Continous Counter A/D Convertor or up/down Counter

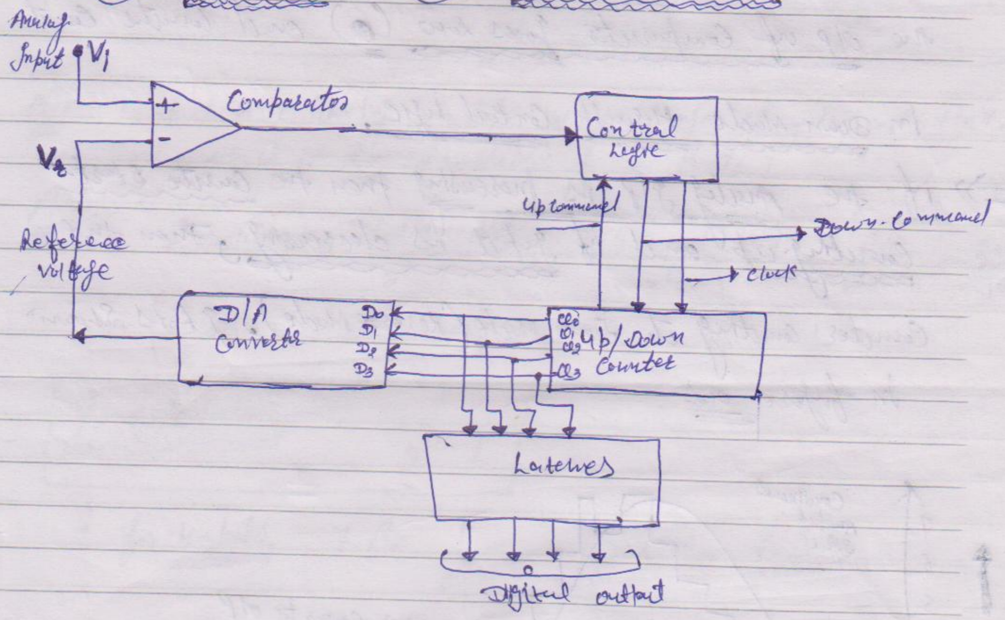
(7)

⟹ It make the use of D/A converter, A/D Converter

The Main Components of this Converter are ⟹ (I) Comparator

(II) Control Logic (III) Counter (up/Down)

(IV) Latches (V) D/A Converters



Block Diagram of Counter type A/D Converter

→ The Analog Input which is to be view as digital is given to the Comparator.

→ The output of D/A Converter is the Reference voltage (V_2) which to be compared with the analog Input-voltage (V_{in}) at Comparator.

If the Reference voltage (V_2) is Less than the Analog Input V_{in} ($V_2 < V_{in}$), then the O/P of Comparator goes High (1), and Counter Start Counting in up Mode, via Control Logic. but the Counter give the binary counts and an Analog Reference O/P is obtained from the D/A converter, which is then compared with Analog voltage (V_{in})

⟹ whenever the V_R (Reference voltage) is equal to the or greater than the ~~output~~ Analog input voltage (V_{in}), then the O/P of comparator goes low (0) and counter count in Down mode through control logic.

⟹ If the Analog I/P is increasing then the counter starts counting up and if input is decreasing, then the counter counting its Down mode (Reverse mode). It is shown in figure as

Input & O/P waveforms for Counter type A/D Converter

Q. find the Conversion time & Conversion Rate for a Successive Approximation A/D converter having 2MHz clock and a 5-bit binary Ladder containing Reference voltages of 8V.

Ans. Conversion time (t_c) $= \frac{n}{\text{clock Rate}} = \frac{5}{2\,MHz} = \frac{5}{2 \times 10^6} = 2.5\,\mu sec$

Conversion Rate $=$

Resolution ⇒

Resolution : It is defined as the voltage input change for one bit change in the output. for the n-bit ADC, the number of output levels are 2^n-1.

$$\boxed{\text{Resolution} = \frac{\text{full scale I/P}}{\text{No. of O/P level}} = \frac{\text{full scale I/P}}{2^n-1}}$$

Q: 10-bit ADC having an I/P voltage range of −10 and +10 V. what is the Resolution ? & R % ?

Ans ⇒

$$\text{Resolution} = \frac{\text{full scale I/P}}{2^n-1} = \frac{10-(-10)}{2^{10}-1} = \frac{20}{1024-1} = \frac{20}{1023}$$

$$\boxed{\text{Resolution} = 19.5\,mV}$$

$$\boxed{\%\ \text{Resolution} \Rightarrow \frac{1}{2^n-1}}$$

∴ for 4-bits, $\%R = \frac{1}{2^n-1} = \frac{1}{15} \times 100 = 6.7\%$

Q: An 4-bit (D/A) Converter has an O/P Range of 0 to 1.5V. define its Resolution

Ans $n=4$, full scale O/P in case of D/A $= 1.5V$

$$\text{Resolution} = \frac{V_{OFS}}{2^n-1} = \frac{1.5}{16-1} = \frac{1.5}{15} = 0.1$$

$$\boxed{\text{Resolution} = \frac{100\,mV}{1\,LSB}}$$ [Because $100mV = 100 \times 10^{-3}V = 0.1V$]

So, An I/P voltage of 1 LSB, changes the O/P by 100mV.