Outline

• ADC/DAC

Intro

Transducers used to convert temperatures, flow rates, pressures, amounts of light, etc. convert them to analog electronic signal. They have to be converted to digital signal before computer can “understand” them.

Conversely, to control something like motors, heaters, LED’s, one needs analog voltages (or currents) but computers can produce only digital signals. So there are needs to convert digital signals to analog voltages.

ADC and DAC do exactly these tasks.

I will talk about simple examples of how these devices may be constructed, and what aspects that you may want to pay attention to when you buy them.

DAC

• DAC can be constructed in the following way.

![DIagram](image)

• This circuit requires adjusting the values of the resistors of wildly different values precisely.
• Wildly different values of resistors are also hard to accommodate in IC.
• Transition from one value to next may be slow because of the capacitive effect of the switches (particularly large current – MSB)
• The next example avoids some of the above difficulties.
Describe how the above DAC works. For two samples of switch configuration (on-off-off-off and off-off-on-on), find the output voltage. Assume that the inverting input of the op-amp is at the ground level.

**Important specifications**

- Number of bits – determine precision.
- Maximum voltage – obvious!
- Linearity – average of \((\text{actual voltage} - \text{theoretical voltage})^2\) in terms of fraction of full range (or step size).
- Glitches (Particularly DAC) – in transition from one digital input to the next, like 0111 to 1000, it may effectively go through 1111 or 0000, which produces “unexpected” voltage briefly. If can cause problems elsewhere.