# Rectifier Tables

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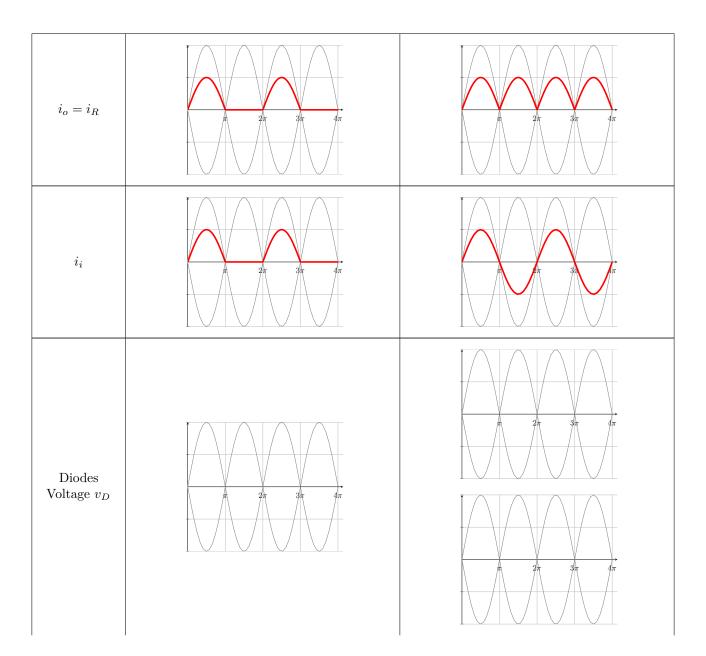
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#### 1 Rectifier Tables

- 1. Monophasic Uncontrolled Rectifiers with R load
- 2. Monophasic Uncontrolled Full Wave Rectifier loads
- 3. Monophasic Controlled Full Wave Rectifier, R vs RL load
- 4. Triphasic Uncontrolled Rectifiers with R load
- 5. Triphasic Controlled Half Wave Rectifier, R vs RL load
- 6. Triphasic Controlled Full Wave Rectifier, R vs RL load

## 1.1 Monophasic Uncontrolled Rectifiers with R load

What	Half Wave Rectifier	Full Wave Rectifier
Circuit Diagram	$v_i \bigodot v_o \gtrless R$	$D1 \times D2 \times $ $v_i \Leftrightarrow D3 \times D4 \times$
$v_i > 0$ equivalent	$i_i$ $v_i \bigotimes v_o \bigotimes R$	
$v_i < 0$ equivalent	$v_i \bigotimes v_o \geqslant R$	
Diode table		
$v_o$	$\frac{1}{2\pi}$ $\frac{3\pi}{4\pi}$	$\frac{1}{2\pi}$ $\frac{3\pi}{4\pi}$
$ar{v_o}$	$\bar{v_o} = \frac{V_{ip}}{\pi}$	$ar{v_o} = rac{2V_{ip}}{\pi}$



#### 1.2 Monophasic Uncontrolled Full Wave Rectifier loads

What	R load	RC load	RLC load
Circuit Diagram			
$v_o$		$\frac{1}{2\pi}$ $\frac{3\pi}{4\pi}$	2\pi 3\pi 4\pi
$v_R$	$2\pi$ $3\pi$ $4\pi$	27 37 4n	27 37 4n
_	_ 2	1.	_ 2,,
$v_R^-$	$\bar{v_R} = \frac{2}{\pi} V_{ip}$	$\bar{v_R} = V_{ip} - \frac{1}{2}\Delta v_R$	$\bar{v_R} = \frac{2}{\pi} V_{ip}$
$v_R$ $v_R$ ripple	$v_R = \frac{1}{\pi}V_{ip}$ Not considered	$v_R = V_{ip} - \frac{1}{2}\Delta v_R$ Triangular approximation $\Delta v_R = \frac{V_{ip}T}{2RC}$	$v_R = \frac{1}{\pi} V_{ip}$ Considering only 1st harmonic $\Delta v_R = HV$
		Triangular approximation	Considering only 1st harmonic

$i_i$		27 37 4n	27 37 4n
$i_{D1}$	2\pi 3\pi 4\pi	$2\pi$ $3\pi$ $4\pi$	$2\pi$ $3\pi$ $4\pi$
$i_{D3}$	27 3A 4π	27 37 4n	$2\pi$ $3\pi$ $4\pi$
$i_C$	No capacitor	2\pi 3\pi 4\pi	2\pi 3\pi 4\pi

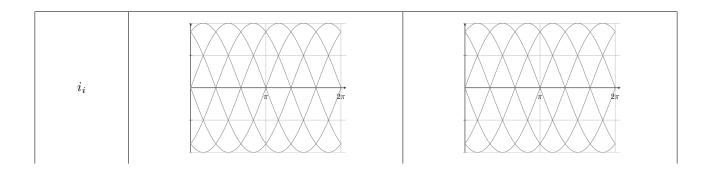
## 1.3 Monophasic Controlled Full Wave Rectifier, R vs RL load

What	Controlled FWR R load	Controlled FWR RL load
Circuit Diagram	$T1$ $T2$ $v_i$ $v_i$ $T3$ $T4$	T1 T2 T2
$v_o$	27 37 47	A 21 31 4π
$ar{v_o}(lpha)$	$\bar{v_o} = \frac{V_i}{\pi} (\cos{(\alpha)} + 1)$	$\bar{v_o} = \frac{2V_i}{\pi} \cos\left(\alpha\right)$
$v_R$	$\frac{1}{2\pi}$ $\frac{3\pi}{4\pi}$	$\frac{1}{2\pi}$ $3\pi$ $4\pi$
Thyristor table		
$i_o(t)$	2 3 3 4 4 T	3/m 3/m 4/m
$ar{i_o}$	$\bar{i_o} = \frac{\bar{v_o}}{R} = \frac{\frac{V_i}{\pi}(\cos(\alpha) + 1)}{R}$	$\bar{i_o} = \frac{\bar{v_o}}{R} = \frac{\frac{2V_i}{\pi}\cos(\alpha)}{R}$

$i_i(t)$	$3\pi$ $3\pi$	2π 3π 4π
$v_{T1}(t)$	$2\pi$ $3\pi$ $4\pi$	$\frac{1}{2\pi}$ $\frac{3\pi}{4\pi}$
Power		$P = V_{1 \text{ RMS}} I_{1 \text{ RMS}} \cos(\varphi_{1})$ $P = V_{ip} I_{o} \frac{2\sqrt{2}}{\pi} \cos(\alpha)$
Apparent Power		$S = V_{\mathrm{RMS}} I_{\mathrm{RMS}}$ $S = \frac{V_{ip}}{\sqrt{2}} I_o$
Power factor		$PF = \frac{2\sqrt{2}}{\pi}\cos\left(\alpha\right)$

## 1.4 Triphasic Uncontrolled Rectifiers with R load

What	$3\Phi$ Half Wave Rectifier	$3\Phi$ Full Wave Rectifier
Circuit Diagram	$\begin{array}{c c} v_i & i_i \\ \hline v_i & i_i \\ \hline \hline v_i & i_i \\ \hline \hline \end{array} \qquad \begin{array}{c c} v_i & i_i \\ \hline \end{array}$	$D1 \times D2 \times D3 \times$ $v_i  i_i  v_i  i_i  v_i  i_i  v_i  i_i  v_i  i_i  v_i  i_i  v_i  v_i $
$v_o$	27	27
Peaks/period	3  peaks/period	3 peaks/period
Period	$\frac{2\pi}{3}$	$\frac{2\pi}{6} = \frac{\pi}{3}$
Integration limits	$\frac{\pi}{6}, \frac{5\pi}{6}$	$\frac{\pi}{3}, \frac{2\pi}{3}$
Load Voltage	Phase Voltage	Line Voltage
	I	
$ar{v_o}$	$\bar{v_o} = \frac{1}{\frac{2\pi}{3}} \int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} V_{PN} \sin\left(\theta\right) d\theta$ $\bar{v_o} = \frac{3V_{PN}}{2\pi} \left[-\cos\left(\theta\right)\right]_{\frac{\pi}{6}}^{\frac{5\pi}{6}}$ $\bar{v_o} = \frac{3\sqrt{3}}{2\pi} V_{PN}$	$\bar{v_o} = \frac{1}{\frac{\pi}{3}} \int_{\frac{\pi}{3}}^{\frac{2\pi}{3}} V_{LL} \sin(\theta) d\theta$ $\bar{v_o} = \frac{3V_{LL}}{\pi} \left[ -\cos(\theta) \right]_{\frac{3\pi}{3}}^{\frac{2\pi}{3}}$ $\bar{v_o} = \frac{3}{\pi} V_{LL}$
$ar{v_o}$ Diode table	$\bar{v_o} = \frac{3V_{PN}}{2\pi} \left[ -\cos\left(\theta\right) \right]_{\frac{\pi}{6}}^{\frac{5\pi}{6}}$	$\bar{v_o} = \frac{3V_{LL}}{\pi} \left[ -\cos\left(\theta\right) \right]_{\frac{\pi}{3}}^{\frac{2\pi}{3}}$



#### 1.5 Triphasic Controlled Half Wave Rectifier, R vs RL load

What	$3\Phi$ Controlled HWR R load	3Φ Controlled HWR RL load
Circuit Diagram		
$v_o$	φ	27
$v_R$	27	27
Peaks/period	3 peaks/period	3 peaks/period
Period		
Integration limits		
Load Voltage		
$ar{v_o}(lpha)$		$\bar{v_o} = \frac{1}{\frac{2\pi}{3}} \int_{\frac{\pi}{6} + \alpha}^{\frac{5\pi}{6} + \alpha} V_{PN} \sin(\theta) d\theta$ $\bar{v_o} = \frac{3V_{PN}}{2\pi} [-\cos(\theta)]_{\frac{\pi}{6} + \alpha}^{\frac{5\pi}{6} + \alpha}$ $\bar{v_o} = \frac{3\sqrt{3}}{2\pi} V_{PN} \cos(\alpha)$
Thyristor table		

$i_o$	27	27
$i_i$	φ 1 2 π	27

#### 1.6 Triphasic Controlled Full Wave Rectifier, R vs RL load

What	$3\Phi$ Controlled FWR R load	$3\Phi$ Controlled FWR RL load
Circuit Diagram	$ \begin{array}{c} T1 \\ v_i \\ i_i \\ v_i \\ i_i \\ v_i \\ i_i \end{array} $	$T1$ $v_{i}$
$v_o$	27	2π
$v_R$	27	27
Peaks/period	6 peaks/period	6 peaks/period
Period		
Integration limits		$\frac{\pi}{3} + \alpha, \frac{2\pi}{3} + \alpha$
Load Voltage		
		$1 \int_{-3}^{2\pi} + \alpha$
$ar{v_o}(lpha)$		$\bar{v_o} = \frac{1}{\frac{\pi}{3}} \int_{\frac{\pi}{3} + \alpha}^{\frac{2\pi}{3} + \alpha} V_{LL} \sin(\theta) d\theta$ $\bar{v_o} = \frac{3V_{LL}}{\pi} \left[ -\cos(\theta) \right]_{\frac{\pi}{3} + \alpha}^{\frac{2\pi}{3} + \alpha}$ $\bar{v_o} = \frac{3}{\pi} V_{LL} \cos(\alpha)$

$i_o$	27	277
$i_i$	2π	27