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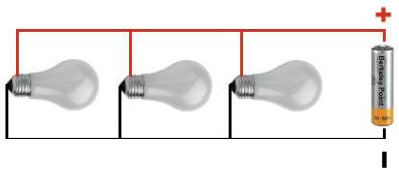
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

Class 07 – Parallel Circuits
Ohm's & Watts Law Analysis



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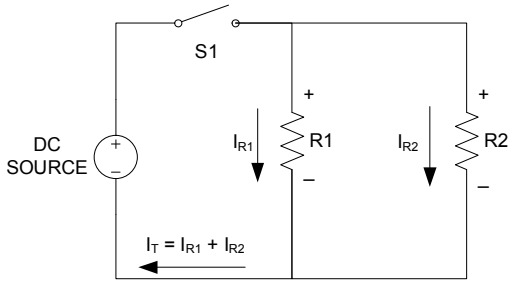
- Parallel Circuits
  - Any circuit having a multiple current paths
  - Characteristics
    - Applied voltage is equal across all parallel components
    - Multiple current paths inversely proportional to resistance



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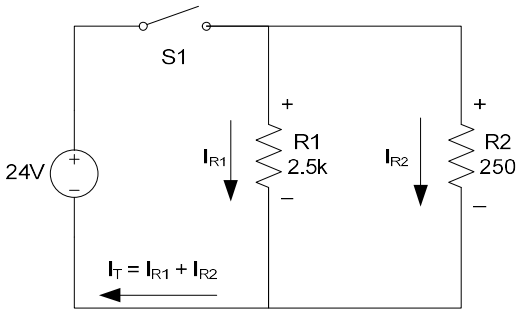
- Parallel Circuits
  - *Parallel resistance* is equal to product over the sum of the resistance (for two resistor circuits)

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$R_T = \frac{2.5K\Omega \times 250\Omega}{2.5k\Omega + 250\Omega}$$

$$R_T = ?\Omega$$



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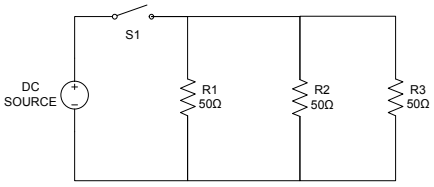
- Parallel Circuits
  - *Parallel resistance* is equal to resistor value divided by number of equal branch resistors

$$R_T = \frac{R_{all}}{N}$$

$$R_T = \frac{50\Omega}{3}$$

$$R_T = ?\Omega$$



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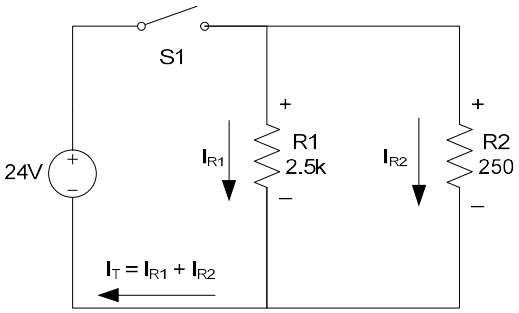
- Parallel Circuits
  - *Parallel resistance* is equal to the inverse of the conductance sum.

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_n}}$$

$$R_T = \frac{1}{\frac{1}{2.5k\Omega} + \frac{1}{250\Omega}}$$

$$R_T = ?\Omega$$



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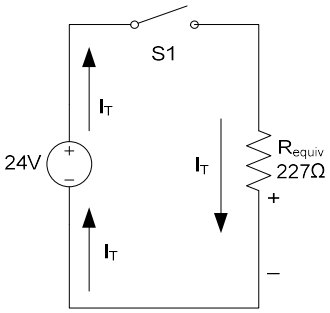
- Parallel Circuits
  - *Parallel resistance* reduces to a single series resistor, R_T for calculating total current.

$$R_T = 227\Omega$$

$$I_T = \frac{V_S}{R_T}$$

$$I_T = \frac{24V}{227\Omega}$$



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- Parallel Circuits
  - **Kirchhoff's Current Law** – the total circuit current is equal to the sum of the branch currents

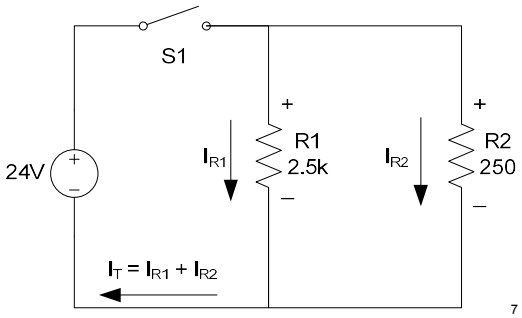
$$I_{R1} = \frac{24V}{2.5k\Omega} = ?\,mA$$

$$I_{R2} = \frac{24V}{250\Omega} = ?\,mA$$

$$I_T = I_{R1} + I_{R2}$$

$$I_T = ?\,mA + ?\,mA$$

$$I_T = 105.7mA$$



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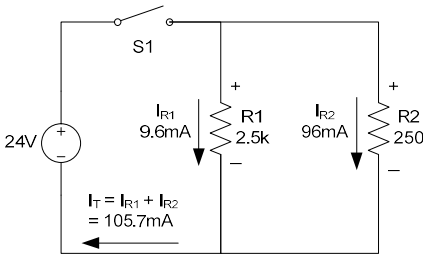
- Parallel Circuits
  - KCL – current divider
    - (+) Easily split currents for component level needs
    - (-) stiff voltage source required

$$I_{R1} = \frac{24V}{2.5k\Omega} = 9.6mA$$

$$I_{R2} = \frac{24V}{250\Omega} = 96mA$$



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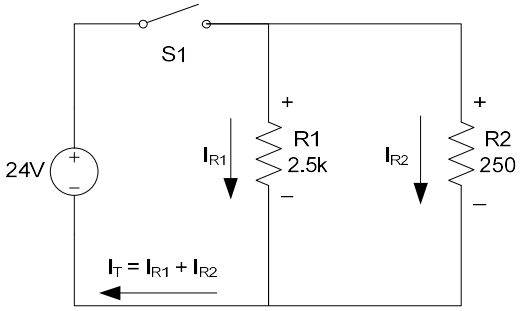
- Parallel Circuits
  - **Ohm's Law** - total current is directly proportional to source voltage and inversely proportional to total equivalent resistance.

$$I_T = \frac{V_S}{R_T}$$

$$I_T = \frac{24V}{227\Omega}$$

$$I_T = ?\,mA$$



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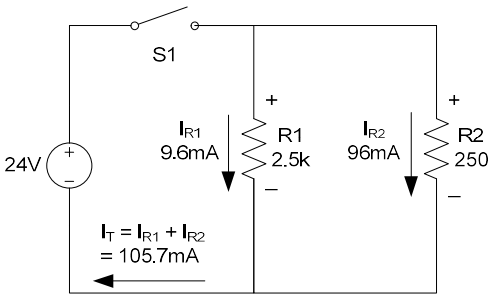
- Parallel Circuits
  - **Power** – the total power consumed is the sum of the individual branch powers.

$$P_T = P_{R1} + P_{R2} + P_{Rn...}$$

$$P_{R1} = V_S \times I_{R1} = 24V \times 9.6mA$$
$$P_{R2} = V_S \times I_{R2} = 24V \times 96mA$$

$$P_T = P_{R1} + P_{R2}$$
$$P_T = W$$



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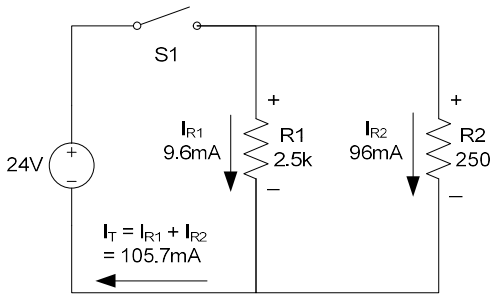
- Parallel Circuits
  - **Power** – the total power consumed is directly proportional to total current and source potential.

$$P_T = V_S \times I_T$$
$$P_T = 24V \times 105.7mA$$
$$P_T = W$$



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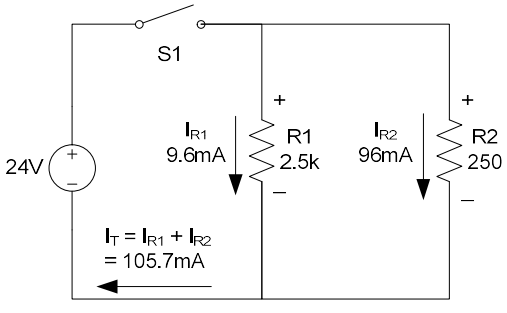
- Parallel Circuits
  - **Power** – the total power consumed is directly proportional to total current squared and total resistance.

$$P_T = I_T^2 \times R_T$$
$$P_T = (105.7mA)^2 \times 227\Omega$$
$$P_T = ?W$$



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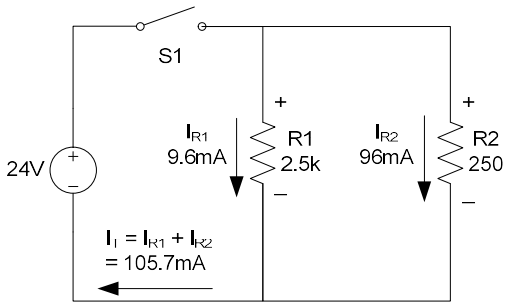
- Parallel Circuits
  - **Power** – the total power consumed is directly proportional to voltage squared and inversely proportional to total resistance

$$P_T = \frac{V_S^2}{R_T}$$

$$P_T = \frac{(24V)^2}{227\Omega}$$

$$P_T = ?W$$



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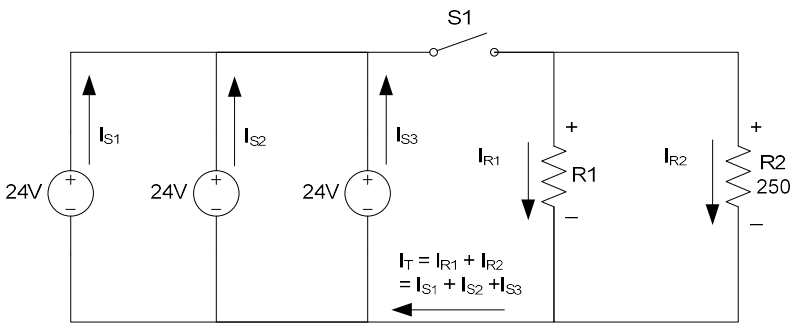
- Parallel Circuits
  - **Sources in Parallel** – parallel connected power sources are current adding



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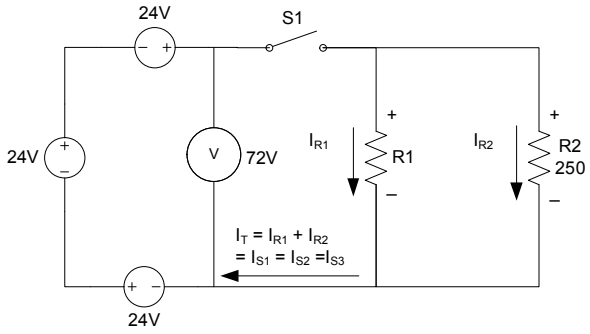
- Parallel Circuits
  - **Sources in Series** – series connected power sources are voltage adding



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- Lab 07 – Parallel Circuits

Learning Objectives

- Build parallel circuits as per a schematic diagram
- Measure electrical values using a digital voltmeter
- Use Ohm's Law to validate field measurements
- Use a data table and schematic diagrams to capture field measurements

		Points Possible
Documentation	Quality of documentation (neatness, clarity, spelling, grammar), Expected and measured values recorded on schematic diagram	**10**
Circuit 1	Expected and measured resistor values recorded in data table with percent error	**5**
	Expected and measured total resistance recorded in data table with percent error	**5**
	Expected and measured branch and total currents recorded in data table with percent error	**5**
Circuit 2	Expected and measured total resistance recorded in data table with percent error	**5**
	Expected and measured branch and total currents recorded in data table with percent error	**5**
Circuit 3	Min / max voltage levels recorded	**5**
Conclusions	Questions answered completely & accurately	**10**
	Total	**50**

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