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

Inverting amplifier,

$$V_0 = -\frac{R_f}{R}$$

$$V_0 = -\frac{2R}{R} \times \left(\frac{-V_R}{4}\right)$$

$$\boxed{V_0 = +\frac{V_R}{2}}$$

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.

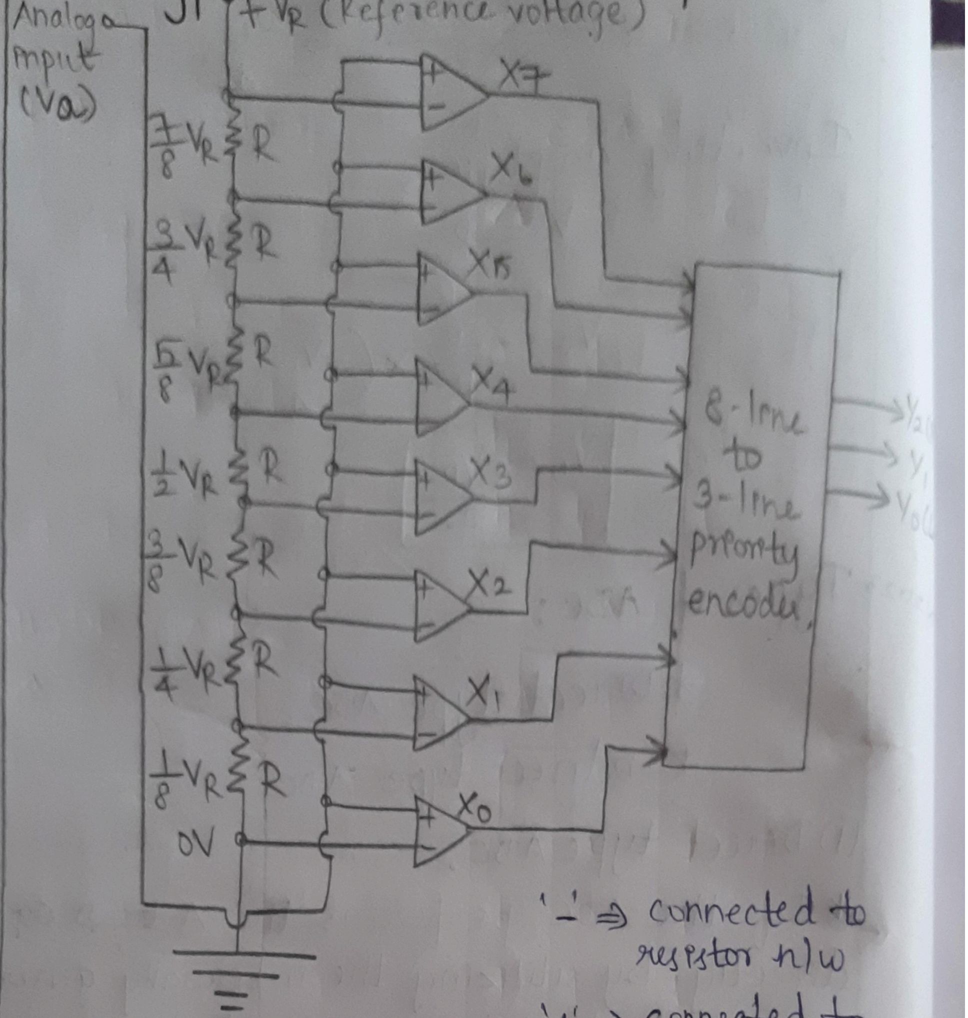
Eg: Counter type ADC, Successive Approximation ADC, Flash type ADC.

(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.

Flash type ADC - Parallel comparator:



'−' ⇒ connected to resistor n/w

'+' ⇒ connected to analog input

$V_a > V_d$, $x = 1$

$V_a < V_d$, $x = 0$

$V_a = V_d$, Previous value

V_d = generated voltage

I/P voltage	X_7	X_6	X_5	X_4	X_3	X_2	X_1	X_0	Y_2	Y_1	Y_0
0 to $V_R/8$	0	0	0	0	0	0	0	1	0	0	0
$V_R/8$ to $2V_R/8$	0	0	0	0	0	0	1	1	0	0	1
$\frac{2V_R}{8}$ to $\frac{3V_R}{8}$	0	0	0	0	0	1	1	1	0	1	0
$\frac{3V_R}{8}$ to $\frac{4V_R}{8}$	0	0	0	0	1	1	1	1	0	1	1
$\frac{4V_R}{8}$ to $\frac{5V_R}{8}$	0	0	0	1	1	1	1	1	1	0	0
$\frac{5V_R}{8}$ to $\frac{6V_R}{8}$	0	0	1	1	1	1	1	1	1	0	1
$\frac{6V_R}{8}$ to $\frac{7V_R}{8}$	0	1	1	1	1	1	1	1	1	1	0
$\frac{7V_R}{8}$ to $\frac{8V_R}{8}$	1	1	1	1	1	1	1	1	1	1	1

No. of comparators required $= 2^N - 1$

Since it is a 3 bit comparator,

$= 2^3 - 1$

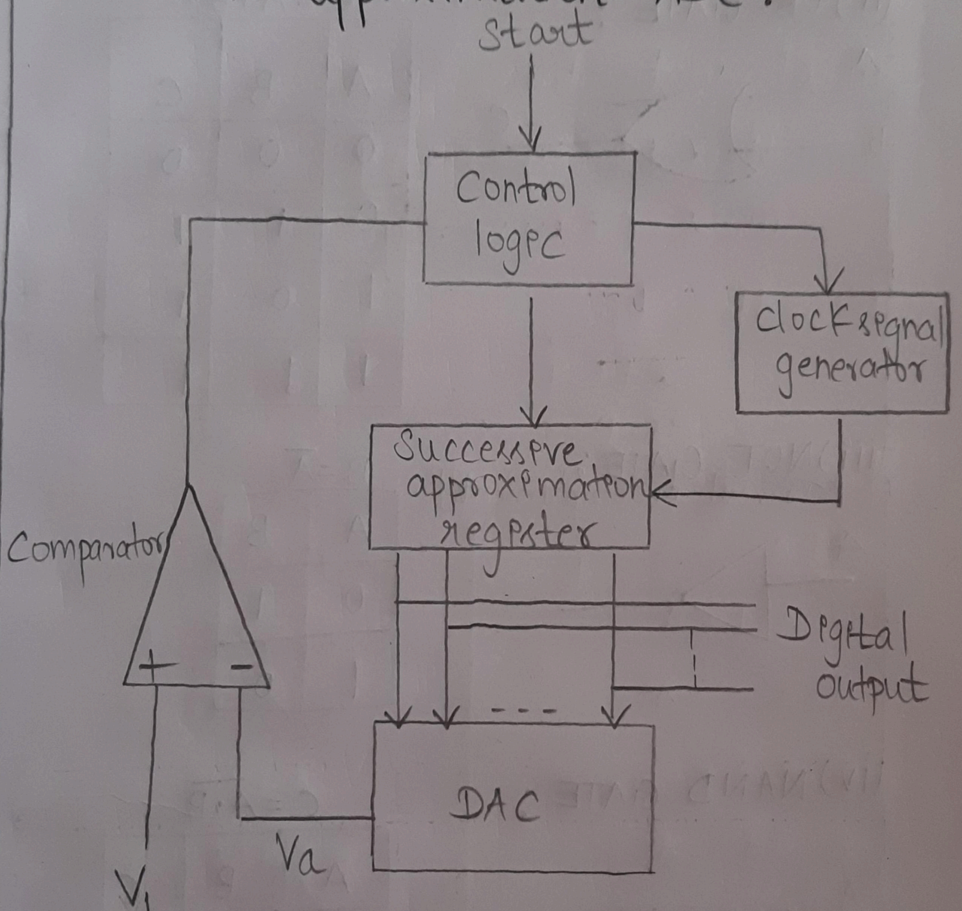
$= 7$

we used 8 comparator, because it has 8 line to 3 line priority encoder.

Disadvantage ⇒ More no. of comparator is used

Advantages ⇒ High speed, conversion time (less) 100 nano second & conversion done simultaneously.

Successive approximation - ADC :



i/p = 11 V

	0000
Make MSB = 1	1000
if Va > Vd	1100
Va < Vd	0100

8V 1000 ⟹ 12V 1100 ⟹ 10V 1010 ⟹ 11V 1011

Va > Vd, Va < Vd, Va > Vd, Va = Vd

BCD

8 4 2 1

2^3 2^2 2^1 2^0

1 0 0 0

$0 \times 2^0 = 0$

$0 \times 2^1 = 0$

$0 \times 2^2 = 0$

$1 \times 2^3 = 8$

} 8V