

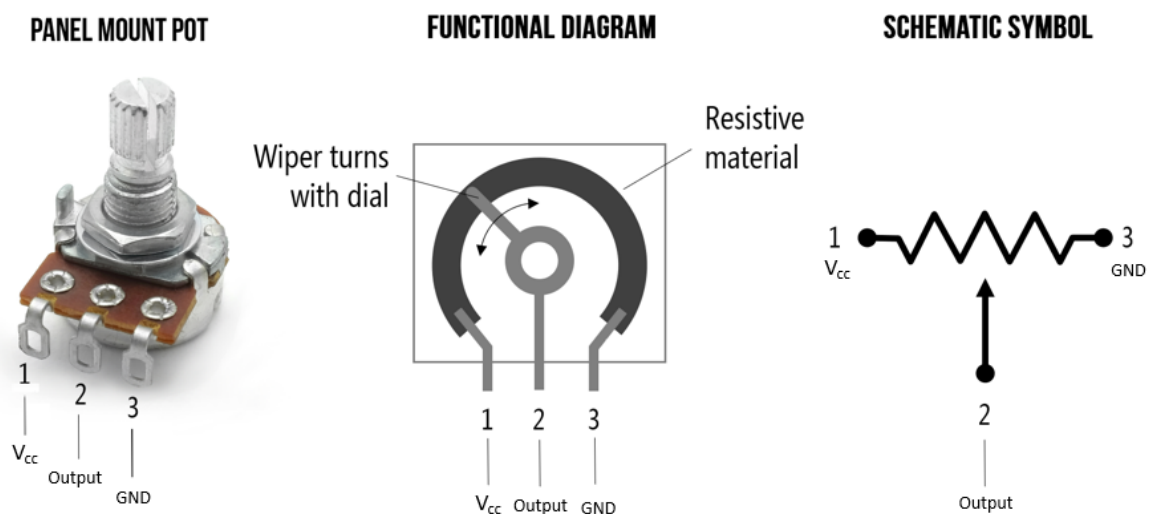
Exercise set 11 - Sensors

Exercise 1 (Already given in the lecture)

Consider a potentiometer covering the range of 350° powered with $\pm 10V$. Considering an electrical noise of $20mV$:

1. Give the maximum resolution that can be obtained.
2. Suggest an A/D (analog to digital) converter for this potentiometer. Give the:
 - number of divisions
 - number of bits
 - resolution

Reminder: A potentiometer is a 3 terminal variable resistor in which the resistance is varied.



Exercise 2

Consider a force sensor with $100N$ range, outputting an electrical signal between 0 and $100mV$ for the full range. The bandwidth of this force sensor is $100Hz$. The signal is conditioned and adapted to the analog input of an acquisition card by an amplifier (amplification and filtering). The A/D converter of this acquisition card has a resolution of $10bit$ over an input range of 0 to $5V$.

1. Determine the force resolution (in terms of $N/division$) using the force sensor directly on the analog input without passing the signal through an amplifier.
2. Suggest an amplification to use the analog input to its full range of $5V$.
3. Determine the new force resolution.
4. Propose a sampling period to acquire the force signal without deteriorating it on the frequency level in terms of theoretical limits and the practical aspects.
5. Explain the acquisition constraints on the force signal using this acquisition card on a PC with a sampling frequency of $50Hz$.

Exercise 3

Consider a rotary incremental encoder to measure the position of a rotary arm. This encoder has 1000 lines (physical holes) per revolution. A counter for quadrature-phase signals is used as an interface to this encoder.

1. Give the resolution in position of the robot arm in the absence of reducer.
2. Give the resolution in position of the robot arm in the presence of a reducer with a reduction ratio of 30.
3. Give the number of tracks that an equivalent optical absolute encoder on the load side should have to give the same resolution (as in point 2.).
4. Let's say that we use an absolute optical encoder with a 16bit counter. What would be the maximum measured position range?

Exercise 4

We want to realize the angular axis of a robot with a rotary motor and a reducer. An absolute sensor of 20bit is used over a range of 360° . Initially, the actuation is direct.

1. Give the linear resolution at the extremity of an arm of 350mm.

We now add a reducer with a reduction ratio of 3.

2. Give the linear resolution at the extremity of an arm of 350mm.
3. Is the absolute sensing still valid in case we use this reducer?