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To: EDGES Group

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Subject: Optimization of EDGES Fourpoint antenna using FEKO

FEKO EM Simulation software was used to optimize the EDGES "fourpoint" antenna. The simulation was carried out over 100 to 210 MHz in 5 MHz steps. The parameters being optimized for minimum average reflection coefficient squared were the following:

    1] Side length of petal

    2] Diagonal length of petal

    3] Gap between petal

    4] Height of the vertical "lip" of the petal at the outer point

The following parameters were held fixed

    1] Height of petal above ground plane 48 cm

    2] Height of vertical "lip" at the inner point 1.27 cm

Two "optimal" designs were obtained. In the first no dielectric was placed in the gap so in order to increase the capacitance across the gap the height of the vertical "lip" was increased in a linear manner from the inside to the outside edge.

The optimum parameters were:

    1] Side length of petal 30.48 cm

    2] Diagonal length of petal 60 cm

    3] Gap between petals 2.4 cm

    4] Height of lip at outer edge 7 cm

In the second design the lip height was held constant at 1.27 cm and a Teflon dielectric ($\varepsilon_1 = 2.1$) was used to increase the capacitance away from the inner termination points.

The optimum parameters were

    1] Side length of petal 30.48

2] Diagonal length of petal 60 cm

3] Gap between petals 1.6 cm

4] Length of dielectric 16.48 cm

Figure 1 and 2 show the 2 designs and Figure 3 shows the antenna impedance for each design.

Comments on the designs

The second design, which uses dielectric to increase the capacitance between petals is very similar to the current design which has been deployed in the field. Fixing the height to 48 cm is needed to avoid a dip in the zenith response which starts to develop at the high frequency end of the band. Some tests were made to avoid this problem by using a conical ground plane but it was still not possible to obtain more than a 2:1 frequency range with a good pattern and low reflection coefficient.
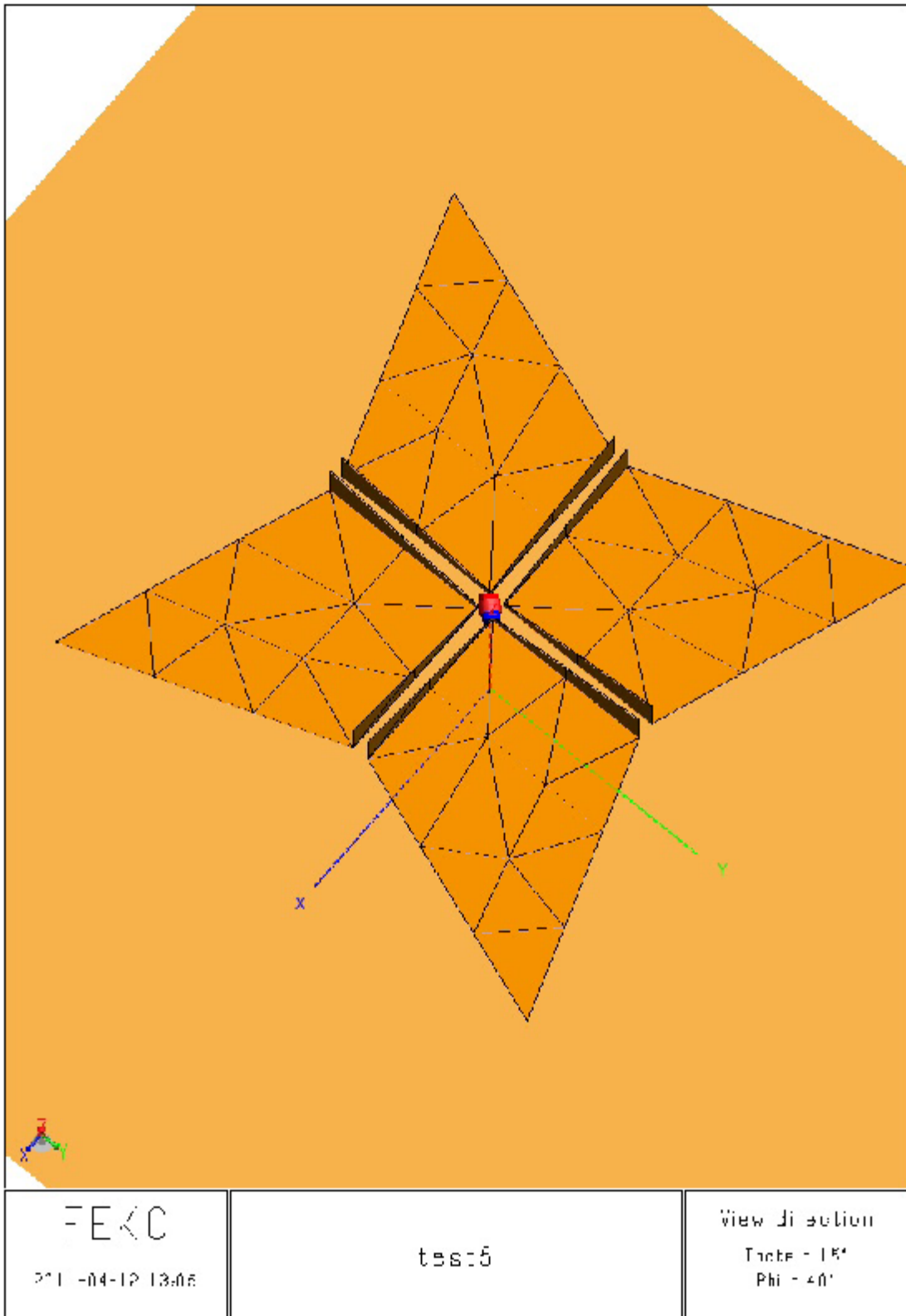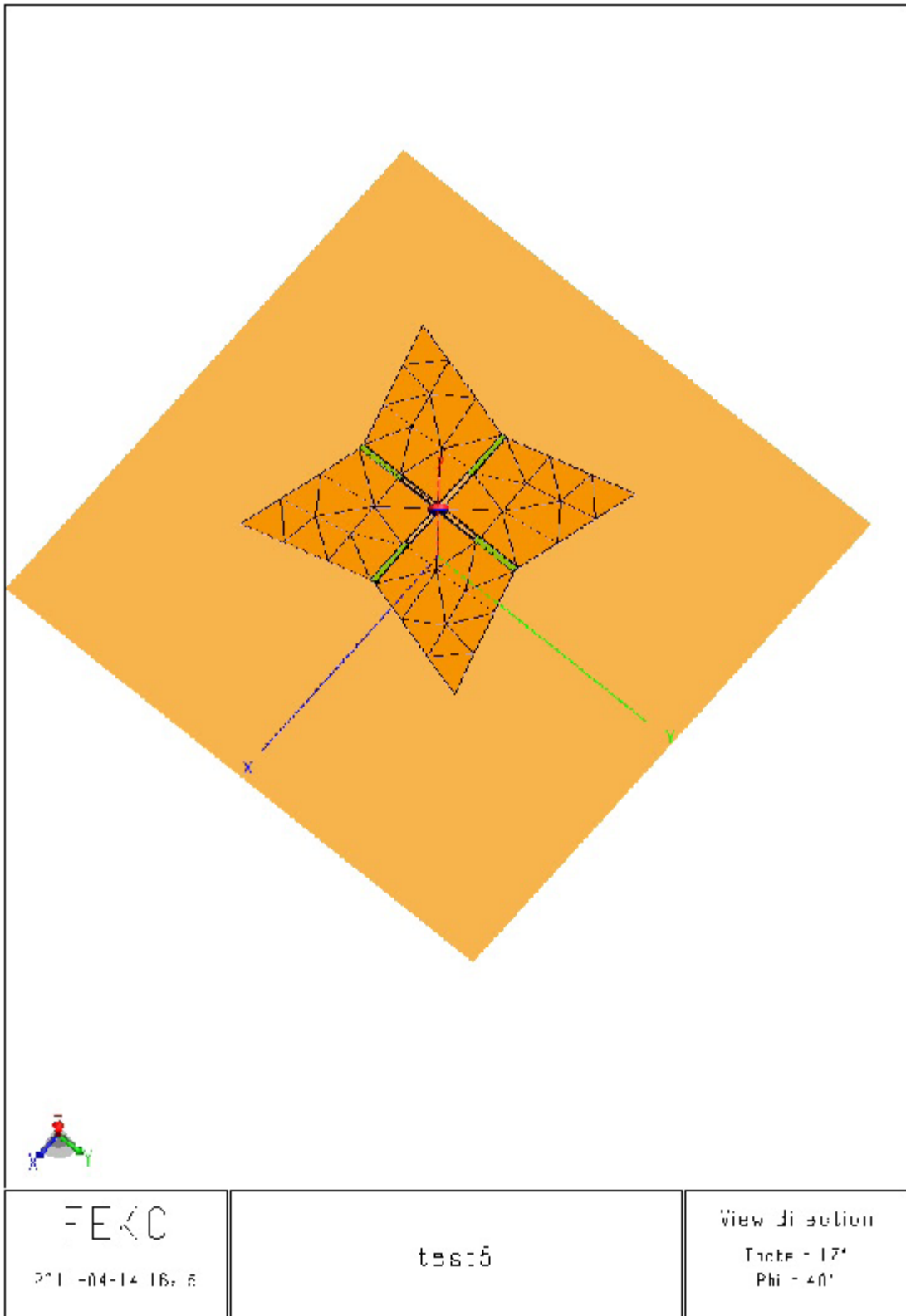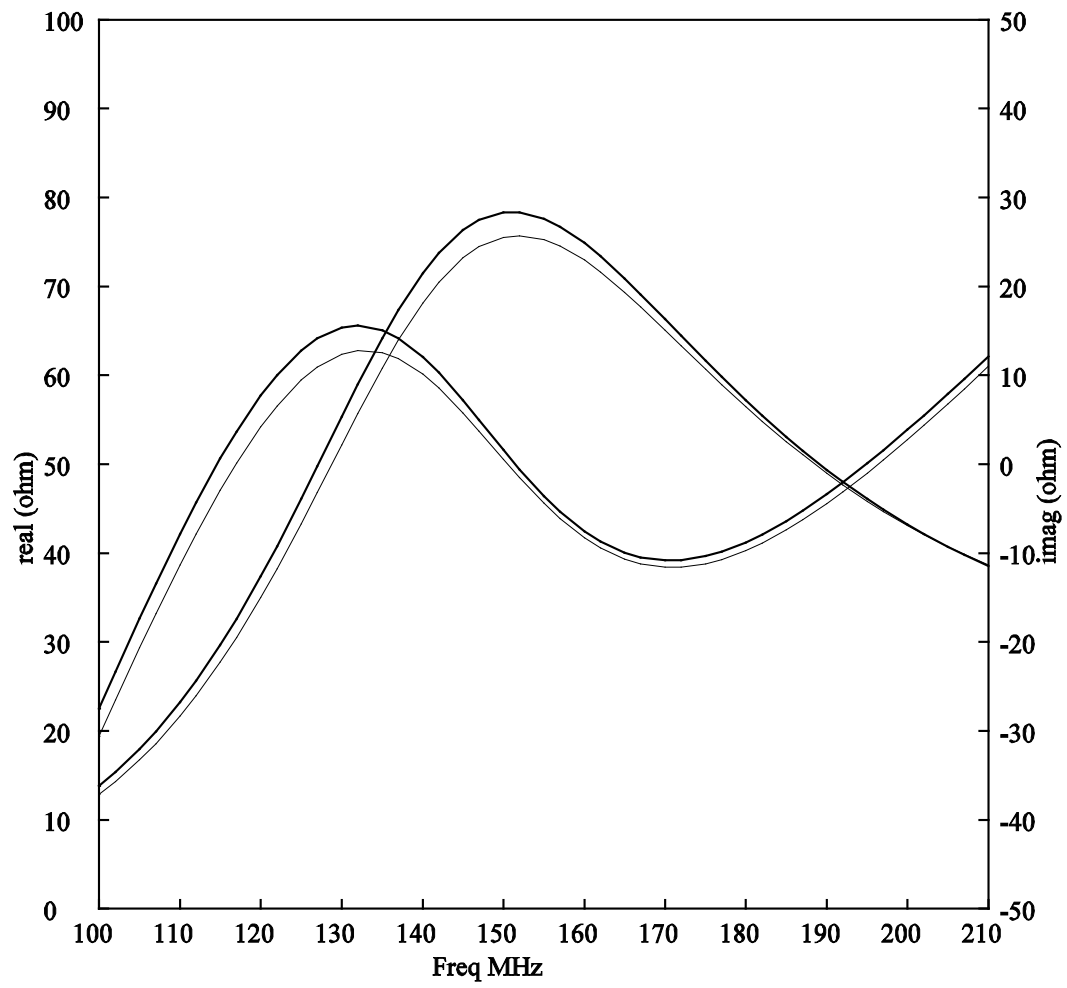
Figure 1

Figure 2

Figure 3. Thick and thin curves are for the first and second optional respectively.