**Harold’s AC Circuits**

**Cheat Sheet**

2 December 2024

**Circuit Laws**

|  |  |  |
| --- | --- | --- |
| **Circuit Law** | **Formula** | |
| **Kirchhoff’s Current Law (KCL)** |  |  |
| The total current flowing into a node or junction must equal the total current flowing out of the node or junction.  (conservation of charge) | |
| **Kirchhoff’s Voltage Law (KVL)** |  |  |
| The sum of all voltages around a circuit loop is equal to zero.  (conservation of energy) | |
| **Ohm’s Law** |  | A circular diagram of electrical symbols  Description automatically generated with medium confidence |
| **Power** |  | An across (V) times a through (I) variable. |
| **Electrical Energy** |  |  |

**Components in Series/Parallel**

|  |  |  |  |
| --- | --- | --- | --- |
| **Element** | **Resistor** | **Capacitor** | **Inductor** |
| **Component** |  | Toshin Kogyo 220μF Electrolytic Capacitor 63V dc, Radial, Through Hole -  1JUTSJ221M0 |  |
| **Symbol** | Vector clip art of RSA electronics capacitor symbol | Public domain vectors |  |  |
| **Denoted by** |  |  |  |
| **Units** | Ω (Ohm) | F (Farad) | H (Henry) |
| **Equation** |  |  |  |
| **Series** |  |  |  |
|  |  |  |
| **Parallel** |  |  |  |
|  |  |  |

**Impedance**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Units** | **Impedance (Z)** | **Phasor Notation** | **Complex Notation** |
| **Resistance (R)** | Ω (Ohm) |  |  |  |
| **Inductance (L)** | mH (Henry) |  |  |  |
| **Capacitance (C)** | µF (Farad) |  |  |  |
| **Impedance (Z)** | Ω (Ohm) |  |  | ZRe + ZImj |
| **Alternating Voltage (V)** | V (Volts) |  |  | VRe + VImj |
| **Alternating Current (I)** | A (Ampere) |  |  | IRe + IImj |
| NOTE: In circuits, is used to denote instead of , which is already used for current. | | | | |

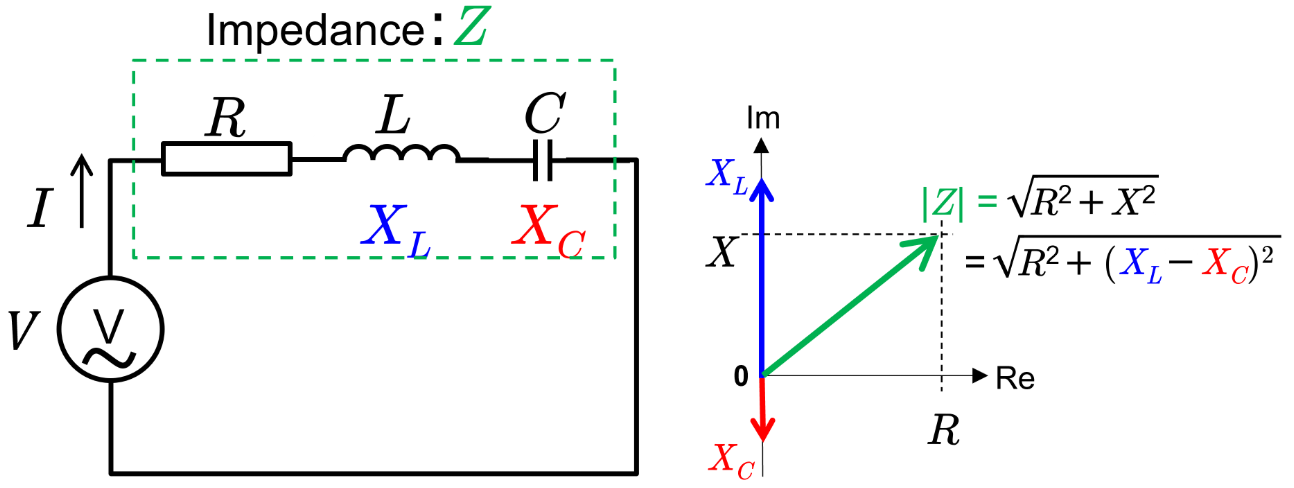
**Phasor Math**

|  |  |  |
| --- | --- | --- |
| **Circuit Law** | **Formula** | **TI-84 Calculator** |
| **Phasor**  **(Polar)** |  | [MODE] RADIAN  [MODE]  [2nd] [QUIT]  [8] [0] [2nd] [ex] [-] [3] [0] [2nd] [π] [] [180] [2nd] [i] [ENTER] |
| **Complex**  **(Rectangular)** |  | [MODE] DEGREE  [MODE] a+bi  [2nd] [QUIT]  [2]+[3][2nd] [i] [ENTER] |
| **Addition** | 1. Convert from polar to rectangular form 2. Add real to real and imaginary to imaginary 3. Convert back from rectangular to polar form | |
| **Division** |  |  |
| **Rectangular Polar** |  | [MODE] DEGREE  [MODE]  [2nd] [QUIT]  [2] + [3] [2nd] [i] [ENTER]  [ANS] = 3.61e56.31i  [2] + [3] [2nd] [i] [ENTER]  [MATH][CPX][ ▶Polar] [ENTER] |
| **Polar Rectangular** |  | [MODE] RADIAN  [MODE] a+bi  [2nd] [QUIT]  8] [0] [2nd] [ex] [-] [3] [0] [2nd] [π] [] [180] [2nd] [i] [ENTER]  [ANS] = 69.28 – 40i  8] [0] [2nd] [ex] [-] [3] [0] [2nd] [π] [] [180] [2nd] [i] [ENTER]  [MATH][CPX][ ▶Rect] [ENTER] |

**Resonance**

|  |  |  |
| --- | --- | --- |
| **Term** | **Formula** | **TI-84 Calculator** |
| **Frequency (Hz)** |  | [MODE] DEGREE  [MODE] RADIAN |
| **Resonance Frequency** |  |  |

**AC Circuit Example #1: Series RLC**

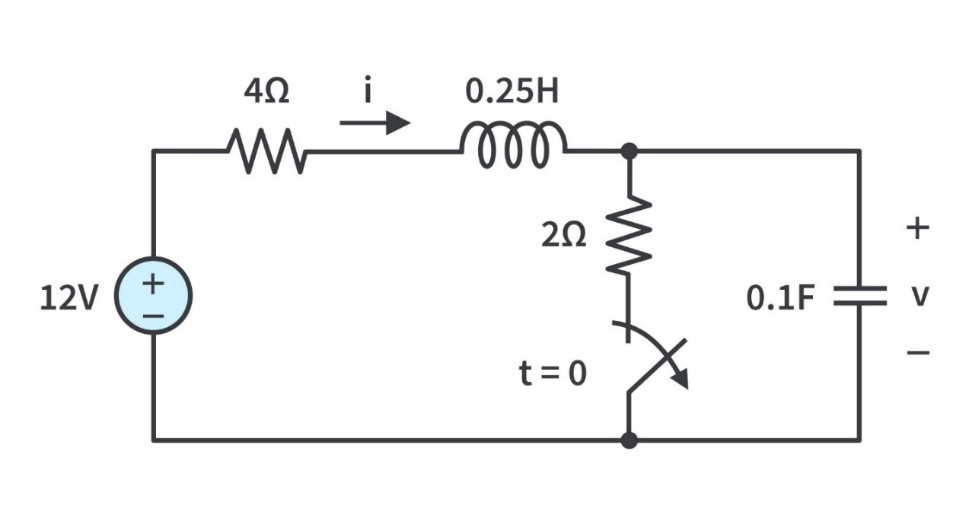


**AC Circuit Example #2: Parallel RLC**

A diagram of electrical circuits

Description automatically generated

**AC Circuit Example #3: Series (RL) and Parallel (RC)**



1. Determine the impedance from series and parallel components using complex notation.
2. Substitute values.
3. Convert from complex to polar notation.

**Sources:**

* Electrical Technology (2020 Oct). Resistance, Capacitance & Inductance in Series-Parallel – Equation & Formulas. <https://www.electricaltechnology.org/2020/10/resistance-inductance-capacitance-series-parallel-formulas.html>
* LibreTexts Physics (2024). 9.6: Electrical Energy and Power. <https://phys.libretexts.org/Bookshelves/University_Physics/University_Physics_(OpenStax)/University_Physics_II_-_Thermodynamics_Electricity_and_Magnetism_(OpenStax)/09%3A_Current_and_Resistance/9.06%3A_Electrical_Energy_and_Power>
* Tech Web (2024). Resonant Circuits: Resonant Frequency and Q Factor. <https://techweb.rohm.com/product/power-device/si/18332/>