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Series resistance. If resistor R_1 is in series with resistor R_2 , this combination behaves like one resistor with a value equal to $R_1 + R_2$. See Figure 3.6. This means if replace the two series resistors in a circuit with one resistor at $R = R_1 + R_2$, the behavior will be the same. The V equals $V_1 + V_2$. By KCL, the currents through the two resistors are the same. These two facts can be used to derive the **voltage divider rule**

$$V_2 = I * R_2 = (V/R) * R_2 = V * R_2 / (R_1 + R_2)$$

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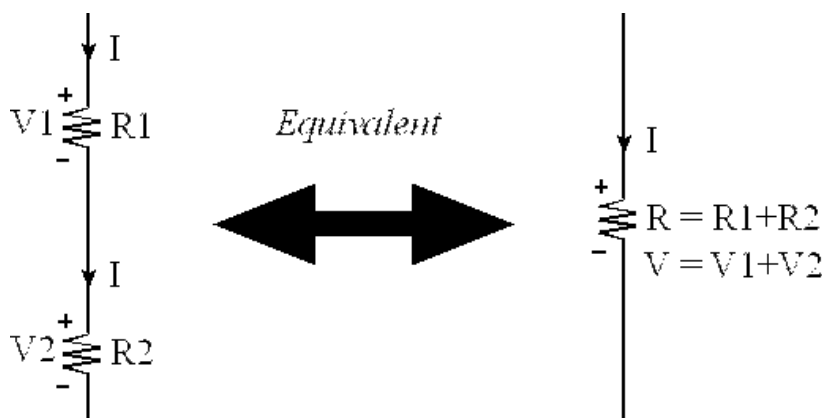


Figure 3.6. The series combination of two resistors, R_1 R_2 , is equivalent to one resistor at $R_1 + R_2$.

CHECKPOINT 3.10

Using Figure 3.6, assume I is 1mA, R_1 is 2k Ω and R_2 is 3k Ω , what is V ?

Hide Answer

Total resistance is 2k Ω + 3k Ω = 5k Ω . Ohm's Law $V = I * R = 0.001A * 5000\Omega = 5V$.

CHECKPOINT 3.11

Using Figure 3.6, assume V is 10V, R_1 is 2k Ω and R_2 is 3k Ω , what is V_2 ?

Hide Answer

Total resistance is 2k Ω + 3k Ω = 5k Ω . $I = 10V / 5k\Omega = 2mA$. $V_2 = I * R_2 = 0.002A * 3000\Omega = 6V$.

Parallel resistance. If resistor R_1 is in parallel with resistor R_2 , this combination behaves like one resistor with a value equal to

$$R = \frac{R_1 * R_2}{R_1 + R_2} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

See Figure 3.7. This means we can replace the two parallel resistors in a circuit with one resistor at $R = R_1 * R_2 / (R_1 + R_2)$. The voltages across R_1 and R_2 will be the same because of KVL. Due to KCL, $I = I_1 + I_2$. These facts can be used to derive the **current divider rule**

$$I_1 = V/R_1 = (I * R)/R_1 = I * (R_1 * R_2 / (R_1 + R_2)) / R_1 = I * R_2 / (R_1 + R_2)$$

$$I_2 = V/R_2 = (I * R)/R_2 = I * (R_1 * R_2 / (R_1 + R_2)) / R_2 = I * R_1 / (R_1 + R_2)$$

$$I = I_1 + I_2$$

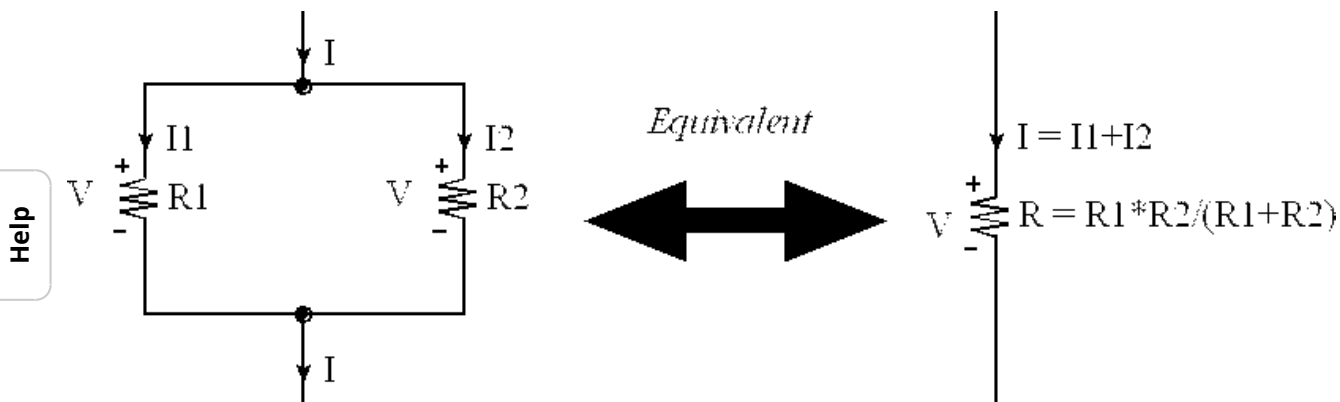


Figure 3.7. The parallel combination of two resistors, R_1 R_2 , is equivalent to one resistor at $R_1 * R_2 / (R_1 + R_2)$.

CHECKPOINT 3.12

Using Figure 3.7, assume I is 1mA, R_1 is 2k Ω and R_2 is 4k Ω , what is V ?

Hide Answer

Total resistance is $2000 * 4000 / (2000 + 4000) = 1333\Omega$. $V = I * R = 0.001A * 1333\Omega = 1.333V$.

CHECKPOINT 3.13

Using Figure 3.7, assume V is 10V, R_1 is 2k Ω and R_2 is 4k Ω , what is I_2 ?

Hide Answer

Ohm's Law $I_2 = V/R_2 = 10V/4000\Omega = 2.5mA$

Portions of this chapter were reprinted with approval from Embedded Systems: Introduction to ARM Cortex-M

Microcontrollers, 2013, ISBN: 978-1477508992. For more information on this book, see <http://users.ece.utexas.edu>



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