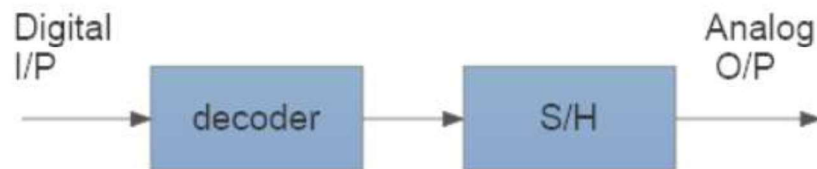# Digital to Analog(D/A) conversion

- A digital to analog converter (DAC) converts a digital signal to an analog signal in form of voltage or current.
- Two methods:
  - Binary Weighted Resistor method and
  - R-2R Ladder

Digital
I/P

decoder → S/H

Analog
O/P

Binary Weighted Resistor method

- Depending upon the digital input bit Logic circuit performs switching of resistor networks between Vref and ground.
- Transistors are used to switch between V_{ref} and ground (bit high or low)
- weighted resistors are used to distinguish each bit from the MSB to LSB.
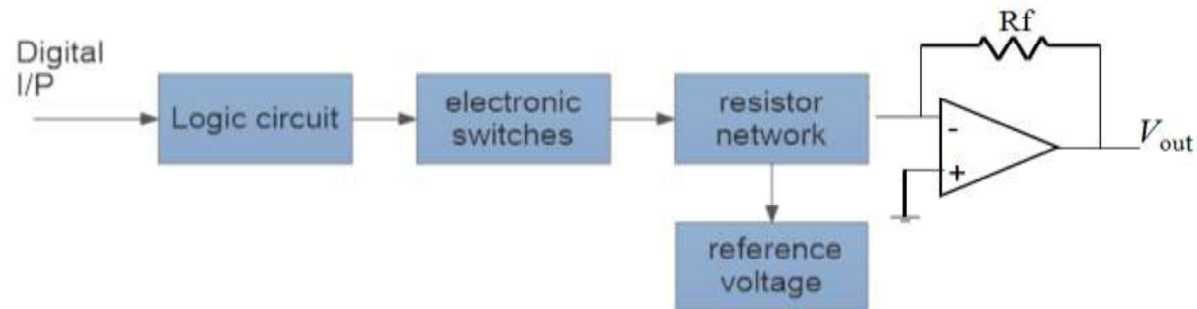
Contd...

Resistors are connected to V_{ref} if corresponding bit is high or ground if corresponding bit is low
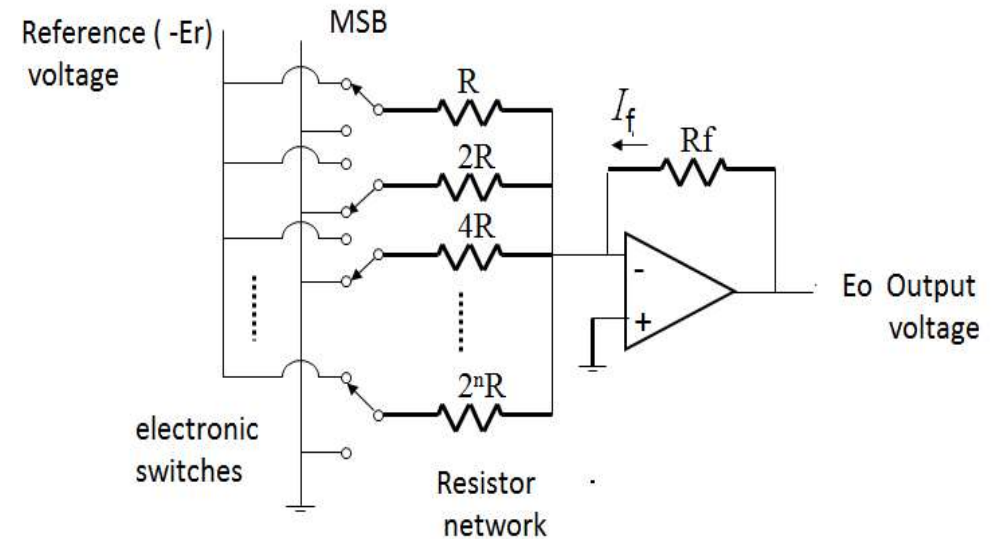The output voltage is,

$$E_o = I_f R_f$$

If R is connected to Er,

$$E_o = \frac{E_r R_f}{R}$$

The general expression is,

$$E_o = I_f R_f = \left(\frac{a_0}{R} + \frac{a_1}{2R} + \frac{a_2}{4R} + \Lambda + \frac{a_{n-1}}{2^{n-1}R} \right) R_f E_r$$

Reference (-Er) voltage
MSB
R
2R
4R
I_f
Rf
-
+
Eo Output voltage
$2^n R$
electronic switches
Resistor network

For a code of 1001

Binary Weighted Resistor

▶ Advantages
  ◦ Simple Construction/Analysis
  ◦ Fast Conversion
▶ Disadvantages
  ◦ A 10 bit DAC needs resistors ranging from R to R/1024
  ◦ Requires low switch resistances in transistors
  ◦ Can be expensive. Therefore, usually limited to 8-bit resolution.