



MARINE INSTITUTE

Electrotechnology 1100

Experiment 7
Voltage Dividers

BASIC INFORMATION

Resistive Voltage Dividers are used to create lower voltages from higher voltage sources. This type of circuit is used for biasing electronics circuits.

The simplest method is to use a series dropping resistor to drop the voltage to the level required by the load. This series voltage divider is dependent upon the load current remaining relatively constant. If the load current changes, the voltage drop of the series dropping resistor changes, and the load voltage changes. The circuit is said to have 'poor regulation'.

To improve regulation, a bleeder is added in parallel with the load to make the circuit less susceptible to changes in load current. This voltage divider is solved using series/parallel rule. The voltage divider can be expanded to provide multiple loads at different voltages and currents from a single source.

This Lab will have you design and construct these three types of voltage dividers.

OBJECTIVES:

When you have completed this experiment, you should be able to:

- Design a series voltage divider circuit to meet a specific voltage and current.
- Design a voltage divider circuit to meet a specific voltage and current.
- Design a voltage divider circuit to meet specific voltages and currents for multiple loads.

EQUIPMENT & MATERIALS REQUIRED:

Power Supply:	0-60/70V dc.
Instruments:	Analog Voltmeter. Analog Milliammeter.
Resistors:	120 Ω , 1W. 250 Ω , 5W - Brown Ceramic or 250 Ω , 1W. 360 Ω , 1W. 500 Ω , 5W - Black Ceramic or White Rectangular Ceramic. 560 Ω , 1W. 1.0k Ω .
Miscellaneous:	Orange board. 3 Black Alligator Clip to Banana Plug test leads. 3 Red Alligator Clip to Banana Plug test leads. Quick clips.

PROCEDURE:

PART A: Series Voltage Divider.

- A1. Design a series voltage divider to provide 12V to a 1kΩ resistor from a 21V supply as shown by Figure 7-1. Put your design values in Table 7-1.

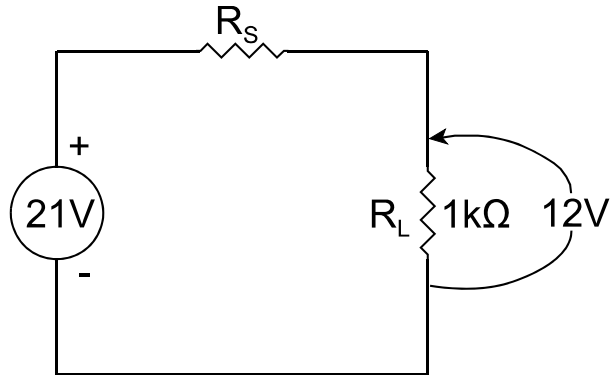


Figure 7-1

- A2. Construct the circuit shown in Figure 7-1. You will have to use two resistors to make your design R_S .
- A3. Measure and record in Table 7-2 the load voltage V_{L_1} and current I_{L_1} .
- A4. Replace the 1kΩ load resistor with 560Ω, and measure and record in Table 7-2 the new load voltage V_{L_2} and current I_{L_2} .
- A5. Calculate the % Voltage Regulation using Formula 1 and record in Table 7-2.

$$\% \text{ Voltage Regulation} = \frac{(V_{L_1} - V_{L_2})}{V_{L_1}} * 100\% \quad \text{Formula 1.}$$

Design Calculations

PART B: Voltage Divider.

- B1. Design a voltage divider to provide 12V to a 1k Ω resistor from a 21V supply with a bleeder current of 24mA as shown by Figure 7-2. Put your design values in Table 7-3.

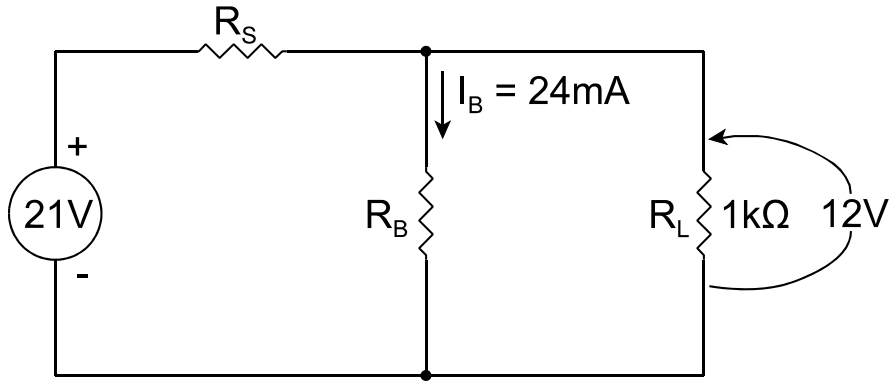


Figure 7-2

- B2. Construct the circuit shown in Figure 7-2.
- B3. Measure and record in Table 7-2 the load voltage V_{L_1} and current I_{L_1} .
- B4. Replace the 1k Ω load resistor with 560 Ω , and measure and record in Table 7-2 the new load voltage V_{L_2} and current I_{L_2} .
- B5. Calculate the % Voltage Regulation using Formula 1 and record in Table 7-2.
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Design Calculations

PART C: Multiple Voltage Divider.

C1. Design a voltage divider to provide the following loads from a 20V supply with a bleeder current of 20mA as shown by Figure 7-3.

5V drawing 25mW.

14V drawing 350mW.

Use resistors for your loads. Put your design values in Table 7-4.

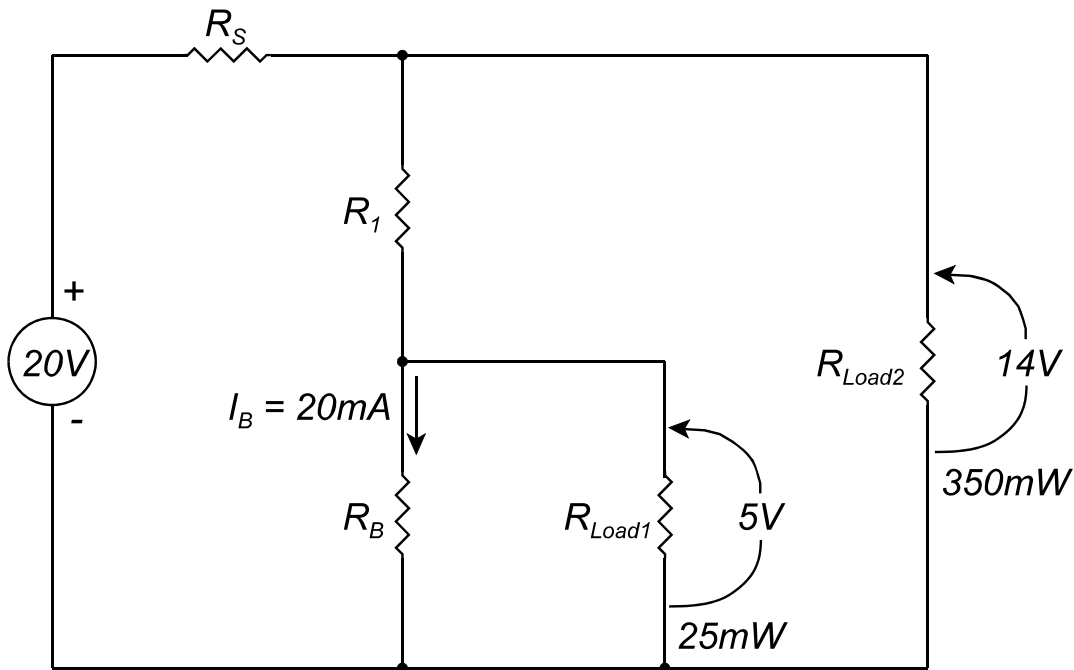


Figure 7-3

C2. Construct the circuit shown in Figure 7-3.

C3. Measure and record in Table 7-5 the load voltages (V_{Load1} and V_{Load2}) and currents (I_{Load1} and I_{Load2}).

C4. Disconnect your circuit and return all equipment to its proper place.

Design Calculations

RESULTS:

Table 7-1 Series Voltage Divider Design

Resistor	Power (mW)	Voltage (V)	Current (mA)	Resistance (Ω)
Total		21		
R_S				
R_L		12		1k

Table 7-2 Voltage Divider Measurements

Procedure	V_{L_1} (V)	I_{L_1} (mA)	V_{L_2} (V)	I_{L_2} (mA)	% Voltage Regulation
A					
Step	A3		A4		A5
B					
Step	B3		B4		B5

Table 7-3 Voltage Divider Design

Resistor	Power (mW)	Voltage (V)	Current (mA)	Resistance (Ω)
Total		21		
R_S				
R_L		12		1k
R_B			24	

Table 7-4 Multiple Voltage Divider Design

Resistor	Power (mW)	Voltage (V)	Current (mA)	Resistance (Ω)
Total		20		
R_S				
R_{Load2}	350	14		
R_1				
R_{Load1}	25	5		
R_B			20	

Table 7-5 Multiple Voltage Divider Measurements

Procedure	V_{Load1} (V)	I_{Load1} (mA)	V_{Load2} (V)	I_{Load2} (mA)
C				
Step	C3			

QUESTIONS:

1. What is the main source of error between your measurements in Tables 7-2 and 7-5 and your design calculations in Tables 7-1, 7-3 and 7-4?

Hints: It has nothing to do with sources of measurement error (human or machine - meter accuracy). What meter was NOT used in this experiment and why would we use that meter? Colors.

2. Does the error discussed in Question 1 have an appreciable effect on your results? Why?

3. In Procedure A, Step A4, why does the load voltage change?

4. Why does the voltage divider in Procedure B have better regulation than the series voltage divider in Procedure A?
