6) Monotonicity:

* A converter is said to have good monotonicity if it does not miss any step backward when stepped through its entire range.

7) Conversion time:

* It is the time required for the conversion of analog signal into its digital equivalent.

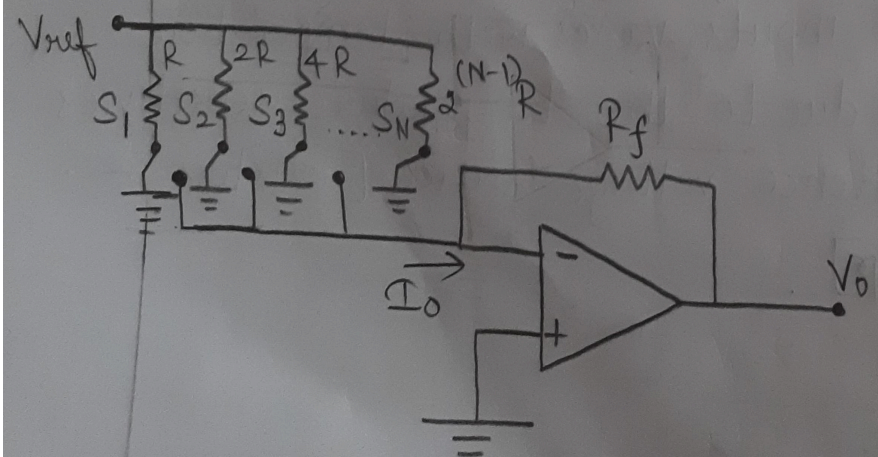
8) Stability:

* Performance of a converter changes with temperature, aging of components and power supply variation. So, all the parameters such as gain, linearity and monoticity must be specified over a full temperature & power supply ranges.

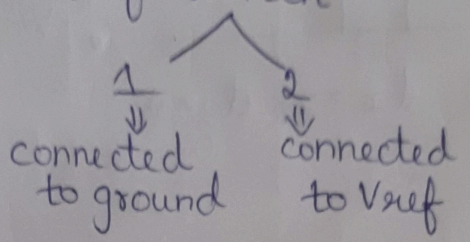
Types of D/A:

1) Weighted resistor D/A converter
2) R-2R ladder D/A converter

9/10/2023 1) Weighted resistor D/A converter:



* It has summing amplifier.
* 'N' electronic switches are present
* Weighted resistor nlw [2R, $(2)^2$R, $(2)^3$R, ...]
* If the position of all the switch is 1 (ground) the output is zero.
* The switches are controlled by 'N' bit digital input word.
* Two positions of switch



$$I_0 = I_1 + I_2 + I_3 + \ldots\ldots I_n$$

The o/p voltage is the voltage across the Vref

$$V_0 = (I_0 R_f)$$

$$V_0 = -(I_1 + I_2 + I_3 + \ldots\ldots I_N) R_f$$

$$V_0 = \left(\frac{V_{ref}}{R} S_1 + \frac{V_{ref}}{2R} S_2 + \frac{V_{ref}}{3R} S_3 + \ldots\ldots \frac{V_{ref}}{2^{N-1} R} S_N\right) R_f$$

$$V_0 = -\frac{2V_{ref}}{R} R_f \left[\frac{S_1}{2^1} + \frac{S_2}{2^2} + \frac{S_3}{2^3} + \ldots\ldots \frac{S_N}{2^N}\right]$$

If $2R_f = R$,

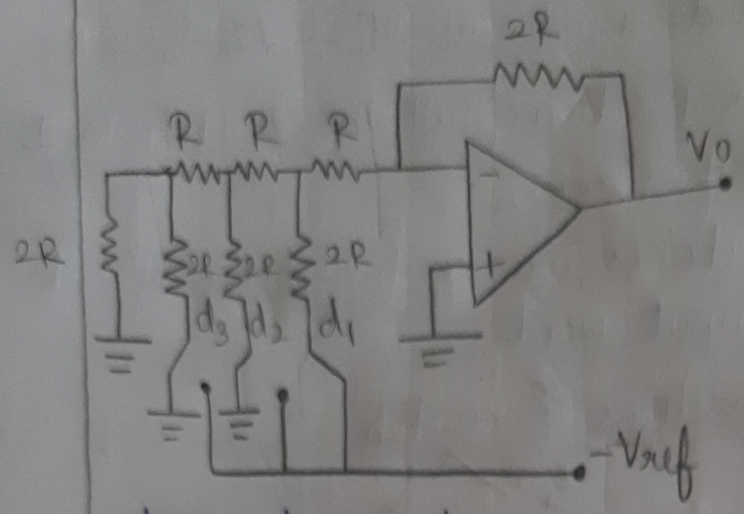
$$V_0 = -V_{ref}\left[S_1 2^{-1} + S_2 2^{-2} + S_3 2^{-3} + \ldots S_N 2^{-N}\right]$$

$$\boxed{V_0 = -V_{ref} D}$$

* V_0 is directly proportional to the digital word.
* Disadvantage ⇒ Different range of resistors are used.
* Op-Amp is used in this converter.

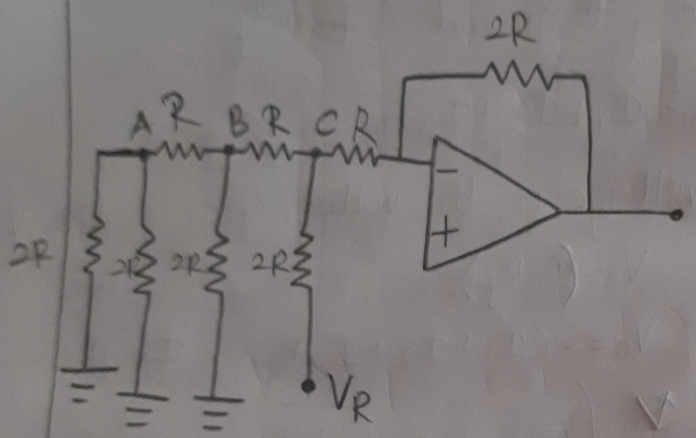
2) R-2R ladder network:

*Op-Amp is used in this network.



$d_1=0 \quad d_2=0 \quad d_3=0$

1 0 0



Input 1 ⇒ connected to Vref

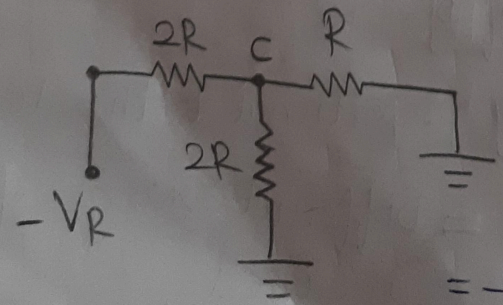
Input 0 ⇒ " to ground

Node A,

$$2R \,||\, 2R = \frac{4R^2}{4R}$$

$$= R$$

Node C,



$$2R \,||\, R = \frac{2R^2}{3R}$$

$$= \frac{2}{3}R$$

$$= \frac{-V_R \times \frac{2}{3}R}{2R + \frac{2}{3}R}$$

$$= \frac{-V_R\left(\frac{2}{3}\right)R}{\frac{8R}{3}} \Rightarrow \frac{-V_R}{4}$$

Inverting amplifier,

$$V_o = -\frac{R_f}{R}$$

$$V_o = -\frac{2R}{R} \times \left(\frac{-V_R}{4}\right)$$

$$\boxed{V_o = +\frac{V_R}{2}}$$

10/2023 Types of ADC:

*Direct type ADC
*Indirect type ADC

(i) Direct type ADC:

*If the ADC performs the A to D conversion directly by utilizing the internally generated equivalent digital (binary) code for comparing with the analog i/p, then it is called as Direct type ADC.

Eg: Counter type ADC, Successive Approximation ADC, Flash type ADC.

(ii) Indirect type ADC:

*If the ADC performs the analog to digital conversion by an indirect method, then it is called an Indirect type ADC. In general, first it converts the analog i/p into a linear function of time (or frequency) and then it will produce the digital (binary) output.

*Dual slope ADC is the best eg of an indirect type ADC.