10-12 PLTW Engineering

10-12/Engineering Notation

April 7, 2020

10-12/Digital Electronics
Lesson: **4/7/2020**

Objective/Learning Target:
Students will be able to convert from scientific, to engineering notation and apply SI prefixes

Review of Scientific Notation

- Very large or very small numbers are often expressed in a compact form called scientific notation.

An example might be 4.23×10^6

The long version of the number would be 4,230,000

How to write in Scientific Notation

- Example 4,230,000

- Shift the decimal point so there is one digit (not a zero) before the decimal point.
- In this case 4.23
- Now multiply that number x10 and add an exponent equal to the number of moves
- In this case 6. Therefor 4.23×10^{6}

Positive or negative exponent??

- The exponent will be positive if the decimal point is moved to the LEFT
- The exponent will be negative if the decimal point is moved to the RIGHT
- Written in scientific notation .00000423 would be 4.23×10^{-6}

Scientific vs. Engineering Notation

- What is the difference between scientific and engineering notations?
- The short answer is NOT MUCH
- The only difference between scientific and engineering notation is the exponent on the 10 is always a multiple of 3 with engineering notation

Engineering Notation

- When converting to engineering notation the key is moving the decimal in jumps of 3.
- For example 17,250,000

- Moving in jumps of 3 limits how far we can move the decimal to the left = 17.25×10^6

- But why is engineering notation different???

Engineering vs. SI prefix Notation

- When converting to engineering notation the key is moving the decimal in jumps of 3.
- For example $17,250,000 = 17.25 \times 10^6$

- The reason for the jumps of 3 is that Engineering notation is a direct conversion to SI prefix notation.

SI prefix Notation

- ˙SI prefix notation allows us to shorten the length of numbers even more than scientific and engineering notation.

- Why do we need to keep shortening the digits of our numbers?
- Electronic components are often very small. SI prefix notation shrinks numbers so they fit.

SI prefix Notation

Table 5. SI prefixes

Factor	Name	Symbol	Factor	Name	Symbol
10^{24}	yotta	Y	10^{-1}	deci	d
10^{21}	zetta	Z	10^{-2}	centi	c
10^{18}	exa	E	10^{-3}	milli	m
10^{15}	peta	P	10^{-6}	micro	μ
10^{12}	tera	T	10^{-9}	nano	n
10^{9}	giga	G	10^{-12}	pico	p
10^{6}	mega	M	10^{-15}	femto	f
10^{3}	kilo	k	10^{-18}	atto	a
10^{2}	hecto	h	10^{-21}	zepto	z
10^{1}	deka	da	10^{-24}	yocto	y

- SI prefix notation allows us to substitute a prefix in place of the x10 and exponent in scientific and engineering notation.
- An example would be 3,600,000 Hz
- Scientific and engineering notation = 3.6 x 10^{6} Hz
- **SI prefix = 3.6 MHz (Mega-Hertz)**
- As you can see in this example, this SI prefix Mega (M) corresponds to 10^{6}
- So we combine that to the significant digits and original units to get our equivalent number.
- https://www.albert.io/blog/ultimate-guide-to-si-units-and-unit-conversions/

Try some on your own

(Answers on slide 13)

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1. Convert these numbers to **engineering notation**.
   a. 7,100,000
   b. 25,000
   c. 870,000
   d. 1,250,000

Try some on your own

(Answers on last slide)

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1. Convert these numbers to **<u>SI prefix notation</u>**.
   a. 7,100,000 V
   b. 25,000 Ω
   c. 870,000 Hz
   d. 1,250,000 A

Try some on your own

(Answers)

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1. Convert these numbers to **engineering notation**.
   a. $7{,}100{,}000 = 7.1 \times 10^{6}$
   b. $25{,}000 = 25 \times 10^{3}$
   c. $870{,}000 = 870 \times 10^{3}$
   d. $1{,}250{,}000 = 1.25 \times 10^{6}$

Try some on your own

(Answers)

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1. Convert these numbers to **<u>SI prefix notation</u>**.
   a. 7,100,000 V = 7.1 MV
   b. 25,000 Ω = 25 kΩ
   c. 870,000 Hz = 870 kHz
   d. 1,250,000 A = 1.25 MA

Helpful Links

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Guide to engineering notation

Guide to SI Prefixes