Basic Electronics Part 4
by
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Recall that if we have a string of resistors, R1, R2, R3, in series, we can find a single equivalent resistor, $R_T$, to replace that string using the formula

$$R_T = R1 + R2 + R3 .$$

Similarly, if we have a string of resistors, R1, R2, R3, in parallel, we can find a single equivalent resistor, $R_T$, to replace that string using the formula

$$\frac{1}{R_T} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} .$$

We now consider how to use these equivalent relationships to simplify a series/parallel circuit. Consider figure 1

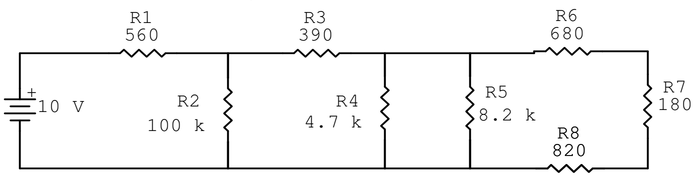


Fig. 1

We begin working at the point farthest from the voltage source. Notice that resistors R6, R7, and R8 are in series. This means we can replace them with one equivalent resistor, $R9 = R6 + R7 + R8$. The value of R9 is 1680 ohms. This leaves us with the equivalent circuit in figure 2

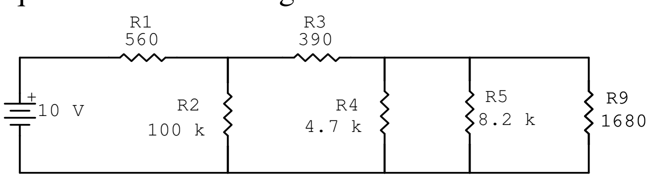


Fig. 2

In figure 2 we observe that the three resistors, R4, R5, and R9, are connected in parallel. This means we can replace them with one equivalent resistor, R10 as follows:

$$\frac{1}{R10} = \frac{1}{R4} + \frac{1}{R5} + \frac{1}{R9} .$$

The value of R10 is 1075 ohms. This leaves us with the equivalent circuit in figure 3

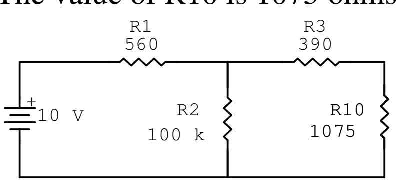


Fig. 3

In figure 3, R3 and R10 are in series, so we can replace them with an equivalent resistor, R11 having a value of 1465 ohms. This leads to the equivalent circuit in figure 4

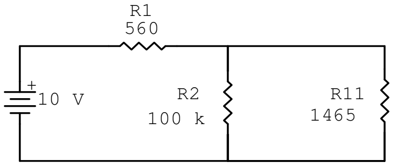

Fig 4

Now we see that R2 and R11 are in parallel so we can replace them with an equivalent resistor, R12, having a value of 1444 ohms. This leads to the circuit in figure 5

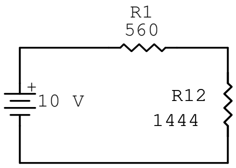

Fig 5

This is a series circuit and we can now write a final equivalent circuit shown in figure 6

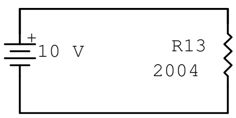

Fig 6

We may now calculate the total current that flows from the voltage supply using this equivalent resistor. Ohm's Law is used as follows:

$$I = \frac{E}{R13} = \frac{10}{2004} = 4.99x10^{-3}$$

The total current is 4.99 mA.