PRACTICUM IV

Production Technologies

Practical # 1

RF structure design, fabrication using PCB Maker, and testing

Task 1. Simple elements with *QUCS*

1.1 Study main functions and interface of the *Quite Universal Circuit Simulator*

https://qucs-help.readthedocs.io/en/latest/#

https://en.wikipedia.org/wiki/Quite_Universal_Circuit_Simulator

http://qucs.sourceforge.net/

http://qucs.sourceforge.net/docs/tutorial/functions.pdf

http://qucs.sourceforge.net/docs/tutorial/getstarted.pdf

1.2 Design a micro strip line with a chosen impedance:

1) verify with the teaching fellow parameters of the substrate (fabric-reinforced laminate with a thin copper layer),
2) verify with the teaching fellow the micro strip impedance,
3) for the remaining parameters of the substrate, leave the default values.

Note: The strip line calculator is located in the tools tab.

<u>Task 2</u>. Calculating the amplitude-frequency characteristic (AFC) of a 50-Oohm micro strip line

2.1 Use frequency range 1–25 GHz (1 GHz = 10^9 Hz).

2.2 Compare the frequency response of the 50- and 100-Ohm strip lines with lengths of 0.1, 2 and 10 mm. An example of the calculated design is shown in Fig. 1.

2.3 The calculation results should be presented as plots of **S[11]**, **S[21]** in a semi-logarithmic scale, similar to those shown in Fig. 2.

2.4 Note: This task involves using a parameter sweep in addition to modeling of S-parameters.

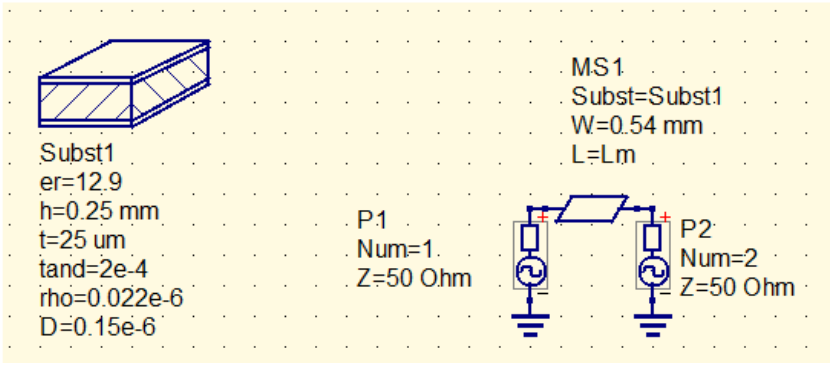

Figure 1

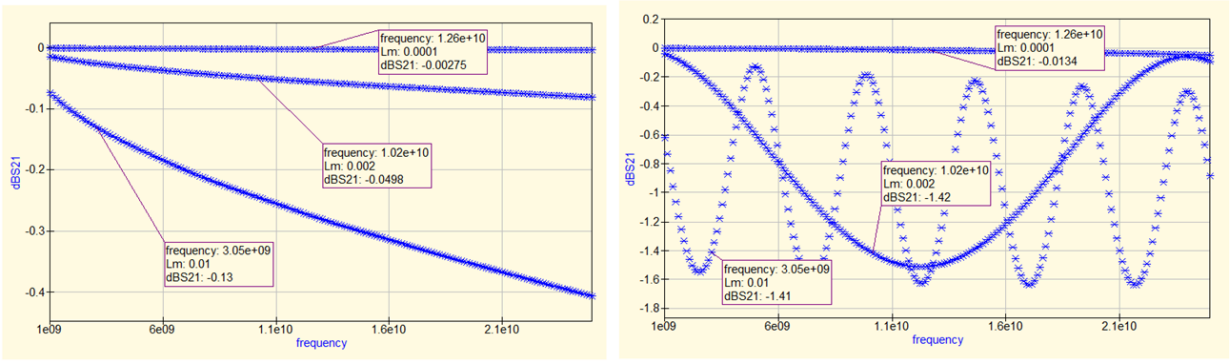

Figure 2. Left panel: impedance Z = 50 Ohm; Right panel: impedance Z ≠ 50 Ohm

<u>Task 3.</u> Design of a notch-filter /bonus task/

3.1 Using the structural elements which are available in the QUCS component base, recreate the circuit of the band-stop strip filter shown in Fig. 3.

3.2 Determine the amplitude-frequency characteristic of the filter using the substrate with a relative permittivity of 2.1, a loss tangent of $7 \cdot 10^{-4}$, and a thickness of 0.5 mm.

3.3 By changing the dielectric constant to 4.2, optimize the strip widths to achieve line impedances of 50 Ohms.

3.4 Taking into account that $v_{notch} = c / 4L$, where $L = \lambda_{eff}/4$, is the length of the side branch), change the length of the shoulder of the side branch (or external radius) to maintain the "dip" in the frequency response in the vicinity of 4 GHz.

3.5 Present the calculation results as plots of **S[21]** and **S[43]** in the semi-logarithmic scale similar to those shown in Fig. 4.

3.6 Note: This task involves using a parameter sweep in addition to modeling of S-parameters.

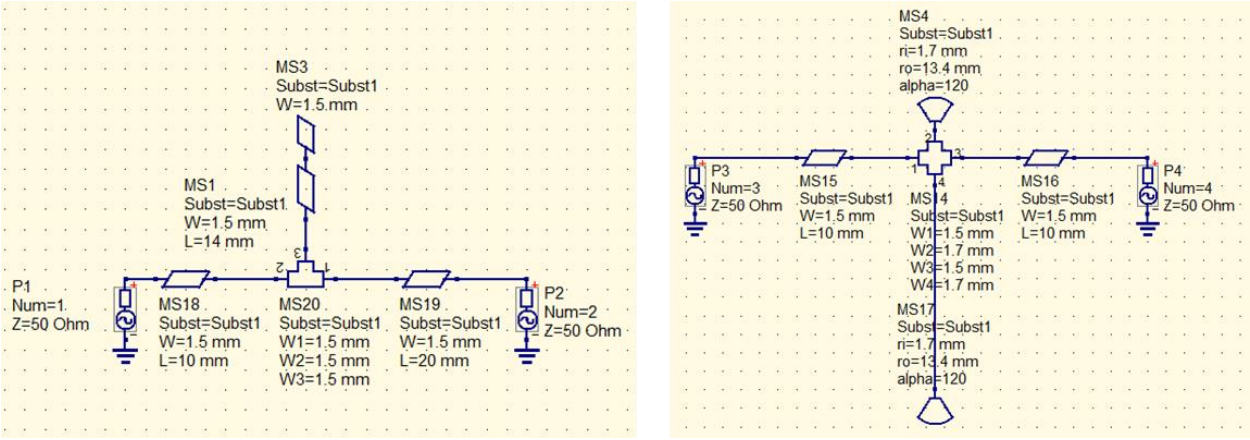

Figure 3

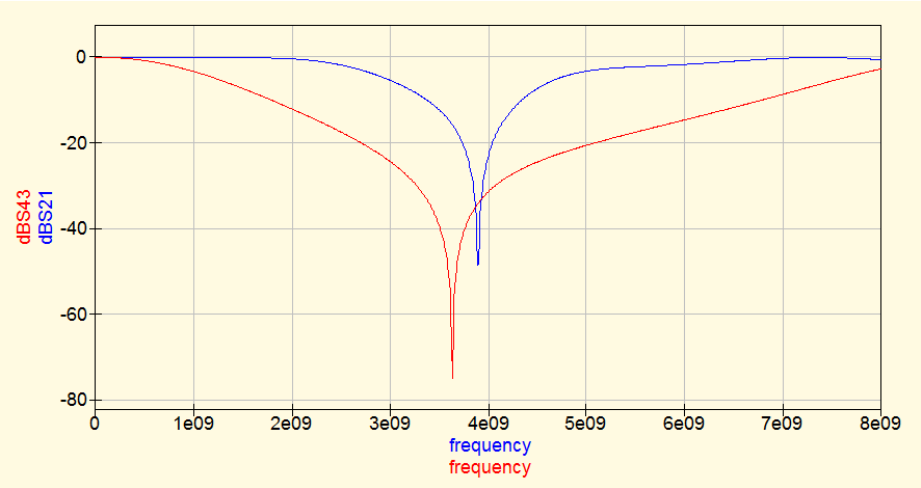

Figure 4