Important Power Converter Characteristics Formulas PDF

Formulas
Examples
with Units

List of 19
Important Power Converter Characteristics Formulas

1) Average DC Output Voltage of Single Phase Full Converter Formula

Evaluate Formula

Formula

$$V_{avg\text{-}dc(full)} = \frac{2 \cdot V_{m\text{-}dc(full)} \cdot \cos\left(\alpha_{full}\right)}{\pi}$$

Example with Units

$$73.0084\,\text{V} = \frac{2 \cdot 140\,\text{V} \cdot \cos\left(35°\right)}{3.1416}$$

2) Average Load Current of Three Phase Semi-Current Formula

Evaluate Formula

Formula

$$I_{L(3\Phi\text{-}semi)} = \frac{V_{avg(3\Phi\text{-}semi)}}{R_{3\Phi\text{-}semi}}$$

Example with Units

$$0.8693\,\text{A} = \frac{25.21\,\text{V}}{29\,\Omega}$$

3) Average Output Voltage for Continuous Load Current Formula

Evaluate Formula

Formula

$$V_{avg(3\Phi\text{-}half)} = \frac{3 \cdot \sqrt{3} \cdot V_{in(3\Phi\text{-}half)i} \cdot \left(\cos\left(\alpha_{d(3\Phi\text{-}half)}\right)\right)}{2 \cdot \pi}$$

Example with Units

$$38.9556\,\text{V} = \frac{3 \cdot \sqrt{3} \cdot 182\,\text{V} \cdot \left(\cos\left(75°\right)\right)}{2 \cdot 3.1416}$$

4) Average Output Voltage for PWM Control Formula

Evaluate Formula

Formula

$$E_{dc} = \left(\frac{E_m}{\pi}\right) \cdot \sum\left(x, 1, p, \left(\cos\left(\alpha_k\right) - \cos\left(\beta_k\right)\right)\right)$$

Example with Units

$$80.3916\,\text{V} = \left(\frac{230\,\text{V}}{3.1416}\right) \cdot \sum\left(x, 1, 3, \left(\cos\left(30°\right) - \cos\left(60.0°\right)\right)\right)$$

5) Average Output Voltage for Three-Phase Converter Formula

Evaluate Formula

Formula

$$V_{avg(3\Phi\text{-full})} = \frac{2 \cdot V_{m(3\Phi\text{-full})} \cdot \cos\left(\frac{\alpha_{d(3\Phi\text{-full})}}{2}\right)}{\pi}$$

Example with Units

$$115.2489\,\text{V} = \frac{2 \cdot 221\,\text{V} \cdot \cos\left(\frac{70°}{2}\right)}{3.1416}$$

6) Average Output Voltage of Single Phase Semi-Converter with Highly Inductive Load Formula

Evaluate Formula

Formula

$$V_{avg(semi)} = \left(\frac{V_{m(semi)}}{\pi}\right) \cdot \left(1 + \cos\left(\alpha_{(semi)}\right)\right)$$

Example with Units

$$9.7278\,\text{V} = \left(\frac{22.8\,\text{V}}{3.1416}\right) \cdot \left(1 + \cos\left(70.1°\right)\right)$$

7) Average Output Voltage of Single Phase Thyristor Converter with Resistive Load Formula

Evaluate Formula

Formula

$$V_{avg(thy)} = \left(\frac{V_{in(thy)}}{2 \cdot \pi}\right) \cdot \left(1 + \cos\left(\alpha_{d(thy)}\right)\right)$$

Example with Units

$$2.5568\,\text{V} = \left(\frac{12\,\text{V}}{2 \cdot 3.1416}\right) \cdot \left(1 + \cos\left(70.2°\right)\right)$$

8) DC Output Voltage for First Converter Formula

Evaluate Formula

Formula

$$V_{out(first)} = \frac{2 \cdot V_{in(dual)} \cdot \left(\cos\left(\alpha_{1(dual)}\right)\right)}{\pi}$$

Example with Units

$$73.7829\,\text{V} = \frac{2 \cdot 125\,\text{V} \cdot \left(\cos\left(22°\right)\right)}{3.1416}$$

9) DC Output Voltage of Second Converter Formula

Evaluate Formula

Formula

$$V_{out(second)} = \frac{2 \cdot V_{in(dual)} \cdot \left(\cos\left(\alpha_{2(dual)}\right)\right)}{\pi}$$

Example with Units

$$39.7887\,\text{V} = \frac{2 \cdot 125\,\text{V} \cdot \left(\cos\left(60°\right)\right)}{3.1416}$$

10) Fundamental Supply Current for PWM Control Formula

Evaluate Formula

Formula

$$I_{S(fund)} = \left(\frac{\sqrt{2} \cdot I_a}{\pi}\right) \cdot \sum\left(x, 1, p, \left(\cos\left(\alpha_k\right)\right) - \left(\cos\left(\beta_k\right)\right)\right)$$

Example with Units

$$1.0875\,\text{A} = \left(\frac{\sqrt{2} \cdot 2.2\,\text{A}}{3.1416}\right) \cdot \sum\left(x, 1, 3, \left(\cos\left(30°\right)\right) - \left(\cos\left(60.0°\right)\right)\right)$$

11) RMS Harmonic Current for PWM Control Formula

Evaluate Formula

Formula

$$I_n = \left(\frac{\sqrt{2} \cdot I_a}{\pi}\right) \cdot \sum\left(x, 1, p, \left(\cos\left(n \cdot \alpha_k\right)\right) - \left(\cos\left(n \cdot \beta_k\right)\right)\right)$$

Example with Units

$$2.971\,\text{A} = \left(\frac{\sqrt{2} \cdot 2.2\,\text{A}}{3.1416}\right) \cdot \sum\left(x, 1, 3, \left(\cos\left(3.0 \cdot 30°\right)\right) - \left(\cos\left(3.0 \cdot 60.0°\right)\right)\right)$$

12) RMS Output Voltage for Continuous Load Current Formula

Evaluate Formula

Formula

$$V_{rms(3\Phi\text{-half})} = \sqrt{3} \cdot V_{in(3\Phi\text{-half})i} \cdot \left(\left(\frac{1}{6}\right) + \frac{\sqrt{3} \cdot \cos\left(2 \cdot \alpha_{d(3\Phi\text{-half})}\right)}{8 \cdot \pi}\right)^{0.5}$$

Example with Units

$$103.1076\,\text{V} = \sqrt{3} \cdot 182\,\text{V} \cdot \left(\left(\frac{1}{6}\right) + \frac{\sqrt{3} \cdot \cos\left(2 \cdot 75°\right)}{8 \cdot 3.1416}\right)^{0.5}$$

13) RMS Output Voltage for Resistive Load Formula

Evaluate Formula

Formula

$$V_{rms(3\Phi\text{-half})} = \sqrt{3} \cdot V_{m(3\Phi\text{-half})} \cdot \left(\sqrt{\left(\frac{1}{6}\right) + \left(\frac{\sqrt{3} \cdot \cos\left(2 \cdot \alpha_{d(3\Phi\text{-half})}\right)}{8 \cdot \pi}\right)}\right)$$

Example with Units

$$125.7686\,\text{V} = \sqrt{3} \cdot 222\,\text{V} \cdot \left(\sqrt{\left(\frac{1}{6}\right) + \left(\frac{\sqrt{3} \cdot \cos\left(2 \cdot 75°\right)}{8 \cdot 3.1416}\right)}\right)$$

14) RMS Output Voltage for Three Phase Semi-Converter Formula

Evaluate Formula

Formula

$$V_{rms(3\Phi\text{-semi})} = \sqrt{3} \cdot V_{in(3\Phi\text{-semi})} \cdot \left(\left(\frac{3}{4 \cdot \pi} \right) \cdot \left(\pi - \alpha_{(3\Phi\text{-semi})} + \left(\frac{\sin\left(2 \cdot \alpha_{(3\Phi\text{-semi})} \right)}{2} \right) \right) \right)^{0.5}$$

Example with Units

$$14.0231\,\text{V} = \sqrt{3} \cdot 22.7\,\text{V} \cdot \left(\left(\frac{3}{4 \cdot 3.1416} \right) \cdot \left(3.1416 - 70.3^\circ + \left(\frac{\sin\left(2 \cdot 70.3^\circ \right)}{2} \right) \right) \right)^{0.5}$$

15) RMS Output Voltage of Single Phase Full Converter Formula

Evaluate Formula

Formula

$$V_{rms(full)} = \frac{V_{m(full)}}{\sqrt{2}}$$

Example with Units

$$154.8564\,\text{V} = \frac{219\,\text{V}}{\sqrt{2}}$$

16) RMS Output Voltage of Single Phase Semi-Converter with Highly Inductive Load Formula

Evaluate Formula

Formula

$$V_{rms(semi)} = \left(\frac{V_{m(semi)}}{2^{0.5}} \right) \cdot \left(\frac{180 - \alpha_{(semi)}}{180} + \left(\frac{0.5}{\pi} \right) \cdot \sin\left(2 \cdot \alpha_{(semi)} \right) \right)^{0.5}$$

Example with Units

$$16.8711\,\text{V} = \left(\frac{22.8\,\text{V}}{2^{0.5}} \right) \cdot \left(\frac{180 - 70.1^\circ}{180} + \left(\frac{0.5}{3.1416} \right) \cdot \sin\left(2 \cdot 70.1^\circ \right) \right)^{0.5}$$

17) RMS Output Voltage of Single Phase Thyristor Converter with Resistive Load Formula

Evaluate Formula

Formula

$$V_{rms(thy)} = \left(\frac{V_{in(thy)}}{2} \right) \cdot \left(\frac{180 - \alpha_{d(thy)}}{180} + \left(\frac{0.5}{\pi} \right) \cdot \sin\left(2 \cdot \alpha_{d(thy)} \right) \right)^{0.5}$$

Example with Units

$$6.2775\,\text{V} = \left(\frac{12\,\text{V}}{2} \right) \cdot \left(\frac{180 - 70.2^\circ}{180} + \left(\frac{0.5}{3.1416} \right) \cdot \sin\left(2 \cdot 70.2^\circ \right) \right)^{0.5}$$

18) RMS Output Voltage of Three-Phase Full Converter Formula

Evaluate Formula

Formula

$$V_{rms(3\Phi\text{-full})} = \left((6)^{0.5} \right) \cdot V_{in(3\Phi\text{-full})} \cdot \left(\left(0.25 + 0.65 \cdot \frac{\cos\left(2 \cdot \alpha_{d(3\Phi\text{-full})} \right)}{\pi} \right)^{0.5} \right)$$

Example with Units

$$163.0118\,\text{V} = \left((6)^{0.5} \right) \cdot 220\,\text{V} \cdot \left(\left(0.25 + 0.65 \cdot \frac{\cos\left(2 \cdot 70° \right)}{3.1416} \right)^{0.5} \right)$$

19) RMS Supply Current for PWM Control Formula

Evaluate Formula

Formula

$$I_{rms} = \frac{I_a}{\sqrt{\pi}} \cdot \sqrt{\sum\left(x, 1, p, \left(\beta_k - \alpha_k \right) \right)}$$

Example with Units

$$1.5556\,\text{A} = \frac{2.2\,\text{A}}{\sqrt{3.1416}} \cdot \sqrt{\sum\left(x, 1, 3, \left(60.0° - 30° \right) \right)}$$

Variables used in list of Power Converter Characteristics Formulas above

- E_{dc} Average Output Voltage of PWM Controlled Converter *(Volt)*
- E_m Peak Input Voltage of PWM Converter *(Volt)*
- I_a Armature Current *(Ampere)*
- $I_{L(3\Phi\text{-semi})}$ Load Current 3 Phase Semi Converter *(Ampere)*
- I_n RMS nth Harmonic Current *(Ampere)*
- I_{rms} Root Mean Square Current *(Ampere)*
- $I_{S(fund)}$ Fundamental Supply Current *(Ampere)*
- **n** Harmonic Order
- **p** Number of Pulse in Half-cycle of PWM
- $R_{3\Phi\text{-semi}}$ Resistance 3 Phase Semi Converter *(Ohm)*
- $V_{avg(3\Phi\text{-full})}$ Average Voltage 3 Phase Full Converter *(Volt)*
- $V_{avg(3\Phi\text{-half})}$ Average Voltage 3 Phase Half Converter *(Volt)*
- $V_{avg(3\Phi\text{-semi})}$ Average Voltage 3 Phase Semi Converter *(Volt)*
- $V_{avg(semi)}$ Average Voltage Semi Converter *(Volt)*
- $V_{avg(thy)}$ Average Voltage Thyristor Converter *(Volt)*
- $V_{avg\text{-}dc(full)}$ Average Voltage Full Converter *(Volt)*
- $V_{in(3\Phi\text{-full})}$ Peak Input Voltage 3 Phase Full Converter *(Volt)*
- $V_{in(3\Phi\text{-half})i}$ Peak Input Voltage 3 Phase Half Converter *(Volt)*
- $V_{in(3\Phi\text{-semi})}$ Peak Input Voltage 3 Phase Semi Converter *(Volt)*
- $V_{in(dual)}$ Peak Input Voltage Dual Converter *(Volt)*

Constants, Functions, Measurements used in list of Power Converter Characteristics 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: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- 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.*
- Functions: **sum**, sum(i, from, to, expr) *Summation or sigma (∑) notation is a method used to write out a long sum in a concise way.*
- Measurement: **Electric Current** in Ampere (A) *Electric Current 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*

- $V_{in(thy)}$ Peak Input Voltage Thyristor Converter *(Volt)*
- $V_{m(3\Phi\text{-full})}$ Peak Phase Voltage Full Converter *(Volt)*
- $V_{m(3\Phi\text{-half})}$ Peak Phase Voltage *(Volt)*
- $V_{m(full)}$ Maximum Input Voltage Full Converter *(Volt)*
- $V_{m(semi)}$ Maximum Input Voltage Semi Converter *(Volt)*
- $V_{m\text{-}dc(full)}$ Maximum DC Output Voltage Full Converter *(Volt)*
- $V_{out(first)}$ DC Output Voltage First Converter *(Volt)*
- $V_{out(second)}$ DC Output Voltage Second Converter *(Volt)*
- $V_{rms(3\Phi\text{-full})}$ RMS Output Voltage 3 Phase Full Converter *(Volt)*
- $V_{rms(3\Phi\text{-half})}$ RMS Output Voltage 3 Phase Half Converter *(Volt)*
- $V_{rms(3\Phi\text{-semi})}$ RMS Output Voltage 3 Phase Semi Converter *(Volt)*
- $V_{rms(full)}$ RMS Output Voltage Full Converter *(Volt)*
- $V_{rms(semi)}$ RMS Output Voltage Semi Converter *(Volt)*
- $V_{rms(thy)}$ RMS Voltage Thyristor Converter *(Volt)*
- $\alpha_{(3\Phi\text{-semi})}$ Delay Angle of 3 Phase Semi Converter *(Degree)*
- $\alpha_{(semi)}$ Delay Angle Semi Converter *(Degree)*
- $\alpha_{1(dual)}$ Delay Angle of First Converter *(Degree)*
- $\alpha_{2(dual)}$ Delay Angle of Second Converter *(Degree)*
- $\alpha_{d(3\Phi\text{-full})}$ Delay Angle of 3 Phase Full Converter *(Degree)*
- $\alpha_{d(3\Phi\text{-half})}$ Delay Angle of 3 Phase Half Converter *(Degree)*
- $\alpha_{d(thy)}$ Delay Angle of Thyristor Converter *(Degree)*

- α_{full} Firing Angle Full Converter *(Degree)*
- α_k Excitation Angle *(Degree)*
- β_k Symmetrical Angle *(Degree)*

Download other Important Converters PDFs

- Important Power Converter Characteristics Formulas

Try our Unique Visual Calculators

- Percentage decrease
- HCF of three numbers
- Multiply fraction

Please SHARE this PDF with someone who needs it!

This PDF can be downloaded in these languages

English Spanish French German Russian Italian Portuguese Polish Dutch

7/9/2024 | 5:13:33 AM UTC