calculatoratoz.com

unitsconverters.com

Synchronous Motor Circuit Formulas

Calculators! Examples! Conversions!

Bookmark **calculatoratoz.com**, **unitsconverters.com**

Widest Coverage of Calculators and Growing - **30,000+ Calculators!**
Calculate With a Different Unit for Each Variable - **In built Unit Conversion!**
Widest Collection of Measurements and Units - **250+ Measurements!**

Feel free to SHARE this document with your friends!

Please leave your feedback here...

List of 31 Synchronous Motor Circuit Formulas

Synchronous Motor Circuit

1) 3 Phase Input Power of Synchronous Motor

Open Calculator

fx $$P_{in(3\Phi)} = \sqrt{3} \cdot V_L \cdot I_L \cdot \cos(\Phi_s)$$

ex $$1584W = \sqrt{3} \cdot 192V \cdot 5.5A \cdot \cos(30^\circ)$$

2) 3 Phase Mechanical Power of Synchronous Motor

Open Calculator

fx $$P_{me(3\Phi)} = P_{in(3\Phi)} - 3 \cdot I_a^2 \cdot R_a$$

ex $$1056.25W = 1584W - 3 \cdot (3.70A)^2 \cdot 12.85\Omega$$

3) Angular Slot Pitch in Synchronous Motor

Open Calculator

fx $$Y = \frac{P \cdot 180}{n_s \cdot 2}$$

ex $$162.8406^\circ = \frac{3 \cdot 180}{95 \cdot 2}$$

4) Armature Current of Synchronous Motor given 3 Phase Mechanical Power

Open Calculator

fx $$I_a = \sqrt{\frac{P_{in(3\Phi)} - P_{me(3\Phi)}}{3 \cdot R_a}}$$

ex $$3.7\text{A} = \sqrt{\frac{1584\text{W} - 1056.2505\text{W}}{3 \cdot 12.85\Omega}}$$

5) Armature Current of Synchronous Motor given Input Power

Open Calculator

fx $$I_a = \frac{P_{in}}{\cos(\Phi_s) \cdot V}$$

ex $$3.699853\text{A} = \frac{769\text{W}}{\cos(30^\circ) \cdot 240\text{V}}$$

6) Armature Current of Synchronous Motor given Mechanical Power

Open Calculator

fx $$I_a = \sqrt{\frac{P_{in} - P_m}{R_a}}$$

ex $$3.700878\text{A} = \sqrt{\frac{769\text{W} - 593\text{W}}{12.85\Omega}}$$

7) Armature Resistance of Synchronous Motor given 3 Phase Mechanical Power

Open Calculator

fx $$R_a = \frac{P_{in(3\Phi)} - P_{me(3\Phi)}}{3 \cdot I_a^2}$$

ex $$12.85\Omega = \frac{1584W - 1056.2505W}{3 \cdot (3.70A)^2}$$

8) Armature Resistance of Synchronous Motor given Input Power

Open Calculator

fx $$R_a = \frac{P_{in} - P_m}{I_a^2}$$

ex $$12.8561\Omega = \frac{769W - 593W}{(3.70A)^2}$$

9) Armature Winding Constant of Synchronous Motor

Open Calculator

fx $$K_a = \frac{E_b}{\Phi \cdot N_s}$$

ex $$0.614762 = \frac{180V}{0.12Wb \cdot 23300rev/min}$$

10) Back EMF of Synchronous Motor using Mechanical Power

Open Calculator

$$E_b = \frac{P_m}{I_a \cdot \cos(\alpha - \Phi_s)}$$

$$179.8755\text{V} = \frac{593\text{W}}{3.70\text{A} \cdot \cos(57^\circ - 30^\circ)}$$

11) Distribution Factor in Synchronous Motor

Open Calculator

$$K_d = \frac{\sin\left(\frac{n_s \cdot Y}{2}\right)}{n_s \cdot \sin\left(\frac{Y}{2}\right)}$$

$$0.001297 = \frac{\sin\left(\frac{95 \cdot 162.8^\circ}{2}\right)}{95 \cdot \sin\left(\frac{162.8^\circ}{2}\right)}$$

12) Input Power of Synchronous Motor

Open Calculator

$$P_{in} = I_a \cdot V \cdot \cos(\Phi_s)$$

$$769.0306\text{W} = 3.70\text{A} \cdot 240\text{V} \cdot \cos(30^\circ)$$

13) Load Current of Synchronous Motor given 3 Phase Mechanical Power

Open Calculator

fx $$I_L = \frac{P_{me(3\Phi)} + 3 \cdot I_a^2 \cdot R_a}{\sqrt{3} \cdot V_L \cdot \cos(\Phi_s)}$$

ex $$5.5A = \frac{1056.2505W + 3 \cdot (3.70A)^2 \cdot 12.85\Omega}{\sqrt{3} \cdot 192V \cdot \cos(30^\circ)}$$

14) Load Current of Synchronous Motor using 3 Phase Input Power

Open Calculator

fx $$I_L = \frac{P_{in(3\Phi)}}{\sqrt{3} \cdot V_L \cdot \cos(\Phi_s)}$$

ex $$5.5A = \frac{1584W}{\sqrt{3} \cdot 192V \cdot \cos(30^\circ)}$$

15) Load Voltage of Synchronous Motor given 3 Phase Mechanical Power

Open Calculator

fx $$V_L = \frac{P_{me(3\Phi)} + 3 \cdot I_a^2 \cdot R_a}{\sqrt{3} \cdot I_L \cdot \cos(\Phi_s)}$$

ex $$192V = \frac{1056.2505W + 3 \cdot (3.70A)^2 \cdot 12.85\Omega}{\sqrt{3} \cdot 5.5A \cdot \cos(30^\circ)}$$

16) Load Voltage of Synchronous Motor using 3 Phase Input Power

Open Calculator

fx $$V_L = \frac{P_{in(3\Phi)}}{\sqrt{3} \cdot I_L \cdot \cos(\Phi_s)}$$

ex $$192V = \frac{1584W}{\sqrt{3} \cdot 5.5A \cdot \cos(30^\circ)}$$

17) Magnetic Flux of Synchronous Motor given Back EMF

Open Calculator

fx $$\Phi = \frac{E_b}{K_a \cdot N_s}$$

ex $$0.120937Wb = \frac{180V}{0.61 \cdot 23300rev/min}$$

18) Mechanical Power of Synchronous Motor

Open Calculator

fx $$P_m = E_b \cdot I_a \cdot \cos(\alpha - \Phi_s)$$

ex $$593.4103W = 180V \cdot 3.70A \cdot \cos(57^\circ - 30^\circ)$$

19) Mechanical Power of Synchronous Motor given Gross Torque

Open Calculator

fx $$P_m = \tau_g \cdot N_s$$

ex $$592.9128W = 0.243N*m \cdot 23300rev/min$$

20) Mechanical Power of Synchronous Motor given Input Power

Open Calculator

fx $P_m = P_{in} - I_a^2 \cdot R_a$

ex $593.0835\text{W} = 769\text{W} - (3.70\text{A})^2 \cdot 12.85\Omega$

21) Number of Poles given Synchronous Speed in Synchronous Motor

Open Calculator

fx $P = \frac{f \cdot 120}{N_s}$

ex $3 = \frac{61\text{Hz} \cdot 120}{23300\text{rev/min}}$

22) Output Power for Synchronous Motor

Open Calculator

fx $P_{out} = I_a^2 \cdot R_a$

ex $175.9165\text{W} = (3.70\text{A})^2 \cdot 12.85\Omega$

23) Phase Angle between Voltage and Armature Current given Input Power

Open Calculator

fx $\Phi_s = a\cos\left(\frac{P_{in}}{V \cdot I_a}\right)$

ex $30.00394^\circ = a\cos\left(\frac{769\text{W}}{240\text{V} \cdot 3.70\text{A}}\right)$

24) Power Factor of Synchronous Motor given 3 Phase Mechanical Power

Open Calculator

fx $$\text{Cos}\Phi = \frac{\text{P}_{\text{me}(3\Phi)} + 3 \cdot \text{I}_\text{a}^2 \cdot \text{R}_\text{a}}{\sqrt{3} \cdot \text{V}_\text{L} \cdot \text{I}_\text{L}}$$

ex $$0.866025 = \frac{1056.2505\text{W} + 3 \cdot (3.70\text{A})^2 \cdot 12.85\Omega}{\sqrt{3} \cdot 192\text{V} \cdot 5.5\text{A}}$$

25) Power Factor of Synchronous Motor given Input Power

Open Calculator

fx $$\text{Cos}\Phi = \frac{\text{P}_\text{in}}{\text{V} \cdot \text{I}_\text{a}}$$

ex $$0.865991 = \frac{769\text{W}}{240\text{V} \cdot 3.70\text{A}}$$

26) Power Factor of Synchronous Motor using 3 Phase Input Power

Open Calculator

fx $$\text{Cos}\Phi = \frac{\text{P}_{\text{in}(3\Phi)}}{\sqrt{3} \cdot \text{V}_\text{L} \cdot \text{I}_\text{L}}$$

ex $$0.866025 = \frac{1584\text{W}}{\sqrt{3} \cdot 192\text{V} \cdot 5.5\text{A}}$$

27) Pull Out Torque in Synchronous Motor

Open Calculator

$$\tau = \frac{3 \cdot V_{\Phi} \cdot E_a}{9.55 \cdot N_m \cdot X_s}$$

$$0.034575\text{N*m} = \frac{3 \cdot 28.75\text{V} \cdot 25.55\text{V}}{9.55 \cdot 13560\text{rev/min} \cdot 4.7\Omega}$$

28) Synchronous Speed of Synchronous Motor

Open Calculator

$$N_s = \frac{120 \cdot f}{P}$$

$$23300.28\text{rev/min} = \frac{120 \cdot 61\text{Hz}}{3}$$

29) Synchronous Speed of Synchronous Motor given Mechanical Power

Open Calculator

$$N_s = \frac{P_m}{\tau_g}$$

$$23303.43\text{rev/min} = \frac{593\text{W}}{0.243\text{N*m}}$$

30) Torque Induced in Synchronous Motor

Open Calculator

$$\tau = \frac{3 \cdot V_{\Phi} \cdot E_a \cdot \sin(\delta)}{9.55 \cdot N_m \cdot X_s}$$

$$0.033397\text{N*m} = \frac{3 \cdot 28.75\text{V} \cdot 25.55\text{V} \cdot \sin(75^\circ)}{9.55 \cdot 13560\text{rev/min} \cdot 4.7\Omega}$$

31) Voltage of Synchronous Motor given Input Power

Open Calculator

fx $$V = \frac{P_{in}}{I_a \cdot \cos(\Phi_s)}$$

ex $$239.9905\text{V} = \frac{769\text{W}}{3.70\text{A} \cdot \cos(30^\circ)}$$

Variables Used

- **CosΦ** Power Factor
- E_a Internal Generated Voltage *(Volt)*
- E_b Back EMF *(Volt)*
- **f** Frequency *(Hertz)*
- I_a Armature Current *(Ampere)*
- I_L Load Current *(Ampere)*
- K_a Armature Winding Constant
- K_d Distribution Factor
- N_m Motor Speed *(Revolution per Minute)*
- n_s Number of Slots
- N_s Synchronous Speed *(Revolution per Minute)*
- **P** Number of Poles
- P_{in} Input Power *(Watt)*
- $P_{in(3\Phi)}$ Three Phase Input Power *(Watt)*
- P_m Mechanical Power *(Watt)*
- $P_{me(3\Phi)}$ Three Phase Mechanical Power *(Watt)*
- P_{out} Output Power *(Watt)*
- R_a Armature Resistance *(Ohm)*
- **V** Voltage *(Volt)*
- V_L Load Voltage *(Volt)*
- V_Φ Terminal Voltage *(Volt)*

- X_S Synchronous Reactance *(Ohm)*
- Y Angular Slot Pitch *(Degree)*
- α Load Angle *(Degree)*
- δ Torque Angle *(Degree)*
- τ Torque *(Newton Meter)*
- τ_g Gross Torque *(Newton Meter)*
- Φ Magnetic Flux *(Weber)*
- Φ_s Phase Difference *(Degree)*

Constants, Functions, Measurements used

- Function: **acos**, acos(Number)
  Inverse trigonometric cosine function
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Magnetic Flux** in Weber (Wb)
  Magnetic Flux Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion
- Measurement: **Angular Velocity** in Revolution per Minute (rev/min)
  Angular Velocity Unit Conversion
- Measurement: **Torque** in Newton Meter (N*m)
  Torque Unit Conversion

Check other formula lists

- **Synchronous Motor Circuit Formulas**

Feel free to SHARE this document with your friends!

PDF Available in

English Spanish French German Russian Italian Portuguese Polish Dutch

2/13/2024 | 4:51:22 AM UTC *Please leave your feedback here...*