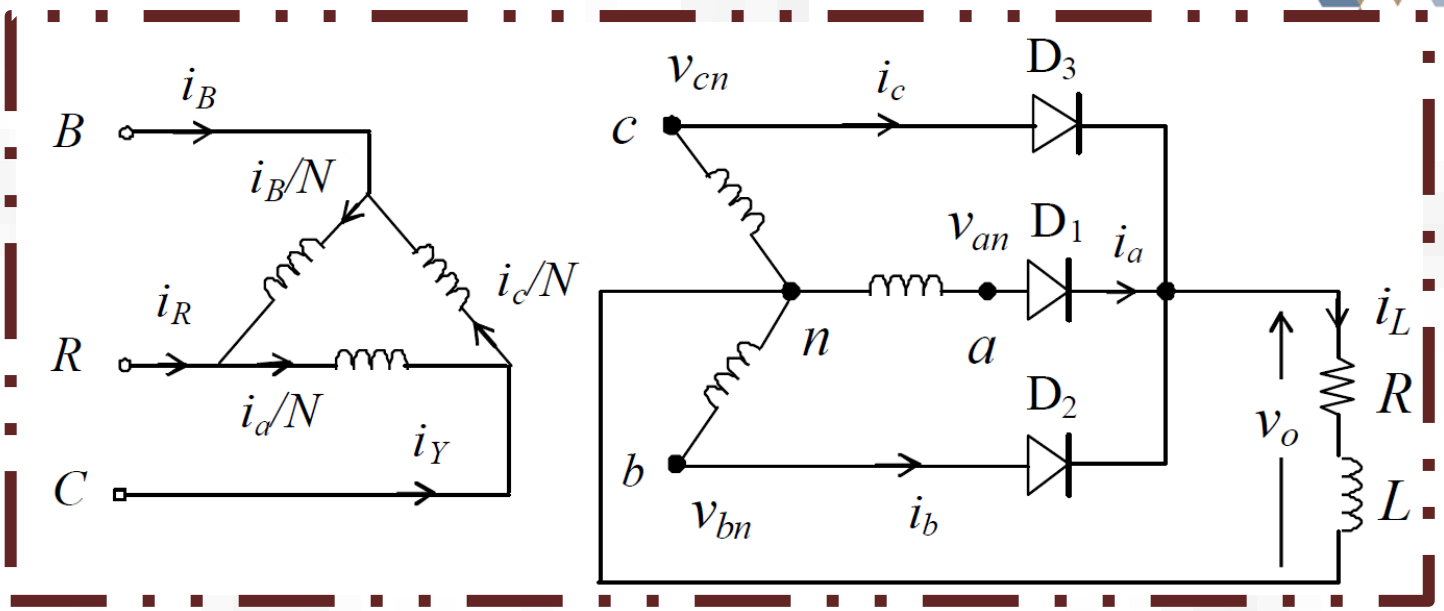
ELK 331E/331
Power Electronic Circuits/Güç Elektroniği Devreleri

The Three Phase Half-Wave Uncontrolled Rectifier
Üç Fazlı Yarım Dalga Kontrolsüz Doğrultucular

Assoc. Prof. Dr. Mehmet Onur GÜLBAHÇE

Uncontrolled Three-phase Half-wave Rectifier



- **The diode in a particular phase conducts during the period when the voltage on that phase is higher than that on the other two phases.**

- **The conduction angle of each diode is $2\pi/3$**

- **Applications:**

•Battery charging
•Electrolytic processes
•Simple DC supply circuits where low cost is prioritized over performance

Advantages:

•Simple design and easy to implement
•Fewer components (only three diodes)

Disadvantages:

•High ripple in the output voltage
•Limited to low and moderate power app. due to the neutral return path requirement
•Diodes must handle high peak currents

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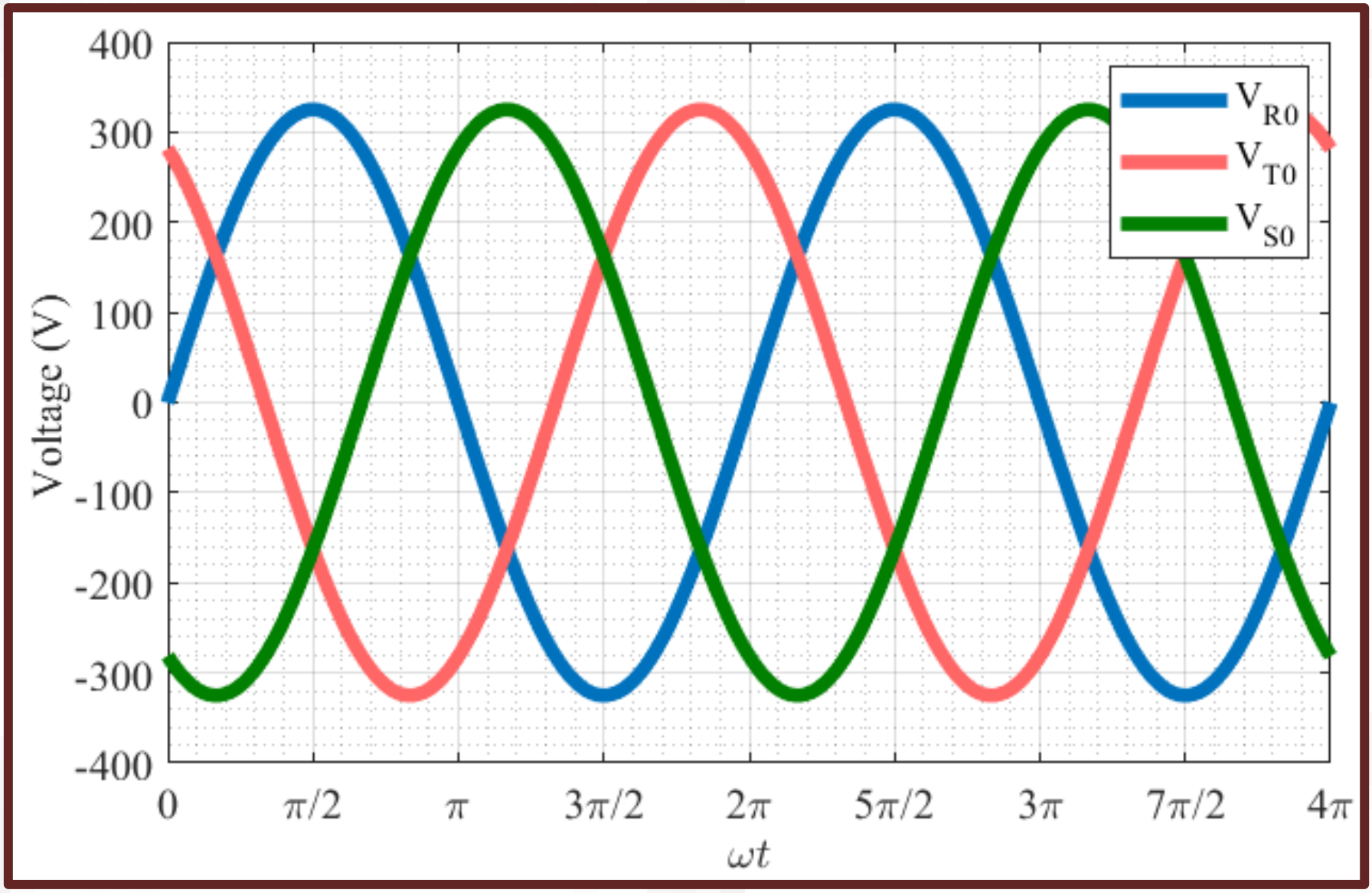

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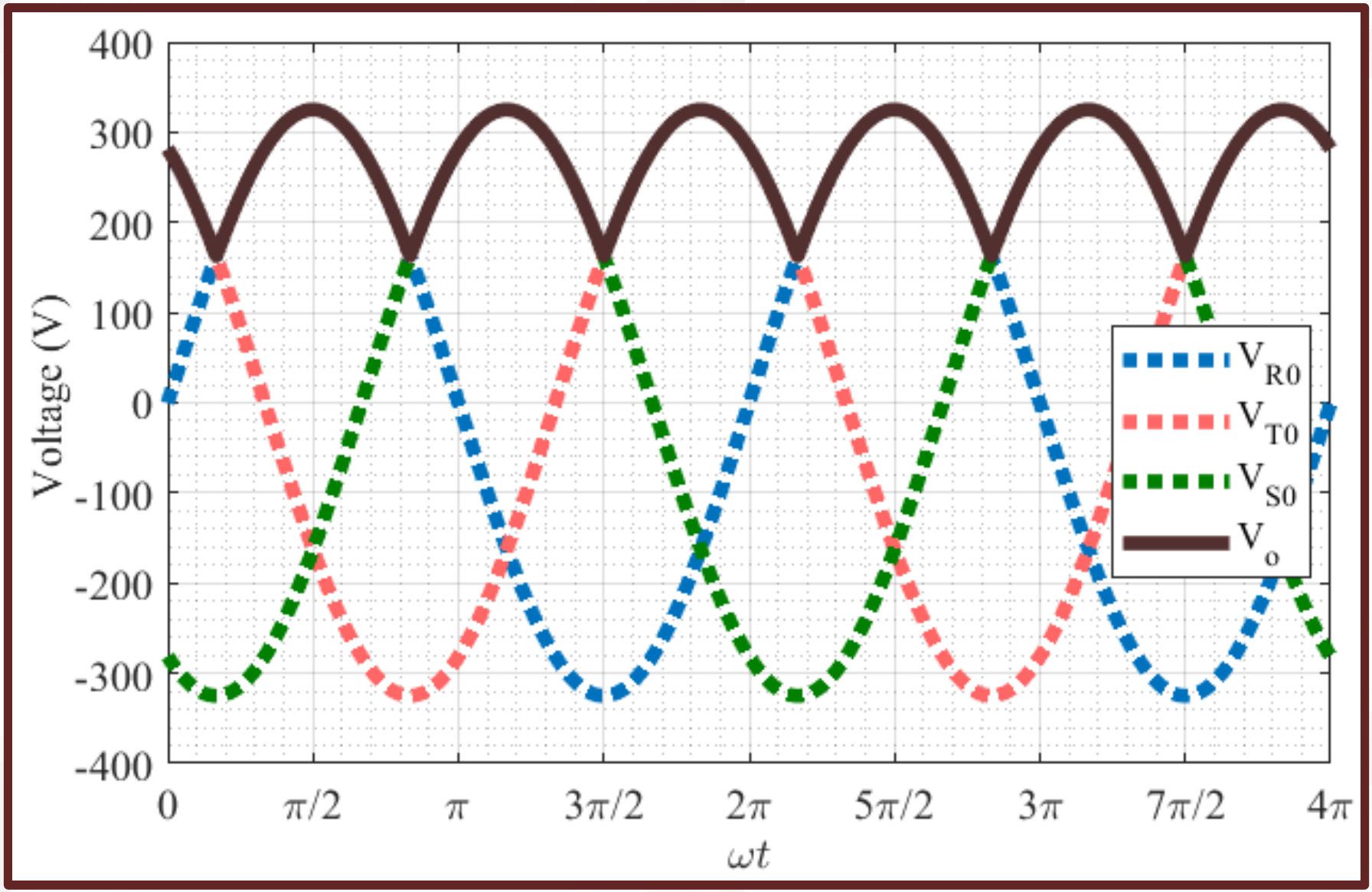

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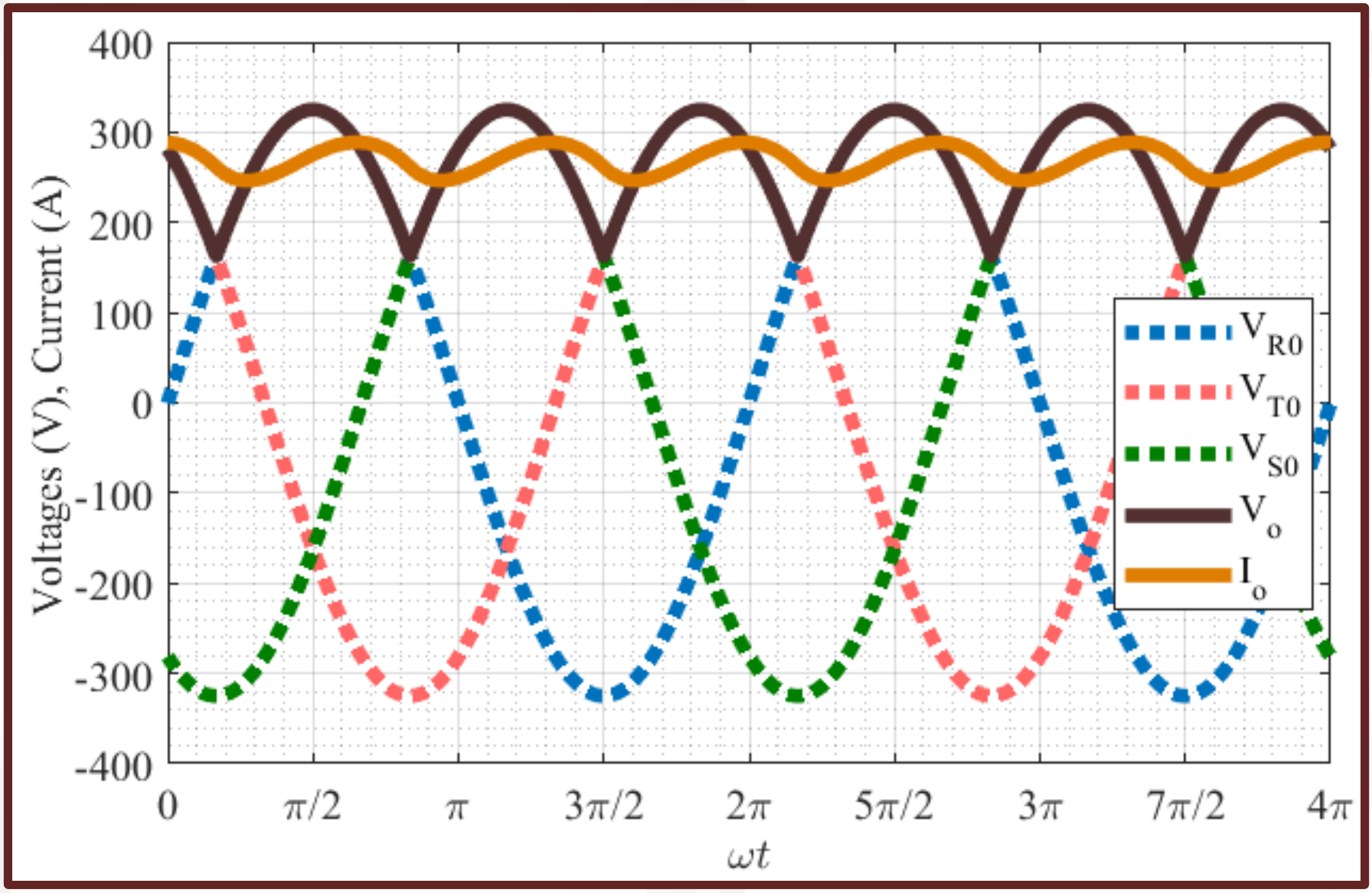

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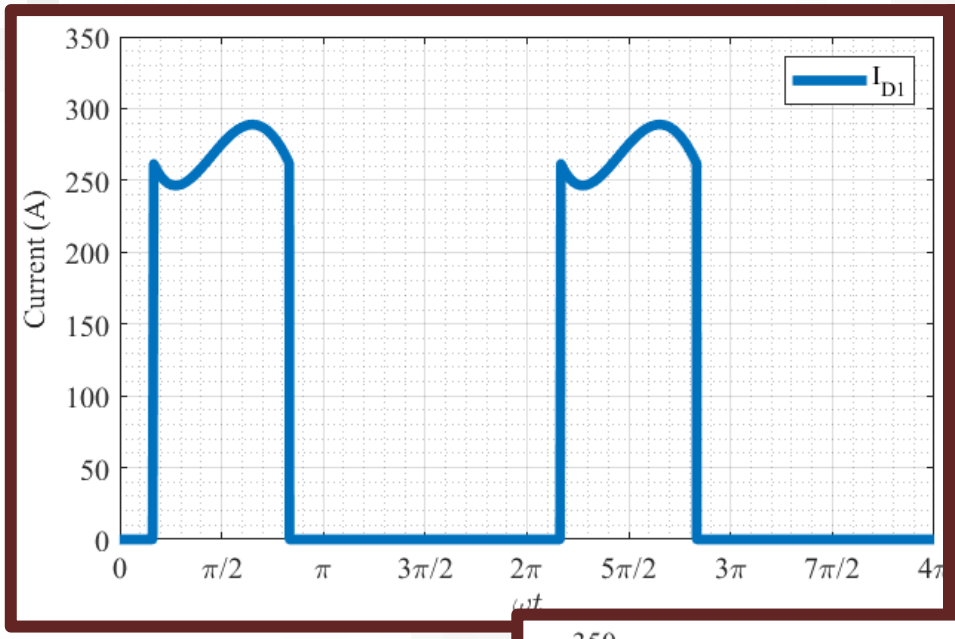

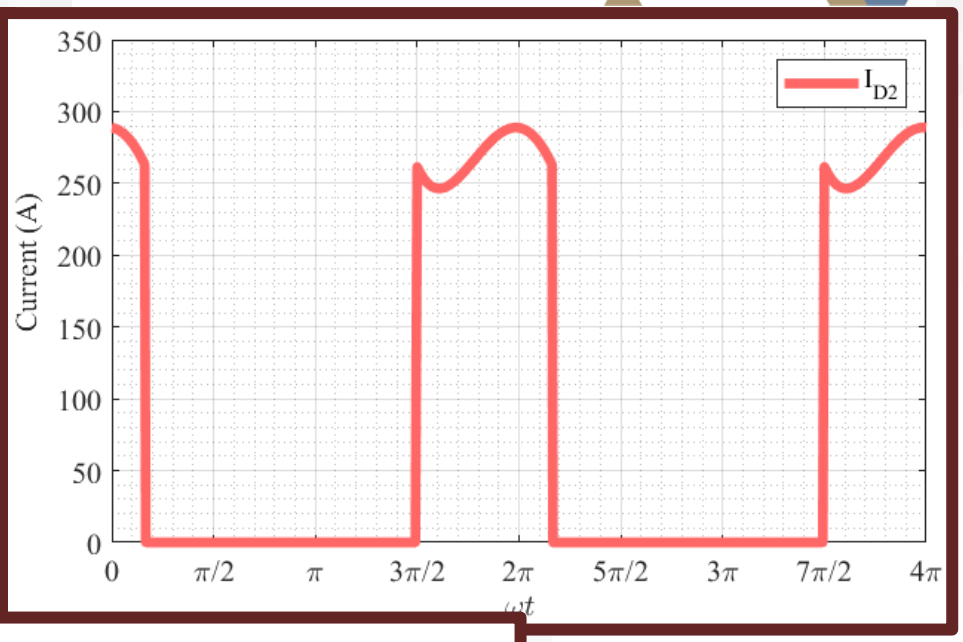

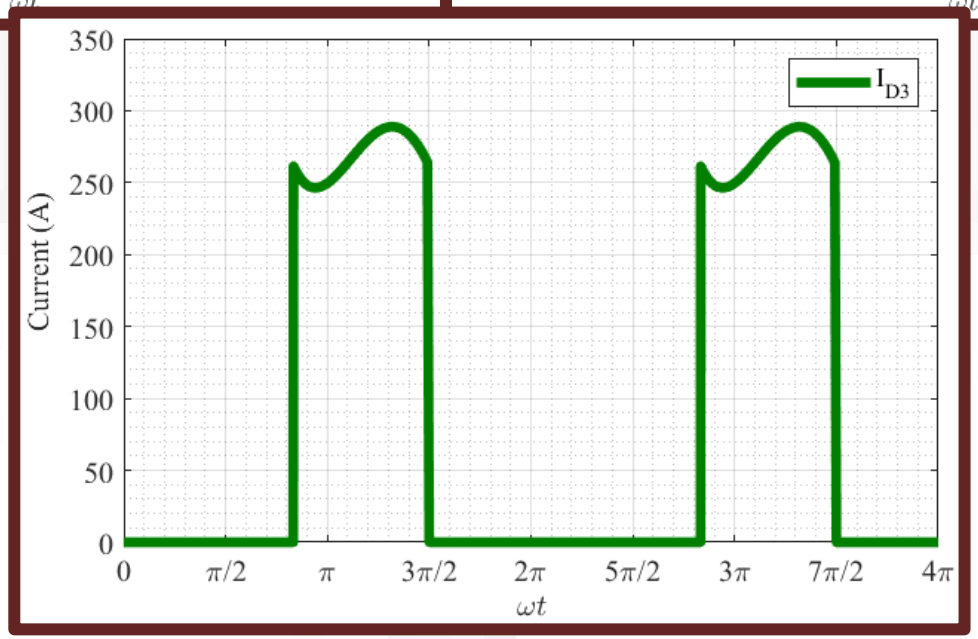

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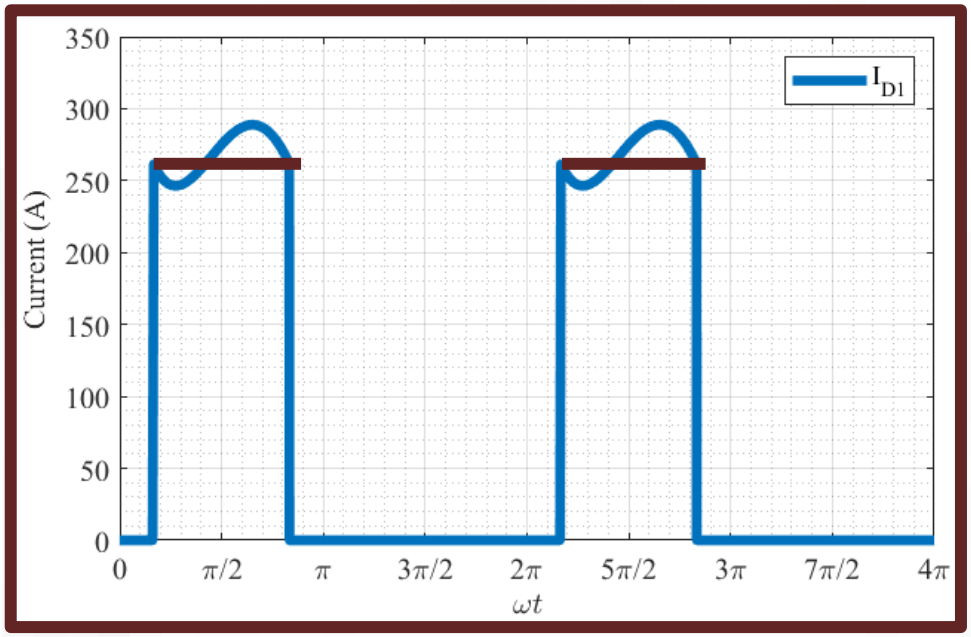

If we assume that the load is highly inductive, the load current can be taken to be smooth and ripple free.

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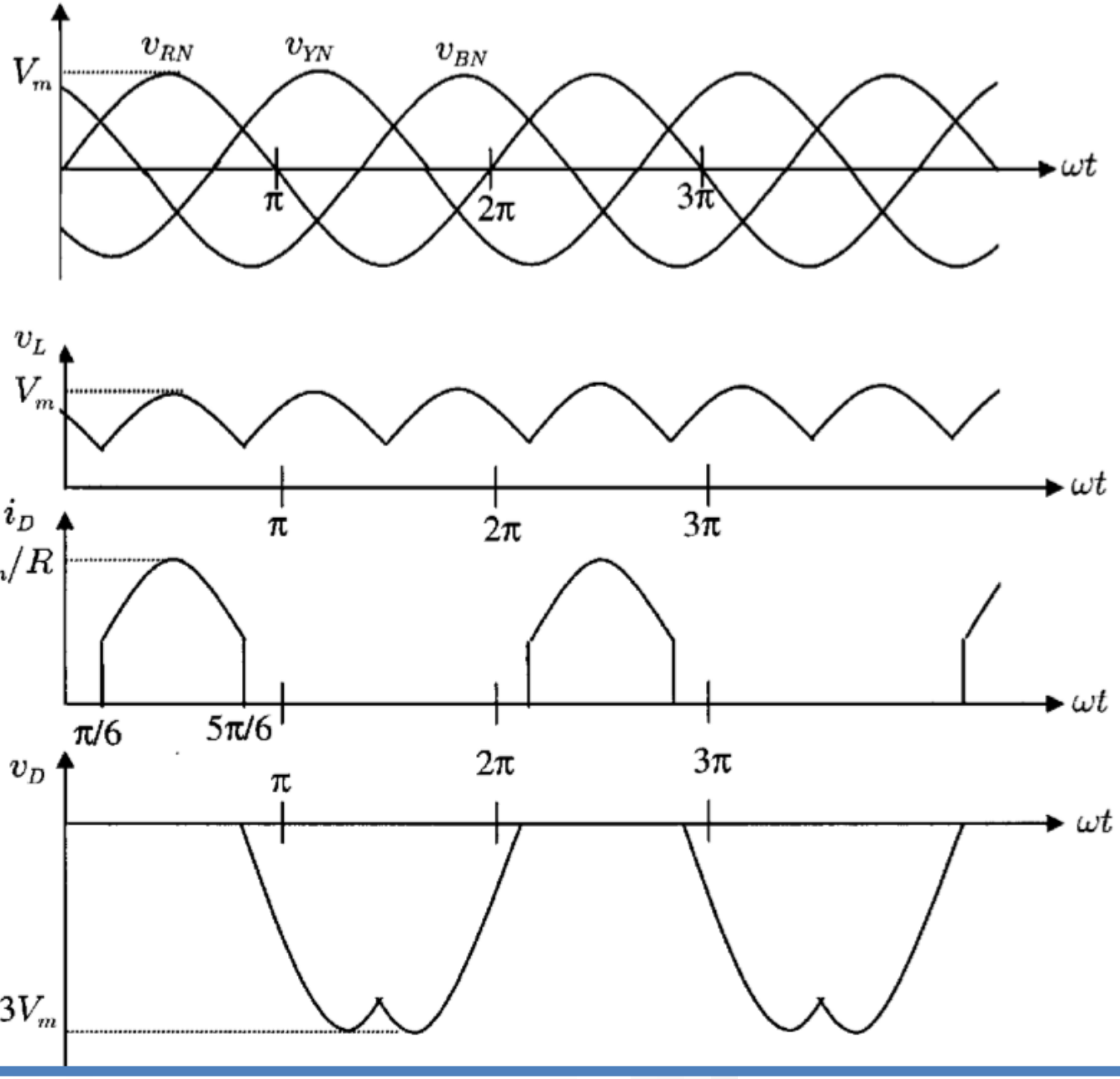

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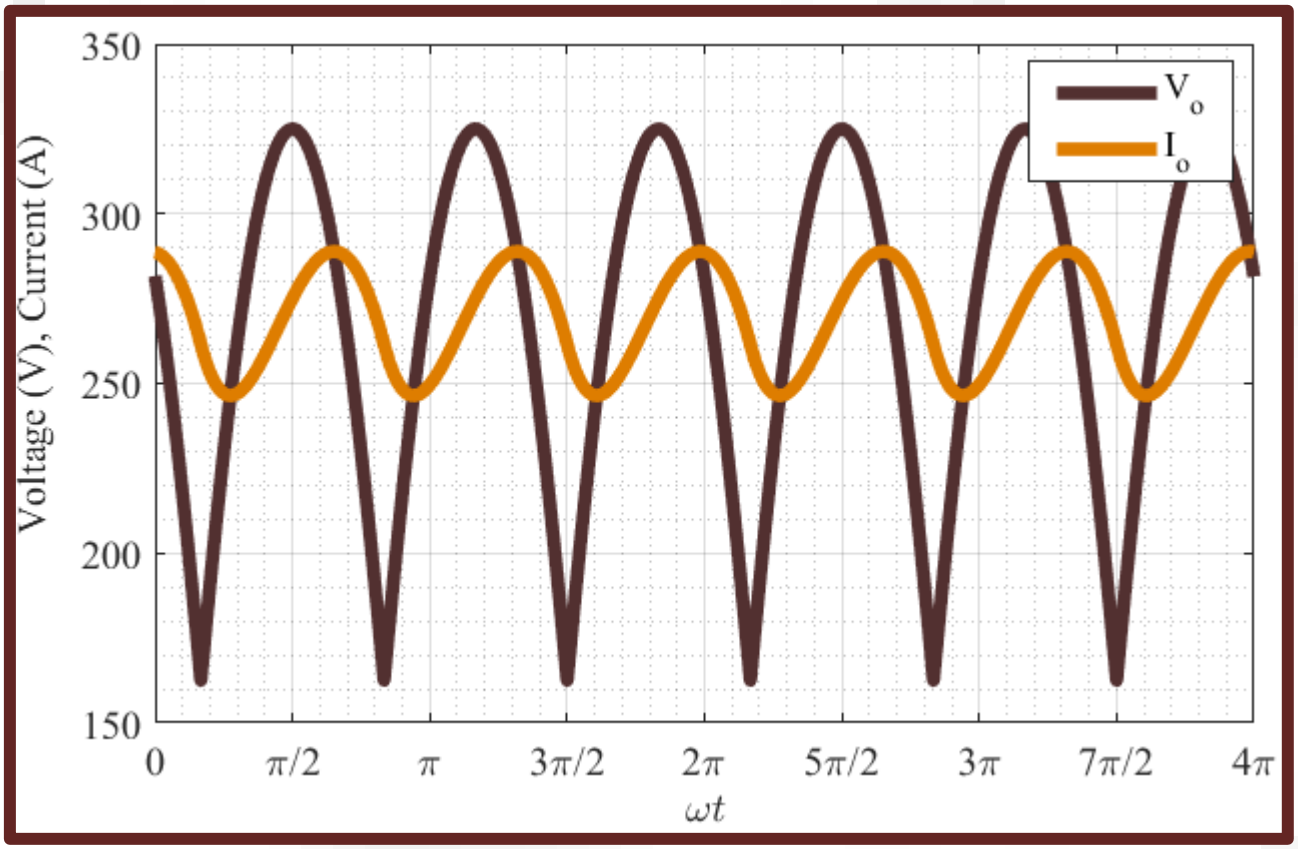

$$V_{R0} = V_m \sin(\omega t)$$

$$V_{S0} = V_m \sin(\omega t - \frac{2\pi}{3})$$

$$V_{T0} = V_m \sin(\omega t - \frac{4\pi}{3})$$

$$V_{o\,(AVG)} = \frac{1}{2\pi/3} \int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} V_m \sin(\omega t)\ d(\omega t) = \frac{3\sqrt{3}V_m}{2\pi} = 0.827V_m$$

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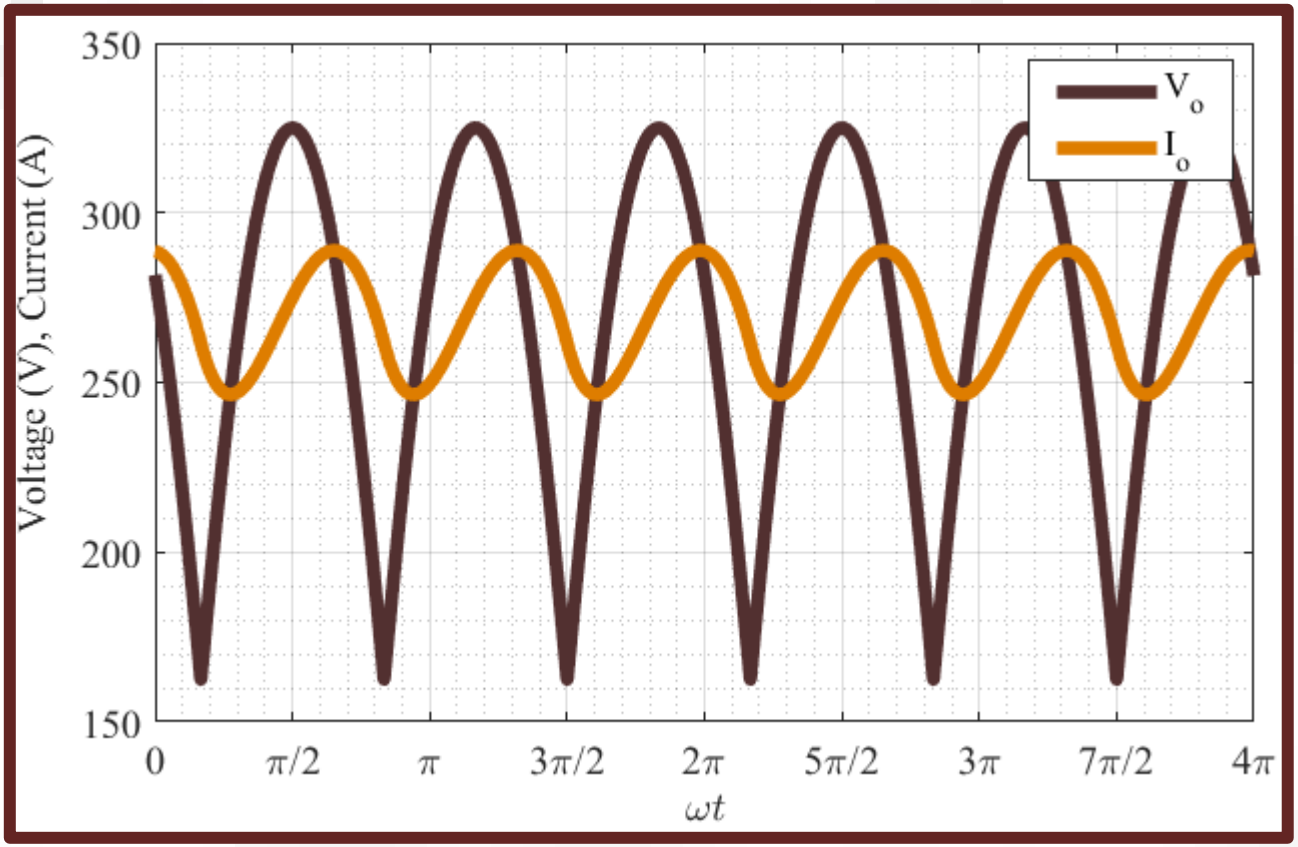

$$I_{o\ (AVG)} = \frac{V_{o(AVG)}}{R}$$

$$V_{o\ (RMS)} = \sqrt{\frac{1}{2\pi/3}\int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} [V_m \sin(\omega t)]^2\, d(\omega t)} = 0.84V_m$$

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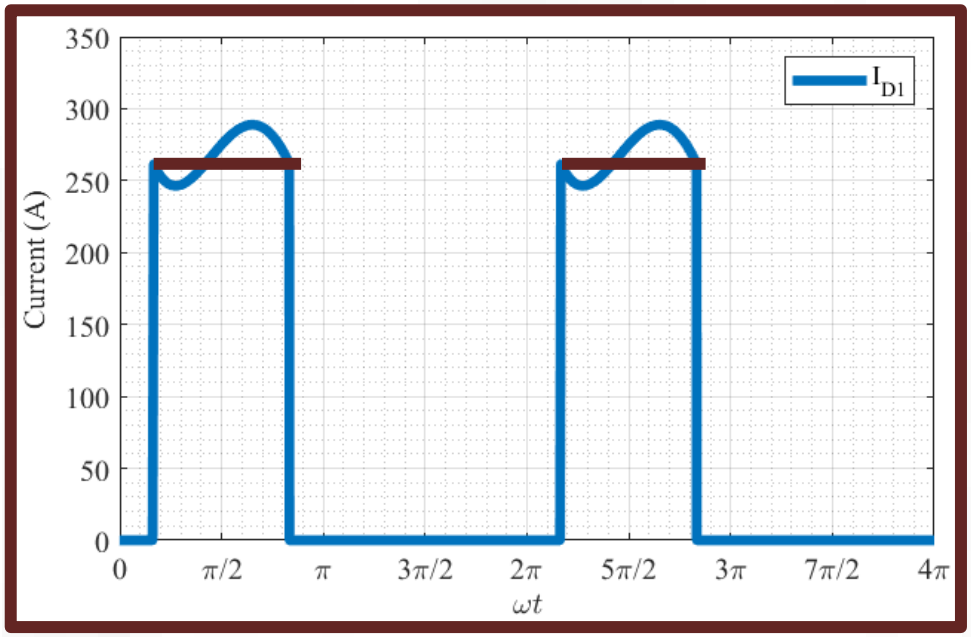

The rms current in each transformer secondary winding can also be found as:

$$I_s = I_m\sqrt{\frac{1}{2\pi}\left(\frac{\pi}{3}+\frac{\sqrt{3}}{4}\right)} = 0.485\ I_m$$

$$I_m = \frac{V_m}{R}$$