

Basic Electronics Part 12
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We will now consider what happens if we place multiple capacitors in a dc circuit. Connecting capacitors in parallel is equivalent to adding the plate areas. This means that the total capacitance is the sum of the individual capacitances. If a 10- μF capacitor is connected in parallel with a 20- μF capacitor, the voltage is the same across the parallel capacitors (see Fig. 1).

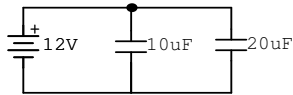


Fig. 1

The equivalent capacitance would be 30- μF .

Connecting capacitors in series is equivalent to increasing the thickness of the dielectric. Therefore, the combined capacitance is less than the smallest individual value. If we have C_1 and C_2 connected in series, the equivalent capacitance is given by

$$\frac{1}{C_{EQ}} = \frac{1}{C_1} + \frac{1}{C_2} .$$

Consider $C_1 = 10\text{-}\mu\text{F}$ and $C_2 = 20\text{-}\mu\text{F}$ connected in series as in Fig. 2.

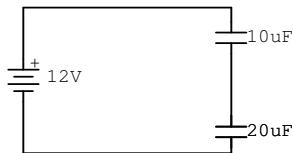


Fig. 2

The equivalent capacitance is given by

$$\frac{1}{C_{EQ}} = \frac{1}{10} + \frac{1}{20} = \frac{3}{20}$$

This means that $C_{EQ} = 20/3 = 6.7\ \mu\text{F}$.

There is a division of voltage across unequal capacitors in series. The voltage across each of the capacitors in Fig. 2 is inversely proportional to its capacitance. The smaller capacitance has the larger proportion of the applied voltage. The reason is that the series capacitances all have the same charge because they are in one current path. With equal charge, a smaller capacitance has a greater potential difference. Since the equivalent capacitance is 6.7 μF and the applied voltage is 12 volts, the charge on the equivalent system is

$$Q = CV$$

where Q is the charge stored in the dielectric in coulombs (C),
 V is the voltage across the plates of the capacitor, and
 C is the capacitance in farads.

In this situation, $Q = 80 \times 10^{-6}$ coulombs. Since C_1 and C_2 each have this charge then the voltage across C_1 is given by

$$V_1 = \frac{Q}{C_1} = 8 \text{ volts} .$$

Similarly, the voltage across C_2 is 4 volts.

Notice that we have used the symbol C for capacitance and for coulombs. It should be clear in usage which one we mean.