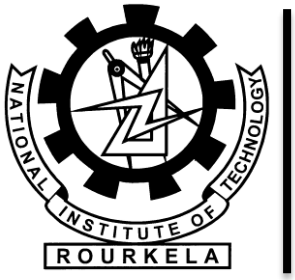
Simulation # 7

Two port network – Z Parameters



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Aim of the Expt.:

- Understand two port circuits
- Calculate Z parameters for two port networks
- Use Multisim to find the Z parameters for given circuit

Theory:

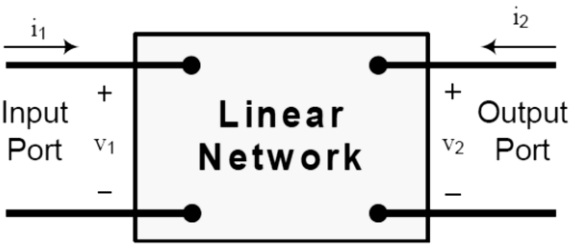

Figure 1 Generalisation of two port network

There are six groups of two-port circuit parameters (e.g., the impedance z-parameters, admittance y-parameters, hybrid h-parameters, etc) that can be used to relate the input/output voltage & current variables. Any set of parameters can be derived from the other ones.

The z-parameters are defined by:

$$V_1 = Z_{11} I_1 + Z_{12} I_2$$
$$V_2 = Z_{21} I_1 + Z_{22} I_2$$

These parameters can be measured by the following tests (based on open-circuit input port condition, and open-circuit output port condition):

$$Z_{11} = V_1 / I_1 \text{ when } I_2 = 0$$
$$Z_{12} = V_1 / I_2 \text{ when } I_1 = 0$$
$$Z_{21} = V_2 / I_1 \text{ when } I_2 = 0$$
$$Z_{22} = V_2 / I_2 \text{ when } I_1 = 0$$

Circuit:

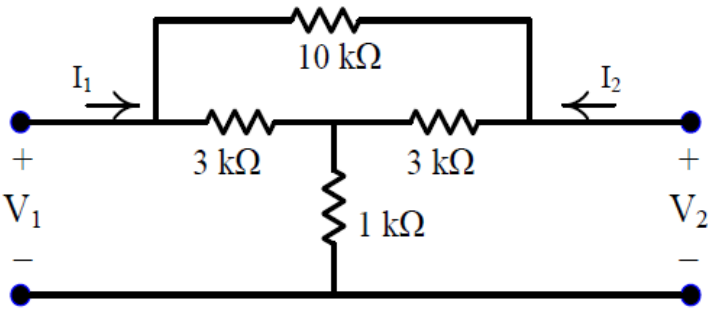

Figure 2 Circuit for experiment

Simulation:

1. Build the circuit of Figure 2 in Multisim Electronics Workbench.
2. Apply a DC voltage test source to the input port with the output port open. Use a voltmeter and ammeter to read the values of the voltages and currents necessary to compute Z_{11} and Z_{21}. Observe the proper polarity of the currents.
3. Repeat a similar procedure with a DC voltage test source applied to the output port with the input port open. Use a voltmeter and ammeter to read the voltage and current values, and derive the parameters Z_{22} and Z_{12}.
4. Record the values of the Z-parameters in Table 1.

Table 1 Z-parameters for circuit 1

Z-parameters	Z11	Z12	Z21	Z22
Simulation				
Calculation				

Questions:

1. Explain whether this two-port circuit is reciprocal, and why?
2. Explain whether this two-port circuit is symmetric, and why?
3. Run the simulation for a loaded two port network as shown in Figure 3 and find the voltage and current gain. Vs= 10 V DC, $G_v=V_2/V_s$ and current gain $G_i=I_2/I_1$.

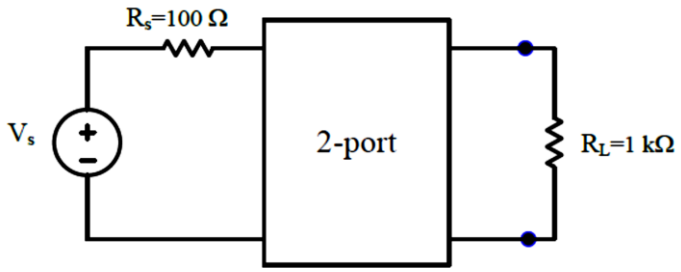

Figure 3 Loaded two-port network