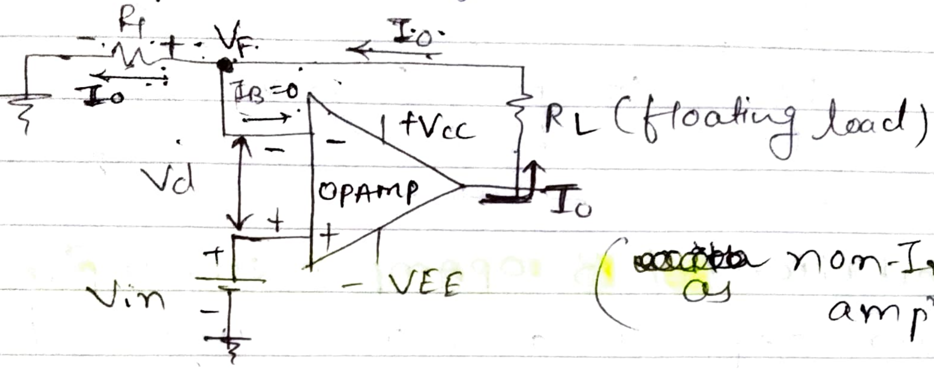
→ Voltage to current (V to I) converter with floating load

> Here load is called floating load because it is not connected to ground.



(as non-Inv. ampr)

> I/p v/g is applied to non-inv. terminal of OPAmp. 'RL' is connected in place of f/b resistor 'RF'.

> As the f/b v/g across 'R1' is propotional to the o/p c/n 'Io' & appears in series with i/p v/g. Therefore it is called as c/n series -ve f/b ampr.

> By apply KVL to i/p loop,

$$V_{in} = V_d + V_F$$

But as the gain of OPAmp is very large we can neglect 'Vd' ie $V_d \approx 0$

$$\therefore V_{in} = V_F$$
$$= R_1 \times I_o \quad \text{.... becoz } I_B \approx 0 \;\therefore R_i = \infty \text{ or high}$$

$$\boxed{\therefore I_o = \frac{V_{in}}{R_1}}$$

> Thus it shows that i/p v/g is converted in to propotional o/p c/n $I_o = V_{in}/R_1$, if 'R1' is a precision resistor then we can adjust o/p c/n.

→ App^n → low v/g dc & ac voltmeter, LED & zener diode Tester.

[f/b → feedback]

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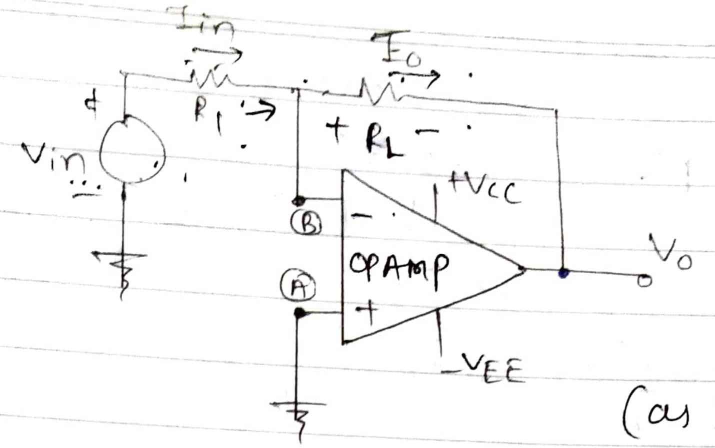


(as Inverting ampr)

> Here we are applying i/p v/g at inv. terminal. As due to virtual ground concept c/n flowing in to the inverting terminal is zero.

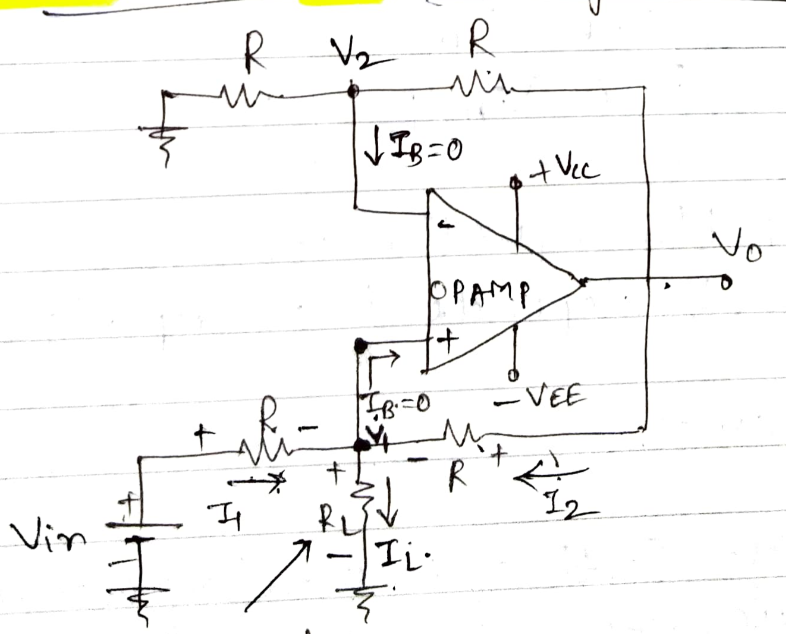
$\therefore I_{in} = I_o$

But $\boxed{I_{in} = V_{in}/R_1}$ ... ∵ 'B' is at virtual gnd.

Thus c/n flowing through the load is propotional to i/p v/g Vin. $\therefore \boxed{I_o = V_{in}/R_1}$

→ App^n → As a relay driver, LED driver, DC voltmeter, zener diode testing.

→ V to I Convertor with grounded load.



Grounded load.

Applying KCL at node V_1,

$I_B + I_L = I_1 + I_2$

but $I_B = 0$

$\therefore I_L = I_1 + I_2 \longrightarrow ①$

& $I_1 = \frac{V_{in} - V_1}{R}$ & $I_2 = \frac{V_O - V_1}{R}$

substituting these values in eq^n ①.

$$I_L = \frac{V_{in} - V_1}{R} + \frac{V_O - V_1}{R}$$

$$\therefore I_L R = V_{in} + V_O - 2V_1$$

$$\therefore V_1 = \frac{V_{in} + V_O - I_L R}{2} \longrightarrow ②$$

As the OPAMP is in non-Inverting mode,

$$\text{Gain } A_{VF} = 1 + \frac{R}{R} = 2$$

$$\& V_O = A_{VF} \times V_1 = 2V_1.$$

Substituting V_1 from eq^n ②,

$$V_O = V_{in} + V_O - I_L R$$

$$\therefore I_L R = V_{in}$$

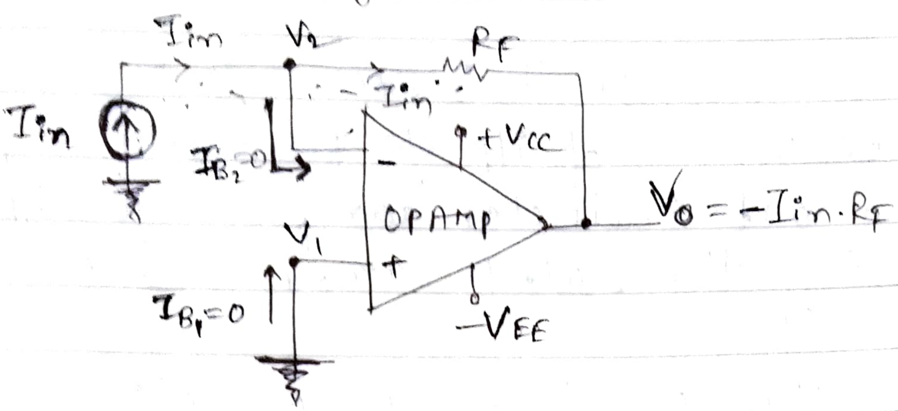
$$\therefore \boxed{I_L = V_{in}/R}$$

Thus from this equation it is clear that load c/n is dependent on i/p v/g & resistor 'R'.

> **App^n is same.**

Zenerdiode testing, As a relay driver, LED driver, DC voltmeter.

Current to voltage convertor (I to V)



→ As per the concept of virtual short.

$V_1 \approx V_2$

& as i/p impedance is very high ∴ $I_{B1} = I_{B2} = 0$.

Gain of inverting ampr,

$$A_{VF} = \frac{-R_F}{R_1} = \frac{V_o}{V_{in}}$$

$$\therefore V_o = -\frac{R_F}{R_1} V_{in}. \longrightarrow (1)$$

→ As $V_1 \approx V_2$ and $V_1 = 0$ as non-Inv. terminal is connected to ground ∴ $V_2 = 0$.

Thus inverting terminal is also at ground potential & entire i/p vlg appears across R_i.

$$\therefore I_{in} = V_{in}/R_i$$

$$\therefore V_{in} = I_{in} \cdot R_i$$

put this value in equation (1).

$$\therefore V_o = -\frac{R_F}{R_1} I_{in} \cdot R_1$$

$$\therefore \boxed{V_o = -R_F \cdot I_{in}}$$

which indicates that o/p vlg is propotional to i/p current Iin.

→ Appn → Light intensity meter, D/A convertor.