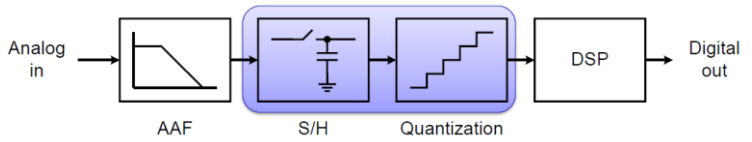
Analog Systems Design

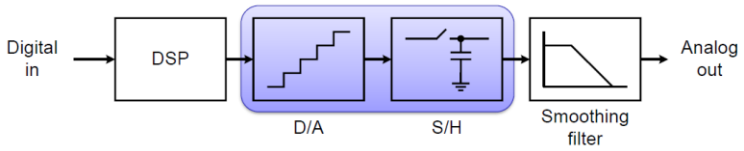
4. Data Converters Specifications 1 (DC characteristics)

1. ADC Vs DAC

- ADC



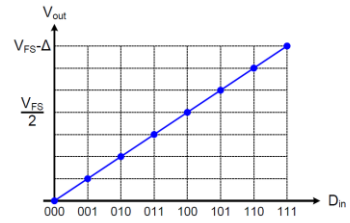
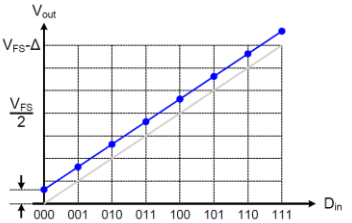
- DAC



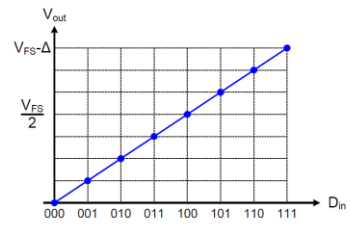
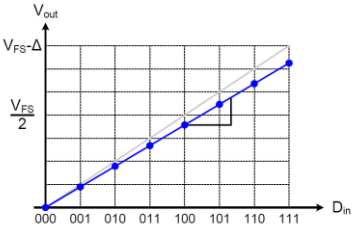
- Signals could be **Unipolar** : 0 to FS or **Bipolar** : -FS to FS

2. Static DC Specifications

- Offset error

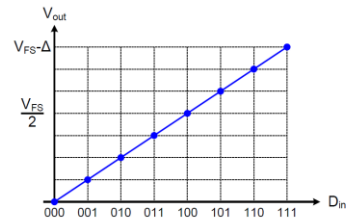
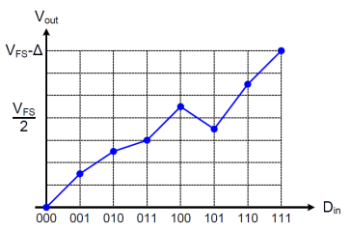
Definition		
The transfer function shifts up/down with the same slope		

- Gain error

Definition		
Error in the transfer function slope		

1) Offset error and Gain error can be calibrated by two points calibrations
    1. Trim the gain error (+/- error correction factor)
    2. Trim the gain error

- DAC monotonicity

Definition		
The expectation of the DAC TF is increasing the input will increase the output (monotonic)		

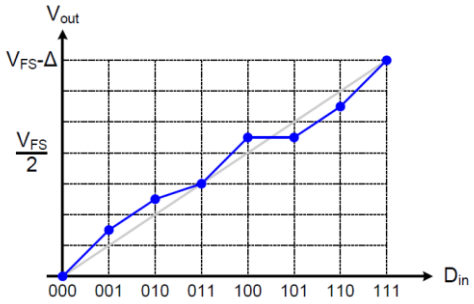
1) Non-monotonic means increasing the input will decrease the output at some points and it can be catastrophic in control loops (turn negative feedback into positive feedback)

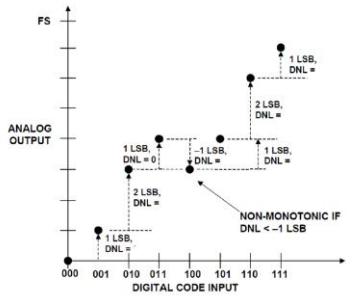
- Linearity

Generally linearity can be described based on two factors DNL and INL

1) DAC DNL

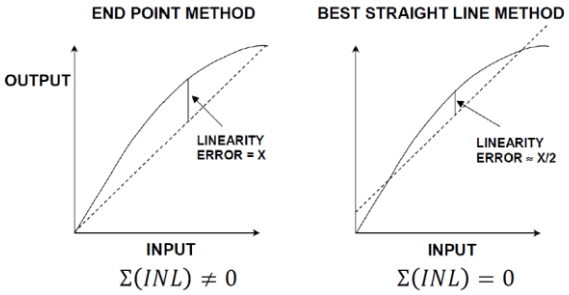
- DNL is the deviation of an output step from 1 LSB ($\Delta = V_{FS}/2$)
- $DNL_i = \frac{i^{th}\ step\ size - \Delta}{\Delta} \rightarrow$ ideal DNL of a step = 0
- If $DNL_i = -1 \rightarrow$ means that an output step does not changed when the input changed
- If $DNL_i < -1 \rightarrow$ means non-monotonicity





2) DAC INL

- INL can be measured relative to
  - Line joining the ideal end points → more accurate
  - A best fit straight line → may be misleading



- The peak to peak INL remains the same