

Series/Parallel Reduction of Resistor Networks

There are some occasions where a complex network of resistors is encountered. While a brute-force solution is possible, it is advantageous to first reduce the resistor network. By repeatedly using the equations for resistors in series and parallel, the network can be simplified.

The procedure is simple. Find pairs of resistors in the network that are in parallel or in series. Replace the pair with the equivalent resistance as defined by the equation for series or parallel resistors. Repeat the reduction process until a single equivalent resistance is found.

The difficulty comes in correctly identifying parallel or series connected resistors. Remember that two resistors are not in series if another component is connected at their common junction. Resistors are not in parallel unless both of their terminals are connected to the same nodes. It is easy to be fooled by the schematic diagram. Two resistors drawn in parallel may or may not be in an electrically parallel configuration.

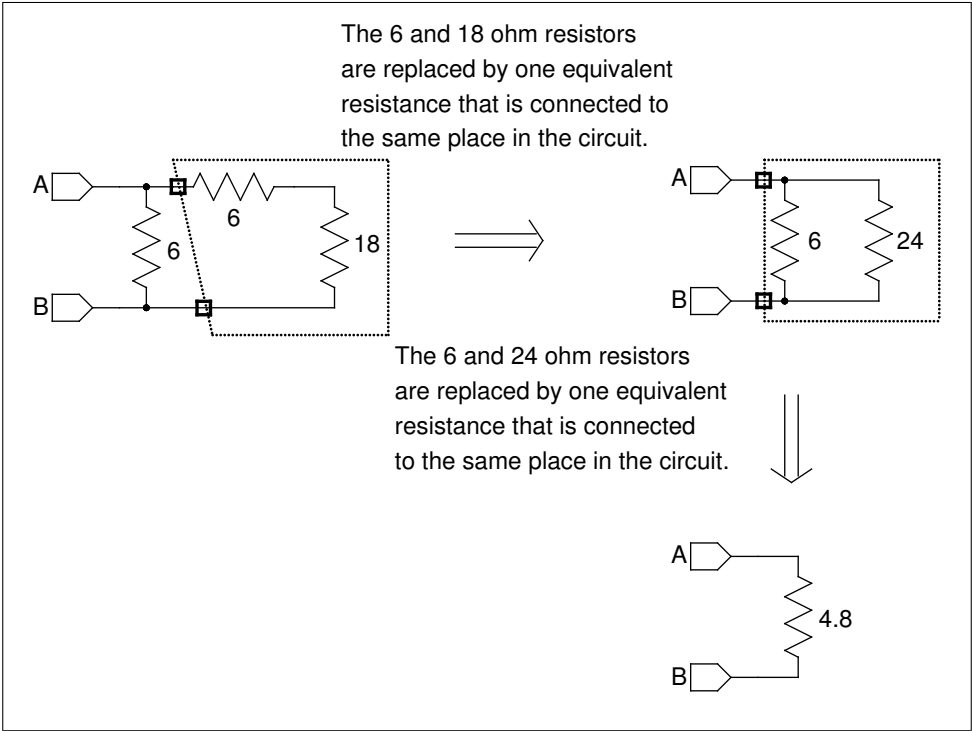


Figure 1: A Simple Network to Reduce

Consider the network above. In the first step we notice that the 6 ohm and 18 ohm resistors are in series. We can thus replace them with one resistor of 24 ohms. Now we see that the 6 and 24 resistors are in parallel. Using the equation for resistors in parallel gives us the equivalent resistance between terminals A and B to be:

$$R_{eq} = (6 * 24)/(6 + 24) = 4.8\Omega$$

Now let's tackle a more complex network. The solution is shown schematically step by step.

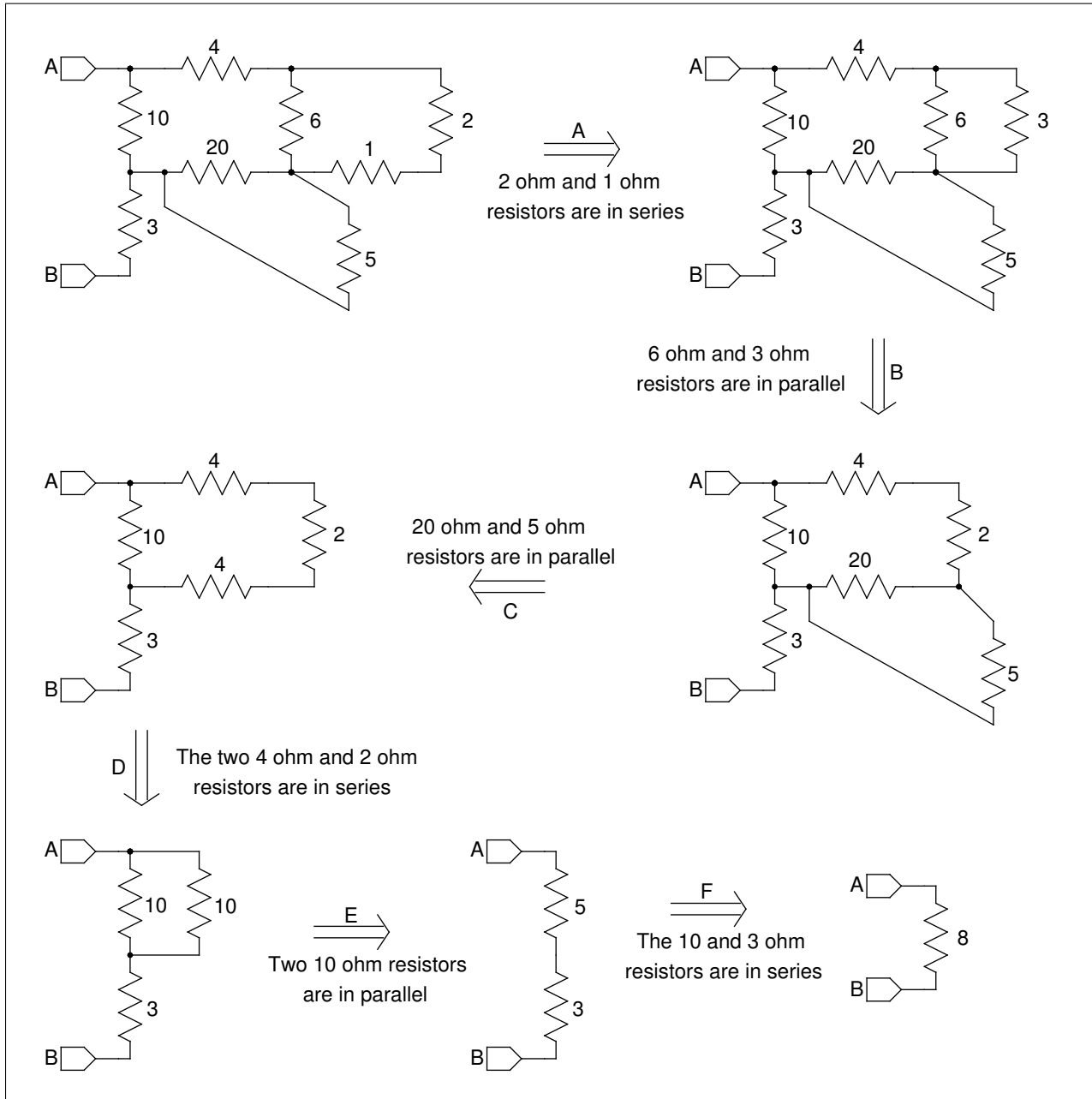


Figure 2: A Bigger Network to Reduce