Rectifier Tables

Diego Trapero

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1 Rectifier Tables

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3. Monophasic Controlled Full Wave Rectifier, R vs RL load
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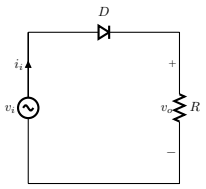
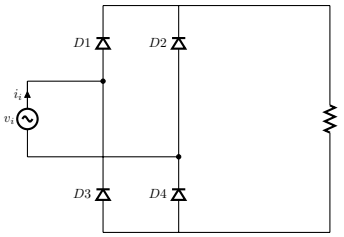
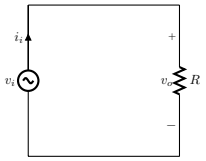
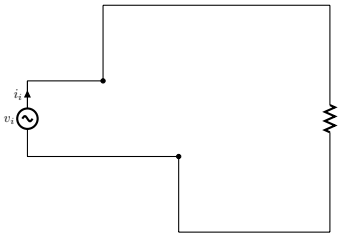
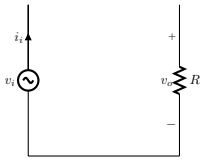
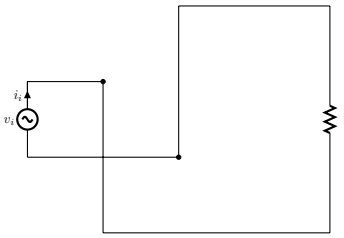
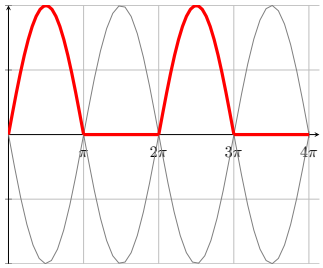
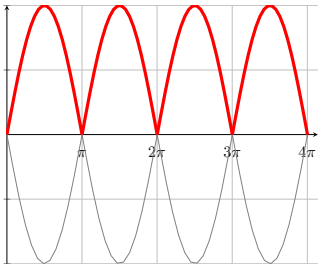
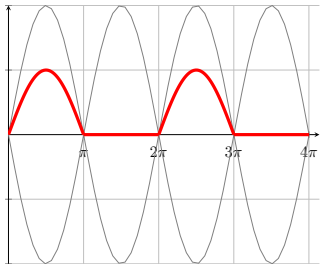
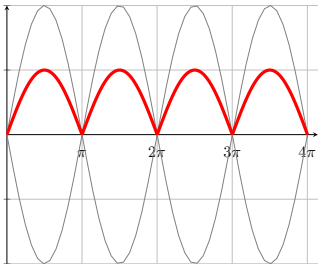
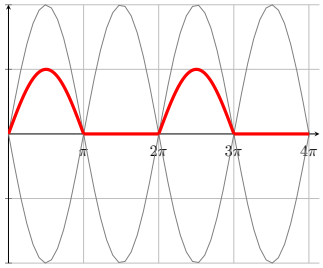
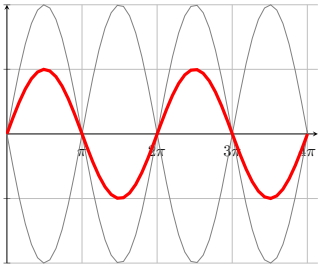
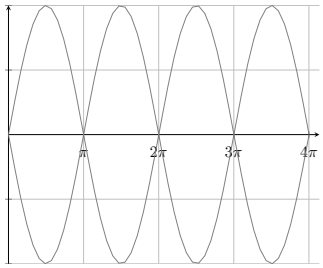
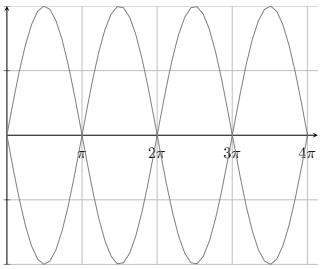
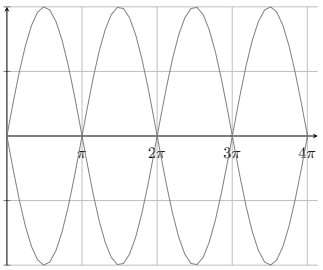
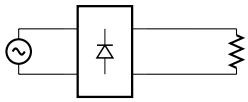
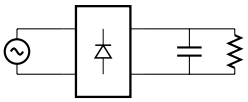
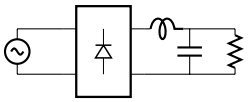
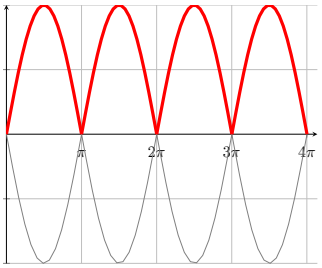
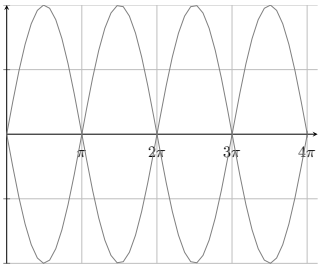
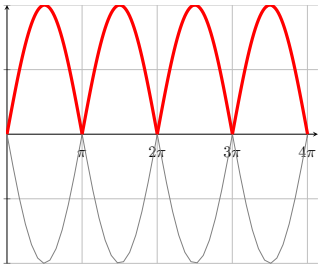
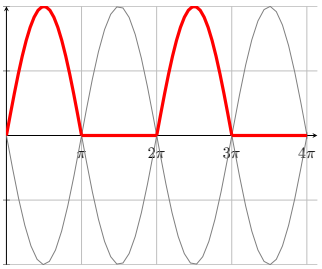
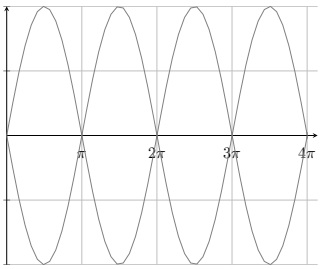
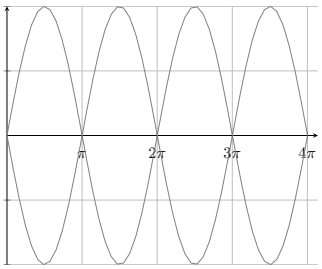
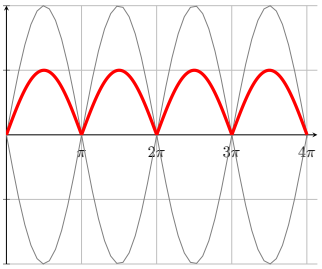
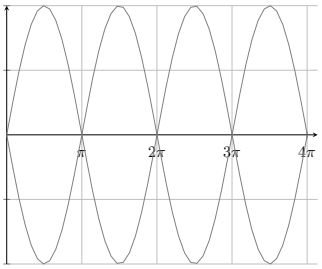
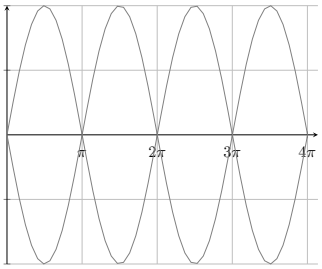
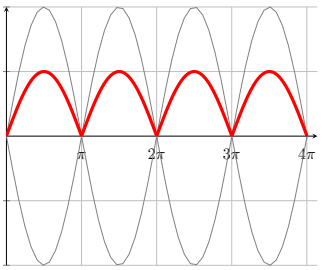
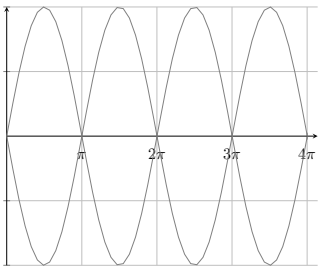
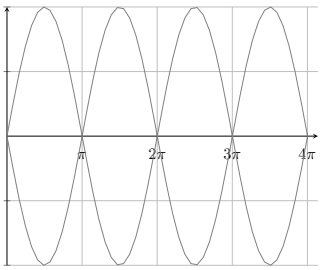
6. Triphasic Controlled Full Wave Rectifier, R vs RL load

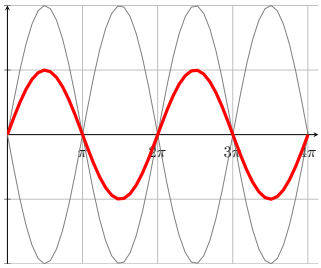
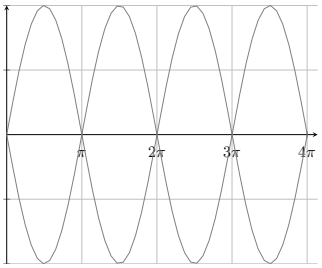
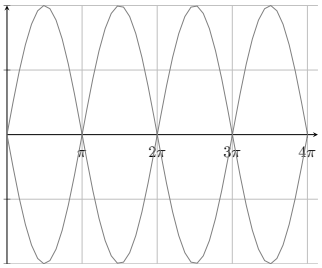
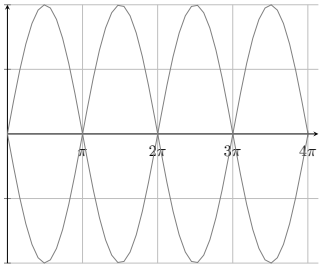
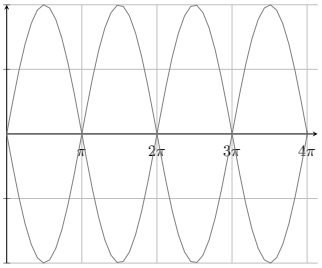
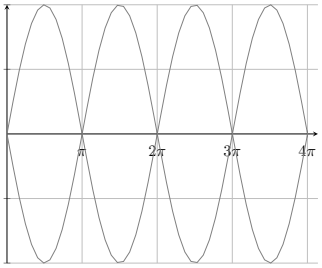
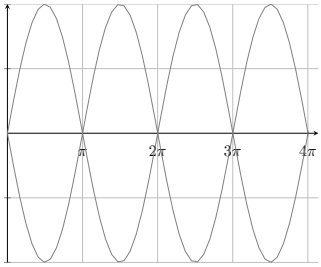
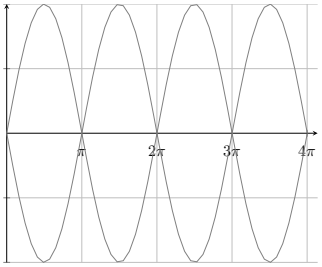
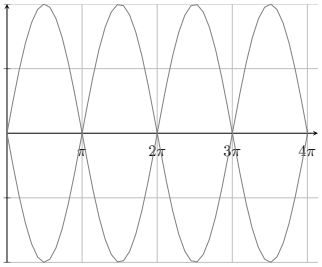
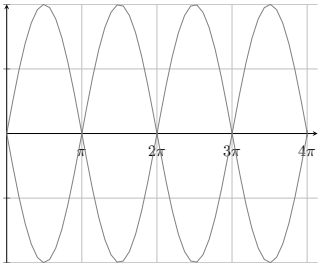
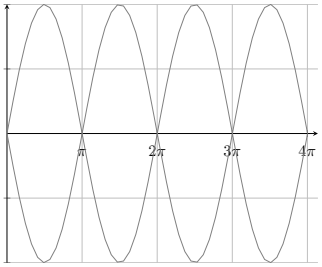
1.1 Monophasic Uncontrolled Rectifiers with R load

What	Half Wave Rectifier	Full Wave Rectifier
Circuit Diagram		
$v_i > 0$ equivalent		
$v_i < 0$ equivalent		
Diode table		
v_o		
$\bar{v_o}$	$\bar{v_o} = \frac{V_{ip}}{\pi}$	$\bar{v_o} = \frac{2V_{ip}}{\pi}$

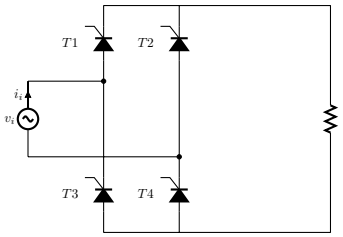
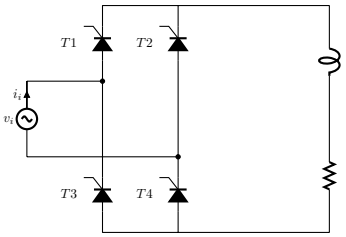
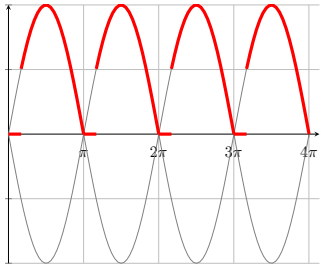
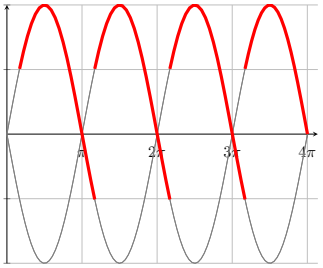
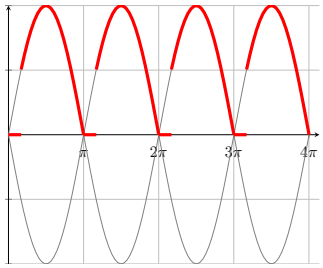
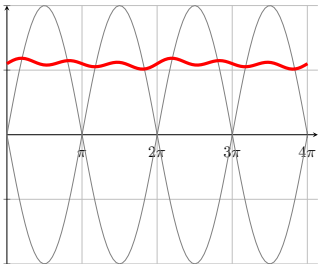
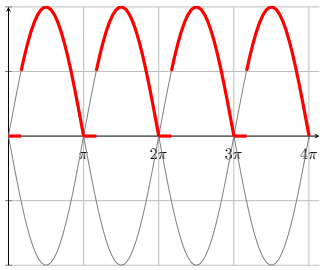
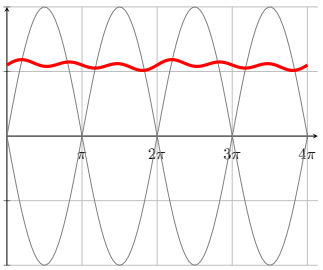
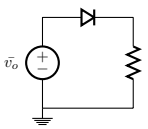
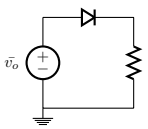
$i_o = i_R$		
i_i		
Diodes Voltage v_D		 

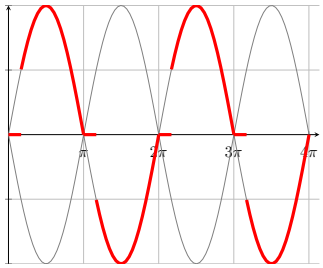
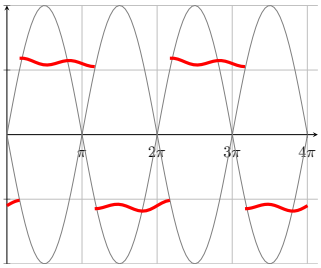
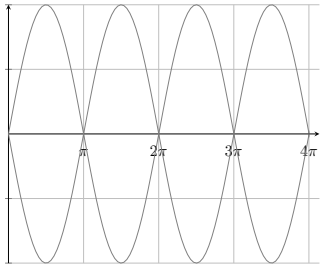
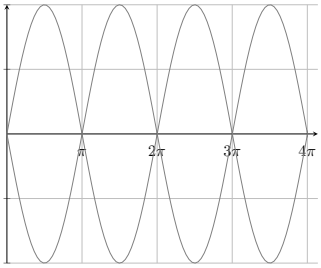
1.2 Monophasic Uncontrolled Full Wave Rectifier loads

What	R load	RC load	RLC load
Circuit Diagram			
v_o			
v_R			
$\bar{v_R}$	$\bar{v_R} = \frac{2}{\pi} V_{ip}$	$\bar{v_R} = V_{ip} - \frac{1}{2}\Delta v_R$	$\bar{v_R} = \frac{2}{\pi} V_{ip}$
v_R ripple	Not considered	Triangular approximation $\Delta v_R = \frac{V_{ip} T}{2RC}$	Considering only 1st harmonic $\Delta v_R = HV$
i_R			
i_o			

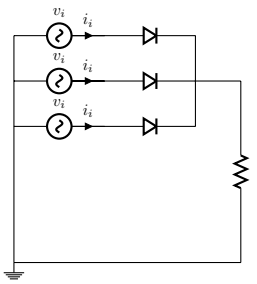
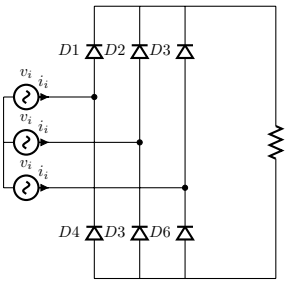
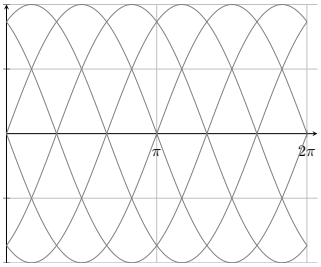
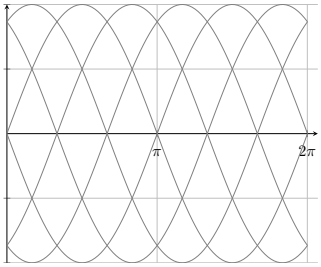
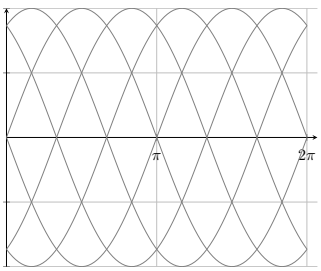
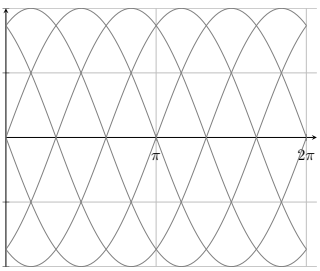
i_i			
i_{D1}			
i_{D3}			
i_C	No capacitor		

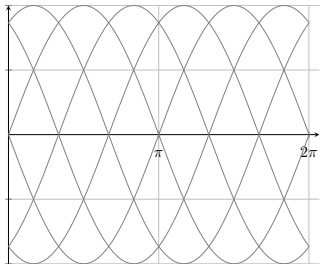
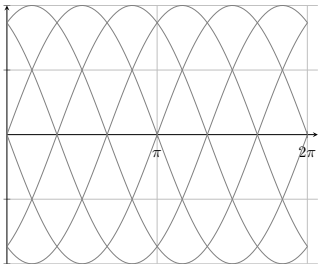
1.3 Monophasic Controlled Full Wave Rectifier, R vs RL load

What	Controlled FWR R load	Controlled FWR RL load
Circuit Diagram		
v_o		
$\bar{v_o}(\alpha)$	$\bar{v_o} = \frac{V_i}{\pi}(\cos(\alpha) + 1)$	$\bar{v_o} = \frac{2V_i}{\pi}\cos(\alpha)$
v_R		
Thyristor table		
$i_o(t)$		
$\bar{i_o}$	 $\bar{i_o} = \frac{\bar{v_o}}{R} = \frac{\frac{V_i}{\pi}(\cos(\alpha) + 1)}{R}$	 $\bar{i_o} = \frac{\bar{v_o}}{R} = \frac{\frac{2V_i}{\pi}\cos(\alpha)}{R}$

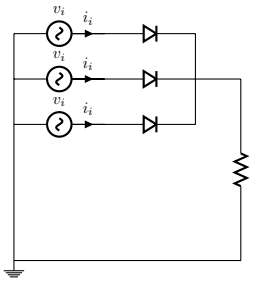
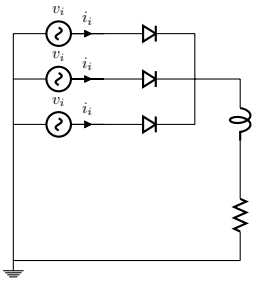
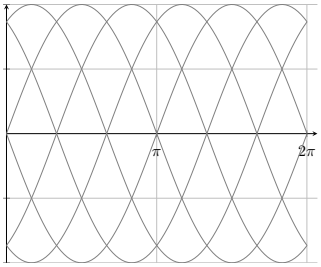
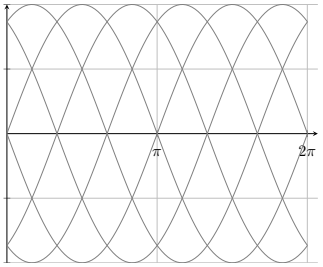
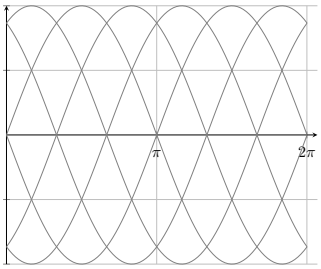
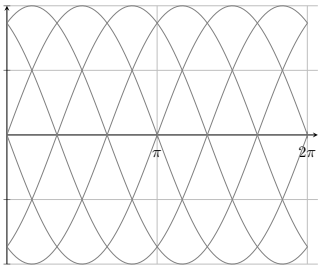
$i_i(t)$		
$v_{T1}(t)$		
Power		$P = V_{1\ \mathrm{RMS}} I_{1\ \mathrm{RMS}} \cos(\varphi_1)$ $P = V_{ip} I_o \frac{2\sqrt{2}}{\pi} \cos(\alpha)$
Apparent Power		$S = V_{\mathrm{RMS}} I_{\mathrm{RMS}}$ $S = \frac{V_{ip}}{\sqrt{2}} I_o$
Power factor		$\mathrm{PF} = \frac{2\sqrt{2}}{\pi} \cos(\alpha)$

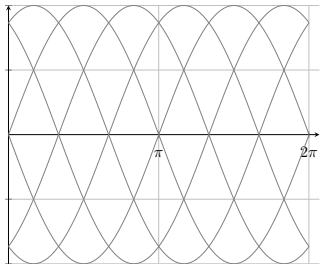
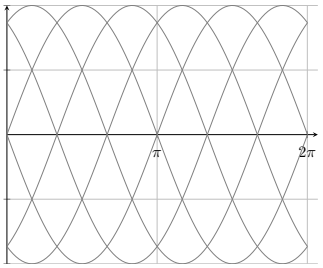
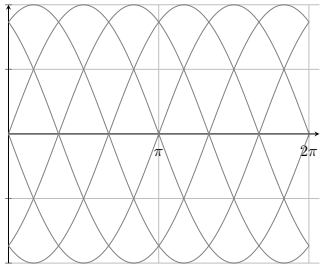
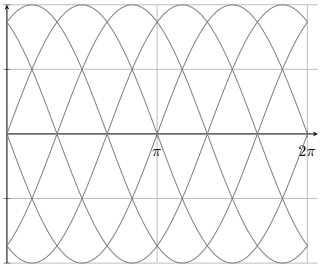
1.4 Triphasic Uncontrolled Rectifiers with R load

What	3Φ Half Wave Rectifier	3Φ Full Wave Rectifier
Circuit Diagram		
v_o		
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
$\bar{v_o}$	$\bar{v_o} = \frac{1}{\frac{2\pi}{3}} \int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} V_{PN} \sin(\theta)\, d\theta$ $\bar{v_o} = \frac{3V_{PN}}{2\pi}[-\cos(\theta)]_{\frac{\pi}{6}}^{\frac{5\pi}{6}}$ $\bar{v_o} = \frac{3\sqrt{3}}{2\pi} V_{PN}$	$\bar{v_o} = \frac{1}{\frac{\pi}{3}} \int_{\frac{\pi}{3}}^{\frac{2\pi}{3}} V_{LL} \sin(\theta)\, d\theta$ $\bar{v_o} = \frac{3V_{LL}}{\pi}[-\cos(\theta)]_{\frac{\pi}{3}}^{\frac{2\pi}{3}}$ $\bar{v_o} = \frac{3}{\pi} V_{LL}$
Diode table		
i_o		

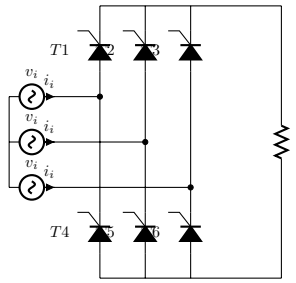
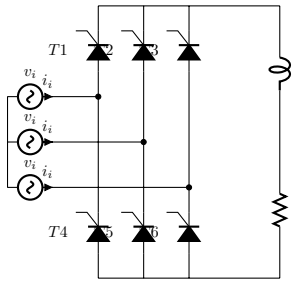
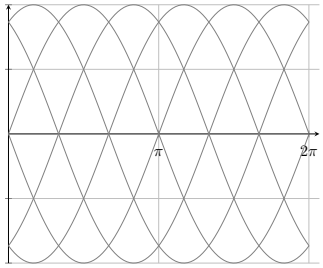
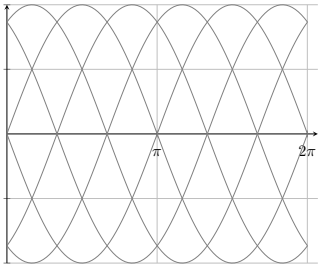
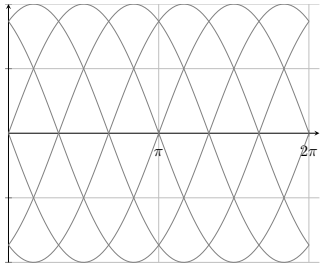
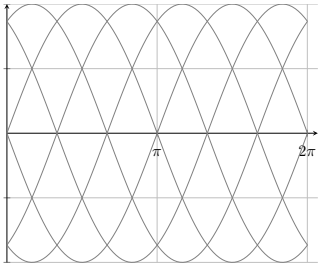
i_i		

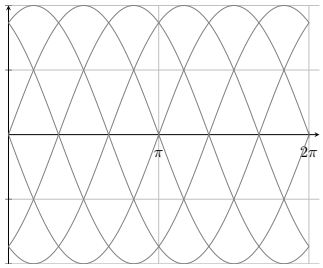
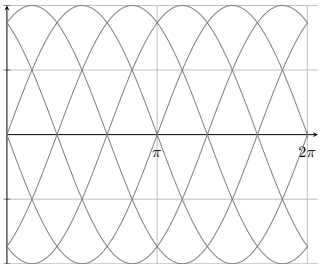
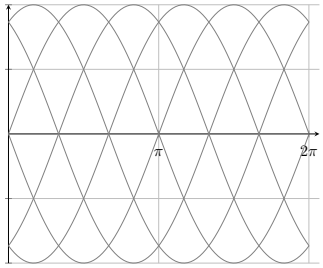
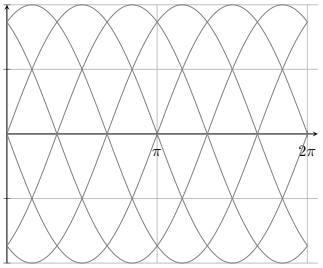
1.5 Triphasic Controlled Half Wave Rectifier, R vs RL load

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

i_o		
i_i		

1.6 Triphasic Controlled Full Wave Rectifier, R vs RL load

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

i_o		
i_i