Design your own bioimpedance meter

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5TH CLABIO
LATIN AMERICAN BIOIMPEDANCE
FLORIANOPOLIS – BRAZIL - 2024

https://clabio.tec.br/

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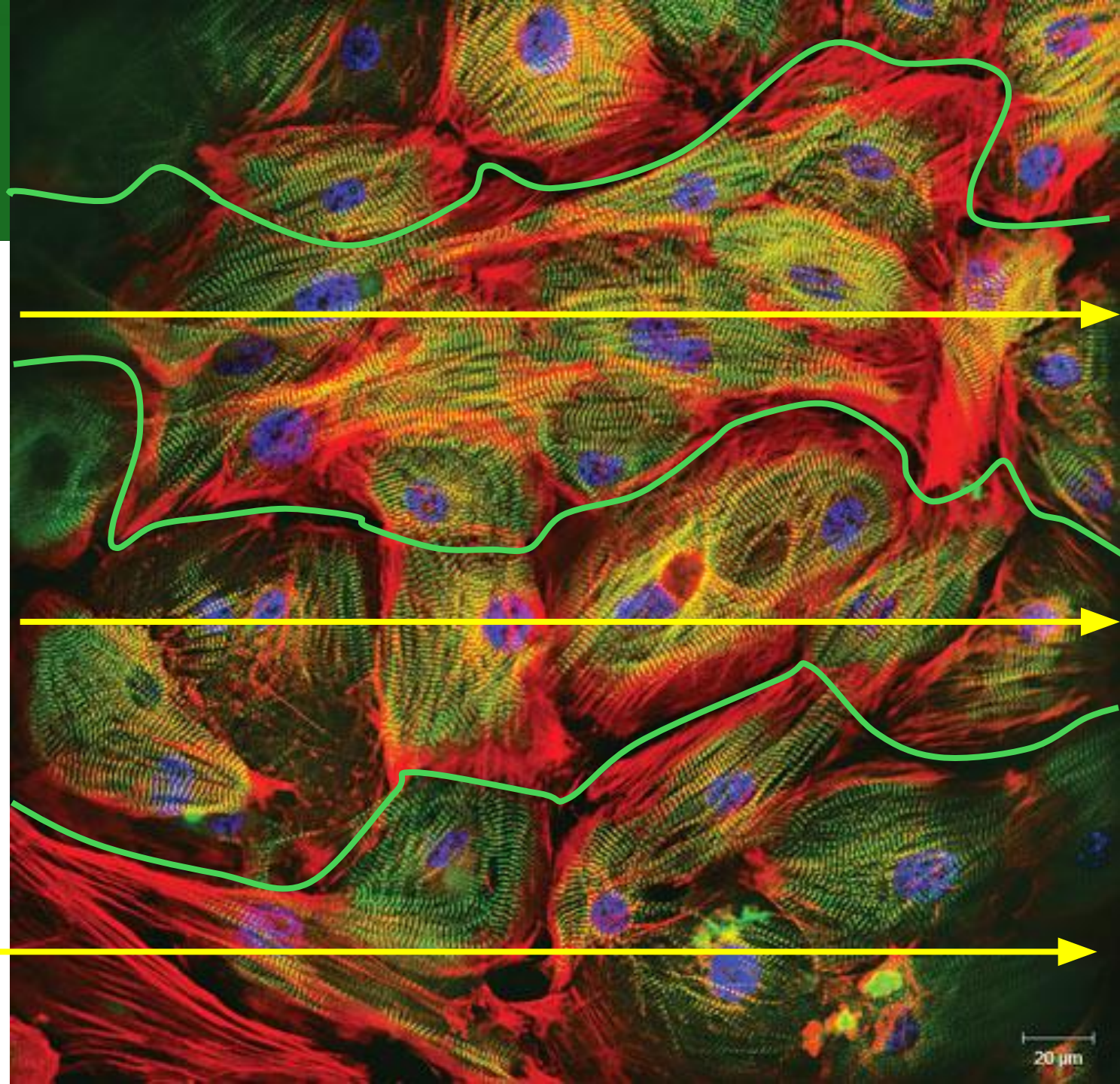

SIMULATIONS in LTSpice

Bioimpedance meter

- **LTSpice**
  - ✔ https://www.analog.com/en/resources/design-tools-and-calculators/ltspice-simulator.htm
  - ✔ Draw the **circuit 1** according to this guide
- **Current source effects**
  - ✔ Output current bandwidth
  - ✔ Output impedance range
  - ✔ Load range;
- **Measuring Front-End**
  - ✔ Gain bandwidth
  - ✔ Input impedance of the instrumentation amplifier

Current source

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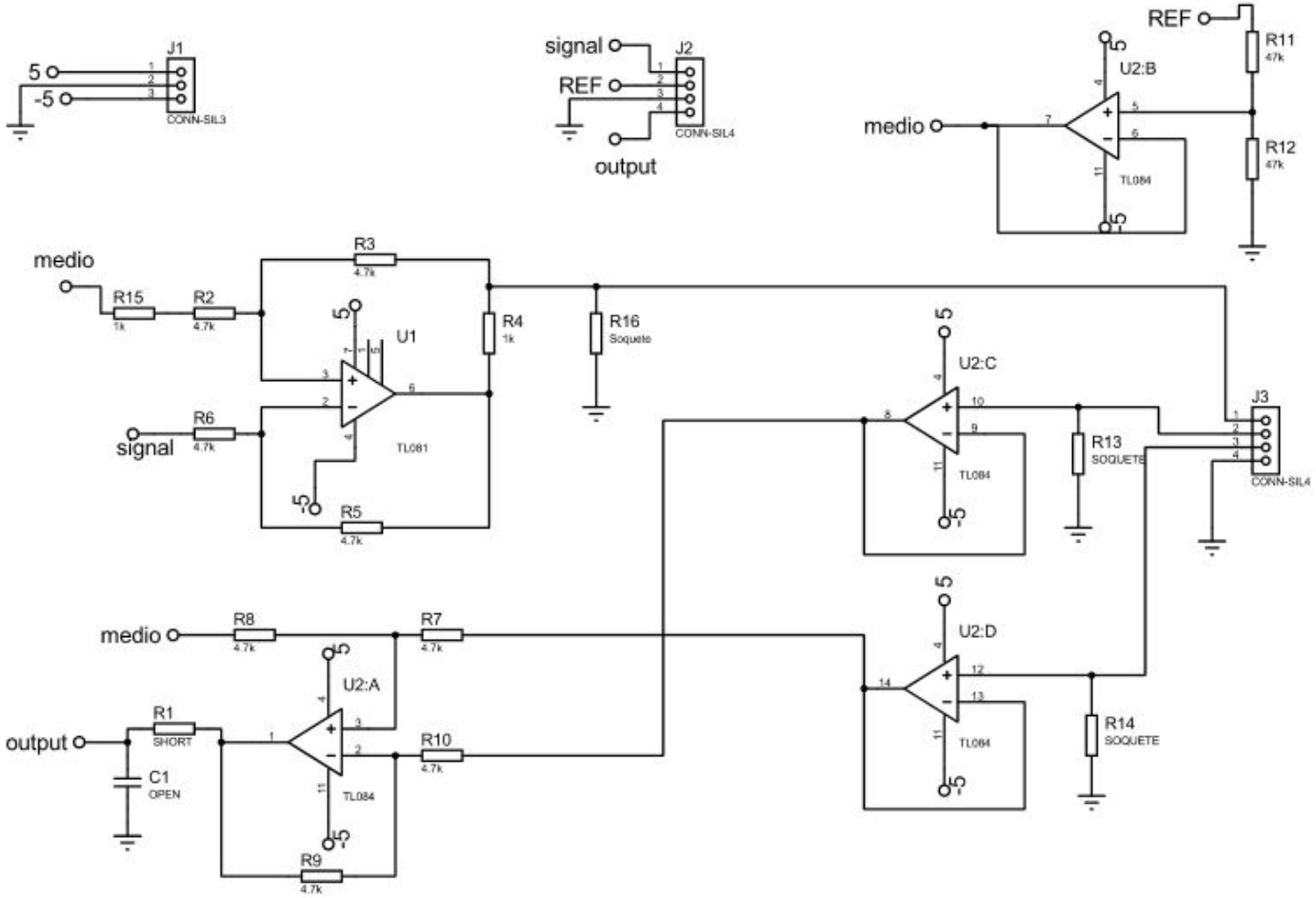
METHODS:

i) Connect the REF to ground;
ii) Set the function generator (FG) to have a sinewave of 1 Vpp;
iii) Connect the FG to the input signal of the circuit board;
iv) Connect the 1 kΩ resistor (load) at R16 in the circuit board;
v) Measure the voltage across the load by using the oscilloscope and fill out the Table;
vi) Repeat the previous item by connecting the 1 nF capacitor in parallel to the load at R16 and fill out the Table;
vii) Calculate the load for both cases and then the errors in percentage.

Frequency [kHz]	Vout [Vpp] @ 1 kΩ	Vout [Vpp] @ 1 kΩ // 1 nF	Calculated load [kΩ]	Error [%]
0.1				
1				
10				
100				
1000				

What does happen with the output impedance of the current source?



Current Source

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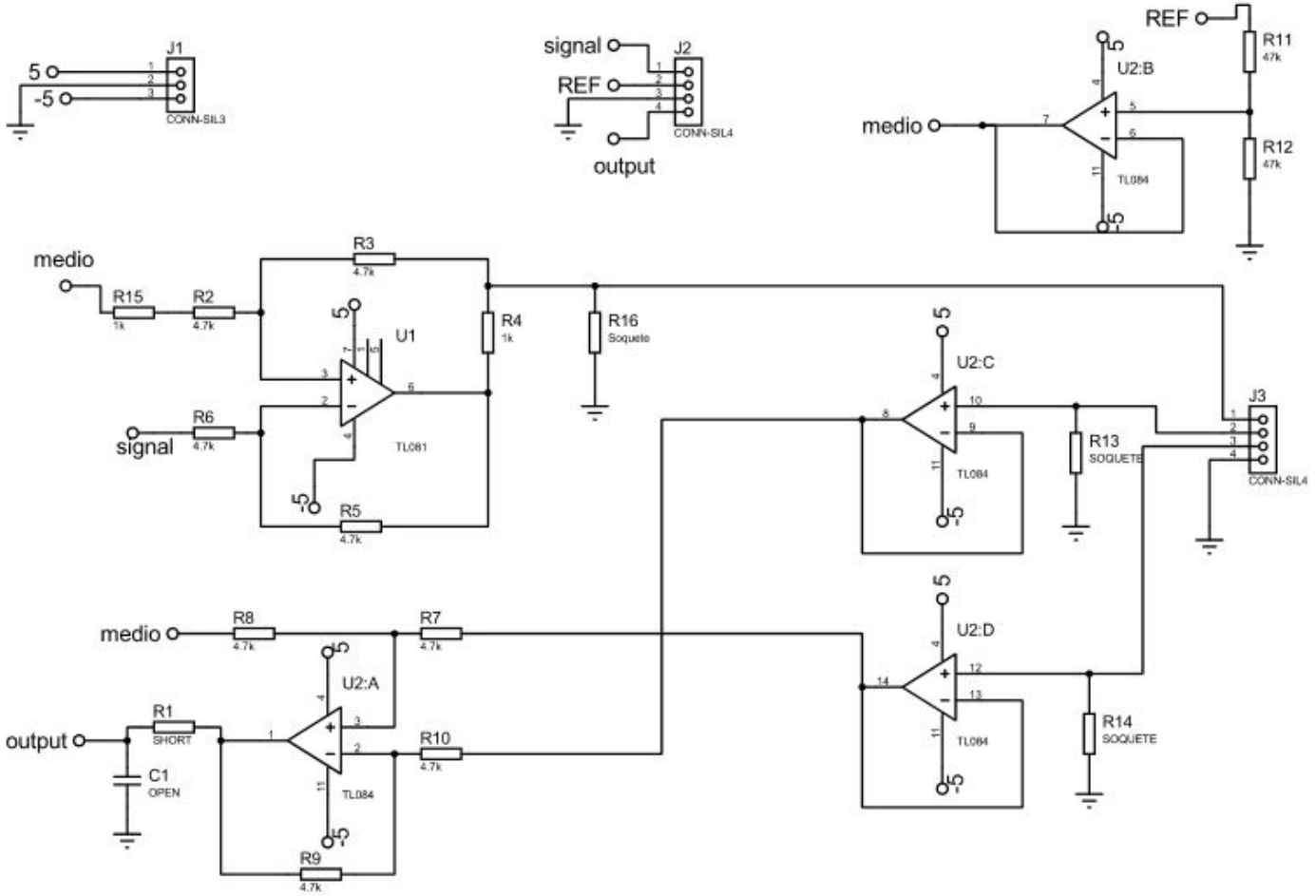
METHODS:

i) Connect the REF to ground;
ii) Set the function generator (FG) to have a sinewave of 1 Vpp at 100 kHz;
iii) Connect the FG to the input signal of the circuit board;
iv) Measure the voltage across the loads at R16 by using the oscilloscope and fill out the Table;
v) Calculate the output current and then the errors in percentage;

Frequency [kHz]	Vout [Vpp]				Calculated Iout [mApp]	Error [%]
	100 Ω	1kΩ	4.7 kΩ	10 kΩ		
0.1						
1						
10						
100						
1000						

What does happen with the output impedance of the current source?



Instrumentation amplifier

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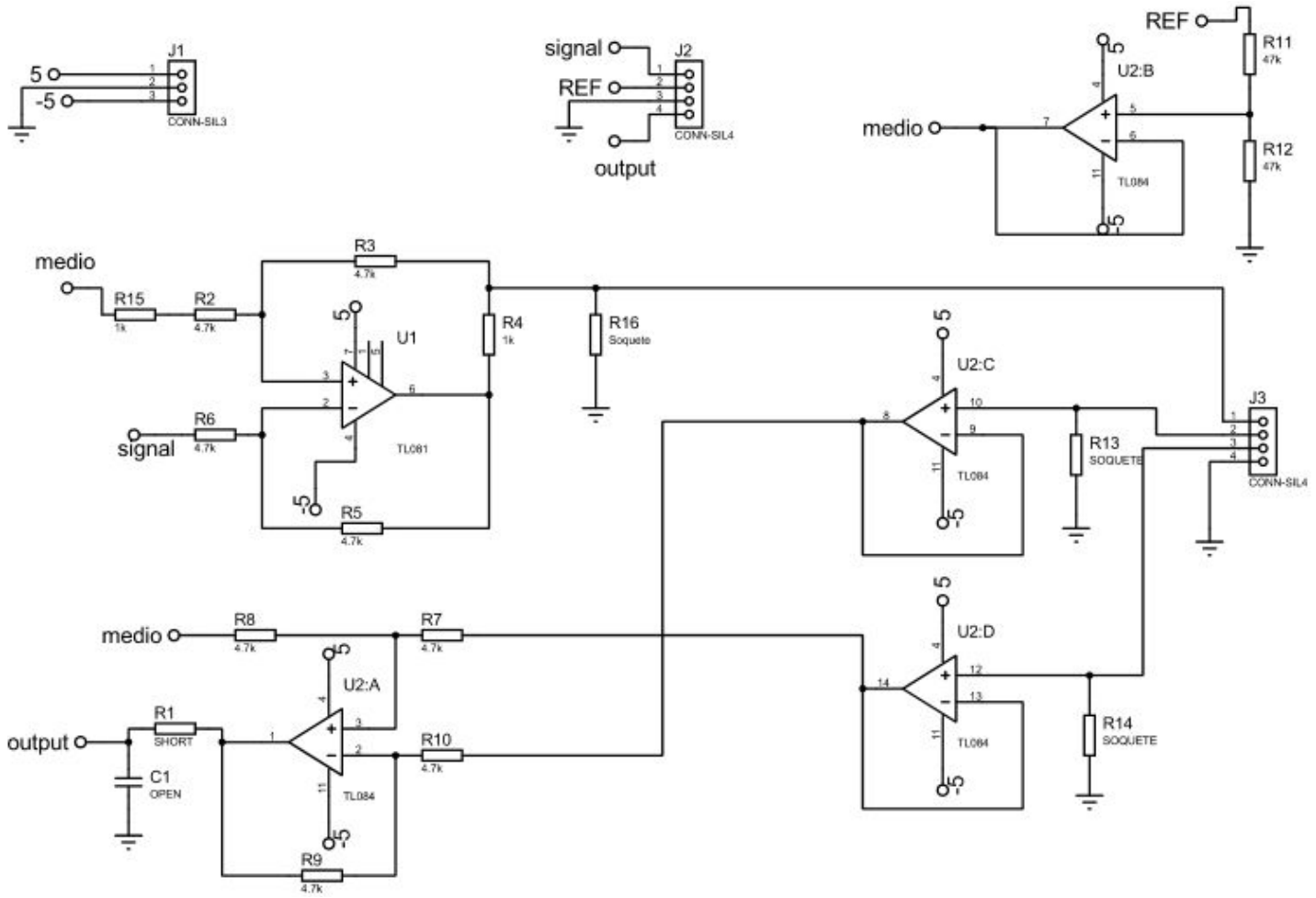
METHODS:

i) Connect the REF to ground;
ii) Set the function generator (FG) to have a sinewave of 1 Vpp at 100 kHz;
iii) Connect the FG to the input signal of the circuit board;
iv) Connect the 1 kΩ resistor (load) at R16 in the circuit board;
v) Connect the 10 MΩ resistors (**Rin**) at R13 and R14 in the circuit board;
vi) Measure the output voltages by using the oscilloscope and fill out the Table;
vii) Calculate the load and then the errors in percentage;

Frequency [kHz]	Vout [Vpp] Rin= 0 Ω	Vout [Vpp] Rin= 10 MΩ	Calculated load [kΩ]	Error [%]
0.1				
1				
10				
100				
1000				

What does what happen with the input impedance of the instrumentation amplifier?



Circuit Design

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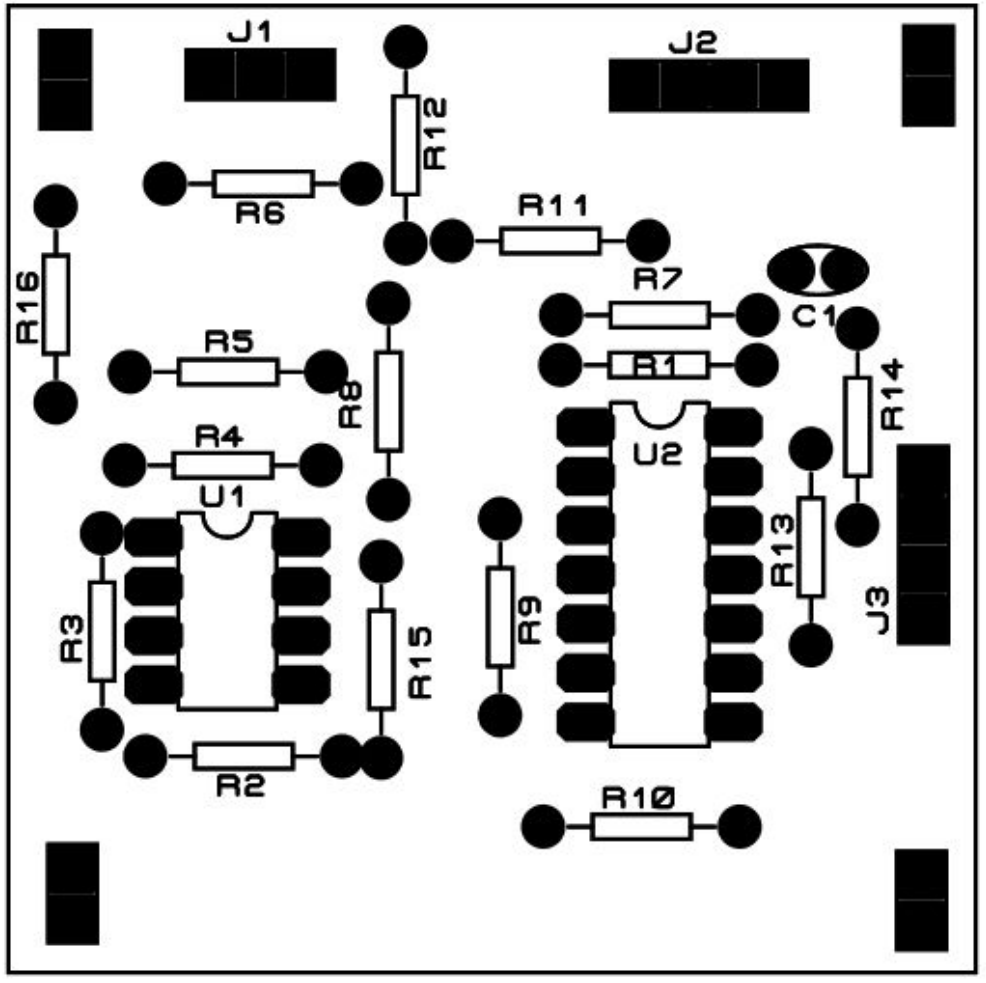

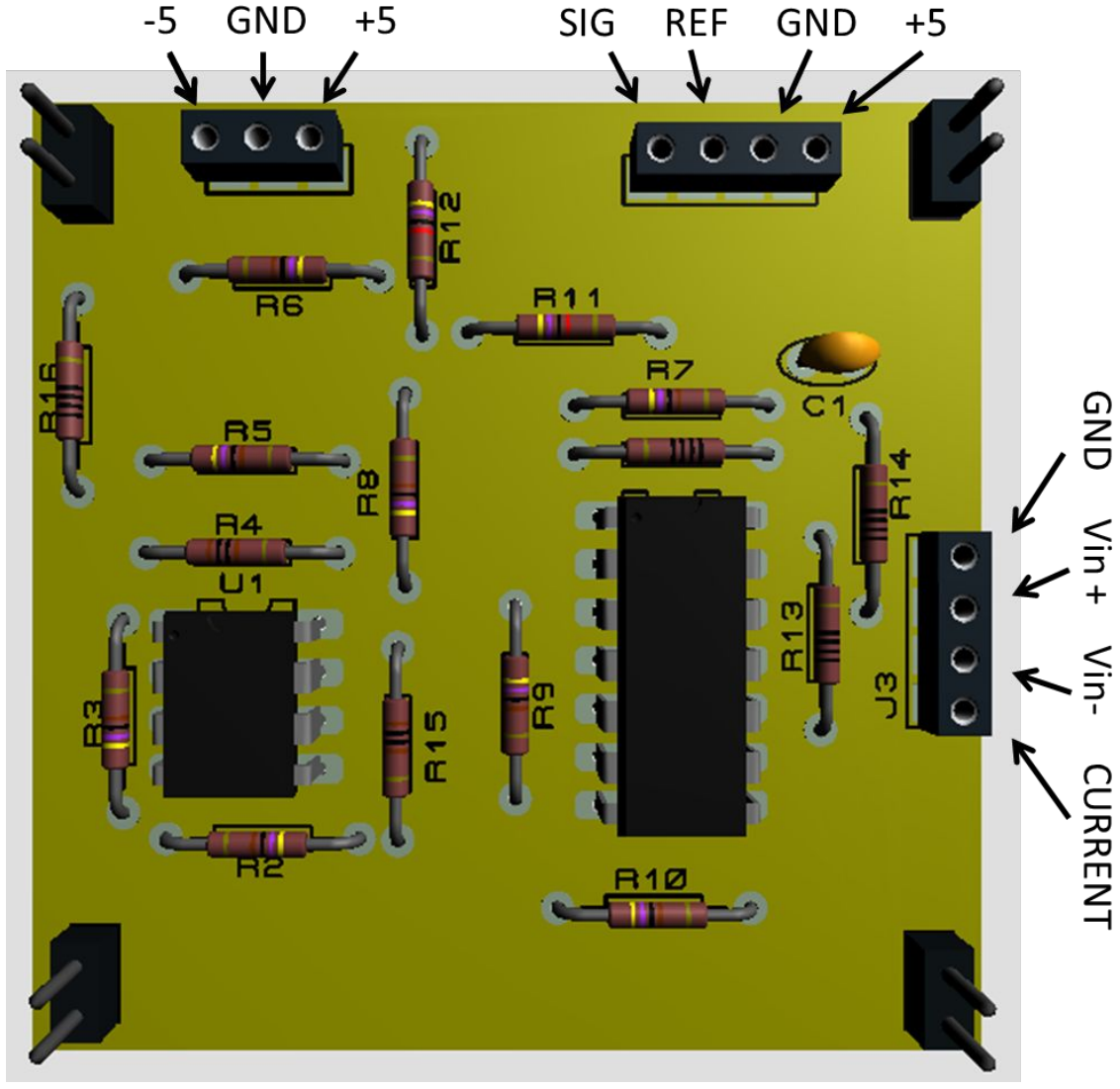

End of part 02

Bioimpedance Meter

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