The DPI integrator

$$I_{out} = I_0 e^{\frac{\kappa V_C}{U_T}}$$

$$I_1 + I_2 = I_{in}$$

$$I_2 = I_\tau + I_C$$

$$I_C = C \frac{d}{dt} V_C$$

$$I_C = C \frac{U_T}{\kappa I_{out}} \frac{d}{dt} I_{out}$$

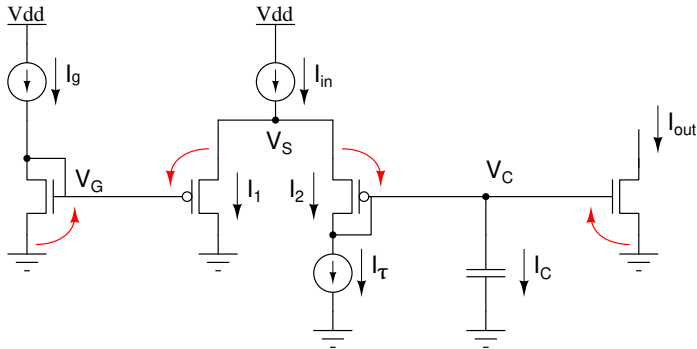$$\tau = \frac{C U_T}{\kappa I_\tau}$$

$$\text{if } I_{in} \gg I_\tau$$

$$I_g \cdot I_1 = I_2 \cdot I_{out}$$

$$I_g \cdot (I_{in} - I_\tau - I_C) = (I_\tau + I_C) \cdot I_{out}$$

$$\boxed{\tau \left(1 + \frac{I_g}{I_{out}} \right) \frac{d}{dt} I_{out} + I_{out} = \frac{I_g I_{in}}{I_\tau} - I_g}$$

$$\boxed{\tau \frac{d}{dt} I_{out} + I_{out} = \frac{I_g}{I_\tau} I_{in}}$$