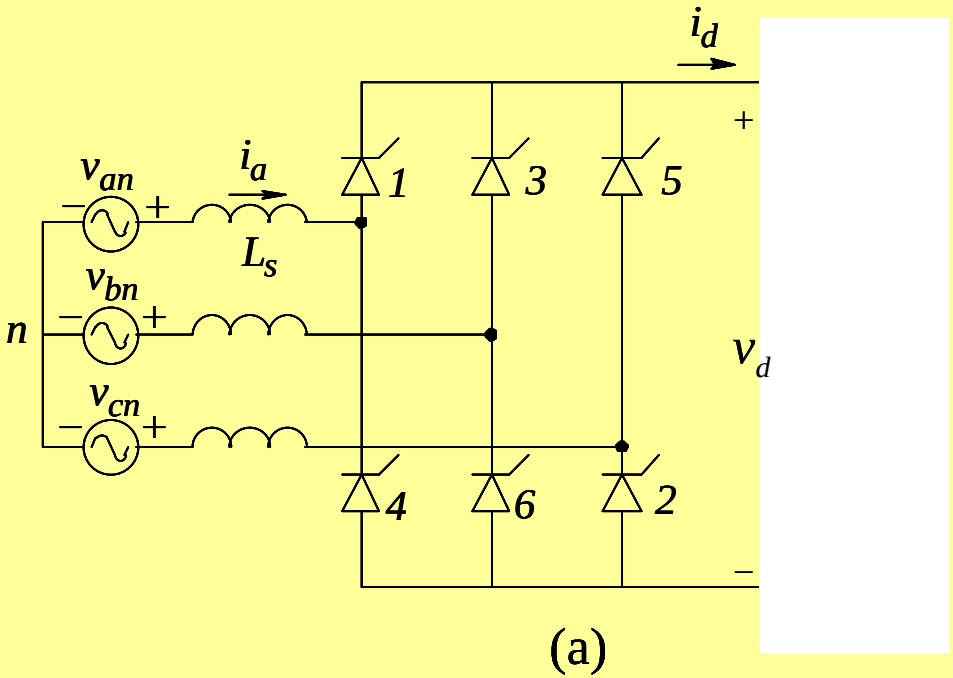
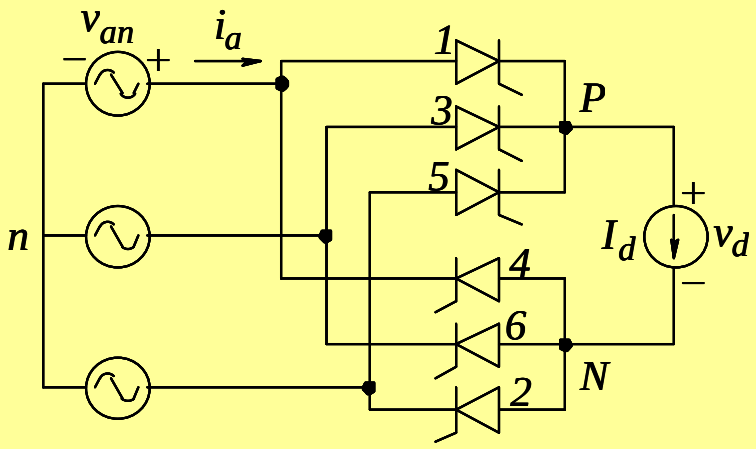
Three-Phase Thyristor Converters

- Applications
- Three-Phase Thyristor Converter Operation
- Applications in HVDC Systems

THREE-PHASE, FULL-BRIDGE THYRISTOR CONVERTERS

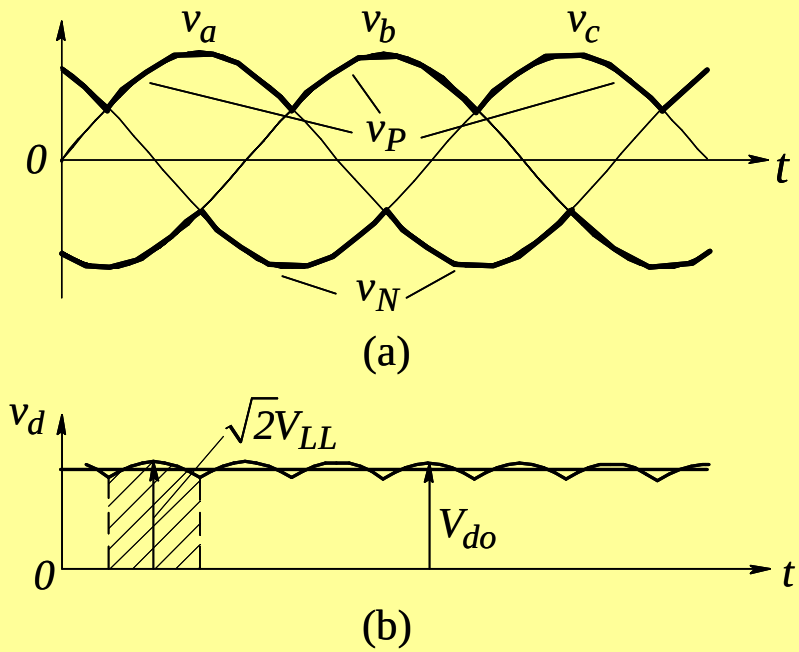


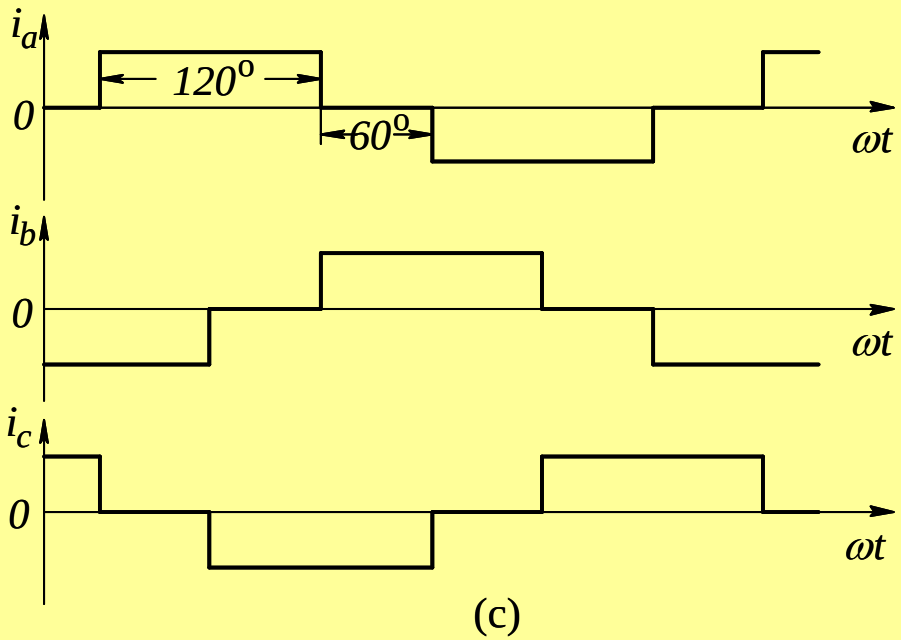
(a)

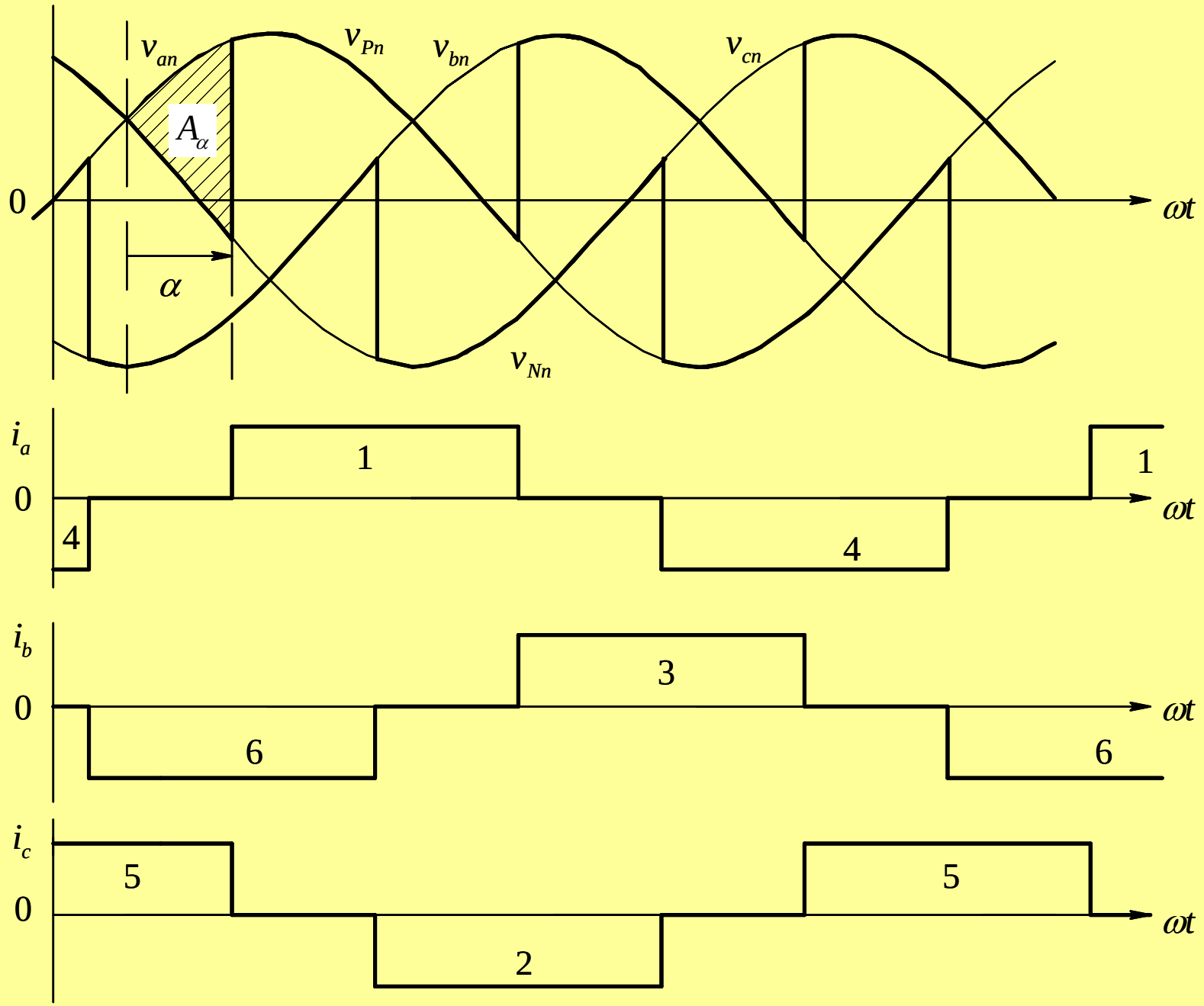


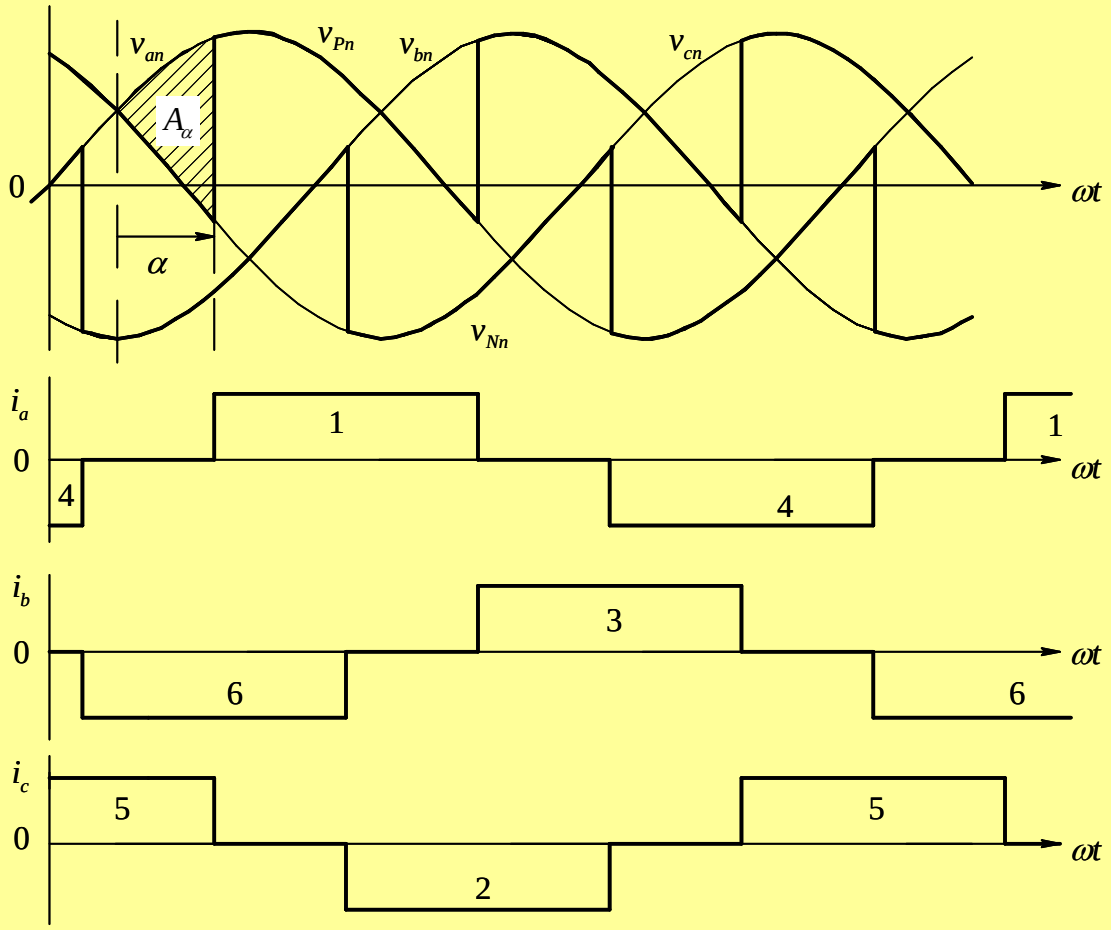
(b)

Three-Phase Diode Rectifier Waveforms





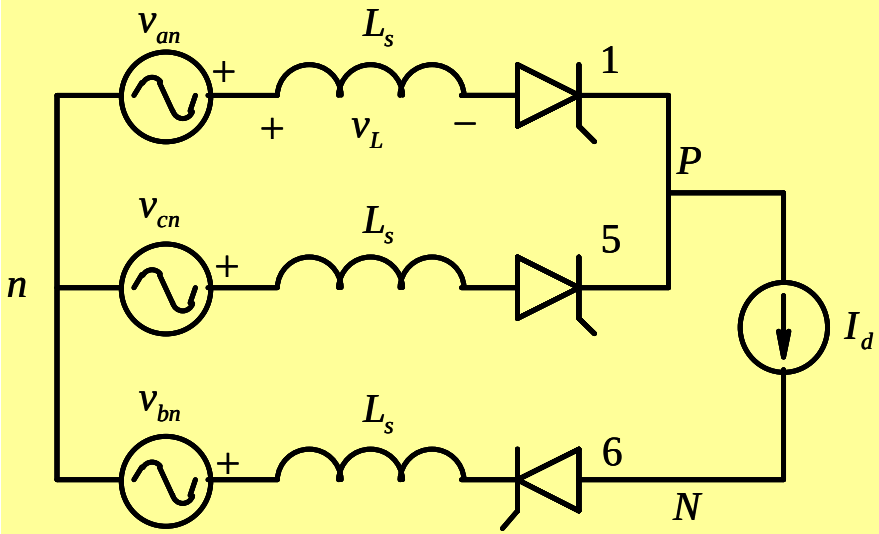




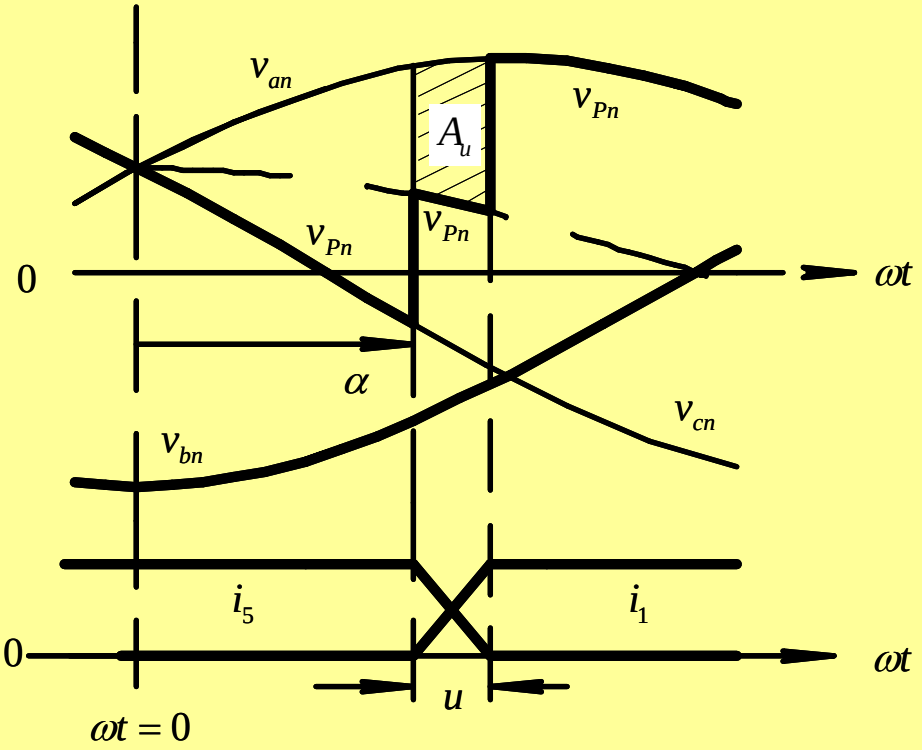
$$V_{do} = \frac{1}{\pi/3}\int_{-\pi/6}^{\pi/6} \hat{V}_{LL}\cos\omega t \cdot d(\omega t) = \frac{3}{\pi}\hat{V}_{LL} \qquad \Delta V_\alpha = \frac{1}{\pi/3}\underbrace{\int_0^\alpha \hat{V}_{LL}\sin\omega t \cdot d(\omega t)}_{A_\alpha} = \frac{3}{\pi}\hat{V}_{LL}(1-\cos\alpha)$$

$$V_{d\alpha} = \frac{3}{\pi}\hat{V}_{LL}\cos\alpha$$

Effect of L_s



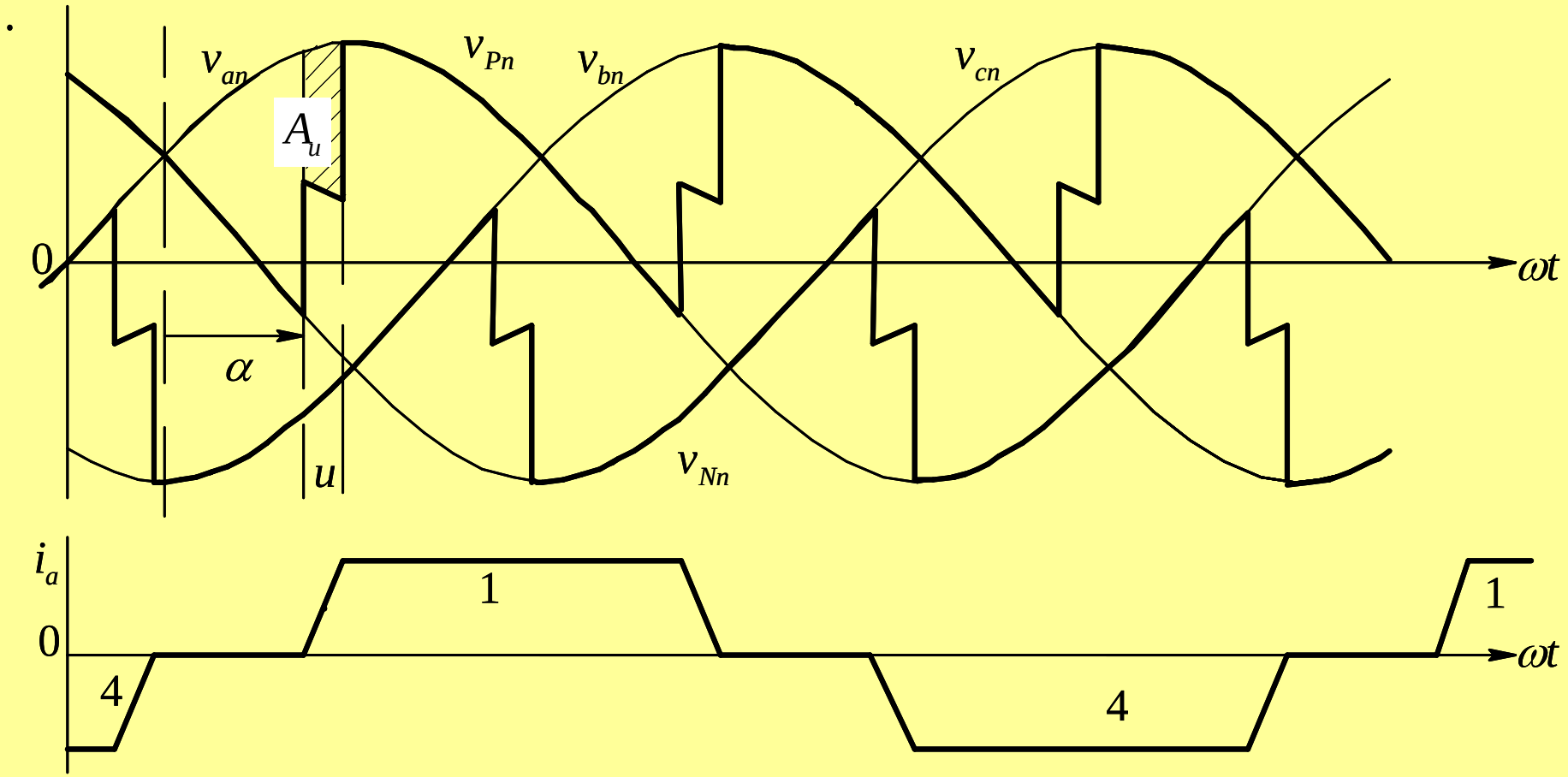
(a)



(b)

$$A_u = \int_{\alpha}^{\alpha+u} v_L \, d(\omega t) = \omega L_s \int_{0}^{I_d} di_s = \omega L_s I_d$$

$$\Delta V_u = \frac{A_u}{\pi/3} = \frac{3}{\pi} \omega L_s I_d$$



$$A_u = \int_{\alpha}^{\alpha+u} v_L \, d(\omega t) = \omega L_s \int_0^{I_d} di_s = \omega L_s I_d \qquad \Delta V_u = \frac{A_u}{\pi/3} = \frac{3}{\pi}\omega L_s I_d$$

$$V_d = V_{do} - \Delta V_\alpha - \Delta V_u \qquad V_d = \frac{3}{\pi}\hat{V}_{LL}\cos\alpha - \frac{3}{\pi}\omega L_s I_d$$

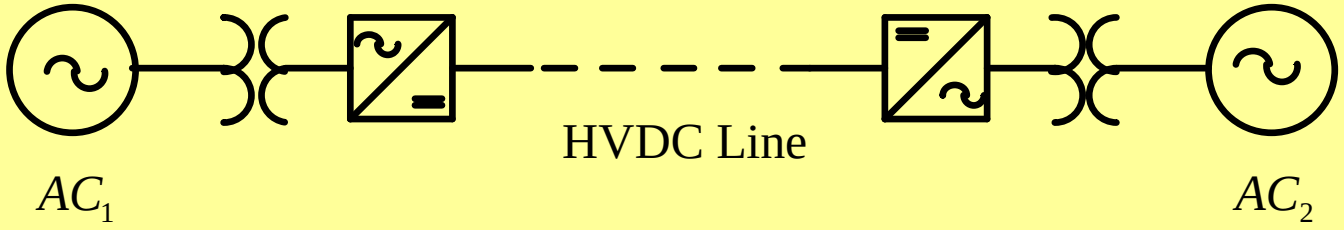
Current Harmonics and the Reactive Power:

$$\hat{I}_{ah} = \frac{\hat{I}_{a1}}{h}$$

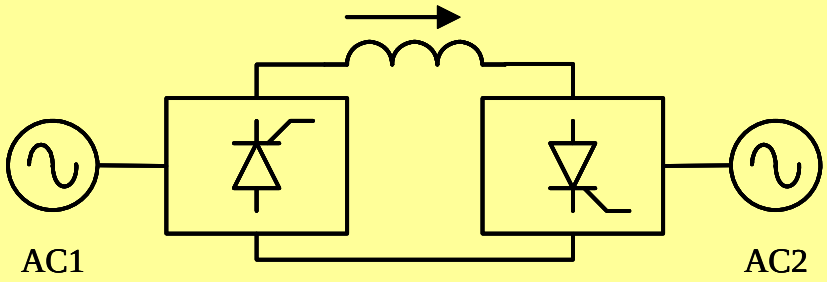
$$Q = \frac{3}{2}\hat{V}_{an}\hat{I}_{a1}\sin\phi_1$$

$$\phi_1 = \alpha + \frac{u}{2}$$

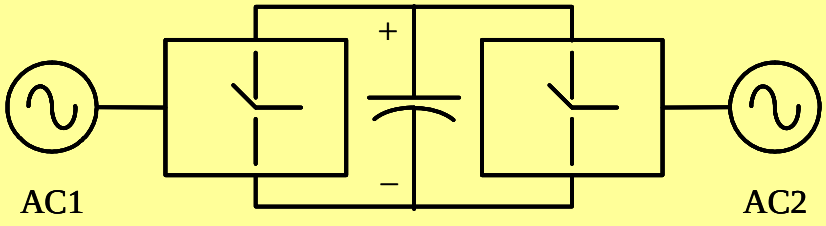
HVDC System



HVDC Systems: Voltage-Link and Current-Link

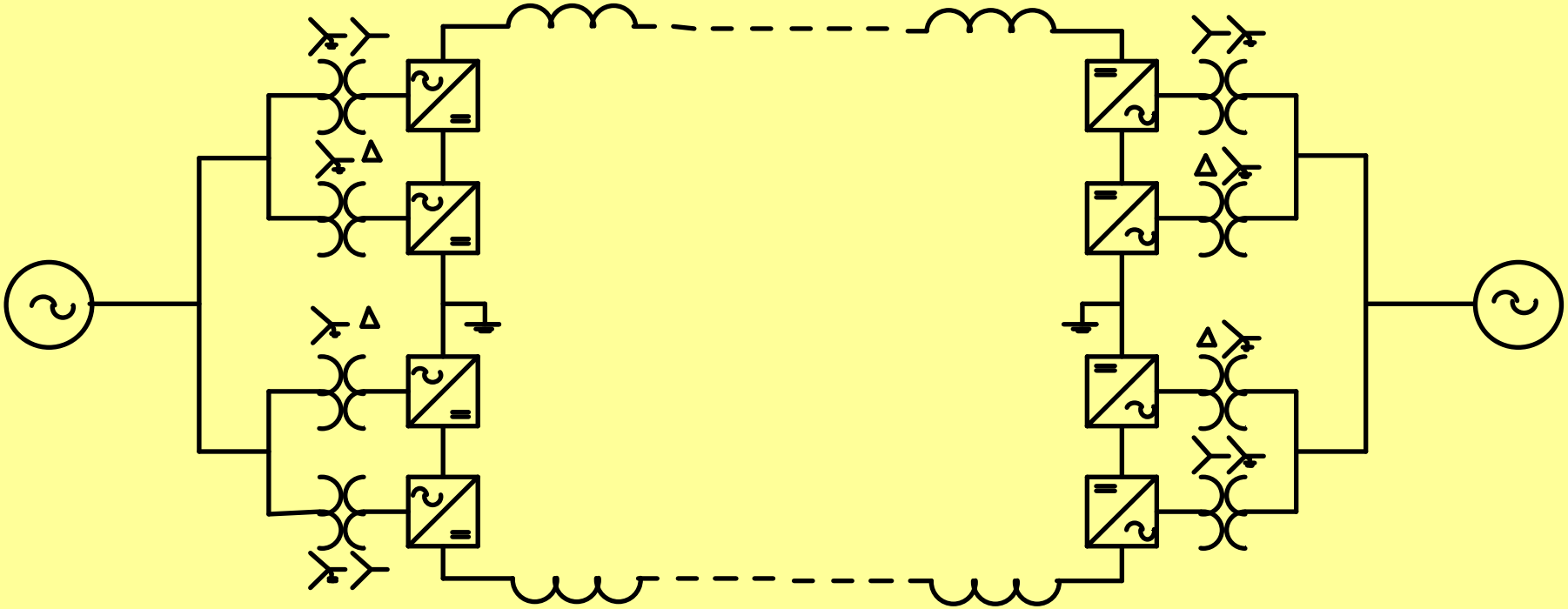


(*a*)

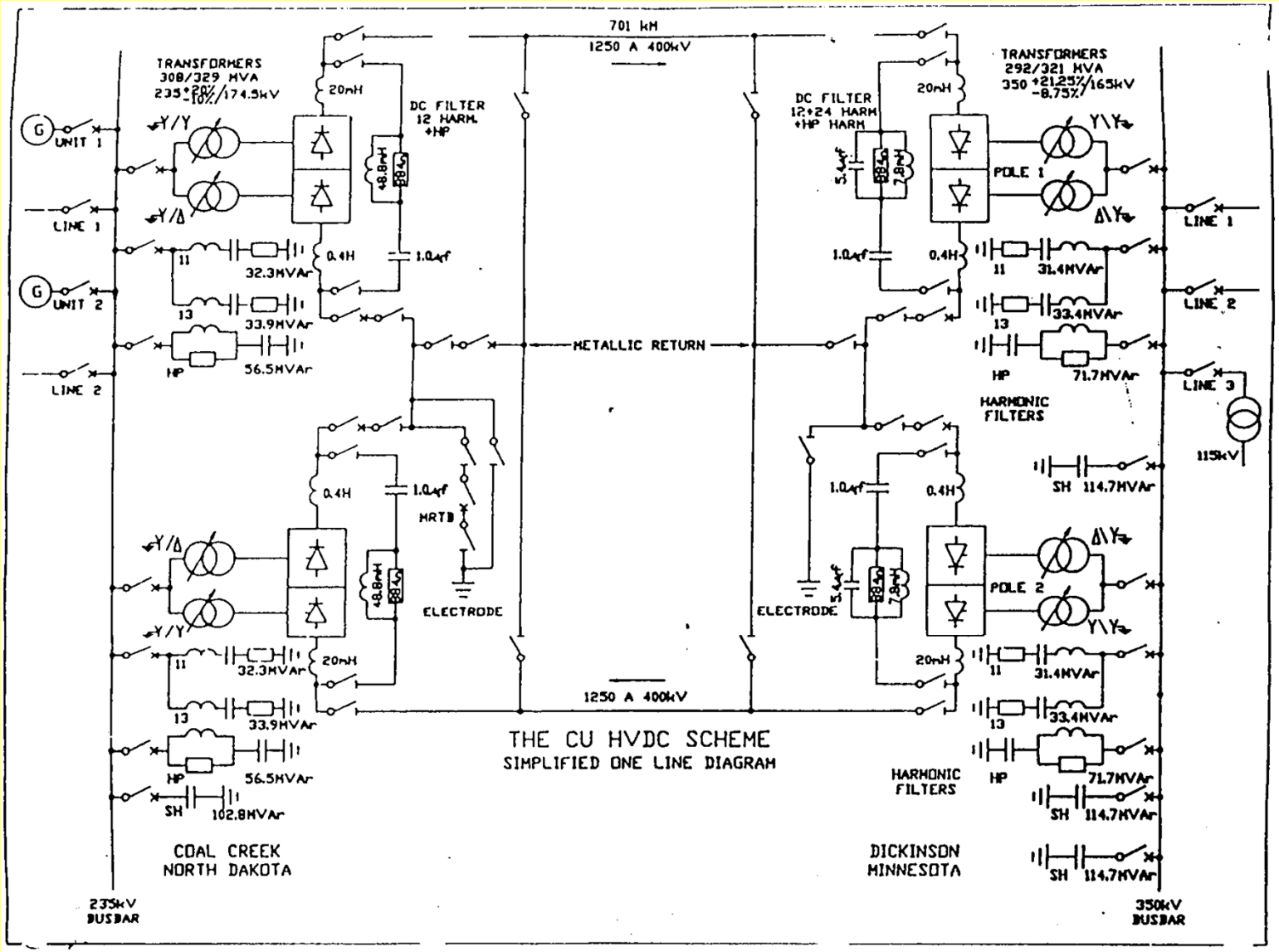


(*b*)

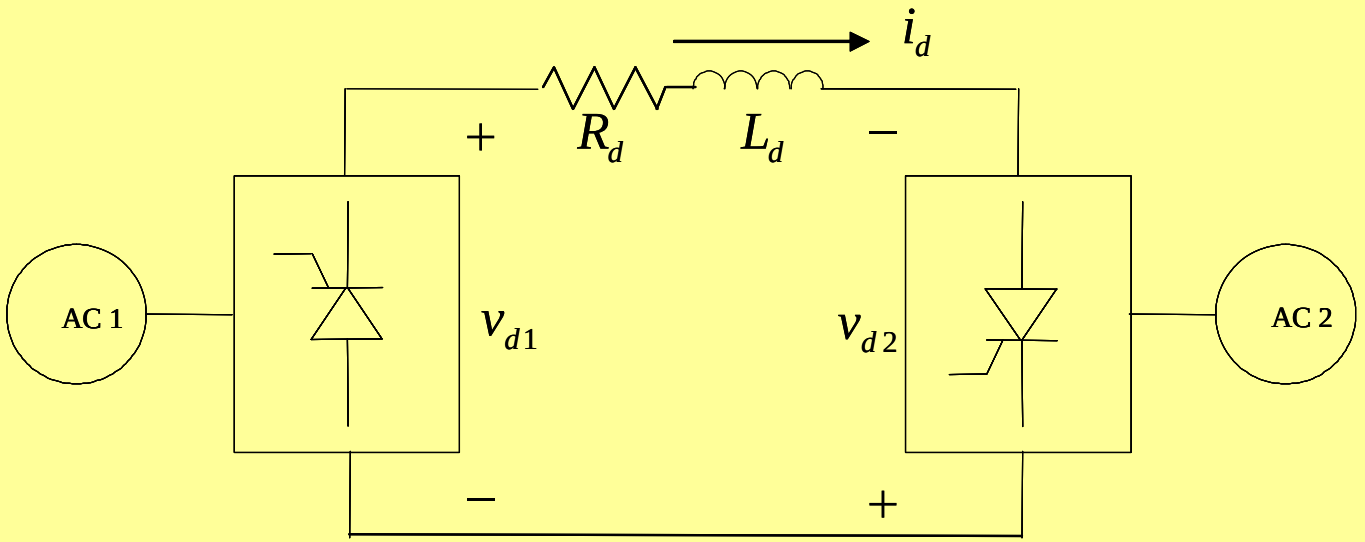
Current-Link HVDC Systems



CU One-line Diagram



Current-Link Systems



$$V_{d1} = \frac{3}{\pi}\hat{V}_{LL1}\cos\alpha_1 - \frac{3}{\pi}\omega L_{s1} I_d$$

$$V_{d2} = \frac{3}{\pi}\hat{V}_{LL2}\cos\alpha_2 - \frac{3}{\pi}\omega L_{s2} I_d$$

$$I_d = \frac{V_{d1} + V_{d2}}{R_d}$$

Summary

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