Voltage Dividers

Air Washington Electronics ~ Direct Current Lab

Revised: Wednesday, July 10, 2013

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Overview

In this lab, students are asked to build a voltage divider based on a schematic. Calculations and measurements will be taken and analyzed. From these measurements, current will then be calculated. In the second activity, students are presented with a set of specifications and asked to build a loaded voltage divider based on those specifications using only standard value ±5% resistors. Students must provide observations and conclusions to demonstrate understanding of the concepts.

Requirements

To meet all requirements for this lab, you must complete all activities, questions, critical thinking activities and questions, and observations and conclusions.

Course Objectives

- Demonstrate proper measurement techniques for voltage, current, and resistance.
- Demonstrate proper operating techniques and evaluate for proper operation the following list of test equipment: DC Power Supply and Digital Multimeter
- Demonstrate acceptable techniques to construct circuits from schematic drawings on solderless and/or solder type breadboards.
- Demonstrate ability to document a breadboard circuit, schematic, pictorial layouts, predict circuit operation, test circuit operation, and compare test results.

Module Objectives

- Build a voltage divider per schematic and take/analyze measurements.
- Analyze and compare values between calculated and measured values.
- Choose resistors needed to meet stated specifications using standard ±5% resistor values.
- Predict and support circuit response to specific changes and support.

Activities & Assessments

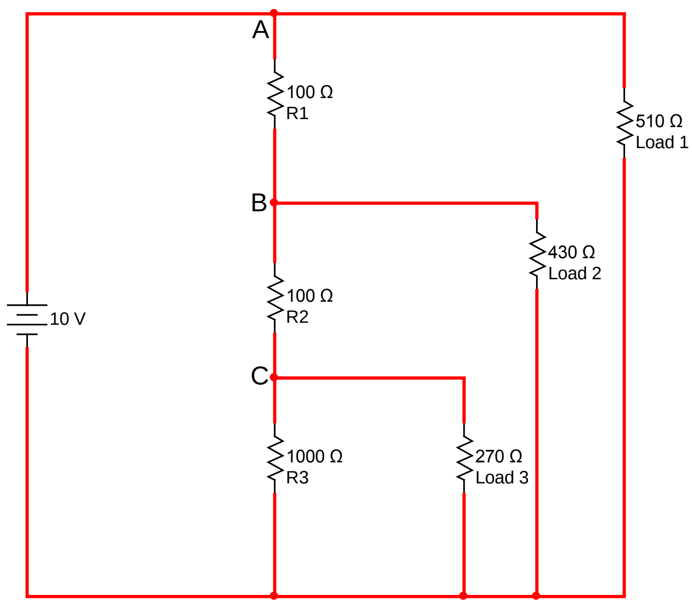
1. Voltage Divider Circuit
2. Designing a Loaded Voltage Divider
3. Critical Thinking

1: Voltage Divider Circuit

Components & Equipment Needed

- 9V battery or DC Power Supply
- Breadboard & Jumper Wires
- Resistors: 1k (3), 270 Ω, 430 Ω, 510 Ω

Schematic



Procedure

Step 1: Build the circuit shown in the schematic.

Step 2: Take measurements and perform calculations as required in the table below.

	Calculated Value	Measured Value	% Difference
V_{R1}			
V_{R2}			
V_{R3}			
V_{Load1}			
V_{Load2}			
V_{Load3}			
V_{Total}			
I_{Load1}			
I_{Load2}			
I_{Load3}			
I_{Total}			
I_b			

Questions

1. If you were to remove Load 3, what would happen to total current? Does anything change in regards to Load 1 or Load 2? Please explain.

2: Designing a Loaded Voltage Divider

Components & Equipment Needed

- 9 V Battery or DC Power Supply
- Breadboard & Jumper Wires
- Resistors: TBD

Procedure

Step 1: Design a loaded voltage divider using the specifications below. Enter your calculated values in the table in Step 3.

- Load A requires 9 V and about 10 mA
- Load B requires 5 V and about 8 mA
- Load C requires 2 V and about 3 mA

Step 2: Build the loaded voltage divider on a breadboard using standard value (±5%) resistors. Be aware that your values may not come out exact, so use the best possible resistance for the circuit. Use a design similar to that shown in the schematic of the first activity (Voltage Divider Circuit).

Step 3: Measure and record the values in the table below. Calculate the percentage of difference between your calculated and measured values.

	Calculated Value	Measured Value	% Difference
R_1			
R_2			
R_3			
V_{R1}			
V_{R2}			
V_{R3}			
V_{Load1}			
V_{Load2}			
V_{Load3}			
V_{Total}			
I_{Load1}			
I_{Load2}			
I_{Load3}			
I_{Total}			
I_b			

Questions

1. If R3 were to open, what would happen to the rest of the circuit? Would any of the other loads be affected? Please explain your answer.

3: Critical Thinking

Your supervisor has decided that you are ready to accept new challenges and asks you to take the lead in solving a new customer's dilemma.

A new customer has decided that they would like to utilize two (2) of your company's SuperBright 1600 lamps and the new Sensor Array that was recently developed. They are not interested in purchasing any of the power supplies as they already have a 100 V power supply in place that is being used to run another part of their system.

The specs for the SuperBright 1600's indicate that they require a 24V power supply and have a resistance of 15 Ω each. The Sensor Array requires 12V and has a resistance of 1500 Ω. Recall that there is an existing requirement on the power supply of 100 V and 500 mA.

They would like you to design a system that will allow them to operate all four (4) of these components from a single 100 V power supply.

In addition to your calculations and a table of calculated and actual values, your supervisor will want a schematic created in Multisim. The "actual" values will be those that result from standard value resistors with a tolerance of ±5%. Because of this tolerance requirement, it is important to indicate in your table of values the percent difference between the calculated and actual values.