TI DSP, MCU 및 Xilinx Zynq FPGA 프로그래밍 전문가 과정

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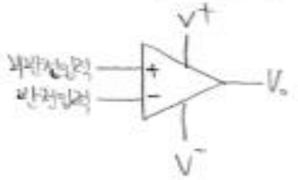
목차

회로이론

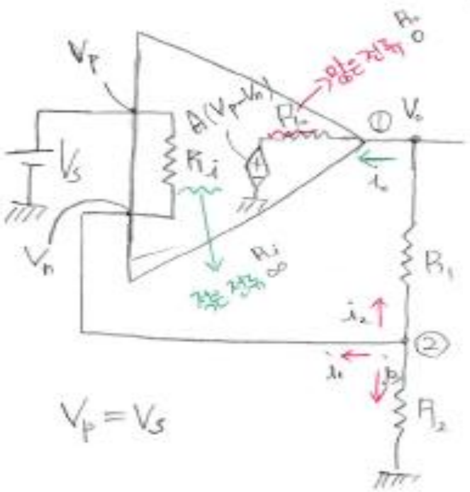
11) OPP_AMP

∘ OP-AMP



※ open loop Amp

⇒ MPU 6050을 사용하여 적분과 미분으로 뽑은 θ값을 구함



$V_p = V_s$

① $\dfrac{V_o - A(V_p - V_n)}{R_o} = \dfrac{V_n - V_o}{R_1} \Rightarrow V_p - V_n = \dfrac{R_o V_o - R_o V_n + R_1 V_o}{A R_1}$

② $\dfrac{V_o - V_n}{R} + \dfrac{V_n - V_p}{R_i} + \dfrac{V_n}{R_2} = 0 \Rightarrow \dfrac{R_o R_2 V_o - R_o R_2 V_n + R_1 R_2 V_o + A R_o R_i V_n - A R_2 R_i V_o + A R_1 R_i V_n}{A R_1 R_2 R_i} = 0$

$\therefore V_o = \dfrac{R_o R_2 - A R_2 R_i - A R_1 R_i}{R_o R_2 + R_1 R_2 - A R_2 R_i} V_n$

③ $V_p = \dfrac{R_o V_o - R_o V_n + R_1 V_o + A R_1 V_n}{A R_1}$

④ $V_p = \dfrac{R_1(R_o R_2 - A R_2 R_i - A R_1 R_i) V_n + A R_1 (R_o R_2 + R_1 R_2 - A R_2 R_i) V_n + R_o(R_o R_2 - A R_2 R_i - A R_1 R_i) V_n - R_o (R_o R_2 + R_1 R_2 - A R_2 R_i) V_n}{A R_1 (R_o R_2 + R_1 R_2 - A R_2 R_i)}$

$\dfrac{1}{V_o}$, G값을 구하기 위함.

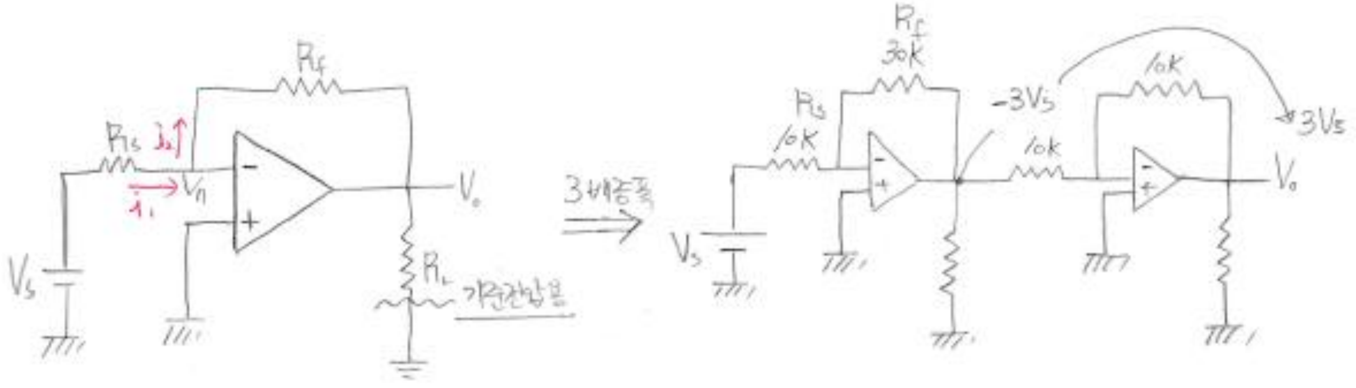
$= \dfrac{(A R_1 R_o R_2 + A R_1^2 R_2 + A^2 R_1 R_2 R_i - A R_1 R_2 R_i - A^2 R_1^2 R_i - A R_1 R_o R_i) V_n}{A R_1 (R_o R_2 + R_1 R_2 - A R_2 R_i)} \times \boxed{\dfrac{1}{V_n} \dfrac{(R_o R_2 + R_1 R_2 - A R_2 R_i)}{(R_o R_2 - A R_2 R_i - A R_1 R_i)}}$

⑤ $G = \dfrac{R_o R_2 - A R_2 R_i - A R_1 R_i}{R_o R_2 + R_1 R_2 - A R_2 R_i - R_2 R_i - R_1 R_i - R_o R_i} \Rightarrow \lim_{A \to \infty} \lim_{R_i \to \infty} \lim_{R_o \to 0}$

$= \dfrac{-A R_2 R_i - A R_1 R_i}{R_1 R_2 - A R_2 R_i - R_2 R_i - R_1 R_i} \Rightarrow \therefore \dfrac{R_2 + R_1}{R_2}$

12) Inverting Amplifier

○ Inverting - Amplifier



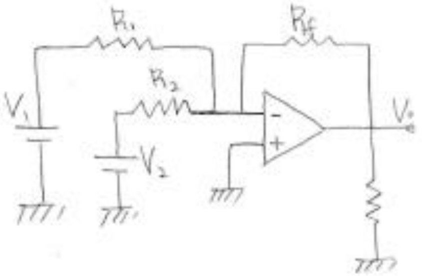
$0 = V_p = V_n$, $i_n = i_p = 0$

① $\dfrac{V_s - \overset{0}{V_n}}{R_s} = \dfrac{\overset{0}{V_n} - V_o}{R_f}$

$\therefore \; G = \dfrac{V_o}{V_s} = -\left(\dfrac{R_f}{R_s}\right)$

13) Summing Amplifier

○ Summing Amplifier



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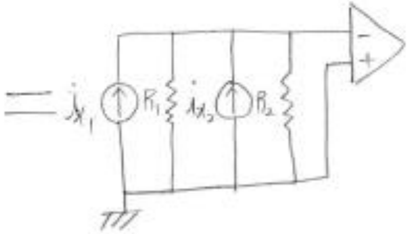
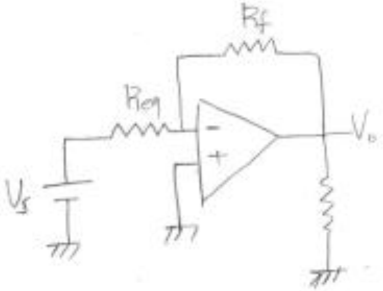


$V_p = V_n$, $i_p = i_n = 0$

$$i_s = \frac{V_1}{R_1} + \frac{V_2}{R_2}$$

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

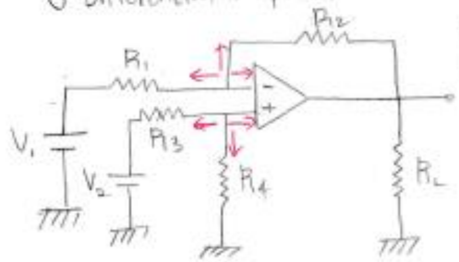
⇒



$$\therefore G = \frac{R_f}{R_{eq}} = \frac{R_1 + R_2}{R_1 R_2} R_f = \frac{R_f}{R_2} + \frac{R_f}{R_1}$$

증폭비

○ Differential Amplifier



$[i_p = i_n = 0 , V_p = V_n]$

① $\frac{V_n - V_1}{R_1} + \frac{V_n - V_o}{R_2} = 0 \Rightarrow$

② $\frac{V_p - V_2}{R_3} + \frac{V_p}{R_4} = 0 \Rightarrow R_4 V_p - R_4 V_2 + R_3 V_p = 0$

$(R_3 + R_4) V_p = R_4 V_2$

③ $V_p = \frac{R_4}{R_3 + R_4} V_2 = V_n$

④ $\frac{\frac{R_4 V_2}{R_3 + R_4} - V_1}{R_1} + \frac{\frac{R_4 V_2}{R_3 + R_4} - V_o}{R_2} = 0 \Rightarrow \frac{R_4 V_2 - (R_3 + R_4) V_1}{R_1 (R_3 + R_4)} + \frac{R_4 V_2 - (R_3 + R_4) V_o}{R_2 (R_3 + R_4)}$

⑤ $\frac{R_2 R_4 V_2 - R_2 (R_3 + R_4) V_1 + R_1 R_4 V_2 - R_1 (R_3 + R_4) V_o}{R_1 R_2 (R_3 + R_4)} = 0$

$$V_o = \frac{R_2 R_4 V_2 + R_1 R_4 V_2 - R_2 (R_3 + R_4) V_1}{R_1 (R_3 + R_4)}$$

$$= \underbrace{\boxed{\frac{R_2 R_4 + R_1 R_4}{R_1 (R_3 + R_4)}}}_{G_2} V_2 - \underbrace{\boxed{\frac{R_2}{R_1}}}_{G_1} V_1$$

뺄셈기

14) 임피던스와 공진에서의 Q값

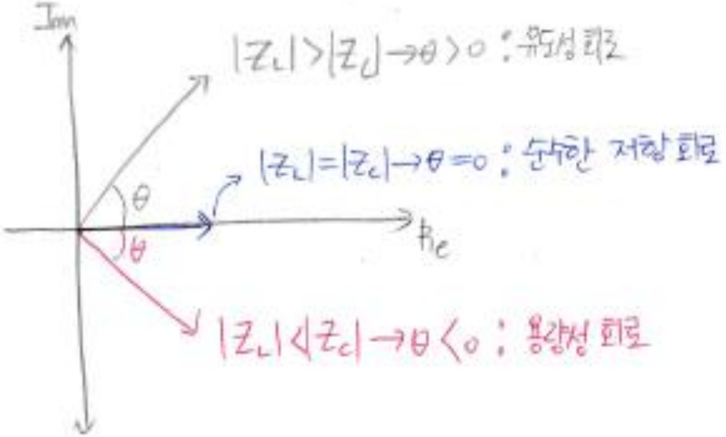
○ 임피던스

$$Z_{eq} = Z_R + Z_L + Z_C = R + j\omega L + \frac{1}{j\omega C}$$

$$= R + j\left(\omega L + \frac{1}{\omega C}\right)^{=0}$$ 공진주파수

$Z_{eq} = R$, $\omega L = \frac{1}{\omega C}$ ⇒ "공진상태"

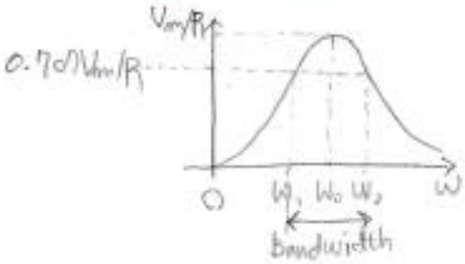
$$\therefore \omega = \frac{1}{\sqrt{LC}}$$



○ Selectivity

※ $Q_s = \frac{X_0}{R}$, $X_0 = \omega_0 L = \frac{1}{\omega_0 C}$

진폭률의 민감도



$$I_s = \frac{V_s}{Z_{eq}} = \frac{V_m\angle 0^\circ}{\sqrt{R^2+\left(\omega L - \frac{1}{\omega C}\right)^2}\angle\theta} = \frac{V_m}{\sqrt{R^2+\left(\omega L - \frac{1}{\omega C}\right)^2}}\angle -\theta$$

$P(\omega_0) = \frac{1}{2}\frac{V_m^2}{R}$ Max

$P(\omega_1) = P(\omega_2) = \frac{V_m^2}{4R}$ 일반적으로.

※ 직렬 공진회로에서 Q값과 Bandwidth를 R, L, C로 풀기

$Q_s = \frac{\omega_0}{\text{Bandwidth}}$, $Q_s = \frac{X_0}{R}$

⇒ Bandwith $= \frac{\omega_0}{Q_s} = R\sqrt{\frac{C}{L}}\cdot\frac{1}{\sqrt{LC}} = \frac{R}{L}$ 모터제어시 대역폭

※ $Q_s = 2\pi\left(\frac{W}{W_R}\right) = 2\pi\frac{\text{최대 축적 에너지}}{\text{한주기 동안 소비된 에너지}}$