Master Thesis

Buenos Aires Institute of Technology

Manufacturing and assembly manual

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1. Abstract

The following document specifies the materials and methods required to manufacture the device. It is divided into three-dimensional models on the one hand and electronics on the other.

For a better understanding of the text, it is necessary for the user to previously read the report pertinent to the thesis. This will facilitate the understanding of the steps to follow. In turn, it is considered that reading it is essential to be able to proceed to manufacture the device and make modifications if one does not have exactly the same components.

2. Three-Dimensional Models

In order to print the three-dimensional models designed in this project, it is necessary to have a 3D molten deposition printer. As minimum requirements, it must be able to print ABS (that is, reach 240 ° C) and have a printing surface of at least 20 cm x 20 cm. In this work a Ender 3 Pro from the company Creality was used.

Materials

- 500 gr of 1.75 mm PLA filament.
- 500 gr of 1.75 mm ABS filament.
- 500 gr of 1.75 mm HIPS filament.
- 14 neodymium magnets. Diameter: 10 mm.Thickness: 2 mm.
- Instant adhesive gel.
- Rotative Encoder Knob.

Together with the 3D models in .STL format, printing profiles are also provided in *.curaprofile* format suitable for the Cura Slicer software, therefore, if the user wishes to use another slcier program, it will be necessary to adapt the profiles.

2.1. Heater

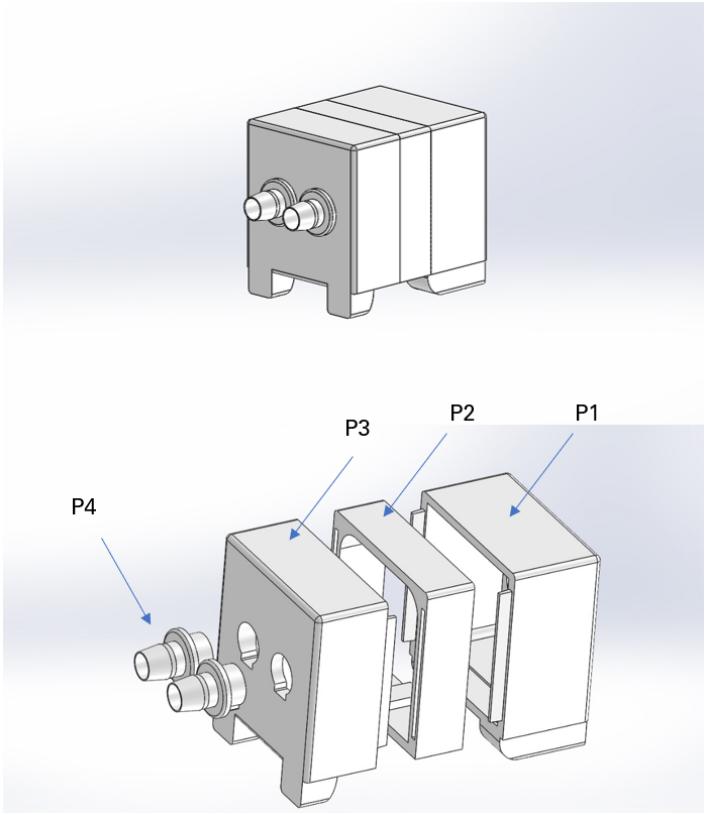

Figura 1: Final 3D model of the heating module. It consists of 4 components. P1: Fan component. P2: Component for resistors. P3: Conductive Component. P4: Connectors

This module must be printed entirely with ABS. None of the four components require supports in order to be printed.For the 4 pieces use the *ABS profile.curaprofile* profile from the *Calefactor* folder. The four components must be printed with the same profile making a single modification:

- P1: Infill= 35 %
- P2: Infill= 20 %
- P3: Infill= 30 %
- P4: Infill= 100 %

The assembly of the module is carried out by slots on the sides of each piece. After introducing the fan and the relevant cables, the junction between P1 and P2 is sealed with liquid silicone to avoid thermal loss. On the other hand, the union between P2 and P3 is not sealed, in order to provide the possibility of adjusting the internal components in case of a problem. However, once the insert is made, a covering is made with teflon tape and reinforced tape to minimize heat loss. Finally, the fit between P3 and P4 was sealed with liquid silicone and the P4 pieces were coated with teflon tape before coupling the hoses. The entire heater is covered by a jacket made of aluminized thermal insulation with encapsulated bubbles.

2.2. Main Cabinet

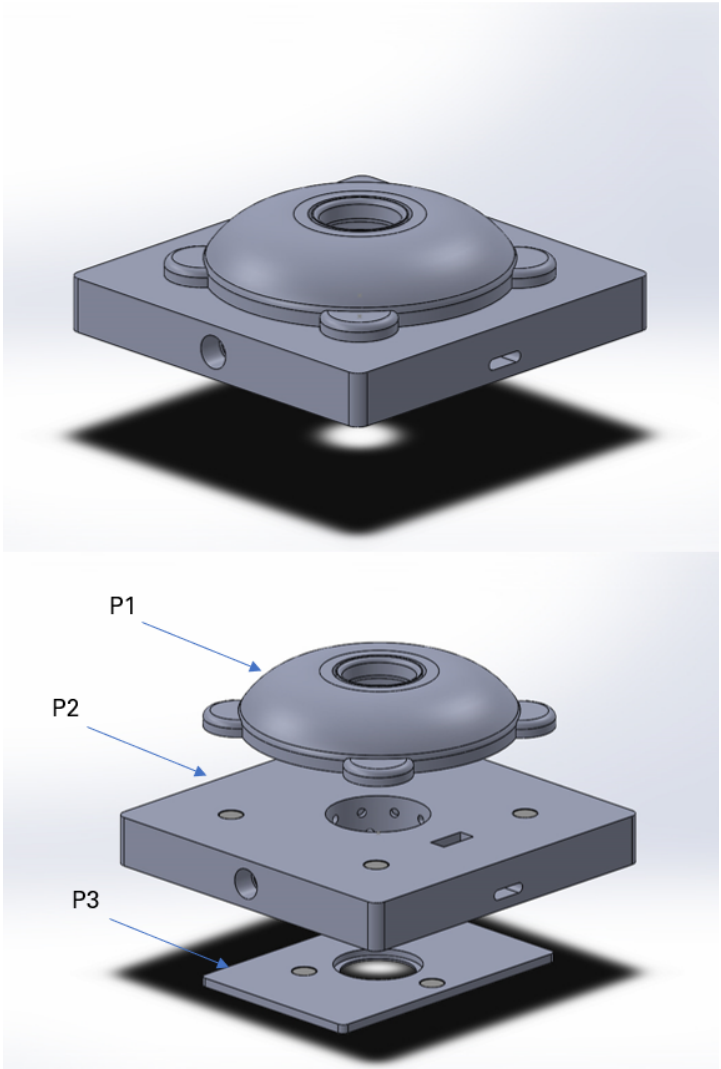

Figura 2: Final 3D model of the main cabinet module. It consists of 3 components. P1: Cap. P2: Cabinet. P3: Platen adapter.

This module must be printed entirety with HIPS. Only part P1 requires supports to be printed. For part P1 use the *HIPS P1.curaprofile* profile from the *Gabinete Principal* folder. Pieces P2 and P3 must be printed with the *HIPS P2.curaprofile* profile.

In addition to the 3 models that can be seen in the figure, there are 4 other accessory models to complete the module (to be printed with the *HIPS P2.curaprofile* profile):

- Applicator A: This piece is attached by a magnet to piece P2 before starting the test. Its function is to prevent a possible displacement of the Petri dish caused by the force of the magnets. It must be pre-assembled with Applicator B.
- Applicator B
- Cable Supplement: This is a rectangular piece that must be embedded in the rectangular hole in piece P2. It is necessary to introduce a 5-way female pin strip, where later the Si7021 temperature

sensor will adhere. To these female pins is where the 5-way cable that will communicate with the operator module is soldered.

- Connector: This is the coupling between the hoses and part P2. Two models of this part must be printed using a 100 % infill

Finally, to finish with the module connections, insert a 5-way cable through the relevant slot, solder each way to a pin on the female pin strip and then adhere the cable insert to the space.

Regarding the magnets, it was found that the best way to adhere them is to use instant adhesive gel.

2.3. Operator Module

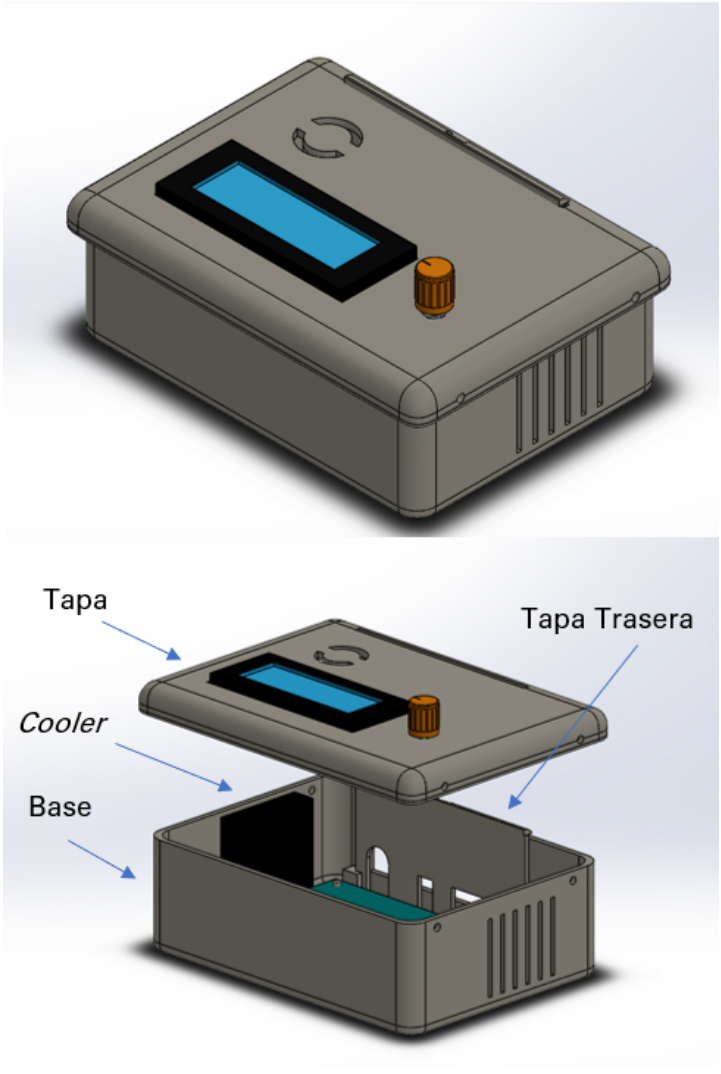

Figura 3: Final 3D model of the operator module. It consists of 2 components. P1: Cap. P2: Base.

This module must be printed in PLA since it does not present specific requirements regarding the temperature to withstand. In the *Módulo Operador* folder there is the *PLA Base.curaprofile* and the *PLA Tapa.curaprofile* profiles to print the piece with the same name.

3. Arduino

Cell Lapse works with an Arduino UNO as a microcontroller. In the *Arduino* folder you can find the 10 *.ino* files that must be compiled into it. There is also the folder *Librerías* in which the 6 libraries used are:

- Adafruit Si7021
- HD44780 master
- LiquidCrystal I2C
- MedianFilterLib
- movingAvg
- PID - Brett Beauregard

The user must be sure that these libraries are in the correct directory before compiling code into the Arduino.

4. Electronics

4.1. Operator Module PCB

For convenience, the list of materials pertinent for the Operator Module is provided in an excel file in the *Electrónica/Placa Motherboard* folder.

In the same folder the use can find the .pdf file with the necessary page to make a PCB engraving using toner.

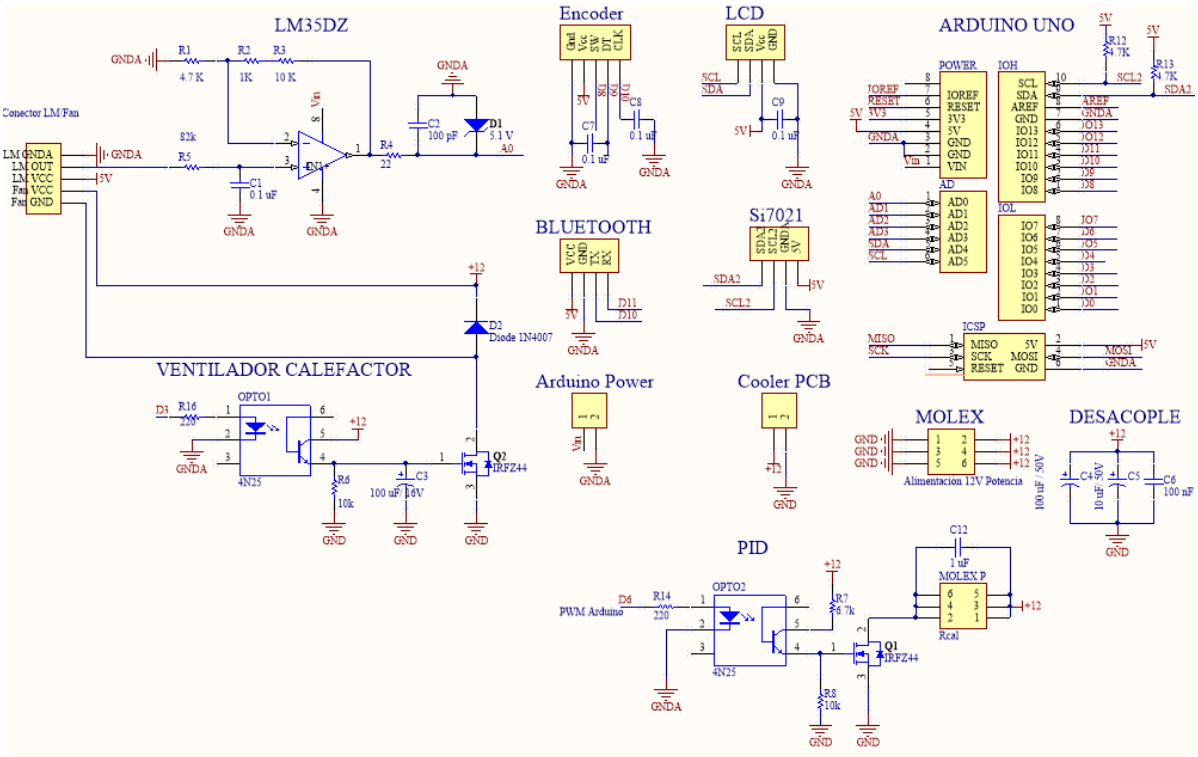

Figura 4: Motherboard Schematics.

4.2. Heater PCB

Materials

- Seven 1 mm male connector pins (J1 a J7)
- 4 male spade terminals (R1 y R2)
- 2 3D printer resistor 40 W
- Metalfilm resistor 330 Ω
- Ceramic capacitor 0.01 uF
- Ceramic capacitor 1 uF
- LM35DZ

The spade terminals are to be solder to the board in the positions where R1 and R2 are located and then fit the resistors there. In the folder *Electrónica - Placa Calefactor* you will find the file with the veneer necessary to make a PCB engraving using toner.

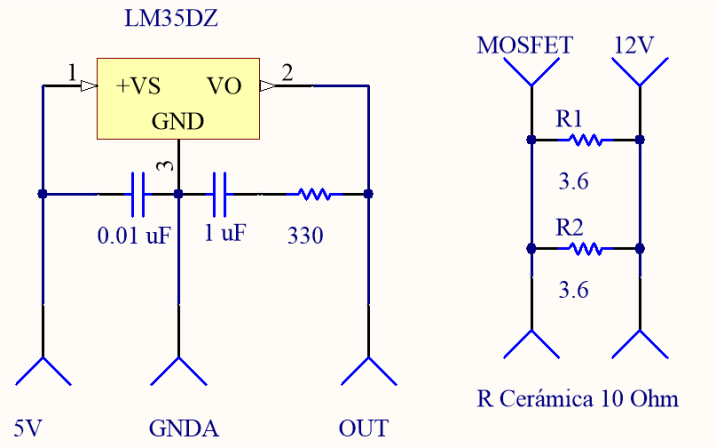

Figura 5: Heater Schematic

The list of materials pertinent for the Heater PCB is provided in an excel file in the *Electrónica/Placa Calefactor* folder.