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Controlled Rectifiers Formulas

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List of 14 Controlled Rectifiers Formulas

Controlled Rectifiers

Full Wave Controlled Rectifiers

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

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

$$\text{ex } 0.478182\text{A} = \frac{22\text{V}}{\pi \cdot 25\Omega} \cdot (1 + \cos(45^\circ))$$

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

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

$$\text{ex } 11.95456\text{V} = \frac{22\text{V}}{\pi} \cdot (1 + \cos(45^\circ))$$


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

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

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d_img.jpg\)](#)

$$\text{ex } 9.453321\text{V} = \frac{2 \cdot 21\text{V} \cdot \cos(45^\circ)}{\pi}$$



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

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

Open Calculator 


$$\text{ex } 0.587618\text{A} = \frac{22\text{V}}{25\Omega} \cdot \sqrt{\frac{1}{2} - \frac{0.84\text{rad}}{2 \cdot \pi} + \frac{\sin(2 \cdot 45^\circ)}{4 \cdot \pi}}$$

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

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

Open Calculator 

$$\text{ex } 14.69045\text{V} = 22\text{V} \cdot \sqrt{\frac{1}{2} - \frac{0.84\text{rad}}{2 \cdot \pi} + \frac{\sin(2 \cdot 45^\circ)}{4 \cdot \pi}}$$

6) RMS Voltage of Full Wave Thyristor Rectifier with R Load 

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

Open Calculator 

$$\text{ex } 14.02271\text{V} = \sqrt{((0.5 \cdot \sin(2 \cdot 45^\circ)) + \pi - 0.84\text{rad}) \cdot \left(\frac{(21\text{V})^2}{2 \cdot \pi}\right)}$$

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

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

Open Calculator 

$$\text{ex } 14.84924\text{V} = \frac{21\text{V}}{\sqrt{2}}$$



Half Wave Controlled Rectifiers

8) Average Load Voltage of Half Wave Thyristor Rectifier with RLE Load

fx

Open Calculator 

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

ex

$$15.70558\text{V} = \left(\frac{21\text{V}}{2 \cdot \pi} \right) \cdot (\cos(45^\circ) + \cos(180^\circ)) + \left(\frac{20\text{V}}{2} \right) \cdot \left(1 + \left(\frac{1.26\text{rad} + 0.84\text{rad}}{\pi} \right) \right)$$

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

fx

Open Calculator 

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

ex

$$5.977279\text{V} = \frac{22\text{V}}{2 \cdot \pi} \cdot (1 + \cos(45^\circ))$$

10) Average Voltage of Half Wave Thyristor Rectifier with RL Load

fx

Open Calculator 

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

ex

$$5.705584\text{V} = \left(\frac{21\text{V}}{2 \cdot \pi} \right) \cdot (\cos(45^\circ) - \cos(180^\circ))$$

11) Form Factor of Half Wave Thyristor Rectifier with R Load

fx


Open Calculator 

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

ex

$$1.737868 = \frac{\left(\frac{1}{\pi} \cdot \left((\pi - 0.84\text{rad}) + \frac{\sin(2 \cdot 45^\circ)}{2} \right) \right)^{\frac{1}{2}}}{\frac{1}{\pi} \cdot (1 + \cos(45^\circ))}$$




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

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

Open Calculator 

$$\text{ex } 9.915551\text{V} = \frac{21\text{V} \cdot \sqrt{\pi - 0.84\text{rad} + (0.5 \cdot \sin(2 \cdot 45^\circ))}}{2 \cdot \sqrt{\pi}}$$

13) Turn On Angle of Half Wave Rectifier 

$$\text{fx } \theta_r = a \sin\left(\frac{E_L}{V_{\text{i(max)}}}\right)$$

Open Calculator 

$$\text{ex } 1.268131\text{rad} = a \sin\left(\frac{21\text{V}}{22\text{V}}\right)$$

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

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

Open Calculator 

$$\text{ex } 1.374773 = \sqrt{(1.7)^2 - 1}$$







Variables Used

- 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

- **Constant:** π , 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **asin**, asin(Number)
Inverse trigonometric sine function
- **Function:** **cos**, cos(Angle)
Trigonometric cosine function
- **Function:** **sin**, sin(Angle)
Trigonometric sine function
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Measurement:** **Electric Current** in Ampere (A)
Electric Current Unit Conversion 
- **Measurement:** **Angle** in Degree ($^{\circ}$), 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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