EE-463 STATIC POWER CONVERSION-I

3-Phase Diode Rectifiers

Ozan Keysan

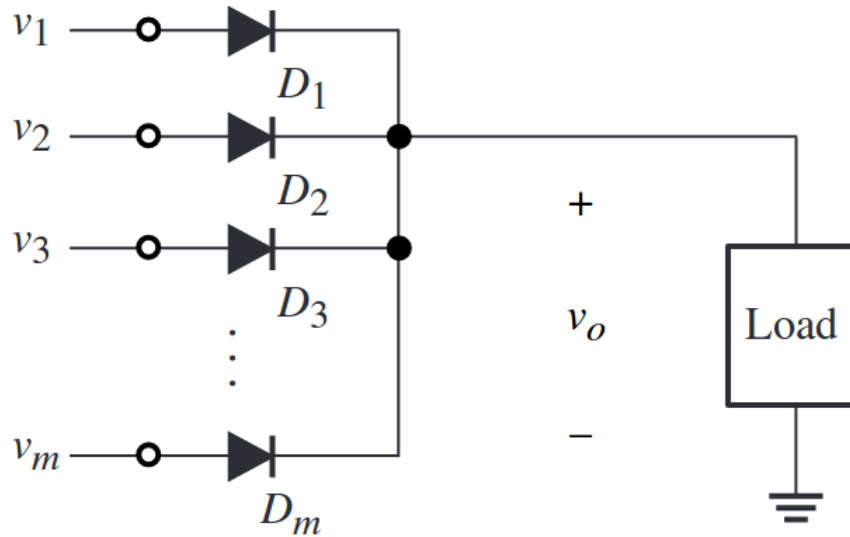keysan.me

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3-Phase Half Wave Rectifier

3-Phase Half Wave Rectifier
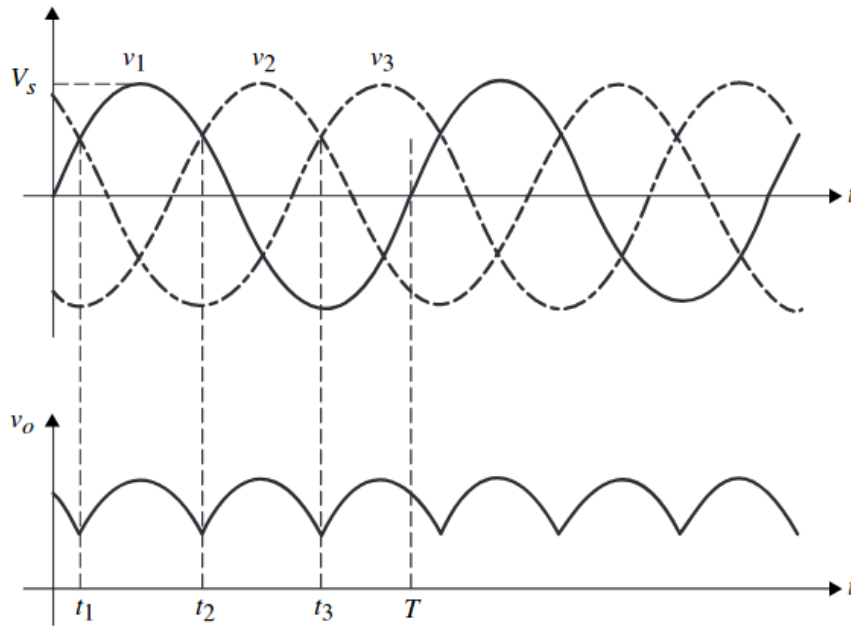
N-Phase Generalized Form

3-Phase Half Wave Rectifier
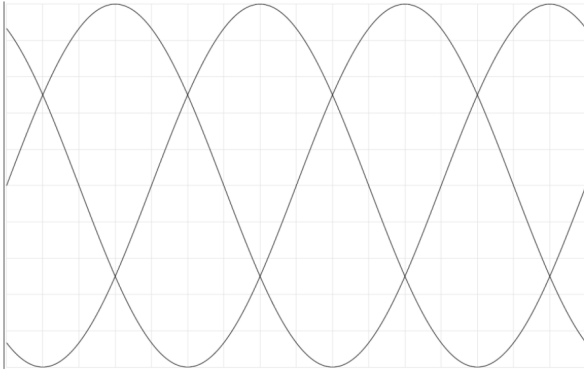
N-Phase Generalized Form

3-Phase Half Wave Rectifier

Voltage Waveforms

3-Phase Half Wave Rectifier

3-Phase Half Wave Rectifier

Average Voltage?

$$V_{dc} = \frac{3\sqrt{6}}{2\pi} V_{rms}$$

3-Phase Half Wave Rectifier

Average Voltage?

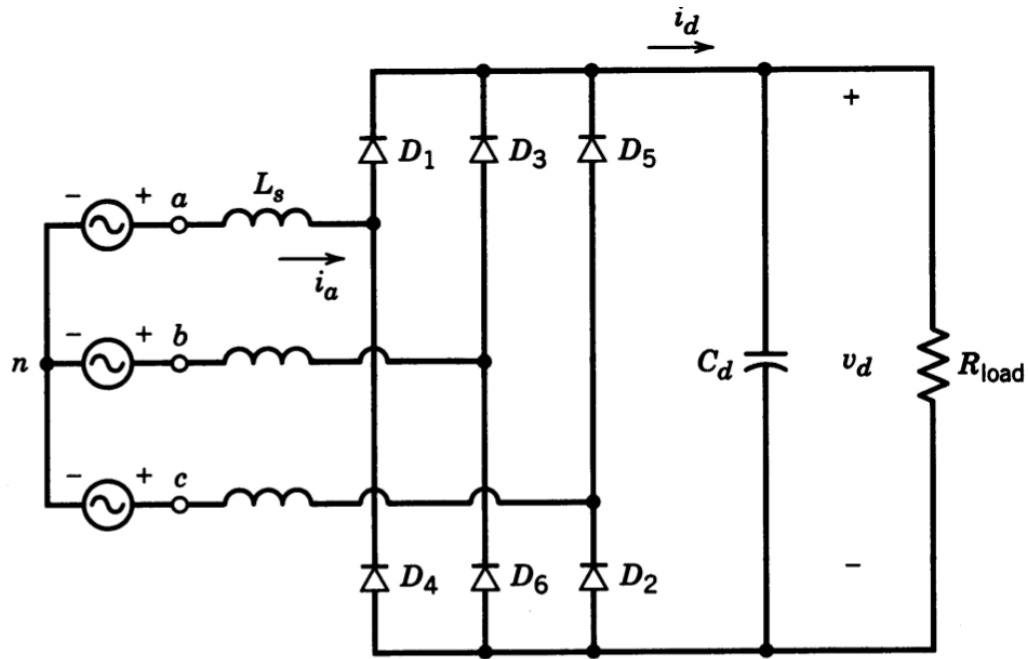$$V_{dc} = \frac{3\sqrt{6}}{2\pi} V_{rms}$$

Comparison with the single phase rectifier?

3-Phase Full Wave (Bridge) Rectifier

3-Phase Full Wave (Bridge) Rectifier

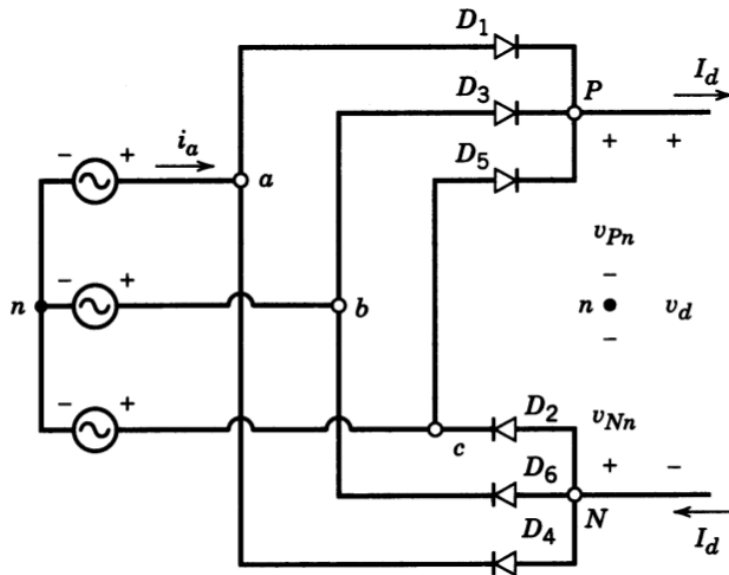# 3-Phase Full Wave (Bridge) Rectifier

3-Phase Full Wave (Bridge) Rectifier

Ignore Ls and redraw

3-Phase Full Wave (Bridge) Rectifier
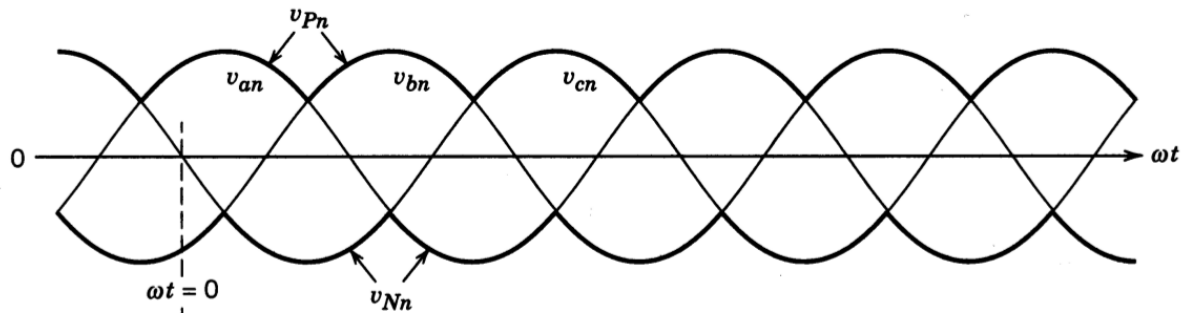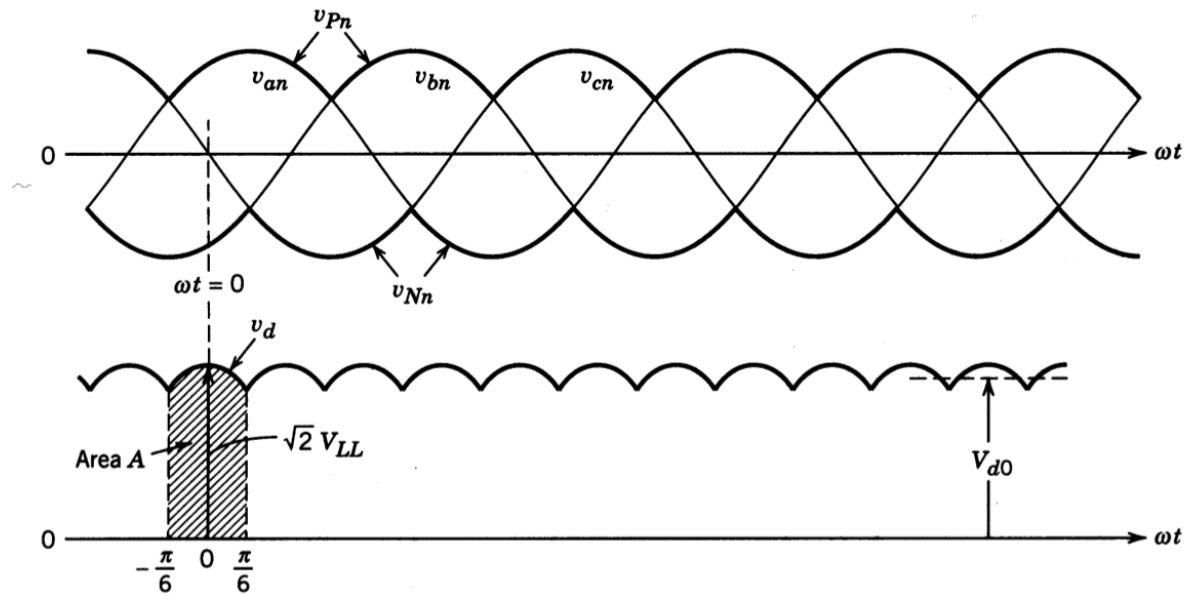
Ignore Ls and redraw

3-Phase Full Wave (Bridge) Rectifier

Can you draw the voltage and current waveforms?

3-Phase Full Wave (Bridge) Rectifier

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3-Phase Full Wave (Bridge) Rectifier

Average voltage?

3-Phase Full Wave (Bridge) Rectifier

Average voltage?: Twice of the half wave rectifier

$$V_{dc} = \frac{3\sqrt{6}}{\pi} V_{ph}$$

or

3-Phase Full Wave (Bridge) Rectifier

Average voltage?: Twice of the half wave rectifier
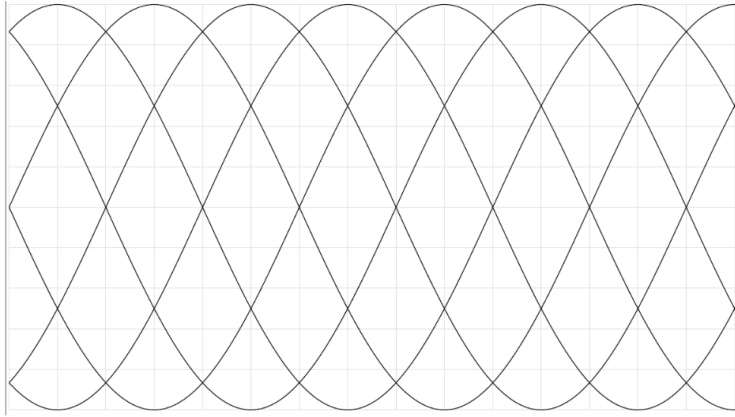
$$V_{dc} = \frac{3\sqrt{6}}{\pi} V_{ph}$$

or

$$V_{dc} = \frac{3\sqrt{2}}{\pi} V_{l-l} = 1.35 V_{l-l}$$

=540 Vdc for a 400 V grid

3-Phase Full Wave (Bridge) Rectifier
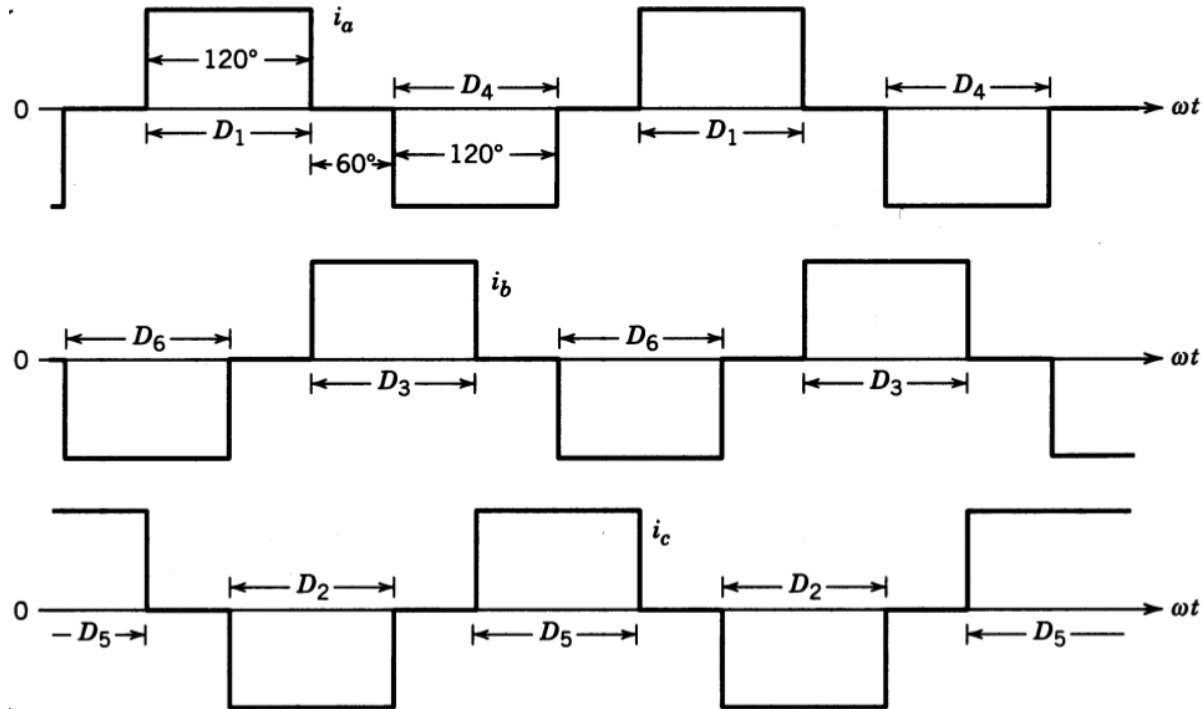
Output voltage waveforms

3-Phase Full Wave (Bridge) Rectifier

Output voltage waveforms

What about the current waveforms?
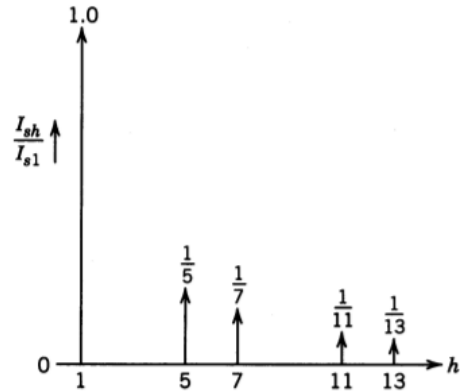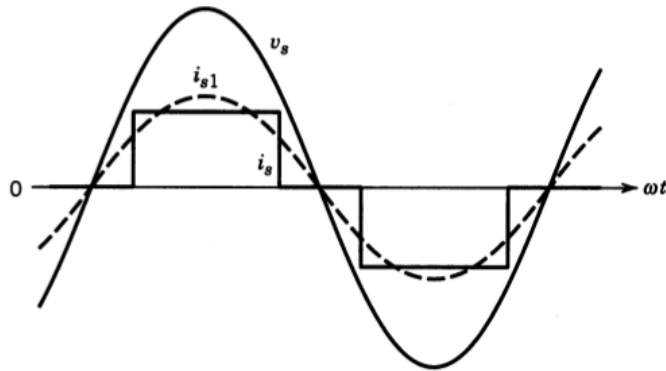
What about the current waveforms?

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What are the differences wrt single phase?

What about the current waveforms?

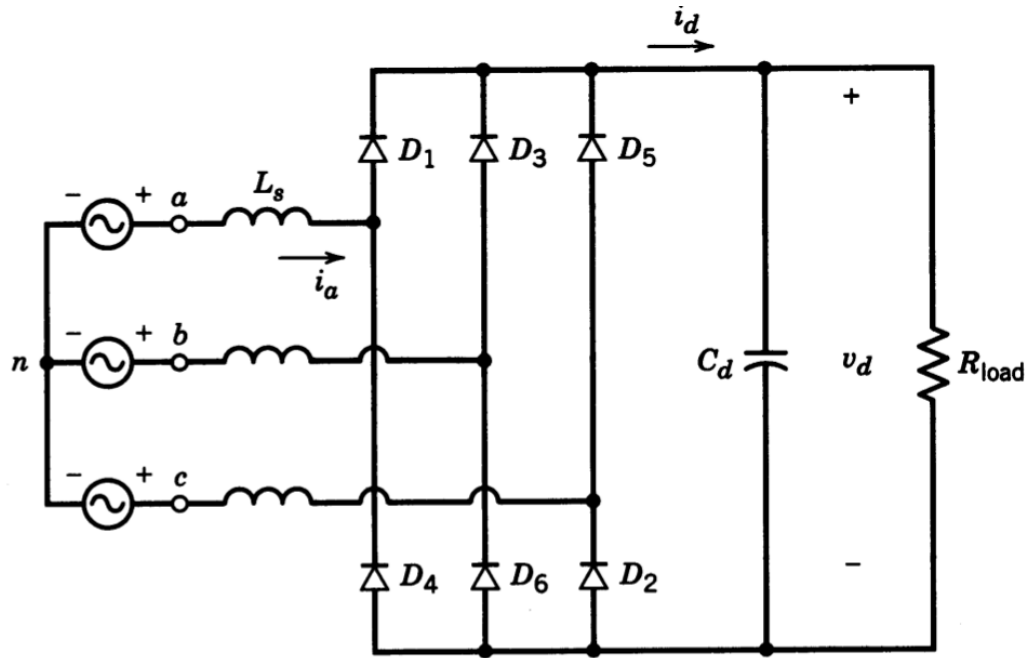What are the differences wrt single phase?
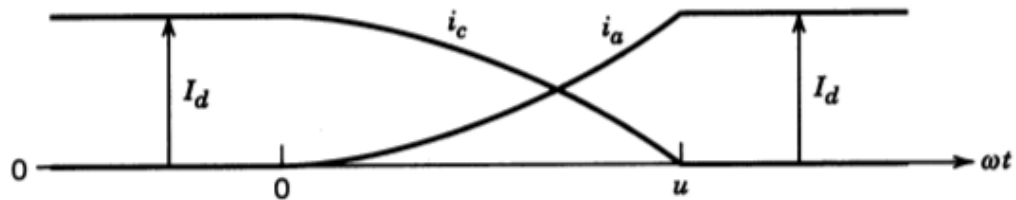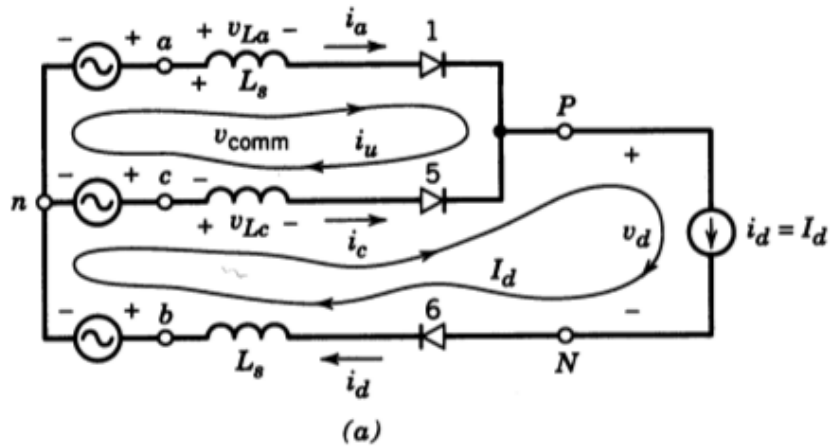

No 3rd order harmonics!

Comparison of Rectifiers

Type	Vout	ΔVout	f_{ripple}
Single Phase	$\dfrac{2\sqrt{2}}{\pi}V_{ph}$ = 207 V	$\sqrt{2}V_{ph} = 325V$	100 Hz
3-phase Half Bridge	$\dfrac{3\sqrt{2}}{2\pi}V_{l-l}$ = 270 V	$\dfrac{\sqrt{2}}{2}V_{ph} = 162.5V$	150 Hz
3-phase Full Bridge	$\dfrac{3\sqrt{2}}{\pi}V_{l-l}$ = 540 V	$(1 - \frac{\sqrt{3}}{2})\sqrt{2}V_{l-l} = 75.8V$	300 Hz

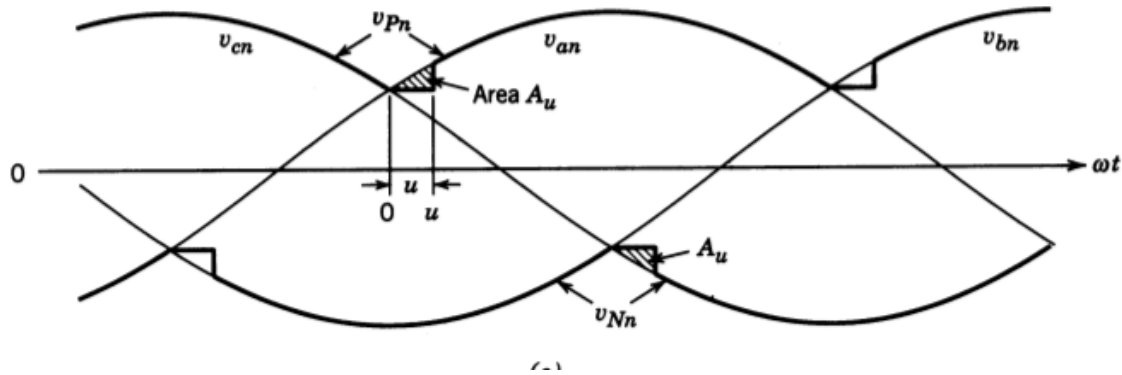# Commentation in 3-Phase Rectifiers

Commutation in 3-Phase Rectifiers

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(a)

Commutation in 3-Phase Rectifiers

Commentation in 3-Phase Rectifiers

Average Voltage

Without Commutation

$$V_{dc} = \frac{3\sqrt{2}}{\pi} V_{l-l} = 1.35 V_{l-l}$$

Average Voltage

Without Commutation

$$V_{dc} = \frac{3\sqrt{2}}{\pi}V_{l-l} = 1.35V_{l-l}$$

With Commutation

$$V_{dc} = \frac{3\sqrt{2}}{\pi}V_{l-l} - \frac{3}{\pi}\omega L_s I_d$$

More info

Commutation Simulation, MultiSim Simulation Examples

You can download this presentation from:
keysan.me/ee463