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# DC Shunt Motor Formulas

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# List of 23 DC Shunt Motor Formulas

## DC Shunt Motor

### Current

#### 1) Armature Current of Shunt DC Motor given Input Power

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

$$\text{ex } 3.715481\text{A} = \frac{888\text{W}}{239\text{V}}$$

#### 2) Armature Current of Shunt DC Motor given Torque

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

$$\text{ex } 3.72807\text{A} = \frac{0.85\text{N}\cdot\text{m}}{2 \cdot 0.114\text{Wb}}$$

#### 3) Armature Current of Shunt DC Motor given Voltage

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

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d\_img.jpg\)](#)

$$\text{ex } 3.703704\text{A} = \frac{239\text{V} - 231\text{V}}{2.16\Omega}$$



#### 4) Field Current of DC Shunt Motor

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$ex \quad 1.503145A = \frac{239V}{159\Omega}$$

#### Flux

#### 5) Magnetic Flux of DC Shunt Motor given Kf

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

[Open Calculator !\[\]\(5361750c22c4e047a52f4eac1ec2d4cc\_img.jpg\)](#)

$$ex \quad 0.114176Wb = \frac{231V}{161rev/s \cdot 2}$$

#### 6) Magnetic Flux of DC Shunt Motor given Torque

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

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e\_img.jpg\)](#)

$$ex \quad 0.114865Wb = \frac{0.85N*m}{2 \cdot 3.7A}$$



## Mechanical Specifications

### 7) Machine Constant of DC Shunt Motor given Torque

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

[Open Calculator !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5\_img.jpg\)](#)

$$ex \quad 2.015173 = \frac{0.85N \cdot m}{0.114Wb \cdot 3.7A}$$

### 8) Machine Construction Constant of DC Shunt Motor given Angular Speed

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

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a\_img.jpg\)](#)

$$ex \quad 2.003094 = \frac{231V}{0.114Wb \cdot 161rev/s}$$

### 9) Machine Construction Constant of Shunt DC Motor

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

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a\_img.jpg\)](#)

$$ex \quad 2.015226 = \frac{60 \cdot 6}{4 \cdot 44.66}$$



## 10) Machine Construction Constant using Speed of Shunt DC Motor

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

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$ex \quad 2.175589 = \frac{75V - 3.7A \cdot 2.16\Omega}{2579.98\text{rev}/\text{min} \cdot 0.114\text{Wb}}$$

## 11) Number of Armature Conductors of DC Shunt Motor using K

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$ex \quad 44.66501 = \frac{60 \cdot 6}{2.015 \cdot 4}$$

## 12) Number of Parallel Paths of Shunt DC Motor

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

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

## 13) Number of Poles of Shunt DC Motor

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

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$ex \quad 4.000449 = \frac{60 \cdot 6}{2.015 \cdot 44.66}$$



## Resistance

### 14) Armature Resistance of Shunt DC Motor given Voltage

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

[Open Calculator !\[\]\(950a62bbddad88d64435fd35607dfc42\_img.jpg\)](#)

$$\text{ex } 2.162162\Omega = \frac{239V - 231V}{3.7A}$$

### 15) Shunt Field Resistance of Shunt DC Motor given Shunt Field Current

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

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719\_img.jpg\)](#)

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

## Speed

### 16) Angular Speed of DC Shunt Motor given Kf

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

[Open Calculator !\[\]\(aab88c0d099e5d18d6533a97b13ec28d\_img.jpg\)](#)

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




17) Angular Speed of DC Shunt Motor given Output Power 

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)


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

18) Full Load Speed of Shunt DC Motor 

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

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5\_img.jpg\)](#)


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

19) No Load Speed of Shunt DC Motor 

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

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2\_img.jpg\)](#)

$$ex \quad 2.389523 \text{ rev/min} = \frac{12012 \text{ rev/min} \cdot 0.19 \text{ rev/min}}{100 + 0.19 \text{ rev/min}}$$

20) Speed Regulation of Shunt DC Motor 

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

[Open Calculator !\[\]\(06a315363e7801bba8c7489a6694af19\_img.jpg\)](#)

$$ex \quad 12012.01 \text{ rev/min} = \left( \frac{2.58 \text{ rev/min} - 0.19 \text{ rev/min}}{0.19 \text{ rev/min}} \right) \cdot 100$$



## 21) Torque of DC Motor given Output Power

[Open Calculator !\[\]\(3d8c13c92b853674f749aac6fa869926\_img.jpg\)](#)

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

$$ex \quad 0.850144N*m = \frac{860W}{161rev/s}$$

## Voltage & EMF

### 22) Voltage of Shunt DC Motor

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6\_img.jpg\)](#)

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

$$ex \quad 238.992V = 231V + 3.7A \cdot 2.16\Omega$$

### 23) Voltage of Shunt DC Motor given Shunt Field Current

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9\_img.jpg\)](#)

$$fx \quad V_{sp} = I_{sh} \cdot R_{sh}$$

$$ex \quad 238.341V = 1.499A \cdot 159\Omega$$





## Variables Used








- $E_b$  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)
- $\Phi$  Magnetic Flux (Weber)



- $\omega_s$  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: Magnetic Flux** in Weber (Wb)  
*Magnetic Flux Unit Conversion* 
- **Measurement: Electric Resistance** in Ohm ( $\Omega$ )  
*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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