The root directory for PhysTherm on the Qosain cloud is:

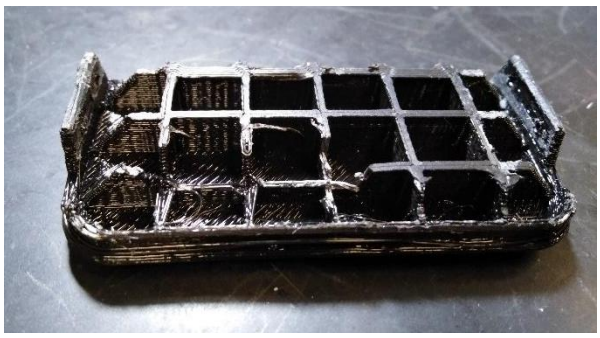
Type B / PhysTherm / Machining Packages /

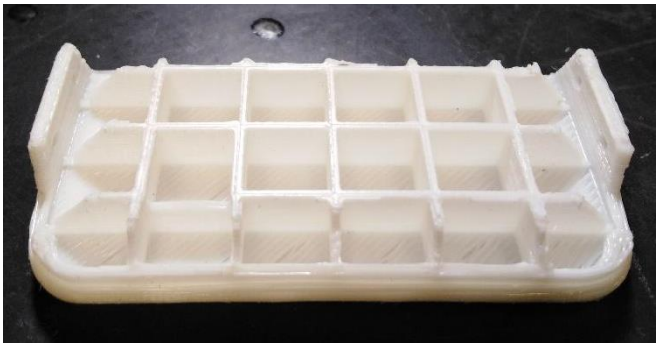
Mechanical:

These files are to be printed on an FDM printer. The print would be carried out using **x3g** files copied to the SD card of the printer, which can be found in *…Minimal / Mechanical* directory. The source files of **Ultimaker Cura** i.e. the 3mf project files can be found in *…Source / Mechanical* directory. The optimal print parameters set in these x3g files are attached in **Appendix-A**. Following is the list of files you will need to print for PhysTherm:

Part	File name (x3g)	No. of Parts in one x3g file	Printing time	PLA length (m)
PhysTherm Bottom	PhysInstrument_Therm_Bottom_12.x3g	12	9 hours	42.8
PhysTherm Top	PhysInstrument_Top_12.x3g	12	5 hours	24.3

After printing, clean and finish the 3d printer parts carefully. All the holes in the printed part are to be unblocked/finished using a drill machine.





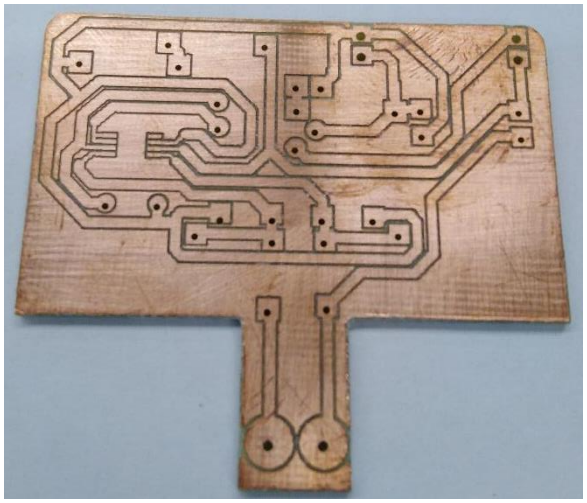
Electrical:

PCB Routing:

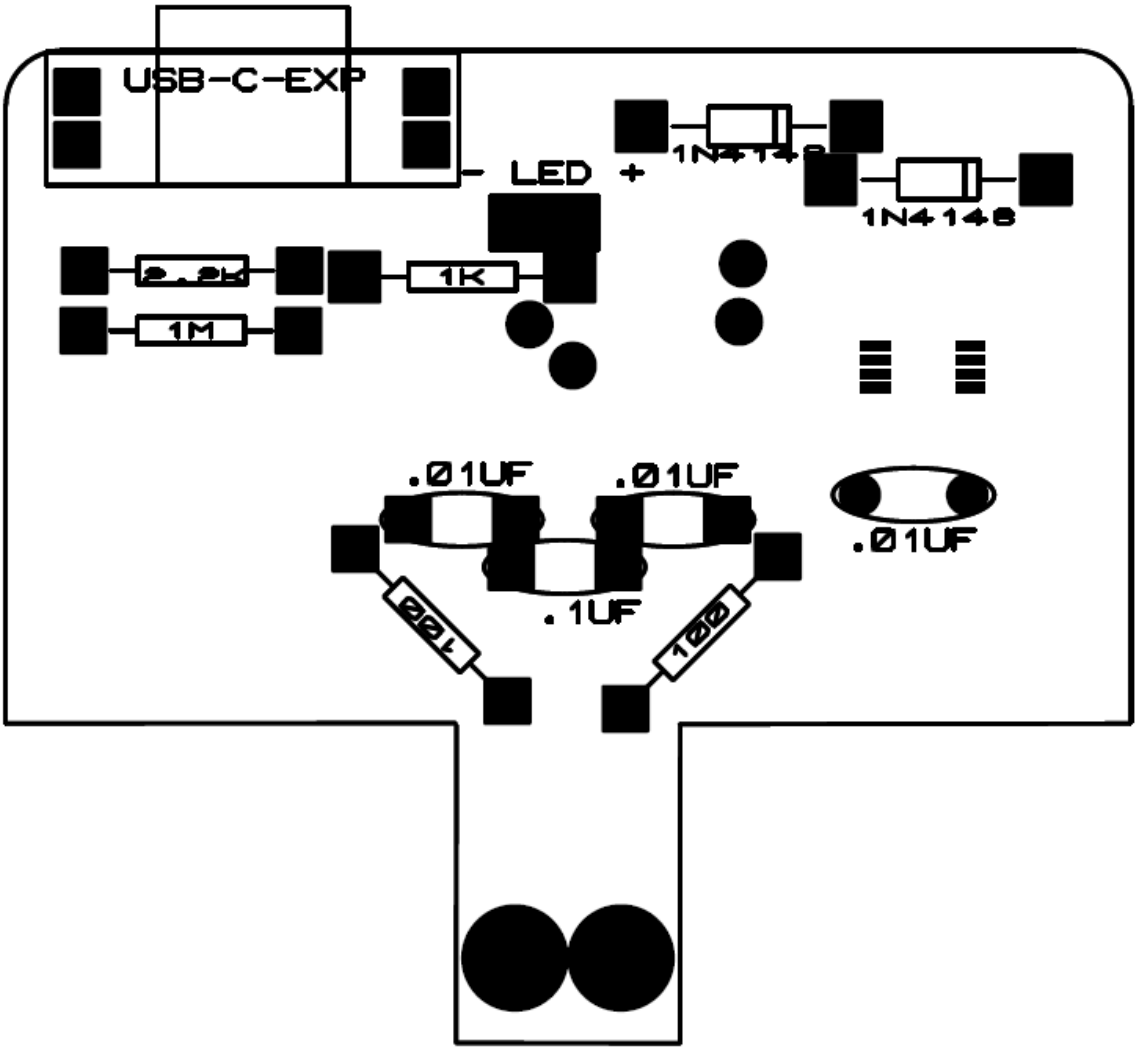
The router files are located at *…Minimal / Electrical* directory and the proteus project file is located at *…Source / Electrical*. Following is the list of router files for PhysTherm:

File name	File description	No of PCBs in each file
25x_PhysTherm_Mill_30d V-Cut.plt	Mill file for PCB router	25
25x_PhysTherm_Drill_0.7mm.ncp	0.7mm Drill file for PCB router	
25x_PhysTherm_Drill_1mm.ncp	1mm Drill file for PCB router	
25x_PhysTherm_Drill_2mm.ncp	2mm Drill file for PCB router	
25x_PhysTherm_Edge.plt	Edge file for PCB router	

After leaving the PCB router, it's necessary to rub these PCBs with sand paper (**P800** grit size will be fine). Then it will look like:



For the component placement, refer to the image bellow,

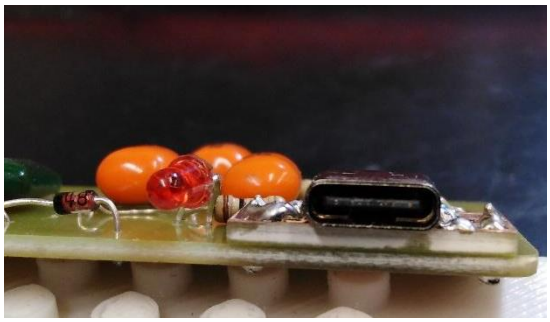


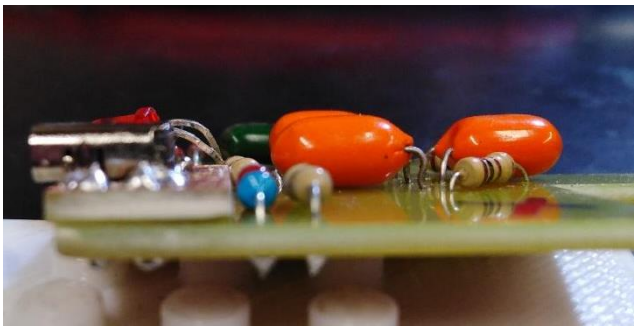
The list of all the electrical components for PhysTherm is provided in **Appendix-B**.

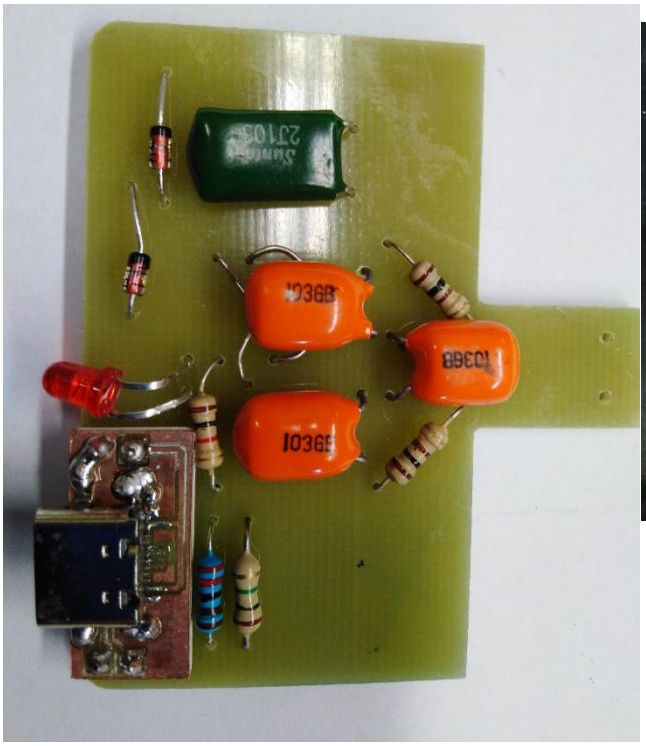
Soldering:

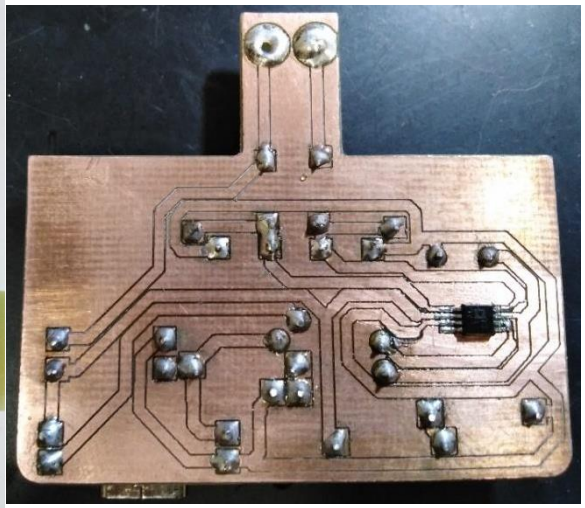
Leave the 2-pin connector for now and solder the rest of the components on the PCB. Do not forget to use the SMT solder flux (**Mechanic UV223**).

Result will look like:





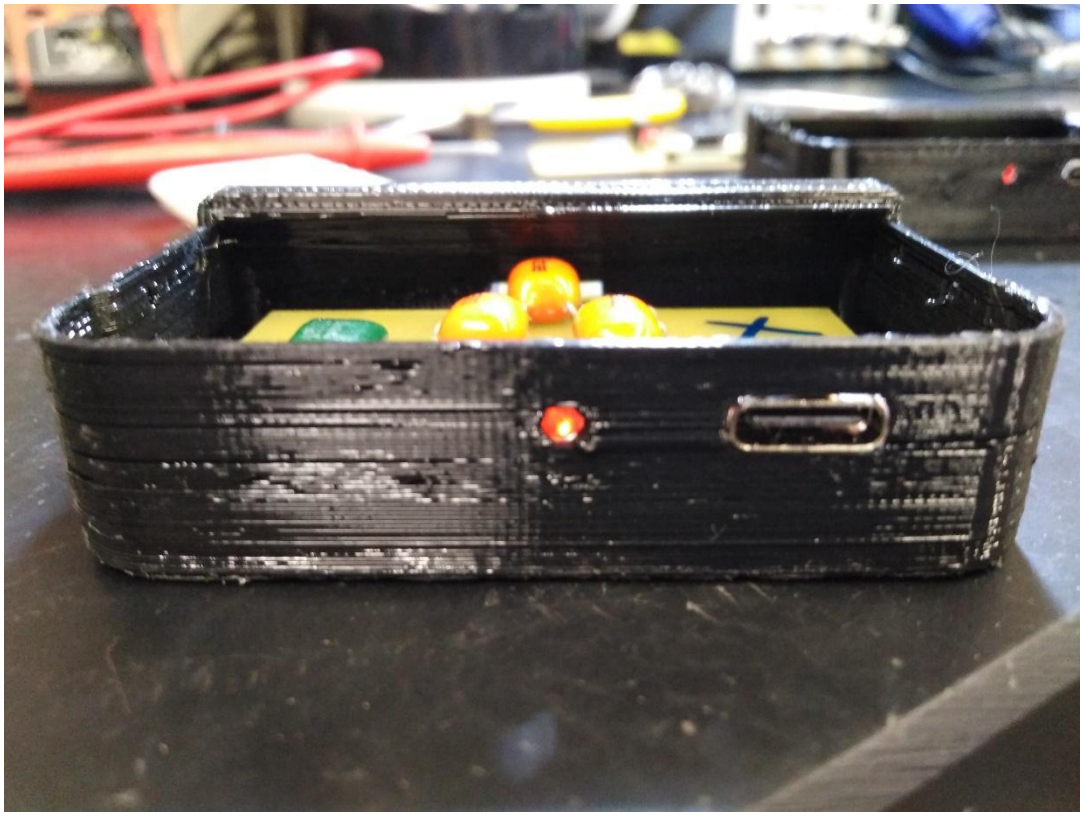




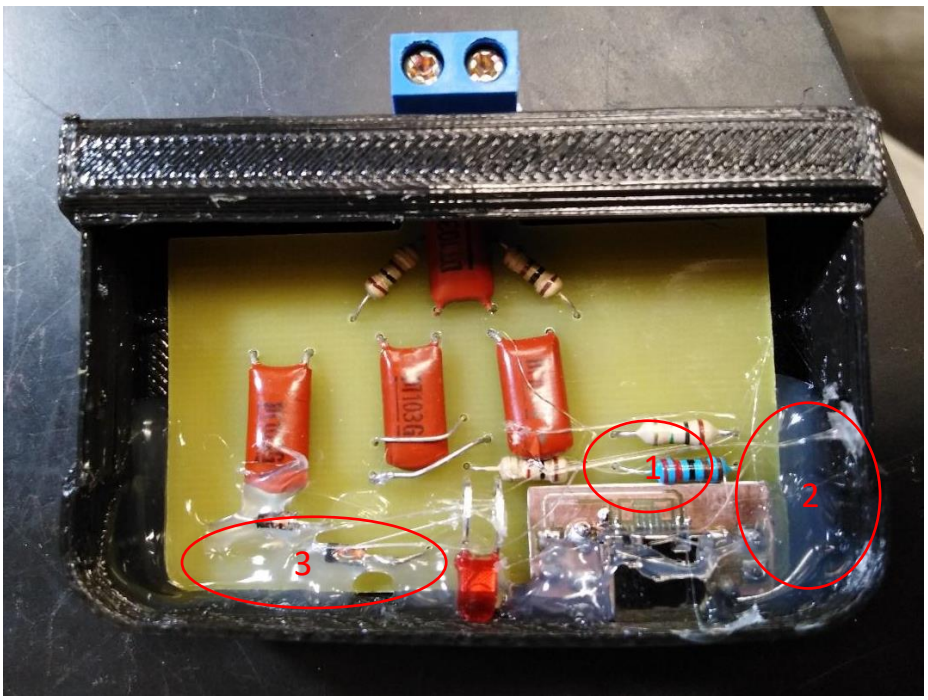
Assembly:

Put the PCB inside the casing, and fit the USB and the LED in the respective cutouts.

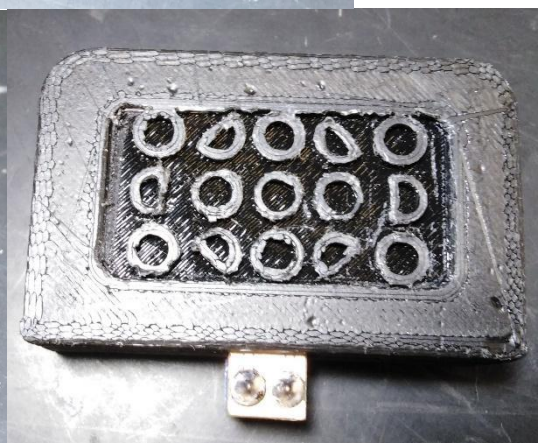
Now push the PCB a little bit so that the USB fits in its slot in the casing. Also adjust the LED in the slot. Now it will look like:



Now solder the 2-pin connector on the PCB. Apply silicon on all the points mentioned in the above picture. The importance of applying silicon on each point is indicated by the number mentioned.



Now put the top part on and fit properly. At last, put in the rivets of size **ϕ1.7*3** and use solder to push these rivets a bit deep in the casing. This way the rivets will fit firmly.



Testing:

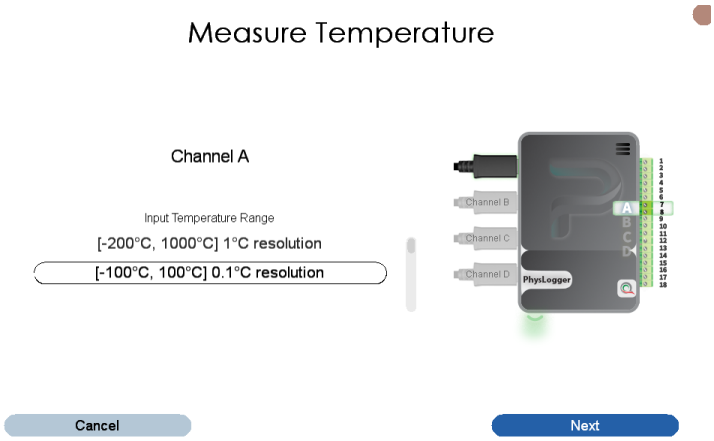
Connect your PC / Laptop to PhysLogger USB C port with USB C-to-C cable like this:

Put a beaker filled with water on the heating plate and turn the heater ON.

Connect the PhysTherm to any channel of Physlogger and connect a thermocouple with the PhysTherm connector and put the thermocouple in the beaker like this:

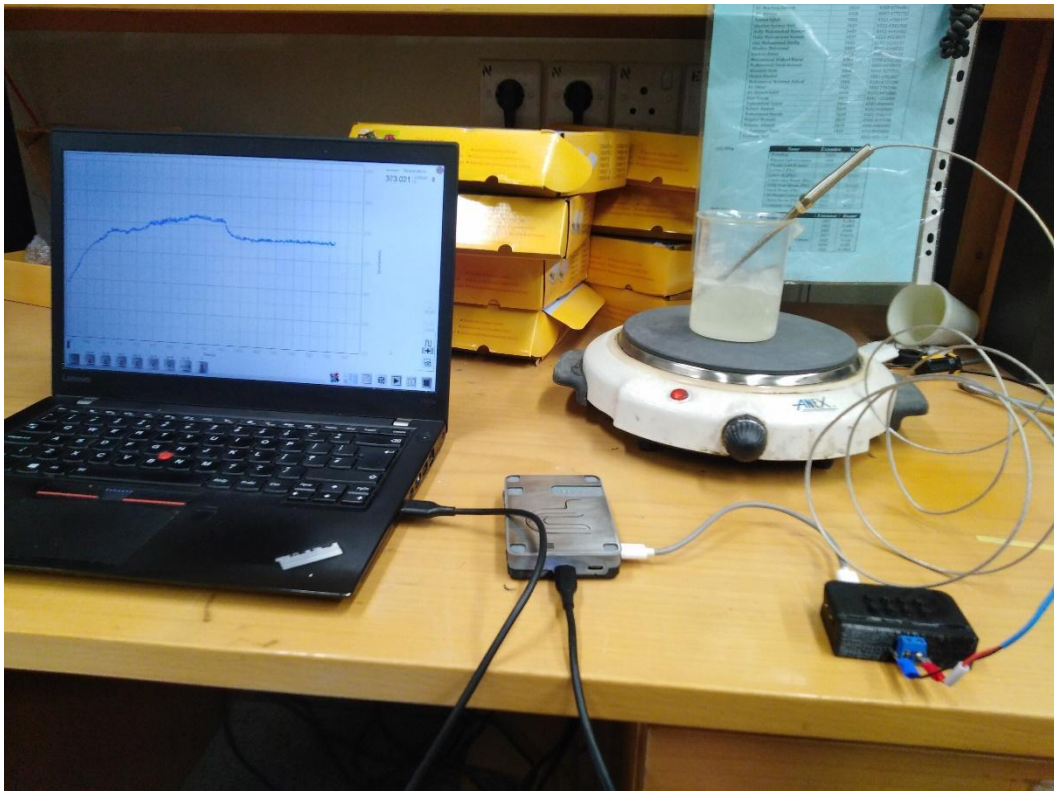
Open the PhysLogger desktop and go to **PhysLogger Gen 2** > **Measure** > **Temperature**.

Select the range **-100** to **100** degrees Celsius and resolution **0.1** degrees Celsius. Also select the channel that you connected PhysTherm to. The screen will be like (for channel A):



In the Quantity menu, select **t** at bottom left and select **4** or **5** Hz rate.

Wait for approximately 1 minute. At boiling point, for testing purpose only, the probe should say **371** - **374 K**. Anything before 371 and after 374 is suspicious.



Appendix-A:

Print Parameters for PhysTherm 3D printed parts	
Feature	**Value**
Layer height	0.3 mm
Temperature	220 C
Brim / Skirt	Skirt
Retract distance	2 mm
Infill line distance	8 mm (Grid)
Supports Configuration	OFF

Appendix B:

Bill of Materials for PhysTherm (Electrical)			
Item name	**Link**	**Count**	**Cost (Rs)**
0.01uF Capacitor	-	3	3
0.1uF Capacitor	-	1	2
1K Resistor	-	1	0.8
100 Ohm Resistor	-	2	2
2K2 Resistor	-	1	0.8
1 M Resistor	-	1	5
IC AD8495	link	1	825
3mm red LED	-	1	1
1N4148 Diode	-	2	14
USB-C expansion	-	1	25
2 pin Terminal Block Connector	-	1	8
PCB size for 25 PhysTherm PCBs	-	(288 x 214) mm	410
Total			900

For 3D printing:

Bill of Materials for PhysTherm (Mechanical)			
Part	**No. of Parts in one x3g file**	**PLA length (m) per x3g file**	**Cost (Rs)**
PhysTherm Bottom	12	42.8	460
PhysTherm Top	12	24.3	260
Total cost for the lot			720
Total calculated cost for one unit			60

Total cost for a PhysTherm unit	**960 Rs**