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AC Circuit Design Formulas

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List of 45 AC Circuit Design Formulas

AC Circuit Design

1) Capacitance for Parallel RLC Circuit using Q Factor

Open Calculator

fx $$C = \frac{L \cdot Q_{||}^2}{R^2}$$

ex $$349.3578\mu F = \frac{0.79mH \cdot (39.9)^2}{(60\Omega)^2}$$

2) Capacitance for Series RLC Circuit given Q Factor

Open Calculator

fx $$C = \frac{L}{Q_{se}^2 \cdot R^2}$$

ex $$351.1111\mu F = \frac{0.79mH}{(0.025)^2 \cdot (60\Omega)^2}$$

3) Capacitance given Cut off Frequency

Open Calculator

fx $$C = \frac{1}{2 \cdot R \cdot \pi \cdot f_c}$$

ex $$350.4072\mu F = \frac{1}{2 \cdot 60\Omega \cdot \pi \cdot 7.57Hz}$$

4) Capacitance using Time Constant

Open Calculator

fx $$C = \frac{\tau}{R}$$

ex $$350\mu F = \frac{21ms}{60\Omega}$$

5) Complex Power

Open Calculator

fx $$S = \sqrt{P^2 + Q^2}$$

ex $$270.5199VA = \sqrt{(235W)^2 + (134VAR)^2}$$

6) Complex Power given Power Factor

Open Calculator

fx $$S = \frac{P}{\cos(\Phi)}$$

ex $$271.3546VA = \frac{235W}{\cos(30°)}$$

7) Current using Complex Power

Open Calculator

fx $$I = \sqrt{\frac{S}{Z}}$$

ex $$2.09723A = \sqrt{\frac{270.5VA}{61.5\Omega}}$$

8) Current using Power Factor

Open Calculator

$$I = \frac{P}{\cos\Phi \cdot V}$$

$$2.101968\text{A} = \frac{235\text{W}}{0.86 \cdot 130\text{V}}$$

9) Cut Off Frequency for RC circuit

Open Calculator

$$f_c = \frac{1}{2 \cdot \pi \cdot C \cdot R}$$

$$7.578807\text{Hz} = \frac{1}{2 \cdot \pi \cdot 350\mu\text{F} \cdot 60\Omega}$$

10) Electric Current using Reactive Power

Open Calculator

$$I = \frac{Q}{V \cdot \sin(\Phi)}$$

$$2.061538\text{A} = \frac{134\text{VAR}}{130\text{V} \cdot \sin(30^\circ)}$$

11) Electric Current using Real Power

Open Calculator

$$I = \frac{P}{V \cdot \cos(\Phi)}$$

$$2.087343\text{A} = \frac{235\text{W}}{130\text{V} \cdot \cos(30^\circ)}$$

12) Electrical Angle

Open Calculator

fx $$\theta_e = \left(\frac{N_p}{2}\right) \cdot \theta_m$$

ex $$160^\circ = \left(\frac{4}{2}\right) \cdot 80^\circ$$

13) Frequency using Time Period

Open Calculator

fx $$\omega_n = \frac{1}{2 \cdot \pi \cdot T}$$

ex $$0.050207\text{Hz} = \frac{1}{2 \cdot \pi \cdot 3.17}$$

14) Impedance given Complex Power and Current

Open Calculator

fx $$Z = \frac{S}{I^2}$$

ex $$61.33787\Omega = \frac{270.5\text{VA}}{(2.1\text{A})^2}$$

15) Impedance given Complex Power and Voltage

Open Calculator

fx $$Z = \frac{V^2}{S}$$

ex $$62.47689\Omega = \frac{(130\text{V})^2}{270.5\text{VA}}$$

16) Inductance for Parallel RLC Circuit using Q Factor

Open Calculator

fx $$L = \frac{C \cdot R^2}{Q_{||}^2}$$

ex $$0.791452\text{mH} = \frac{350\mu\text{F} \cdot (60\Omega)^2}{(39.9)^2}$$

17) Inductance for Series RLC Circuit given Q Factor

Open Calculator

fx $$L = C \cdot Q_{se}^2 \cdot R^2$$

ex $$0.7875\text{mH} = 350\mu\text{F} \cdot (0.025)^2 \cdot (60\Omega)^2$$

18) Line to Neutral Current using Reactive Power

Open Calculator

fx $$I_{ln} = \frac{Q}{3 \cdot V_{ln} \cdot \sin(\Phi)}$$

ex $$1.296565\text{A} = \frac{134\text{VAR}}{3 \cdot 68.9\text{V} \cdot \sin(30^\circ)}$$

19) Line to Neutral Current using Real Power

Open Calculator

fx $$I_{ln} = \frac{P}{3 \cdot \cos(\Phi) \cdot V_{ln}}$$

ex $$1.312795\text{A} = \frac{235\text{W}}{3 \cdot \cos(30^\circ) \cdot 68.9\text{V}}$$

20) Line to Neutral Voltage using Reactive Power

Open Calculator

fx $$V_{ln} = \frac{Q}{3 \cdot \sin(\Phi) \cdot I_{ln}}$$

ex $$68.71795\text{V} = \frac{134\text{VAR}}{3 \cdot \sin(30^\circ) \cdot 1.3\text{A}}$$

21) Line to Neutral Voltage using Real Power

Open Calculator

fx $$V_{ln} = \frac{P}{3 \cdot \cos(\Phi) \cdot I_{ln}}$$

ex $$69.57811\text{V} = \frac{235\text{W}}{3 \cdot \cos(30^\circ) \cdot 1.3\text{A}}$$

22) Power Factor given Power

Open Calculator

fx $$\cos\Phi = \frac{P}{V \cdot I}$$

ex $$0.860806 = \frac{235\text{W}}{130\text{V} \cdot 2.1\text{A}}$$

23) Power Factor given Power Factor Angle

Open Calculator

fx $$\cos\Phi = \cos(\Phi)$$

ex $$0.866025 = \cos(30^\circ)$$

24) Power in Single-Phase AC Circuits

Open Calculator

fx $$P = V \cdot I \cdot \cos(\Phi)$$

ex $$236.4249\text{W} = 130\text{V} \cdot 2.1\text{A} \cdot \cos(30^\circ)$$

25) Power in Single-Phase AC Circuits using Current

Open Calculator

fx $$P = I^2 \cdot R \cdot \cos(\Phi)$$

ex $$229.1503\text{W} = (2.1\text{A})^2 \cdot 60\Omega \cdot \cos(30^\circ)$$

26) Q Factor for Parallel RLC Circuit

Open Calculator

fx $$Q_{||} = R \cdot \left(\sqrt{\frac{C}{L}}\right)$$

ex $$39.93666 = 60\Omega \cdot \left(\sqrt{\frac{350\mu\text{F}}{0.79\text{mH}}}\right)$$

27) Q Factor for Series RLC Circuit

Open Calculator

fx $$Q_{se} = \frac{1}{R} \cdot \left(\sqrt{\frac{L}{C}}\right)$$

ex $$0.02504 = \frac{1}{60\Omega} \cdot \left(\sqrt{\frac{0.79\text{mH}}{350\mu\text{F}}}\right)$$

28) Reactive Power

Open Calculator

fx $Q = I \cdot V \cdot \sin(\Phi)$

ex $136.5\text{VAR} = 2.1\text{A} \cdot 130\text{V} \cdot \sin(30^\circ)$

29) Reactive Power using Line-to-Neutral Current

Open Calculator

fx $Q = 3 \cdot I_{ln} \cdot V_{ln} \cdot \sin(\Phi)$

ex $134.355\text{VAR} = 3 \cdot 1.3\text{A} \cdot 68.9\text{V} \cdot \sin(30^\circ)$

30) Reactive Power using RMS Voltage and Current

Open Calculator

fx $Q = V_{rms} \cdot I_{rms} \cdot \sin(\Phi)$

ex $135.125\text{VAR} = 57.5\text{V} \cdot 4.7\text{A} \cdot \sin(30^\circ)$

31) Real Power in AC Circuit

Open Calculator

fx $P = V \cdot I \cdot \cos(\Phi)$

ex $236.4249\text{W} = 130\text{V} \cdot 2.1\text{A} \cdot \cos(30^\circ)$

32) Real Power using Line-to-Neutral Voltage

Open Calculator

fx $P = 3 \cdot I_{ln} \cdot V_{ln} \cdot \cos(\Phi)$

ex $232.7097\text{W} = 3 \cdot 1.3\text{A} \cdot 68.9\text{V} \cdot \cos(30^\circ)$

33) Real Power using RMS Voltage and Current

Open Calculator

fx $$P = I_{rms} \cdot V_{rms} \cdot \cos(\Phi)$$

ex $$234.0434W = 4.7A \cdot 57.5V \cdot \cos(30^\circ)$$

34) Resistance for Parallel RLC Circuit using Q Factor

Open Calculator

fx $$R = \frac{Q_{||}}{\sqrt{\frac{C}{L}}}$$

ex $$59.94492\Omega = \frac{39.9}{\sqrt{\frac{350\mu F}{0.79mH}}}$$

35) Resistance for Series RLC Circuit given Q Factor

Open Calculator

fx $$R = \frac{\sqrt{L}}{Q_{se} \cdot \sqrt{C}}$$

ex $$60.09516\Omega = \frac{\sqrt{0.79mH}}{0.025 \cdot \sqrt{350\mu F}}$$

36) Resistance using Time Constant

Open Calculator

fx $$R = \frac{\tau}{C}$$

ex $$60\Omega = \frac{21ms}{350\mu F}$$

37) Resonant Frequency for RLC circuit

Open Calculator

fx $$f_o = \frac{1}{2 \cdot \pi \cdot \sqrt{L \cdot C}}$$

ex $$302.6722\text{Hz} = \frac{1}{2 \cdot \pi \cdot \sqrt{0.79\text{mH} \cdot 350\mu\text{F}}}$$

38) RMS Current using Reactive Power

Open Calculator

fx $$I_{rms} = \frac{Q}{V_{rms} \cdot \sin(\Phi)}$$

ex $$4.66087\text{A} = \frac{134\text{VAR}}{57.5\text{V} \cdot \sin(30^\circ)}$$

39) RMS Current using Real Power

Open Calculator

fx $$I_{rms} = \frac{P}{V_{rms} \cdot \cos(\Phi)}$$

ex $$4.719211\text{A} = \frac{235\text{W}}{57.5\text{V} \cdot \cos(30^\circ)}$$

40) RMS Voltage using Reactive Power

Open Calculator

fx $$V_{rms} = \frac{Q}{I_{rms} \cdot \sin(\Phi)}$$

ex $$57.02128\text{V} = \frac{134\text{VAR}}{4.7\text{A} \cdot \sin(30^\circ)}$$

41) RMS Voltage using Real Power

Open Calculator

fx $$V_{rms} = \frac{P}{I_{rms} \cdot \cos(\Phi)}$$

ex $$57.73503V = \frac{235W}{4.7A \cdot \cos(30^\circ)}$$

42) Voltage using Complex Power

Open Calculator

fx $$V = \sqrt{S \cdot Z}$$

ex $$128.9796V = \sqrt{270.5VA \cdot 61.5\Omega}$$

43) Voltage using Power Factor

Open Calculator

fx $$V = \frac{P}{\cos\Phi \cdot I}$$

ex $$130.1218V = \frac{235W}{0.86 \cdot 2.1A}$$

44) Voltage using Reactive Power

Open Calculator

fx $$V = \frac{Q}{I \cdot \sin(\Phi)}$$

ex $$127.619V = \frac{134VAR}{2.1A \cdot \sin(30^\circ)}$$

45) Voltage using Real Power

Open Calculator

fx $$V = \frac{P}{I \cdot \cos(\Phi)}$$

ex $$129.2165\text{V} = \frac{235\text{W}}{2.1\text{A} \cdot \cos(30^\circ)}$$

Variables Used

- **C** Capacitance *(Microfarad)*
- **cosΦ** Power Factor
- f_c Cut-off Frequency *(Hertz)*
- f_o Resonant Frequency *(Hertz)*
- **I** Current *(Ampere)*
- I_{ln} Line to Neutral Current *(Ampere)*
- I_{rms} Root Mean Square Current *(Ampere)*
- **L** Inductance *(Millihenry)*
- N_p Number of Poles
- **P** Real Power *(Watt)*
- **Q** Reactive Power *(Volt Ampere Reactive)*
- $Q_{||}$ Parallel RLC Quality Factor
- Q_{se} Series RLC Quality Factor
- **R** Resistance *(Ohm)*
- **S** Complex Power *(Volt Ampere)*
- **T** Time Period
- **V** Voltage *(Volt)*
- V_{ln} Line to Neutral Voltage *(Volt)*
- V_{rms} Root Mean Square Voltage *(Volt)*
- **Z** Impedance *(Ohm)*
- θ_e Electrical Angle *(Degree)*
- θ_m Mechanical Angle *(Degree)*

- τ Time Constant *(Millisecond)*
- Φ Phase Difference *(Degree)*
- ω_n Natural Frequency *(Hertz)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Time** in Millisecond (ms)
  Time Unit Conversion
- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Power** in Volt Ampere (VA), Watt (W), Volt Ampere Reactive (VAR)
  Power Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Capacitance** in Microfarad (µF)
  Capacitance Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion

- Measurement: **Inductance** in Millihenry (mH)
  Inductance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion

Check other formula lists

- AC Circuit Design Formulas
- RLC Circuit Formulas
- AC Power Formulas

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