Unit :- 5

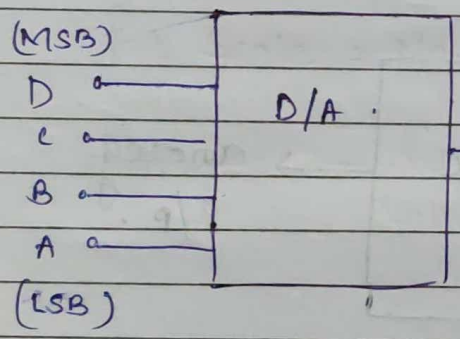
A/D and D/A Converter.

* Analog quantity are Continous range of value.

* Temperature, pressure, light etc are analog quantity.

* Digital Quantity is a discrete quantity.

Digital to Analog Converter.



→ It convert digital number into analog.

→ The Binary number or BCD number is Converted to Voltage and current.

→ 4 Input is given Thus, $2^4 = 16$ Combinational Input.

Analog Output = K x digital Input.

K = proportional factor (constant Value).

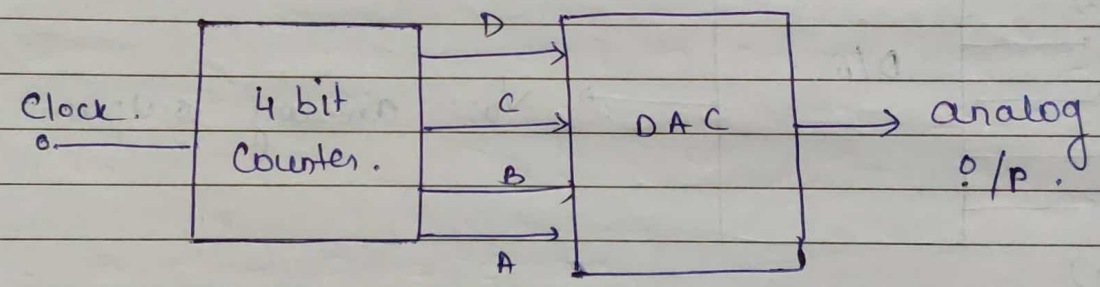
→ It do not provide a exact analog value.

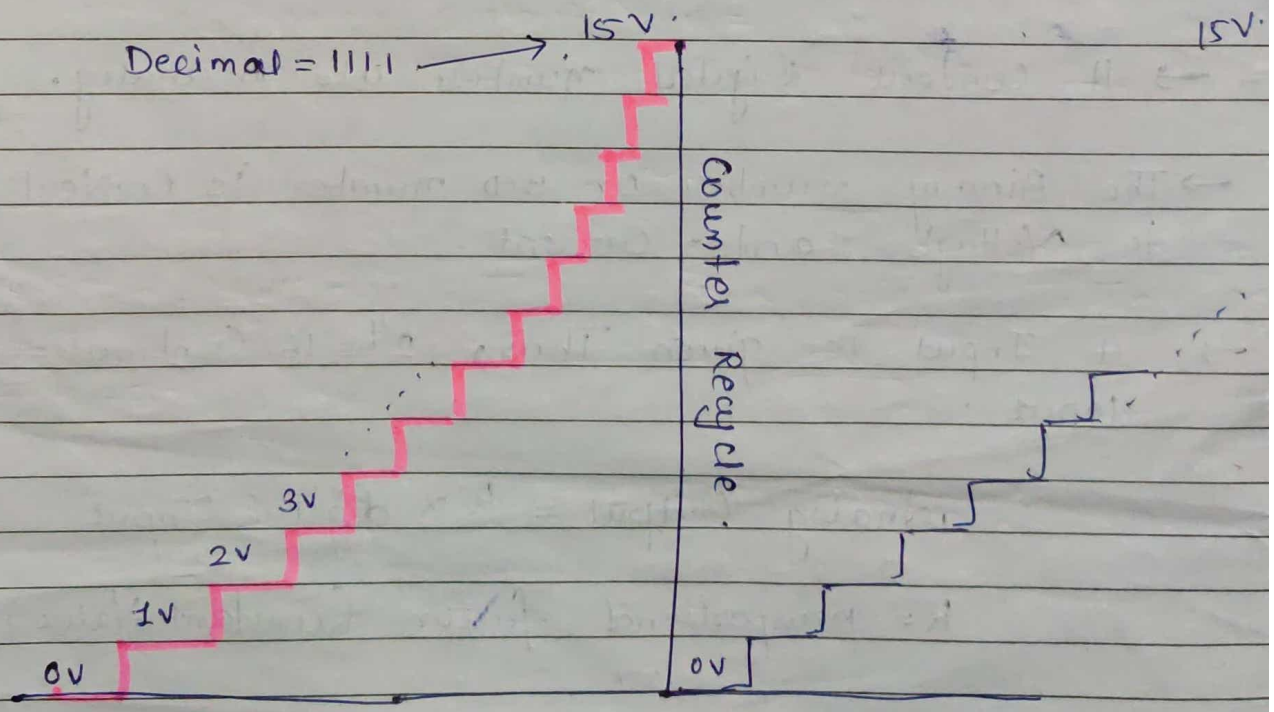
→ The output of DAC = pseudo Analog Quantity.

→ No. of I/p Increase = Output Values will Increased.

= A Counter is recycle again after 16 state, then DAC o/p = staircase waveform of 1 V.

	I/p.		o/p.
Counter :-	0000	→	0V.
	1111	→	15V.





* Parameter of DAC.

1. Resolution. (step size) =.

The smallest change that occur. in analog o/p will change digital Input.

It is Reciprocal of number of discrete steps in full-scale o/p of DAC.

$$\% \text{ Resolution} = \frac{\text{Step Size}}{\text{full Scale}} \times 100\ \%.$$

full Scale = No. of steps x Step size.

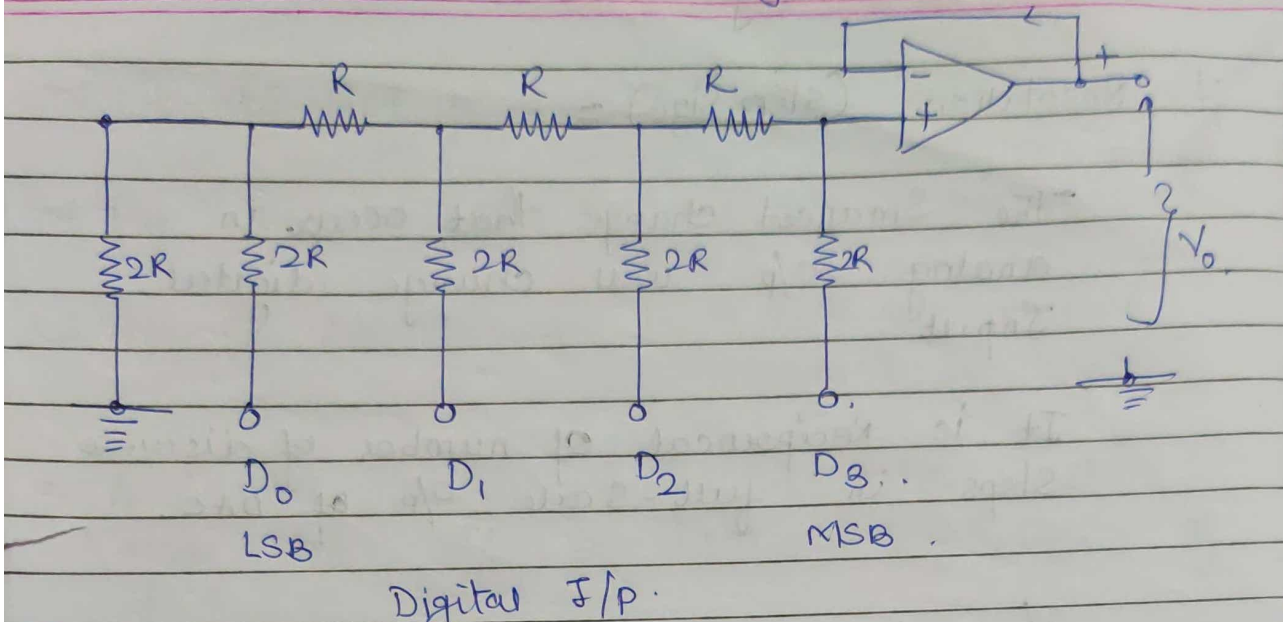
Step size :- difference of voltage bet^n two Value.

(2) Accuracy :- Defined by full Scale error & linearity error in percentage

(3) Setting Time :- The Setting time shows the operating speed of DAC. The time when I/p changes and the time that o/p enters a error band for the last time.

(4) Offset Voltage :- When Binary I/p = 0 then o/p of DAC = 0. But if there exist a small change in output is called offset voltage.

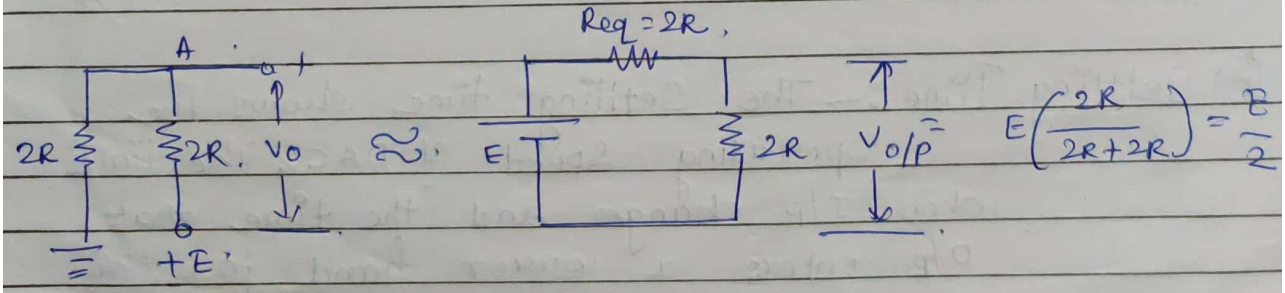
R – 2R Ladder Type DAC.



→ Most widely used.
→ Ladder N/w is used i.e Series – parallel Combination of two Resistor. R and 2R.

→ Voltage follower is used to prevent loading.
→ 4 digital I/P is given through 2R Resistor.
⇒ D_0 D_1 D_2 D_3.

Eg:- D when I/P = $^{MSB}1000^{LSB}$.
Then Analog output V_{out} = ?
D_0 = ground, D_1 = ground, D_2 = ground, D_3 = 1.



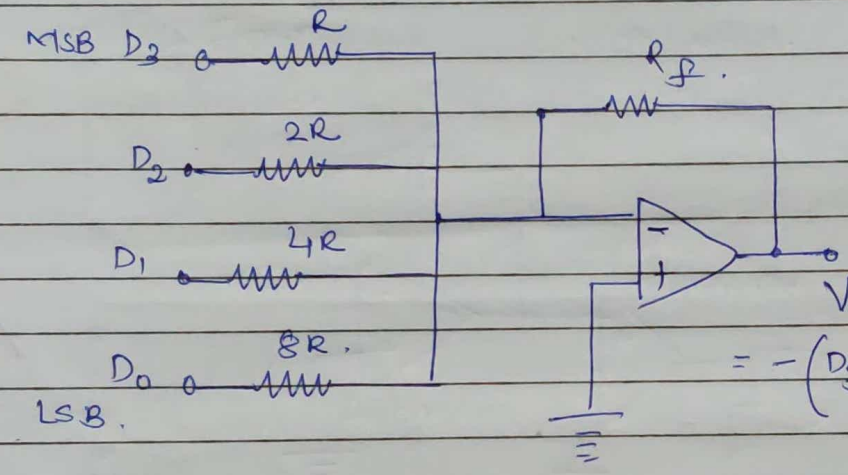
1000 = E/2 ; 0100 = E/4 ; 0010 = E/8.
0001 = E/16.

Weighted – Resistor Type DAC.

→ Operational amplifier is used.
→ It produce weighted sum of digital input.

→ Op-amp is connected as Inverting amplifier,

→ Each input is amplified by Ratio of feedback Resistance divided by I/p resistance



D_3 = amplified by $\frac{Rf}{R}$.

D_2 = amplified by $\frac{Rf}{2R}$.

D_1 = amplified by $\frac{Rf}{4R}$.

D_0 = amplified by $\frac{Rf}{8R}$.

The Op-amp adds and Invert as:-

$$V_{out} = -\left[D_3 + \frac{D_2}{2} + \frac{D_1}{4} + \frac{D_0}{8}\right] \times \left[\frac{R_f}{R}\right]$$

Disadvantage :—

→ Each Resistor will be of different value for each bit position of digital Input.

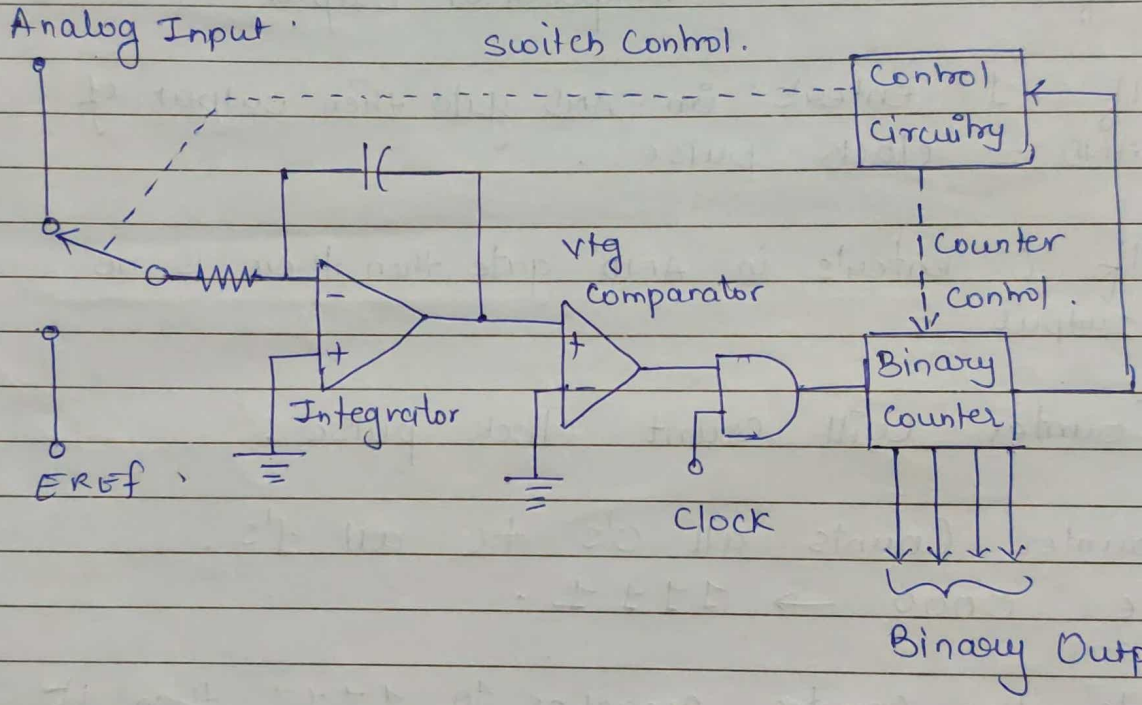
Analog To Digital Converter (ADC)

Input = Analog. / output = digital.

Type of ADC

1. Dual slope
2. Successive - Approximation.
3. Specific A/D converter.

DUAL- SLOPE A/D CONVERTER.



→ Slowest Converter.
→ Low Sensitive to Noise.
→ It take large Conversion Time, It is not used in Data Acquition application.

→ It is used as Voltmeter and Multimeter.
→ Input = analog.
Output = Digital.
→ To Integrate Input = Operational Amplifier is used. (Integrator)
→ R and C value is fixed.

→ Most Accurate ADC Converter.

→ Integrator output is a ramp signal.

→ V_{in} and V_{ref} polarity should be opposite with other.

i.e If V_{in} = positive. then V_{ref} = Negative. / If V_{in} = Negative. then V_{ref} = positive.

→ if $V_{in} > 0$ then Comparator output = 1.
If $V_{in} < 0$ then Comparator output = 0.

→ If 1 enters in AND gate then output of AND = clock pulse.

→ If 0 enters in AND gate then there is no output.

→ Counter will count clock pulse.

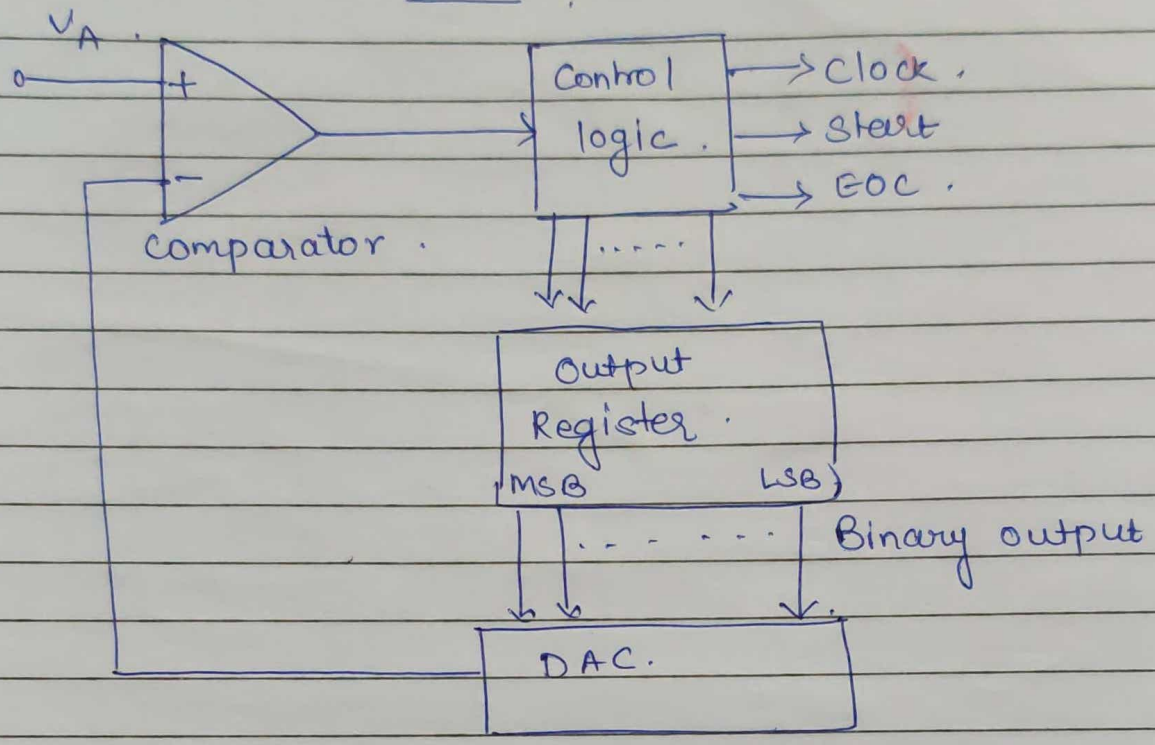
→ Counter Counts all 0's to all 1's.
i.e 0000 → 1111.

→ Once the Counter reaches to 1111 then it restart again and the control circuit changes the switch from V_{in} to V_{ref}.

→ Again Counter starts Counting from 0's to 1's

Successive – Approximation ADC.

4 Bit



→ Widely used.

→ less time to Convert the Signal from Analog to digital.

→ It has fixed Conversion Time.