1 Purpose and Learning Objectives

1. Analyze Rogers Corporation PCB data sheets
2. Find ADS LineCalc utility
3. Familiarize yourself with LineCalc
4. Name and set different substrate parameters in LineCalc
5. Describe different parameters and explain how they affect the impedance and length of microstrip line

2 Using Line Calc to design microstrip lines

Go to Rogers Corporation web site, then go to Advanced Circuit Materials link and find the appropriate substrate parameters ($\epsilon_r$, $\tan\delta$) for RT Duroid 5870 and RO 4003C. For each find two thicknesses of the substrate 62mils and 32mils, 1oz EDC copper. If the thickness of the dielectric is not available exactly as specified, select the closest value commercially available. This means that you will have to find four different laminates. To find these parameters, look at the High-Frequency laminates - Product selection guide. In a table or a paragraph, write the specifications of the substrates you found.

1. Start ADS. In schematic window, click on Tools, Line Calc, Start Line Calc. LineCalc window should open. Choose the microstrip line (MLIN).

2. Design a 50\Omega, 10\Omega, 100\Omega and 90°, 10° line, for the substrate RT/Duroid RO4003. Use the same substrate as one of the two RO 4003 found above. **Hint**: The degrees in Line Calc represent the “electrical length” of a line. Electrical length is calculated as $\frac{2\pi l}{\lambda}$, where $\lambda$ is the wavelength, and $l$ is the actual length of the line. $\lambda = \frac{c}{\sqrt{\epsilon_{eff}}}$ where $c$ is the speed of light, $f$ is the frequency and $\epsilon_{eff}$ is the effective dielectric constant.

3. Design a 50\Omega, 10\Omega, 100\Omega and 90° line, 10° for the substrate RT/Duroid 6002, select the height and copper thickness of your choice.

4. Use equations for microstrip lines from Ulaby’s book (see Handout or Section 2-5, page 61, 6th edition of Ulaby) and Matlab to calculate transmission line impedances. How do they compare to the ones from LineCalc?
3 Line Calc Part II

1. A microstrip transmission line is given for the default substrate values (MLIN-DEFAULT). \( W = 1.25 \text{mil}, \ L = 124 \text{mil} \) at 10GHz. If you do not know copper thickness, what is the characteristic impedance error that you can make? What if you do not know the \( \epsilon_r \)? *Hint:* You have to know what are the possible values of copper thicknesses and dielectric constants of laminates. Use Rogers Corp. data sheets to estimate minimum and maximum values for both. Then use LineCalc to find how much error could you make by not knowing the copper thickness or dielectric constant.

2. Pick 5 different transmission lines that LineCalc can calculate. Sketch the lines. Find the impedances of the lines for default values in LineCalc.
Figure 1: Calculating length and width of a microstrip transmission line using Line Calc.