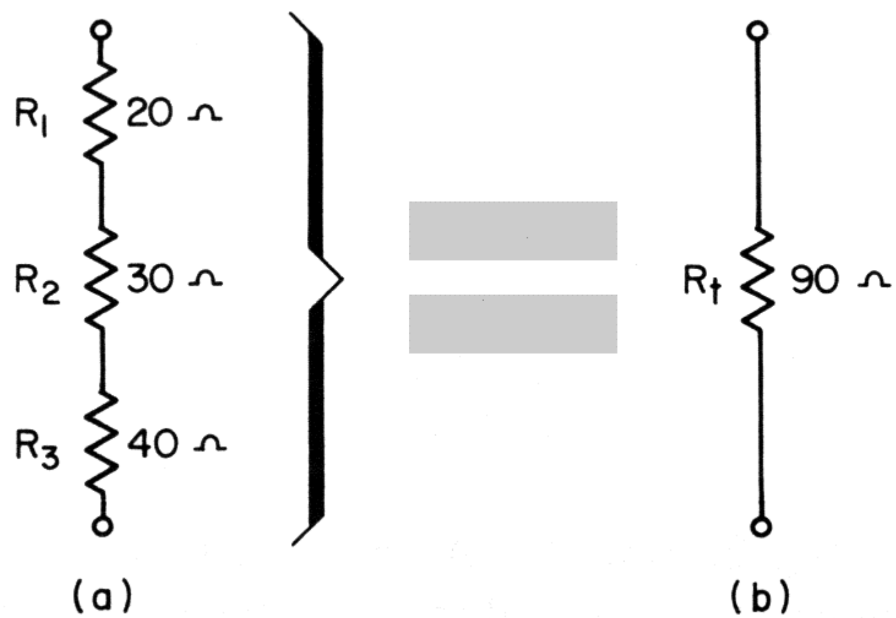
Series and Parallel Circuits

How to Simplify to Find

Total Resistance, Current and Voltage

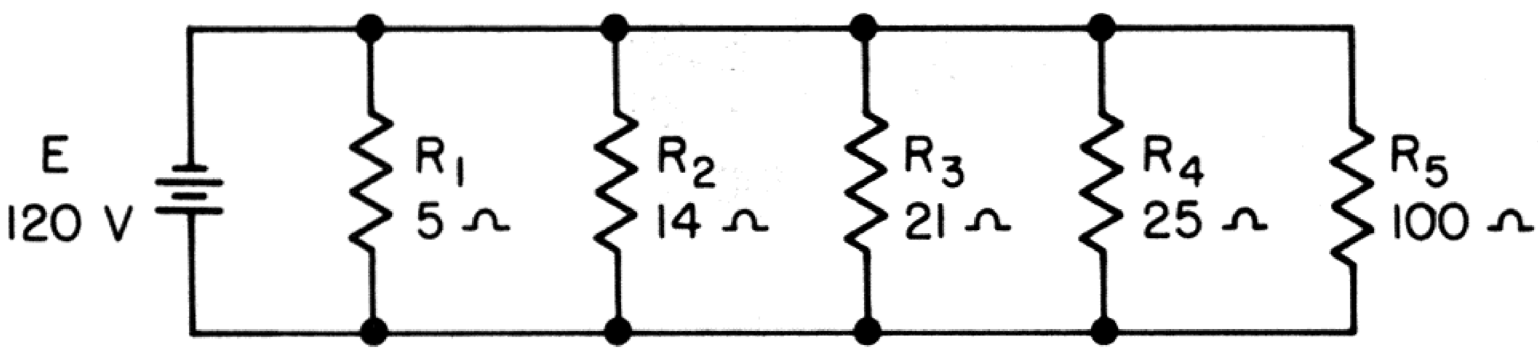
Series Circuits

- Series Circuits are the simplest to work with.
- Here we have three resistors of different resistances. They share a single connection point. When added together the total resistance is 90-Ohms.



Parallel Circuits

- A parallel circuit is shown here and it has TWO common connection points with another component. In this case another resistor. We cannot add the values of each resistor together like we can in the previous series circuit. So what do we need to do?



Calculating Total Resistance of a Parallel Circuit

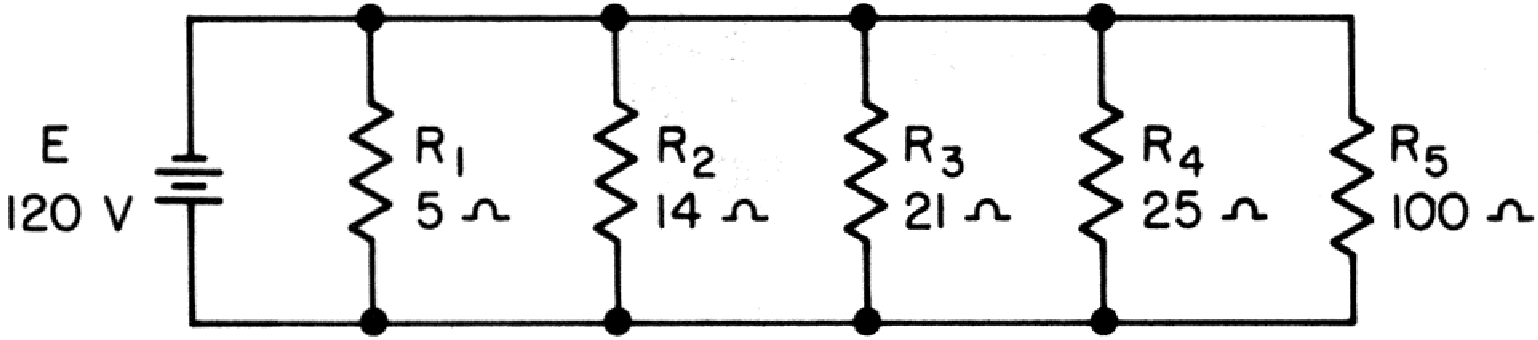
Two methods can be used to calculate the total resistance of the parallel circuit. They are the Product Over Sum equation or the Reciprocal Formula.

Product Over Sum is $R_T = \frac{(R1 \text{ x } R2)}{(R1 + R2)}$

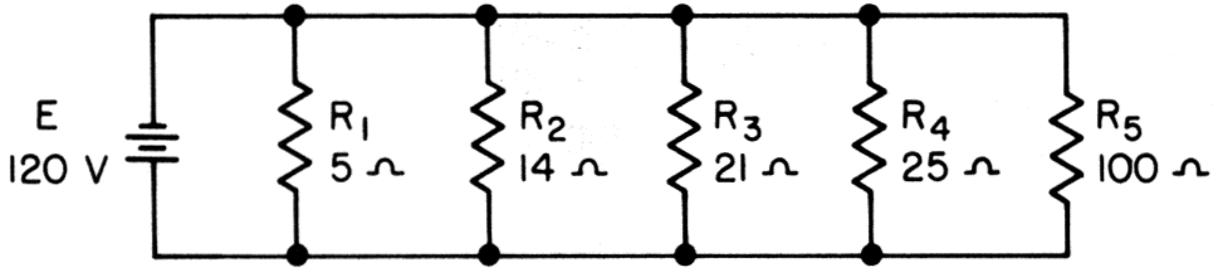
Reciprocal Formula is $R_T = \frac{1}{\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}+\frac{1}{R4}+\frac{1}{R5}}$

Calculating Total Resistance of a Parallel Circuit

- So let use calculate R_T in this circuit.
- $R_T = \frac{1}{\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}+\frac{1}{R4}+\frac{1}{R5}}$



Calculating Total Resistance of a Parallel Circuit



- $R_T = \dfrac{1}{\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}+\frac{1}{R4}+\frac{1}{R5}} = \dfrac{1}{\frac{1}{5}+\frac{1}{14}+\frac{1}{21}+\frac{1}{25}+\frac{1}{100}}$

$$= \frac{1}{0.2 + 0.0714 + 0.0476 + 0.04 + 0.01} = \frac{1}{0.369} = 2.7\Omega$$

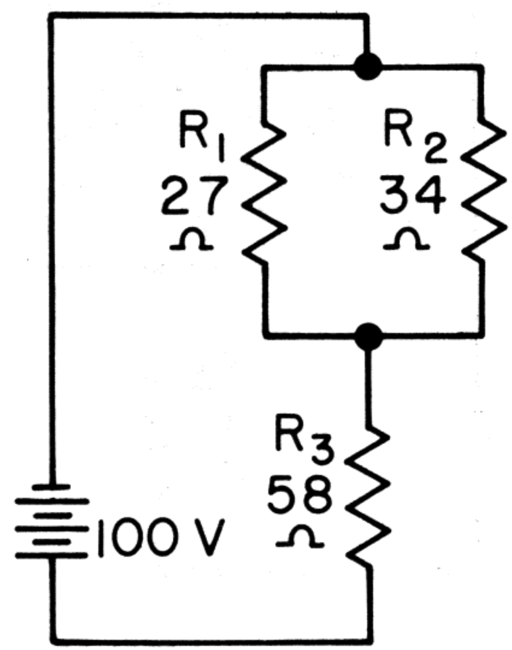
Series-Parallel Circuits

If we combined a series circuit with a parallel circuit we produce a Series-Parallel circuit.

- R1 and R2 are in parallel and R3 is in series with R1 ‖ R2.

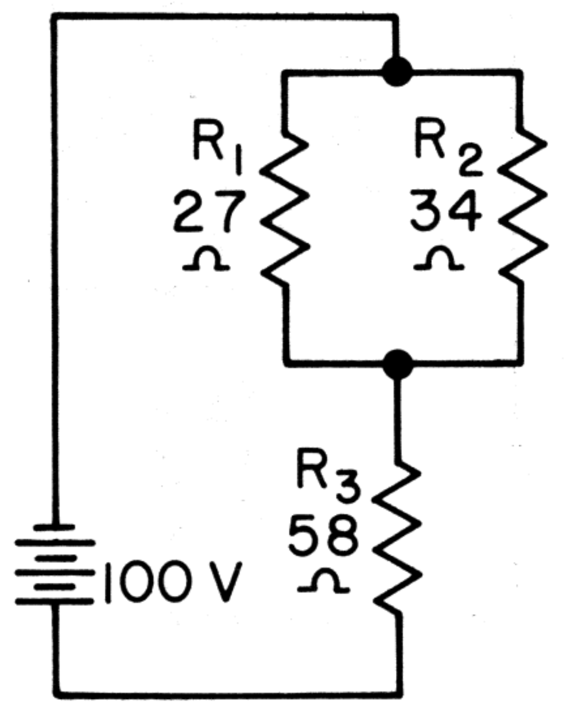
The double lines between R1 and R2 is a symbol for parallel.

We need to calculate R1 ‖ R2 first before adding R3.



Series-Parallel Circuits

- Here we can use the shorter Product Over Sum equation as we only have two parallel resistors.



$$R_{1\parallel 2} = \frac{(R1 \times R2)}{(R1 + R2)} = \frac{27 \, x \, 34}{27+34} = \frac{918}{61}$$

$R_{1\parallel 2}$ = 15.049Ω + R3 = R_T

R_T = 15.049 + 58 = 73.049Ω

- R_T = 73Ω

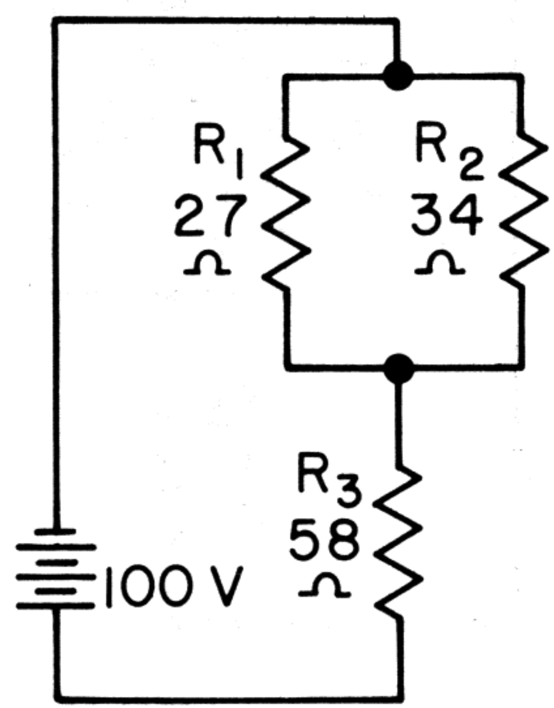
Series-Parallel Circuits

- Now that we have our circuit resistance of RT we can calculate circuit current by using Ohm's Law.

If RT = 73Ω and E = 100V

$I = \frac{100}{73}$ = 1.369 Amps or 1.37 A

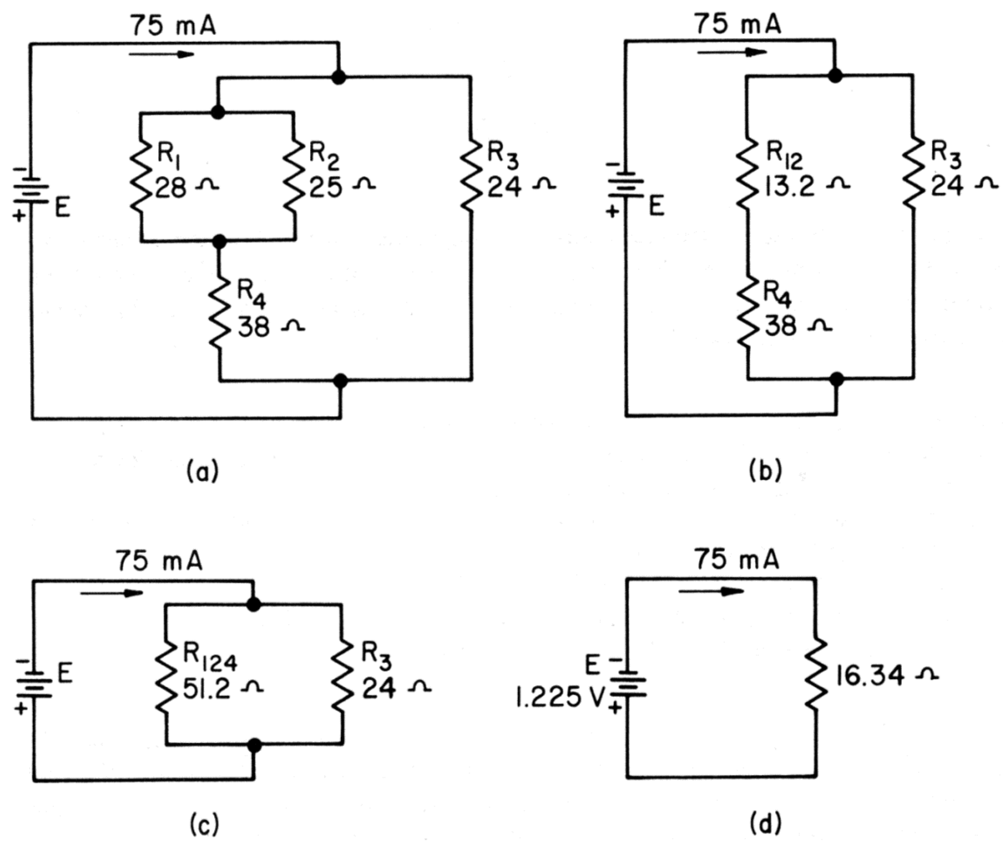
The parallel resistors must be reduced to a single series value before being added to the series resistor.



Series-Parallel Circuits

- Series-Parallel circuits can be more complex as in this case:

In circuit (a) we have our original complex circuit. In circuit (b) we have resistors R_1 and R_2 combined to get 13.2Ω. R_4 is in series with the newly combined R_{12} and their added value is 51.2Ω. And now (c) we are left with R_{124} in parallel with R_3. (d) is our final circuit.



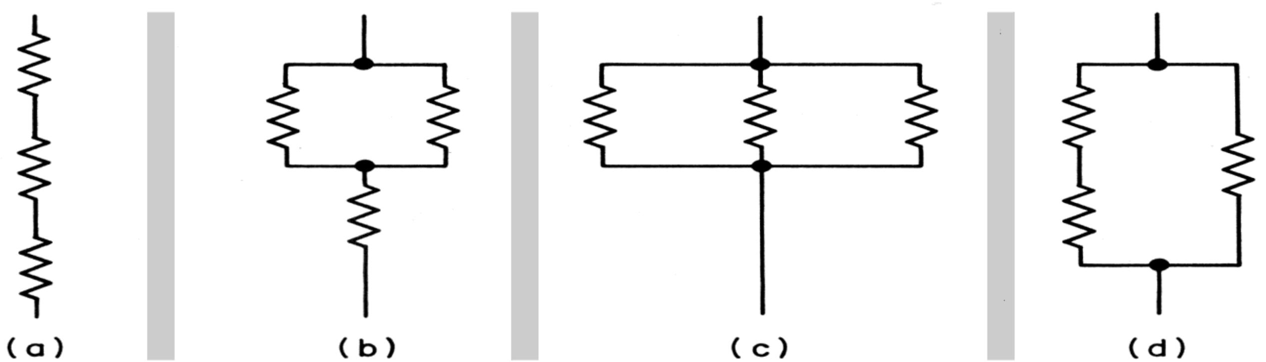
Series-Parallel Circuits

- Series, Parallel and Series-Parallel circuits are our three main types of circuits and they are common in DC and AC supplied circuits.
- A series circuit has one shared connection point between components.
- A parallel circuit has two shared connection points between components.

Series-Parallel Circuits

A series-parallel circuit can have two components sharing one connection point with a single component while they have two common connection points between them.

Series **Series-Parallel** **Parallel** **Series-Parallel**



Series-Parallel Circuits

The End