Electrical Units of Measurement

In the electrical industry, it is common to use very large numbers, possibly in the thousands or very small numbers such as one millionth in the electronics industry. If these numbers were to be written in their basic units this would **take relatively a lot of time and greatly increase the chance of error**. An abbreviated method using "scientific notation" or simply the power of 10 expressed numbers is a more convenient form. To express numbers in scientific notation, move the decimal point until there is one significant digit to the left of the decimal place and then multiply the result by the appropriate power of ten to make the number equal to its basic value. *For example:*

$328 = 3.28 * 10^{2}$

$825,000 = 8.25 * 10^{5}$

$0.006 = 6 * 10^{-3}$

To simplify even more, a number of standard units of measure has been standardized using a prefix and symbol to establish a relationship between a number of very large and small numbers. The following table, shows these standard metric prefixes that are used today:

Table 1: Metric Prefixes

PREFIX	SYMBOL	MULTIPLIER	EXPONENT FORM
exa	E	1, 000, 000, 000, 000, 000, 000	10^{18}
pera	P	1, 000, 000, 000, 000, 000	10^{15}
tera	T	1, 000, 000, 000, 000	10^{12}
giga	G	1, 000, 000, 000	10^{9}
mega	M	1, 000, 000	10^{6}
kilo	k	1, 000	10^{3}
hecto	h	100	10^{2}
deca	da	10	10^{1}
Basic Unit	Basic Unit	1	10^{0}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0. 001	10^{-3}
micro	μ	0. 000, 001	10^{-6}
nano	n	0. 000, 000, 001	10^{-9}
pico	p	0. 000, 000, 000, 001	10^{-12}
femto	f	0. 000, 000, 000, 000, 001	10^{-15}
atto	a	0. 000, 000, 000, 000, 000, 001	10^{-18}

Using these prefixes rather than scientific notation makes writing these numbers even easier. Not all of these prefixes must be memorized as only certain number units are commonly used in the electrical/electronic industry. It is a good idea to be familiar with the mega and kilo for large numbers and milli and micro for the small numbers. Table 2 shows some examples changing units of current, although this will work the same for voltage, resistance, etc.

Table 2 Changing Units of Current

TO CONVERT FROM	TO	MOVE DECIMAL POINT	EXAMPLE
A	mA	3 places to the right	0.251 A = 251 mA
A	μA	6 places to the right	4 A = 4, 000, 000 μA
mA	A	3 places to the left	38 mA = 0.038 A
μA	A	6 places to the left	325.2 μA = 0.000, 325 2 A
mA	A	3 places to the left	425 mA = 0.425 A
A	mA	3 places to the right	852 A = 852, 000 mA

Using table 3 may be used to convert, but keep in mind this table will not always be available. Example using table: 8 kv to millivolts. First, from the kilo in the vertical column, move to the right to the horizontal column. The constant found in this box is 10^6 . Therefore:

8 kV $= 8 * 10^6$ mV
$= 8 * 1, 000, 000$ mV
=8, 000, 000 mV

Table 3 Unit Conversion Table

	micro	milli	units	kilo	Mega
micro		0.001	10^{-6}	10^{-9}	10^{-12}
milli	1, 000		0.001	10^{-6}	10^{-9}
units	10^6	1, 000		0.001	10^{-6}
kilo	10^9	10^6	1, 000		0.001
Mega	10^{12}	10^9	10^6	1, 000	

Table 4 shows the relationship between each of the prefixes that you will be using:

Table 4: Information Metric Prefix Table

Prefix	Mega	kilo	Decimal Point	milli	micro
Symbol	M	k	.	m	μ
Relation to base unit	1, 000, 000	1, 000	1	0.001 or 1/1, 000	0.000, 001 or 1/1, 000, 000
Example	5 MΩ	8 kV	12 V,A or Ω	6mV	12 μA
Pronounced	5 Megaohms (5, 000 kΩ or 5, 000, 000 Ω)	8 kilovolts (0.008 MV or 8, 000 V)	Volts Amps Ohms	6 millivolts (0.006 V)	12 microamps (0.012 mA or 0.000, 012 A)
# of spaces from decimal	6 ←	3 ←	0	→ 3	→ 6