**EXPERIMENT 1**

**Metrics Prefixes:**

Electrical and Electronics applications most often utilize the use of metric units. These metric units have metric prefixes in such a way that adjacent metrics prefixes are separated by a factor of 1000 (****) or 0.001(****). The factor is 1000 when moving from a higher value prefix to its lower adjacent prefix. It is 0.001 when moving from a lower prefix to its adjacent higher prefix.

The most utilized metric prefixes are shown in **Table 1-1** and the conversion math between prefixes is shown in **Table 1-2**.

|  |  |  |  |
| --- | --- | --- | --- |
| **Metric Prefix Name** | **Value Notation** | **Scientific Notation** | **Symbol** |
| Femto | One Quintillionth |  | **f** |
| Pico | One Trillionth |  | **p** |
| Nano | One Billionth |  | **n** |
| Micro | One Millionth |  |  |
| Milli | One Thousandth |  | **m** |
| Basic prefix | One | = 1 | **Any basic unit.**  |
| Kilo | One Thousand |  | **K** |
| Mega | One Million |  | **M** |
| Giga | One Billion |  | **G** |
| Tera | One Trillion |  | **T** |

**Table 1-1. Metric prefixes and their symbols.**

Referring to **Table 1-1** and keeping in mind the engineering notation, one can express any number by using the proper metric prefix for it. For example, a current value of 0.02 A (Amperes) can be expressed in engineering notation as 20 **×**A**.** When referencing **Table 1-1** this indicates that it isa current value of 20 mA.

|  |
| --- |
| **Math Operation, Division or Multiplication** |
|  **This Direction multiply**  |
|  **This Direction divide**  |
| T | G | M | K | Basic  | m |  | p | n | **f** |
|  |  |  |  |  |  |  |  |  |  |

**Table 1-2. Metric unit and Engineering notation conversion chart.**

# Prefix Multiplication & Division:

Most often, when dealing with electronics analysis and calculations, multiplication and divisions of various electrical quantities with different prefixes occur. **Table 1-3** and **Table 1-4** can be used to expedite the calculation process and provide the prefix answer without the need to enter the prefix corresponding powers of 10 into the calculator.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Prefix** | **T** | **G** | **M** | **K** | **Basic** | **m** | **µ** | **n** | **p** |
| **T** | **1024** | **1021** | **1018** | **1015** | **T** | **G** | **M** | **K** | **Basic** |
| **G** | **1021** | **1018** | **1015** | **T** | **G** | **M** | **K** | **Basic** | **m** |
| **M** | **1018** | **1015** | **T** | **G** | **M** | **K** | **Basic** | **m** | **µ** |
| **K** | **1015** | **T** | **G** | **M** | **K** | **Basic** | **m** | **µ** | **n** |
| **Basic** | **T** | **G** | **M** | **K** | **Basic** | **m** | ***µ*** | **n** | **p** |
| **m** | **G** | **M** | **K** | **Basic** | **m** | **µ** | **n** | **p** | **f** |
| **µ** | **M** | **K** | **Basic** | **m** | **µ** | **n** | **p** | **f** | **10-18** |
| **n** | **K** | **Basic** | **m** | **µ** | **n** | **p** | **f** | **10-18** | **10-21** |
| **p** | **Basic** | **m** | **µ** | **n** | **p** | **f** | **10-18** | **10-21** | **10-24** |

**Table 1-3. Metrics prefixes multiplication table. Note: Basic refers to the basic unit with no prefix.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Prefix** | **T** | **G** | **M** | **K** | **Basic** | **m** | **µ** | **n** | **p** |
| **T** | **Basic** | **m** | **µ** | **n** | **p** | **f** | **10-18** | **10-21** | **10-24** |
| **G** | **K** | **Basic** | **m** | **µ** | **n** | **p** | **f** | **10-18** | **10-21** |
| **M** | **M** | **K** | **Basic** | **m** | **µ** | **n** | **p** | **f** | **10-18** |
| **K** | **G** | **M** | **K** | **Basic** | **m** | **µ** | **n** | **p** | **f** |
| **Basic** | **T** | **G** | **M** | **K** | **Basic** | **m** | **µ** | **n** | **p** |
| **m** | **1015** | **T** | **G** | **M** | **K** | **Basic** | **m** | **µ** | **n** |
| **µ** | **1018** | **1015** | **T** | **G** | **M** | **K** | **Basic** | **m** | **µ** |
| **n** | **1021** | **1018** | **1015** | **T** | **G** | **M** | **K** | **Basic** | **m** |
| **p** | **1024** | **1021** | **1018** | **1015** | **T** | **G** | **M** | **K** | **Basic** |

**Table 1-4. Metrics prefixes division table (Row1 elements ÷ Column1 elements). Note: Basic refers to the basic unit with no prefix.**

# Unit Multiplication & Division:

Some basic unit multiplications and divisions are so common which warrants listing them. The following are such listing:

 **Multiplications:**

1. **Ω × A = V**  (Ohms × Amperes = Volts).
2. **A × V = W** (Amperes × Volts = Watts).
3. **A × S = C** (Amperes ×Seconds = Coulombs).
4. **W × S = J** (Watts × Seconds = Joules).

 **Divisions:**

 a- **V ÷ Ω = A** (Volts ÷ Ohms = Amperes).

 b- **V ÷ A = Ω**  (Volts ÷ Amperes = Ohms).

 c- **W ÷ A = V** (Watts ÷ Amperes = Volts).

 d- **W ÷ V = A** (Watts ÷ Volts = Amperes).

 e- **C ÷ S = A** (Coulombs ÷ Seconds = Amperes).

**Lab Procedure:**

Complete the following tables:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ROW** | **QUANTITY** | **UNIT** | **ABBREVIATION** | **SYMBOL** |
| 1 | Current |  |  |  |
| 2 |  | Volts |  |  |
| 3 |  |  | R |  |
| 4 | Frequency |  |  |  |
| **5** |  |  |  | **W** |

**Table 1-5. Quantities symbols, unit and unit symbols.**

|  |  |  |  |
| --- | --- | --- | --- |
| **QUANTITY** | **SCIENTIFIC NOTATION** | **ENGINEERING NOTATION** | **METRIC VALUE** |
| 185.3 V | 1.853 × $10^{2}$ V | 0.1853 × $10^{3}$ V | 0.1853 KV |
| 24000 Ω |  |  |  |
| 3,200,000,000 Hz |  |  |  |
| 0.000125 A |  |  |  |
| 0.00000000022 F |  |  |  |
| 38000 W |  |  |  |
| 375,000 Ω |  |  |  |
| 0.000022 H |  |  |  |

**Table 1-6 Conversion to Scientific, Engineering Notations & Metrics representations**

|  |  |
| --- | --- |
| **METRIC VALUE** | **ENGINEERING NOTATION** |
| 150 mH | 150 × $10^{-3}$ H |
| 100 µA |  |
| 45 KV |  |
| 3.2 GHz |  |
| 220 KΩ |  |
| 375 mV |  |
| 38 nS |  |
| 4 MΩ |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **METRIC UNIT** | **MATH OPERATION** | **METRIC UNIT** | **METRIC UNIT RESULT** |
| micro | Multiplied by | Kilo = milli |
| milli | Multiplied by |  milli = |
| nano | Multiplied by |  Kilo = |
| milli | Multiplied by |  Mega = |
| milli | Divided by |  Nano = |
| nano | Divided by |  Femto =  |
| Mega | Divided by |  Mega = |
| micro | Divided by |  Kilo = |