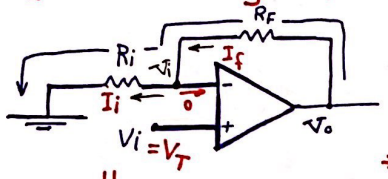
Electronics 236 → L19 Op Amps

Non-Inverting Amp.

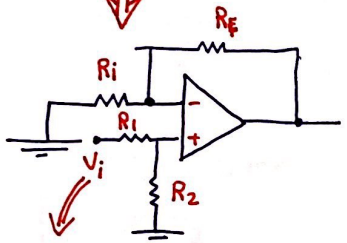


$I_p = I_n = 0$

$V_p = V_n = V_+ = V_-$

$\rightarrow i_i = \frac{V_i}{R_i}$

$\rightarrow i_f = i_i + i_n$ ($i_n \rightarrow 0$)



$V_+ = \frac{R_2}{R_1+R_2} \cdot V_i$

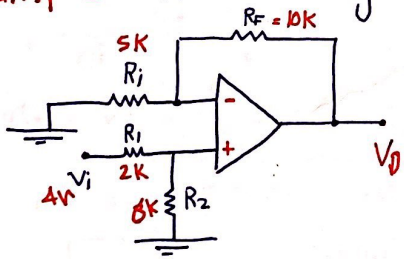
$V_o = I_f R_F + I_i R_i$

$V_o = I_f (R_F + R_i)$

$= \frac{V_i}{R_i}(R_F + R_i)$

$$\boxed{V_o = V_i \left(1 + \frac{R_F}{R_i}\right)}$$, general case V_+ Instead of V_i

Example "Non-inverting"



$V_o = V_+ \left(1 + \frac{R_F}{R_i}\right)$

$= 3\left(1 + \frac{10K}{5K}\right) = 9$ volt

$-V_{sat} \leq V_o \leq +V_{sat}$

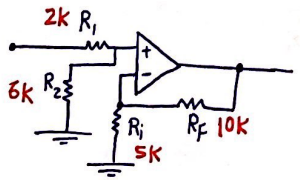
$V_+ = \frac{6K}{8K} \cdot 4 = 3$

* الدارة هاي نفس اللي فوق

للفرض حدا طلب الـ Gain = 1 يعني $1 = \frac{V_o}{V_+}$

الحل انو يا بخلي R_F short و R_i open

↘ Buffer circuit



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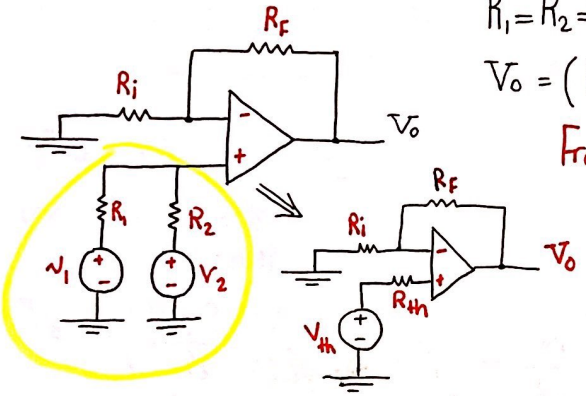
Non_Inverting Adder



$R_1 = R_2 = R_F = R_i = R$

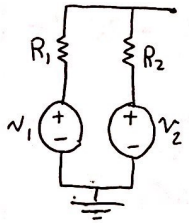
$V_o = \left(1 + \frac{R_F}{R_i}\right) \cdot V_+$

From [1]

$V_o = (2) \cdot \left(\frac{1}{2}(V_1 + V_2)\right)$

$V_o = V_1 + V_2$

Super Position :



[1] Kill V_2

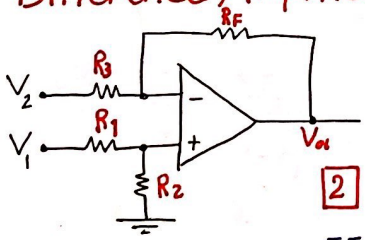
$V'_{th} = \frac{R}{R+R} V_1 = \frac{1}{2} V_1$

[2] kill V_1

$V''_{th} = \frac{R}{2R} \cdot V_2 = \frac{1}{2} V_2$

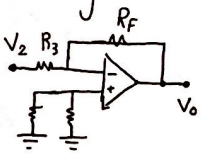
[3] Total $= V'_{th} + V''_{th} = \frac{1}{2}(V_1 + V_2) \ldots$ [1]

Difference Amplifier - mix of Inverting & non-Inverting



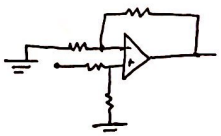
[1] kill V_1 $\Rightarrow$ Inverting

$V_o = -\frac{R_F}{R_3} V_2$



[2] kill V_2 $\Rightarrow$ Non_Inverting

$V_o = \left(1 + \frac{R_F}{R_3}\right) V_+$, $V_+ = \frac{R_2}{R_1 + R_2} \cdot V_1$



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Difference Amplifier Continue

$$V_o = \underbrace{\left(1+\frac{R_F}{R_3}\right)\left(\frac{R_2}{R_1+R_2}\right)}_{a} V_1 - \underbrace{\frac{R_F}{R_3}}_{b} V_2$$

$$V_o = a V_1 - b V_2$$

let $R_1 = R_3 = R$

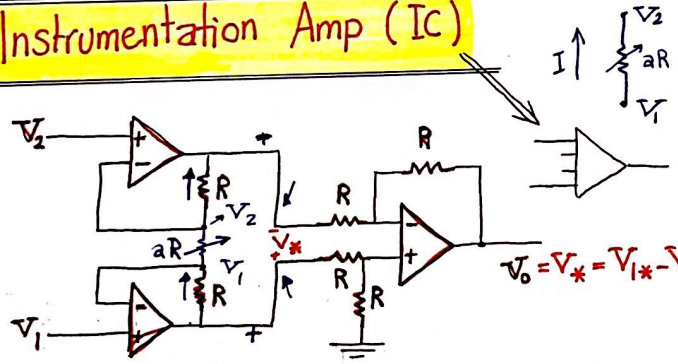
$R_2 = R_F = mR$

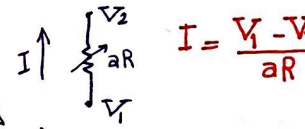
$$V_o = \left(\frac{R_3+R_F}{R_3}\right)\left(\frac{R_2}{R_1+R_2}\right) V_1 - \frac{R_F}{R_3} V_2$$

$$= \frac{R_2}{R_3} V_1 - \frac{R_F}{R_3} V_2 = mV_1 - mV_2 = m(V_1 - V_2) \quad \cdots \circledast$$

Difference Amplifier

Instrumentation Amp (IC)





$$I = \frac{V_1 - V_2}{aR}$$

From 1 : $V_o = V_*$

$$V_o = \left(1+\frac{2}{a}\right)(V_1 - V_2)$$

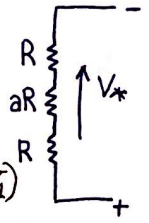
$m(V_1 - V_2)$ هي نفسها ⊛

$m = 1 + \frac{2}{a}$ يعني

$$V_* = I \cdot (R + R_a) \Leftarrow$$

$$= \frac{(a+2)R}{aR}(V_1 - V_2)$$

$$V_* = \left(1+\frac{2}{a}\right)(V_1 - V_2) \cdots 1$$



يعني لما بدي اغير بال Gain بس يعني بغير بقيمة a في المقاومة المتغيرة .

هنا يعني only changeng potentiometer value, Gain is adjested + Buffers

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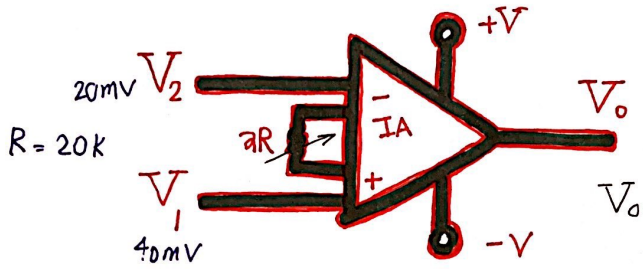
IC



$$V_o = \left(1+\frac{2}{a}\right)(V_1 - V_2)$$

5 = Gain بدنا ال

$$5 = \left(1+\frac{2}{a}\right)(40m - 20m)$$

$$250 = 1 + \frac{2}{a} \Rightarrow a = \frac{2}{240}$$

$$aR = \frac{2}{240} \times 20K =$$

$$\frac{1}{2}(V_1 + V_2)$$

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