ECE 2300

Electronics Circuits
and
Electronics Devices Laboratory

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Laboratory 1

Resistor Networks

Background

- Series and Parallel Resistor Combinations
- Ohm's Law
- Kirchoff Voltage Law
- Kirchoff Current Law
- Voltage Divider
- Current Divider

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Ohm’s Law

Ohms Law:

V = I*R (volts = amps*ohms)

Power in a Resistor

1. **P = V*I** (watts = volts * amps**)**
2. **P = V^2 / R**
3. **P = I^2*R**

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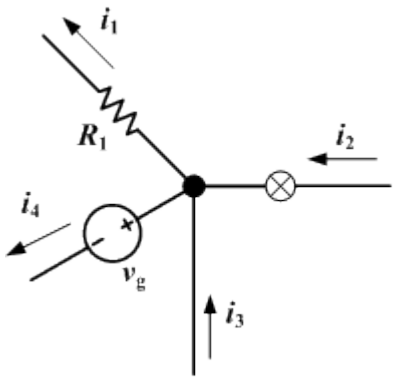
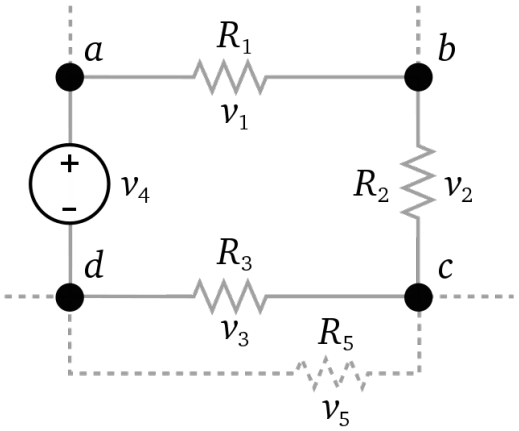
Kirchoff Laws

- **Kirchoff Current Law:**



The sum of currents in and out of any circuit node must equal zero.

- **Kirchoff Voltage Law:**



The sum of voltages in any closed circuit loop must be equal to zero.

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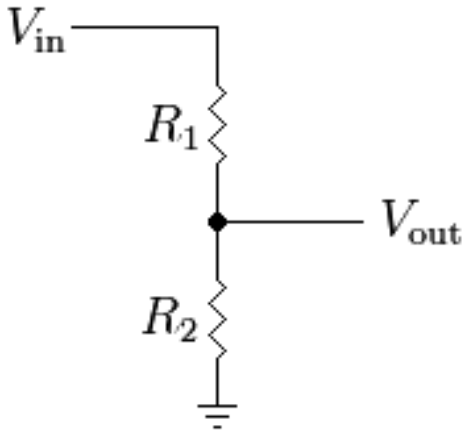
Voltage Divider



$$V_{out} = V_{in} * \frac{R_2}{R_1 + R_2}$$

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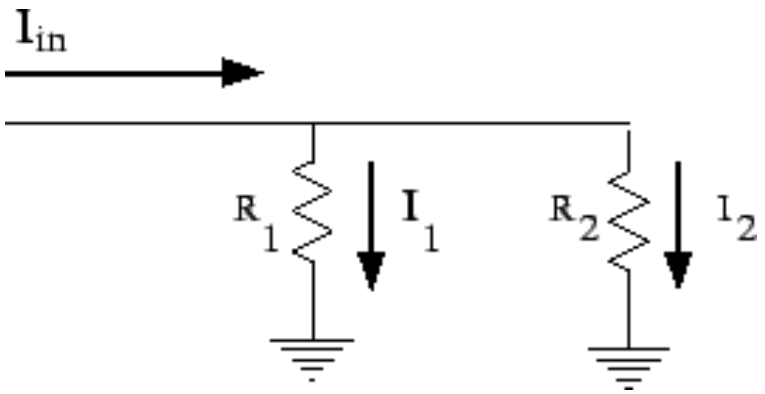
Current Divider



$$I_1 = I_{in} \frac{R_2}{R_1 + R_2} \qquad I_2 = I_{in} \frac{R_1}{R_1 + R_2}$$

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Lab Supplies

- Resistors
  - 1 each of:

    402 Ohm
    499 Ohm
    806 Ohm
    1 Kilo-Ohm
    2 Kilo-Ohm
    4.99 Kilo-Ohm
    10 Kilo-Ohm

  - 2 each of: 100 Ohm

    Some kits have a typo on Parts List. The 100 Ohm resistor should be **Brn-Blk-Blk-Blk-Brn**

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1% Resistor Code

COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE	
Black	0	0	0	1Ω		
Brown	1	1	1	10Ω	± 1%	(F)
Red	2	2	2	100Ω	± 2%	(G)
Orange	3	3	3	1KΩ		
Yellow	4	4	4	10KΩ		
Green	5	5	5	100KΩ	±0.5%	(D)
Blue	6	6	6	1MΩ	±0.25%	(C)
Violet	7	7	7	10MΩ	±0.10%	(B)
Grey	8	8	8		±0.05%	
White	9	9	9			
Gold				0.1	± 5%	(J)
Silver				0.01	± 10%	(K)

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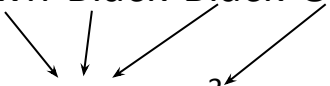
Resistor Code

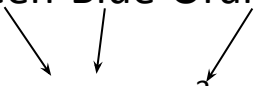
Examples:

1. Brown-Black-Black-Orange-Brown 100 KiloOhms Ohms 1%



$100 \times 10^3 = 100 \times 1000 = 100{,}000$

2. Brown-Green-Black-Black-Brown 150 Ohms 1%
3. Red-Red-Blue-Red-Brown 22.6 KiloOhms 1%
4. Green-Blue-Orange-Gold 56 KiloOhms 5%



$56 \times 10^3 = 56 \times 1000 = 56000$

Do not confuse with Scientific Notation. There is no decimal point!

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Test Set-up

- Breadboard
- Digital Multi-meter
- Mini grabbers
  - 2 red
  - 2 black

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Easy Clips or Mini-Grabbers

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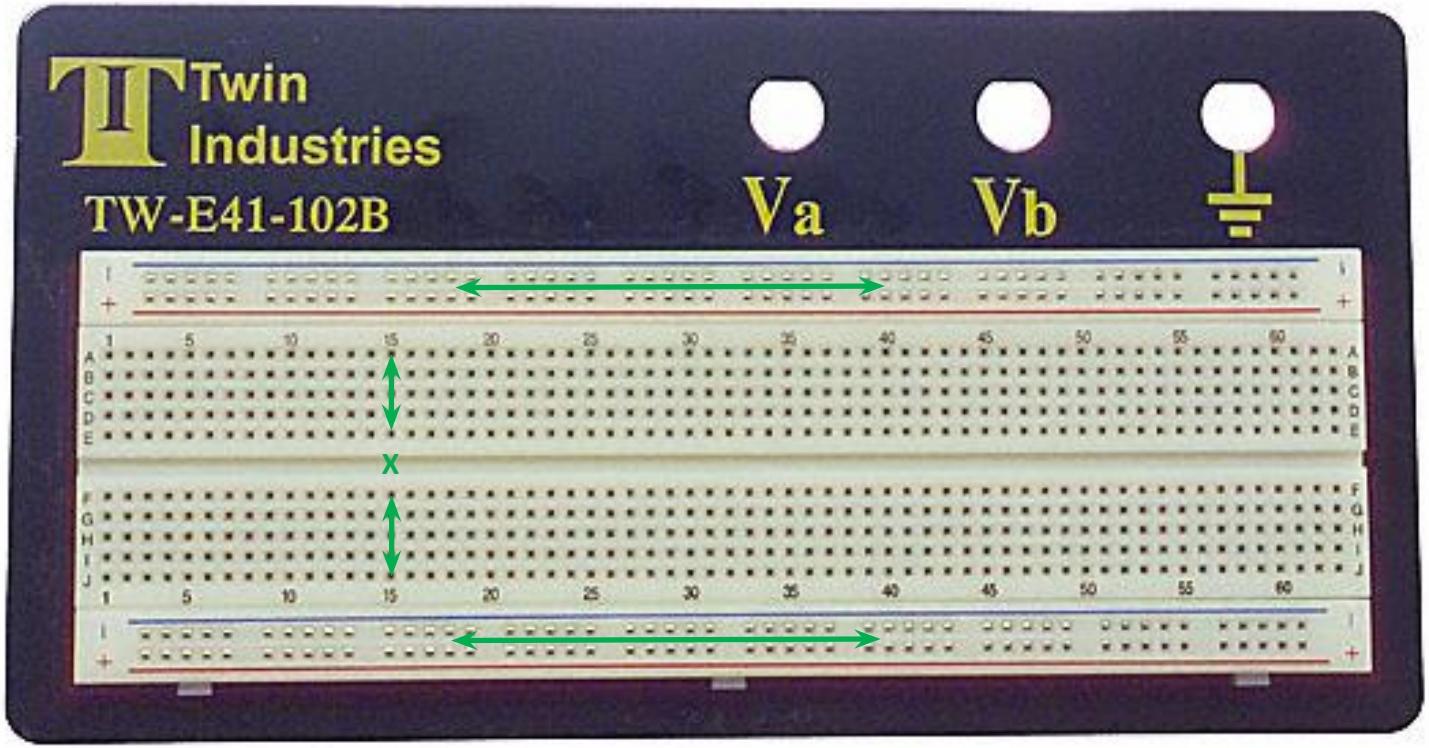
The Breadboard



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Handheld Digital Multimeter

Fluke 117

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Circuits

- Series Resistors
- Parallel Resistors and Current Divider
- Voltage Divider
- Resistor Network

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Series Resistance

Resistors add in series

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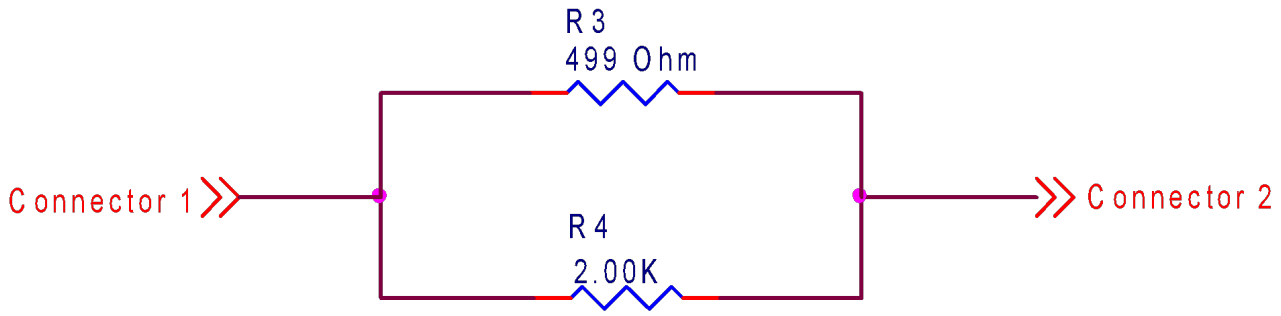
Parallel Resistance



$$R_{total} = \frac{R_3 * R_4}{R_3 + R_4} = \frac{1}{\frac{1}{R_3} + \frac{1}{R_4}}$$

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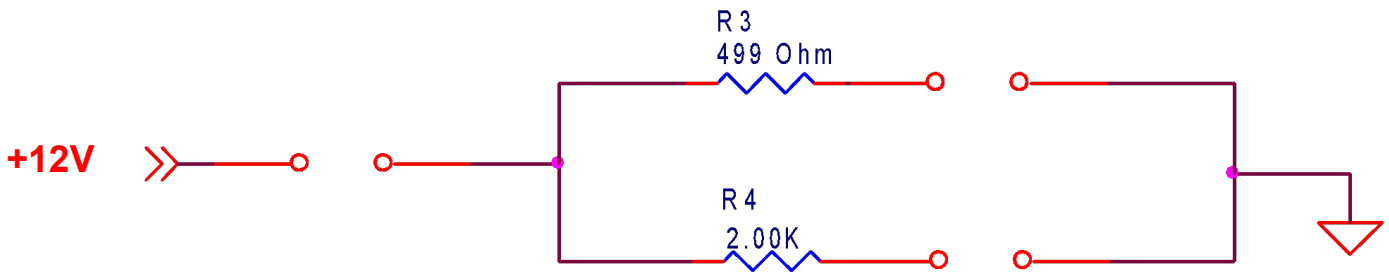
Current Divider

$$I_3 = I_{total} \frac{R_4}{R_3 + R_4}$$



$$I_4 = I_{total} \frac{R_3}{R_3 + R_4}$$

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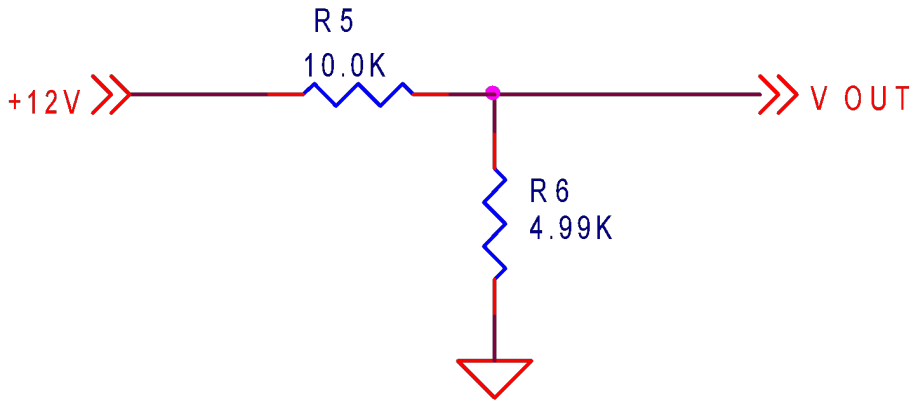
Voltage Divider



$$V_{out} = +12V * \frac{R_6}{R_5 + R_6}$$

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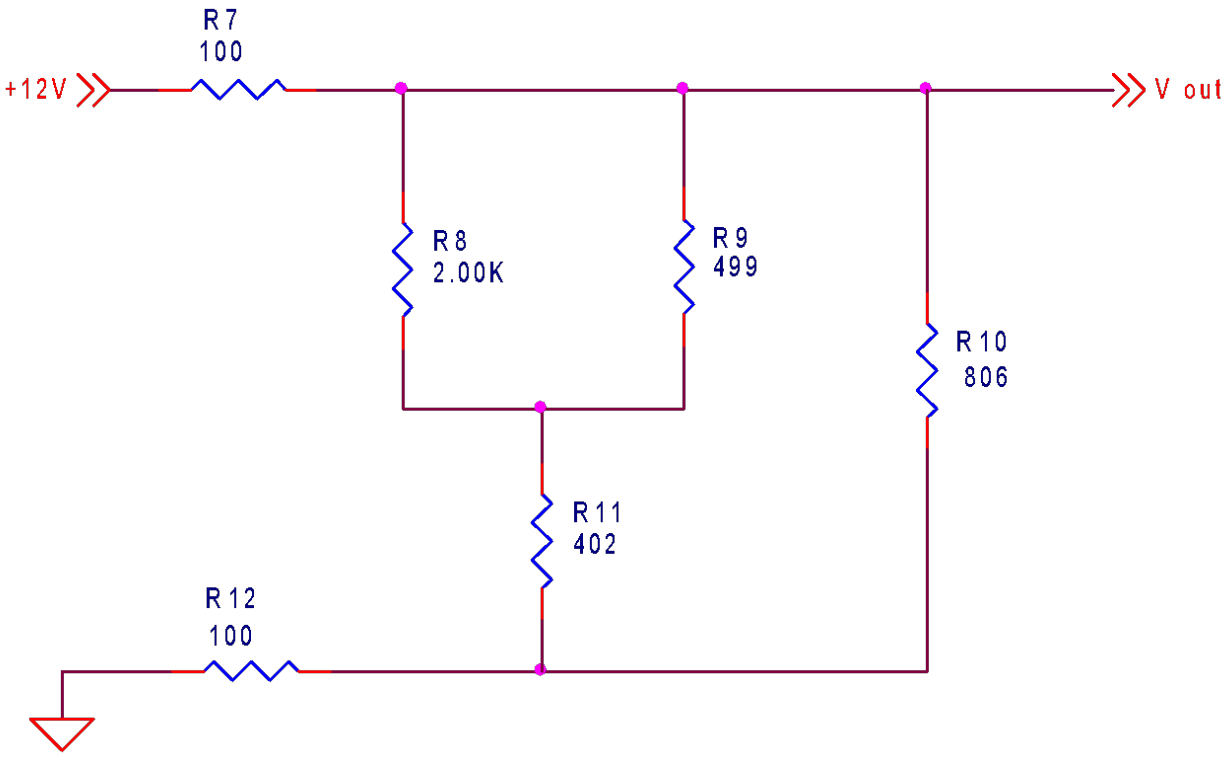
Resistor Network



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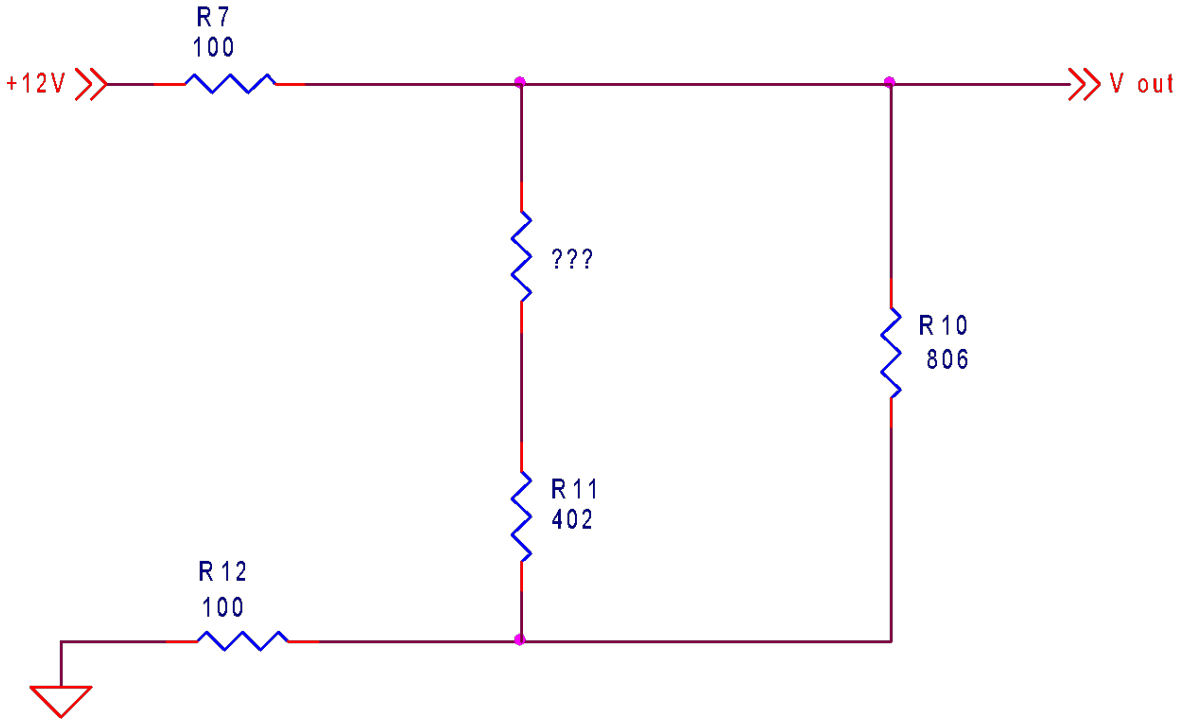
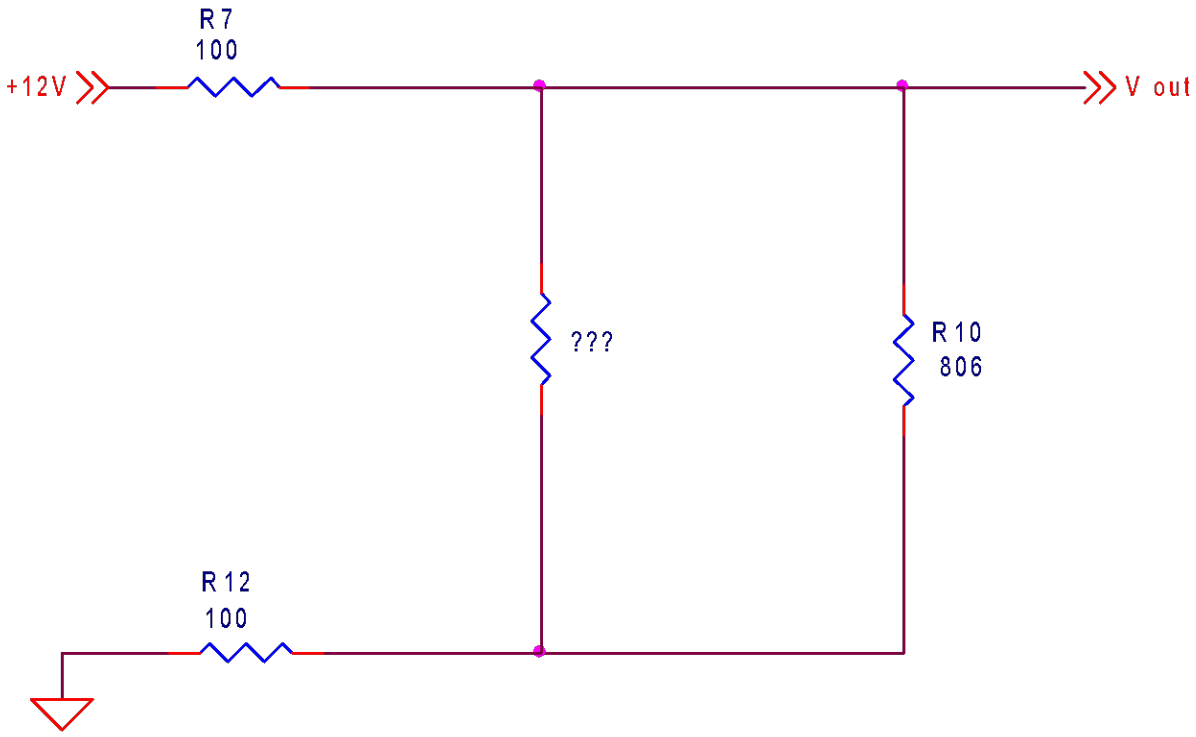
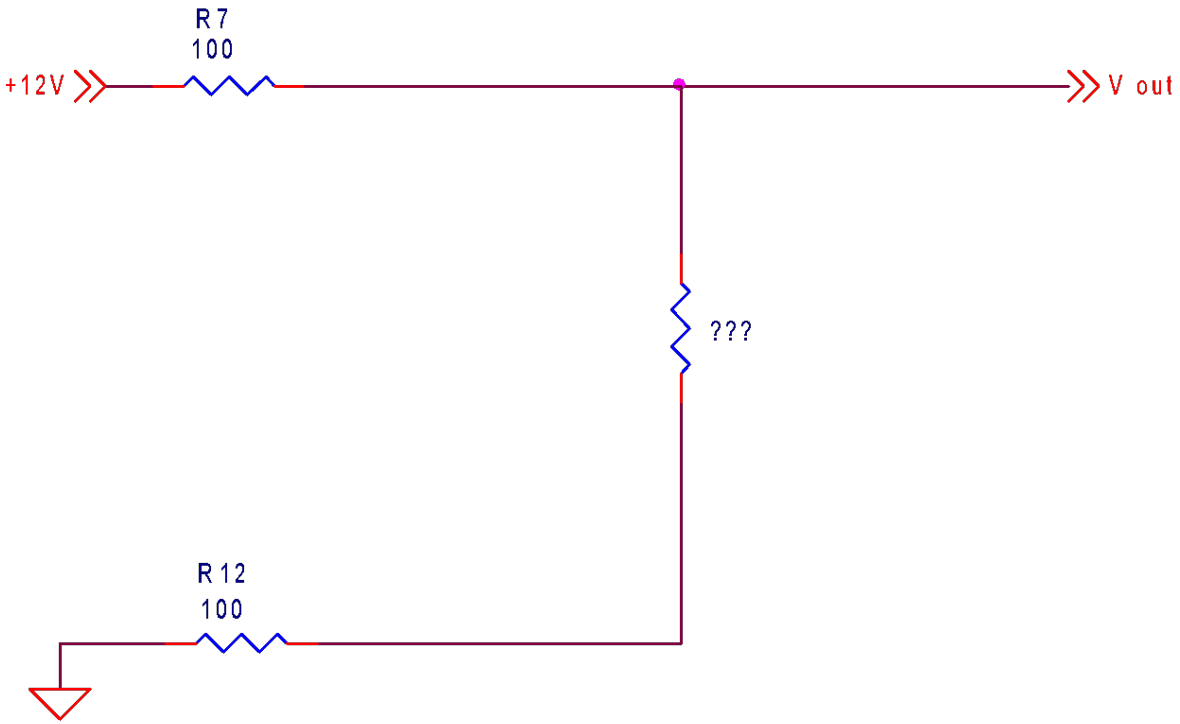
Resistor Network



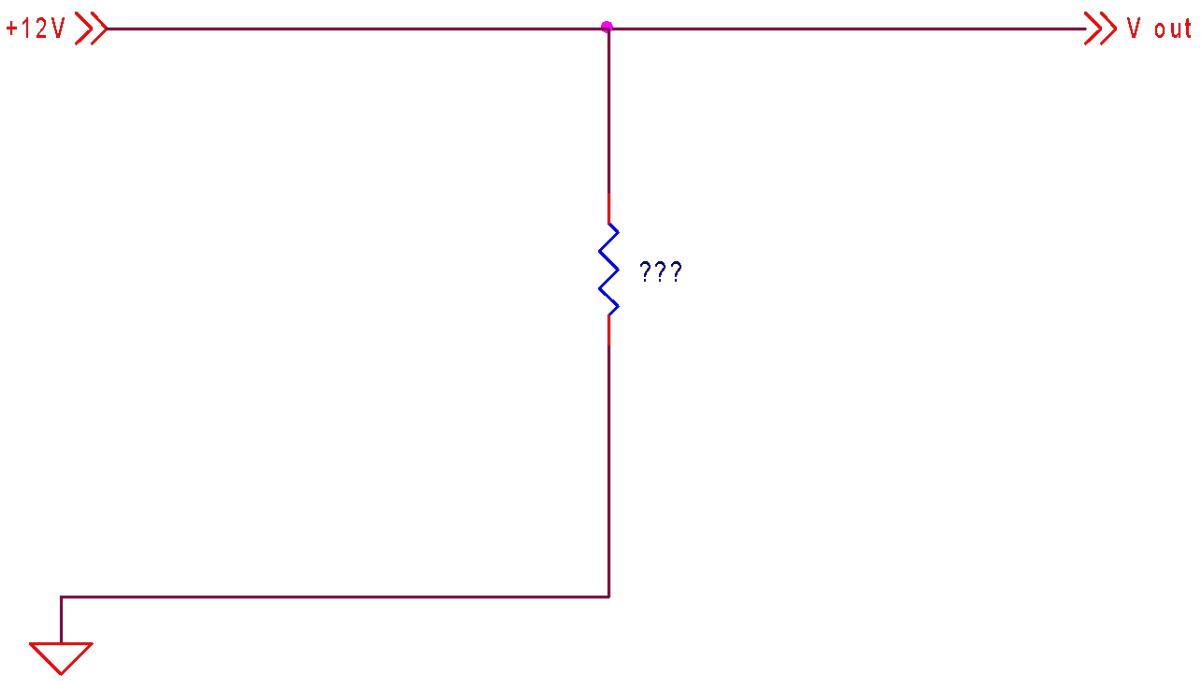
Resistor Network



Resistor Network



Resistor Network



Thevenin Equivalent Circuit

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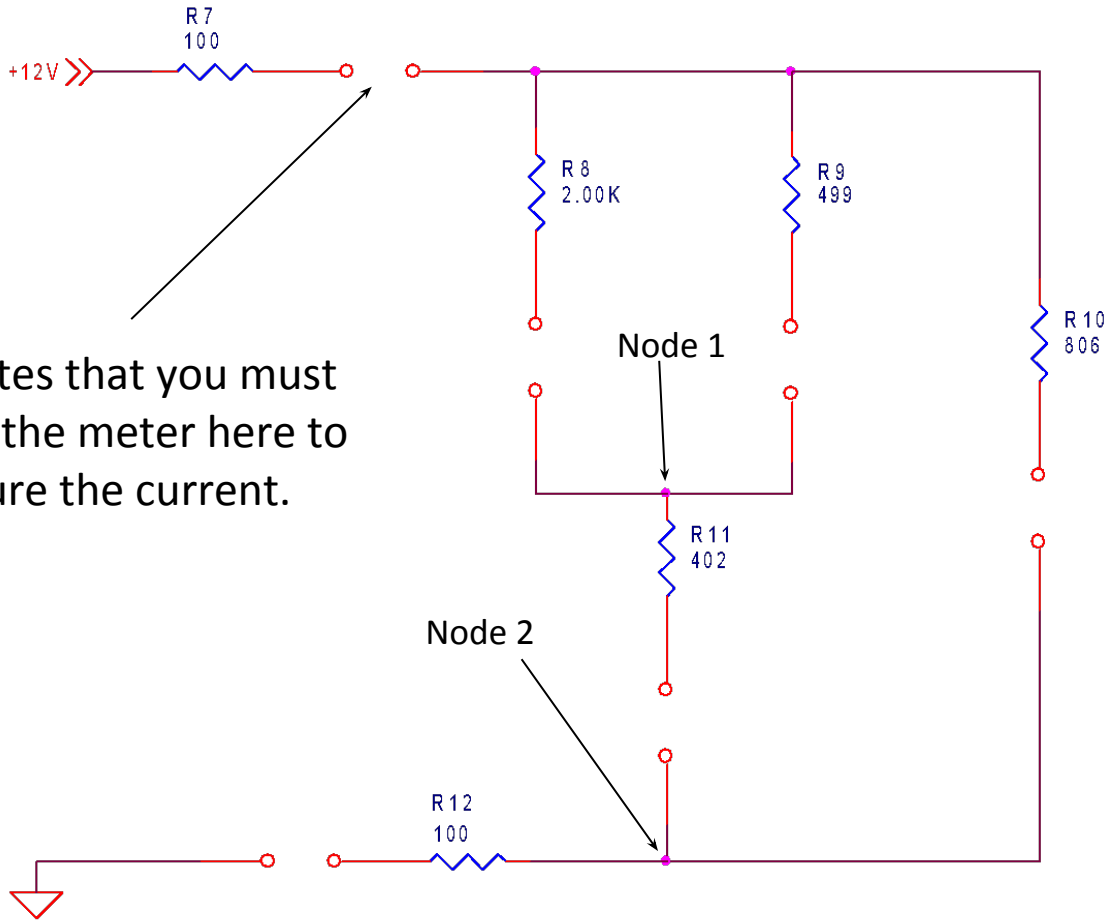
Resistor Network



Indicates that you must insert the meter here to measure the current.

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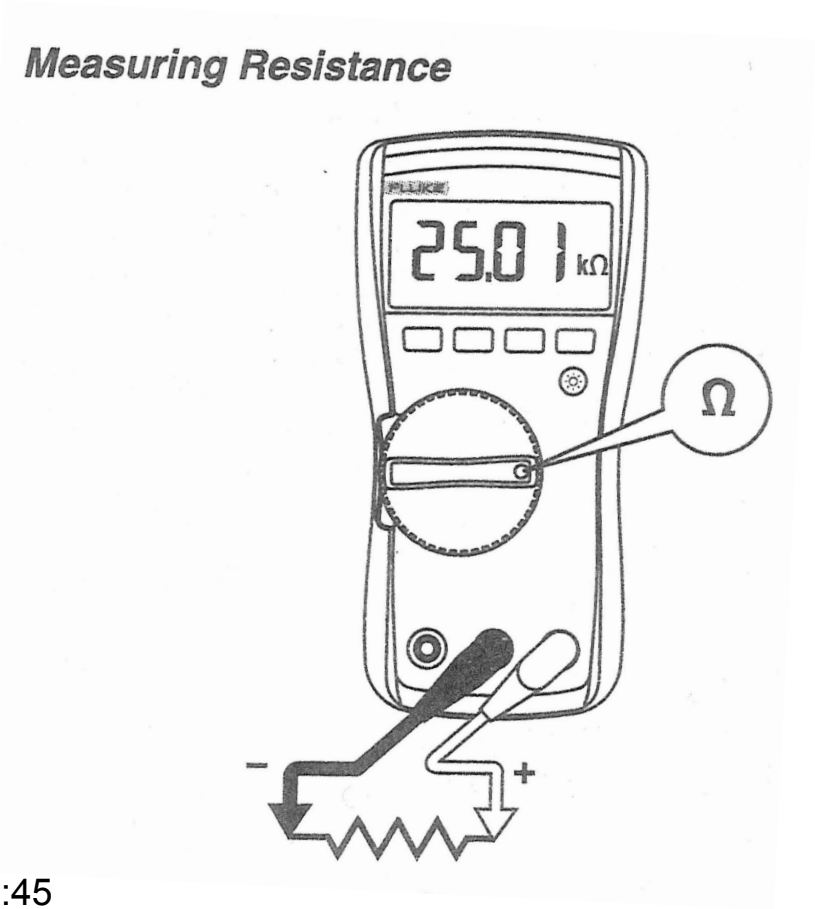
Measurements

- Resistance - measured across resistor (in parallel)



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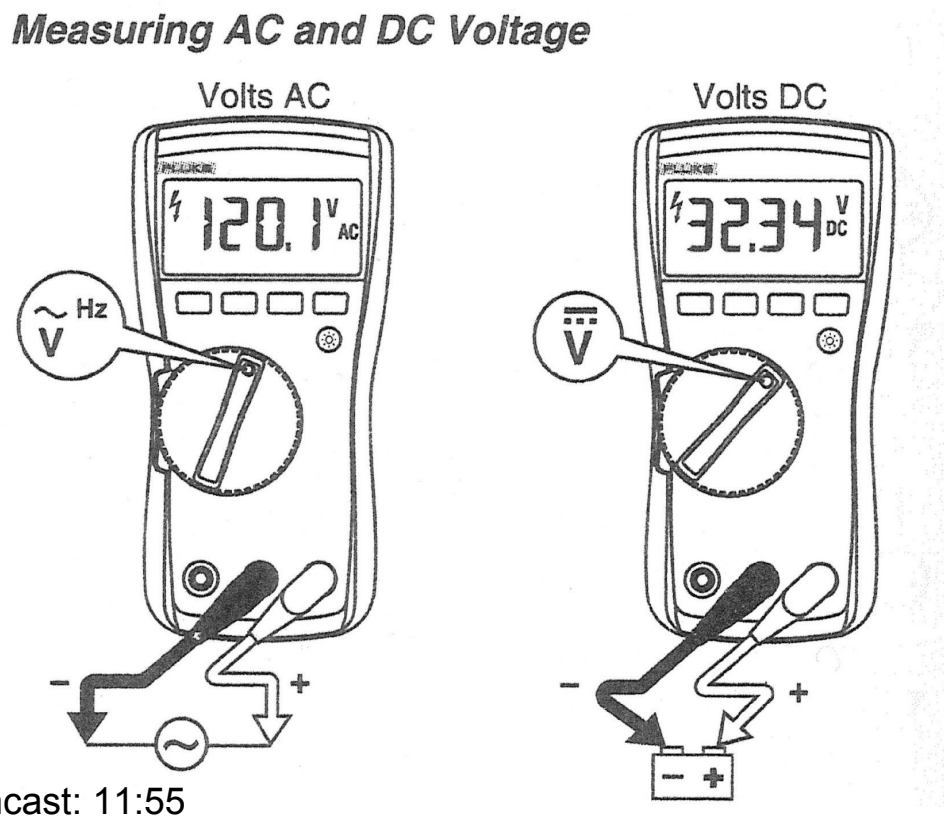
Measurements

- DC Voltage - measured in parallel



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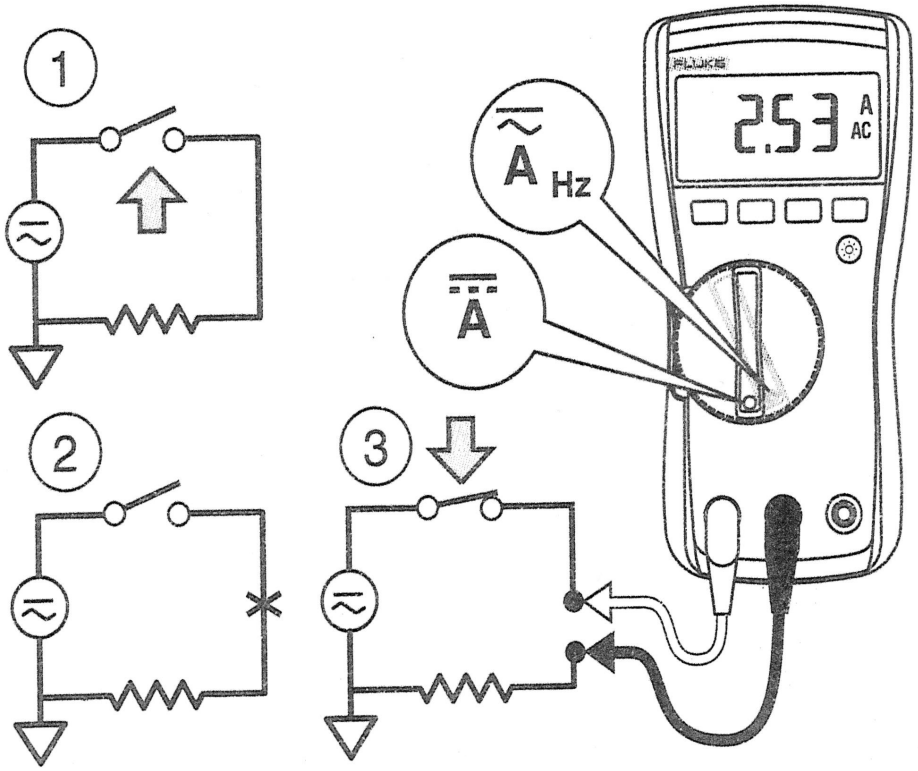
Measurements

DC Current – measured in series (you must insert the meter into the circuit)



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Results

Laboratory 1

Circuit	Parameter	Calculated Value	Measured Value
Series Resistance	Total Resistance		
Parallel Resistance	Total Resistance		
Current Divider	Input Current		
	Current in R3		
	Current in R4		
Voltage Divider	Output Voltage		
Resistor Network	Total Resistance		
	Output Voltage		
	Voltage at Node 1		
	Voltage at Node 2		
	Current in R7		
	Current in R8		
	Current in R9		
	Current in R10		
	Current in R11		
	Current in R12		
	Voltage Across R7		
	Voltage Across R8		
	Voltage Across R9		
	Voltage Across R10		
	Voltage Across R11		
	Voltage Across R12		