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DC Motor Characteristics Formulas

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List of 26 DC Motor Characteristics Formulas

DC Motor Characteristics

1) Angular Speed given Electrical Efficiency of DC Motor

Open Calculator

fx $$\omega_s = \frac{\eta_e \cdot V_s \cdot I_a}{\tau_a}$$

ex $$52.1788\text{rev/s} = \frac{0.8 \cdot 240\text{V} \cdot 0.724\text{A}}{0.424\text{N*m}}$$

2) Armature Current given Electrical Efficiency of DC Motor

Open Calculator

fx $$I_a = \frac{\omega_s \cdot \tau_a}{V_s \cdot \eta_e}$$

ex $$0.723989\text{A} = \frac{52.178\text{rev/s} \cdot 0.424\text{N*m}}{240\text{V} \cdot 0.8}$$

3) Armature Current of DC Motor

Open Calculator

fx $$I_a = \frac{V_a}{K_f \cdot \Phi \cdot \omega_s}$$

ex $$0.724496\text{A} = \frac{320\text{V}}{1.135 \cdot 1.187\text{Wb} \cdot 52.178\text{rev/s}}$$

4) Armature Torque given Electrical Efficiency of DC Motor

Open Calculator

fx $$\tau_a = \frac{I_a \cdot V_s \cdot \eta_e}{\omega_s}$$

ex $$0.424006\text{N*m} = \frac{0.724\text{A} \cdot 240\text{V} \cdot 0.8}{52.178\text{rev/s}}$$

5) Armature Torque given Mechanical Efficiency of DC Motor

Open Calculator

fx $$\tau_a = \eta_m \cdot \tau$$

ex $$0.4236\text{N*m} = 0.60 \cdot 0.706\text{N*m}$$

6) Back EMF Equation of DC Motor

Open Calculator

fx $$E_b = \frac{n \cdot \Phi \cdot Z \cdot N}{60 \cdot n_{||}}$$

ex $$24.94334\text{V} = \frac{4 \cdot 1.187\text{Wb} \cdot 14 \cdot 1290\text{rev/min}}{60 \cdot 6}$$

7) Constant Losses given Mechanical Loss

Open Calculator

fx $$C_{loss} = P_{core} + L_m$$

ex $$15.9\text{W} = 6.8\text{W} + 9.1\text{W}$$

8) Converted Power given Electrical Efficiency of DC Motor

Open Calculator

fx $P_{conv} = \eta_e \cdot P_{in}$

ex $62.4W = 0.8 \cdot 78W$

9) Core Loss given Mechanical Loss of DC Motor

Open Calculator

fx $P_{core} = C_{loss} - L_m$

ex $6.8W = 15.9W - 9.1W$

10) DC Motor Frequency given Speed

Open Calculator

fx $f = \frac{n \cdot N}{120}$

ex $4.502949Hz = \frac{4 \cdot 1290rev/min}{120}$

11) Electrical Efficiency of DC Motor

Open Calculator

fx $\eta_e = \frac{\tau_a \cdot \omega_s}{V_s \cdot I_a}$

ex $0.799988 = \frac{0.424N*m \cdot 52.178rev/s}{240V \cdot 0.724A}$

12) Input Power given Electrical Efficiency of DC Motor

Open Calculator

fx $$P_{in} = \frac{P_{conv}}{\eta_e}$$

ex $$78W = \frac{62.4W}{0.8}$$

13) Machine Construction Constant of DC Motor

Open Calculator

fx $$K_f = \frac{V_s - I_a \cdot R_a}{\Phi \cdot N}$$

ex $$1.135516 = \frac{240V - 0.724A \cdot 80\Omega}{1.187Wb \cdot 1290rev/min}$$

14) Magnetic Flux of DC Motor

Open Calculator

fx $$\Phi = \frac{V_s - I_a \cdot R_a}{K_f \cdot N}$$

ex $$1.187539Wb = \frac{240V - 0.724A \cdot 80\Omega}{1.135 \cdot 1290rev/min}$$

15) Mechanical Efficiency of DC Motor

Open Calculator

fx $$\eta_m = \frac{\tau_a}{\tau}$$

ex $$0.600567 = \frac{0.424N*m}{0.706N*m}$$

16) Mechanical Power Developed in DC Motor given Input Power

Open Calculator

$$P_m = P_{in} - \left(I_a^2 \cdot R_a\right)$$

$$36.06592\text{W} = 78\text{W} - \left((0.724\text{A})^2 \cdot 80\Omega\right)$$

17) Motor Speed of DC Motor

Open Calculator

$$N = \frac{60 \cdot n_{||} \cdot E_b}{Z \cdot n \cdot \Phi}$$

$$1289.983\text{rev/min} = \frac{60 \cdot 6 \cdot 24.943\text{V}}{14 \cdot 4 \cdot 1.187\text{Wb}}$$

18) Motor Speed of DC Motor given Flux

Open Calculator

$$N = \frac{V_s - I_a \cdot R_a}{K_f \cdot \Phi}$$

$$1290.586\text{rev/min} = \frac{240\text{V} - 0.724\text{A} \cdot 80\Omega}{1.135 \cdot 1.187\text{Wb}}$$

19) Motor Torque given Mechanical Efficiency of DC Motor

Open Calculator

$$\tau = \frac{\tau_a}{\eta_m}$$

$$0.706667\text{N*m} = \frac{0.424\text{N*m}}{0.60}$$

20) Motor Torque of Series DC Motor given Machine Constant

Open Calculator

fx $\tau = K_f \cdot \Phi \cdot I_a^2$

ex $0.706193\text{N*m} = 1.135 \cdot 1.187\text{Wb} \cdot (0.724\text{A})^2$

21) Output Power given Overall Efficiency of DC Motor

Open Calculator

fx $P_{out} = P_{in} \cdot \eta_o$

ex $36.66\text{W} = 78\text{W} \cdot 0.47$

22) Overall Efficiency of DC Motor

Open Calculator

fx $\eta_o = \frac{P_m}{P_{in}}$

ex $0.461538 = \frac{36\text{W}}{78\text{W}}$

23) Overall Efficiency of DC Motor given Input Power

Open Calculator

fx $\eta_o = \frac{P_{in} - \left(P_{cu(a)} + P_{cu(f)} + P_{loss}\right)}{P_{in}}$

ex $0.417949 = \frac{78\text{W} - (1.25\text{W} + 2.81\text{W} + 41.34\text{W})}{78\text{W}}$

24) Supply Voltage given Electrical Efficiency of DC Motor

Open Calculator

fx $$V_s = \frac{\omega_s \cdot \tau_a}{I_a \cdot \eta_e}$$

ex $$239.9963\text{V} = \frac{52.178\text{rev/s} \cdot 0.424\text{N*m}}{0.724\text{A} \cdot 0.8}$$

25) Supply Voltage given Overall Efficiency of DC Motor

Open Calculator

fx $$V_s = \frac{(I - I_{sh})^2 \cdot R_a + L_m + P_{core}}{I \cdot (1 - \eta_o)}$$

ex $$240.5996\text{V} = \frac{(0.658\text{A} - 1.58\text{A})^2 \cdot 80\Omega + 9.1\text{W} + 6.8\text{W}}{0.658\text{A} \cdot (1 - 0.47)}$$

26) Total Power Loss given Overall Efficiency of DC Motor

Open Calculator

fx $$P_{loss} = P_{in} - \eta_o \cdot P_{in}$$

ex $$41.34\text{W} = 78\text{W} - 0.47 \cdot 78\text{W}$$

Variables Used

- C_{loss} Constant Loss *(Watt)*
- E_b Back EMF *(Volt)*
- f Frequency *(Hertz)*
- I Electric Current *(Ampere)*
- I_a Armature Current *(Ampere)*
- I_{sh} Shunt Field Current *(Ampere)*
- K_f Constant of Machine Construction
- L_m Mechanical Losses *(Watt)*
- n Number of Poles
- N Motor Speed *(Revolution per Minute)*
- $n_{||}$ Number of Parallel Paths
- P_{conv} Converted Power *(Watt)*
- P_{core} Core Losses *(Watt)*
- $P_{cu(a)}$ Armature Copper Loss *(Watt)*
- $P_{cu(f)}$ Field Copper Losses *(Watt)*
- P_{in} Input Power *(Watt)*
- P_{loss} Power Loss *(Watt)*
- P_m Mechanical Power *(Watt)*
- P_{out} Output Power *(Watt)*
- R_a Armature Resistance *(Ohm)*
- V_a Armature Voltage *(Volt)*

- V_s Supply Voltage *(Volt)*
- Z Number of Conductors
- η_e Electrical Efficiency
- η_m Mechanical Efficiency
- η_o Overall Efficiency
- τ Motor Torque *(Newton Meter)*
- τ_a Armature Torque *(Newton Meter)*
- Φ Magnetic Flux *(Weber)*
- ω_s Angular Speed *(Revolution per Second)*

Constants, Functions, Measurements used

- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Power** in Watt (W)
  Power 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 Second (rev/s), Revolution per Minute (rev/min)
  Angular Velocity Unit Conversion
- Measurement: **Torque** in Newton Meter (N*m)
  Torque Unit Conversion

Check other formula lists

- **DC Motor Characteristics Formulas**
- **DC Series Motor Formulas**
- **DC Shunt Motor Formulas**

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