ECE 6345
FALL 2006

Class Project

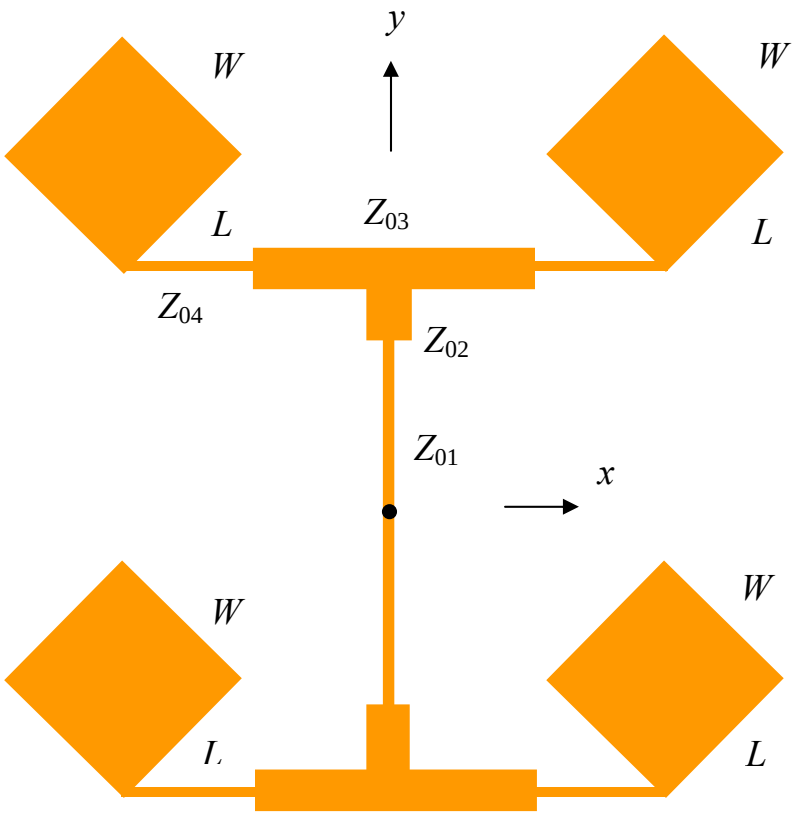
The purpose of this project is to design and analyze a 2×2 element corporate-fed microstrip antenna array for RHCP at 1.575 GHz. The array is shown below.

Each antenna is a nearly-square patch that is on a substrate of relative permittivity $\varepsilon_r = 2.2$ with a thickness of h = 0.1524 cm and a loss tangent of 0.001. Assume that the conductivity of the patch and ground plane metal is 3.0×10^7 S/m. The spacing between elements is λ_0 in both directions. There should be a 50 Ω match at the central feed point.

The characteristic impedance of each line that connects to a patch (line 4) is chosen as $Z_{04} = 100\,\Omega$. The length of this line is $L_4 = \lambda_{g4}/4$, where λ_{g4} is the guided wavelength on line 4. Line 3 has an impedance that is chosen to give a match when connected to line 4 (Note: the impedance of line 3 is not the same as that of line 4). The length of line 2 (with characteristic impedance Z_{02}) is $\lambda_{g2}/4$, where λ_{g2} is the guided wavelength on line 2. This line acts as a quarter-wave transformer to match to the impedance of line 1, which is $Z_{01} = 100\,\Omega$. The feed is located symmetrically in the vertical direction along line 1.

Note: As part of the design process, you will need to calculate the Q (or bandwidth) of each patch. Make sure that you account for all effects (space-wave power, surface-wave power, conductor loss, and dielectric loss) when you do this. Although the substrate geometry is the same as that used in the homework problems, do not assume that the bandwidth is that given in any of the homework problems (any bandwidth numbers that were given there may have been made up!).

Layout of patch array



PROJECT TASKS

1) Provide a complete design for the array, using the CAD formulas for the rectangular patch as the basis for the design. Give all dimensions for the patch and for the microstrip line feed network.

2) For a single RHCP patch element, oriented as shown in the figure, plot the RHCP and LHCP pattern amplitudes versus angle θ in the *xz* ad *yz* planes. Plot both patterns on the same plot, using a normalized scale so that the RHCP pattern is zero dB at the maximum.

3) For the entire array, plot the RHCP and LHCP pattern amplitudes versus angle θ in the *xz* ad *yz* planes. Plot both patterns on the same plot, using a normalized scale so that the RHCP pattern is zero dB at the maximum.

NOTES

1) Microstrip line design formulas may be found in a variety of places, such as the Pozar microwave book.

2) The amplitude of the RHCP and LHCP components of the far-field pattern may be found from E_θ and E_ϕ, using the formulas developed in ECE 6340.

Your project should have enough derivation so that all of the steps are clearly understandable. However, you do not need to re-derive anything that was already derived in class, or in ECE 6340.

Feel free to do others tasks beyond those suggested above, for extra credit. For example, you may wish to explore using Ansoft Designer to verify or further investigate your design.