



# **DC Drives Formulas**

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### **List of 11 DC Drives Formulas**

## DC Drives

## Single Phase Drives

1) Average Armature Voltage of Single Phase Full-Converter Drives

$$ag{V_{
m a(full)}} = rac{2 \cdot {
m V_m} \cdot {
m cos}(lpha)}{\pi}$$

Open Calculator 🗗

2) Average Armature Voltage of Single Phase Half-Wave Converter Drive

$$extbf{K} V_{ ext{a(half)}} = rac{ ext{V}_{ ext{m}}}{2 \cdot \pi} \cdot (1 + \cos(lpha))$$

Open Calculator 🗗

$$ext{ex} \ 46.98961 ext{V} = rac{220 ext{V}}{2 \cdot \pi} \cdot (1 + \cos(70^\circ))$$

3) Average Field Voltage of Single Phase Semi-Converter Drives

$$V_{
m f(semi)} = \left(rac{V_{
m m}}{\pi}
ight) \cdot (1+\cos(lpha))$$

Open Calculator

$$\texttt{ex} \boxed{93.97922 \text{V} = \left(\frac{220 \text{V}}{\pi}\right) \cdot \left(1 + \cos(70°)\right)}$$





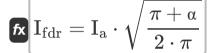
#### 4) Input Power of Single Phase Full Converter Drives



$$ext{P}_{ ext{in}} = \left(rac{2\cdot\sqrt{2}}{\pi}
ight)\cdot\cos(lpha)$$

Open Calculator

#### 5) RMS Value of Freewheeling Diode Current in Half Wave Converter Drives



Open Calculator

$$25 ext{A} = 30 ext{A} \cdot \sqrt{rac{\pi + 70^\circ}{2 \cdot \pi}}$$

# 6) RMS Value of Thyristor Current in Half Wave Converter Drives

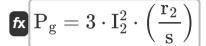
$$I_{
m sr} = I_{
m a} \cdot \left(rac{\pi - lpha}{2 \cdot \pi}
ight)^{rac{1}{2}}$$

$$oxed{16.58312 ext{A} = 30 ext{A} \cdot \left(rac{\pi - 70^{\circ}}{2 \cdot \pi}
ight)^{rac{1}{2}}}$$



## Three Phase Drives

7) Air Gap Power in Three Phase Induction Motor Drives 🗗



Open Calculator

ex  $21.93485 \mathrm{W} = 3 \cdot \left(1.352 \mathrm{A}\right)^2 \cdot \left(\frac{0.4 \Omega}{0.1}\right)$ 

8) Armature Terminal Voltage in Half-Wave Converter Drives

 $extbf{V}_{
m o} = \left(rac{3\cdot {
m V}_{
m ml}}{2\cdot \pi}
ight)\cdot \cos(lpha)$ 

Open Calculator 🗗

9) Average Armature Voltage of Three Phase Full-Converter Drives 🖸

 $ag{V_{a( ext{full\_3p})} = rac{3 \cdot \sqrt{3} \cdot V_{m} \cdot \cos(lpha)}{\pi}}$ 

Open Calculator 🖸

 $\boxed{124.4533\mathrm{V} = \frac{3\cdot\sqrt{3}\cdot220\mathrm{V}\cdot\cos(70°)}{\pi}}$ 



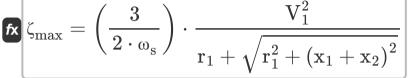
#### 10) Average Field Voltage of Three Phase Semi-Converter Drive

 $\mathbf{v}_{\mathrm{f(semi\_3p)}} = rac{3 \cdot \mathrm{V_m} \cdot (1 + \cos(lpha))}{2 \cdot \pi}$ 

Open Calculator

 $extbf{ex} 140.9688 ext{V} = rac{3 \cdot 220 ext{V} \cdot (1 + \cos(70\degree))}{2 \cdot \pi}$ 

# 11) Maximum Torque in Induction Motor Drives



Open Calculator

ex

$$127.8202 ext{N*m} = \left(rac{3}{2 \cdot 157 ext{m/s}}
ight) \cdot rac{\left(230 ext{V}
ight)^2}{0.6 \Omega + \sqrt{\left(0.6 \Omega
ight)^2 + \left(1.6 \Omega + 1.7 \Omega
ight)^2}}$$



#### Variables Used

- **l**<sub>2</sub> Rotor Current (Ampere)
- **l**<sub>a</sub> Armature Current (Ampere)
- Ifdr RMS Freewheeling Diode Current (Ampere)
- Isr RMS of Source Current (Ampere)
- Pa Air Gap Power (Watt)
- Pin Input Power (Watt)
- r<sub>1</sub> Stator Resistance (Ohm)
- r<sub>2</sub> Rotor Resistance (Ohm)
- S Slip
- V<sub>1</sub> Terminal Voltage (Volt)
- Va(full) Full Drive Armature Voltage (Volt)
- Va(full 3p) Full Drive Armature Voltage in Three Phase (Volt)
- Va(half) Half Drive Armature Voltage (Volt)
- V<sub>f(semi)</sub> Semi Drive Field Voltage (Volt)
- V<sub>f(semi\_3p)</sub> Semi Drive Field Voltage in Three Phase (Volt)
- V<sub>m</sub> Peak Input Voltage (Volt)
- V<sub>ml</sub> Maximum Line Voltage (Volt)
- **V** Average Output Voltage (Volt)
- X<sub>1</sub> Stator Leakage Reactance (Ohm)
- X<sub>2</sub> Rotor Leakage Reactance (Ohm)
- α Delay Angle of Thyristor (Degree)





DC Drives Formulas...

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- ζ<sub>max</sub> Maximum Torque (Newton Meter)
- ω<sub>s</sub> Synchronous Speed (Meter per Second)





# Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
   Archimedes' constant
- Function: cos, cos(Angle)

  Trigonometric cosine function
- Function: sqrt, sqrt(Number) Square root function
- Measurement: Electric Current in Ampere (A)
  Electric Current Unit Conversion
- Measurement: Speed in Meter per Second (m/s)
   Speed Unit Conversion
- Measurement: Power in Watt (W)
   Power Unit Conversion
- Measurement: Angle in Degree (°)
   Angle Unit Conversion
- Measurement: Electric Resistance in Ohm (Ω)
   Electric Resistance Unit Conversion
- Measurement: Electric Potential in Volt (V)
   Electric Potential Unit Conversion
- Measurement: Torque in Newton Meter (N\*m)
   Torque Unit Conversion





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- Silicon Controlled Rectifier
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