

**Activity 1.1.3 Scientific and Engineering Notation**

Introduction

In electronics, we frequently work with very small and very large numbers. For example, the propagation delay (i.e., the time it takes for the output to change after the input has changed) for a standard digital logic gate is 0.0000000095 seconds. Moreover, the clock speed of a typical personal computer is 2400000000 Hz. Working with numbers of this magnitude, both large and small, can be cumbersome and prone to error. For this reason we use a power-of-ten notation. With a power-of-ten notation, any number, no matter how large or small, can be expressed as a decimal number multiplied by a power-of-ten.

Scientific and engineering notations are the two most common forms of power-of-ten notation. In the field of electronics, engineering notation is the preferred notation because of the direct mapping between its powers and the **International System of Units** (the International System of Units is abbreviated **SI** from the French *Système International d'Unités*). The SI system is the modern form of the metric system. It is the world's most widely used system of units for science and engineering.

In this activity you will learn how to express numbers in scientific and engineering notation as well as the appropriate SI prefix.

Procedure

1. Express each of the following numbers in *scientific notation*.
   1. 0.00000000356 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. 934,000,000 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. 847 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. 0.00092 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. 3,510,000 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Express each of the following numbers in *engineering notation*.
   1. 0.00000000356 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. 934,000,000 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. 847 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. 0.00092 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. 3,510,000 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Express each of the following numbers using the appropriate *SI prefix*.

Don’t forget to retain the units.

* 1. 0.000047 F =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  2. 17500000 Hz =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  3. 0.0000000157 A =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  4. 6800000 Ω =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  5. 0.00425 V =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Convert the following numbers into the *SI prefix* shown.
   1. 6800 pF =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_μF
   2. 2.7 M Ω =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kΩ
   3. 4.24 GHz =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_MHz
   4. 25.67 μF =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_mF
   5. 0.0127 nSec =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_pSec

**Conclusion**

1. Why is it important to use a power-of-ten notation (i.e., scientific or engineering) when expressing very large or very small numbers?
2. In engineering in general, and in electronics specifically, why do we use engineering notation rather than scientific notation?
3. The SI prefix for 10-15 is *femto* and is abbreviated f. We do not use this prefix in electronics. Why?