6. Circuit Analysis

MTVW 25-Feb-13

Objectives

1. To compare the analysis of series-parallel circuits with experimental measurements.
2. To investigate the effect of "open" and "short" circuits
3. To use Superposition and Mesh Current Analysis to aid in determining circuit values.

Equipment

1. 5 V and -5 VDC power supplies (these are in the same case),
2. One SPST switch,
3. 402 Ω, 90 Ω and 150 Ω carbon resistors,

Preparation

1. Analyze the series-parallel circuit in Figure 1with the switch open and compute the currents, I_0, I_1, I_2, I_3, and I_5 and the voltages, V_{AC}, V_{BA}, $V_{CB,}$ and V_{DC}. Enter the computed values into Table 4 a). Using the computed values in Table 4 a) complete Table 4 c).
2. Analyze the series-parallel circuit in Figure 1with the switch closed and compute the currents, I_0, I_1, I_2, I_3, and I_5 and the voltages, V_{AC}, V_{BA}, $V_{CB,}$ and V_{DC}. Enter the computed values into Table 5 a). Using the computed values in Table 5 a) complete Table 5 c).
3. Analyze the circuit of Figure 2 using superposition to determine the voltage across R_3. Space has been provided for your analysis.
4. Analyze the circuit of Figure 2 using Mesh Current Analysis to determine the voltage across R_3. Space has been provided for your analysis.

Experiment

1. Analysis of a Resistive Circuit using Ohms Law, KVL, and KCL

Consider the series-parallel circuit in Figure 1. Table 4 a), Table 4 c), Table 5 a) and Table 5 c), will have been completed as preparation before attending the lab.

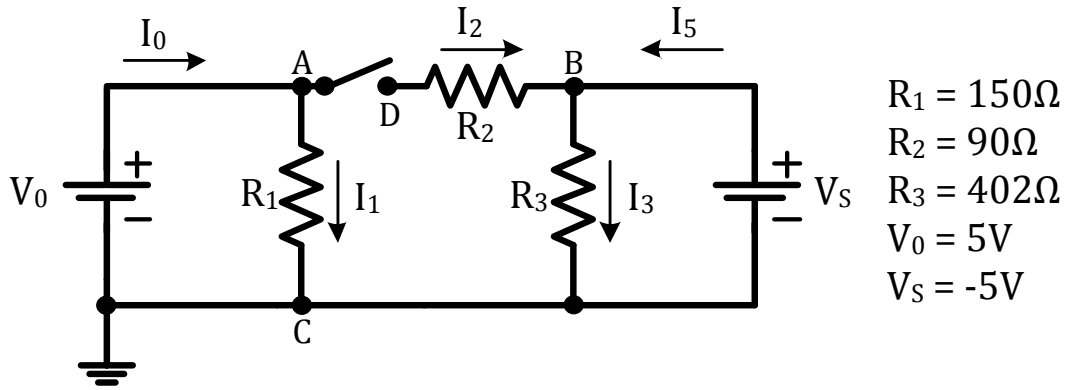

Figure 1: Series-parallel circuit to be analyzed and constructed.

Before wiring up the circuit use the multimeter to measure the resistances of R_1, R_2 and R_3 and enter the measured values into Table 4 b) and Table 5 b). Wire up the circuit and record the measured currents and voltages in Table 4 b) when the switch is open; and into Table 5 b) when the switch is closed.

Verify Ohm's Law for each of the resistors, KCL at nodes A & B, and KVL (around one of the loops) by completing Table 4 c) and Table 5 c) using measured voltages and currents.

2. Analysis of a Resistive Circuit using Superposition and Mesh Current Analysis.

Wire up the circuit of Figure 2 and measure V_{R3}. Compare with your calculated value from your Superposition and Mesh Current Analysis.

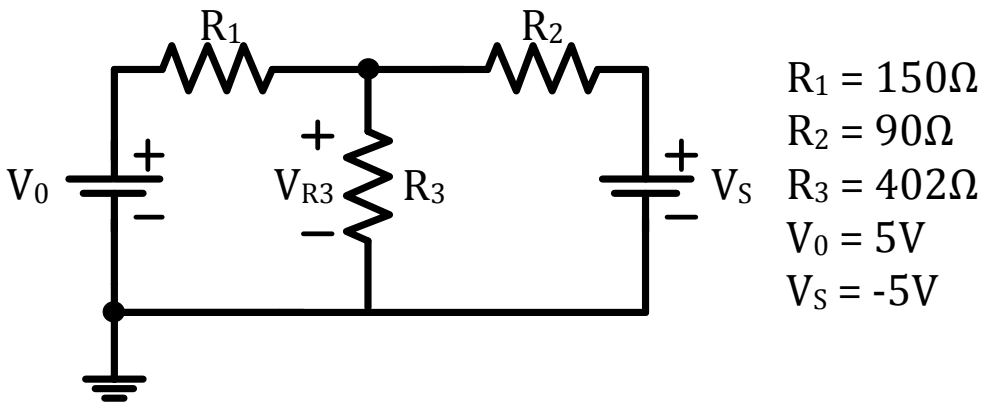

Figure 2: Mesh Loop and Superposition Analysis Circuit.

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Table 4 a). Analysis Results (completed as lab preparation)										
S-Open	I_0	I_1	I_2	I_3		I_5	V_{AC}	V_{BA}	V_{CB}	V_{DC}
S-Open										
Table 4 b). Measured Values										
S-Open	I_0	I_1	I_2	I_3		I_5	V_{AC}	V_{BA}	V_{CB}	V_{DC}
S-Open										
Resistances	R_1		R_2		R_3					
Resistances										
Table 4 c). Computed from Analysis Results (as lab preparation) in Table 4 a)										
S-Open	V_{AC}/I_1		V_{AB}/I_2		V_{BC}/I_3		$V_{AC} + V_{DA} + V_{BD} + V_{CB}$			
S-Open										
s-Open	$I_2 - I_3 + I_5$		$I_0 - I_1 - I_2$							
S-Open										
Table 4 d). Computed from Measured Results in Table 5 b)										
S-Open	V_{AC}/I_1		V_{AB}/I_2		V_{BC}/I_3		$V_{AC} + V_{DA} + V_{BD} + V_{CB}$			
S-Open										
S-Open	$I_2 - I_3 + I_5$		$I_0 - I_1 - I_2$							
S-Open										

Table 5 a). Analysis Results (completed as lab preparation)										
S-Closed	I_0	I_1	I_2	I_3		I_5	V_{AC}	V_{BA}	V_{CB}	V_{DC}
S-Closed										
Table 5 b). Measured Values										
S-Closed	I_0	I_1	I_2	I_3		I_5	V_{AC}	V_{BA}	V_{CB}	V_{DC}
S-Closed										
Resistances	R_1		R_2		R_3					
Resistances										
Table 5 c). Computed from Analysis Results (as lab preparation) in Table 5 a)										
S-Closed	V_{AC}/I_1		V_{AB}/I_2		V_{BC}/I_3		$V_{AC} + V_{DA} + V_{BD} + V_{CB}$			
S-Closed										
S-Closed	$I_2 - I_3 + I_5$		$I_0 - I_1 - I_2$							
S-Closed										
Table 5 d). Computed from Measured Results in Table 5 b)										
S-Closed	V_{AC}/I_1		V_{AB}/I_2		V_{BC}/I_3		$V_{AC} + V_{DA} + V_{BD} + V_{CB}$			
S-Closed										
S-Closed	$I_2 - I_3 + I_5$		$I_0 - I_1 - I_2$							
S-Closed										

Indicate all assumed *voltage polarities* and *current directions

Superposition Analysis of the circuit of Figure 2:

Indicate all assumed *voltage polarities* and *current directions

Mesh Current Analysis of the circuit of Figure 2:

Comparison: