

uebung_3.3.2

Student Group

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Exercise 3.3.2 Additional task to 3.3.1

In this exercise, the same question should be assumed as in exercise 3.3.1. This time, however, the influence of the impedance converter on the sensor signal is to be analyzed. The signal curve of the ECG voltage must be simulated by the voltage source. To do this, select **Piecewise Linear** (3rd from the right) as the voltage source and use the curve below.

In addition, the influence on the current (= output resistor of the sensor) must be taken into account. To do this, insert a resistor with $20 \text{ M}\Omega$ directly in front of the non-inverting inputs.

Instruction

```
120ms, 0
160ms, 0.1m
200ms, 0
260ms, 0
270ms, -0.2m
320ms, 1m
340ms, -0.3m
350ms, 0
440ms, 0
520ms, 0.1m
600ms, 0
820ms, 0
860ms, 0.1m
900ms, 0
960ms, 0
970ms, -0.2m
1020ms, 1m
1040ms, -0.3m
1050ms, 0
1140ms, 0
1220ms, 0.1m
1300ms, 0
1400ms, 0
```

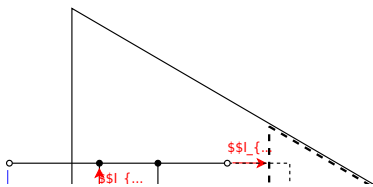
1. Now simulate the time course for 0 s to 2 s with "Use initial conditions".
2. What is the only difference in the output signals? (note y-axis)
3. For a more realistic operational amplifier, 3 additional current sources and an additional voltage source must be taken into account in the equivalent circuit diagram (see [figure 1](#)). In Tina, the values of these current sources can be viewed in the specifications of the simulated operational amplifier (double click on the OPV in **Circuit** » **Type...** » **Model Parameters**). The analysis of the entire circuit (including

the equivalent circuit diagram) is not to be considered here. It is assumed that the "input bias current" of the operational amplifier is the decisive value.

Compare the values of the different operational amplifiers.

4. To simplify matters, think about the additional input voltage that results from the current of a single bias current source at the sensor resistor.

Fig. 1: real OPV



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