

Engineering Units

{ ELTN 130
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As discussed before, exponents are used to represent very large and very small numbers. This is referred to as “Scientific Notation.”

Examples:

$$4,000 \text{ Volts} = 4 \times 10^3 \text{ Volts}$$

$$0.023 \text{ Amps} = 23 \times 10^{-3} \text{ Amps}$$

$$1,500,000 \text{ Ohms} = 1.5 \times 10^6 \text{ Ohms}$$

$$0.000005 \text{ Volts} = 5 \times 10^{-6} \text{ Volts}$$

In Engineering, a more “compact” method is used to write these numbers using prefixes. These is referred to as “Engineering Notation.”

Engineering Notation (ENG)

Metric prefixes with their symbols and corresponding powers of ten and values.

Power of ten	Symbol	Metric Prefix	Value
10^{-12}	p	pico	1/1,000,000,000,000
10^{-9}	n	nano	1/1,000,000,000
10^{-6}	μ	micro	1/1,000,000
10^{-3}	m	milli	1/1,000
10^0			1
10^3	k	kilo	1,000
10^6	M	mega	1,000,000
10^9	G	giga	1,000,000,000
10^{12}	T	tera	1,000,000,000,000

* Note that mega, giga and tera use capital letters, the others are lower case, except for micro which uses the mu (μ)

Most of the time in this class we will only write values from micro to Mega:

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10^{-9}	n	nano	1/1,000,000,000
10^{-6}	μ	micro	1/1,000,000
10^{-3}	m	milli	1/1,000
10^0			1
10^3	k	kilo	1,000
10^6	M	mega	1,000,000
10^9	G	giga	1,000,000,000
10^{12}	T	tera	1,000,000,000,000

When writing values of voltage, current and resistance, we use the symbols V,A, and Ω .

For example:

32V

2.2A

470 Ω

Note that all of these values have between one and three digits in front of the decimal place:

32.0V

2.20A

470.0 Ω

ANY TIME there are more than three digits in front of the decimal place, we need to write the number using Engineering Notation.

For example:

$$3,200.0 \text{ V} = 3.2\text{kV}$$

$$22,400.0\text{A} = 22.4\text{kA}$$

$$4,700,000.0 \Omega = 4.7\text{M} \Omega$$

Note that all of these values have between one and three digits in front of the decimal place.

We do this by moving the decimal place to the left either three or six places. If it's three places we use the letter k* (for kilo), if it's six places we use the letter M (for meg).

* Note that the lower case letter 'k' is used, you will often see a capital 'K' instead.

The values are written in powers of 3 unless the value is between 1 and 999.

For example:

47V - OK!

1A - OK!

330 Ω - OK!

32,200,000 V = 32.2MV

Read as "32.2 Mega Volts"

4,700,000 Ω = 4.7M Ω

Read as "4.7 Meg-Ohms"

ANY time the quantity is a fractional value (less than 1), it MUST be written in Engineering Notation:

For example:

$0.345\text{V} = 345\text{mV}$ Read as "345 milliVolts"

$0.027\text{A} = 27\text{mA}$ Read as "27 milliAmps"

$0.00082\text{V} = 820\mu\text{V}$ Read as "820 microVolts"

$0.000004\text{A} = 4\mu\text{A}$ Read as "4 microAmps"

To convert, we move the decimal place either 3 or 6 positions to the right. If we move the decimal place three places, we use the abbreviation "m" for mili. If it's six places, we use the μ (mu)

The rule of thumb is that there must be between one and three digits in front of the decimal place.

Why is this important? It allows an easy way to represent numbers without writing exponents, yet can still represent very large and very small numbers.

Practice: Which of these are written properly in Engineering notation?

37 V

1.5567V

1 A

1.5 Ω

3,600 Ω

0.02V

47 X 10⁴ V

3000mA

20mV

2000mA

4,700K Ω

Answers:.

- 37 V - Yes, two digits in front of the decimal point (d.p.)
- 1.5567V - Yes, one digit in front of the d.p.
- 1 A - Yes, one digit in front of the d.p.
- 1.5Ω - Yes, one digit in front of the d.p.
- 3,600 Ω - No, 4 digits in front of dp. This should be written 3KΩ
- 0.02V - No, no digits in front of dp. Should be written 20mV
- 47 X 10⁴ V - No, not in powers of 3. Should be written 470K
- 3000mA - No, 4 digits in front of dp. Should be 3 A
- 20mV - Yes, this is fine. Less than 3 digits in front of d.p.
- 400.54mA - Yes, this is fine. 3 digits in front. Digits after d.p. don't matter
- 4,700K Ω - No, too many digits! Should be written as 4.7MΩ

References

www.finallyunderstand.com