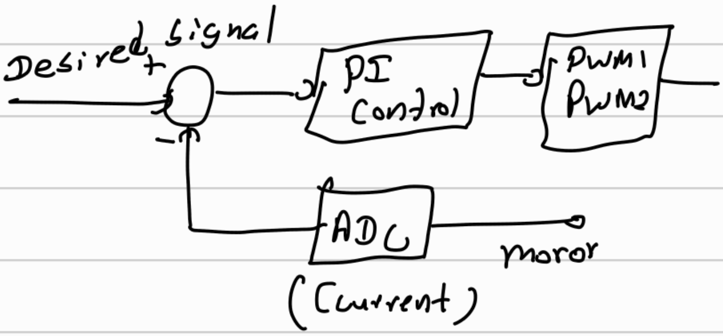
Torque → Current



max torque → rotor flux – current mmf from stator 90° degrees

$$Torque = \frac{3P}{2 \times 2}\left[\lambda_{dr} I_{qs}\right]$$

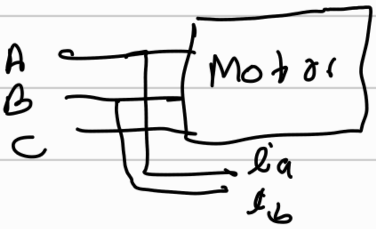
Intterupt

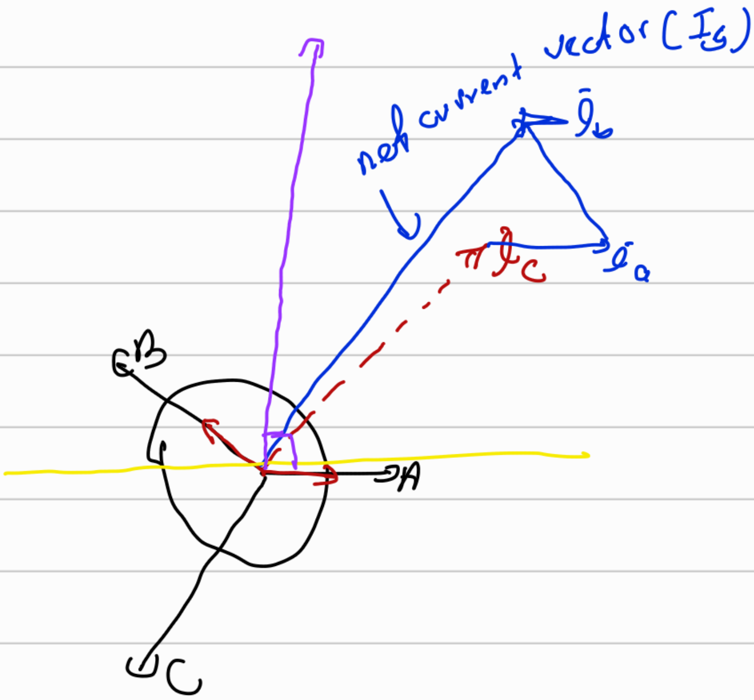
Measure rotor flux angle

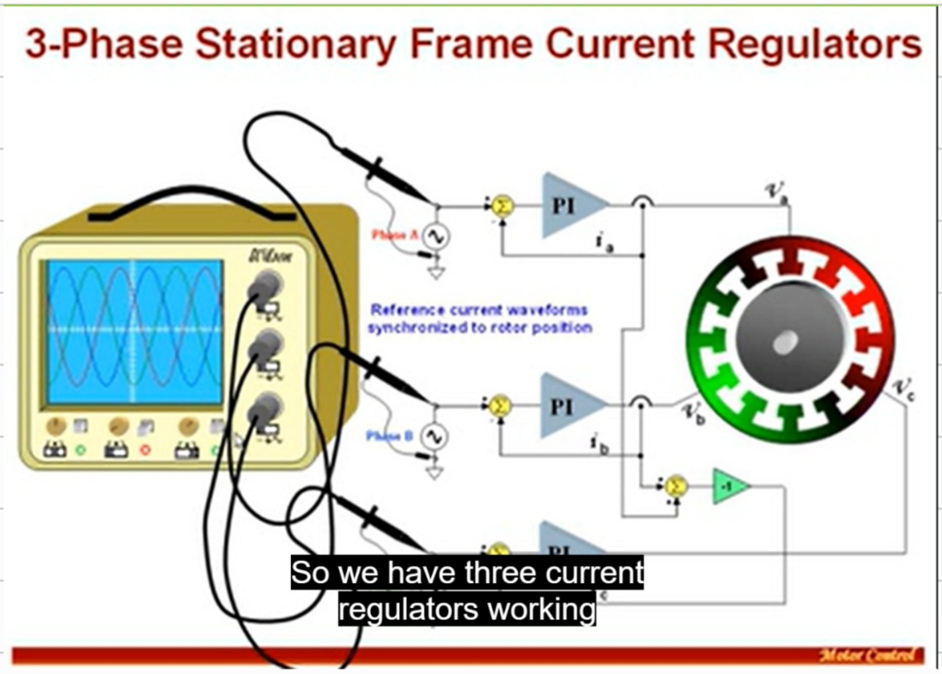
regulate current vector to be 90° wrt rotor flux

Exit Isr

3Phase





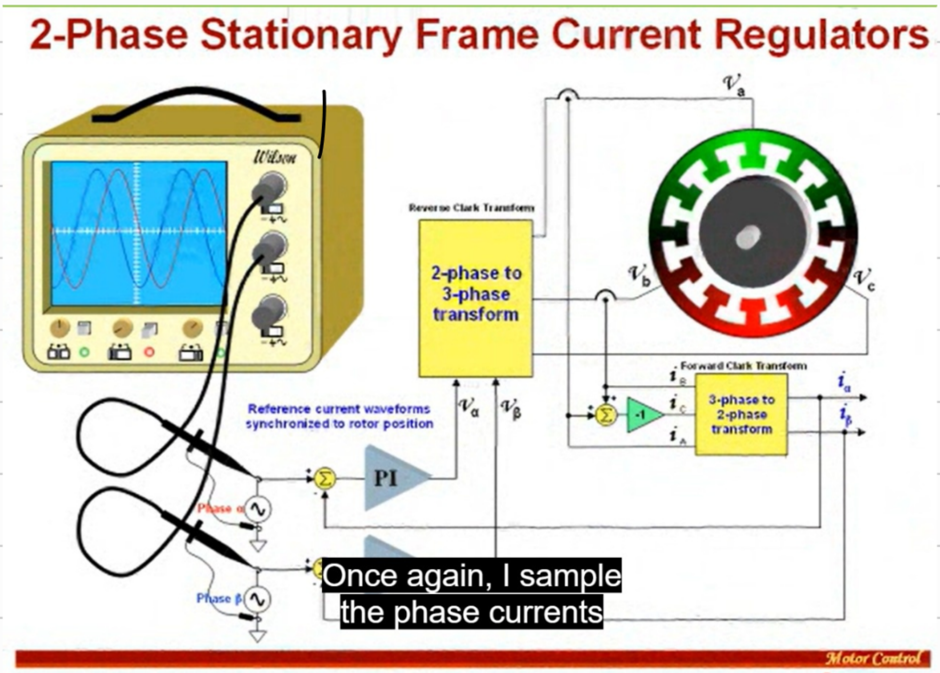


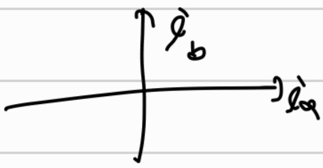
i_a i_b i_c calculated now

Output will take shape of sine waves

generate error signals

Convert the three phase current vectors into two orthogonal vectors

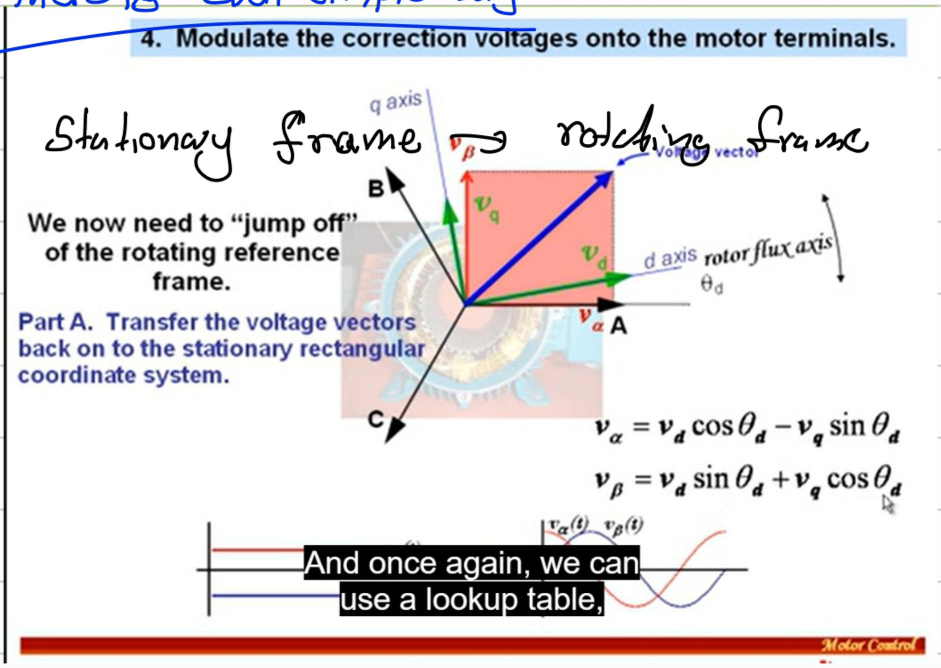




clark transformation → 3phase

There is even simple way

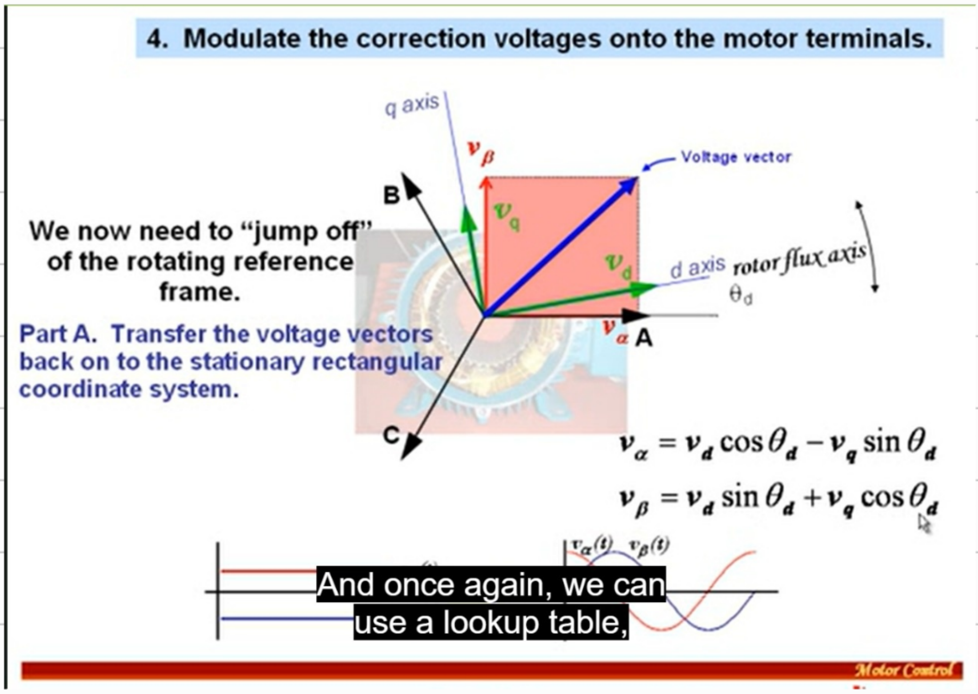
Stationary frame → rotating frame

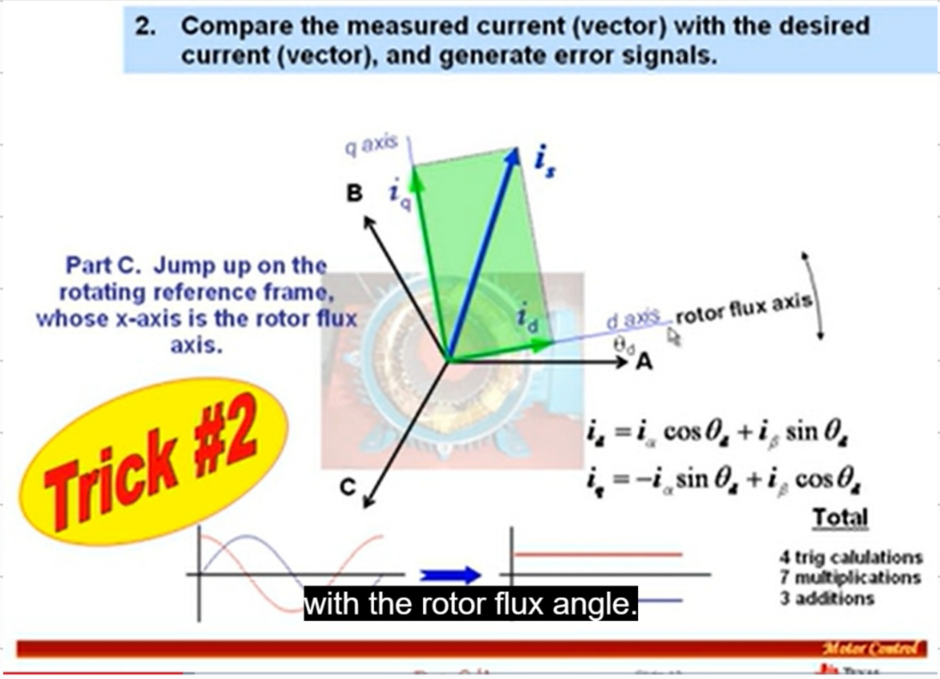


Park transformation

to derive → use lookup table (sin/cos)

i_d, i_q → DC





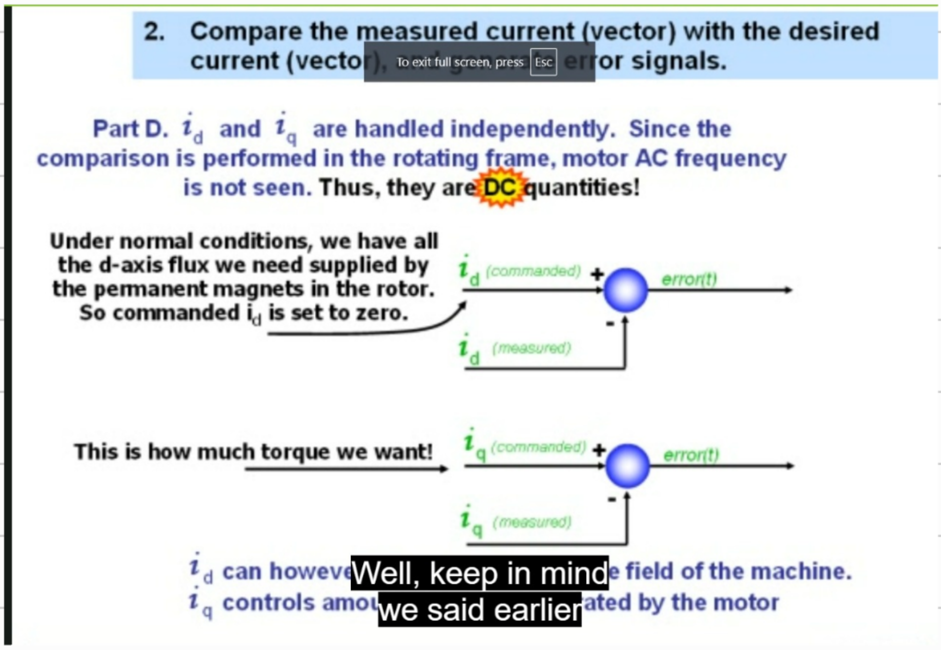
Current regulator pole $+f \rightarrow$ we dont need additional phase compensation

Sampling freq $\uparrow$

Phase delay $\downarrow$

now should bring it to stationary frame

① reverse park transformation



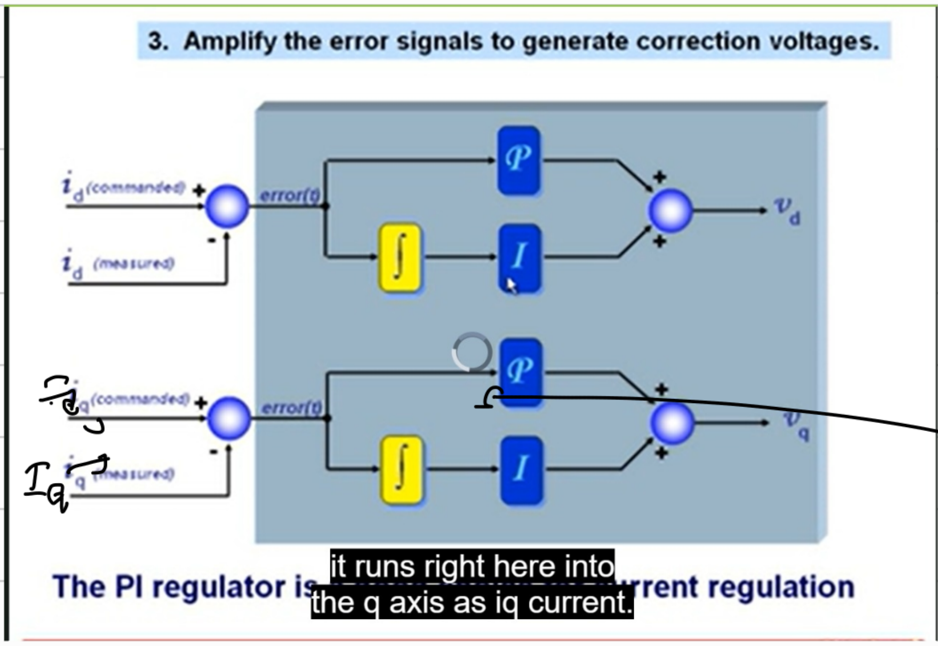
reverese clark → 2 → 3 phase

$$V_a = \frac{2}{3} V_\alpha$$

$$V_b = -\frac{1}{3} V_\alpha + \frac{1}{\sqrt{3}} V_\beta$$

$$V_c = -\frac{1}{3} V_\alpha - \frac{1}{\sqrt{3}} V_\beta$$

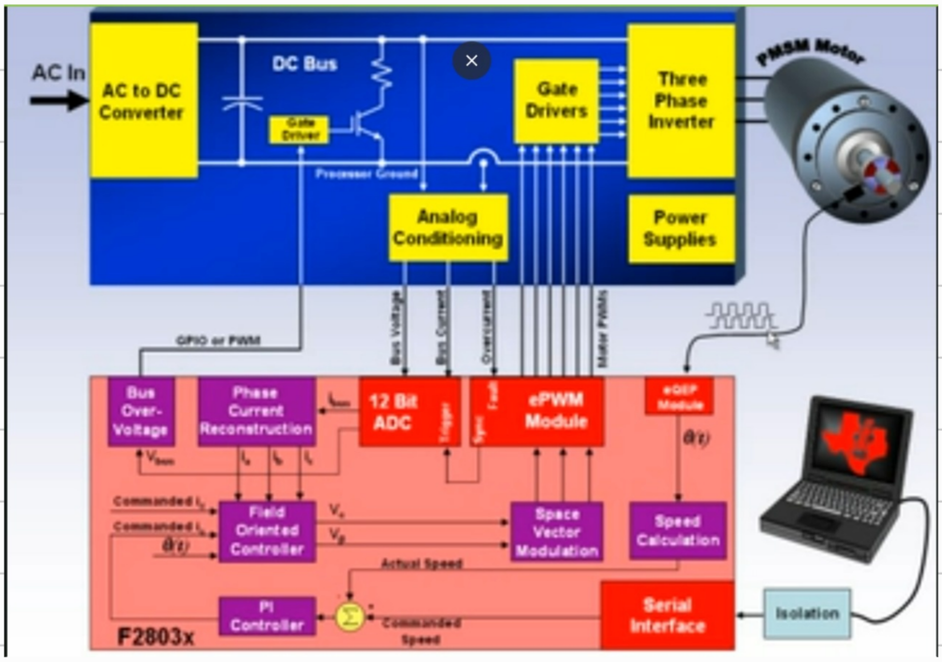
modulator



Iq

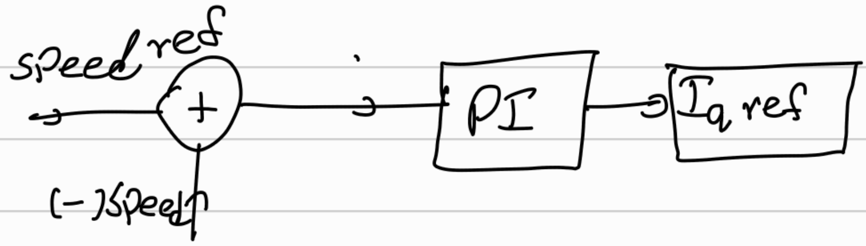
Sampe should exact right time

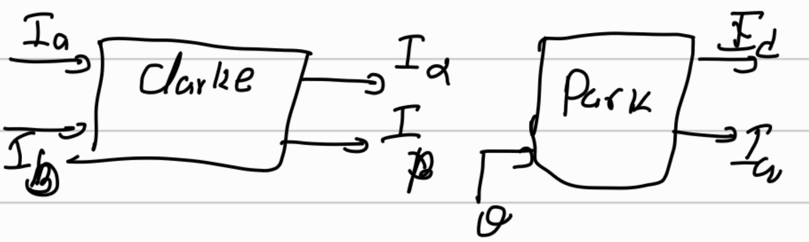
Purple → software

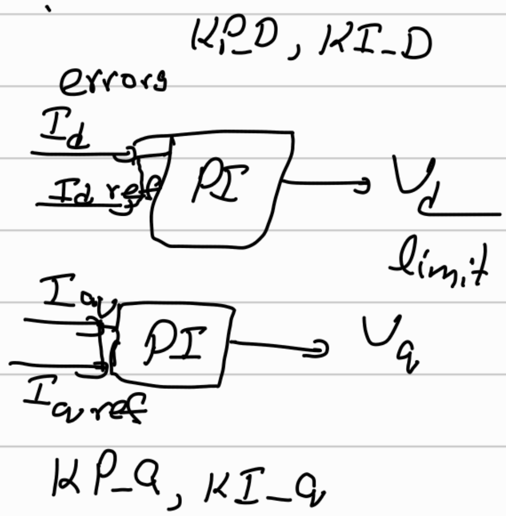


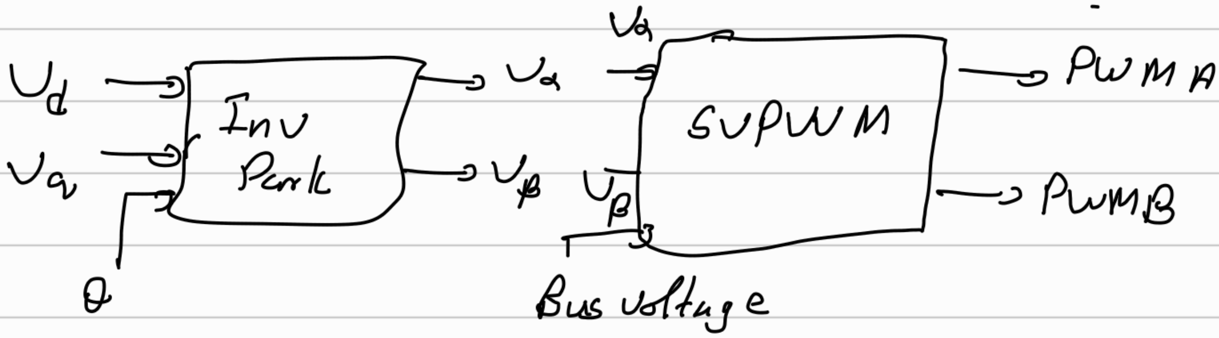
No inv clark → 2 phase

clark → I_a, I_b are not orthogonal and not centered around α-β axis









Speed in P

Interrupts

allow processor to respond promptly to specific event without polling → ensure precise timing

2 interrupt service routines → ADC ISR
timer0_isr

hardware driven
* temporaly hold

stored in prevecttable