Low-power radio design for the IoT
Exercise 1 (24.02.2022)

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Problem 1 L Impedance Matching Network

For the L impedance matching network shown in Fig. 1, address the following points.

- Determine L and C.
- Indicate the main disadvantage of this network and a possible solution.

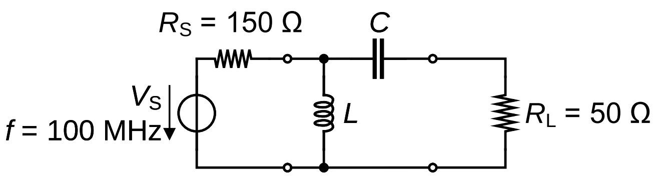

Figure 1: Matching network

Problem 2 Π Impedance Matching Network

Part I: Consider the example for the Π impedance matching network shown in the slides 24 and 25 (Chapter 2). In this example, to calculate the value of R_{virt}, R_{max} is taken equal to R_S ($3000\,\Omega$). Repeat the same example by taking R_L ($50\,\Omega$) as the resistance value used to calculate R_{virt}. In this example, Q is equal to 10 and the resonant frequency, f, is $1\,\text{MHz}$.

- Find the new values for X_{c1} and C_1, X_{c2} and C_2, X_L and L.
- Compare the values for L, C_1 and C_2 with the ones obtained in the example shown in the slides.

Part II: Design the Π filter shown in Fig. 2 for a Q of 5 and a value of f equal to $27\,\text{MHz}$.

- Calculate two values for R_{virt}, one by using R_S and the other by using R_L. Reject one of the two values and motivate the choice.
- Determine X_L, L, X_{c1}, C_1, X_{c2}, C_2.

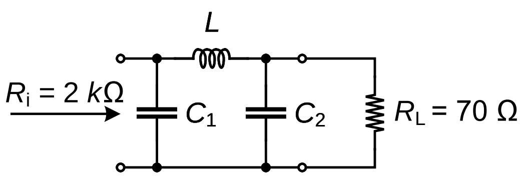

Figure 2: Π filter

Problem 3 Tapped-capacitor Impedance Matching Network

The circuit in Fig. 3 is a tapped-capacitor impedance matching network. Assume that this network operates at $f = 1\,\text{MHz}$ and that $C_1 = 200\,\text{pF}$, $C_2 = 1000\,\text{pF}$ and $R_L = 200\,\Omega$.

- Determine the Q, R_{in} and L for the network in Fig. 3. (Hint: Convert R_L and C_2 to a series equivalent.)

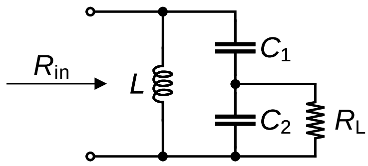

Figure 3: Tapped-capacitor impedance matching network