PACE Electrical Engineering

SI Units and Prefixes

Introduction

The International System of Units (abbreviated SI[1]) provides uniform standard units for measuring length, mass, time, and other quantities. SI Prefixes are used with units to express very large and very small quantities.

SI Units

Base Units

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 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 soon. The rest of the quantities are not important to us.

Derived Units

Units for other common quantities are derived from base units. Examples of these are square meter (m^2) 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 $kg \cdot m/s^2$ (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

[1] SI is an international abbreviation used in all languages

SI Prefixes

Description

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^{-12} F can be expressed as 1 pF (picofarad). Some SI prefixes are:

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^{1}	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

The prefixes deci (10^{-1}), deka (10^{1}), hecto (10^{2}) 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 is more convenient to express that distance in kilometers (km) or thousands of meters. That same distance is 16 km, since $16{,}000 = 16 \times 10^{3}$. We can similarly make use of prefixes to express small distances, such as millimeters (mm) or 10^{-3} m.
- Although a 100 watt (W) light bulb shines brighter than a 60 W bulb, the watt is not a unit 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.