

Important DC Shunt Motor Formulas PDF



Formulas
Examples
with Units

List of 23
Important DC Shunt Motor Formulas

1) Current Formulas

1.1) Armature Current of Shunt DC Motor given Input Power Formula

Formula

$$I_a = \frac{P_{in}}{V_{sp}}$$

Example with Units

$$3.7155 \text{ A} = \frac{888 \text{ W}}{239 \text{ V}}$$

Evaluate Formula 

1.2) Armature Current of Shunt DC Motor given Torque Formula

Formula

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

Example with Units

$$3.7281 \text{ A} = \frac{0.85 \text{ N}\cdot\text{m}}{2 \cdot 0.114 \text{ Wb}}$$

Evaluate Formula 

1.3) Armature Current of Shunt DC Motor given Voltage Formula

Formula

$$I_a = \frac{V_{sp} - E_b}{R_a}$$

Example with Units

$$3.7037 \text{ A} = \frac{239 \text{ V} - 231 \text{ V}}{2.16 \Omega}$$

Evaluate Formula 

1.4) Field Current of DC Shunt Motor Formula

Formula

$$I_f = \frac{V_{sp}}{R_{sh}}$$

Example with Units

$$1.5031 \text{ A} = \frac{239 \text{ V}}{159 \Omega}$$

Evaluate Formula 

2) Flux Formulas

2.1) Magnetic Flux of DC Shunt Motor given Kf Formula

Formula

$$\Phi = \frac{E_b}{\omega_s \cdot K_f}$$

Example with Units

$$0.1142 \text{ Wb} = \frac{231 \text{ V}}{161 \text{ rev/s} \cdot 2}$$

Evaluate Formula 



2.2) Magnetic Flux of DC Shunt Motor given Torque Formula

Formula

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

Example with Units

$$0.1149 \text{ Wb} = \frac{0.85 \text{ N}\cdot\text{m}}{2 \cdot 3.7 \text{ A}}$$

Evaluate Formula 

3) Mechanical Specifications Formulas

3.1) Machine Constant of DC Shunt Motor given Torque Formula

Formula

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

Example with Units

$$2.0152 = \frac{0.85 \text{ N}\cdot\text{m}}{0.114 \text{ Wb} \cdot 3.7 \text{ A}}$$

Evaluate Formula 

3.2) Machine Construction Constant of DC Shunt Motor given Angular Speed Formula

Formula

$$K_f = \frac{E_b}{\Phi \cdot \omega_s}$$

Example with Units

$$2.0031 = \frac{231 \text{ V}}{0.114 \text{ Wb} \cdot 161 \text{ rev/s}}$$

Evaluate Formula 

3.3) Machine Construction Constant of Shunt DC Motor Formula

Formula

$$K_f = \frac{60 \cdot n_{||}}{n \cdot Z}$$

Example

$$2.0152 = \frac{60 \cdot 6}{4 \cdot 44.66}$$

Evaluate Formula 

3.4) Machine Construction Constant using Speed of Shunt DC Motor Formula

Formula

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

Example with Units

$$2.1756 = \frac{75 \text{ V} - 3.7 \text{ A} \cdot 2.16 \Omega}{2579.98 \text{ rev/min} \cdot 0.114 \text{ Wb}}$$

Evaluate Formula 

3.5) Number of Armature Conductors of DC Shunt Motor using K Formula

Formula

$$Z = \frac{60 \cdot n_{||}}{K \cdot n}$$

Example

$$44.665 = \frac{60 \cdot 6}{2.015 \cdot 4}$$

Evaluate Formula 

3.6) Number of Parallel Paths of Shunt DC Motor Formula

Formula

$$n_{||} = \frac{K \cdot Z \cdot n}{60}$$

Example

$$6 = \frac{2.015 \cdot 44.66 \cdot 4}{60}$$

Evaluate Formula 



3.7) Number of Poles of Shunt DC Motor Formula

Formula

$$n = \frac{60 \cdot n_{fl}}{K \cdot Z}$$

Example

$$4.0004 = \frac{60 \cdot 6}{2.015 \cdot 44.66}$$

Evaluate Formula 

4) Resistance Formulas

4.1) Armature Resistance of Shunt DC Motor given Voltage Formula

Formula

$$R_a = \frac{V_{sp} - E_b}{I_a}$$

Example with Units

$$2.1622\Omega = \frac{239\text{v} - 231\text{v}}{3.7\text{A}}$$

Evaluate Formula 

4.2) Shunt Field Resistance of Shunt DC Motor given Shunt Field Current Formula

Formula

$$R_{sh} = \frac{V_{sp}}{I_{sh}}$$

Example with Units

$$159.4396\Omega = \frac{239\text{v}}{1.499\text{A}}$$

Evaluate Formula 

5) Speed Formulas

5.1) Angular Speed of DC Shunt Motor given Kf Formula

Formula

$$\omega_s = \frac{E_b}{K_f \cdot \Phi}$$

Example with Units

$$161.2491\text{rev/s} = \frac{231\text{v}}{2 \cdot 0.114\text{Wb}}$$

Evaluate Formula 

5.2) Angular Speed of DC Shunt Motor given Output Power Formula

Formula

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

Example with Units

$$161.0274\text{rev/s} = \frac{860\text{w}}{0.85\text{N}\cdot\text{m}}$$

Evaluate Formula 

5.3) Full Load Speed of Shunt DC Motor Formula

Formula

$$N_{fl} = \frac{100 \cdot N_{nl}}{N_{reg} + 100}$$

Example with Units

$$0.19\text{rev/min} = \frac{100 \cdot 2.58\text{rev/min}}{12012\text{rev/min} + 100}$$

Evaluate Formula 

5.4) No Load Speed of Shunt DC Motor Formula

Formula

$$N_{nl} = \frac{N_{reg} \cdot N_{fl}}{100 + N_{fl}}$$

Example with Units

$$2.3895\text{rev/min} = \frac{12012\text{rev/min} \cdot 0.19\text{rev/min}}{100 + 0.19\text{rev/min}}$$

Evaluate Formula 



5.5) Speed Regulation of Shunt DC Motor Formula

Formula

$$N_{\text{reg}} = \left(\frac{N_{nl} - N_{fl}}{N_{fl}} \right) \cdot 100$$

Example with Units

$$12012.0099 \text{ rev/min} = \left(\frac{2.58 \text{ rev/min} - 0.19 \text{ rev/min}}{0.19 \text{ rev/min}} \right) \cdot 100$$

Evaluate Formula 

5.6) Torque of DC Motor given Output Power Formula

Formula

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

Example with Units

$$0.8501 \text{ N*m} = \frac{860 \text{ W}}{161 \text{ rev/s}}$$

Evaluate Formula 

6) Voltage & EMF Formulas

6.1) Voltage of Shunt DC Motor Formula

Formula

$$V_{\text{sp}} = E_b + I_a \cdot R_a$$

Example with Units

$$238.992 \text{ V} = 231 \text{ V} + 3.7 \text{ A} \cdot 2.16 \Omega$$

Evaluate Formula 

6.2) Voltage of Shunt DC Motor given Shunt Field Current Formula

Formula

$$V_{\text{sp}} = I_{\text{sh}} \cdot R_{\text{sh}}$$

Example with Units

$$238.341 \text{ V} = 1.499 \text{ A} \cdot 159 \Omega$$

Evaluate Formula 



Variables used in list of DC Shunt Motor Formulas above

- E_b Back EMF (Volt)
- I_a Armature Current (Ampere)
- I_f Field Current (Ampere)
- I_{sh} Shunt Field Current (Ampere)
- K Machine Constant
- K_f Constant of Machine Construction
- n Number of Poles
- N Motor Speed (Revolution per Minute)
- $n_{||}$ Number of Parallel Paths
- N_{fl} Full Load Speed (Revolution per Minute)
- N_{nl} No Load Speed (Revolution per Minute)
- N_{reg} Speed Regulation (Revolution per Minute)
- P_{in} Input Power (Watt)
- P_{out} Output Power (Watt)
- R_a Armature Resistance (Ohm)
- R_{sh} Shunt Field Resistance (Ohm)
- V_{sp} Supply Voltage (Volt)
- V_t Terminal Voltage (Volt)
- Z Number of Conductors
- T Torque (Newton Meter)
- Φ Magnetic Flux (Weber)
- ω_s Angular Speed (Revolution per Second)

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

- **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 Second (rev/s), Revolution per Minute (rev/min)
[Angular Velocity Unit Conversion](#) ↻
- **Measurement: Torque** in Newton Meter (N*m)
[Torque Unit Conversion](#) ↻



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