

# SI Units and Prefixes

The International System of Units (abbreviated SI<sup>1</sup>) provides uniform standard units for measuring length, mass, time, and other quantities. The system defines seven base units. They are listed in the following table:

**Table 1: SI Base Units**

Quantity	Unit	Symbol
length	meter	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
luminous intensity	candela	cd
amount of substance	mole	mol

You are probably familiar with the meter. It's a unit of length equal to 39.37 inches. Mass is a quantity similar to weight, except independent of gravity. You've heard that a person's weight on the moon is one sixth his or her weight on earth, because the moon has less gravity than earth. But, that person's mass would be the same in both places. You, of course, are familiar with time and the units of measure for time. We'll learn about electric current later in this course. The rest of the base quantities are not important to us.

Units for other common quantities are derived from base units. Examples of these are square meters (m<sup>2</sup>) for area and meters per second (m/s) for velocity. Another example is the newton (N), which is a unit of force equal to a kg·m/s<sup>2</sup> (kilogram meter per second squared). Other derived units important in electronics are listed in the following table:

**Table 2: SI Derived Units Important in Electronics**

Quantity	Unit	Symbol
power	watt	W
electric charge	coulomb	C
potential difference	volt	V
electric resistance	ohm	Ω
capacitance	farad	F
inductance	henry	H

When dealing with large or very small quantities it is often convenient to express the quantity in terms of multiples or submultiples of SI units formed by the application of SI prefixes. For example, 1000 m (meters) can be expressed as 1 km (kilometer), where the prefix k means 1000. Similarly, 10<sup>-12</sup> F can be expressed as 1 pF (picofarad). Some SI prefixes are:

<sup>1</sup> SI is an international abbreviation used in all languages.

**Table 3: SI Prefixes**

Factor to multiply unit by	Prefix	Symbol
$10^{12}$	tera	T
$10^9$	giga	G
$10^6$	mega	M
$10^3$	kilo	k
$10^2$	hecto	h
10	deka	da
$10^{-1}$	deci	d
$10^{-2}$	centi	c
$10^{-3}$	milli	m
$10^{-6}$	micro	$\mu$
$10^{-9}$	nano	n
$10^{-12}$	pico	p
$10^{-15}$	femto	f
$10^{-18}$	atto	a

The prefixes deci ( $10^{-1}$ ), deka (10), and hecto (100) are not commonly used.

## Examples

- We're familiar with the mile as a measure of distance, as in, "the mall is 10 miles from here." The SI unit of distance is the meter, as in "the mall is 16,000 meters from here." Since 16,000 is a large number, it may be more convenient to express that distance in kilometers (km) or thousands of meters. That same distance is 16 km since  $16,000 = 16 \times 10^3$ . Small distances may be measured in millimeters (mm) or  $10^{-3}$  m. Very small distances may be measured in nanometers (nm) or  $10^{-9}$  m.
- Although a 100 watt (W) light bulb shines brighter than a 60 W bulb, the watt is not a measure of brightness, it's a measure of how much power the bulb uses. If you were to look at your family's electric bill you'd see that the electric company charges for the amount of kilowatts (kW) used.

## Test Your Understanding

1. A man is six feet tall. If you convert his height to SI units, what unit would you convert it to?

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2. Express 100,000  $\Omega$  in k $\Omega$ 's.

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3. 3.4  $\mu$ V is how many volts?

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