Lab Session 08

Analyze and implement Norton's Theorem

Objective:

- Verify the Norton's theorem theoretically and practically for a given circuit

Equipments and Components Required:

- DC Power supply
- Ammeter
- Voltmeter
- Resistors (Different values)
- Connecting wires
- Ohm meter (DMM)

Theory / Statement:

Norton's theorem states that any linear two-terminal circuit can be replaced by an equivalent circuit consisting of a current source I_N in parallel with a resistor R_N.

Fig. 8.1a (Original circuit)

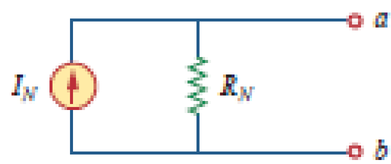


Fig. 8.1 (b) Norton equivalent circuit.

We will find R_N in the same way we find $R_{TH.}$, The Thevenin and Norton resistances are equal

$$R_N = R_{TH}$$

To find the Norton current **I_N** we determine the short-circuit current flowing from terminal *a* to *b* in both circuits in Fig 8.1, It is evident that the short-circuit current in Fig 8.2

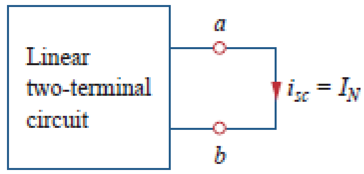


Fig 8.2 (Finding Norton current I_N)

Circuit for Understanding the Norton **Theorem**

Find the Norton equivalent circuit of the circuit in Fig. 8.3 at terminals *a-b*.

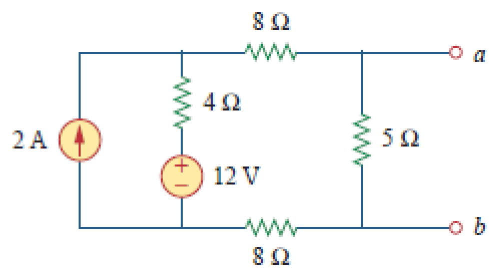


Fig. 8.3(finding R_N & I_N)

ROCEDURE:

1. Connect the circuit diagram as shown in figure 8.3
2. Find R_N by turned off all independent sourceS (Voltage source Short Circuit & Current Source open Circuit)
3. Measure short circuit Current by short circuiting terminals (a & b)
4. Draw the Norton's equivalent circuit as shown in fig 8.6

Step 1 :

We find R_N in the same way we find R_{TH} in the Thevenin equivalent circuit. Set the independent sources equal to zero. This leads to the circuit in Fig. 8.4

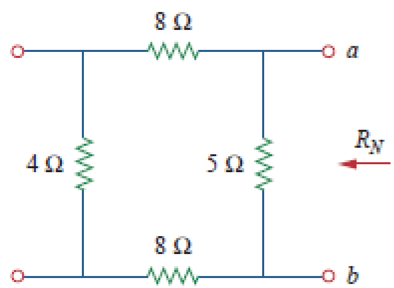


Fig. 8.4 a (finding R_N)

Theoretically:

$$R_N = 5 \,\|\, (8 + 4 + 8) = 5 \,\|\, 20 = \frac{20 \times 5}{25} = 4\ \Omega$$

Simulation Results

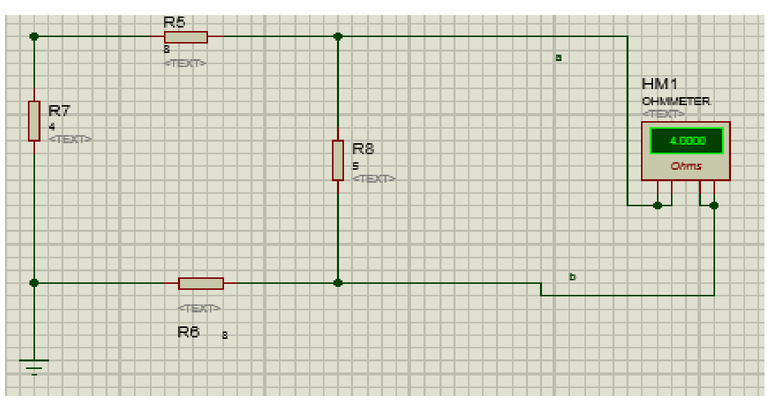


Fig. 8.4 b (finding R_N)

Step 2 :

To find we short-circuit terminals *a* and *b*, as shown in Fig. 8.5 We ignore the **5Ω** resistor because it has been short-circuited. ,

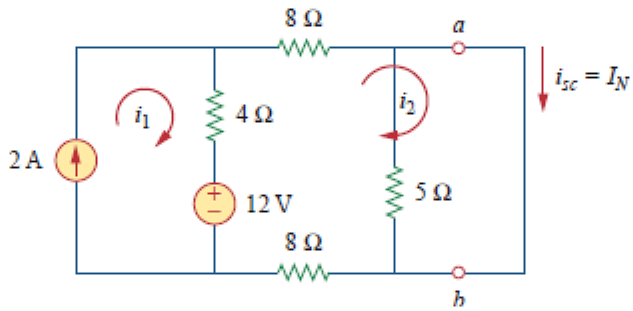


Fig. 8.5 (finding I_N)

Theoretically Results :

By applying mesh analysis, we obtain

$$i_1 = 2\text{ A}, \qquad 20i_2 - 4i_1 - 12 = 0$$

Mesh # 1

$$i_1 = 2A$$

Mesh # 2

$$\mathbf{-12+4\,(i_2-i_1)+8i_2+8i_2=0}$$

$$4i_2 - 4i_1 + 8i_2+8i_2 = 12$$

$$20i_2 - 4i_1 = 12$$

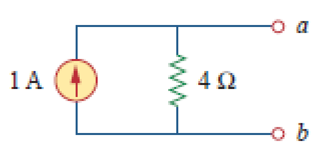
Putting the value of $i_1 = 2A$

$$20i_2 - 4(2) = 12$$

$$20i_2 = 12 + 8$$

$$i_2 = 20 /20 = 1\text{ A}$$

$$\mathbf{i_2 = 1\text{ A} = I_{sc} = I_N}$$



Norton equivalent of the circuit in Fig. 8.6

Simulation Results

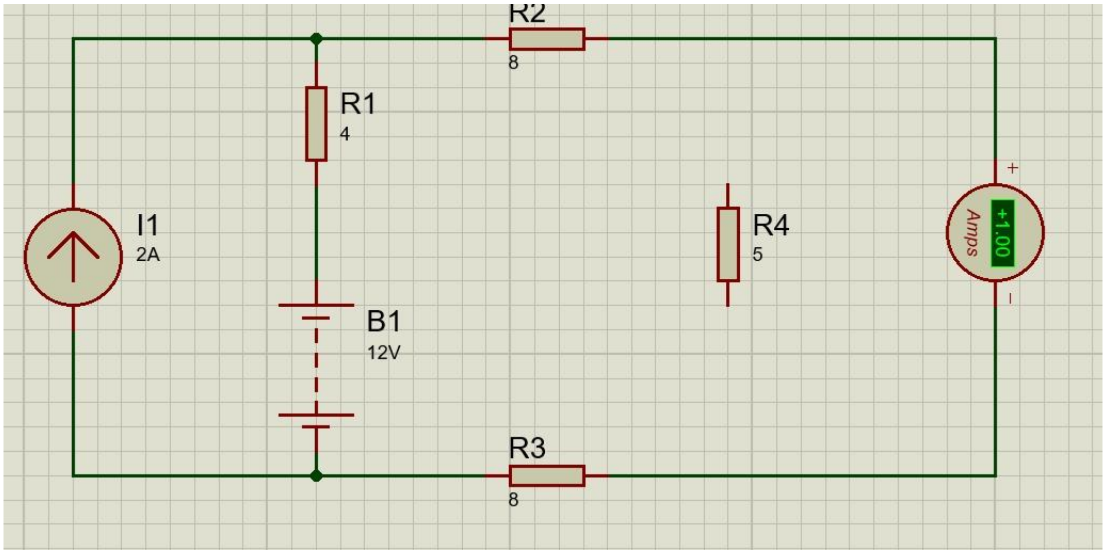


Fig. 8.6 a (finding I_N)

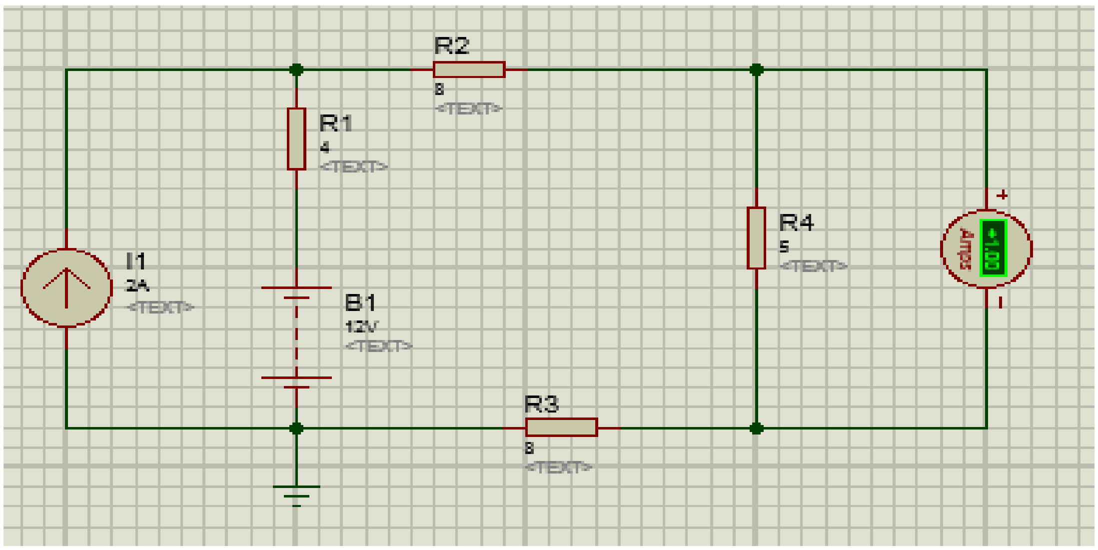


Fig. 8.6 a (finding I_N)

Overall Results and Observation

Table 8.1(Results)

Parameters	R_N	I_N
Theoretical Values		
Practical Values		

Task

Find the Norton equivalent circuit for the circuit in Fig. 8.7, at terminals *a*-*b* and write down your theoretical and practical results in Table 8.1

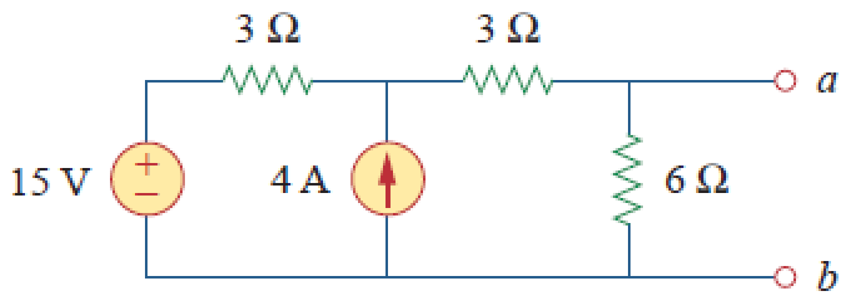


Fig. 8.7 (Task)

Conclusion& Comments: