Using text design equations and Rogers MWI, design a microstrip quad hybrid for a 50 Ω system with a design frequency of 2 GHz on Rogers RT/duroid 5880 (1 oz. copper, 1.574 mm thick). Draw a fully-labeled top view sketch of design.

Per section 7.5 and Figure 7.21, we will need Z_0 = **50 Ω** and 50/√2 = **35.355 Ω** microstrips.

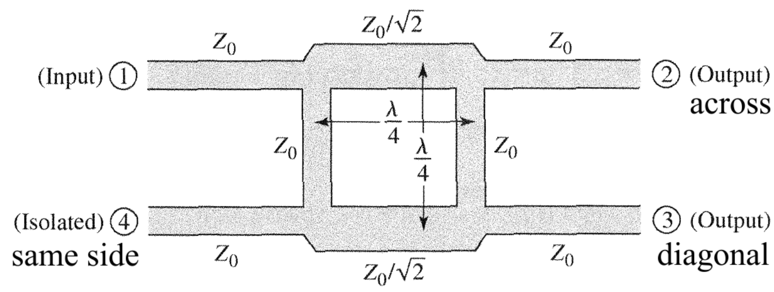


FIGURE 7.21 Geometry of a branch-line coupler.

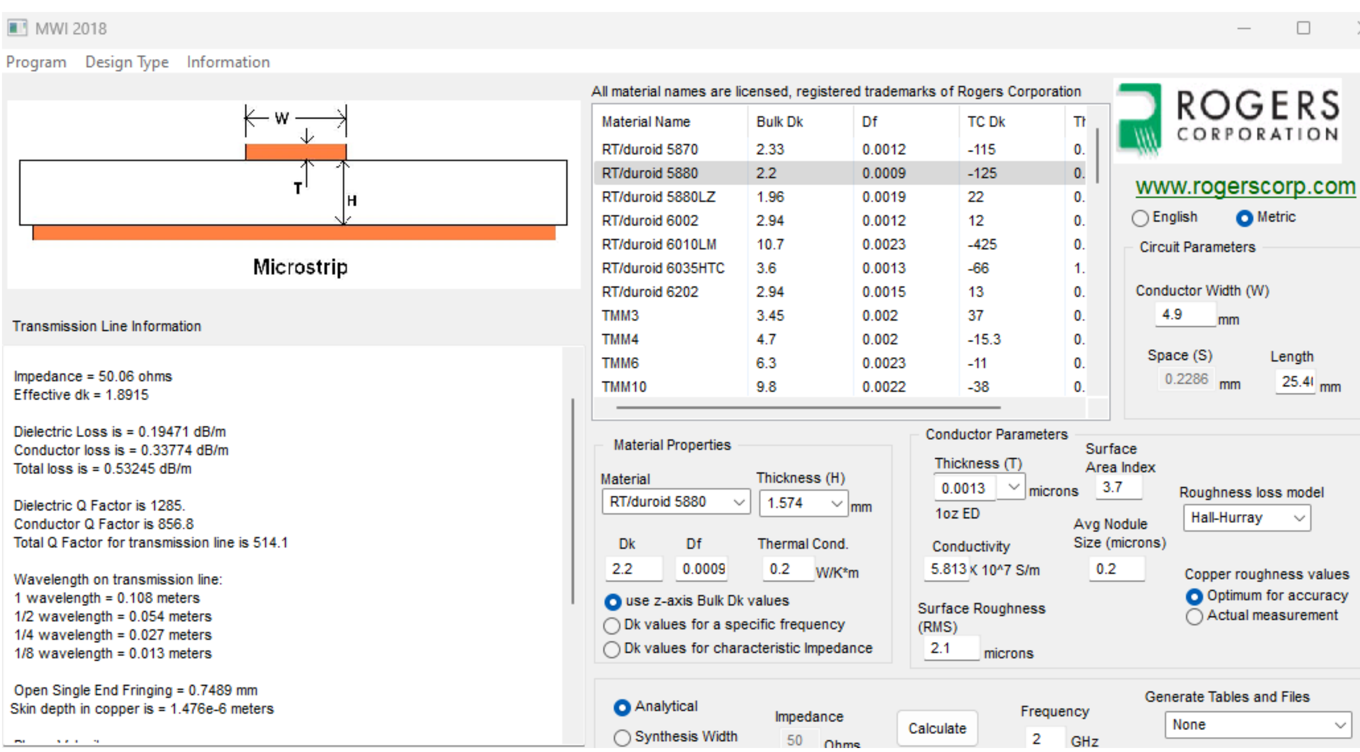
The Rogers RT/duroid 5880 datasheet only gives ε_r = 2.20 (no graph versus frequency).

$\boxed{Z_0 = 50\ \Omega}$

From Rogers MWI at 2 GHz on Rogers RT/duroid 5880 (1 oz. copper, 1.574 mm thick)- $\underline{W_{50} = 4.9\text{ mm}}$ and $\varepsilon_{r,e}$ = 1.8915. Started with 'Synthesis Width' option and changed to 'Analytical' option to get closer values for 50 Ω, only went to one decimal place for width.

Use (3.193) to get $v_p = c/\sqrt{\varepsilon_{r,e}} = 2.9979\times10^8/\sqrt{1.8915} = 2.18\times10^8$ m/s.

$\lambda_{p,50} = v_{p,50}/f = 2.18\times10^8/2\times10^9 = 0.108989$ m = 108.989 mm $\Rightarrow \underline{\lambda_{p,50}/4 = 27.25\text{ mm}}$.



$\boxed{Z_0 = 35.355\ \Omega}$

From Rogers MWI at 2 GHz on Rogers RT/duroid 5880 (1 oz. copper, 1.574 mm thick)- $\underline{W_{35} = 8.0\text{ mm}}$ and $\varepsilon_{r,e} = 1.9507$. Started with $W_{50} = 4.9$ mm used ‘Analytical’ option to get get width value by trial-n-error.

Use (3.193) to get $v_p = c/\sqrt{\varepsilon_{r,e}} = 2.9979\times10^8/\sqrt{1.9507} = 2.146\times10^8$ m/s.

$\lambda_{p,35} = v_{p,35}/f = 2.146\times10^8/2\times10^9 = 0.107323\text{ m} = 107.323\text{ mm} \Rightarrow \underline{\lambda_{p,35}/4 = 26.83\text{ mm}}.$