Analysis of Commutation Phenomenon

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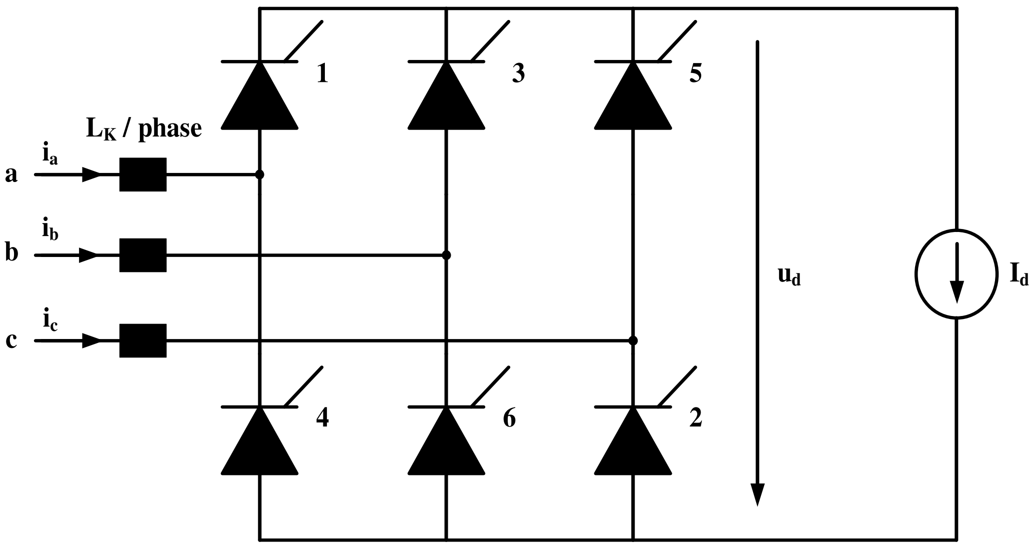
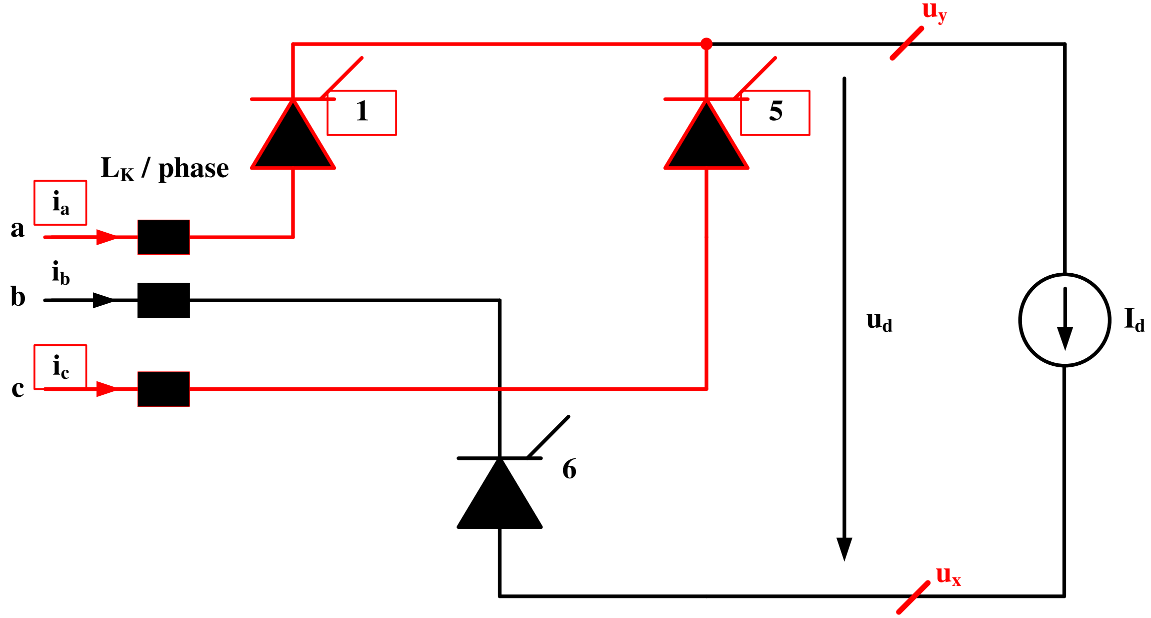
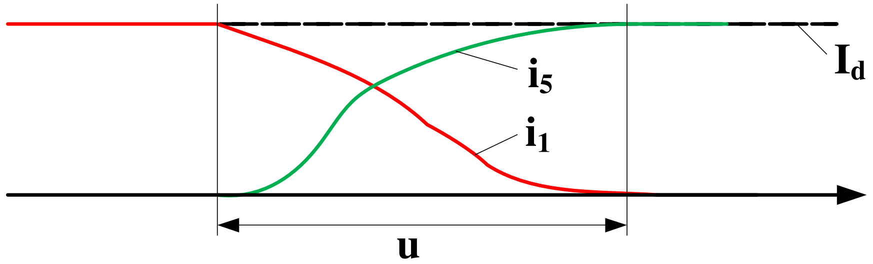
Commutation 1→5

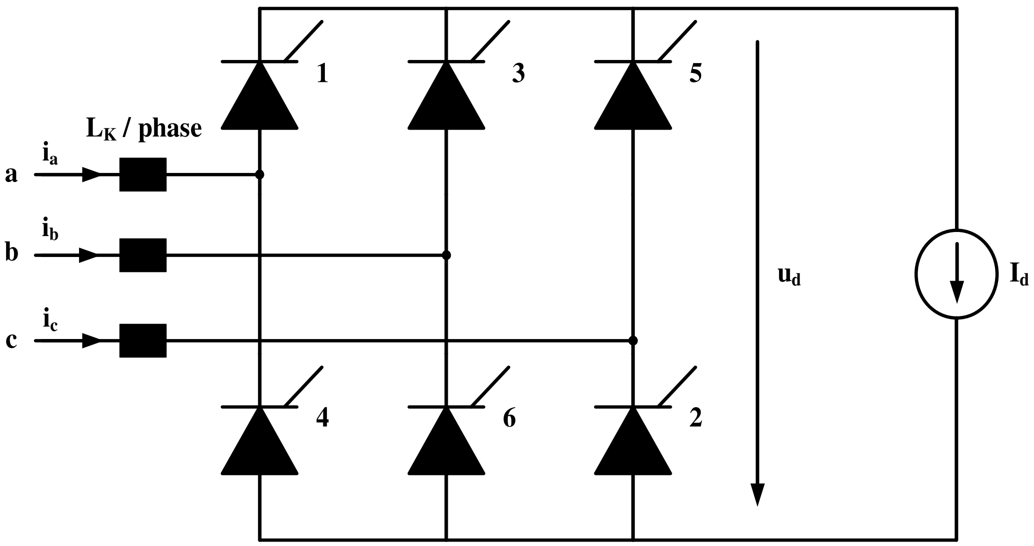


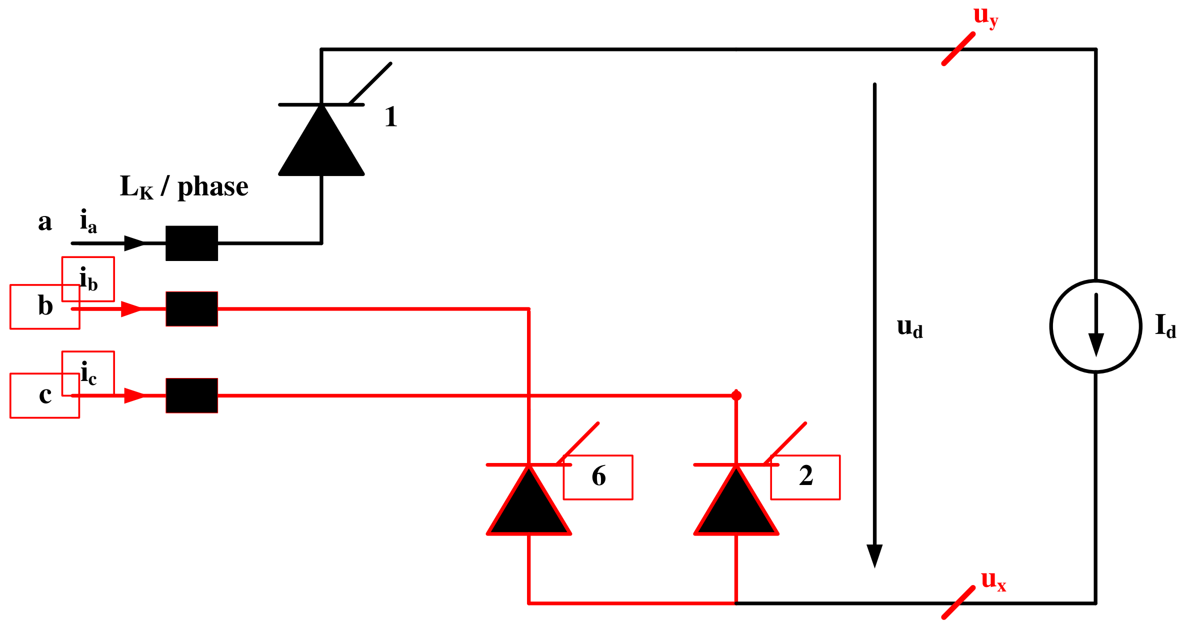


$$\left.\begin{aligned} u_y &= \frac{1}{2}(u_a + u_c) = -\frac{1}{2}u_b \\ u_x &= u_b \\ u_a + u_b + u_c &= 0 \end{aligned}\right\} \Rightarrow u_d = u_y - u_x = -\frac{3}{2}u_b$$

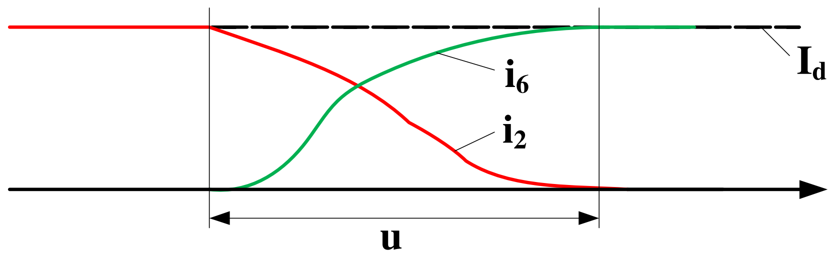


Commutation 2→6

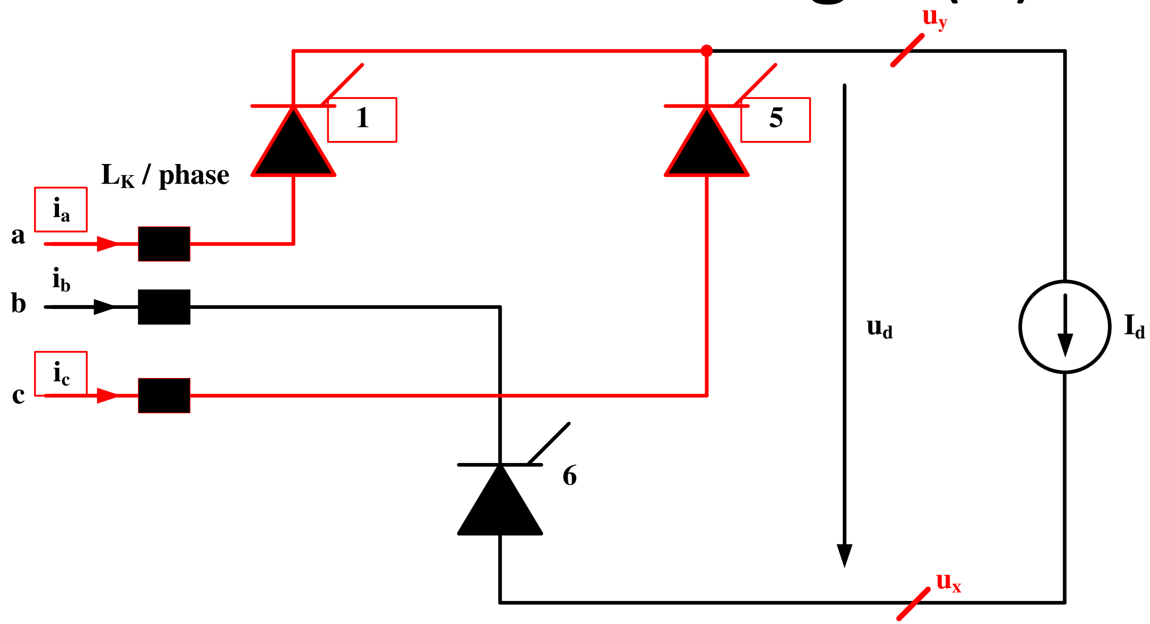




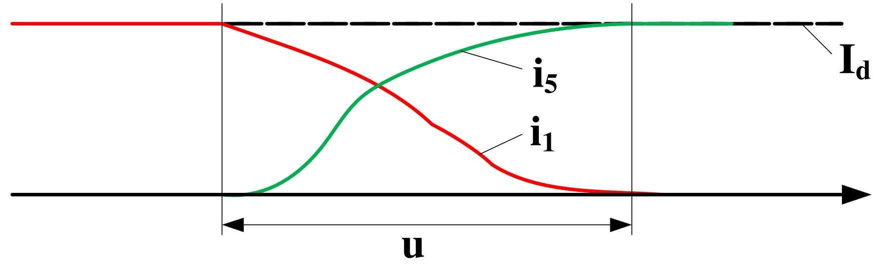
$$\left.\begin{aligned} u_y &= u_a \\ u_x &= \frac{1}{2}\left(u_b + u_c\right) = -\frac{1}{2}u_a \\ u_a + u_b + u_c &= 0 \end{aligned}\right\} \Rightarrow u_d = u_y - u_x = \frac{3}{2}u_a$$



Commutation Angle (u) – Voltage Drop (ΔV_d)

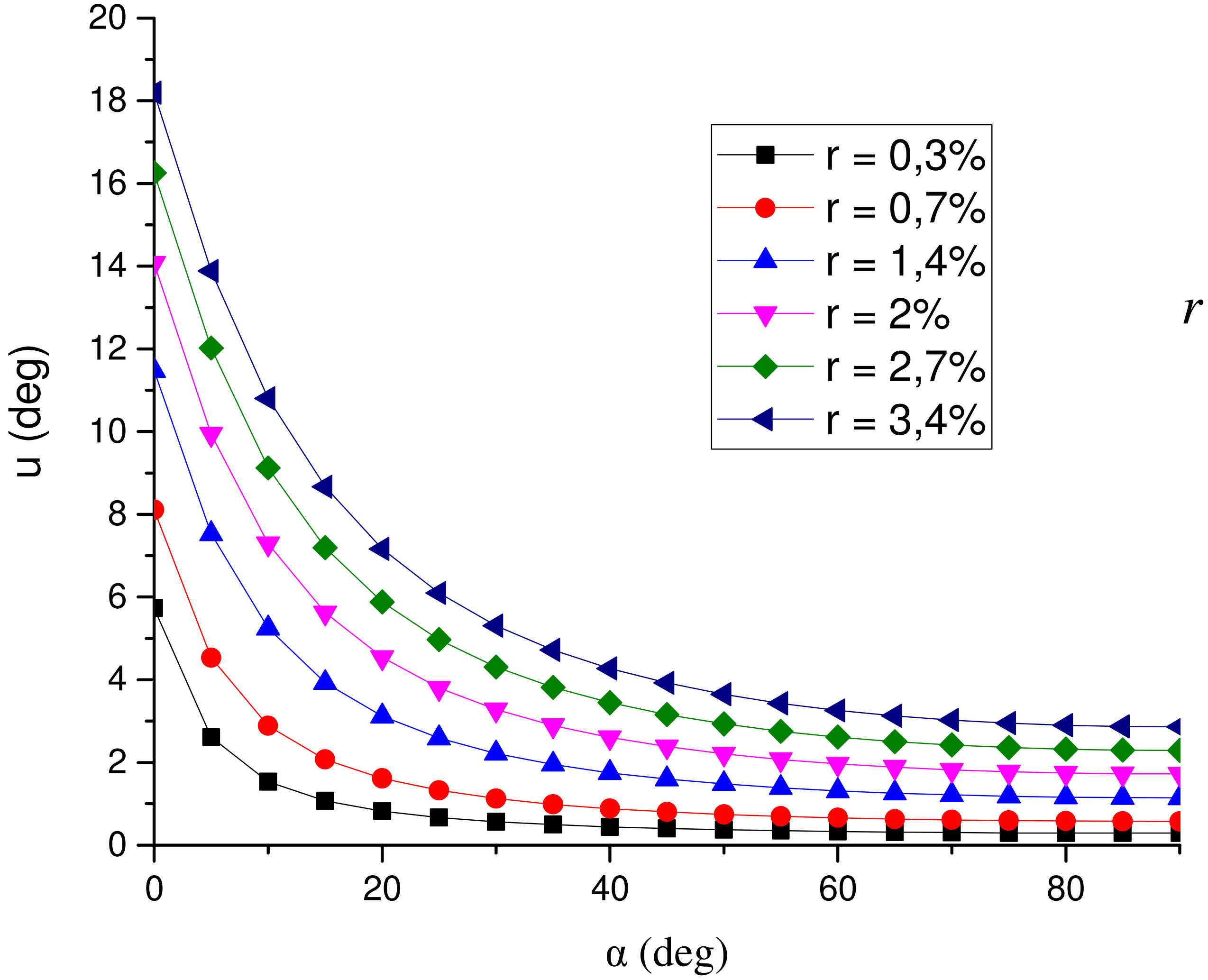


Commutation 1→5 is considered



$$\left.\begin{aligned} i_a &= i_u \\ i_c &= I_d - i_u \\ L_K \frac{di_u}{dt} &= \frac{1}{2}\left(u_c - u_a\right) \end{aligned}\right\} \Rightarrow \left.\begin{aligned} \Delta V_d &= \frac{3}{\pi}\omega L_K I_d \\ \cos\left(a+u\right) &= \cos a - \frac{2\omega L_K}{\sqrt{2}V_{LL}} I_d \end{aligned}\right\} \Rightarrow V_d = V_d^0 - \Delta V_d = \frac{3\sqrt{2}}{\pi} V_{LL}\cos\alpha - \frac{3}{\pi}\omega L_K I_d$$

Commutation Angle (u) – Voltage Drop (ΔV_d), Results



$$r = \frac{\Delta V_d}{V_{LL}}$$

u_d, u_{T1}, i_a, α = 30 deg