



Formulas Examples with Units

List of 16 Important DC Machine Characteristics Formulas

1) Angular Speed of DC Machine using Kf Formula

Formula

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

Example with Units

$$321.0685 \text{ rad/s} = \frac{200 \text{ v}}{2.864 \cdot 0.29 \text{ Wb} \cdot 0.75 \text{ A}}$$

Evaluate Formula 

2) Armature Induced Voltage of DC Machine given Kf Formula

Formula

$$V_a = K_f \cdot I_a \cdot \Phi \cdot \omega_s$$

Example with Units

$$199.9573 \text{ v} = 2.864 \cdot 0.75 \text{ A} \cdot 0.29 \text{ Wb} \cdot 321 \text{ rad/s}$$

Evaluate Formula 

3) Back EMF of DC Generator Formula

Formula

$$E_b = V_o - (I_a \cdot R_a)$$

Example with Units

$$90 \text{ v} = 150 \text{ v} - (0.75 \text{ A} \cdot 80 \Omega)$$

Evaluate Formula 

4) Back Pitch for DC Machine Formula

Formula

$$Y_b = \left(\frac{2 \cdot n_{\text{slot}}}{P} \right) + 1$$

Example

$$22.3333 = \left(\frac{2 \cdot 96}{9} \right) + 1$$

Evaluate Formula 

5) Back Pitch for DC Machine given Coil Span Formula

Formula

$$Y_b = U \cdot K_c$$

Example

$$22.32 = 2.79 \cdot 8$$

Evaluate Formula 

6) Coil Span of DC Motor Formula

Formula

$$K_c = \frac{n_c}{P}$$

Example

$$8 = \frac{72}{9}$$

Evaluate Formula 



7) Design Constant of DC Machine Formula ↻

Formula

$$K_f = \frac{Z \cdot P}{2 \cdot \pi \cdot n_{fl}}$$

Example

$$2.8648 = \frac{12 \cdot 9}{2 \cdot 3.1416 \cdot 6}$$

Evaluate Formula ↻

8) Electrical Efficiency of DC Machine Formula ↻

Formula

$$\eta_e = \frac{\eta_m \cdot \omega_s \cdot \tau}{V_o \cdot I_a}$$

Example with Units

$$0.8668 = \frac{0.49 \cdot 321 \text{ rad/s} \cdot 0.62 \text{ N}\cdot\text{m}}{150 \text{ v} \cdot 0.75 \text{ A}}$$

Evaluate Formula ↻

9) EMF Generated in DC Machine with Lap Winding Formula ↻

Formula

$$E = \frac{N_r \cdot Z \cdot \Phi_p}{60}$$

Example with Units

$$14.4 \text{ v} = \frac{1200 \text{ rev/min} \cdot 12 \cdot 0.06 \text{ wb}}{60}$$

Evaluate Formula ↻

10) Front Pitch for DC Machine Formula ↻

Formula

$$Y_F = \left(\frac{2 \cdot n_{\text{slot}}}{P} \right) - 1$$

Example

$$20.3333 = \left(\frac{2 \cdot 96}{9} \right) - 1$$

Evaluate Formula ↻

11) Input Power of DC Motor Formula ↻

Formula

$$P_{in} = V_s \cdot I_a$$

Example with Units

$$180 \text{ w} = 240 \text{ v} \cdot 0.75 \text{ A}$$

Evaluate Formula ↻

12) Magnetic Flux of DC Machine given Torque Formula ↻

Formula

$$\Phi = \frac{\tau}{K_f \cdot I_a}$$

Example with Units

$$0.2886 \text{ wb} = \frac{0.62 \text{ N}\cdot\text{m}}{2.864 \cdot 0.75 \text{ A}}$$

Evaluate Formula ↻

13) Mechanical Efficiency given Induced Voltage and Armature Current Formula ↻

Formula

$$\eta_m = \frac{\eta_e \cdot V_o \cdot I_a}{\omega_s \cdot \tau}$$

Example with Units

$$0.4861 = \frac{0.86 \cdot 150 \text{ v} \cdot 0.75 \text{ A}}{321 \text{ rad/s} \cdot 0.62 \text{ N}\cdot\text{m}}$$

Evaluate Formula ↻

14) Output Power of DC Machine Formula ↻

Formula

$$P_o = \omega_s \cdot \tau$$

Example with Units

$$199.02 \text{ w} = 321 \text{ rad/s} \cdot 0.62 \text{ N}\cdot\text{m}$$

Evaluate Formula ↻



15) Pole Pitch in DC Generator Formula

Formula

$$Y_p = \frac{n_{\text{slot}}}{P}$$

Example

$$10.6667 = \frac{96}{9}$$

Evaluate Formula 

16) Torque generated in DC Machine Formula

Formula

$$\tau = K_f \cdot \Phi \cdot I_a$$

Example with Units

$$0.6229 \text{ N}\cdot\text{m} = 2.864 \cdot 0.29 \text{ Wb} \cdot 0.75 \text{ A}$$

Evaluate Formula 



Variables used in list of DC Machine Characteristics Formulas above

- E EMF (Volt)
- E_b Back EMF (Volt)
- I_a Armature Current (Ampere)
- K_C Coil Span Factor
- K_f Machine Constant
- n_c Number of Commutator Segments
- $n_{||}$ Number of Parallel Paths
- N_r Rotor Speed (Revolution per Minute)
- n_{slot} Number of Slots
- P Number of Poles
- P_{in} Input Power (Watt)
- P_o Output Power (Watt)
- R_a Armature Resistance (Ohm)
- U Coil Span
- V_a Armature Voltage (Volt)
- V_o Output Voltage (Volt)
- V_s Supply Voltage (Volt)
- Y_b Back Pitch
- Y_F Front Pitch
- Y_P Pole Pitch
- Z Number of Conductors
- η_e Electrical Efficiency
- η_m Mechanical Efficiency
- T Torque (Newton Meter)
- Φ Magnetic Flux (Weber)
- Φ_p Flux per Pole (Weber)
- ω_s Angular Speed (Radian per Second)

Constants, Functions, Measurements used in list of DC Machine Characteristics Formulas above

- **constant(s):** pi, 3.14159265358979323846264338327950288
Archimedes' constant
- **Measurement: Electric Current** in Ampere (A)
Electric Current Unit Conversion ↻
- **Measurement: Power** in Watt (W)
Power 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 Radian per Second (rad/s), Revolution per Minute (rev/min)
Angular Velocity Unit Conversion ↻
- **Measurement: Torque** in Newton Meter (N*m)
Torque Unit Conversion ↻



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