Important DC Drives Formulas PDF

Formulas
Examples
with Units

List of 11
Important DC Drives Formulas

1) Single Phase Drives Formulas

1.1) Average Armature Voltage of Single Phase Full-Converter Drives Formula

Evaluate Formula

Formula

$$V_{a(full)} = \frac{2 \cdot V_m \cdot \cos(\alpha)}{\pi}$$

Example with Units

$$47.9021\,\text{V} = \frac{2 \cdot 220\,\text{V} \cdot \cos(70°)}{3.1416}$$

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

Evaluate Formula

Formula

$$V_{a(half)} = \frac{V_m}{2 \cdot \pi} \cdot (1 + \cos(\alpha))$$

Example with Units

$$46.9896\,\text{V} = \frac{220\,\text{V}}{2 \cdot 3.1416} \cdot (1 + \cos(70°))$$

1.3) Average Field Voltage of Single Phase Semi-Converter Drives Formula

Evaluate Formula

Formula

$$V_{f(semi)} = \left(\frac{V_m}{\pi}\right) \cdot (1 + \cos(\alpha))$$

Example with Units

$$93.9792\,\text{V} = \left(\frac{220\,\text{V}}{3.1416}\right) \cdot (1 + \cos(70°))$$

1.4) Input Power of Single Phase Full Converter Drives Formula

Evaluate Formula

Formula

$$P_{in} = \left(\frac{2 \cdot \sqrt{2}}{\pi}\right) \cdot \cos(\alpha)$$

Example with Units

$$0.3079\,\text{W} = \left(\frac{2 \cdot \sqrt{2}}{3.1416}\right) \cdot \cos(70°)$$

1.5) RMS Value of Freewheeling Diode Current in Half Wave Converter Drives Formula

Evaluate Formula

Formula

$$I_{fdr} = I_a \cdot \sqrt{\frac{\pi + \alpha}{2 \cdot \pi}}$$

Example with Units

$$25\,\text{A} = 30\,\text{A} \cdot \sqrt{\frac{3.1416 + 70°}{2 \cdot 3.1416}}$$

1.6) RMS Value of Thyristor Current in Half Wave Converter Drives Formula

Evaluate Formula

Formula

$$I_{sr} = I_a \cdot \left(\frac{\pi - \alpha}{2 \cdot \pi} \right)^{\frac{1}{2}}$$

Example with Units

$$16.5831\,\text{A} = 30\,\text{A} \cdot \left(\frac{3.1416 - 70^\circ}{2 \cdot 3.1416} \right)^{\frac{1}{2}}$$

2) Three Phase Drives Formulas

2.1) Air Gap Power in Three Phase Induction Motor Drives Formula

Evaluate Formula

Formula

$$P_g = 3 \cdot {I_2}^2 \cdot \left(\frac{r_2}{s} \right)$$

Example with Units

$$21.9348\,\text{W} = 3 \cdot 1.352\,\text{A}^2 \cdot \left(\frac{0.4\,\Omega}{0.1} \right)$$

2.2) Armature Terminal Voltage in Half-Wave Converter Drives Formula

Evaluate Formula

Formula

$$V_o = \left(\frac{3 \cdot V_{ml}}{2 \cdot \pi} \right) \cdot \cos\left(\alpha \right)$$

Example with Units

$$34.2935\,\text{V} = \left(\frac{3 \cdot 210\,\text{V}}{2 \cdot 3.1416} \right) \cdot \cos\left(70^\circ \right)$$

2.3) Average Armature Voltage of Three Phase Full-Converter Drives Formula

Evaluate Formula

Formula

$$V_{a(full\_3p)} = \frac{3 \cdot \sqrt{3} \cdot V_m \cdot \cos\left(\alpha \right)}{\pi}$$

Example with Units

$$124.4533\,\text{V} = \frac{3 \cdot \sqrt{3} \cdot 220\,\text{V} \cdot \cos\left(70^\circ \right)}{3.1416}$$

2.4) Average Field Voltage of Three Phase Semi-Converter Drive Formula

Evaluate Formula

Formula

$$V_{f(semi\_3p)} = \frac{3 \cdot V_m \cdot \left(1 + \cos\left(\alpha \right) \right)}{2 \cdot \pi}$$

Example with Units

$$140.9688\,\text{V} = \frac{3 \cdot 220\,\text{V} \cdot \left(1 + \cos\left(70^\circ \right) \right)}{2 \cdot 3.1416}$$

2.5) Maximum Torque in Induction Motor Drives Formula

Evaluate Formula

Formula

$$\zeta_{max} = \left(\frac{3}{2 \cdot \omega_s} \right) \cdot \frac{{V_1}^2}{r_1 + \sqrt{{r_1}^2 + \left(x_1 + x_2 \right)^2}}$$

Example with Units

$$127.8202\,\text{N*m} = \left(\frac{3}{2 \cdot 157\,\text{m/s}} \right) \cdot \frac{230\,\text{V}^2}{0.6\,\Omega + \sqrt{0.6\,\Omega^2 + \left(1.6\,\Omega + 1.7\,\Omega \right)^2}}$$

Variables used in list of DC Drives Formulas above

- I_2 Rotor Current *(Ampere)*
- I_a Armature Current *(Ampere)*
- I_{fdr} RMS Freewheeling Diode Current *(Ampere)*
- I_{sr} RMS of Source Current *(Ampere)*
- P_g Air Gap Power *(Watt)*
- P_{in} Input Power *(Watt)*
- r_1 Stator Resistance *(Ohm)*
- r_2 Rotor Resistance *(Ohm)*
- **s** Slip
- V_1 Terminal Voltage *(Volt)*
- $V_{a(full)}$ Full Drive Armature Voltage *(Volt)*
- $V_{a(full\_3p)}$ Full Drive Armature Voltage in Three Phase *(Volt)*
- $V_{a(half)}$ Half Drive Armature Voltage *(Volt)*
- $V_{f(semi)}$ Semi Drive Field Voltage *(Volt)*
- $V_{f(semi\_3p)}$ Semi Drive Field Voltage in Three Phase *(Volt)*
- V_m Peak Input Voltage *(Volt)*
- V_{ml} Maximum Line Voltage *(Volt)*
- V_o Average Output Voltage *(Volt)*
- x_1 Stator Leakage Reactance *(Ohm)*
- x_2 Rotor Leakage Reactance *(Ohm)*
- α Delay Angle of Thyristor *(Degree)*
- ζ_{max} Maximum Torque *(Newton Meter)*
- ω_s Synchronous Speed *(Meter per Second)*

Constants, Functions, Measurements used in list of DC Drives Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **cos**, cos(Angle) *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- 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: **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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