Important DC Series Motor Formulas PDF

Formulas
Examples
with Units

List of 16
Important DC Series Motor Formulas

1) Current Formulas

1.1) Armature Current of Series DC Motor Formula

Evaluate Formula

Formula

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

Example with Units

$$0.7249\,\text{A} = \sqrt{\frac{0.708\,\text{N*m}}{1.135 \cdot 1.187\,\text{Wb}}}$$

1.2) Armature Current of Series DC Motor given Input Power Formula

Evaluate Formula

Formula

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

Example with Units

$$0.7208\,\text{A} = \frac{173\,\text{W}}{240\,\text{V}}$$

1.3) Armature Current of Series DC Motor given Speed Formula

Evaluate Formula

Formula

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

Example with Units

$$0.711\,\text{A} = \frac{240\,\text{V} - 1.187\,\text{Wb} \cdot 1.135 \cdot 1290\,\text{rev/min}}{80\,\Omega + 1.58\,\Omega}$$

1.4) Armature Current of Series DC Motor using Voltage Formula

Evaluate Formula

Formula

$$I_a = \frac{V_s - V_a}{R_a + R_{sf}}$$

Example with Units

$$0.7355\,\text{A} = \frac{240\,\text{V} - 180\,\text{V}}{80\,\Omega + 1.58\,\Omega}$$

2) Mechanical Specifications Formulas

2.1) Machine Construction Constant of Series DC Motor using Armature Induced Voltage Formula

Evaluate Formula

Formula

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

Example with Units

$$4.2373 = \frac{180\,\text{V}}{1.187\,\text{Wb} \cdot 49.43\,\text{rad/s} \cdot 0.724\,\text{A}}$$

2.2) Machine Construction Constant of Series DC Motor using Speed Formula

Evaluate Formula

Formula

$$K_f = \frac{V_s - I_a \cdot \left(R_a + R_{sf}\right)}{\Phi \cdot N}$$

Example with Units

$$1.1284 = \frac{240\,\text{V} - 0.724\,\text{A} \cdot \left(80\,\Omega + 1.58\,\Omega\right)}{1.187\,\text{Wb} \cdot 1290\,\text{rev/min}}$$

2.3) Magnetic Flux of Series DC Motor given Speed Formula

Evaluate Formula

Formula

$$\Phi = \frac{V_s - I_a \cdot \left(R_a + R_{sf}\right)}{K_f \cdot N}$$

Example with Units

$$1.1801\,\text{Wb} = \frac{240\,\text{V} - 0.724\,\text{A} \cdot \left(80\,\Omega + 1.58\,\Omega\right)}{1.135 \cdot 1290\,\text{rev/min}}$$

3) Resistance Formulas

3.1) Armature Resistance of Series DC Motor given Voltage Formula

Evaluate Formula

Formula

$$R_a = \left(\frac{V_s - V_a}{I_a}\right) - R_{sf}$$

Example with Units

$$81.2929\,\Omega = \left(\frac{240\,\text{V} - 180\,\text{V}}{0.724\,\text{A}}\right) - 1.58\,\Omega$$

3.2) Series Field Resistance of Series DC Motor given Speed Formula

Evaluate Formula

Formula

$$R_{sh} = \left(\frac{V_s - N \cdot K_f \cdot \Phi}{I_a}\right) - R_a$$

Example with Units

$$0.1142\,\Omega = \left(\frac{240\,\text{V} - 1290\,\text{rev/min} \cdot 1.135 \cdot 1.187\,\text{Wb}}{0.724\,\text{A}}\right) - 80\,\Omega$$

3.3) Series Field Resistance of Series DC Motor given Voltage Formula

Evaluate Formula

Formula

$$R_{sf} = \left(\frac{V_s - V_a}{I_a}\right) - R_a$$

Example with Units

$$2.8729\,\Omega = \left(\frac{240\,\text{V} - 180\,\text{V}}{0.724\,\text{A}}\right) - 80\,\Omega$$

4) Speed Formulas

4.1) Angular Speed of DC Motor given Output Power Formula

Evaluate Formula

Formula

$$\omega_s = \frac{P_{out}}{\tau}$$

Example with Units

$$49.435\,\text{rad/s} = \frac{35\,\text{W}}{0.708\,\text{N*m}}$$

4.2) Speed of Series DC Motor Formula

Evaluate Formula

Formula

$$N = \frac{V_s - I_a \cdot \left(R_a + R_{sh} \right)}{K_f \cdot \Phi}$$

Example with Units

$$1290.0218\,\text{rev/min} = \frac{240\,\text{V} - 0.724\,\text{A} \cdot \left(80\,\Omega + 0.11\,\Omega \right)}{1.135 \cdot 1.187\,\text{Wb}}$$

5) Voltage Formulas

5.1) Armature Induced Voltage of Series DC motor given Voltage Formula

Evaluate Formula

Formula

$$V_a = V_s - I_a \cdot \left(R_a + R_{sf} \right)$$

Example with Units

$$180.9361\,\text{V} = 240\,\text{V} - 0.724\,\text{A} \cdot \left(80\,\Omega + 1.58\,\Omega \right)$$

5.2) Input Power of Series DC Motor Formula

Evaluate Formula

Formula

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

Example with Units

$$173.76\,\text{W} = 240\,\text{V} \cdot 0.724\,\text{A}$$

5.3) Voltage Equation of Series DC Motor Formula

Evaluate Formula

Formula

$$V_s = V_a + I_a \cdot \left(R_a + R_{sf} \right)$$

Example with Units

$$239.0639\,\text{V} = 180\,\text{V} + 0.724\,\text{A} \cdot \left(80\,\Omega + 1.58\,\Omega \right)$$

5.4) Voltage of Series DC Motor given Input Power Formula

Evaluate Formula

Formula

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

Example with Units

$$238.9503\,\text{V} = \frac{173\,\text{W}}{0.724\,\text{A}}$$

Variables used in list of DC Series Motor Formulas above

- I_a Armature Current *(Ampere)*
- K_f Constant of Machine Construction
- **N** Motor Speed *(Revolution per Minute)*
- P_{in} Input Power *(Watt)*
- P_{out} Output Power *(Watt)*
- R_a Armature Resistance *(Ohm)*
- R_{sf} Series Field Resistance *(Ohm)*
- R_{sh} Shunt Field Resistance *(Ohm)*
- V_a Armature Voltage *(Volt)*
- V_s Supply Voltage *(Volt)*
- **τ** Torque *(Newton Meter)*
- **Φ** Magnetic Flux *(Weber)*
- ω_s Angular Speed *(Radian per Second)*

Constants, Functions, Measurements used in list of DC Series Motor Formulas above

- Functions: **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: **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 Revolution per Minute (rev/min), Radian per Second (rad/s)
  Angular Velocity Unit Conversion
- Measurement: **Torque** in Newton Meter (N*m)
  Torque Unit Conversion

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