Data Converters

All the real world quantities are analog in nature. We can represent these quantities electrically as analog signals. An analog signal is a time varying signal that has any number of values (variations) for a given time slot.

In contrast to this, a digital signal varies suddenly from one level to another level and will have only finite number of values (variations) for a given time slot.

वास्तविक में quantities analog in nature के होते हैं। इन quantities को electrically analog signals से represent करते हैं। एक एनालॉग सिग्नल time varying signal होता है जिसमें किसी दिए गए time slot के लिए number of values होते है।

इसके विपरीत, एक डिजिटल सिग्नल suddenly one level to another level में suddenly vary करता है और इसमें एक निश्चित समय स्लॉट के लिए values finite होते है।

Types of Data Converters

The electronic circuits, which can be operated with analog signals are called as analog circuits. Similarly, the electronic circuits, which can be operated with digital signals are called as digital circuits. (इलेक्ट्रॉनिक सर्किट, जिसे एनालॉग सिग्नल से संचालित किया जा सकता है, एनालॉग सर्किट कहलाता है। इसी तरह, इलेक्ट्रॉनिक सर्किट, जिन्हें डिजिटल सिग्नल से संचालित किया जा सकता है, डिजिटल सर्किट कहलाते हैं।)

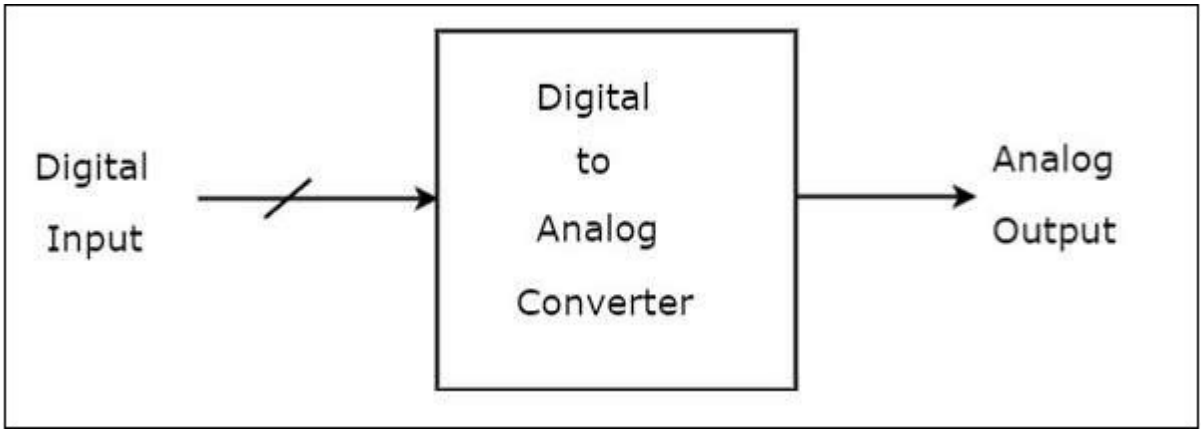
A data converter is an electronic circuit that converts data of one form to another. (डेटा कनवर्टर एक इलेक्ट्रॉनिक सर्किट है जो एक फॉर्म के डेटा को दूसरे फॉर्म में परिवर्तित करता है।)

There are two types of data converters −

1- Analog to Digital Converter
2- Digital to Analog Converter

Digital to Analog Converter:- A Digital to Analog Converter (DAC) converts a digital input signal into an analog output signal. The digital signal is represented with a binary code, which is a combination of bits 0 and 1. (Digital to Analog Converter (DAC) डिजिटल इनपुट सिग्नल को एनालॉग आउटपुट सिग्नल में परिवर्तित करता है। डिजिटल सिग्नल को एक बाइनरी कोड से represented किया गया है, जो बिट्स 0 और 1 का combination है)

The **block diagram** of DAC is shown in the following figure −



A Digital to Analog Converter (DAC) consists of a number of binary inputs and a single output. In general, the number of binary inputs of a DAC will be a power of two. (Digital to Analog Converter (DAC) में कई बाइनरी इनपुट और एक एकल आउटपुट होता हैं। सामान्य तौर पर, DAC के बाइनरी इनपुट की संख्या power of two में होती है)

Applications:

• Modems need DAC to convert data to analog form so that it can be carried over telephone wires.

• Video adapters also need DACs known as RAMDACs to convert digital form of data to analog form.

• Digital Motor Control

• Printers

• Sound Equipments

• Function Generators or Oscilloscopes

• Digital Audio

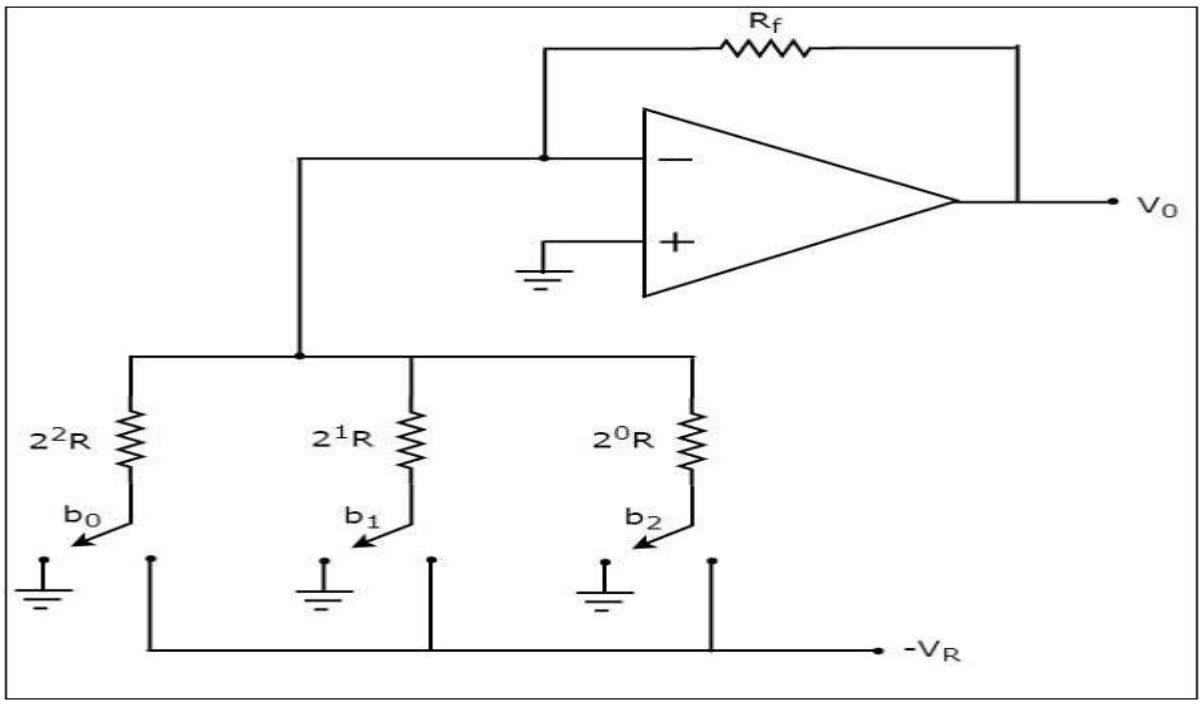
Types of DACs:-

There are two types of DACs

1- Weighted Resistor DAC
2- R-2R Ladder DAC

Weighted Resistor DAC-

A weighted resistor DAC produces an analog output, which is almost equal to the digital (binary) input by using binary weighted resistors in the inverting adder circuit. In short, a binary weighted resistor DAC is called as weighted resistor DAC. (weighted resistor DAC एनालॉग आउटपुट produces करता है, जो inverting adder circuit में binary weighted resistors का उपयोग करके digital (binary) input के लगभग बराबर होता है। संक्षेप में, binary weighted resistor DAC को weighted resistor DAC भी कहा जाता है।)



Advantages:

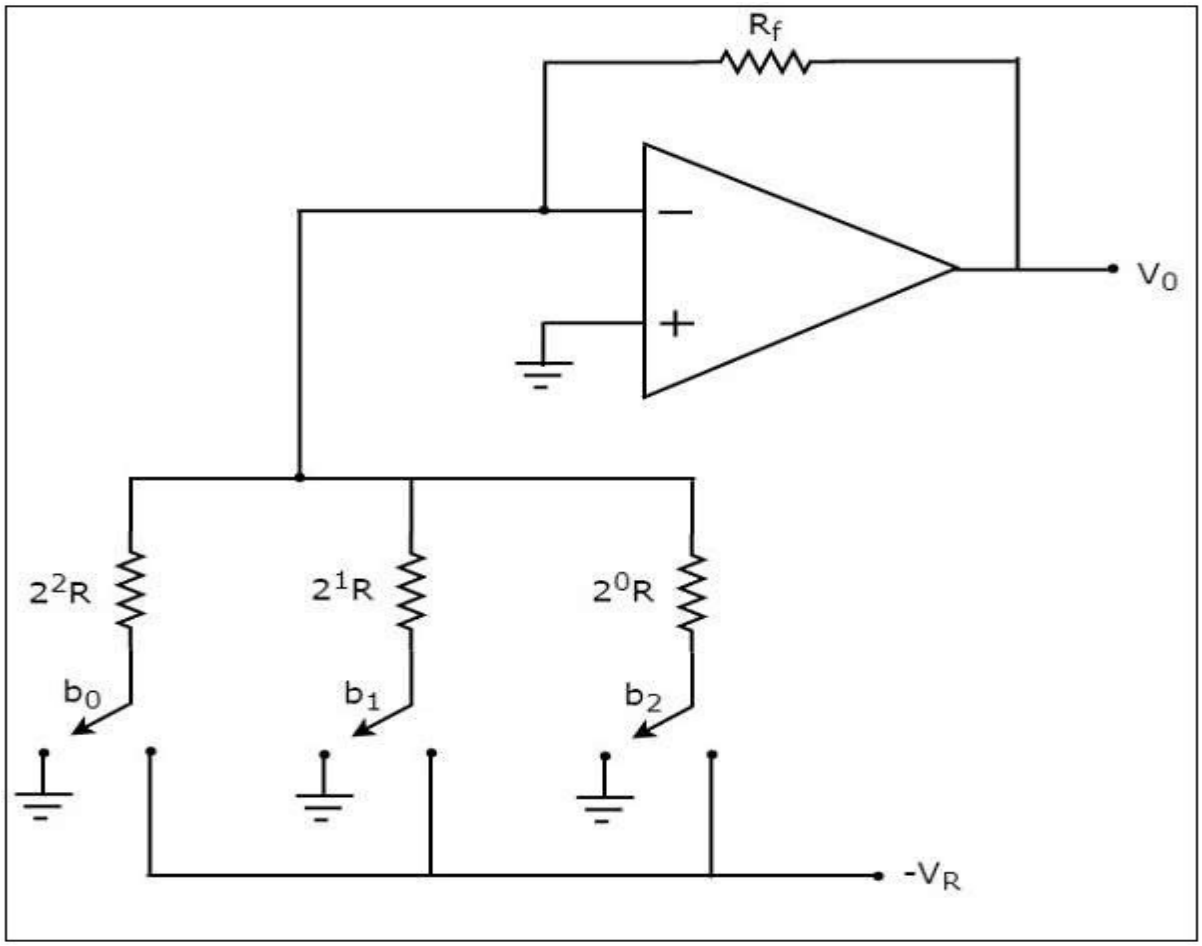
- It is Simple in Construction.
- It provides fast conversion.

Disadvantages:

- This type requires large range of resistors with necessary high precision for low resistors.
- Requires low switch resistances in transistors.
- Can be expensive. Hence resolution is limited to 8-bit size.

R-2R Ladder DAC:-

The R-2R Ladder DAC overcomes the disadvantages of a binary weighted resistor DAC. R-2R Ladder DAC produces an analog output, which uses a R-2R ladder network in the inverting adder circuit.(R-2R लैडर DAC , a binary weighted resistor DAC नुकसान को खत्म करता है। R-2R लैडर DAC एक एनालॉग आउटपुट का उत्पादन करता है, जो R-2R Ladder में inverting adder circuit का उपयोग करता है ।



The **advantages** of a R-2R Ladder DAC are as follows −

- R-2R Ladder DAC contains only two values of resistor: R and 2R. So, it is easy to select and design more accurate resistors.(R-2R लैडर DAC में प्रतिरोधक के केवल दो मान होते हैं: R और 2R । इसलिए, अधिक सटीक प्रतिरोधों का चयन करना और डिजाइन करना आसान है।)

• It does not need as precision resistors as Binary weighted DACs.(इसमे Binary weighted DACs की तरह सटीक (precision) resistors की आवश्यकता नहीं है।)

- It is cheap and easy to manufacture.

• If more number of bits are present in the digital input, then we have to include required number of R-2R sections additionally.(यदि डिजिटल इनपुट की अधिक संख्या होती हैं, तो R-2R sections को बढ़ाते है)

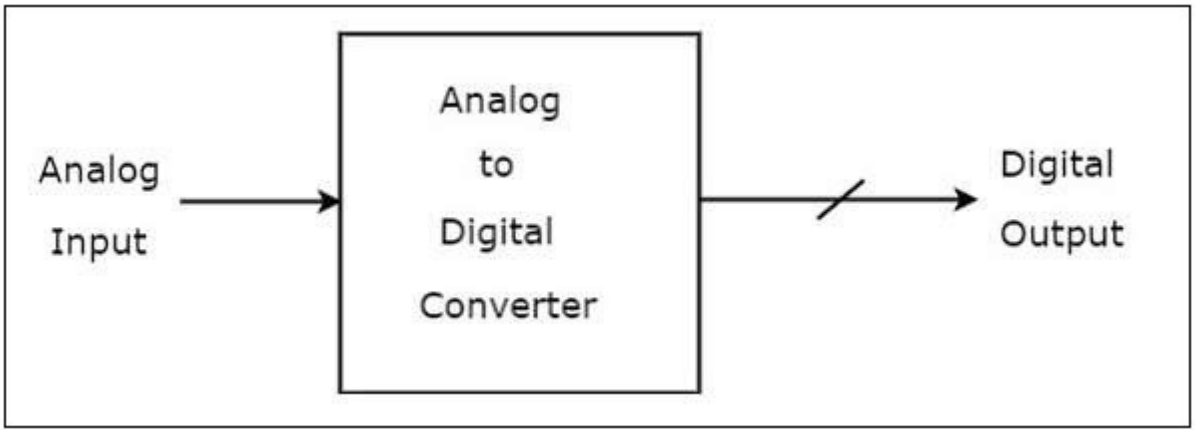
Due to the above advantages, R-2R Ladder DAC is preferable over binary weighted resistor DAC. (उपरोक्त लाभों के कारण, R-2R Ladder DAC , weighted resistor DAC से बेहतर है)

Disadvantages:

• It has slower conversion rate.

Analog to Digital Converter

An Analog to Digital Converter (ADC) converts an analog signal into a digital signal. The digital signal is represented with a binary code, which is a combination of bits 0 and 1. (Analog to Digital Converter (ADC) converts एक analog signal को digital signal में परिवर्तित करता है। डिजिटल सिग्नल को एक बाइनरी कोड के साथ दर्शाया गया है, जो बिट्स 0 और 1 का संयोजन है।)



An Analog to Digital Converter (ADC) consists of a single analog input and many binary outputs. In general, the number of binary outputs of ADC will be a power of two.(एनालॉग से डिजिटल कनवर्टर (ADC) में एकल analog input और कई binary outputs होते हैं। ADC के बाइनरी आउटपुट की संख्या 2 के पॉवर में होता है I)

Applications:

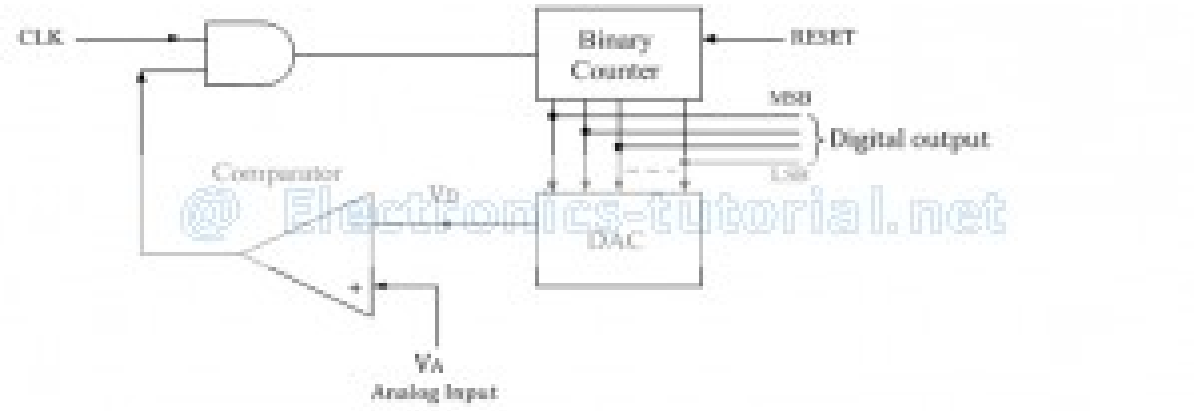
1. Digital Voltmeter: measures voltage in analog and convert to digital form using ADC for digital representation form.
2. Mobile phone: Analog voice is converted to digital form for further processing(speech compression,encoding etc.) before it is converted back to analog form for transmission.
3. Scanner: When we take photo, the scanner uses ADC internally to convert analog information provided by picture into digital information.
4. Voice Recorder: It uses ADC to convert analog voice information to the digital information. Latest VOIP solutions utilize the same concept.

Types of ADCs −

- Counter type ADC
- Successive Approximation ADC
- Flash type ADC

Counter type ADC

A counter type ADC produces a digital output, which is approximately equal to the analog input by using counter operation internally. The counter type ADC is constructed using a binary counter, DAC and a comparator. (counter type ADC एक डिजिटल आउटपुट का उत्पादन करता है, जो आंतरिक रूप से counter operation का उपयोग करके analog input के लगभग बराबर है। counter type ADC में बाइनरी काउंटर, DAC और एक तुलनित्र का उपयोग करके बनाया जाता है)

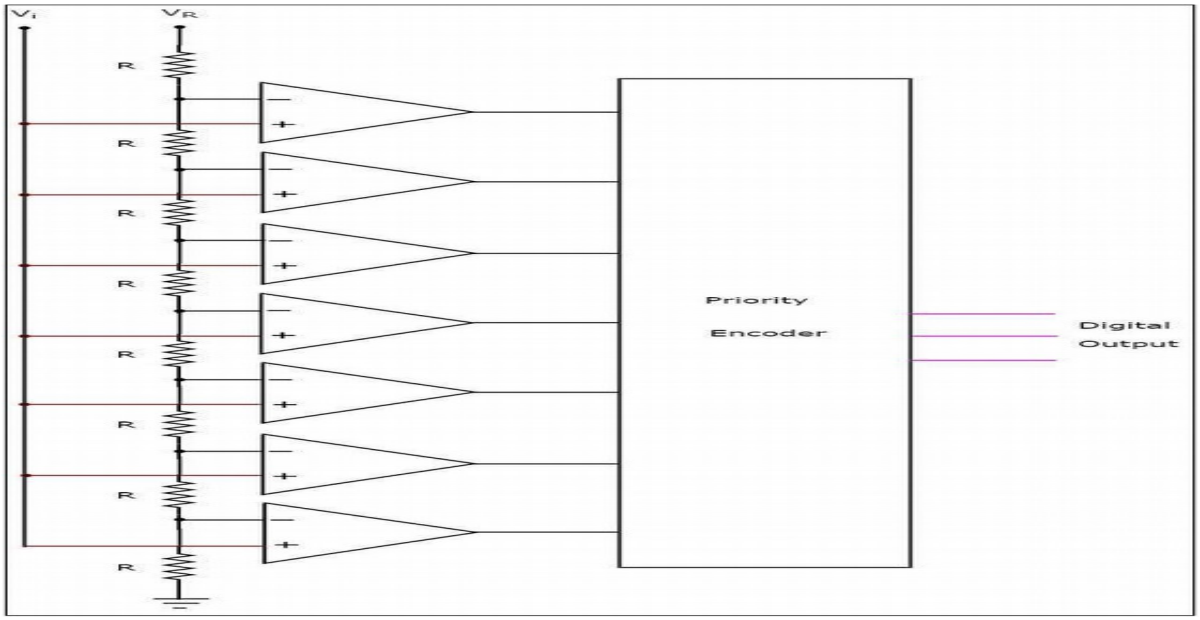


Advantages:
1 Simple construction.
2 Easy to design and less expensive.
3 Speed can be adjusted by adjusting the clock frequency.
4 Faster than dual slope type ADC.

Flash Type ADC

A **flash type ADC** produces an equivalent digital output for a corresponding analog input in no time. Hence, flash type ADC is the fastest ADC. Flash Type ADC is based on the principle of comparing analog input voltage with a set of reference voltages.(**flash type ADC** कुछ समय ही analog input से equivalent digital output उत्पन्न करता है. इसलिए, , **flash type ADC** सबसे तेज़ ADC है. Flash Type ADC analog input voltage को reference voltages के set से comparing के सिद्धांत पर आधारित है।)

To convert the analog input voltage into a digital signal of n-bit output, 2^n – 1 comparators are required.(analog input voltage को n-bit output के digital signal परिवर्तित करने के लिए, (2^n - 1) comparators की आवश्यकता होती है।)



Advantages:

1)It is the fastest type of ADC. Typical conversion time is 100ns or less.

2)The construction is simple and easier to design.

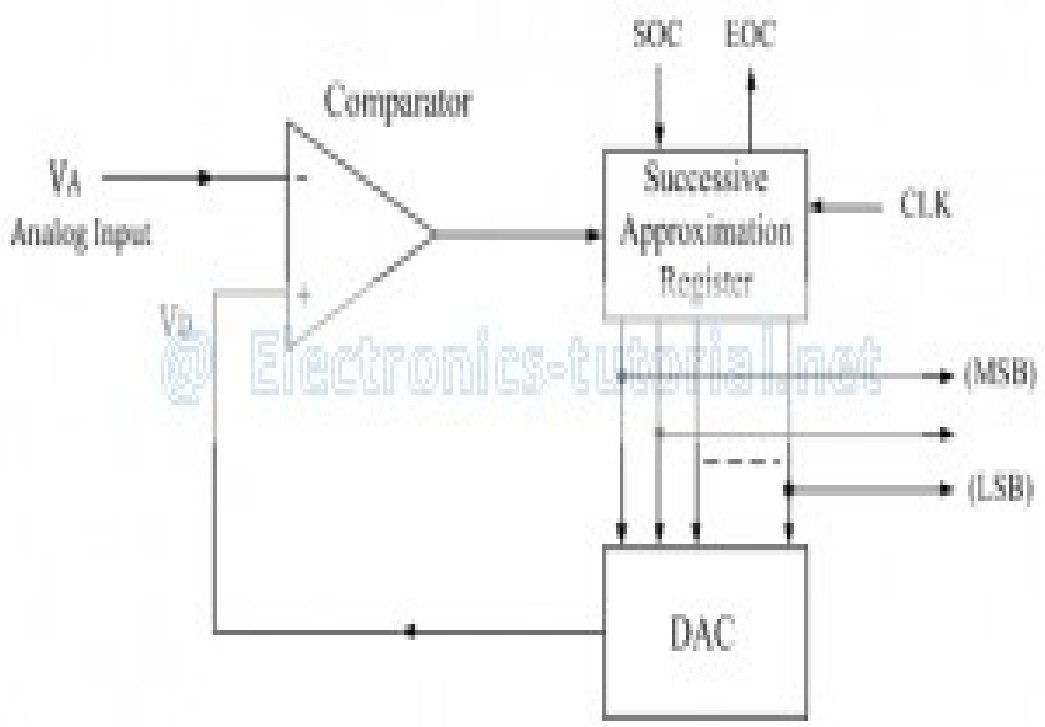
Disadvantages:

1)It is not suitable for higher number of bits.

2)To convert the analog input voltage into a digital signal of n-bit output, (2n – 1) comparators are required. The number of comparators required doubles for each added bit.

Successive Approximation ADC

A successive approximation type ADC produces a digital output, which is approximately equal to the analog input by using successive approximation technique internally.



Advantages:

1 Conversion time is very small.
2 Conversion time is constant and independent of the amplitude of the analog input signal VA.

Disadvantages:

1 Circuit is complex.
2 The conversion time is more compared to flash type ADC.