# Units and symbols for Modules 3 and 4

## A quick look at electrical units and symbols

You will find that a number of units and symbols are commonly encountered in electrical and electronic circuits. If you have already studied Electrical Principles you will already know all about them but if not the following notes should quickly get you up to speed!

| Unit | Abbrev. | Symbol | Notes |
|---|---|---|---|
| Ampere | A | *I* | Unit of electric current (a current of 1 A flows in a conductor when a charge of 1 C is transported in a time interval of 1 s). |
| Coulomb | C | *Q* | Unit of electric charge or quantity of electricity (a *fundamental unit*) |
| Farad | F | *C* | Unit of capacitance (a capacitor has a capacitance of 1 F when a charge of 1 C results in a potential difference of 1 V across its plates). |
| Henry | H | *L* | Unit of inductance (an inductor has an inductance of 1 H when an applied current changing uniformly at a rate of 1 A/s produces a potential difference of 1 V across its terminals). |
| Hertz | Hz | *f* | Unit of frequency (a signal has a frequency of 1 Hz if one complete cycle occurs in a time interval of 1 s). |
| Joule | J | *E* | Unit of energy (a *fundamental unit*) |
| Ohm | Ω | *R* | Unit of resistance (a *fundamental unit*) |
| Second | s | *t* | Unit of time (a *fundamental unit*) |
| Siemen | S | *G* | Unit of conductance (the reciprocal of resistance). |
| Tesla | T | *B* | Unit of magnetic flux density (a flux density of 1 T is produced when a flux of 1 Wb is present over an area of 1 square metre). |
| Volt | V | *V* | Unit of electric potential (we sometimes refer to this as *EMF* or *PD*). |
| Watt | W | *P* | Unit of power (equal to 1 J of energy consumed in a time of 1 s). |
| Weber | Wb | *Φ* | Unit of magnetic flux (a *fundamental unit*) |

## Multiples and sub-multiples

Unfortunately, because the numbers can be very large or very small, many of the electrical units can be cumbersome for everyday use. For example, the voltage present at the antenna input of a VHF radio could be as little as 0.0000015 V. At the same time, the resistance present in an amplifier stage could be as high as 10,000,000 Ω. Clearly we need to make life a little easier. We can do this by using a standard range of multiples and sub-multiples. These use a *prefix* letter in order to add a *multiplier* to the quoted value, as follows:

| *Prefix* | *Abbrev.* | *Multiplier* |
|---|---|---|
| tera | T | $10^{12}$ (= 1,000,000,000,000) |
| giga | G | $10^{9}$ (= 1,000,000,000) |
| mega | M | $10^{6}$ (= 1,000,000) |
| kilo | k | $10^{3}$ (= 1,000) |
| (none) | (none) | $10^{0}$ (= 1) |
| centi | c | $10^{-2}$ (= 0.01) |
| milli | m | $10^{-3}$ (= 0.001) |
| micro | μ | $10^{-6}$ (= 0.000,001) |
| nano | n | $10^{-9}$ (= 0.000,000,001) |
| pico | p | $10^{-12}$ (= 0.000,000,000,001) |

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*Example 1*

An indicator lamp requires a current of 0.15 A. Express this in mA.

*Solution*

To convert A to mA, we apply a multiplier of $10^3$ or 1,000. Thus to convert 0.15 A to mA we multiply 0.15 by 1,000, as follows:

0.15 A = 0.15 × 1,000 = 150 mA

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*Key point*

Multiplying by 1,000 is equivalent to moving the decimal point *three* places to the *right* whilst dividing by 1,000 is equivalent to moving the decimal point *three* places to the *left*. Similarly, multiplying by 1,000,000 is equivalent to moving the decimal point *six* places to the *right* whilst dividing by 1,000,000 is equivalent to moving the decimal point *six* places to the *left*.

*Example 2*

An insulation tester produces a voltage of 2,750 V. Express this in kV.

*Solution*

To convert V to kV we apply a multiplier of $10^{-3}$ or 0.001. Thus we can convert 2,750 V to kV as follows:

2,750 V = 2,750 × 0.001 = 2.75 kV

Here, multiplying by 0.001 is equivalent to moving the decimal point three places to the *left*.

*Example 3*

A capacitor has a value of 27,000 pF. Express this in μF.

*Solution*

There are 1,000,000 pF in 1 μF. Thus, to express the value in 27,000 pF in μF we need to multiply by 0.000,001. The easiest way of doing this is simply to move the decimal point six places to the left. Hence 27,000 pF is equivalent to 0.027 μF (note that we have had to introduce an extra zero before the 2 and after the decimal point).

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**Test your knowledge!**

1. State the units for electric current.
2. State the units for frequency.
3. State the symbol used for capacitance.
4. State the symbol used for conductance.
5. A pulse has a duration of 0.0075 s. Express this time in s.
6. A generator produces a voltage of 440 V. Express this in kV.
7. A signal has a frequency of 15.62 MHz. Express this in kHz.
8. A current of 570 μA flows in a resistor. Express this current in mA.
9. A capacitor has a value of 0.22 μF. Express this capacitance in nF.
10. A resistor has a value of 470 kΩ. Express this resistance in MΩ.