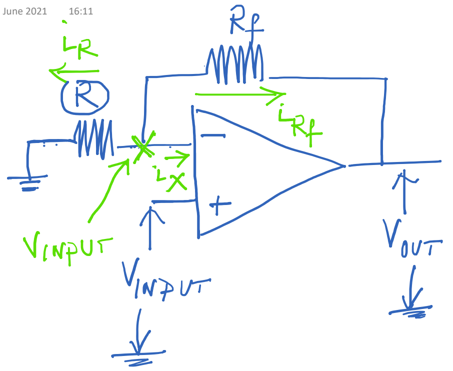
03 June 2021 16:11



② NON-INVERTING AMPLIFIER

$V_{OUT} = ?$

By V.G.C; $V_x = V_{INPUT} \rightarrow ①$

Applying KCL at node 'x'; $i_R + i_{R_f} + i_x = 0$

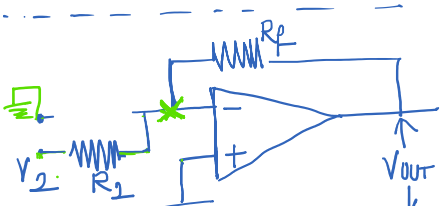
$$\frac{V_x - 0}{R} + \frac{V_x - V_{OUT}}{R_f} + 0 = 0$$

$$V_{OUT} = V_x + V_x \frac{R_f}{R} = V_x \left\{1 + \frac{R_f}{R}\right\}$$

$$① \Rightarrow \boxed{V_{OUT} = V_{INPUT}\left\{1 + \frac{R_f}{R}\right\} \quad \text{GAIN}: \frac{V_{OUT}}{V_{INPUT}} = 1 + \frac{R_f}{R}}$$

* V_{OUT} is not inverted version of V_{INPUT}
* GAIN > 1
① $R_f = 10K$, $R = 1K$; GAIN = 11
② $R_f = 1K$, $R = 10K$; GAIN = 1.1

In case of inverting amplifier; $\text{GAIN} = \frac{-R_f}{R}$; $\left.\begin{matrix} R_f = 1K \\ R = 10K \end{matrix}\right\}$ GAIN $= -0.1 < 1$, $V_{OUT} < V_{INPUT}$



③ INVERTING ADDER

$V_{OUT} = ?$

SUPER POSITION THEOREM

1. If there are multiple inputs, take any one input at a time and find the o/p (rest of inputs, Ground it).
2. Once the o/p's are calculated for each input, add all the o/p's to get final o/p.

① V_1, $V_2 = 0$, $V_x = 0$ (by V.G.C)

V_{OUT_1} (o/p due 'V_1') $= -\frac{R_f}{R_1} V_1$

② V_2, $V_1 = 0$, $V_x = 0$

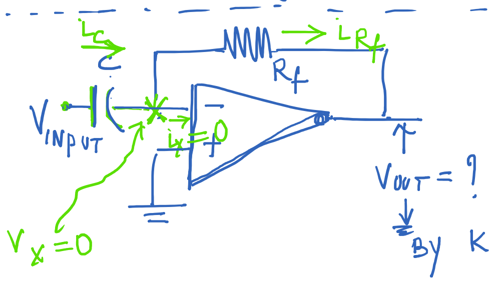
V_{OUT_2} (o/p due to 'V_2') $= -\frac{R_f}{R_2} V_2$

$$V_{OUT} = V_{OUT_1} + V_{OUT_2} = -\frac{R_f}{R_1} V_1 - \frac{R_f}{R_2} V_2 = -\left(\frac{R_f}{R_1} V_1 + \frac{R_f}{R_2} V_2\right)$$

If $R_1 = R_2 = R_f$; $V_{OUT} = -(V_1 + V_2)$

$R_1 = 0.1 R_f$, $R_2 = 0.2 R_f$; $V_{OUT} = -(10V_1 + 20V_2)$

$$V_{OUT} = -\left(\frac{R_f}{R_1} V_1 + \frac{R_f}{R_2} V_2 + \frac{R_f}{R_3} V_3 + \cdots\cdots \frac{R_f}{R_n} V_n\right)$$



$$i_C = C \frac{d}{dt}(V_{INPUT} - 0)$$

$$i_{R_f} = \frac{0 - V_{OUT}}{R_f}$$

By KCL; $i_C = i_x + i_{R_f} = 0 + \left(\frac{-V_{OUT}}{R_f}\right)$

$Q = CV$

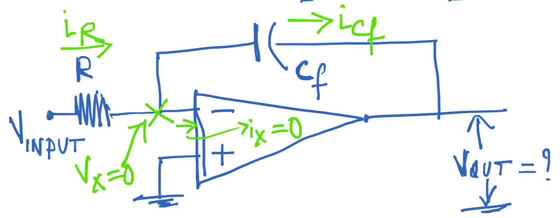
$i = \frac{dq}{dt} = C\frac{dv}{dt}$

$V_x \overset{c}{=} 0$

By KCL ; $i_C = i_x + i_{R_f} = 0 + \left(\frac{-V_{OUT}}{R_f}\right)$

④ INVERTING DIFFERENTIATOR

$$C \frac{d}{dt} V_{INPUT} = -\frac{V_{OUT}}{R_f} \; ; \quad \boxed{V_{OUT} = -R_f C \frac{d}{dt} V_{INPUT}}$$



$$i_R = \frac{V_{INPUT} - 0}{R}$$

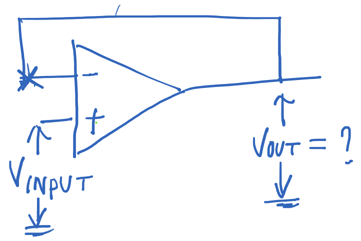
$$i_{cf} = C_f \frac{d}{dt}\{0 - V_{OUT}\} = -C_f \frac{dV_{OUT}}{dt}$$

⑤ INVERTING INTEGRATOR

By KCL ; $i_R = i_x + i_{cf} = i_{cf}$

$$\frac{V_{INPUT}}{R} = -C_f \frac{d}{dt} V_{OUT}$$

$$\boxed{V_{OUT} = \frac{-1}{RC_f} \int V_{INPUT} \, dt}$$



By V.G.C $V_x = V_{INPUT}$; $V_{OUT} = V_x = V_{INPUT}$

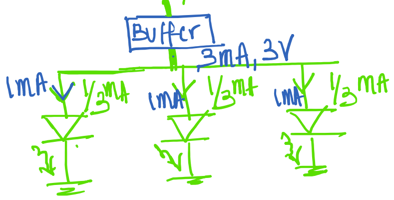
GAIN : $\frac{V_{OUT}}{V_{INPUT}} = 1$

⑥ Unity Gain Amplifier or Voltage follower.

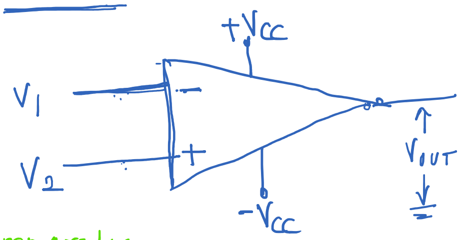
Used for Impedance matching

Buffer circuit (current amplifier)

3V, 1mA Battery of 3mW power



NON-LINEAR APPLICATION:



$$V_{OUT} = \overset{A_{Vd}}{A_{OL}} \{\underbrace{V_2 - V_1}_{>0 \;/\; <0}\} \rightarrow$$

If we take an ideal op-amp ; $A_{OL} = \infty$

$V_{OUT} \neq \infty \quad \pm V_{SAT}$

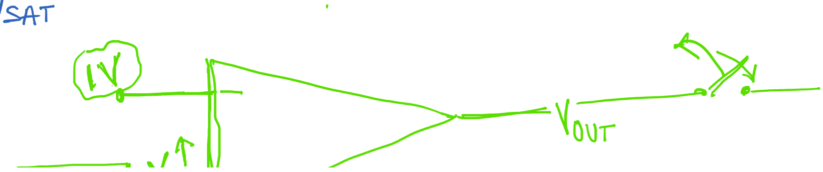
comparator

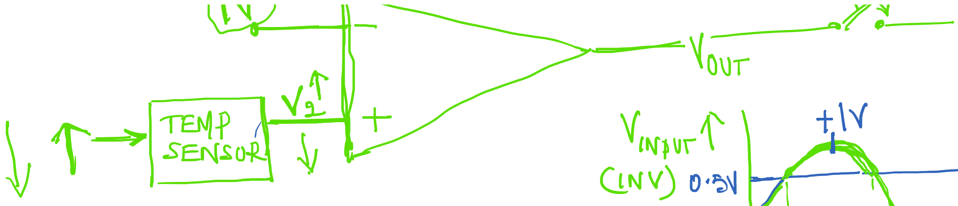
Under what condition we get $+V_{SAT}$ } $(V_2 - V_1) > 0$; $V_2 > V_1$

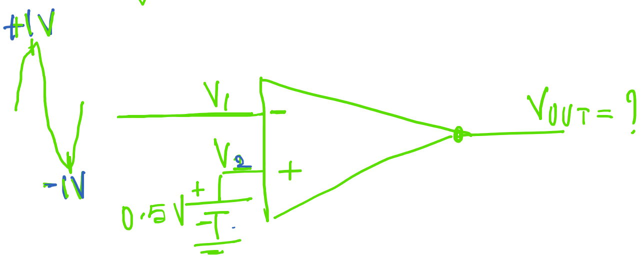
— " — — — — " — $-V_{SAT}$ } $(V_2 - V_1) < 0$; $V_2 < V_1$

$V_2 > V_1$; $V_{OUT} = +V_{SAT}$

$V_2 < V_1$; $V_{OUT} = -V_{SAT}$







$V_1 > V_2$; $V_{OUT} = -V_{cc}$

$V_1 < V_2$: $V_{OUT} = +V_{cc}$