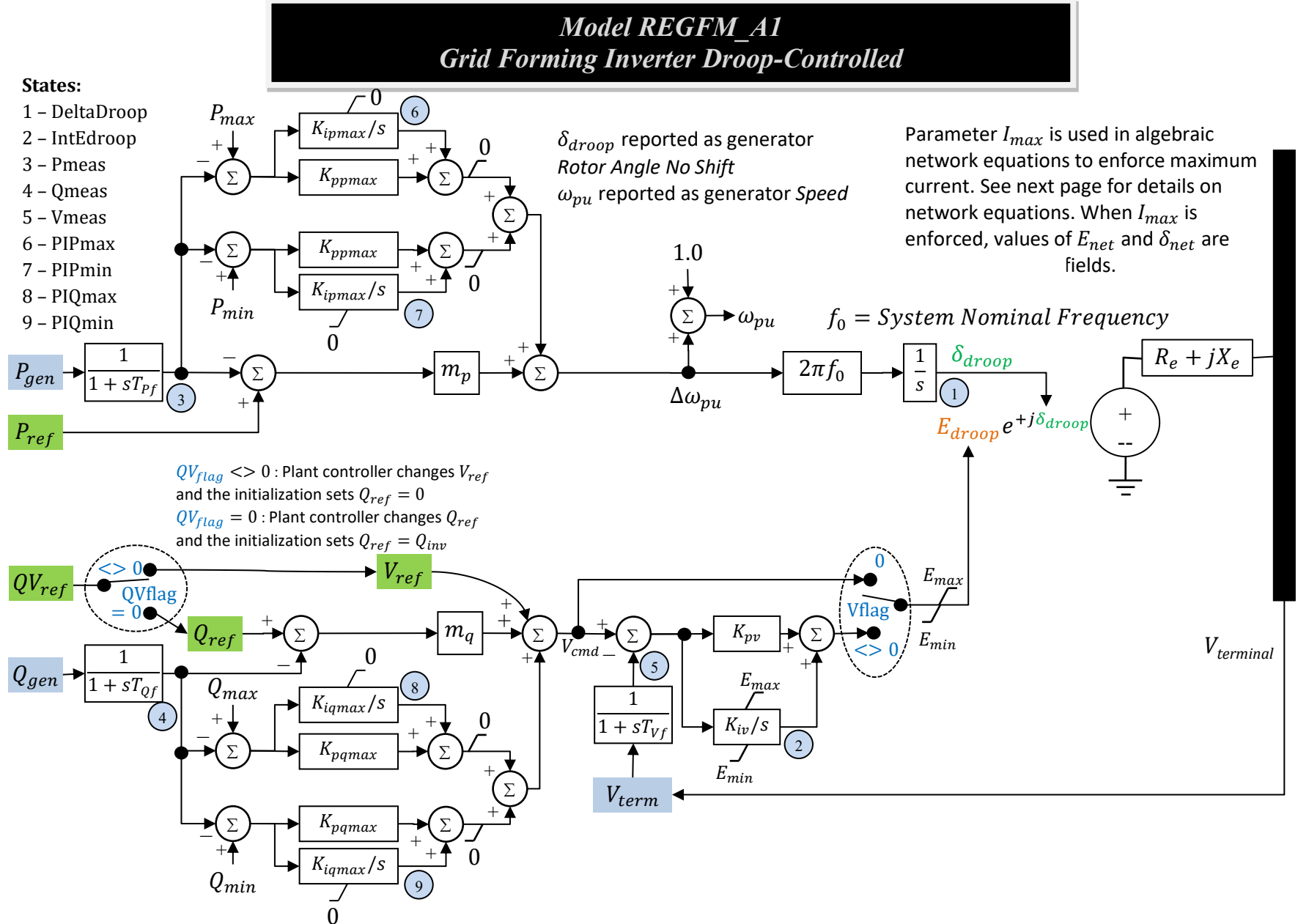
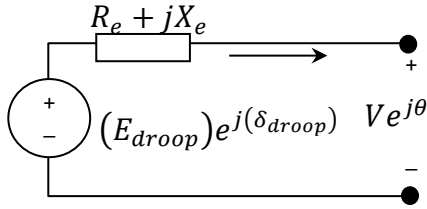


Machine Model REGFM_A1



Network Boundary Equations Explanation

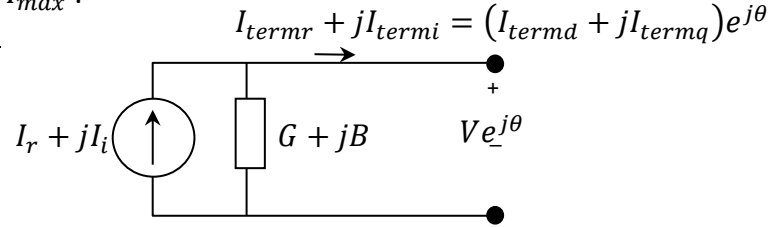
Model States: E_{droop} , δ_{droop} Model Parameters: R_e , X_e , and I_{max} .



$$G + jB = \frac{1}{R_e + jX_e}$$

$$G = \frac{R_e}{R_e^2 + X_e^2}$$

$$B = \frac{-X_e}{R_e^2 + X_e^2}$$



When the current limit is not active, the Norton current on the network reference frame ($I_r + jI_i$) is calculated as follows.

$$\begin{aligned} I_r + jI_i &= E_{droop} e^{j\delta_{droop}} (G + jB) = [E_{droop} \cos(\delta_{droop}) + jE_{droop} \sin(\delta_{droop})] (G + jB) \\ &= [GE_{droop} \cos(\delta_{droop}) - BE_{droop} \sin(\delta_{droop})] + j[BE_{droop} \cos(\delta_{droop}) + GE_{droop} \sin(\delta_{droop})] \\ I_r &= GE_{droop} \cos(\delta_{droop}) - BE_{droop} \sin(\delta_{droop}) \\ I_i &= BE_{droop} \cos(\delta_{droop}) + GE_{droop} \sin(\delta_{droop}) \end{aligned}$$

During the network algebraic solution if the terminal current exceeds the maximum current limit (I_{max}), then the algebraic network equations transition to current equations that have a total current of I_{max} , but the component currents maintain the same ratio as the models desired currents. By assuming they maintain the same ratio, the assumption is that power factor is maintained. Assuming $I_{term} \leq I_{max}$, then terminal currents are the following (subtract off the currents that goes through the Norton admittance).

$$\begin{aligned} I_{termr} &= GE_{droop} \cos(\delta_{droop}) - BE_{droop} \sin(\delta_{droop}) - [GV \cos(\theta) - BV \sin(\theta)] \\ I_{termi} &= BE_{droop} \cos(\delta_{droop}) + GE_{droop} \sin(\delta_{droop}) - [BV \cos(\theta) + GV \sin(\theta)] \end{aligned}$$

If $\sqrt{I_{termr}^2 + I_{termi}^2} > I_{max}$, then the terminal currents transition to

$$\begin{aligned} I_{usedr} &= I_{termr} \frac{I_{max}}{\sqrt{I_{termr}^2 + I_{termi}^2}} \\ I_{usedi} &= I_{termi} \frac{I_{max}}{\sqrt{I_{termr}^2 + I_{termi}^2}} \end{aligned}$$

When the current limit is being enforced the model injects this current at the network.

Users may report results for Machine Other Fields for E_{droop} value in the block diagram and a calculated value of E_{net} and δ_{net} from the following equation. This is for information only.

$$E_{net} e^{j\delta_{net}} = V_{term} e^{j\delta_{term}} + (I_{usedr} + jI_{usedi})(R_e + jX_e)$$

Under normal operation when $I_{term} \leq I_{max}$, then $E_{net} = E_{droop}$ and $\delta_{net} = \delta_{droop}$.