Unit VI

Analog to digital converter

And

Digital to analog converter

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Successive approximation

- A Successive Approximation Register (SAR) is added to the circuit
- Instead of counting up in binary sequence, this register counts by trying all values of bits starting with the MSB and finishing at the LSB.
- The register monitors the comparators output to see if the binary count is greater or less than the analog signal input and adjusts the bits accordingly

Continue

- The SAR architecture mainly uses the binary search algorithm
- The SAR ADC consists of fewer blocks such as one comparator, one DAC (Digital to Analog Converter) and one control logic.
- The algorithm is very similar to like searching a number from telephone book

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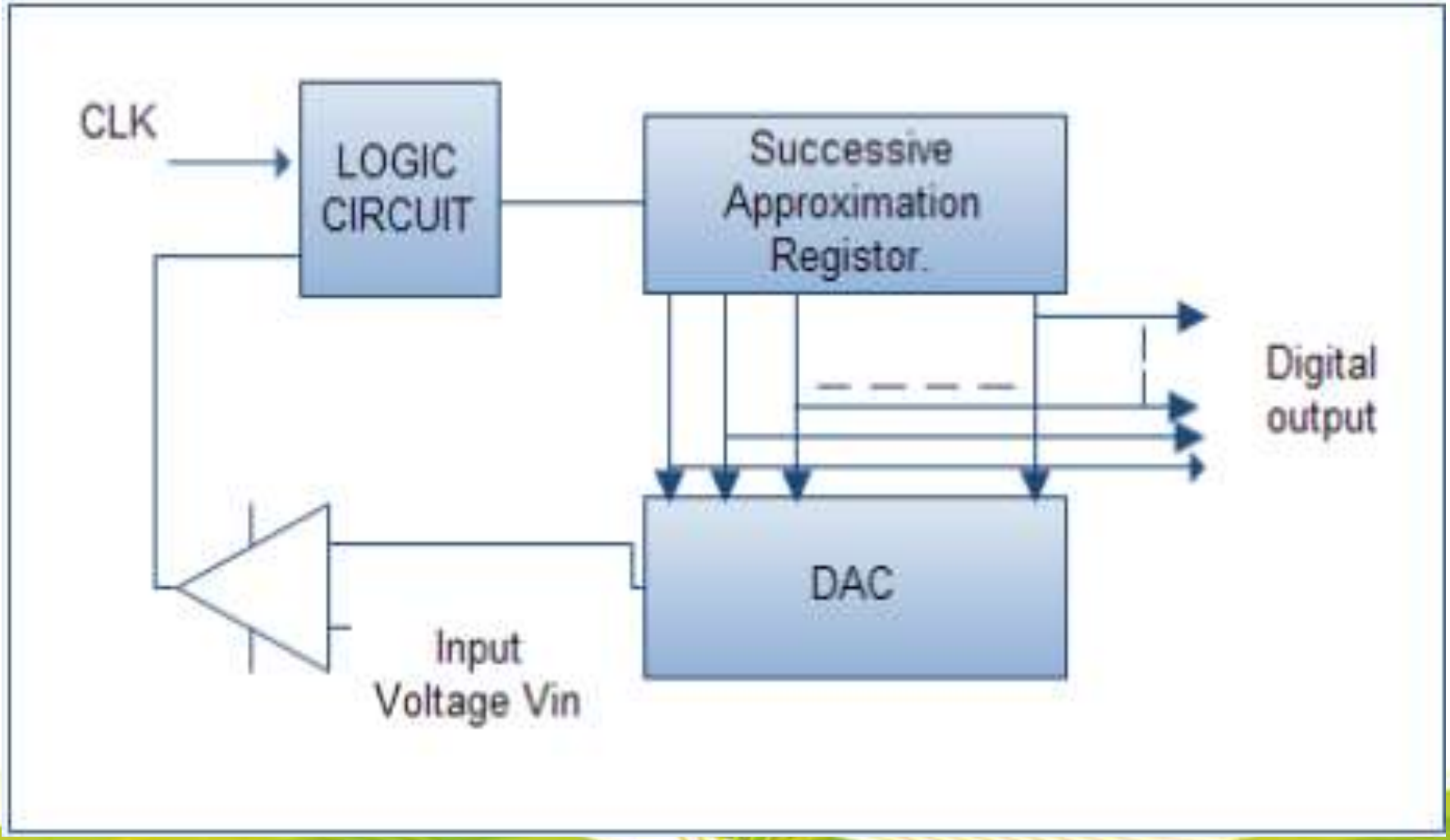
Block Diagram



Applications

- **Scanner** : when you scan a picture with a scanner , what scanner is doing is an analog to digital conversion : it is taking the analog information provided by the picture(light) and converting into digital
- **Recording a voice** : when you record your voice or use a VoIP solution on your computer you are using analog to digital converter to convert you voice , which is analog into digital information

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Part two

Digital to analog converter

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Outline

- Definition
- Types of DAC and each operation
- DAC performance specifications
- Applications of ADC

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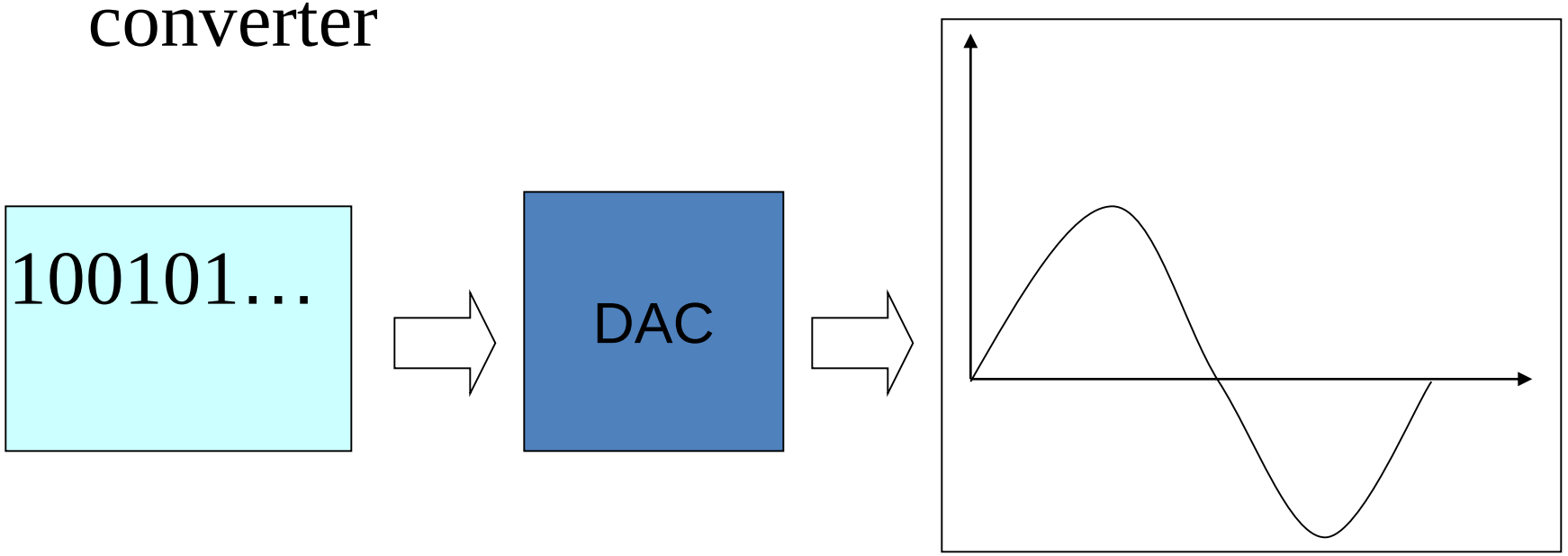
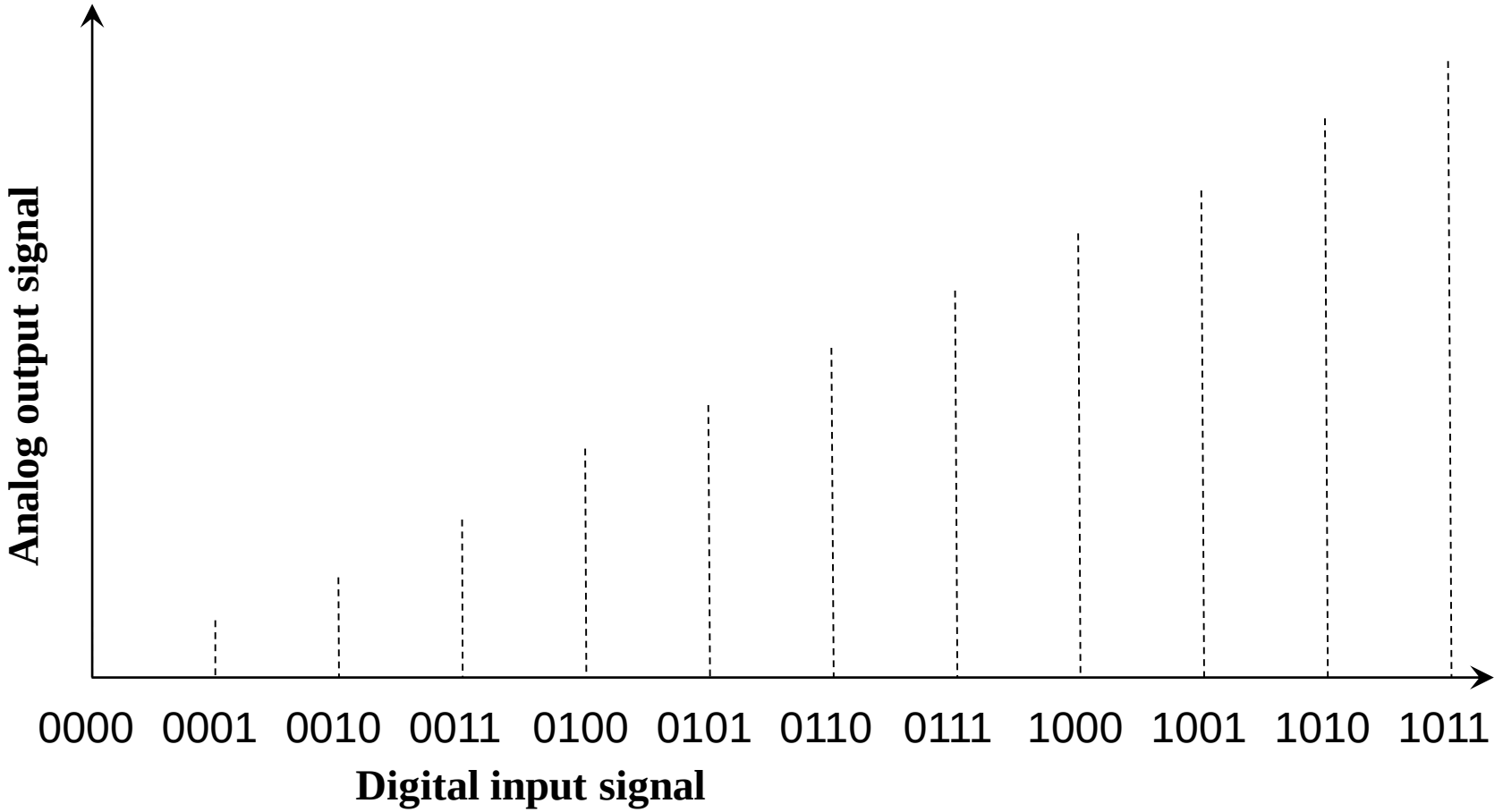
Definition

- To convert digital values to analog voltage
- Performs inverse operation of analog to digital converter



What is DAC


Analog output signal
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
Digital input signal

Continue

$$\text{Analog Output} = \frac{\text{Digital Input}}{(2^N - 1)} \times \text{Reference Input}$$

continue

- DAC is function that converts digital data(usually binary) into analog signal(current , voltage, or electric charge)
- **d**igital-to-**a**nalog **c**onverter, a device (usually a single chip) that converts digital data into analog signals.
- Modems require a DAC to convert data to analog signals that can be carried by telephone wires.
- Video adapters also require DACs, called RAMDACs, to convert digital data to analog signals that the monitor can process.

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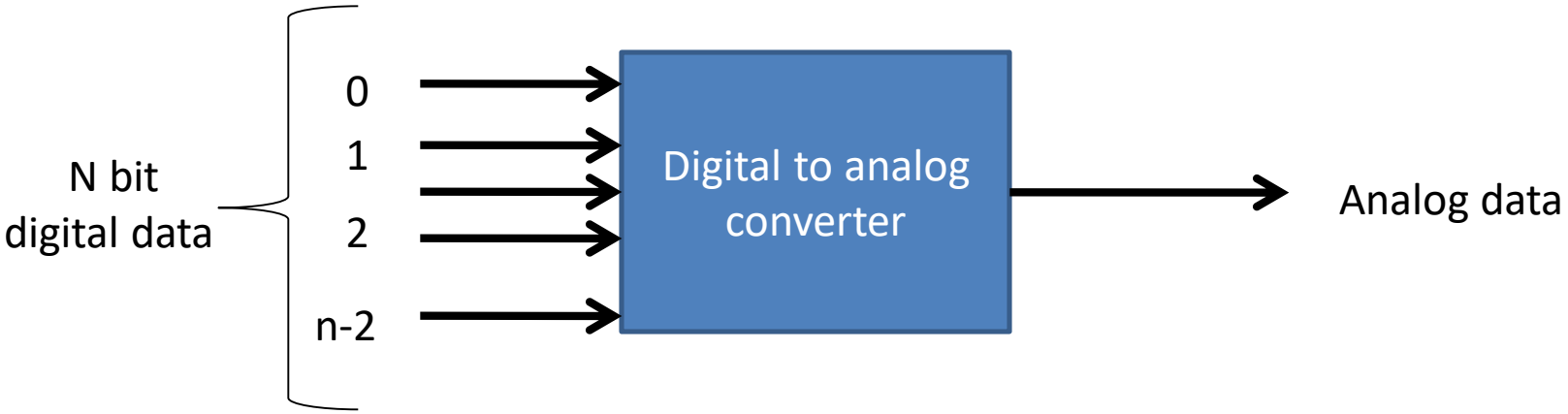
Types of DAC

- There are two types of DAC
  - Weighted Resistor or Resistive Divider type
  - R -2R ladder type DAC



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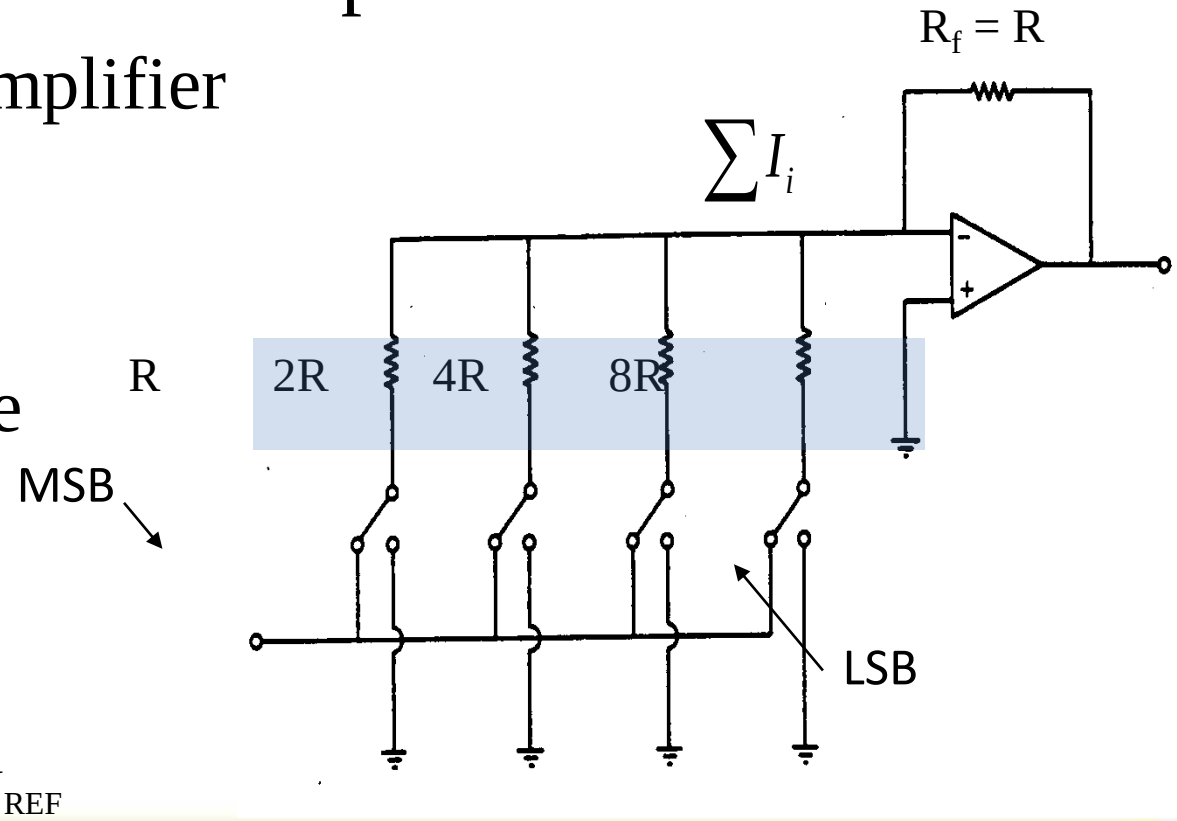
Weighted Resistors

- In this type of DAC components used is
  - Operational amplifier
  - Switches
  - Resistors
  - Voltage source
  - Ground



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Definition of weighted resistors

- Binary Weighted resistors are used to distinguish each bit from the most significant to the least significant
- Binary weighted resistors Reduces current by a factor of 2 for each bit

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Continue

- Binary Weighted resistors is reliable, and simple to do conversion
- The circuit shown is a digital to analog converter 4-bits weighted binary resistance network circuit types.
- Resistor values can be calculated using the weight of the binary number.

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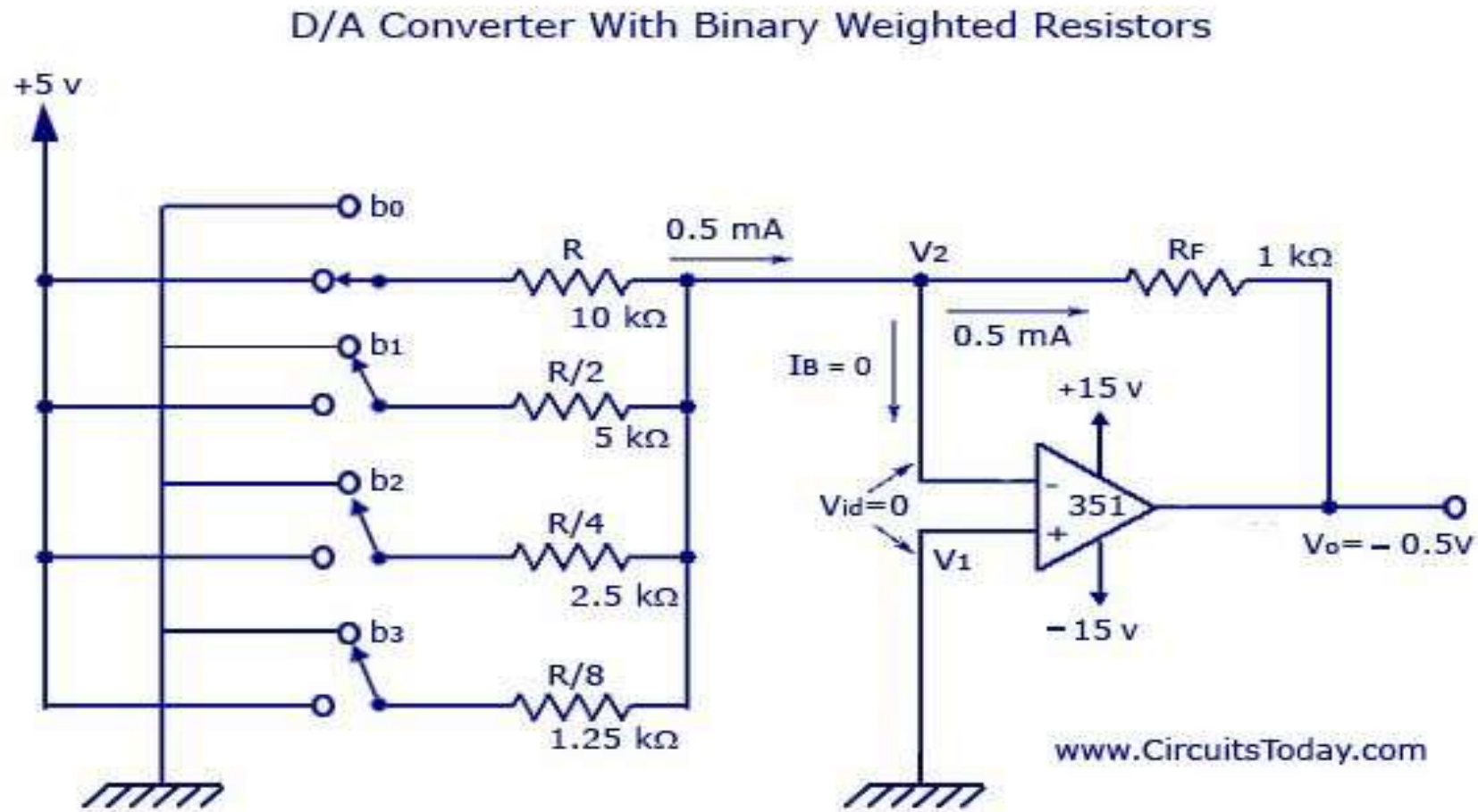
Circuit diagram of weighted resistors



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Quick Quiz

- The most widely used type of ADC is

A. counter- type

B. flash type

C. successive –approximation type

D. dual-slope type

Quick Quiz

- The simplest type of ADC is

A. counter- type

B. flash type

C. successive –approximation type

D. dual-slope type