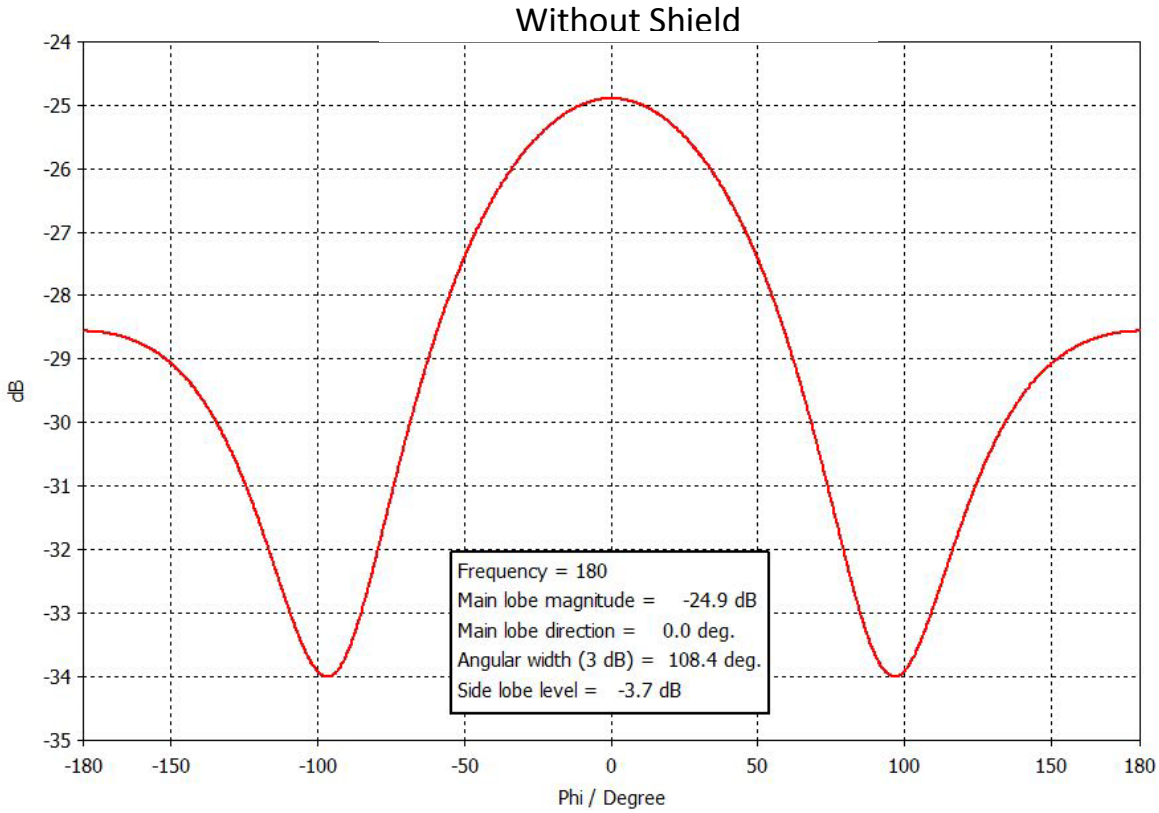

Figure 11. Theta component of farfield gain vs Phi for theta=90 degrees at 180 MHz without a shield. Note that the maximum remains at Phi = 0 degrees for both the shielded and unshielded cases.

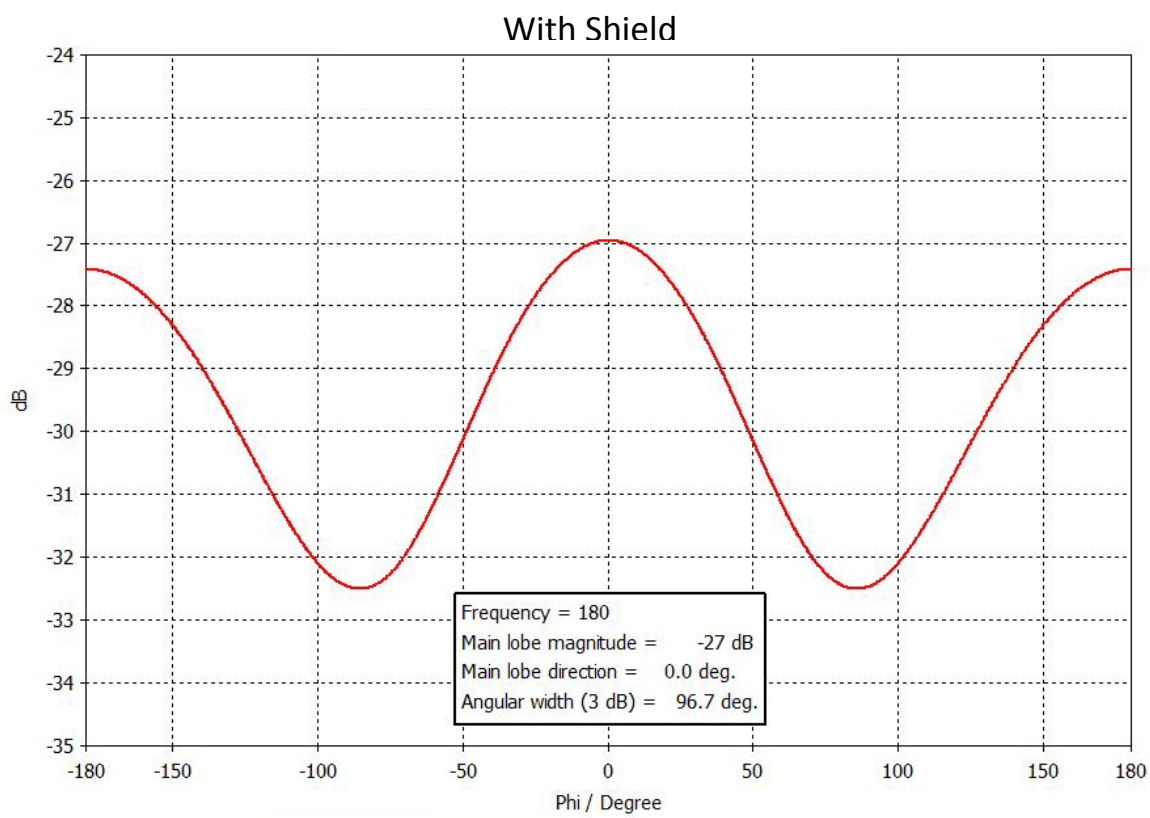

Figure 12. Theta component of farfield gain vs Phi for theta=90 degrees at 180 MHz with a shield. Note that the maximum remains at Phi = 0 degrees for both the shielded and unshielded cases.