WELPCR Mechanical Assembly Instructions

- Step1: Make the BOM for WEL PCR and place the order. Here is the WEL_PCR_BOM.

- Step2: For mechanical design, we need these following design files.
  - WEL_PCR Motherboard
  - WEL-PCR Display Board
  - Metal laser cutting Design
- For metal laser cutting, we went to Falcon Engineering & Laser Services,CNC files from Machine Tool Lab,IIT Bombay.
  - CNC design files from machine and tool lab, IIT Bombay
    For Lid and Tube holder, we need aluminium block of the following dimension
    For 1-piece LID: 3-inch x 3-inch x 1 inch
    For tube holder (9): 2.5-inch x 2.5-inch x 1 inch
  - WELPCR casing laser cutting on acrylic sheet from ELL, IIT Bombay.

- Step3: Solder all the components to printed circuit boards (both Motherboard and the display board following the Schematic file and BOM).

  - Display board

a) b)

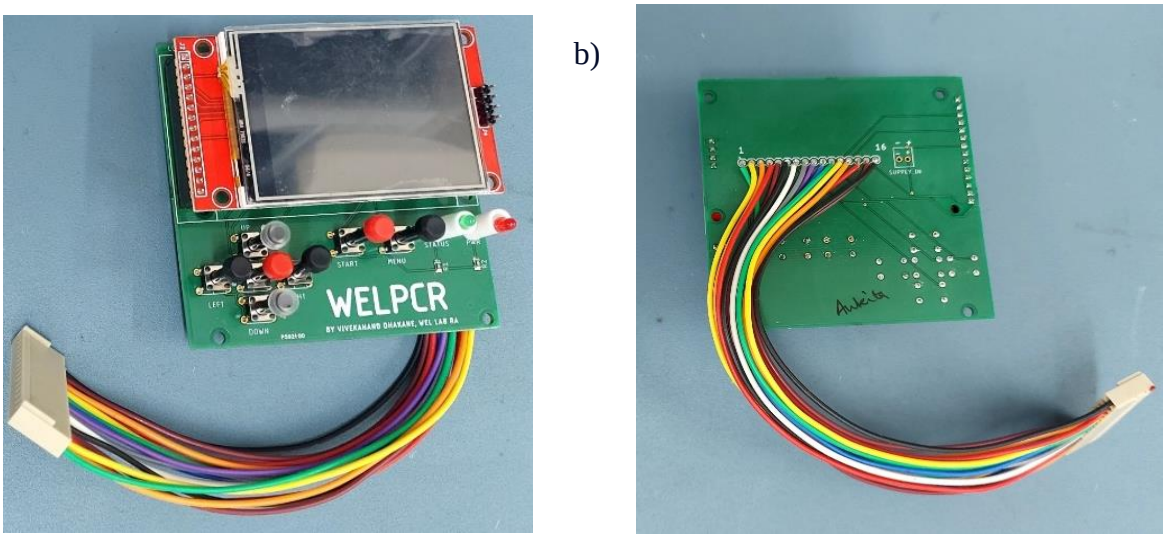
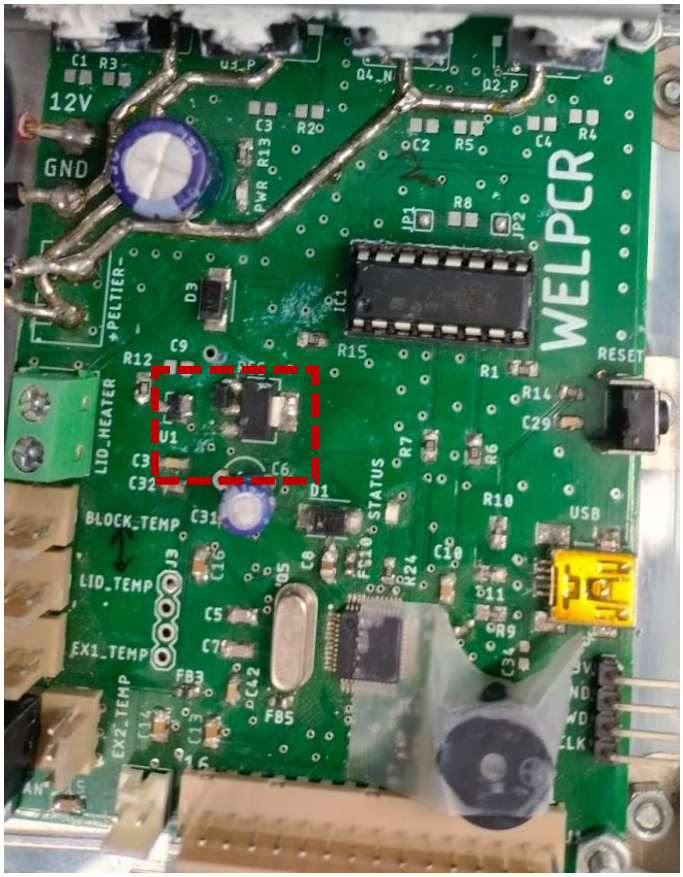


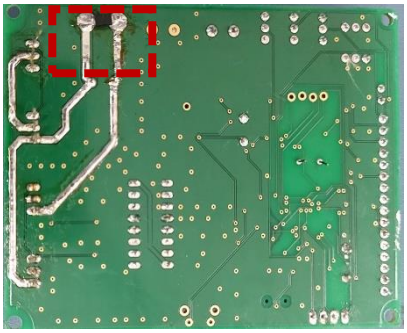
Figure 1:(a) Front view and (b) Back view of the display board

- Motherboard
  - Frontside: Do not forget to add a reg of value 5-10 kΩ in U1 and a Zener diode of 3.3V in reverse bias on the regulator (REG) as mentioned in the figure 2(a).These are implemented to protect the controller. Make sure to thicken the paths connecting the H-Bridge.
    BLOCK_TEMP and LID_TEMP misprinted somehow. We marked an arrow to show the correct variable name on the PCB.
  - Backside: One TVS diode of 12V between positive and negative terminal of power supply.

a)



b)



c)

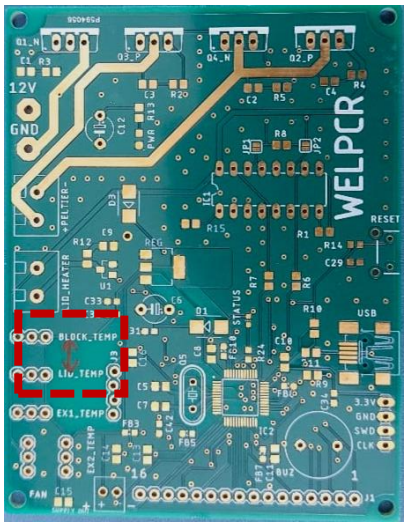


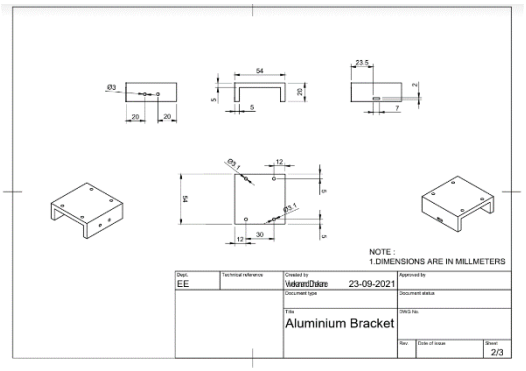
Figure 2: (a) Motherboard highlighting U1 and REG (b) 12V TVS diode

(c) Interchanging of BLOCK_TEMP ←→LID_TEMP

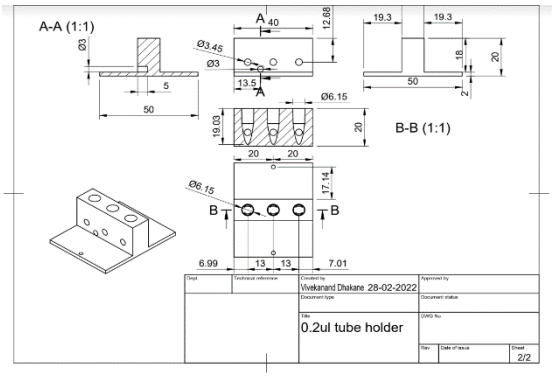
Mechanical Assembly

- Heater lid and Tube holder

a)



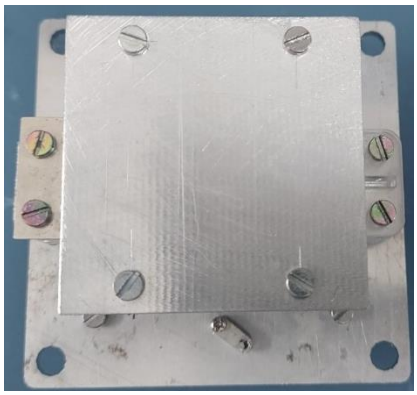
b)



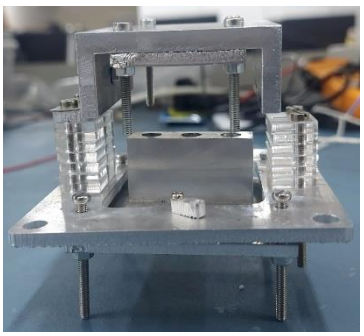
c)

d)

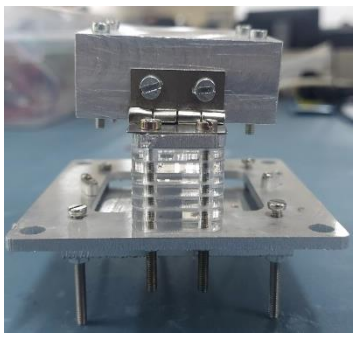
e)



f)



g)



h)

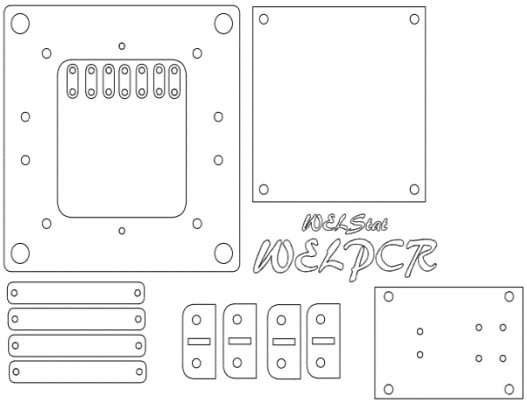
Figure 3: (a) Design of the heater lid (b) Design of tube holder (c) Milling machine at Machine and tool lab, IIT Bombay (d) Heater lid and tube holder made from aluminium block (e) Top view of the lid assembly while lid is closed (f)Front view of the tube holder and lid assembly (g)Left side view, hinge joint (h) Top view of the lid assembly while lid is open

Attach a hinge between the metal lid and the metal plate and connect with the acrylic “C” shaped laser cutting to adjust the height of the tube holder.

- Metal LASER cutting

a)

b)



c)

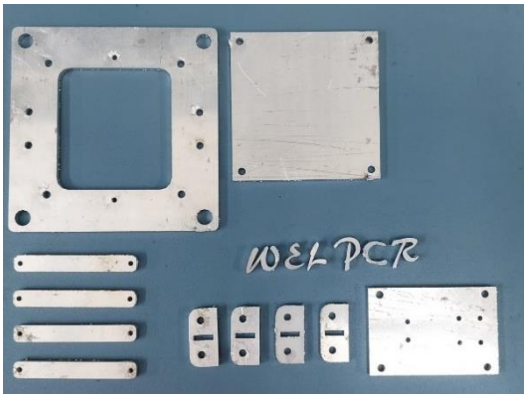


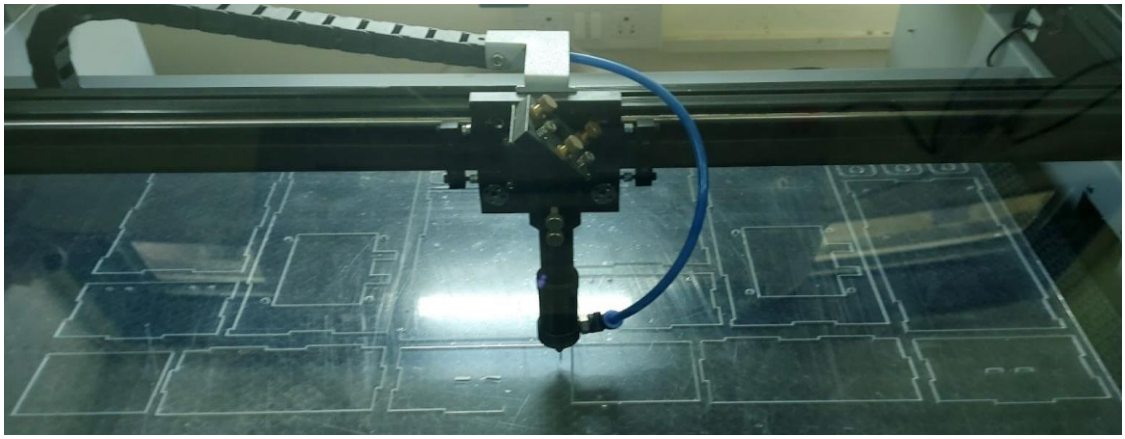
Figure 4: Metal laser cutting tool at Falcon Engineering & Laser Services, Bhandup, Mumbai. (b) Design of metal laser cutting (c) Metallic parts after laser cutting

- Acrylic LASER cutting

LASER cutting was done at ELL Lab, IIT Bombay. After laser cutting whole assembly is enclosed in a transparent acrylic casing. Acrylic casing is usually fixed with an adhesive. But we need to disassemble the casing

many times. So, we use the L-bracket with nut-bolt to connect two right angular faces. For maintenance we may need to open one face of the casing. For that, front face is fixed using a hinged on one side. Front of the WELPCR can be opened easily for maintenance purpose.

a)



b)

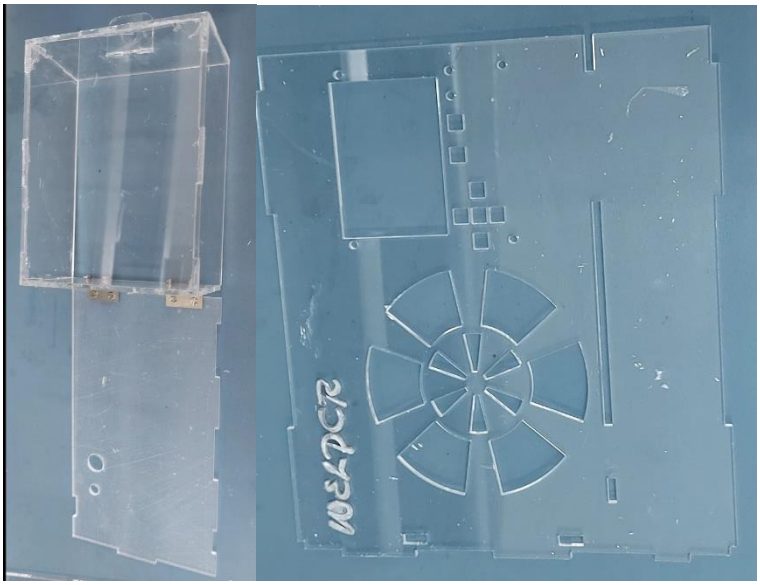
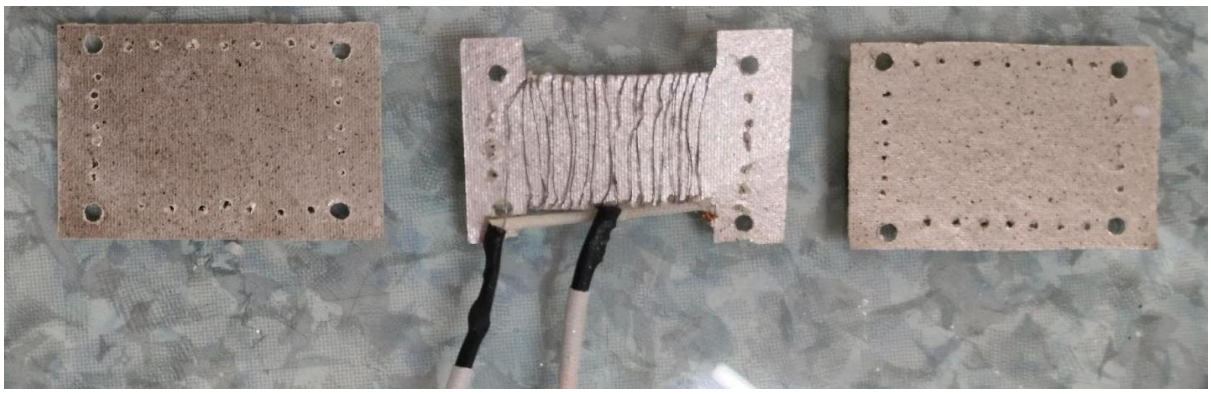


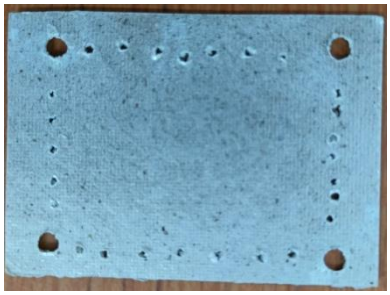
Figure 5: (a) LASER cutting at ELL, IIT Bombay (b) Casing assembly after the LASER cutting

- Lid Heater
  We have used nichrome wire and mica sheet to assemble the lid heater. Two terminals of the nichrome wires are connected to the Vdd and ground pin of the LID_HEATER point on the motherboard. Add thermal paste and assemble with a copper wire.

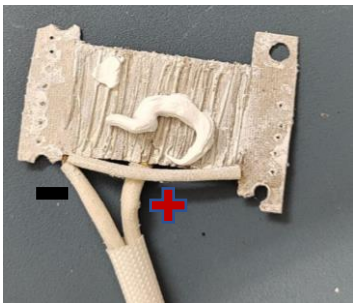
a)



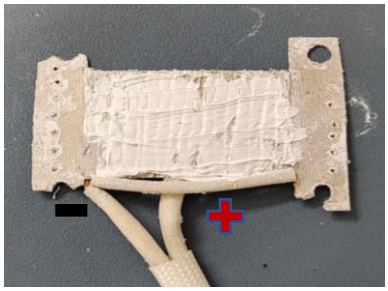
b)



c)



d)



e)

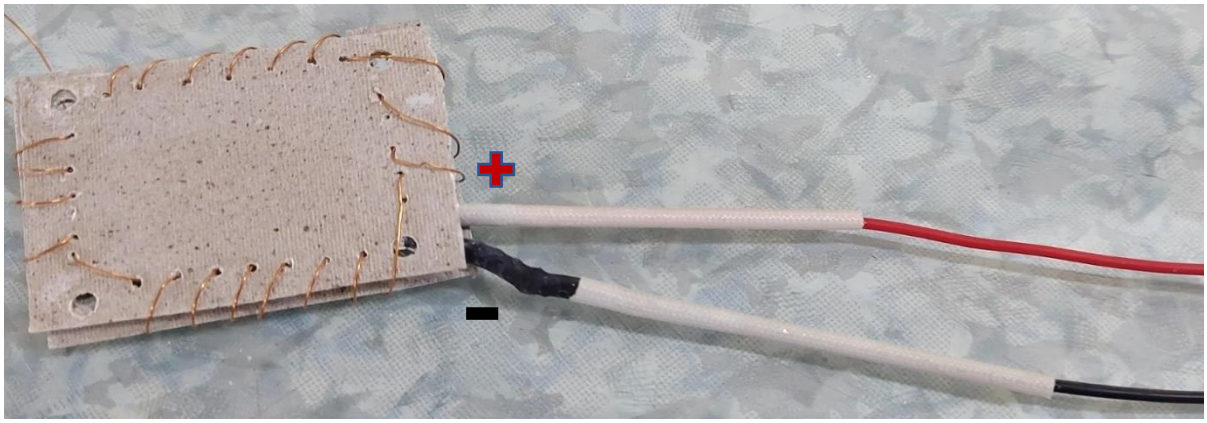


Figure 6: (a) 3 rectangular mica sheets (b) After drilling the holes (c) Added thermal paste (d) Nichrome wire assembly along with thermal paste (e) Live wire connection to the nichrome heater.

- **Assembly Instructions**

1. Cut out 3 rectangles out of mica sheets of dimension (5.4 X 3.6 cm).
2. Cut out a H-shape out of a rectangle and wrap nichrome wire around it, leaving out 3 terminals (2 on the ends and 1 in the middle).
3. Drill four holes of diameter 3mm onto four corners of the mica sheet aligning with the covering metal sheet's holes.
4. Connect the ground terminals together with a copper wire protected from an insulation tube to avoid shorting of the circuit.

5. Connect the ground and live terminal with black and red multi thread wires and securing them through a heat slue and then insulation tubes.
6. Apply thermal paste on the nichrome coil for ensuring even spread of heat once in work.
7. Needled holes on periphery of the mica sheet rectangles and coil them together with copper wire.
8. Secure both the live and ground wires in an insulation tube.
9. Connect the live and ground wires to the LID_HEATER point on the motherboard.

- Thermistor
    1. Take two, 2 mm thermistor and add the two terminals with live(red) and output wires(brown) of a 3 Pin RMC female connector each. Ground line (black) and the output (brown)will be sorted by one 1 kΩ through hole resistor.
    2. Secure both the live and output wires with an insulation tube as shown in the figure 7.

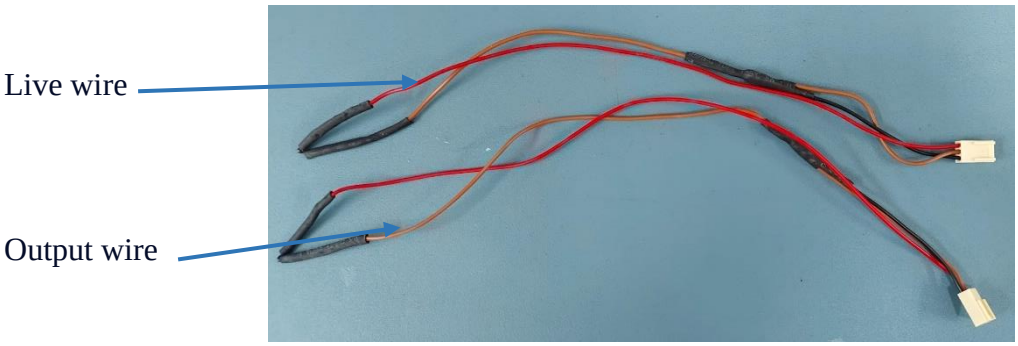


Figure 7: Thermistor assembly with 3 Pin RMC female connector

- Peltier

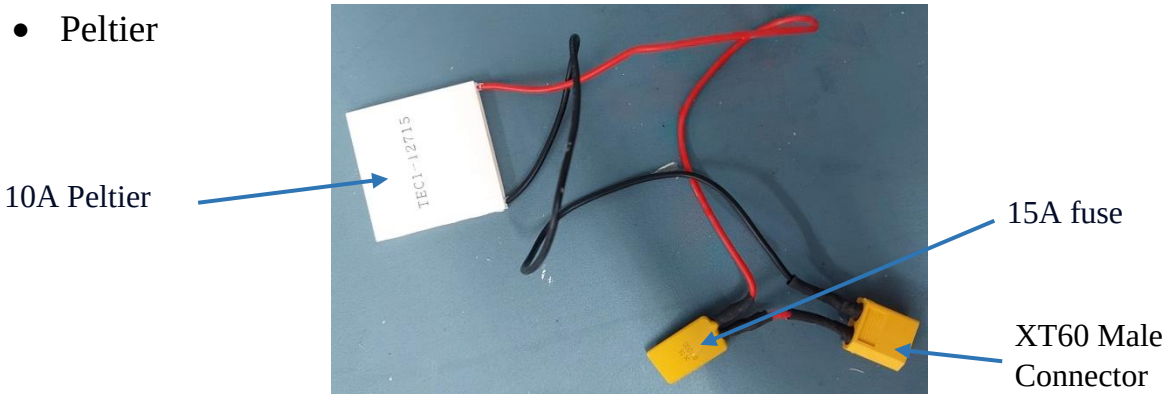
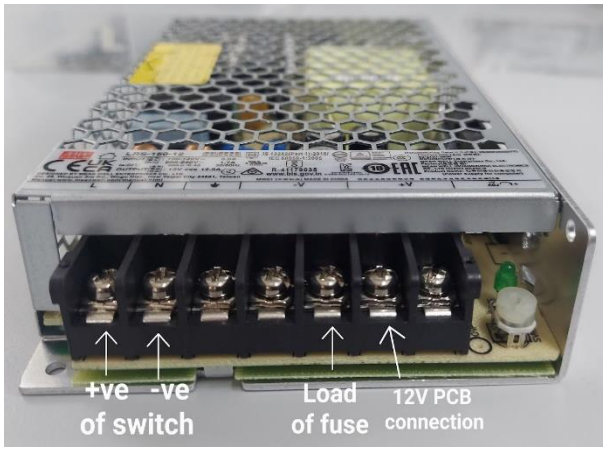


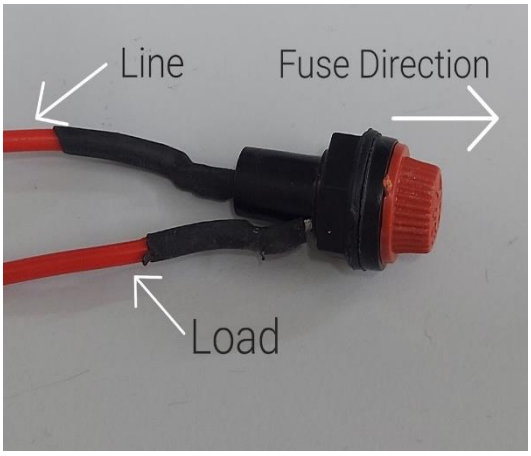
Figure 8: Peltier heat sink assembly

- Power Supply Assembly

a)



b)



c)

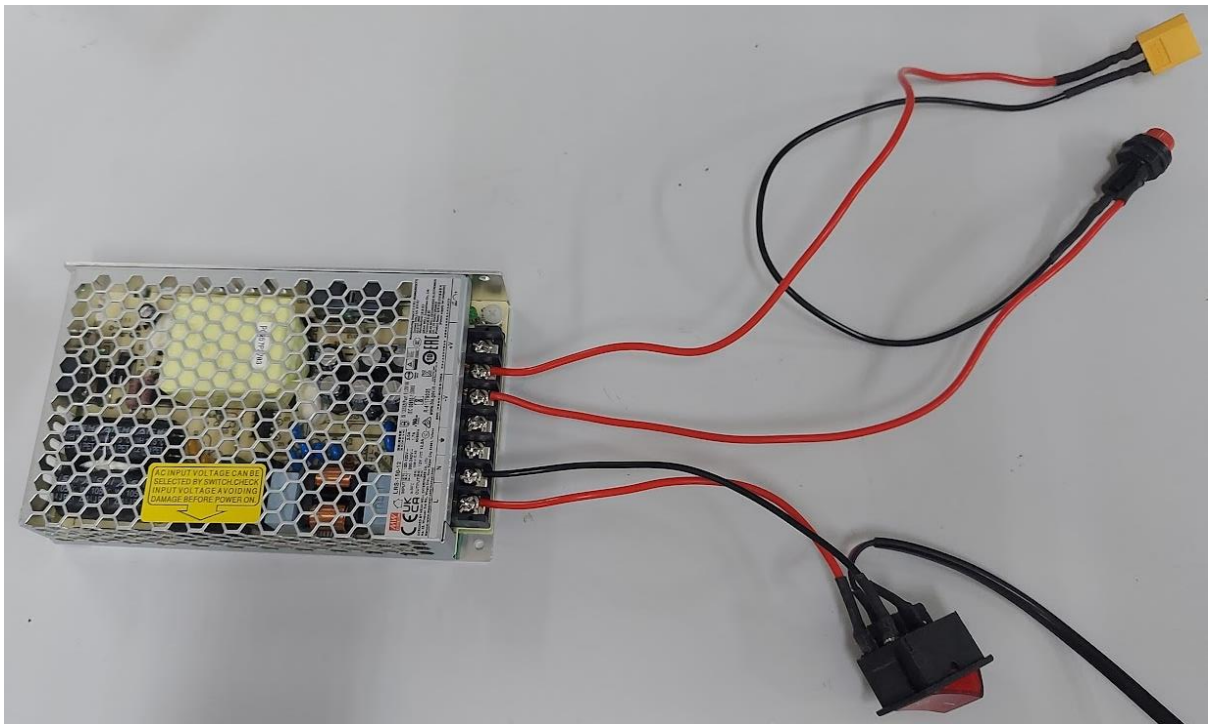


Figure 9: (a) 10A power supply (b) Fuse connection (c) Power supply connection with the switch

- Cooling Fan assembly

a) b) c)

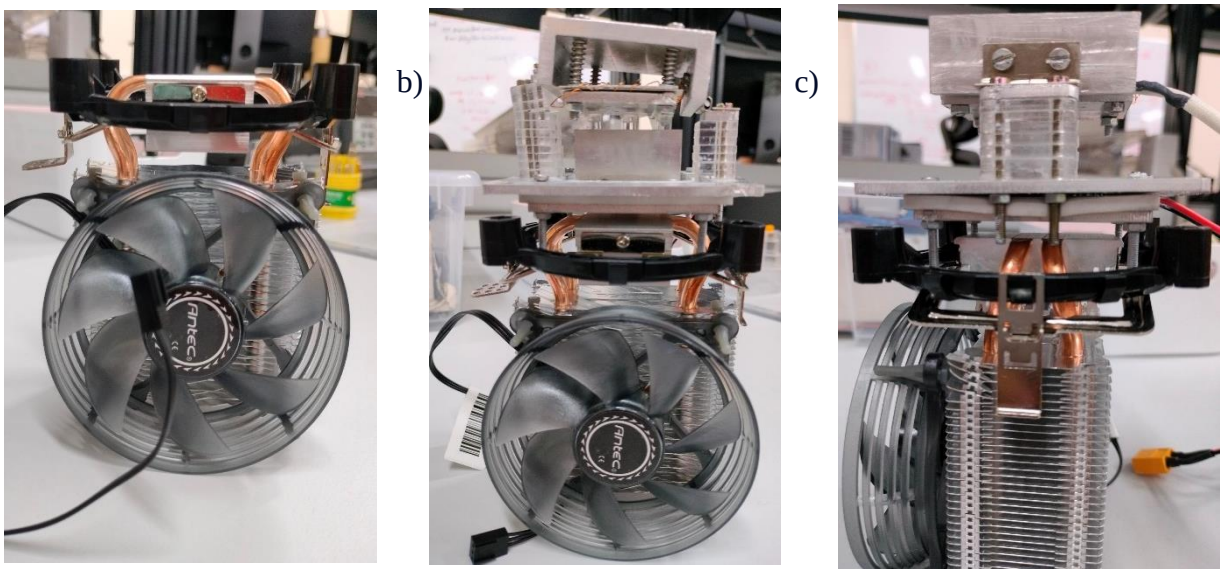


Figure 10: (a) Cooling fan (b) Fan connection with the tube holder, lid and peltier assembly (front view) (c) Fan connection with the tube holder, lid and peltier assembly (side view)

Figure 11: Fully assembled WELPCR