Model Construction

This model is built using the microstrip technology with a substrate with 1.2 mm of thickness, metallization of 0.035 mm and $\epsilon_r = 4.3$. The center frequency of operation is 1.0 GHz and the device should be matched to $50\ \Omega$ in all ports. The parameter list is show in Table 1 and the project template is shown in Fig. 7

Table 1. Parameter list of the model

Parameter	Value	Description
h	1.2 mm	Substrate thickness
eps_r	4.3	Substrate permittivity
t	0.035 mm	Metallization thickness
W50	2.35 mm	50 Ohms line width
W70	1.23 mm	70.71 Ohms line width
l70	42.54 mm	Length of lambda/4 for W70

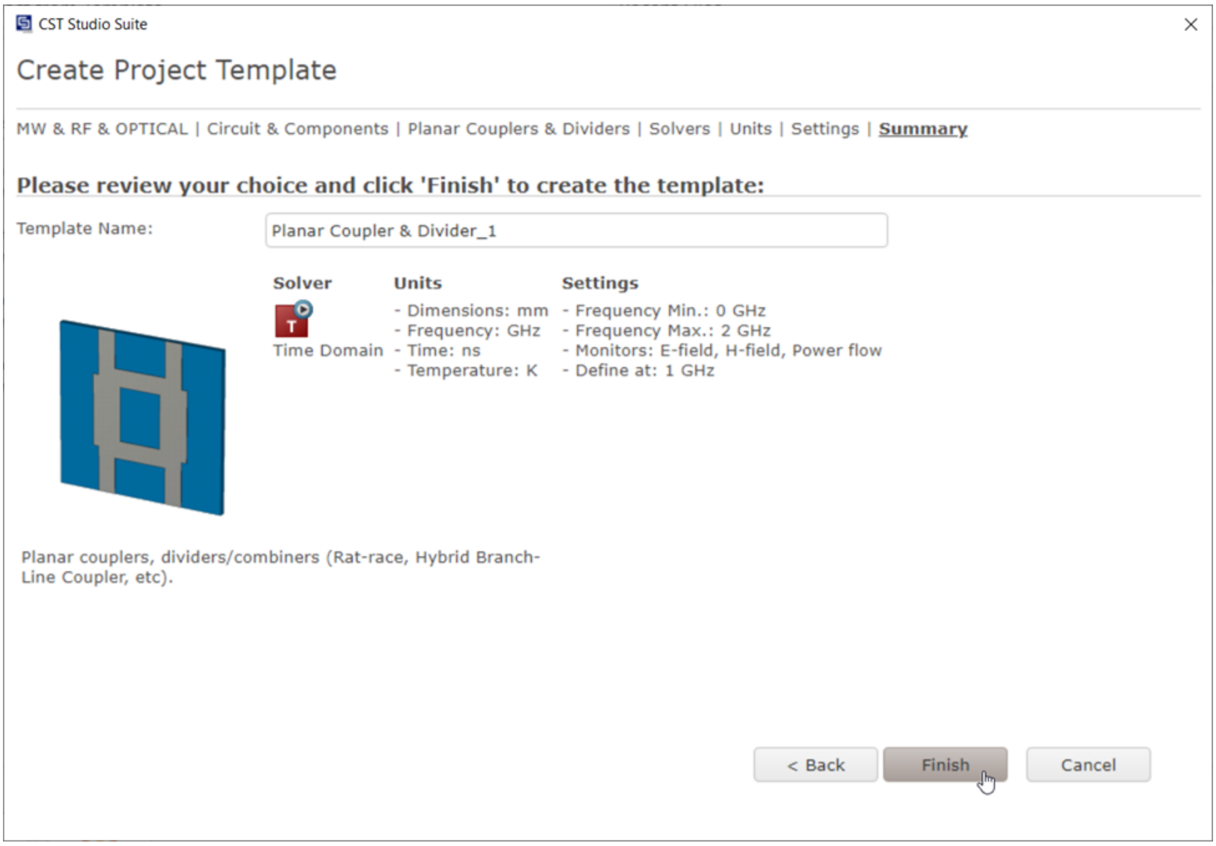

Figure 7: Project template used in this model

The model is built with an input line of $50\,\Omega$, then the signal is divided in a circular structure then go to the output ports with another circular structure. As we have a mirroring symmetry in this model, we will build only the upper half of it, and then use the “mirror transformation” operation to create the other half (see Fig. 8)

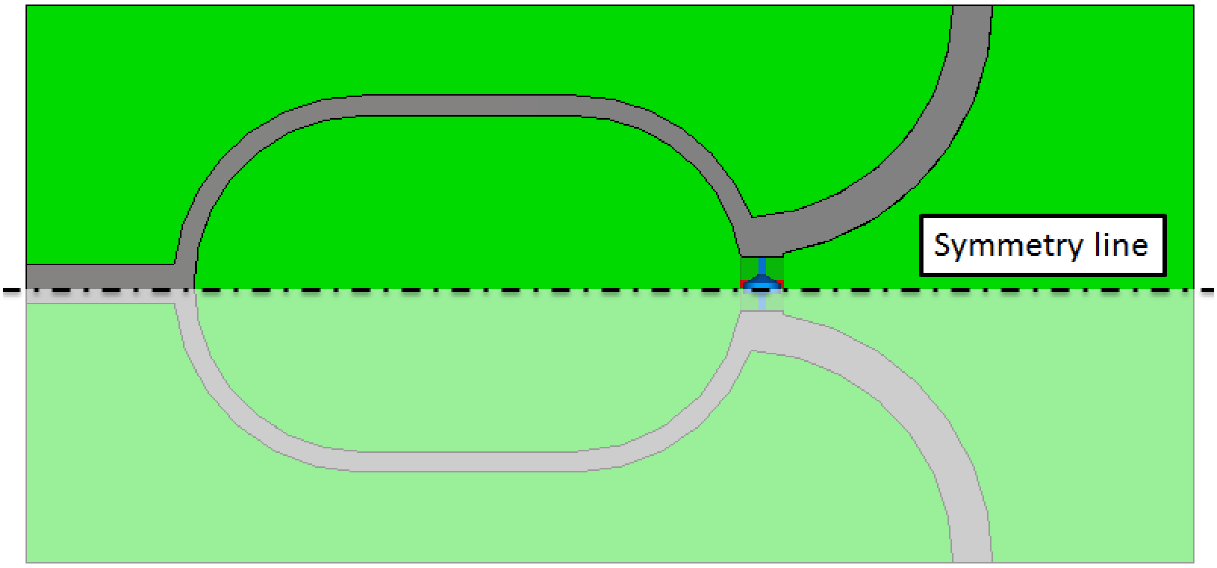

Figure 8: Mirroring symmetry line

We start the modeling by building the input line as a “Brick” with 10 mm length, and because of the symmetry the width is W50/2. The $\lambda/4$ branch is made via “Sweep curve” operation. To define the path we need to define 2 arcs and 1 line, and to define the profile we need a rectangle. The line section gives us the possibility to adjust the electrical size of the splitting structure if necessary. Fig. 9 shows the curves to be swept and their dimensions.

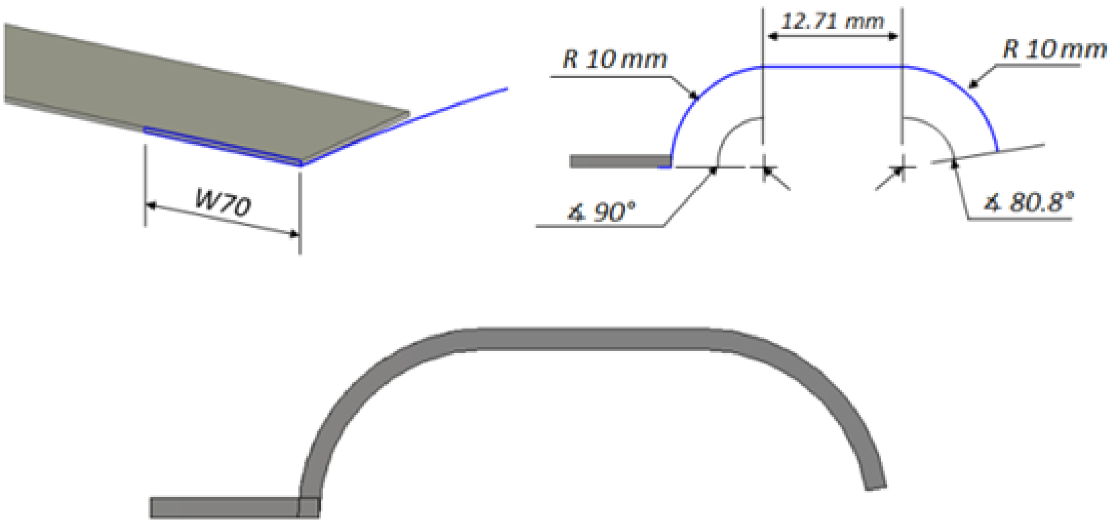

Figure 9: Path of $\lambda/4$ definition. (a) Profile to be swept; (b) The path layout; (c) Final result

On the end of the branch we must place the resistor. In this case we assume a SMD component that has base dimension of 2.5×3.2 mm. Therefore, we build a small brick to make a realistic place where the resistor would be placed (see Fig. 10).

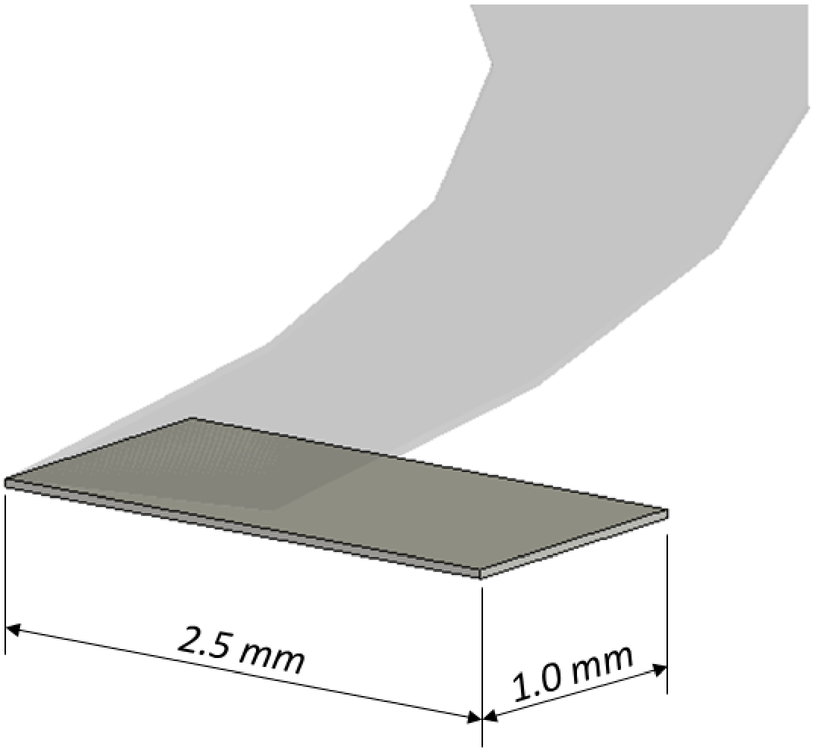

Figure 10: Brick modeled as the pad where the resistor will be connected

The last microstrip component is the output arm. For this part we will also use the “Sweep curve” technique, as shown in Fig. 11.

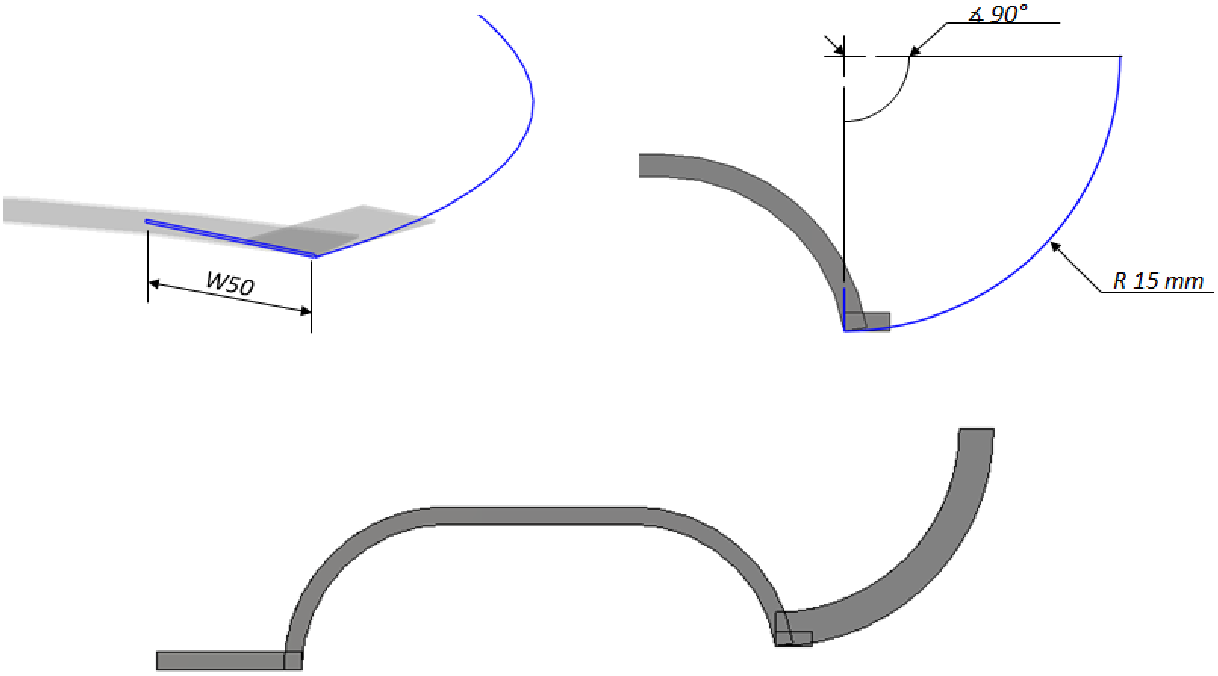

Figure 11: Output arm modeling. (a) Profile to be swept; (b) Path layout; (c) Final result

To finish this part of the modeling, sum all the components. To avoid geometrical calculations, we will construct the substrate as a brick by picking the two most outer points in the metallization (see Fig. 12).

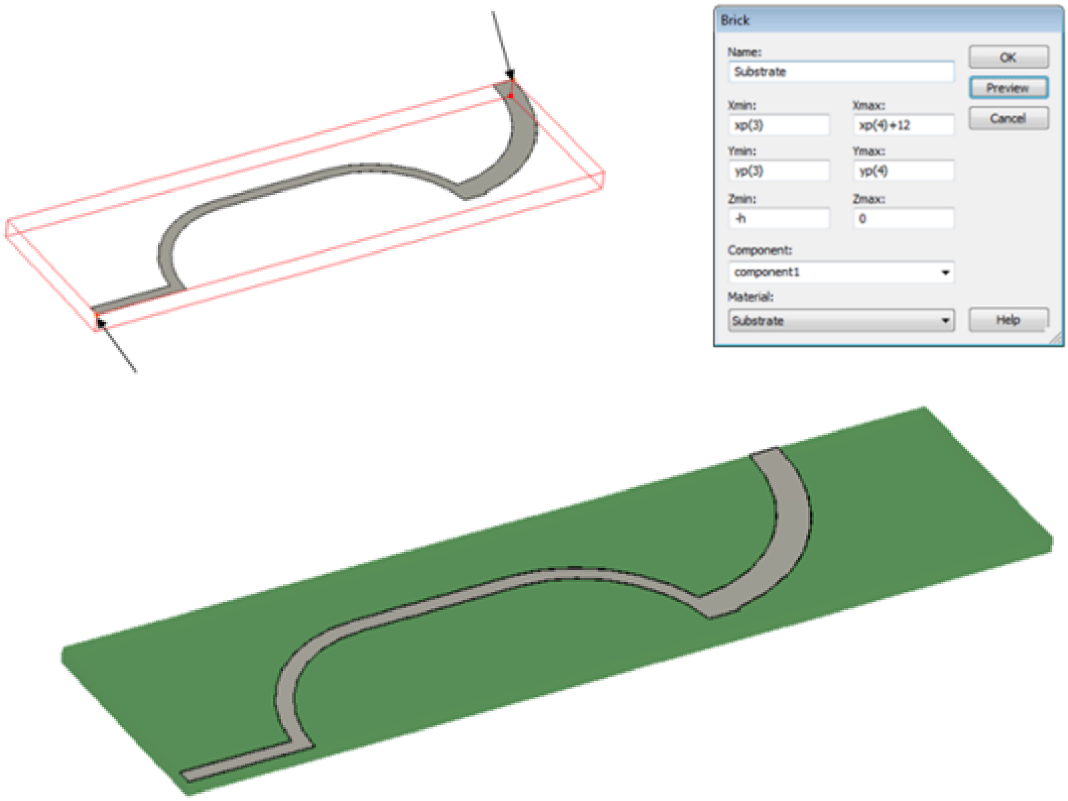

Figure 12: Modeling the substrate. (a) Select the "Brick" geometrical primitive and then pick the most external points of the model, and add an arbitrary thickness to build a preview of the geometry; (b) In the dialog box add an additional space in the X-direction and assign the correct thickness; (c) Final component

The final geometry (Fig. 13) is done by mirroring all the components with respect to the Y-axis (normal), using the “Transform” tool with “Copy” selected.

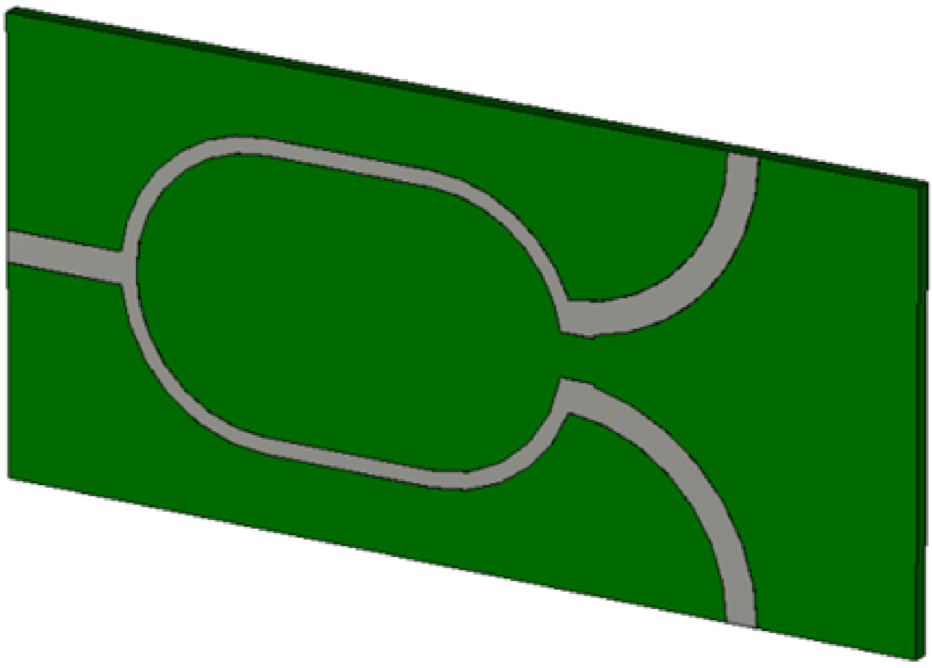

Figure 13: Final geometry of the Wilkinson power divider

The resistor is placed as a lumped element in the model. For the ports, make use of the macro “Calculate port extension coefficient” to create a waveguide port with appropriate dimensions. The final model setup is shown in Fig. 14.

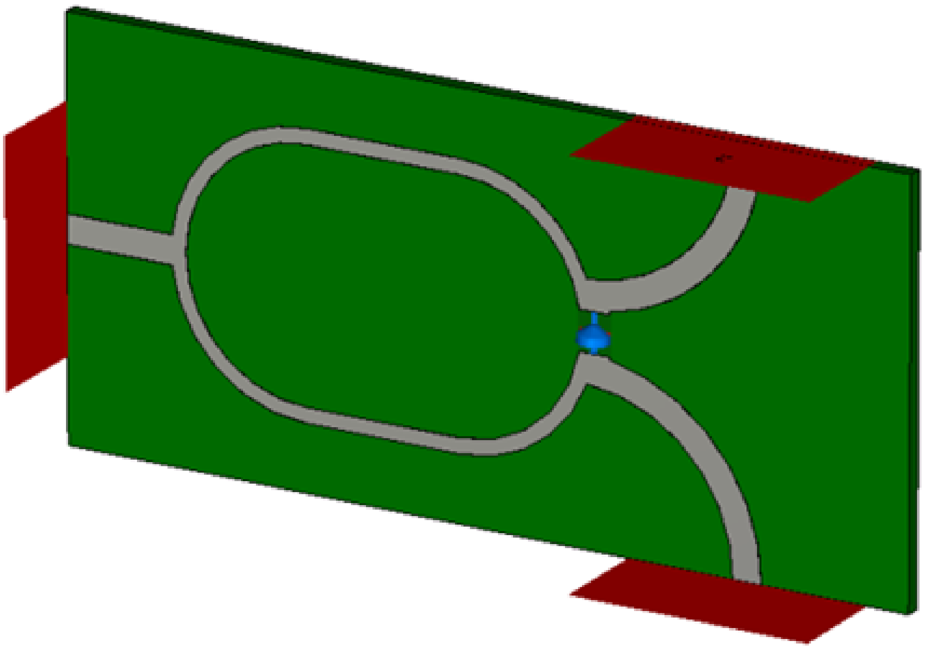

Figure 14: Final model

Based on the S-Parameter matrix (Eq. 1) set two S-parameter symmetries as shown in Fig. 15. The simulation can now be carried out.

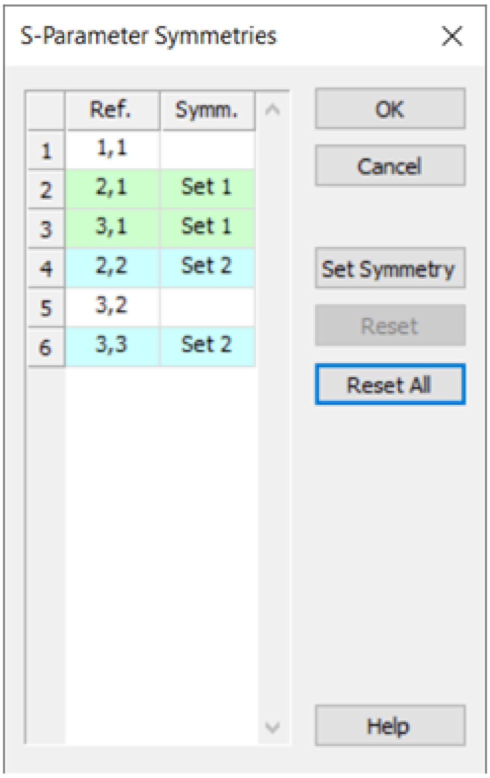

Figure 15: S-parameter symmetries