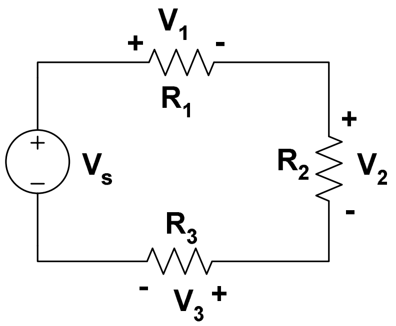
Experiment 5

Series & Parallel Circuits
Voltage Divider & Current Divider Rules

Introduction



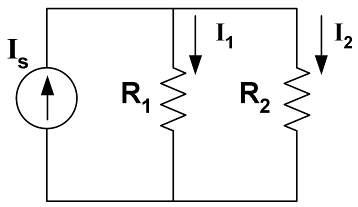


Figure 2: Parallel circuit

For a series circuit shown in Figure 1, the voltages across resistors R_1, R_2 and R_3 can be written as,

$$V_1 = \frac{R_1}{R_1 + R_2 + R_3} V_s$$
$$V_2 = \frac{R_2}{R_1 + R_2 + R_3} V_s \qquad (1)$$
$$V_3 = \frac{R_3}{R_1 + R_2 + R_3} V_s$$

This is the voltage divider rule (VDR).

For a parallel circuit given in Fig. 5.2, the branch currents can be written in terms of the total current as,

$$I_1 = \frac{R_2}{R_1 + R_2} I_s$$
$$I_2 = \frac{R_1}{R_1 + R_2} I_s \qquad (2)$$

This is termed as the current divider rule (CDR).

Objectives

1. To study the voltage current relationships of series and parallel circuits
2. To verify the voltage current divider and voltage divider rules.

Materials

One dc power supply
One multimeter
Assorted resistors

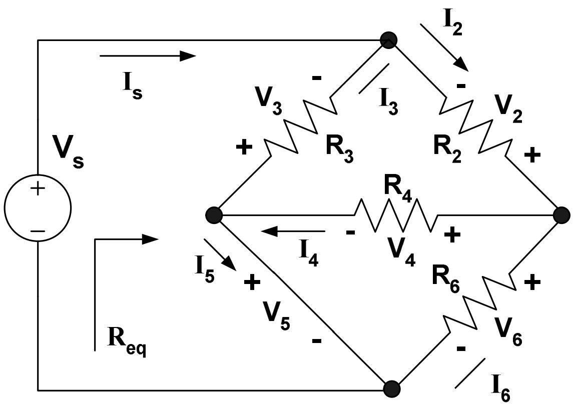


Figure 3: Series-parallel circuit I

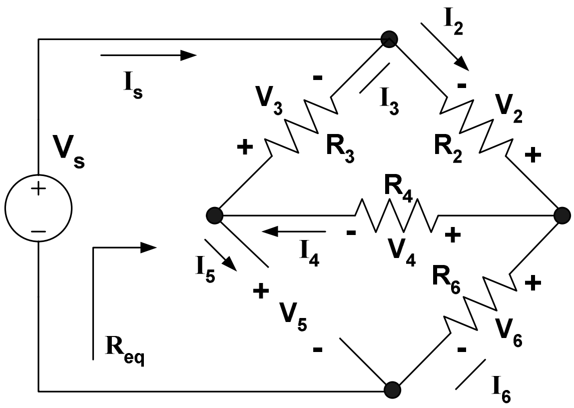


Figure 4: Series-parallel circuit II

R_2 = 100W**, R_3 = 150**W**, R_4 = 220**W**, R_6 = 330**W

Procedure

Simulation

1. Build the circuit given in Figure 3 on *Multisim Electronics Workbench.*
2. Connect voltmeters, ammeters (or multimeters) at appropriate positions to measure voltages and currents shown in Table 1.
3. Disconnect the voltage source. Connect a mutimeter and measure the total resistance and record the value in Table 1. (Remember resistance is always measured without any source connected to the circuit)
4. Repeat steps 2 and 3 for the circuit given in Figure 4 and record the values in Table 2.

Hardwired Experiment

5. Build the circuit of Figure 3 with the hardwired components. Take the voltage current measurements and R_{eq} and record in Table 1. Considering the Workbench results as the base compute the percentage errors.
6. Build the circuit of Figure 4 with the hardwired components. Take the voltage current measurements and R_{eq} and record in Table 2. Considering the Workbench results as the base compute the percentage errors.

Table 1: Simulation and experimental results for Figure 3

	I_s	I_2	I_3	I_4	I_5	I_6	V_2	V_3	V_4	V_5	V_6	R_{eq}
Workbench												
Hardwired												
% Error												

Table 2: Simulation and experimental results for Figure 4

	I_s	I_2	I_3	I_4	I_5	I_6	V_2	V_3	V_4	V_5	V_6	R_{eq}
Workbench												
Hardwired												
% Error												

Questions

Refer to Figure 3 and the results obtained in Table 1 and answer the following questions:

1. Are R_4 and R_6 in parallel or in series? Why? Refer to voltage current measurements for your answer to justify.

2. Are R_3 and R_4 in parallel or in series? Why? Justify

3. Are Vs and R_3 in parallel or in series? Why? Justify

4. Are Vs and R_6 in series or in parallel? Why? Justify.

5. Are Vs and R_{eq}. in parallel or in series? Why? Justify

6. Is VDR applicable for applicable R_3 and R_4? Why? Justify your answer on the basis of theory given in the introduction.

7. Is CDR applicable for R_4 and R_6? Why? Justify your answer on the basis of theory given in the introduction.

8. Is the parallel combination of R_4 and R_6 in series or in parallel with R_2? Why? Justify.

Refer to Figure 4 and the results obtained in Table 2 and answer the following questions:

9. Are R_4 and R_6 in parallel or in series? Why? Refer to voltage current measurements for your answer to justify.

10. Are R_3 and R_4 in parallel or in series? Why? Justify

11. Are Vs and R_3 in parallel or in series? Why? Justify

12. Are Vs and R_6 in series or in parallel? Why? Justify.

13. Are Vs and R_{eq}. in parallel or in series? Why? Justify

14. Is VDR applicable for applicable R_3 and R_4? Why? Justify your answer on the basis of theory given in the introduction.

15. Is CDR applicable for R_4 and R_6? Why? Justify your answer on the basis of theory given in the introduction.

16. Is the parallel combination of R_4 and R_6 in series or in parallel with R_2? Why? Justify.

Any other observations or comments