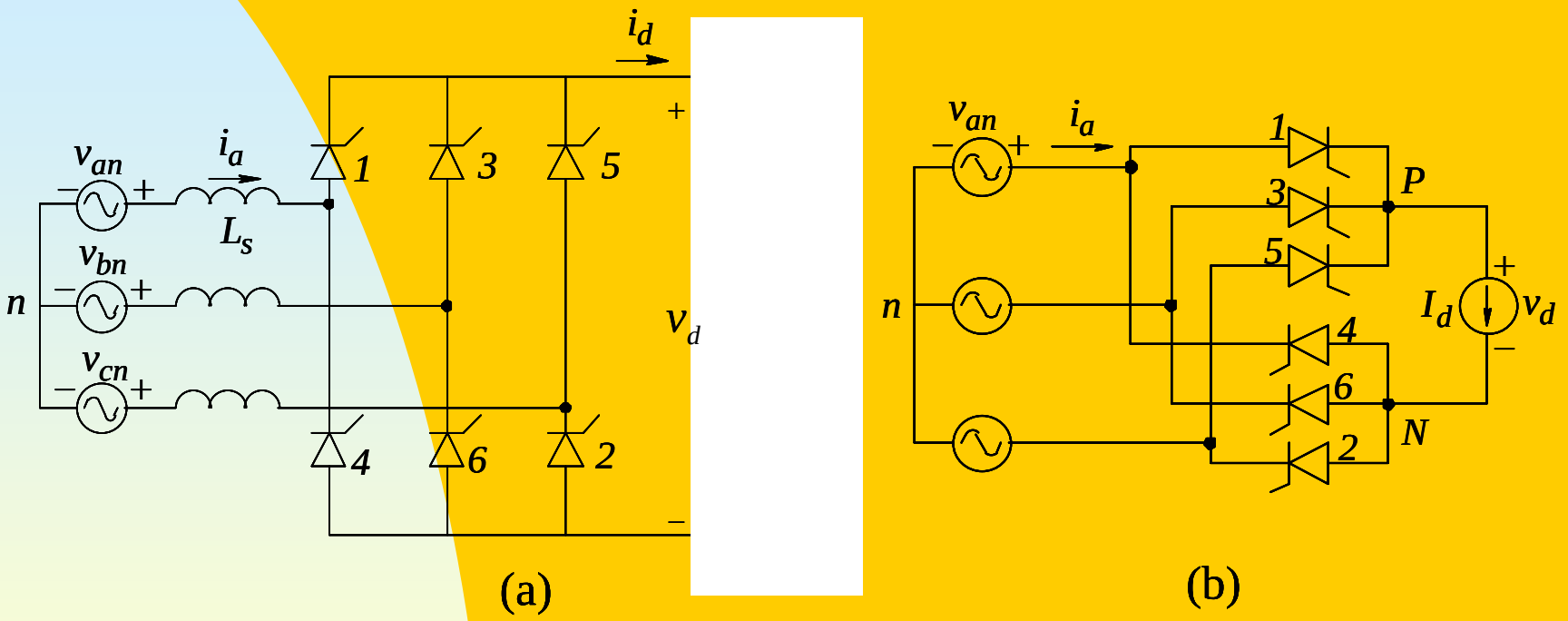
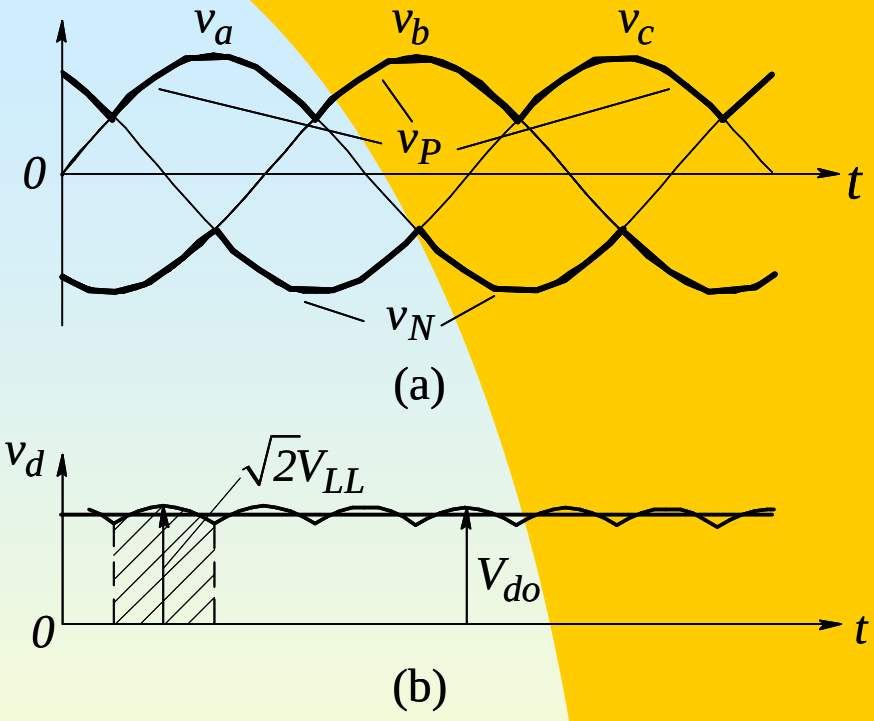
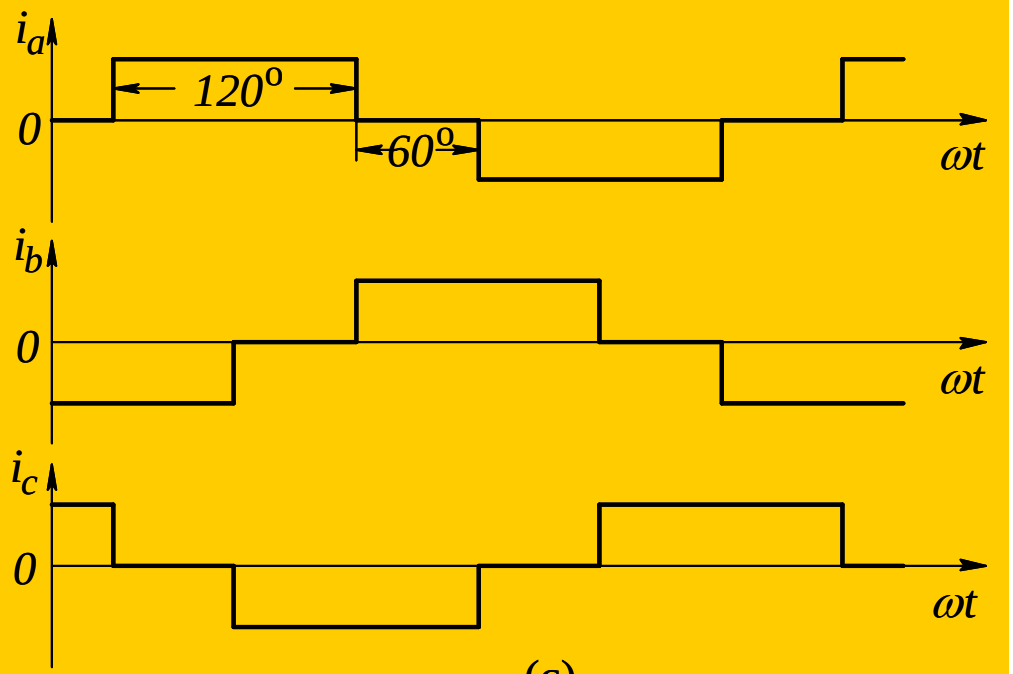
Three-phase Full-Bridge thyristor converter



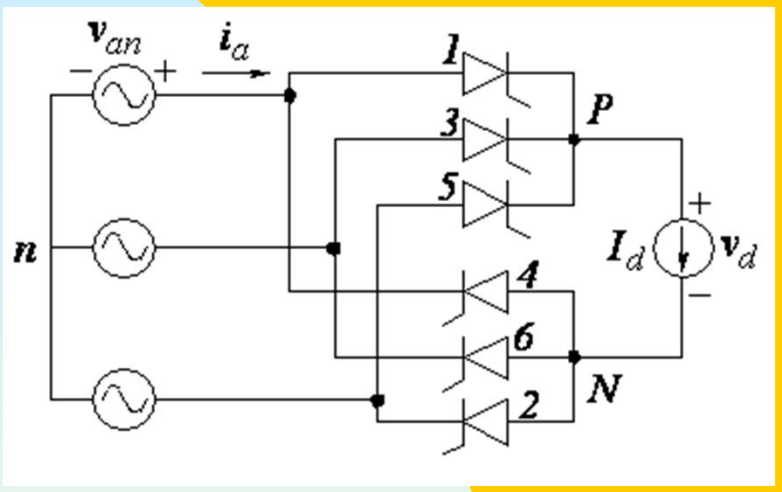
Waveforms in a three-phase rectifier with $\alpha = 0$ and $L_s = 0$

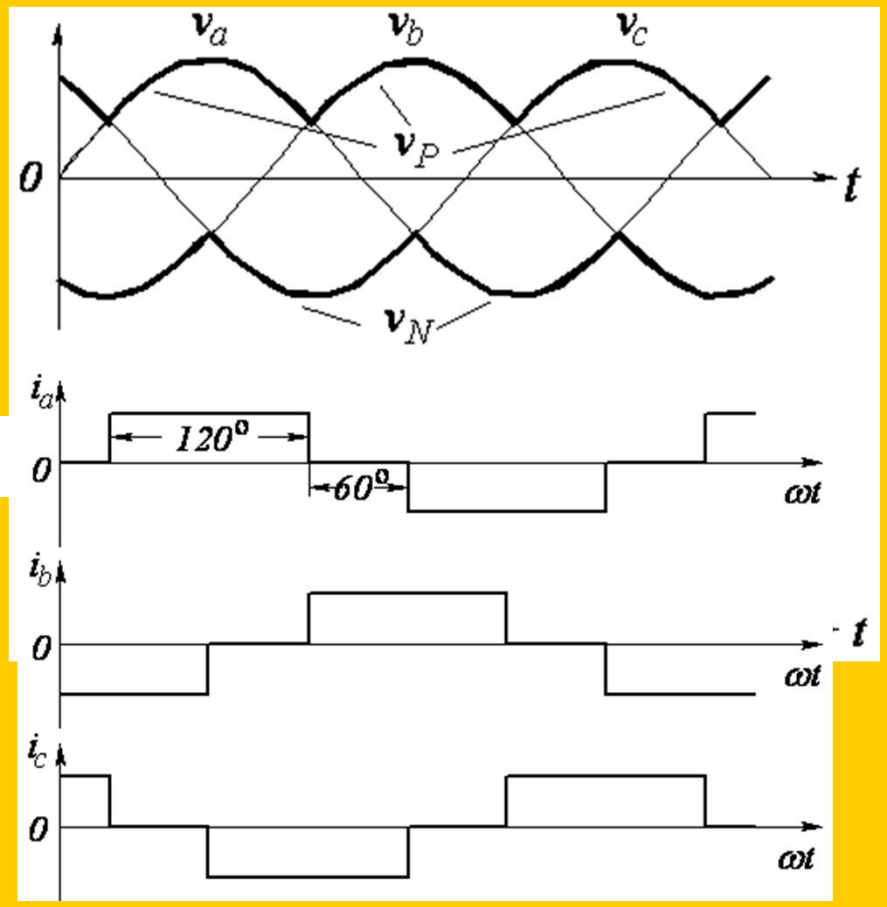




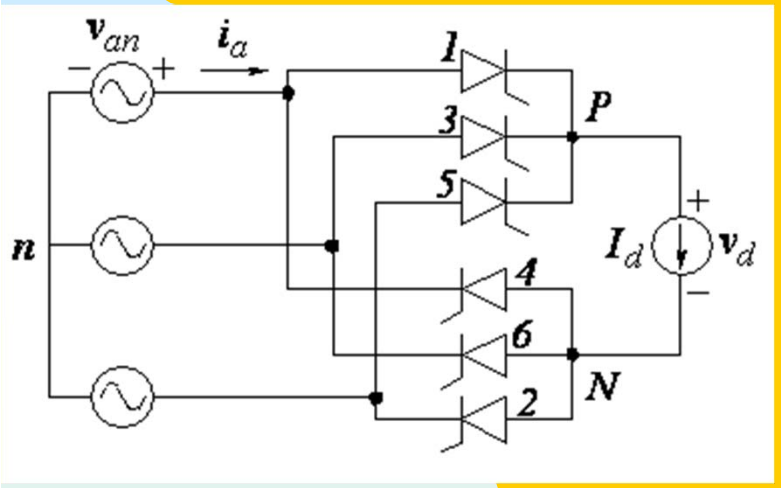
$$V_{do} = \frac{1}{\pi/3}\int_{-\pi/6}^{\pi/6} \sqrt{2}V_{LL}\cos\omega t \cdot d(\omega t) = \frac{3\sqrt{2}}{\pi}V_{LL}$$

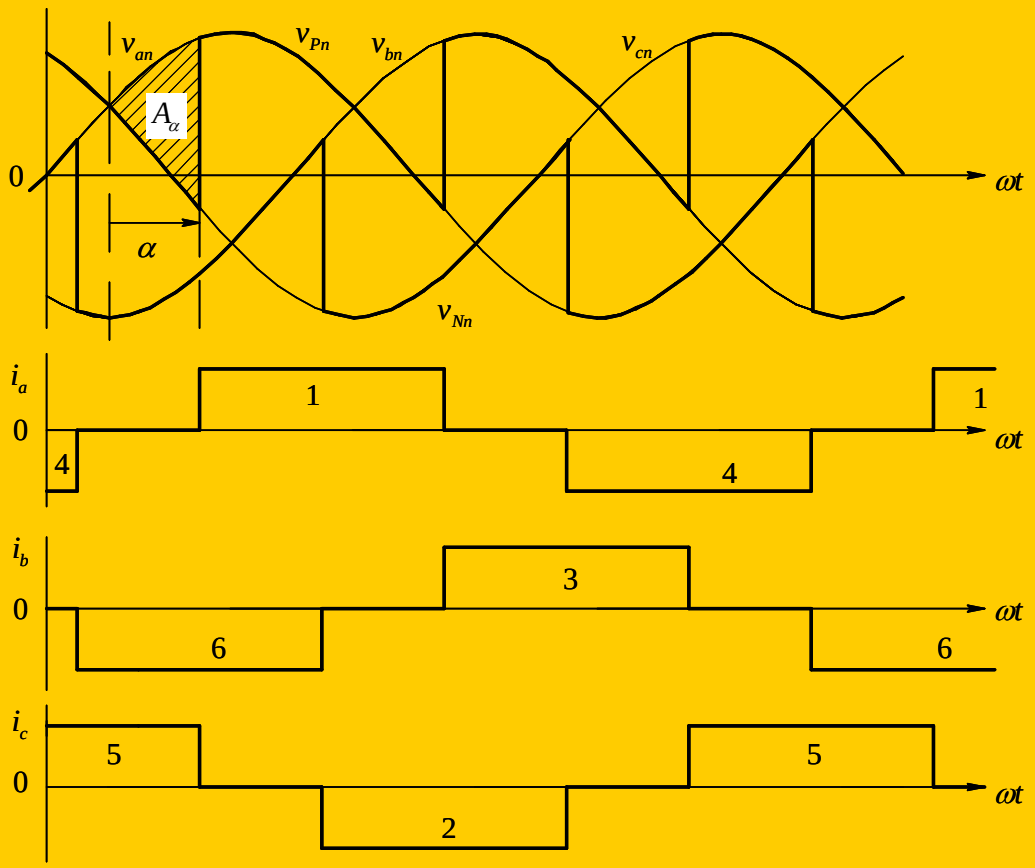
Waveforms in a three-phase rectifier with $\alpha = 0$ and $L_s = 0$





Effect of α

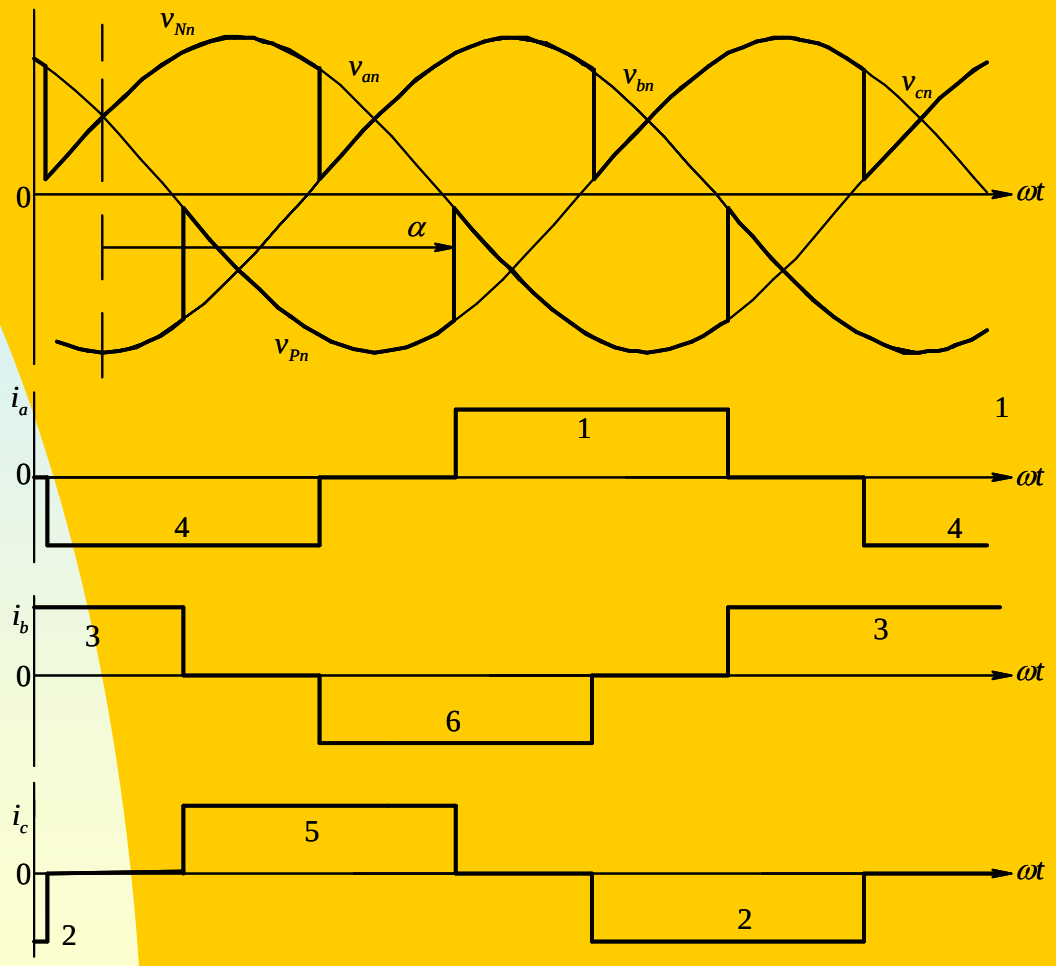




$$\Delta V_\alpha = \frac{1}{\pi/3}\underbrace{\int_0^\alpha \sqrt{2}V_{LL}\sin\omega t \cdot d(\omega t)}_{A_\alpha} = \frac{3\sqrt{2}}{\pi}V_{LL}(1-\cos\alpha)$$

$$V_{d\alpha} = V_{do} - \Delta V_\alpha = \frac{3\sqrt{2}}{\pi}V_{LL}\cos\alpha$$

Waveforms in the inverter mode



DC-Side Voltage as a Function of Delay Angle

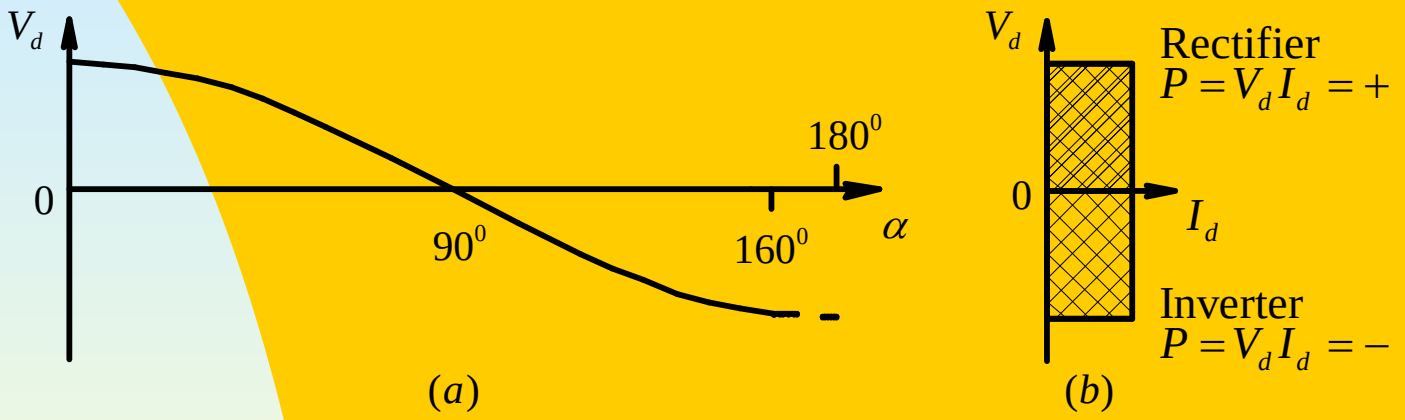
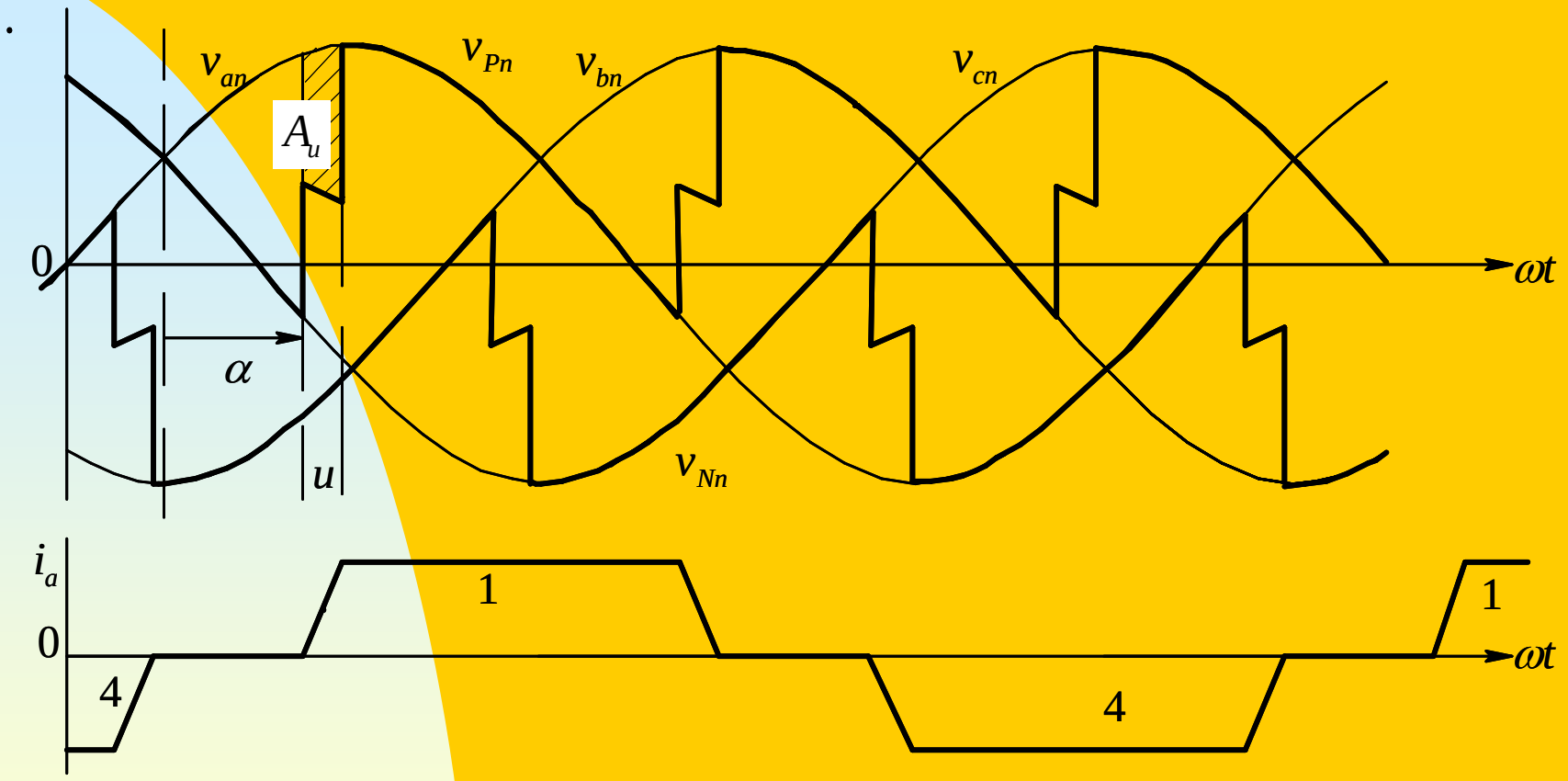


Fig. 7-13 Average dc-side voltage as a function of α .

Thyristor Converter Waveforms in the Presence of AC-Side Inductance



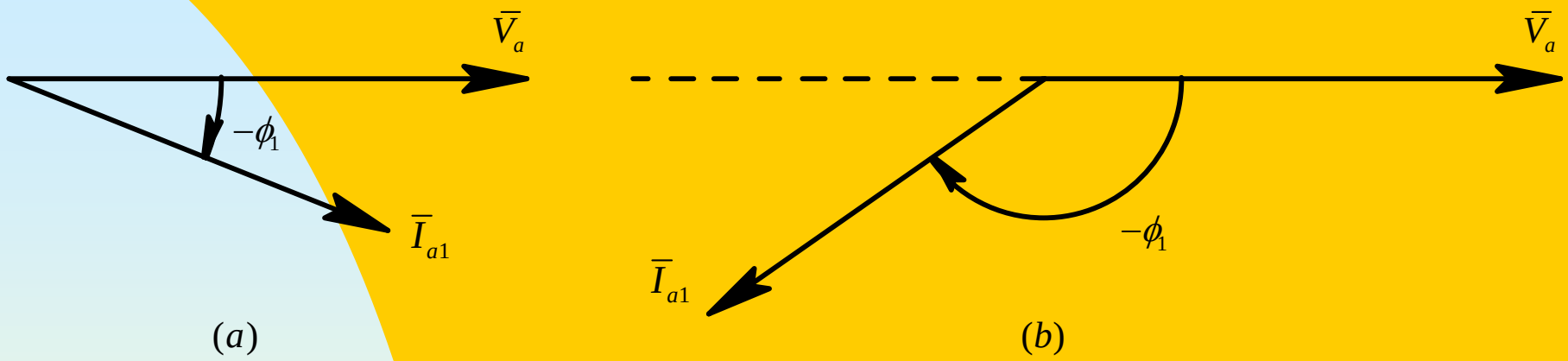
$$A_u = \int_{\alpha}^{\alpha+u} v_L \, d(\omega t) = \omega L_s \int_0^{I_d} di_s = \omega L_s I_d$$

$$V_d = V_{d\alpha} - \Delta V_u$$

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

$$V_d = \frac{3\sqrt{2}}{\pi} V_{LL} \cos\alpha - \frac{3}{\pi}\omega L_s I_d$$

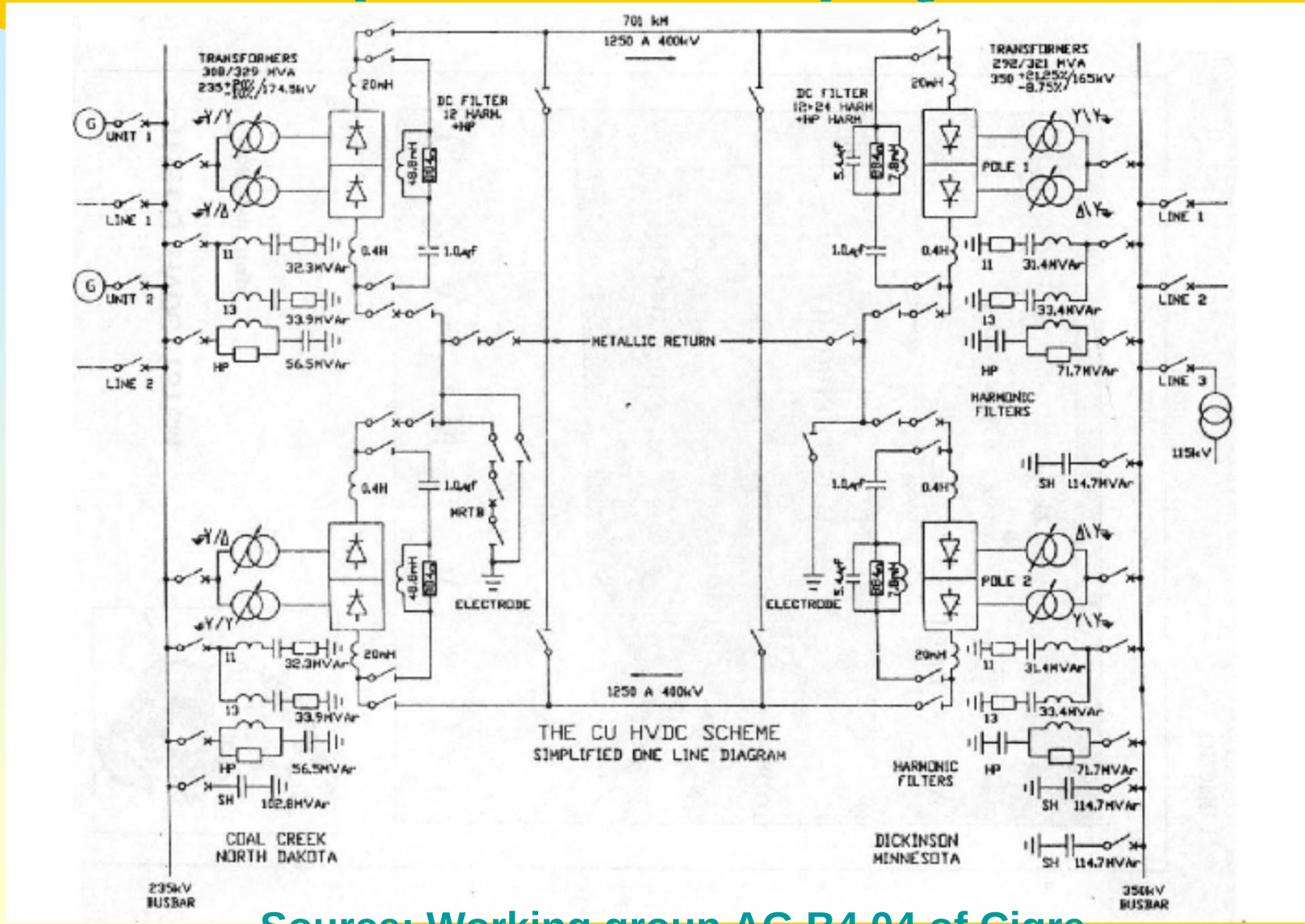
Power Factor Angle and Reactive Power in Rectifier and Inverter Modes



$$\phi_1 (= \alpha + u/2)$$

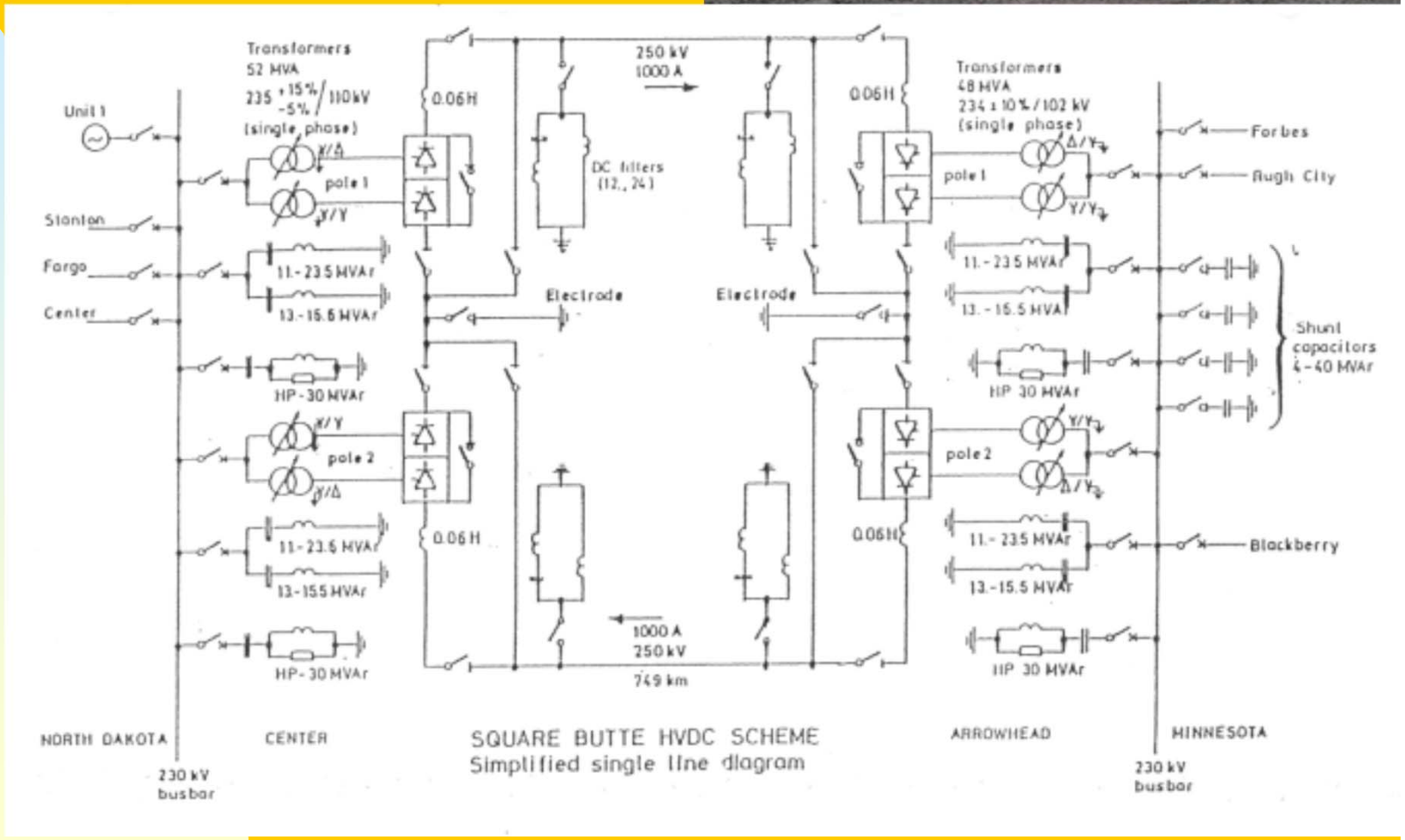
$$Q_{3\phi} = 3V_a I_{a1} \sin(\alpha + u/2)$$

GRE HVDC (Current-Link) System :



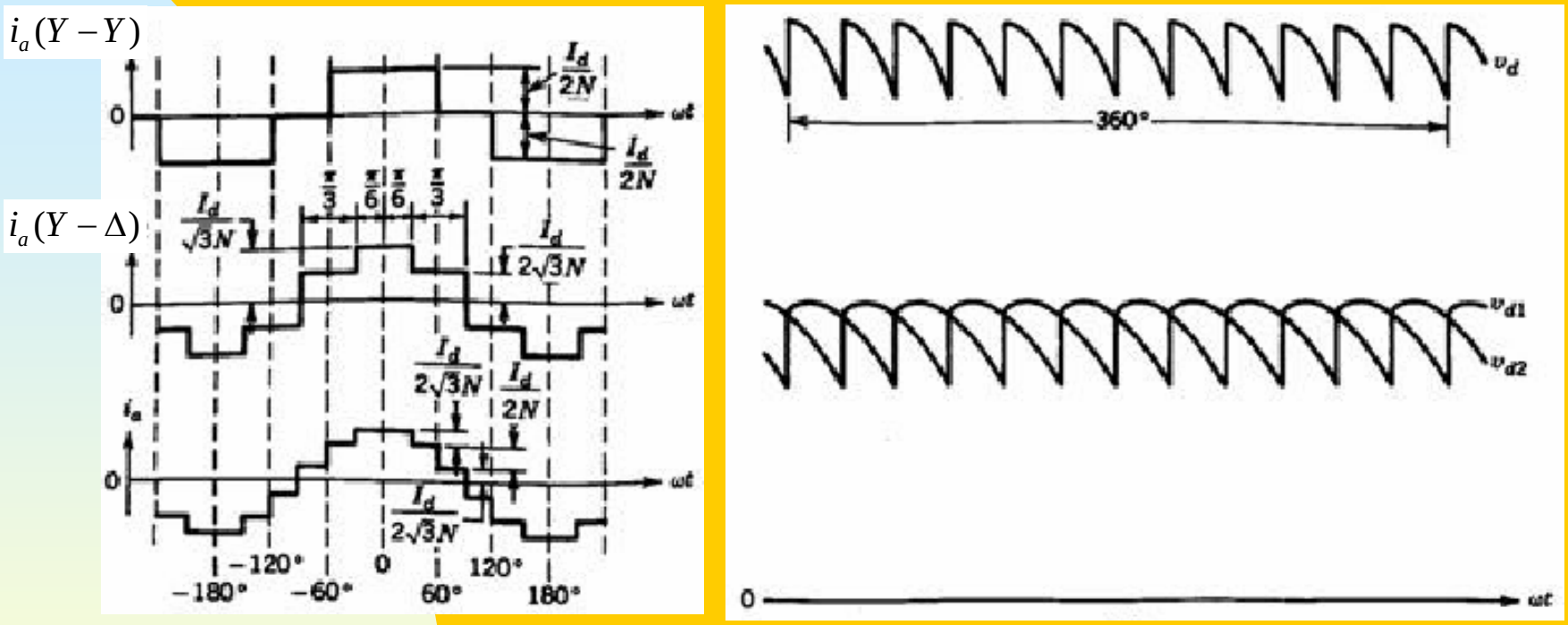
Source: Working group AG B4.04 of Cigre.

Filters and Capacitors in HVDC Terminals



Source: Working group AG B4.04 of Cigre.

12-Pulse Waveforms



(*a*) (*b*)

Fig. 7-17 Six-pulse and 12-pulse current and voltage waveforms [2].