calculatoratoz.com

unitsconverters.com

# Electric Traction Drives Formulas

Calculators! Examples! Conversions!

Bookmark **calculatoratoz.com**, **unitsconverters.com**

Widest Coverage of Calculators and Growing - **30,000+ Calculators!**
Calculate With a Different Unit for Each Variable - **In built Unit Conversion!**
Widest Collection of Measurements and Units - **250+ Measurements!**

Feel free to SHARE this document with your friends!

*Please leave your feedback here...*

# List of 13 Electric Traction Drives Formulas

## Electric Traction Drives

### 1) Average Back Emf with Negligible Commutation Overlap

Open Calculator

fx $E_b = 1.35 \cdot E_L \cdot \cos(\theta)$

ex $145.6046\text{V} = 1.35 \cdot 120\text{V} \cdot \cos(26^\circ)$

### 2) DC Output Voltage of Rectifier in Scherbius Drive Given Maximum Rotor Voltage

Open Calculator

fx $E_{DC} = 3 \cdot \left(\frac{E_{peak}}{\pi}\right)$

ex $210.0845\text{V} = 3 \cdot \left(\frac{220\text{V}}{\pi}\right)$

### 3) DC Output Voltage of Rectifier in Scherbius Drive Given Rotor RMS Line Voltage

Open Calculator

fx $E_{DC} = \left(3 \cdot \sqrt{2}\right) \cdot \left(\frac{E_r}{\pi}\right)$

ex $210.674\text{V} = \left(3 \cdot \sqrt{2}\right) \cdot \left(\frac{156\text{V}}{\pi}\right)$

## 4) DC Output Voltage of Rectifier in Scherbius Drive Given Rotor RMS Line Voltage at Slip

Open Calculator

fx $$E_{DC} = 1.35 \cdot E_{rms}$$

ex $$210.897\text{V} = 1.35 \cdot 156.22\text{V}$$

## 5) Energy Dissipated during Transient Operation

Open Calculator

fx $$E_t = \int\left(R \cdot (i)^2, x, 0, T\right)$$

ex $$160.224\text{J} = \int\left(4.235\Omega \cdot (2.345\text{A})^2, x, 0, 6.88\text{s}\right)$$

## 6) Equivalent Current for Fluctuating and Intermittent Loads

Open Calculator

fx $$I_{eq} = \sqrt{\left(\frac{1}{T}\right) \cdot \int\left((i)^2, x, 1, T\right)}$$

ex $$2.16789\text{A} = \sqrt{\left(\frac{1}{6.88\text{s}}\right) \cdot \int\left((2.345\text{A})^2, x, 1, 6.88\text{s}\right)}$$

## 7) Gear Tooth Ratio

Open Calculator

fx $$a_{gear} = \frac{n_1}{n_2}$$

ex $$3 = \frac{60}{20}$$

## 8) Motor Terminal Voltage in Regenerative Braking

Open Calculator

fx $$V_a = \left(\frac{1}{T}\right) \cdot \int(V_s \cdot x, x, t_{on}, T)$$

ex $$385.8454\text{V} = \left(\frac{1}{6.88\text{s}}\right) \cdot \int(118\text{V} \cdot x, x, 1.53\text{s}, 6.88\text{s})$$

## 9) Slip of Scherbius Drive given RMS Line Voltage

Open Calculator

fx $$s = \left(\frac{E_b}{E_r}\right) \cdot \text{modulus}(\cos(\theta))$$

ex $$0.835418 = \left(\frac{145\text{V}}{156\text{V}}\right) \cdot \text{modulus}(\cos(26^\circ))$$

## 10) Starting Time for Induction Motor under No Load

Open Calculator

fx $$t_s = \left(-\frac{\tau_m}{2}\right) \cdot \int\left(\left(\frac{s}{s_m} + \frac{s_m}{s}\right) \cdot x, x, 1, 0.05\right)$$

ex $$1.203632\text{s} = \left(-\frac{2.359\text{s}}{2}\right) \cdot \int\left(\left(\frac{0.83}{0.67} + \frac{0.67}{0.83}\right) \cdot x, x, 1, 0.05\right)$$

## 11) Time Taken for Drive Speed

Open Calculator

fx $$t = J \cdot \int\left(\frac{1}{\tau - \tau_L}, x, \omega_{m1}, \omega_{m2}\right)$$

ex $$4.509197\text{s} = 10.0\text{kg·m}^2 \cdot \int\left(\frac{1}{5.4\text{N*m} - 0.235\text{N*m}}, x, 2.346\text{rad/s}, 4.675\text{rad/s}\right)$$

## 12) Torque Generated by Scherbius Drive

Open Calculator

fx $$\tau = 1.35 \cdot \left( \frac{E_b \cdot E_L \cdot I_r \cdot E_r}{E_b \cdot \omega_f} \right)$$

ex $$5.346\text{N*m} = 1.35 \cdot \left( \frac{145\text{V} \cdot 120\text{V} \cdot 0.11\text{A} \cdot 156\text{V}}{145\text{V} \cdot 520\text{rad/s}} \right)$$

## 13) Torque of Squirrel Cage Induction Motor

Open Calculator

fx $$\tau = \frac{K \cdot E^2 \cdot R_r}{(R_s + R_r)^2 + (X_s + X_r)^2}$$

ex $$5.339779\text{N*m} = \frac{0.6 \cdot (200\text{V})^2 \cdot 2.75\Omega}{(55\Omega + 2.75\Omega)^2 + (50\Omega + 45\Omega)^2}$$

## Variables Used

- $a_{gear}$ Gear Tooth Ratio
- $E$ Voltage *(Volt)*
- $E_b$ Back Emf *(Volt)*
- $E_{DC}$ DC Voltage *(Volt)*
- $E_L$ AC Line Voltage *(Volt)*
- $E_{peak}$ Peak Voltage *(Volt)*
- $E_r$ RMS Value of Rotor Side Line Voltage *(Volt)*
- $E_{rms}$ Rotor RMS Line Voltage with Slip *(Volt)*
- $E_t$ Energy Dissipated in Transient Operation *(Joule)*
- $i$ Electric Current *(Ampere)*
- $I_{eq}$ Equivalent Current *(Ampere)*
- $I_r$ Rectified Rotor Current *(Ampere)*
- $J$ Moment of Inertia *(Kilogram Square Meter)*
- $K$ Constant
- $n_1$ Number 1 of Teeth of Driving Gear
- $n_2$ Number 2 of Teeth of Driven Gear
- $R$ Resistance of Motor Winding *(Ohm)*
- $R_r$ Rotor Resistance *(Ohm)*
- $R_s$ Stator Resistance *(Ohm)*
- $s$ Slip
- $s_m$ Slip at Maximum Torque
- $t$ Time Taken for Drive Speed *(Second)*
- $T$ Time Taken for Complete Operation *(Second)*
- $t_{on}$ On-Period Time *(Second)*

- $t_s$ Starting Time For Induction motor on No Load *(Second)*
- $V_a$ Motor Terminal Voltage *(Volt)*
- $V_s$ Source Voltage *(Volt)*
- $X_r$ Rotor Reactance *(Ohm)*
- $X_s$ Stator Reactance *(Ohm)*
- $\theta$ Firing Angle *(Degree)*
- $\tau$ Torque *(Newton Meter)*
- $\tau_L$ Load Torque *(Newton Meter)*
- $\tau_m$ Mechanical Time Constant of Motor *(Second)*
- $\omega_f$ Angular Frequency *(Radian per Second)*
- $\omega_{m1}$ Initial Angular Velocity *(Radian per Second)*
- $\omega_{m2}$ Final Angular Velocity *(Radian per Second)*

## Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  *Archimedes' constant*
- Function: **cos**, cos(Angle)
  *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Function: **int**, int(expr, arg, from, to)
  *The definite integral can be used to calculate net signed area, which is the area above the x -axis minus the area below the x -axis.*
- Function: **modulus**, modulus
  *Modulus of a number is the remainder when that number is divided by another number.*
- Function: **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: **Time** in Second (s)
  *Time Unit Conversion*
- Measurement: **Electric Current** in Ampere (A)
  *Electric Current Unit Conversion*
- Measurement: **Energy** in Joule (J)
  *Energy 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: **Angular Velocity** in Radian per Second (rad/s)
  *Angular Velocity Unit Conversion*

- Measurement: **Torque** in Newton Meter (N*m)
  *Torque Unit Conversion*
- Measurement: **Moment of Inertia** in Kilogram Square Meter (kg·m²)
  *Moment of Inertia Unit Conversion*
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  *Angular Frequency Unit Conversion*

## Check other formula lists

- **Electric Traction Drives Formulas**
- **Electric Train Physics Formulas**
- **Mechanics of Train Movement Formulas**
- **Power & Energy Formulas**
- **Traction Physics Formulas**
- **Tractive Effort Formulas**

Feel free to SHARE this document with your friends!

## PDF Available in

English Spanish French German Russian Italian Portuguese Polish Dutch

*5/15/2024 | 5:00:18 AM UTC*

*Please leave your feedback here...*