Lab Report 4

EE23BTECH11049 - Praful Kesavadas

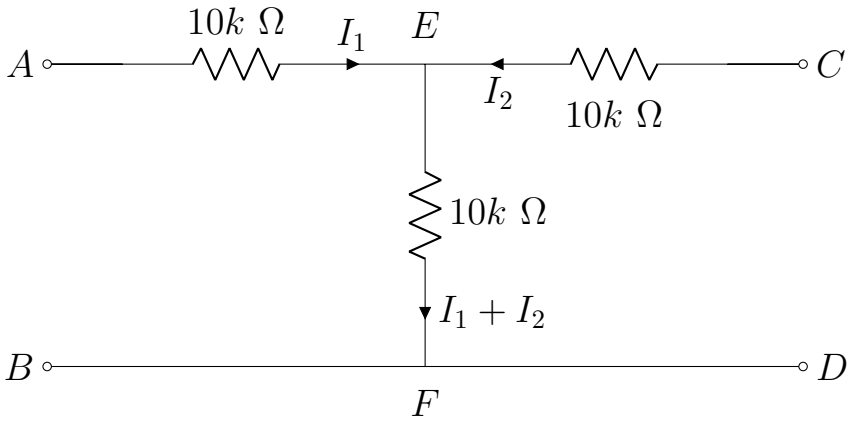
Aim :

– Construct a two port network using resistors and obtain their Z parameters..

Materials Used :

- Resistors (10k Ω, 18k Ω, 22k Ω)
- Breadboard
- Multimeter
- Connecting Wires
- DC Voltage Source

Circuit diagrams:



A and B : Input terminals

C and D : Output terminals

V_{AB} = V_1 V

V_{CD} = V_2 V

KCL at node E, gives

I_{AE} + I_{CE} = I_{EF} $\implies$ I_{EF} = I_1 + I_2

Theory :

– A two-port network is a fundamental concept in electrical engineering that describes a system with two input terminals and two output terminals

– The behavior of the network is characterized by relating the voltage and current at the input port to the voltage and current at the output port.

Z-parameters, also known as impedance parameters or open-circuit impedance parameters, are one of the several representations used to characterize the behavior of two-port networks.

The Z-parameters are represented by a 2 x 2 matrix as follows :

$$Z = \begin{pmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{pmatrix} \Omega$$

The equations are given as :

$V_1 = Z_{11}\ I_1 + Z_{12}\ I_2$ - - - - - - - - - - (1)

$V_2 = Z_{21}\ I_1 + Z_{22}\ I_2$ - - - - - - - - - - (2)

Procedure :

- Connect the circuit as shown in the circuit diagram
- Now set V_1 = 5.62V and check for the current through each resistor using multimeter and note down the values.
- Now set V_2 = 5.62V and again check for the current through each resistor using multimeter and note down the values.

Observations :

– When V_1 = 5.62V (Case 1) $\implies$ $I_1 \approx 0.27$ mA, I_2 = 0 A

– When V_2 = 5.62V (Case 2) $\implies$ I_1 = 0 A, $I_2 \approx 0.28$ mA

Calculations :

(1) Case 1 :

From KVL, $V_2 = 10k\ (I_1 + I_2) = 10k\ I_1$

From eq. (1) and (2),

$5.62 = Z_{11}\ (0.27m) + Z_{12}\ (0)$

$V_2 = Z_{21}\ (0.27\text{m}) + Z_{22}\ (0)$

from these equations, we get

Z_{21} = 10.3k Ω

Z_{11} = 20.81k Ω

(2) Case 2 :

From KVL, $V_1 = 10\text{k}\ (I_1 + I_2) = 10\text{k}\ I_2$

From eq. (1) and (2),

$V_1 = Z_{11}\ (0) + Z_{12}\ (0.28\text{m})$

$5.62 = Z_{21}\ (0) + Z_{22}\ (0.28\text{m})$

from these equations, we get

Z_{12} = 10.3k Ω

Z_{22} = 20.03k Ω

Conclusion :

The Z parameter matrix of the given circuit is :

$$Z = \begin{pmatrix} 20.81 & 10.3 \\ 10.3 & 20.03 \end{pmatrix}\ \text{k}\ \Omega$$