# Analog Ports

Embedded Software

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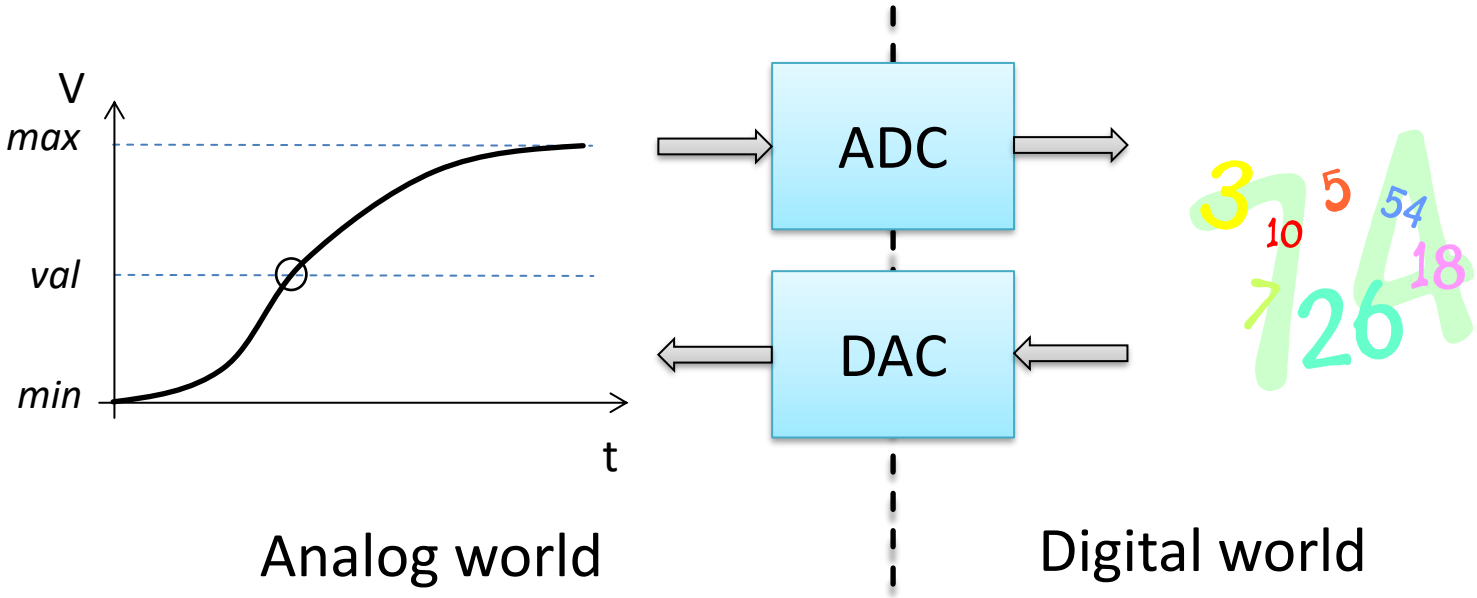
# Analog Ports (1)

- Basic Concepts
  - Most signals are analog (analog world)
  - Microprocessors are digital devices (digital world)
  - Conversion is necessary
    - Analog-to-digital converter
    - Digital-to-analog converter
    - Analog comparator

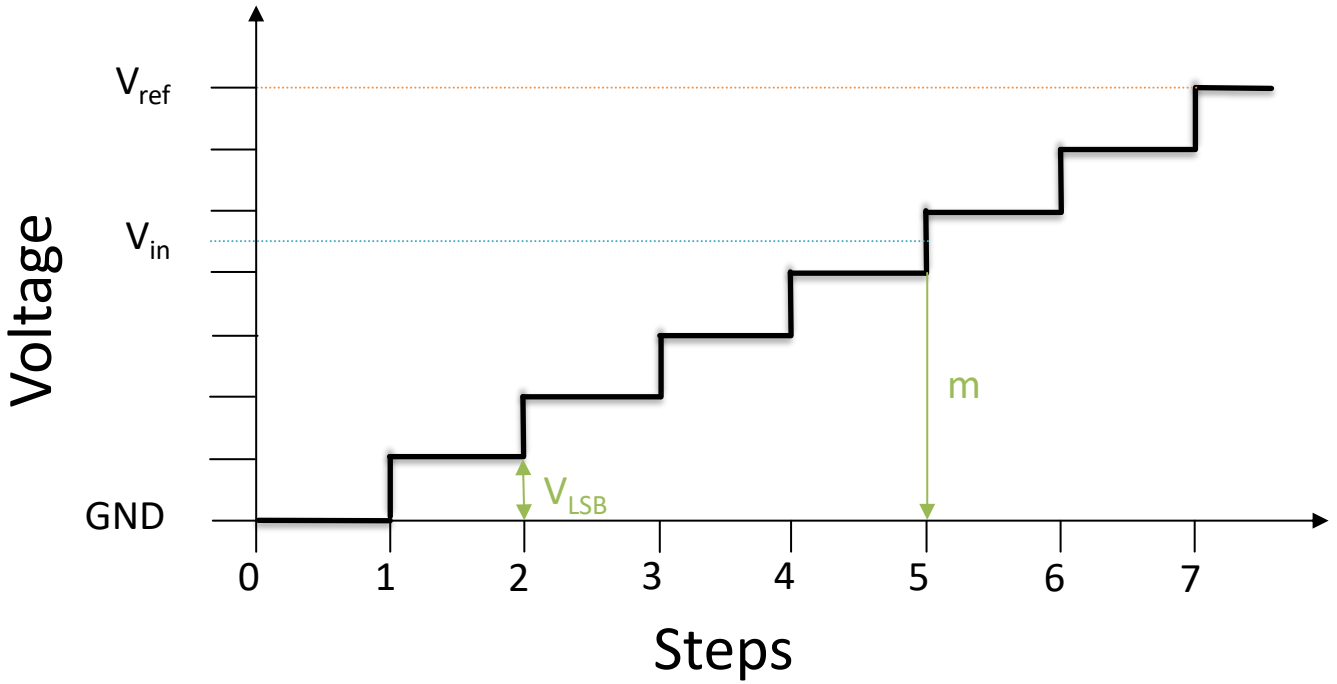
# Analog Ports (2)

- Basic Operation
  - Physical values are converted to numbers



# ADC (1)

- Operating Mode



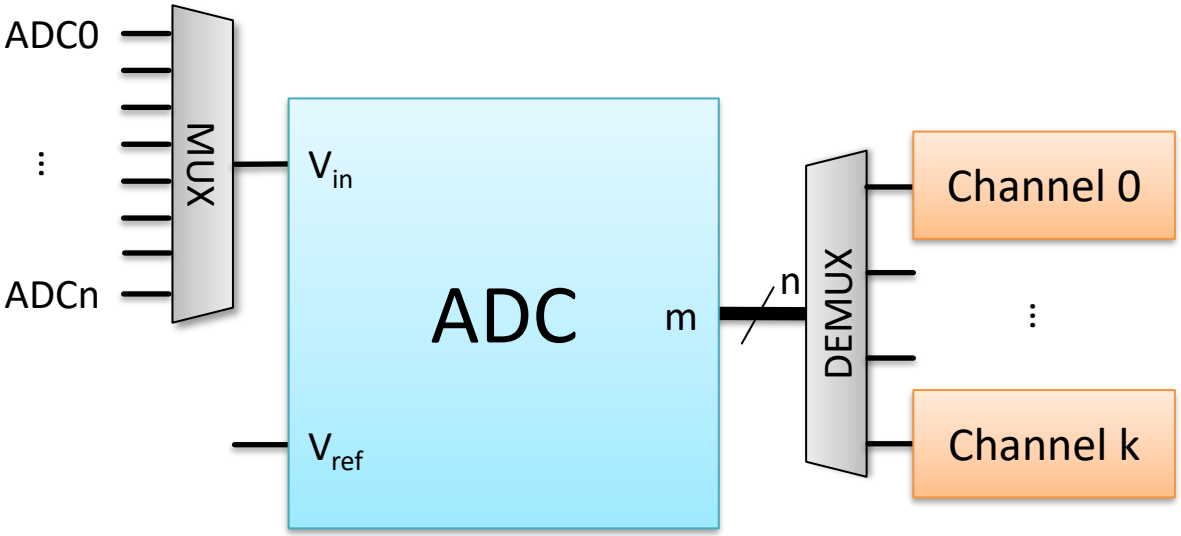
# ADC (2)

- Basic Formulas
  - Range
    - n bit → $2^n$ possible values
  - Resolution
    - $V_{LSB} = \frac{V_{ref}}{2^n}$
  - Result
    - $m = \left\lfloor \frac{V_{in}}{V_{LSB}} \right\rfloor$

**Floor Function (Gauss's Bracket)**
$\lfloor x \rfloor$: Greatest integer less than or equal to *x*. $\lfloor 2.6 \rfloor = 2$ (round down)

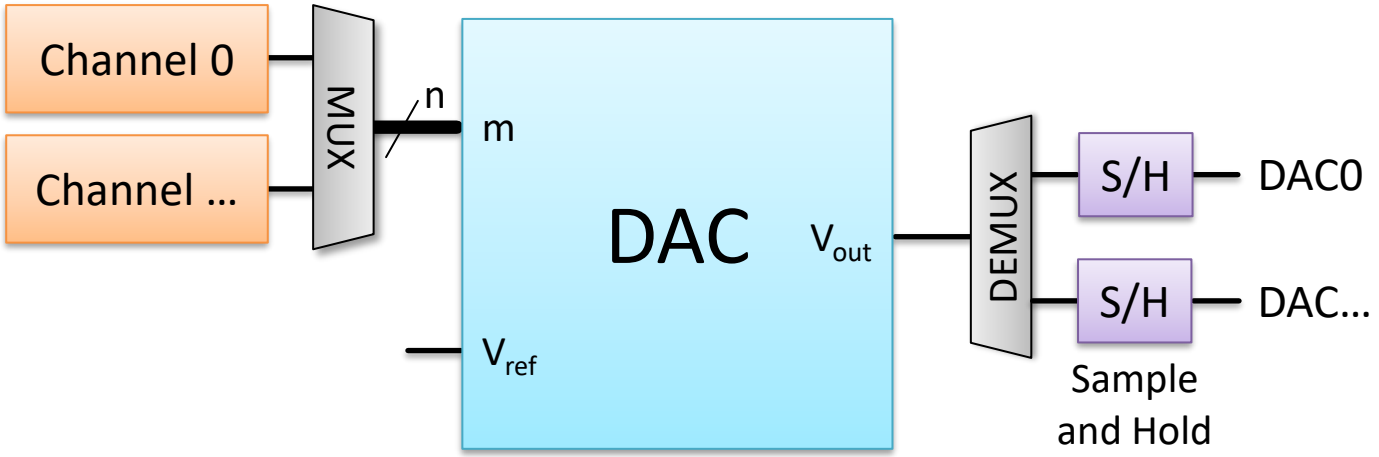
# ADC (3)

- Architecture



# DAC (1)

- Architecture



# DAC (2)

- Basic Formulas
  - Range
    - n bit → $2^n$ possible output voltages
  - Resolution
    - $V_{LSB} = \frac{V_{ref}}{2^n}$
  - Voltage
    - $V_{out} = m \cdot V_{LSB}$ ($0 \leq m < 2^n$)

# AC

- Basic Formulas and Architecture