Current Control System Introduction

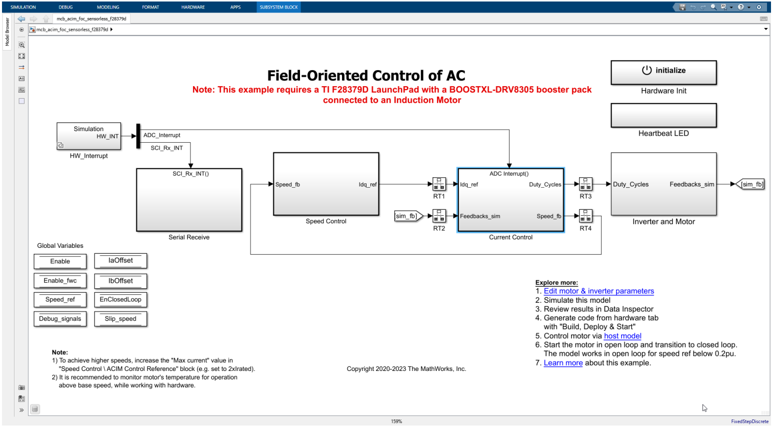


Figure: Field Oriented Control of ACIM

Current Control System (inside.)

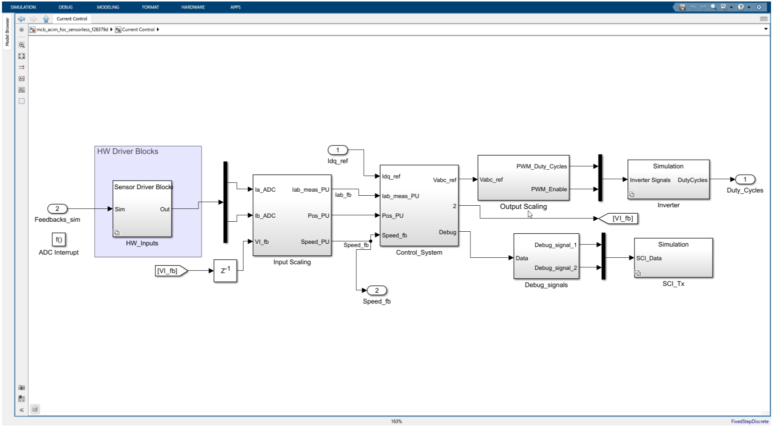
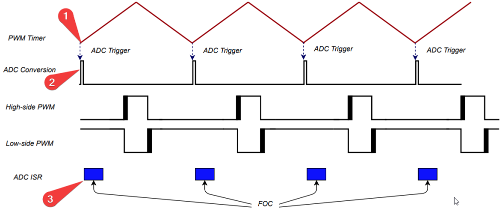


Figure: Field Oriented Control of ACIM

Current Control System (inside.)

- This System is triggered function-call sub-system.
- and it's triggered like so:

Figure 4-2. Hardware Timing and Synchronization



The PWM peripheral of the microcontroller in addition to generating the three phase PWM signals, triggers the ADC channels periodically on period match event. The triggered ADC channels take phase current A and phase current B as inputs and convert the signals to their digital equivalent for use by the software. Simultaneous samples of the phase currents are taken for optimal performance. In addition to phase currents, the software also measures the DC bus voltage. After the ADC conversion of the phase currents is completed, an interrupt is generated. The generated interrupt is used to carry-out start-up and subsequent FOC tasks. The calculated PWM cycles are updated in the PWM module to actuate the motor.

Figure: Image courtesy of Microchip Inc. **Source**

ADC current Offset graph

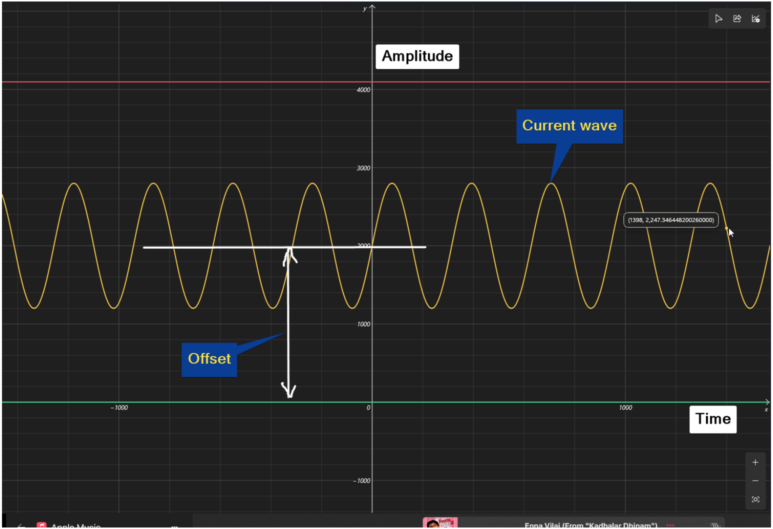


Figure: Offset graph

I_α and I_β currents

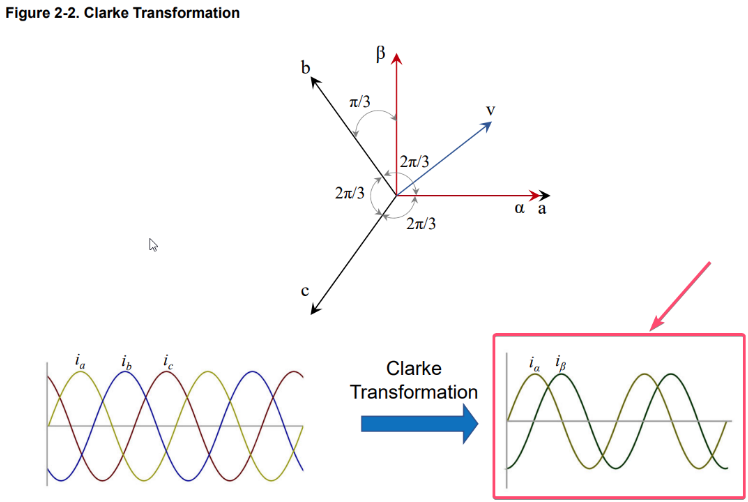


Figure: Image courtesy of Microchip Inc. **Source**

Flux Observer: Rotor Flux Estimation

$$\psi_\alpha = \frac{L_r}{L_m}\left(\int (V_\alpha - I_\alpha R)dt - \sigma L_s I_\alpha\right)$$

$$\psi_\beta = \frac{L_r}{L_m}\left(\int (V_\beta - I_\beta R)dt - \sigma L_s I_\beta\right)$$

- V_α, V_β: Stator voltages in the alpha-beta reference frame.
- I_α, I_β: Stator currents in the alpha-beta reference frame.
- R: Stator resistance.
- L_r, L_m, L_s: Rotor, magnetizing, and stator inductances.
- σ: Total leakage factor.
- $\int (V_\alpha - I_\alpha R)dt$, $\int (V_\beta - I_\beta R)dt$: Flux linkage in the stator windings.
- $\sigma L_s I_\alpha$, $\sigma L_s I_\beta$: Leakage flux not linking with rotor.
- ψ_α, ψ_β: Estimated rotor flux components in alpha-beta frame.

Flux Observer

$$\psi_\alpha = \frac{L_r}{L_m}\left(\int(V_\alpha - I_\alpha R)dt - \sigma L_s I_\alpha\right)$$

$$\psi_\beta = \frac{L_r}{L_m}\left(\int(V_\beta - I_\beta R)dt - \sigma L_s I_\beta\right)$$

- $\frac{L_r}{L_m}$: This ratio represents the fraction of total magnetic flux linking the rotor.
- $\int(V - IR)$dt: Represents the electromagnetic flux linkage.
- $\sigma L_s I$: Represents the leakage flux not linking with rotor.

$$\theta_e = \tan^{-1}\left(\frac{\psi_\beta}{\psi_\alpha}\right)$$

- θ_e rotor flux Position.

Flux Observer

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- θ_e rotor flux Position.

Speed measurement

$$Speed = \frac{d\theta}{dt}$$

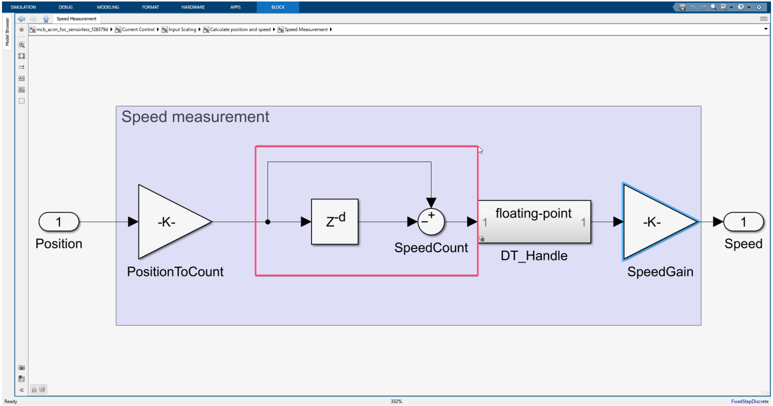

Figure: Inside speed measurement