$$\omega_{ugb} < \frac{\omega_0}{Q_0}$$

for $-20dB$ gain margin

$$\omega_{ugb} = \frac{\omega_0}{10 Q_0}$$

$$\frac{V_o(s)}{V_{in}(s)} = LG_{comp}(s) = \beta H_{comp}(s) G_{PWM} H_{DRV}(s) H_{LC}(s)$$

$$= \beta \frac{k_i}{s} \frac{V_{dd}}{V_m} H_{LC}(s)$$

$$\beta \frac{V_{dd}}{V_m} = K_{u0}$$

$$LG_{comp}(s) = K_{u0} \frac{k_i}{s} H_{LC}(s)$$

$$K_{u0} k_i = \omega_{ugb} = \frac{\omega_0}{10 Q_0}$$

$$k_i = \frac{\omega_0}{K_{u0} 10 \times Q_0} = \frac{1}{10 K_{u0}} \left(\frac{R_{loss}}{L} + \frac{1}{R_{load} C} \right)$$

For no load,

$$R_{Load} = \infty$$

$$k_i = \frac{1}{10 K_{m0}} \left(\frac{R_{loss}}{L} \right)$$

Example

$V_{dd} = 1.8V$, $V_{out} = 1.2V$, $V_{ref} = 0.6V$

$F_{sw} = 1 MHz$, $L = 3.3 \mu H$, $C = 10 \mu F$

$R_{ds\text{-}on} = 50 m\Omega$, $R_{dcr} = 50 m\Omega$, $V_m = 1V$

$$K_{m0} = \frac{V_{dd}}{V_m} \times \beta = 1.8 \times \frac{1}{2} = 0.9$$

$$R_{loss} = R_{ds\text{-}on} + R_{dcr} = 100 m\Omega$$

$$L = 3.3 \mu H$$

$$k_i = \frac{1}{10 \times 0.9} \left(\frac{0.1}{3.3 \mu H} \right) = 3.367 \text{ krad/sec}$$

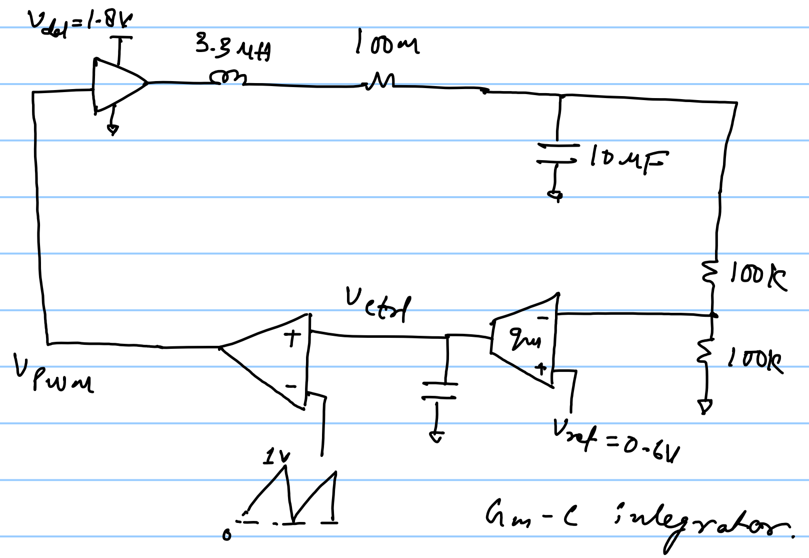
Integrator.

$$\frac{g_m}{C_i} = k_i = 3.367 \text{ krad/sec}$$

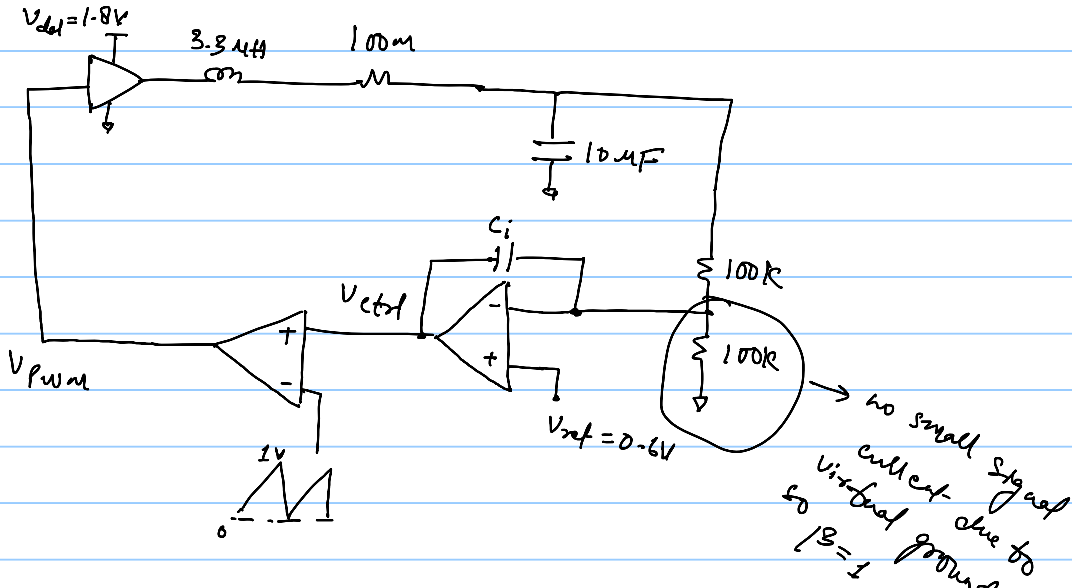
$g_m = 10\,\mu A/V$

$$C_i = \frac{g_m}{k_i} = \frac{10^{-5}}{3.367 \times 10^3} = \frac{1}{3.367} \times 10^{-8}$$

$= 2.97\,nF$



Gm-C integrator.



$$K_{MO} = \frac{V_{dd}}{V_m}$$

$$C_i = 5.94\,nF$$

⇒ Integral or type-1 compensation slows down the loop due to lower ω_{gc}.

⇒ Poor transient response.

⇒ Only suitable for low bandwidth system.
(fixed load ON/OFF system)