

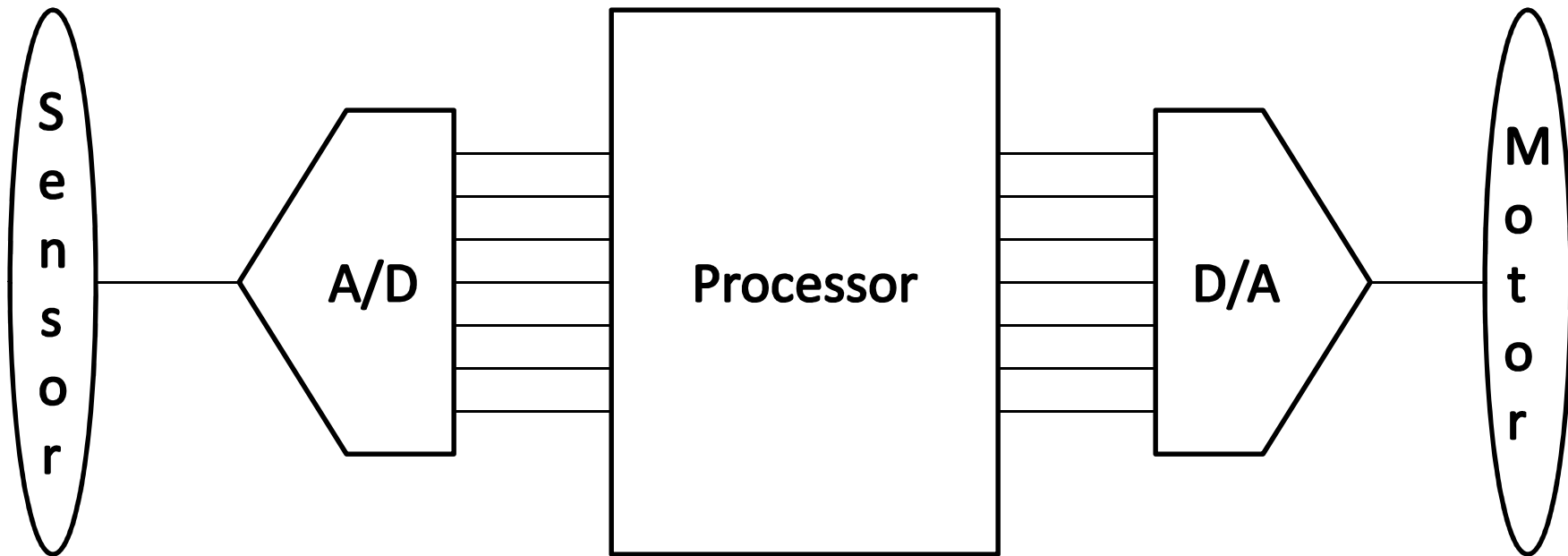


Faculty of Engineering

**MCT242: Electronic Instrumentation**

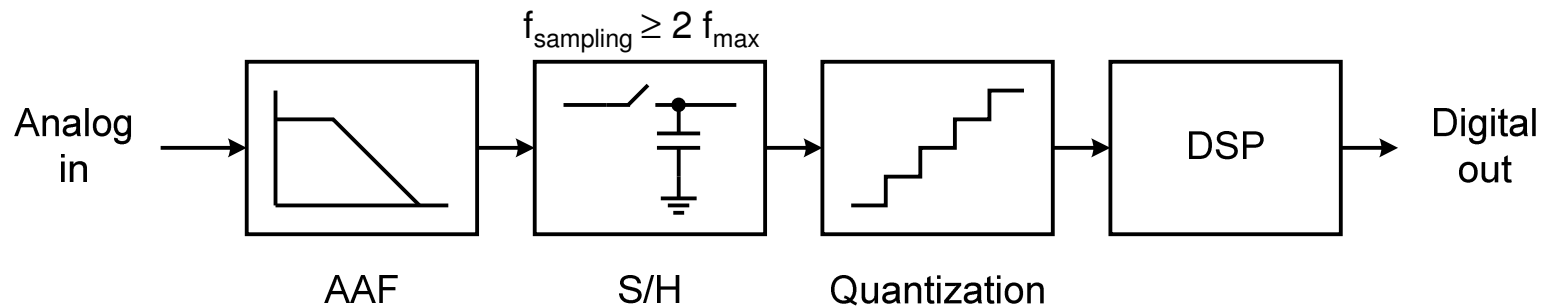
**Lecture 10:  
Digital to Analog Converters**

# A/D and D/A Conversion

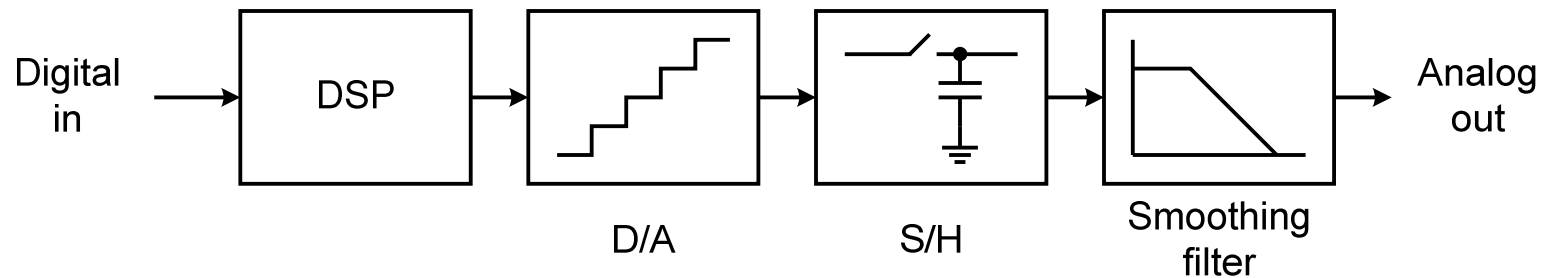


# A/D and D/A Conversion

## A/D Conversion

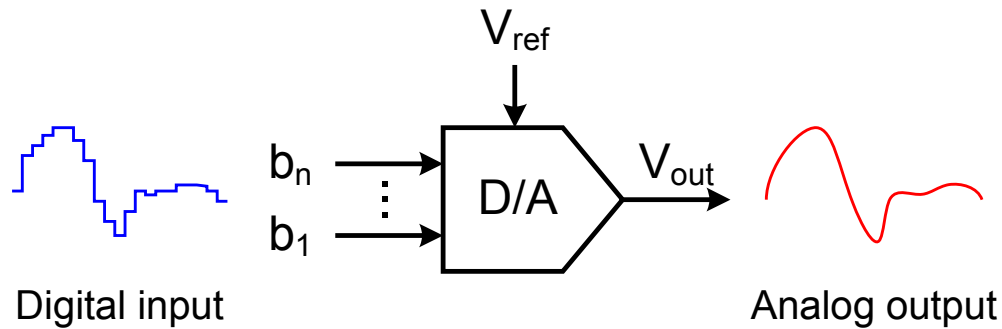


## D/A Conversion



# D/A Converters

# DAC Transfer Characteristic

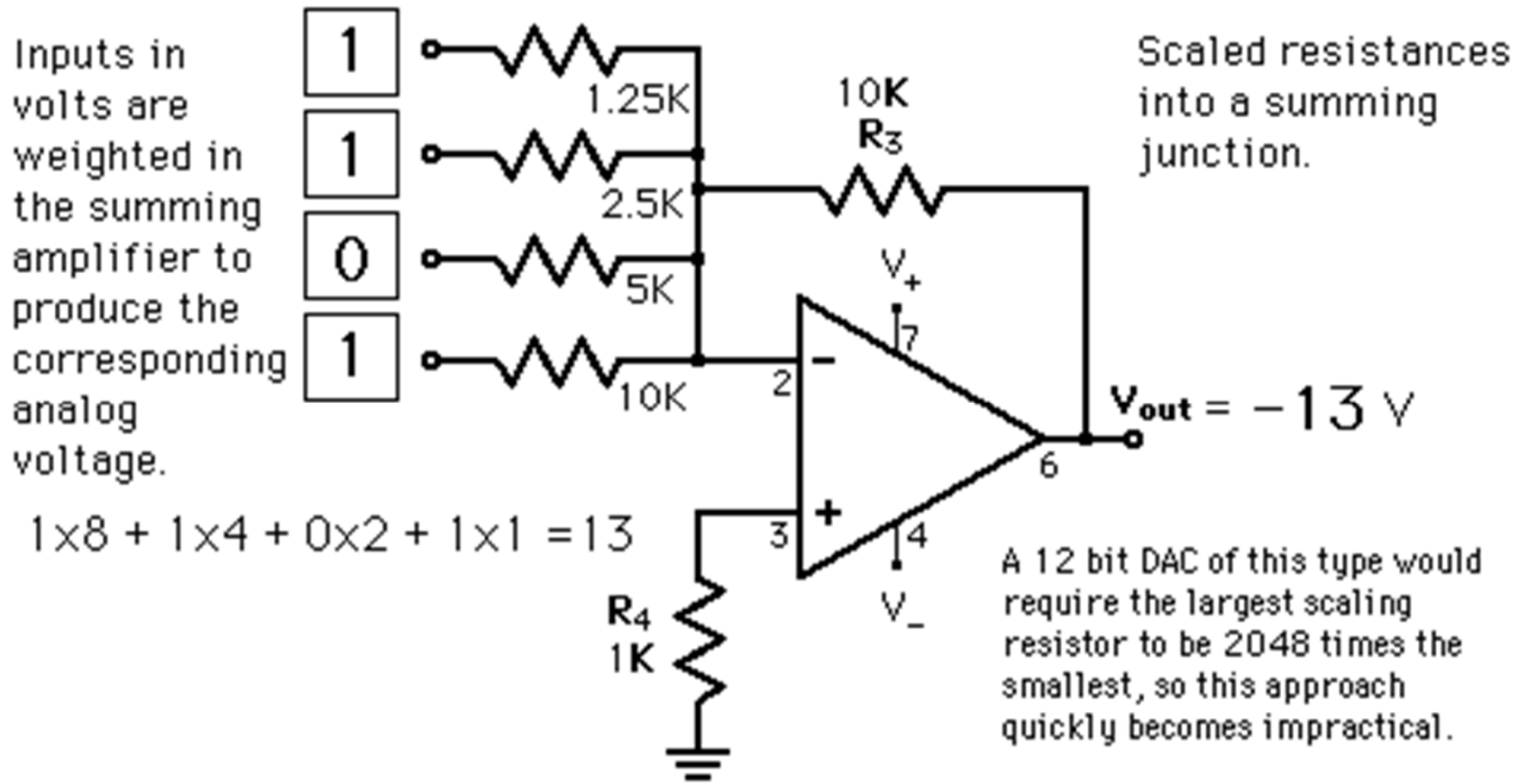


- $N = \#$  of bits
- $V_{FS} =$  Full-scale input
- $\Delta = V_{FS}/2^N = 1\text{LSB}$
- $b_i = 0$  or  $1$
- Multiplication

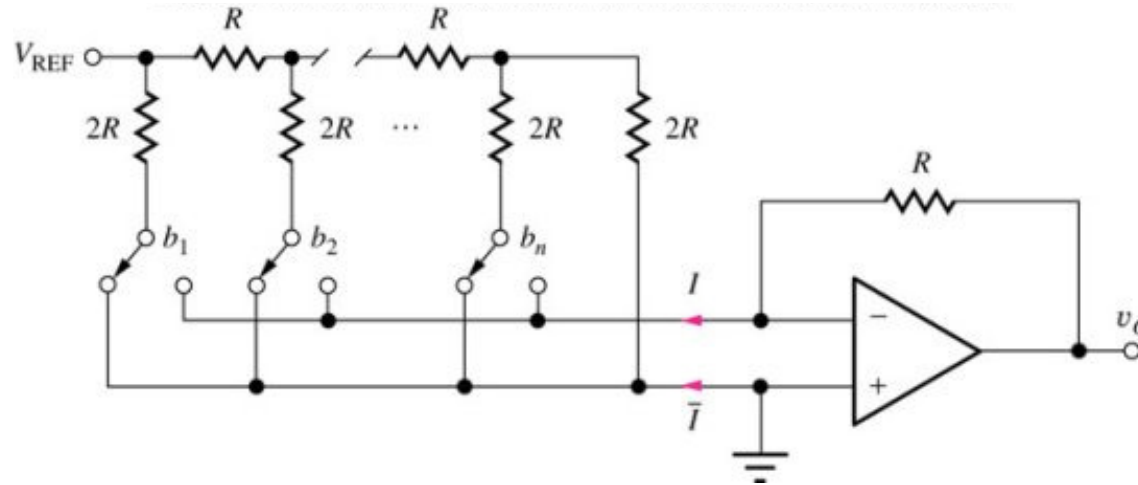
$$V_{out} = V_{FS} \cdot \sum_{i=1}^N \frac{b_i}{2^i} = \Delta \cdot \sum_{i=1}^N b_i \cdot 2^{N-i}$$

Note:  $V_{out} (b_i = 1, \text{ for all } i) = V_{FS} - \Delta = V_{FS}(1-2^{-N}) \neq V_{FS}$

# Weighted Sum DAC



# Inverted R-2R Ladder DAC

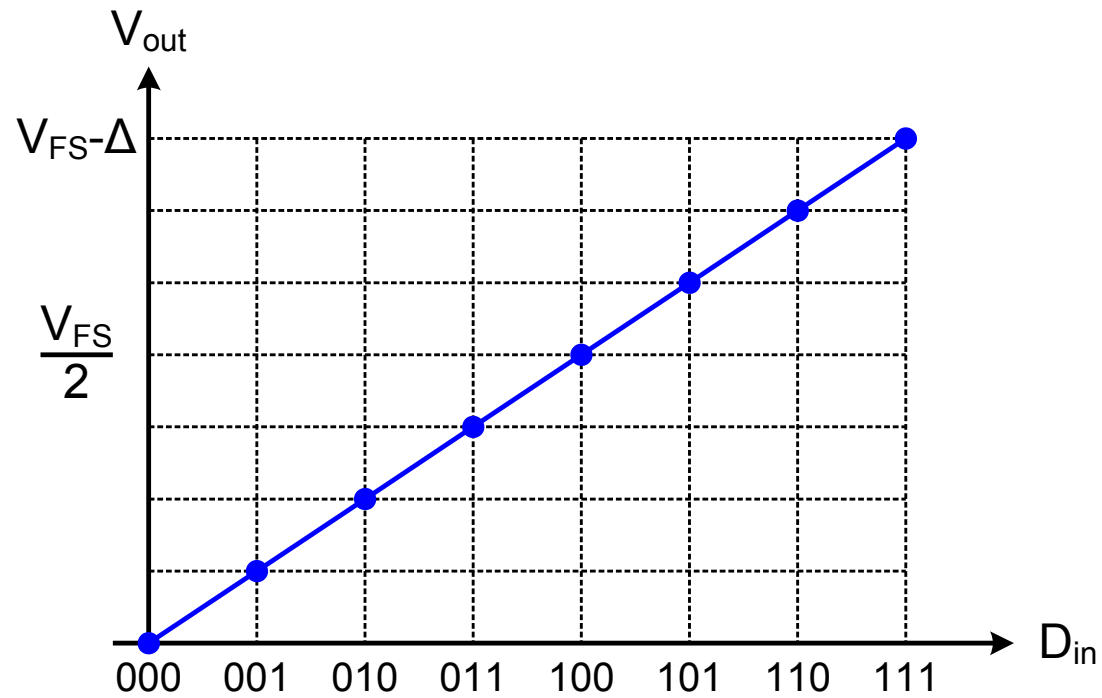


- A very common DAC circuit architecture with good precision.
- Currents in the ladder and the reference source are independent of digital input. This contributes to good conversion precision.
- The “bit switches” need to have very low on-resistance to minimize conversion errors.

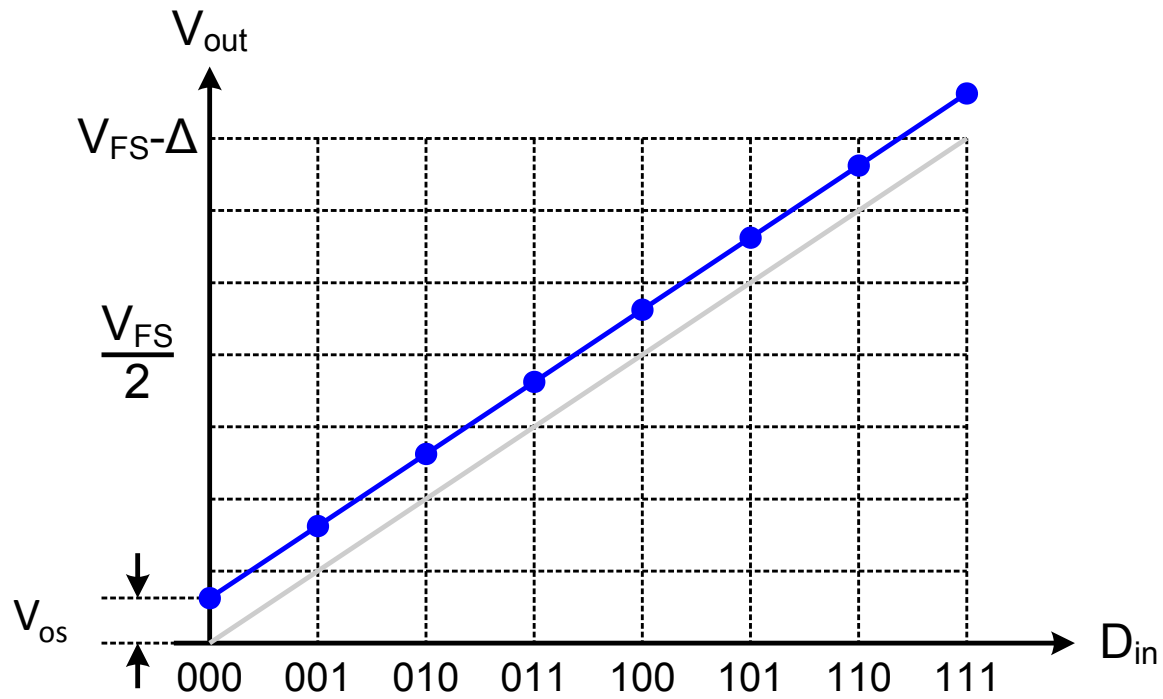
# Static Performance of DAC



# Ideal DAC Transfer Curve



# Offset



# Gain Error

