Important Controlled Rectifiers Formulas PDF

Formulas
Examples
with Units

List of 14
Important Controlled Rectifiers Formulas

1) Full Wave Controlled Rectifiers Formulas

1.1) Average Output Current of Single Phase Full Wave Controlled Rectifier with R Load of FWD Formula

Evaluate Formula

Formula

$$I_{avg} = \frac{V_{i(max)}}{\pi \cdot R} \cdot \left(1 + \cos\left(\alpha_d\right)\right)$$

Example with Units

$$0.4782\,\text{A} = \frac{22\,\text{V}}{3.1416 \cdot 25\,\Omega} \cdot \left(1 + \cos\left(45°\right)\right)$$

1.2) Average Voltage of DC in Single Phase Full Wave Controlled Rectifier with R Load of FWD Formula

Evaluate Formula

Formula

$$V_{dc(full)} = \frac{V_{i(max)}}{\pi} \cdot \left(1 + \cos\left(\alpha_d\right)\right)$$

Example with Units

$$11.9546\,\text{V} = \frac{22\,\text{V}}{3.1416} \cdot \left(1 + \cos\left(45°\right)\right)$$

1.3) Average Voltage of Full Wave Thyristor Rectifier with RL Load (CCM) without FWD Formula

Evaluate Formula

Formula

$$V_{avg(full)} = \frac{2 \cdot V_{o(max)} \cdot \cos\left(\alpha_d\right)}{\pi}$$

Example with Units

$$9.4533\,\text{V} = \frac{2 \cdot 21\,\text{V} \cdot \cos\left(45°\right)}{3.1416}$$

1.4) RMS Output Current of Single Phase Full Wave Controlled Rectifier with R Load of FWD Formula

Evaluate Formula

Formula

$$I_{rms} = \frac{V_{i(max)}}{R} \cdot \sqrt{\frac{1}{2} - \frac{\alpha_r}{2 \cdot \pi} + \frac{\sin\left(2 \cdot \alpha_d\right)}{4 \cdot \pi}}$$

Example with Units

$$0.5876\,\text{A} = \frac{22\,\text{V}}{25\,\Omega} \cdot \sqrt{\frac{1}{2} - \frac{0.84\,\text{rad}}{2 \cdot 3.1416} + \frac{\sin\left(2 \cdot 45°\right)}{4 \cdot 3.1416}}$$

1.5) RMS Output Voltage of Single Phase Full Wave Controlled Rectifier with R Load of FWD Formula

Evaluate Formula

Formula

$$V_{rms(full)} = V_{i(max)} \cdot \sqrt{\frac{1}{2} - \frac{\alpha_r}{2 \cdot \pi} + \frac{\sin\left(2 \cdot \alpha_d\right)}{4 \cdot \pi}}$$

Example with Units

$$14.6905\,\text{V} = 22\,\text{V} \cdot \sqrt{\frac{1}{2} - \frac{0.84\,\text{rad}}{2 \cdot 3.1416} + \frac{\sin\left(2 \cdot 45°\right)}{4 \cdot 3.1416}}$$

1.6) RMS Voltage of Full Wave Thyristor Rectifier with R Load Formula

Evaluate Formula

Formula

$$V_{rms(full)} = \sqrt{\left(\left(0.5 \cdot \sin\left(2 \cdot \alpha_d\right)\right) + \pi - \alpha_r\right) \cdot \left(\frac{V_{o(max)}}{2 \cdot \pi}\right)^2}$$

Example with Units

$$14.0227\,\text{V} = \sqrt{\left(\left(0.5 \cdot \sin\left(2 \cdot 45°\right)\right) + 3.1416 - 0.84\,\text{rad}\right) \cdot \left(\frac{21\,\text{V}}{2 \cdot 3.1416}\right)^2}$$

1.7) RMS Voltage of Full Wave Thyristor Rectifier with RL Load (CCM) without FWD Formula

Evaluate Formula

Formula

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

Example with Units

$$14.8492\,\text{V} = \frac{21\,\text{V}}{\sqrt{2}}$$

2) Half Wave Controlled Rectifiers Formulas

2.1) Average Load Voltage of Half Wave Thyristor Rectifier with RLE Load Formula

Evaluate Formula

Formula

$$V_{L(half)} = \left(\frac{V_{o(max)}}{2 \cdot \pi}\right) \cdot \left(\cos\left(\alpha_d\right) + \cos\left(\beta_d\right)\right) + \left(\frac{E_b}{2}\right) \cdot \left(1 + \left(\frac{\theta_r + \alpha_r}{\pi}\right)\right)$$

Example with Units

$$15.7056\,\text{V} = \left(\frac{21\,\text{V}}{2 \cdot 3.1416}\right) \cdot \left(\cos\left(45°\right) + \cos\left(180°\right)\right) + \left(\frac{20\,\text{V}}{2}\right) \cdot \left(1 + \left(\frac{1.26\,\text{rad} + 0.84\,\text{rad}}{3.1416}\right)\right)$$

2.2) Average Output Voltage of Half Wave Controlled Rectifier with R Load Formula

Evaluate Formula

Formula

$$V_{avg(half)} = \frac{V_{i(max)}}{2 \cdot \pi} \cdot \left(1 + \cos\left(\alpha_d\right)\right)$$

Example with Units

$$5.9773\,\text{V} = \frac{22\,\text{V}}{2 \cdot 3.1416} \cdot \left(1 + \cos\left(45°\right)\right)$$

2.3) Average Voltage of Half Wave Thyristor Rectifier with RL Load Formula

Evaluate Formula

Formula

$$V_{avg(half)} = \left(\frac{V_{o(max)}}{2 \cdot \pi}\right) \cdot \left(\cos\left(\alpha_d\right) - \cos\left(\beta_d\right)\right)$$

Example with Units

$$5.7056\,\text{V} = \left(\frac{21\,\text{V}}{2 \cdot 3.1416}\right) \cdot \left(\cos\left(45°\right) - \cos\left(180°\right)\right)$$

2.4) Form Factor of Half Wave Thyristor Rectifier with R Load Formula

Evaluate Formula

Formula

$$FF = \frac{\left(\frac{1}{\pi} \cdot \left(\left(\pi - \alpha_r\right) + \frac{\sin\left(2 \cdot \alpha_d\right)}{2}\right)\right)^{\frac{1}{2}}}{\frac{1}{\pi} \cdot \left(1 + \cos\left(\alpha_d\right)\right)}$$

Example with Units

$$1.7379 = \frac{\left(\frac{1}{3.1416} \cdot \left(\left(3.1416 - 0.84\,\text{rad}\right) + \frac{\sin\left(2 \cdot 45°\right)}{2}\right)\right)^{\frac{1}{2}}}{\frac{1}{3.1416} \cdot \left(1 + \cos\left(45°\right)\right)}$$

2.5) RMS Output Voltage of Half Wave Thyristor Rectifier with R Load Formula

Evaluate Formula

Formula

$$V_{rms(half)} = \frac{V_{o(max)} \cdot \sqrt{\pi - \alpha_r + \left(0.5 \cdot \sin\left(2 \cdot \alpha_d\right)\right)}}{2 \cdot \sqrt{\pi}}$$

Example with Units

$$9.9156\,\text{V} = \frac{21\,\text{V} \cdot \sqrt{3.1416 - 0.84\,\text{rad} + \left(0.5 \cdot \sin\left(2 \cdot 45°\right)\right)}}{2 \cdot \sqrt{3.1416}}$$

2.6) Turn On Angle of Half Wave Rectifier Formula

Evaluate Formula

Formula

$$\theta_r = asin\left(\frac{E_L}{V_{i(max)}}\right)$$

Example with Units

$$1.2681\,\text{rad} = asin\left(\frac{21\,\text{V}}{22\,\text{V}}\right)$$

2.7) Voltage Ripple Factor of Half Wave Thyristor Rectifier with R Load Formula

Evaluate Formula

Formula

$$RF = \sqrt{FF^2 - 1}$$

Example

$$1.3748 = \sqrt{1.7^2 - 1}$$

Variables used in list of Controlled Rectifiers Formulas above

- E_b Back EMF *(Volt)*
- E_L Load EMF *(Volt)*
- **FF** Form Factor
- I_{avg} Average Output Current *(Ampere)*
- I_{rms} RMS Current *(Ampere)*
- **R** Resistance *(Ohm)*
- **RF** Ripple Factor
- $V_{avg(full)}$ Average Output Voltage in Full Wave *(Volt)*
- $V_{avg(half)}$ Average Output Voltage in Half Wave *(Volt)*
- $V_{dc(full)}$ Average DC Voltage in Full Wave *(Volt)*
- $V_{i(max)}$ Peak Input Voltage *(Volt)*
- $V_{L(half)}$ Average Load Voltage in Half Wave *(Volt)*
- $V_{o(max)}$ Maximum Output Voltage *(Volt)*
- $V_{rms(full)}$ RMS Voltage in Full Wave *(Volt)*
- $V_{rms(half)}$ RMS Voltage in Half Wave *(Volt)*
- α_d Trigger Angle in Degree *(Degree)*
- α_r Trigger Angle in Radians *(Radian)*
- β_d Extinction Angle *(Degree)*
- θ_r Diode Turn On Angle Radians *(Radian)*

Constants, Functions, Measurements used in list of Controlled Rectifiers Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **asin**, asin(Number) *The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.*
- 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.*
- Measurement: **Electric Current** in Ampere (A) *Electric Current Unit Conversion*
- Measurement: **Angle** in Degree (°), Radian (rad) *Angle Unit Conversion*
- Measurement: **Electric Resistance** in Ohm (Ω) *Electric Resistance Unit Conversion*
- Measurement: **Electric Potential** in Volt (V) *Electric Potential Unit Conversion*

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