

# Construction Manual

## Electrodes for Smartphone-ECG



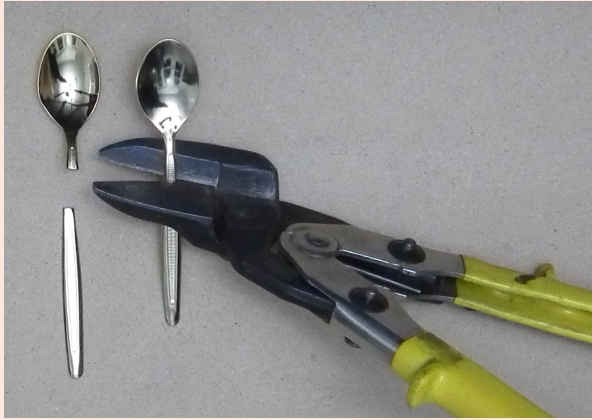
### Required materials

- 3.5 mm 4-conductor male to male TRRS cable
- Heat-shrink tubing 1/8", black, 40mm
- Heat-shrink tubing 3/64", blue, 40mm
- Heat-shrink tubing 3/64", red, 40mm
- 2x Wire ferrules, insulated gray 1x0.14mm<sup>2</sup>x6mm
- 2x Heat-shrink end caps 3mm:1mm
- Connector strip section, 4 pairs, 4-10mm<sup>2</sup>
- Carbon film resistor 10 k $\Omega$  axial lead
- 2x Wire ferrules, non-insulated 1x0.50mm<sup>2</sup>x8mm
- 2x Espresso spoons, gilded



### Recommended tools

- Wire stripper
- Crimp tool
- Screw driver
- Tin snips
- Heat gun
- Diagonal pliers



- A.1 Cut off the handles of the two spoons with tin snips in a way that the stumps can later be screwed into the screw terminals of the connector strips.



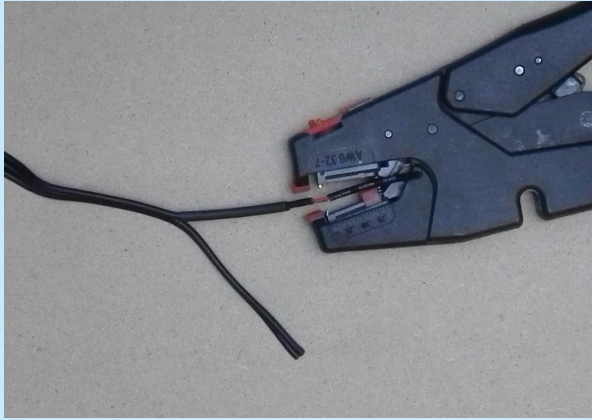
- B.1 Cut the 3.5 mm 4-conductor male to male TRRS cable in half. Thereby, you will get two even long cable ends. Only one cable end is going to be used. The second cable end can be kept for another apparatus.



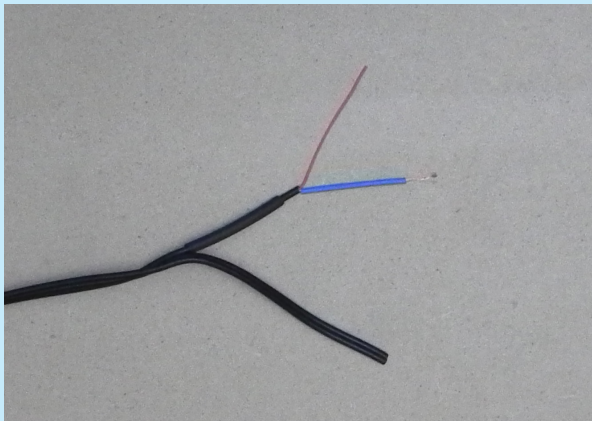
- B.2 The **black** ribbon cable consists of three wires. Separate the three wires. In each of the three cable jackets you will find one insulated copper litz wire (**red**, yellow or white) and one non-insulated copper litz wire. For this experiment we only need the wire with the **red** inner insulated wire. Shorten the non-used wires by about 15 mm. We will use them later to build a strain relief.



- B.3 First, push a black heat-shrink tubing over the cable jacket of the **red** wire until you can see about 70 mm of the wire out of the heat-shrink tubing.



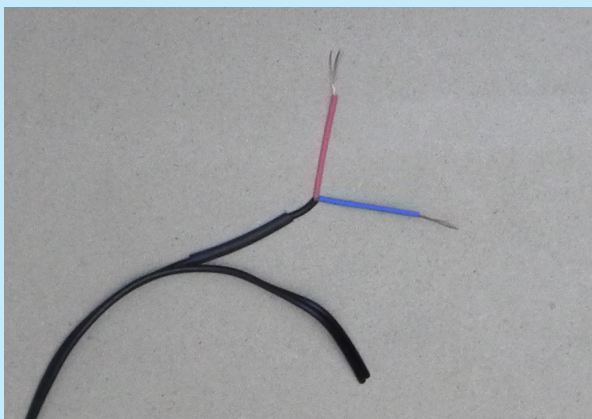
B.4 Remove from the wire with the **red** insulation about 50 mm of the black jacket without damaging the red insulation or the bare copper litz wire.



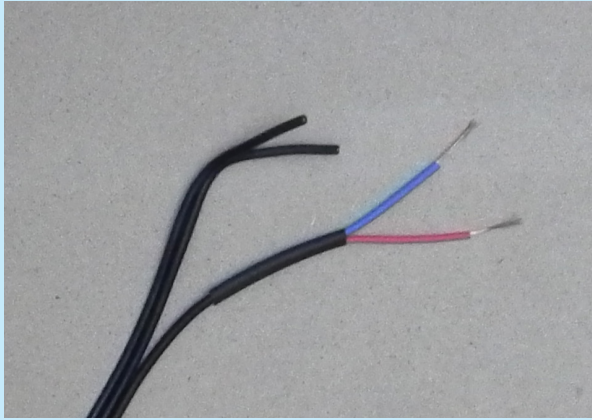
B.5 Thread a **blue** heat-shrink tubing over the bare copper litz wire.



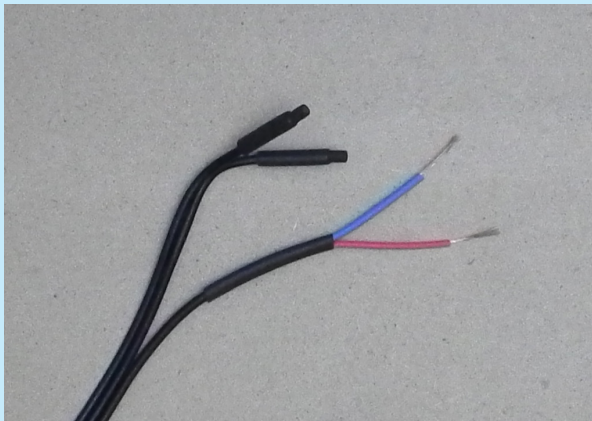
B.6 Use the wire stripper to remove about 30 mm of the **red** insulation.



B.7 Thread a **red** heat-shrink tubing over the copper litz wire with the rest of the red insulation.



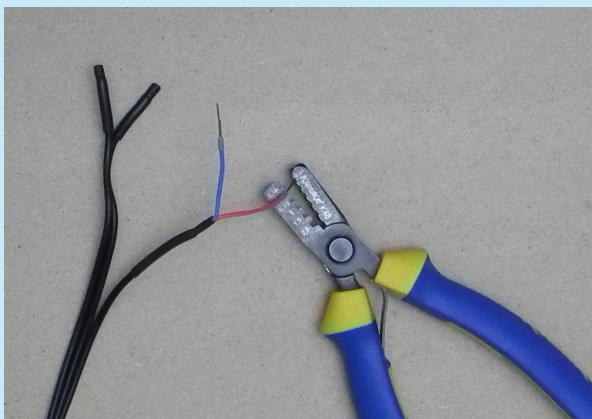
B.8 Pull the **black** heat-shrink tubing a little over the **red** and the **blue** heat-shrink tubing.



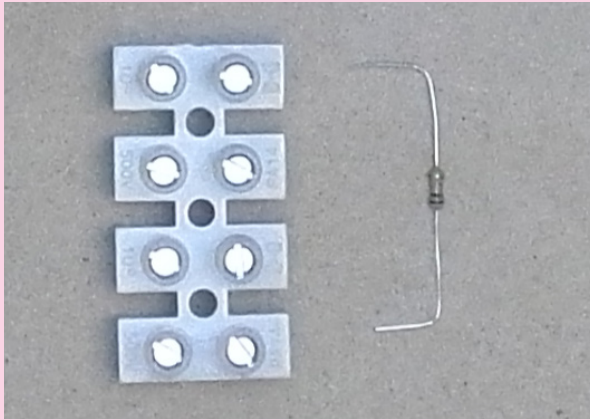
B.9 Put a heat-shrink end cap on each of the unused wires (white and yellow inner insulation).



B.10 Shrink the heat-shrink tubings and end caps with the heat gun.



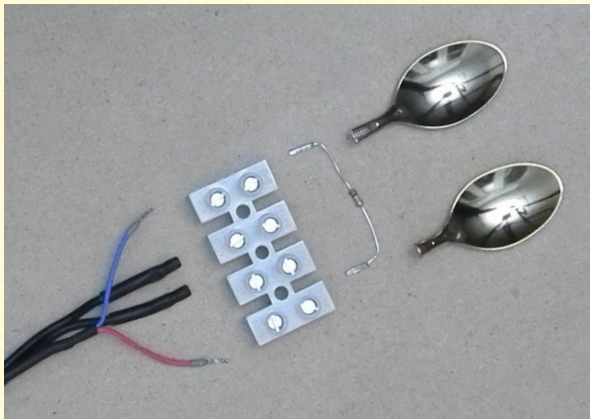
B.11 Crimp the **gray** insulated  $.14 \text{ mm}^2$  wire ferrules onto the ends of the copper litz wires.



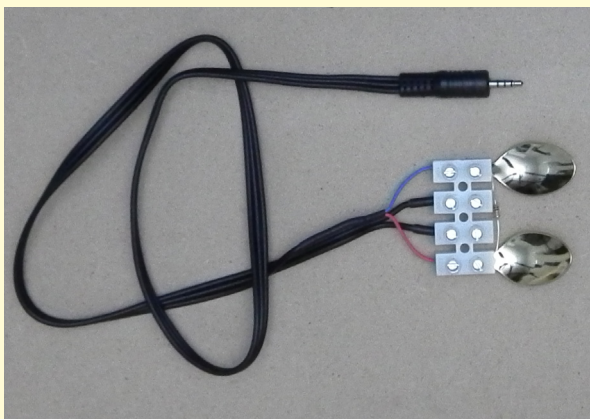
- C.1 Bend the ends of the axial-wired resistor so that the straight center is still 40 mm long and the resistor can then be screwed tightly into the outer connectors of the connector strip section.



- C.2 Crimp the non-insulated wire ferrules onto the ends of the resistor wires.



- D.1 Screw one espresso spoon and one end of the resistor in one of the outer connectors of the connector strip section. Therefore, first insert the spoon and then place the end of the resistor on the spoon handle stump in the connector. Then screw the second spoon and the other end of the resistor into the other outer pole.



- D.2 On the other side of the connector strip section, screw the two wires with the black heat-shrink end caps in the middle connectors. The **red** wire must be connected to the spoon, which will later be held in the left hand. The **blue** wire with the other spoon.