# DAC

## (chapter 13)

MBSD, 6th Semester

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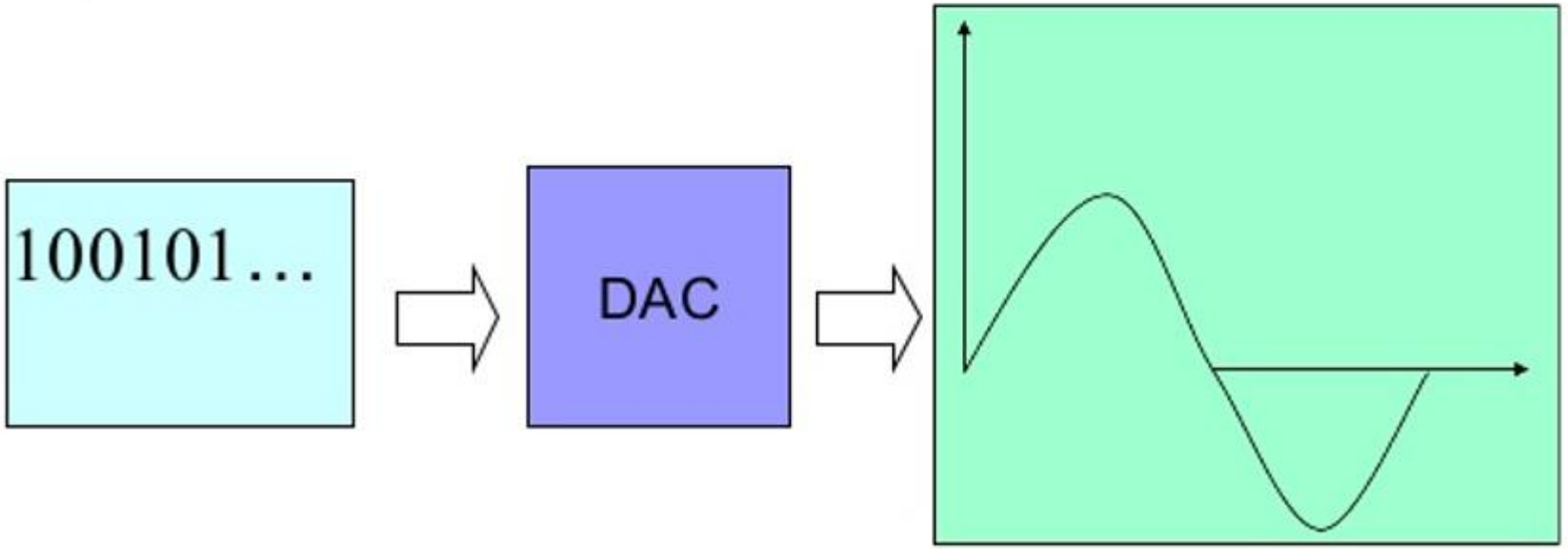
Some photos taken from Khulna University

# DAC: Digital to Analog Convertor

## What is a DAC?

A digital-to-analog converter (DAC) takes a digital code as its input and produces an analog voltage or current as its output. This analog output is proportional to the digital input.

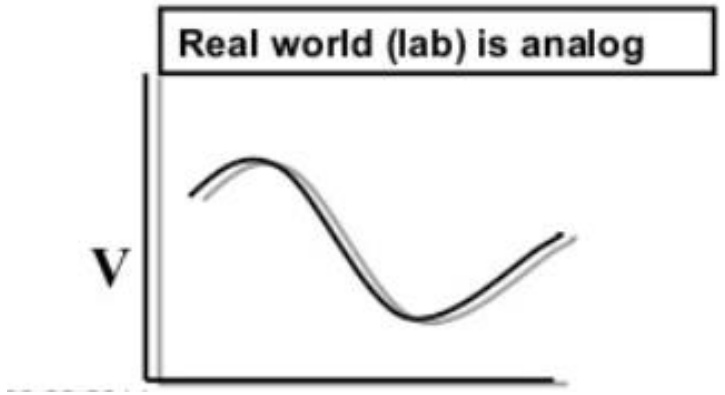


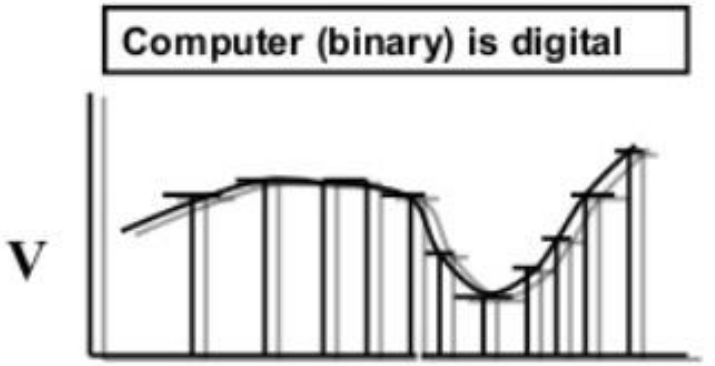
# Terminology

- ***Analog:*** continuously valued signal, such as temperature or speed, with infinite possible values in between.

- ***Digital:*** discretely valued signal, such as integers, encoded in binary.

digital-to-analog converter: DAC, D/A, D2A



# DAC

## ❑ General Concept:

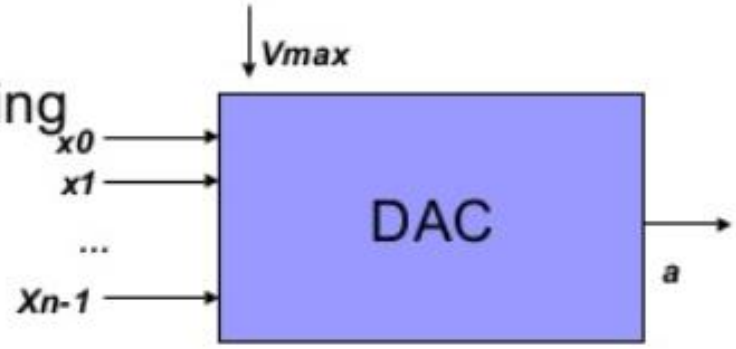
➢ Digital to Analog conversion involves transforming the computer's binary output in 0's and 1's (1's typically = 5.0 volts) into an analog representation of the binary data

## ❑ DAC:

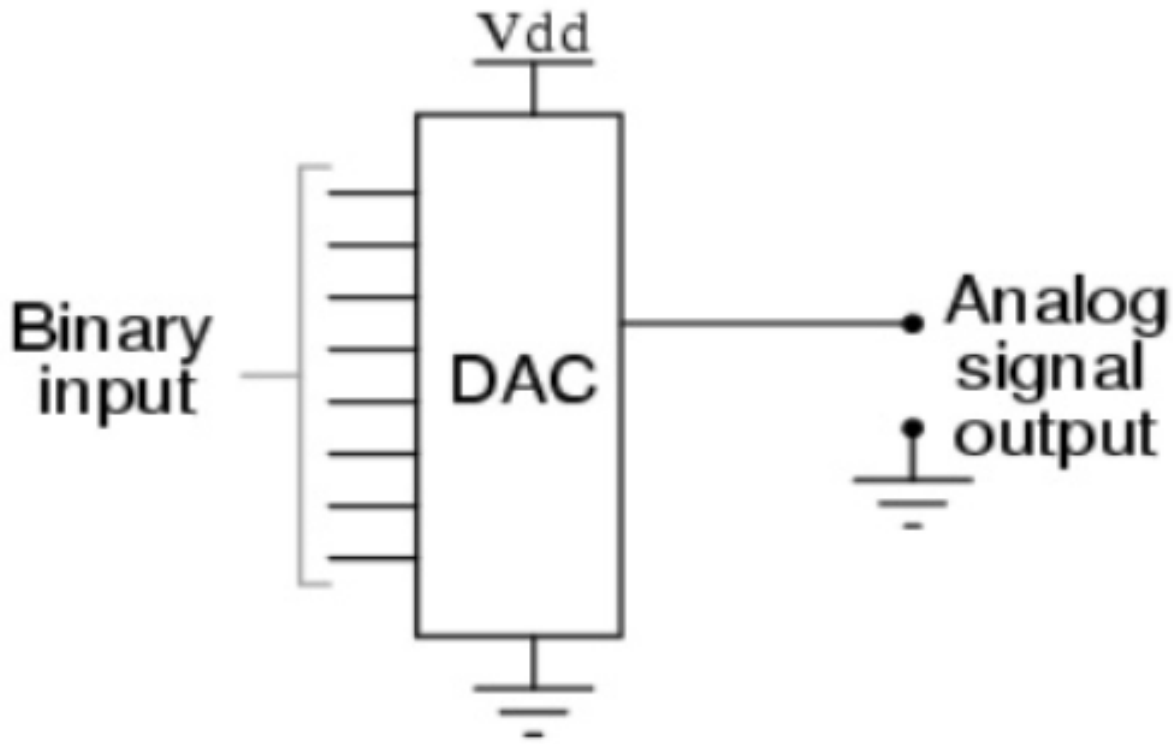
➢ *n* digital inputs for digital encoding

➢ analog input for *Vmax*

➢ analog output *a*



# Block Diagram



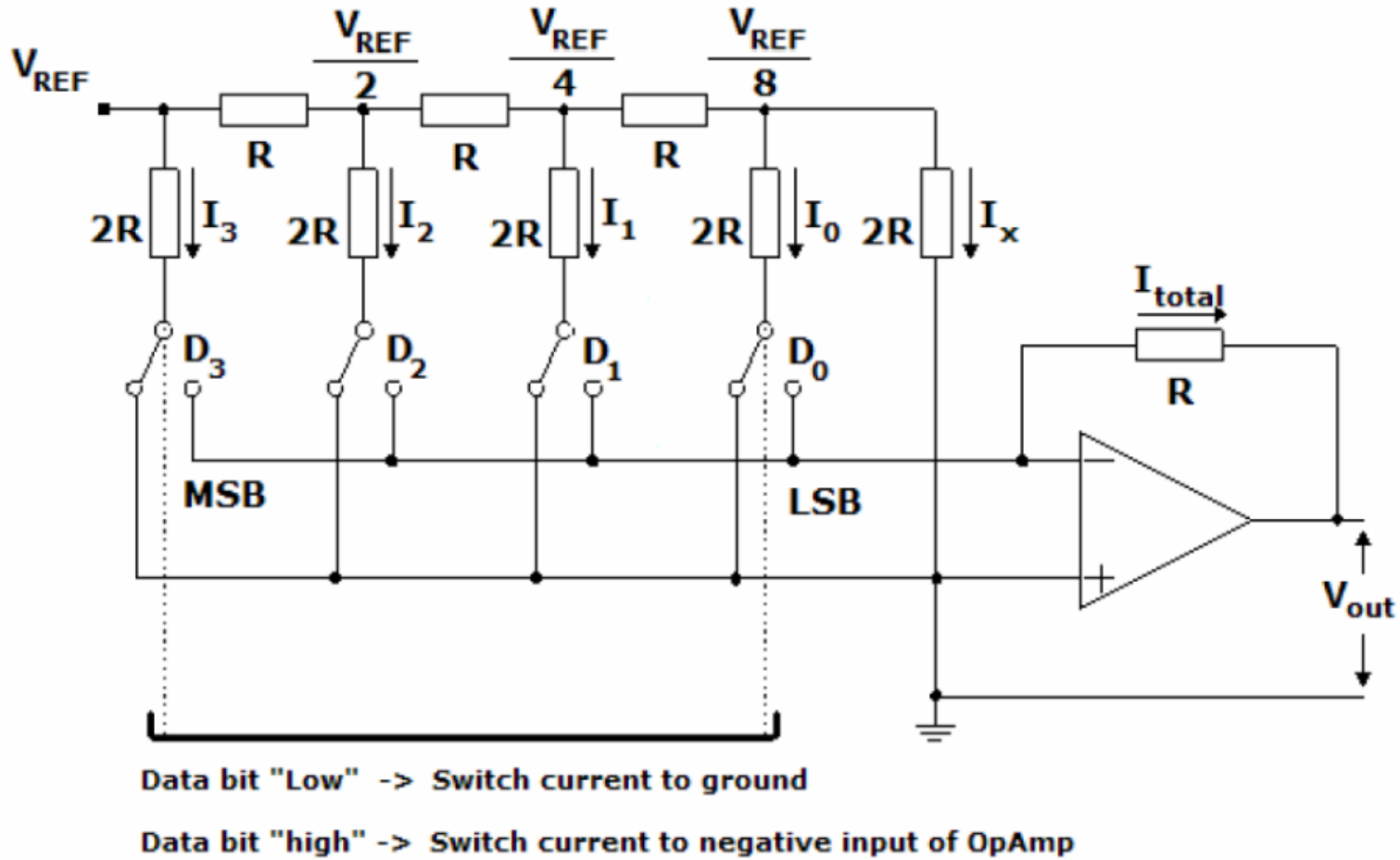
# DAC Resolution

Resolution is the amount of variance in output voltage for every change of the LSB in the digital input.

- Just as with ADCs, there are several common ways of specifying a DAC's resolution:
- Number of bits, $n$
- Number of output codes = $2^n$, or number of steps in the output = $2^n - 1$

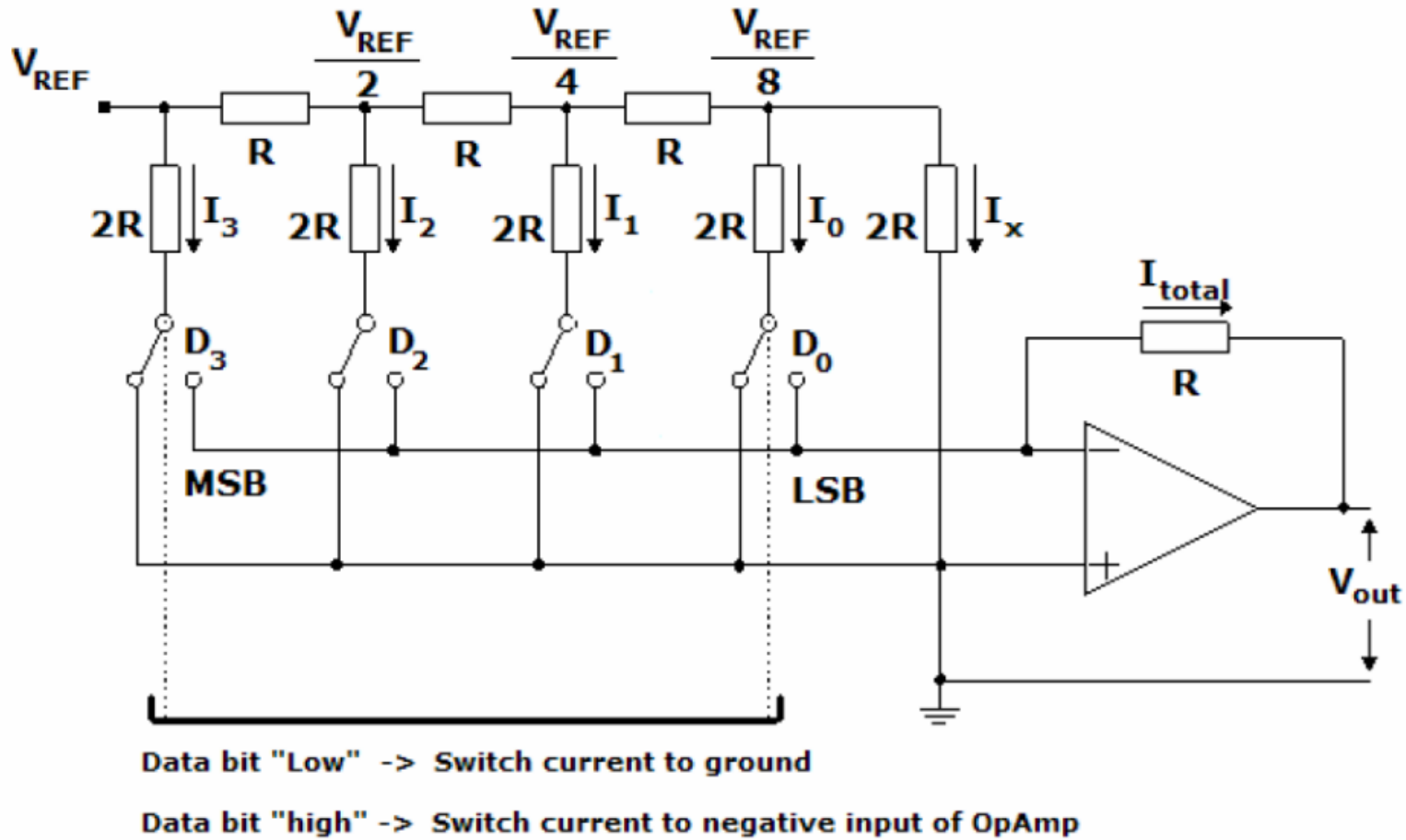
# R/2R 4-bit DAC Architecture (1/2)

- Uses a repeating cascaded structure of resistor values R and 2R to create a binary weighted DAC.
- The R/2R ladder divides down a positive reference voltage by switching individual resistors between a positive reference voltage, $V_{REF}$, and the analogue ground, generating a current.
- The equivalent resistance between $V_{REF}$ and ground is R.
- An operational amplifier converts this current to Voltage ($V_{out}$)

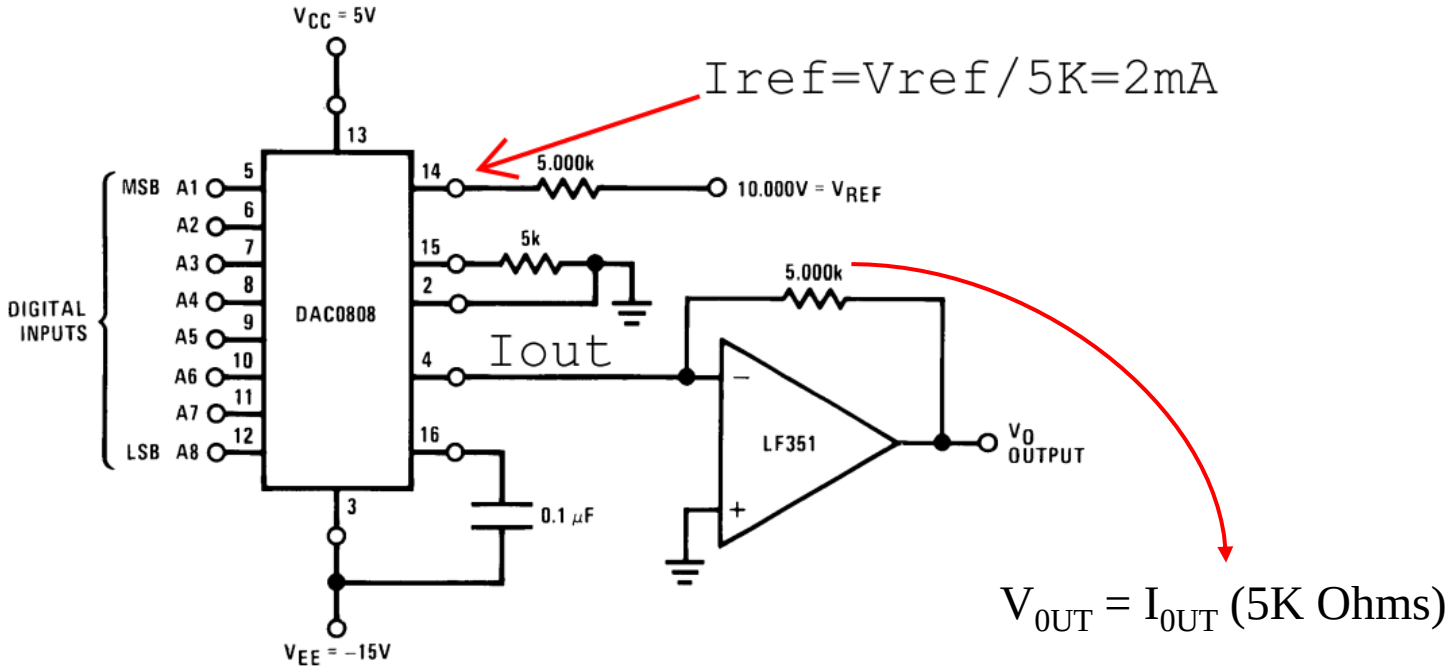


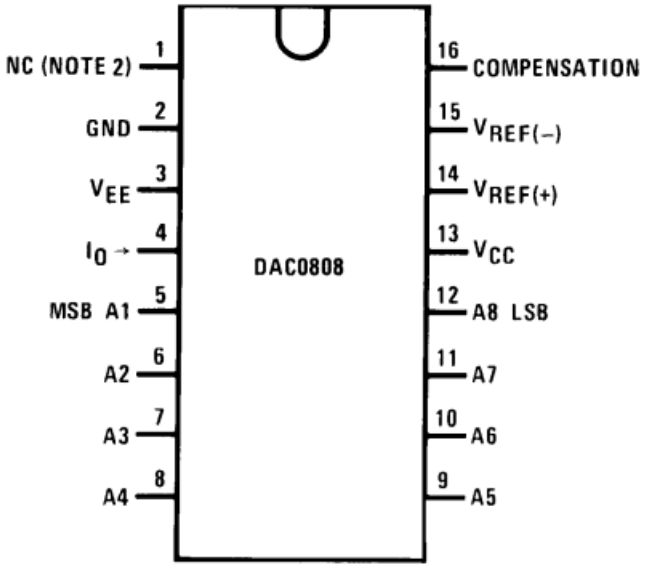
# R/2R 4-bit DAC Architecture (2/2)

- Vout = $\frac{V_{ref}}{2^4}$ * Value
- Example:
  - if Value = 15 & $V_{ref}$ = 2.5 Volts.
  - Vout = ?
- Step size = ?



# Typical Application (DAC0808)




$I_{OUT} = Iref\ (D_7/2 + D_6/4 + D_5/8 + D_4/16 + D_3/32 + D_2/64 + D_1/128 + D_0/256)$

$V_{0UT} = I_{0UT}$ (5K Ohms)

# DAC interfacing