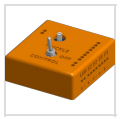


Mar 11, 2020

# 3D Printing Case for LED Controller V.2

Jakub Nedbal[1]

[1]King's College London

*In Development* dx.doi.org/10.17504/protocols.io.bdici4aw

Jakub Nedbal
King's College London

ABSTRACT

The electronics control circuit for the illuminated orbital shaker should be housed in a case to protect it from damage by short-circuit, but also to minimize injury by electrical current and fire hazard.

**This document is part of the Illuminated Orbital Shaker for Microalgae Culture project:**

- Procuring Parts for Algal Shaker
- Assembling LED Controller Electronics
- 3D Printing Case for LED Controller *(this document)*
- Assembling Cooled LED Illuminator
- Cutting and Drilling Clear Acrylic Sheet
- Assembling Algal Shaker

EXTERNAL LINK

https://app.labstep.com/sharelink/b5760252-f0e4-42a3-ae65-595c75d5a999

GUIDELINES

The electronics control circuit for the illuminated orbital shaker should be housed in a case to protect it from damage by short-circuit, but also to minimize injury by electrical current and fire hazard. Any sufficiently large plastic box can be used for this purpose with holes drilled in the appropriate places for switches and connectors. With the wide availability of 3D printers these days, printing the case is a time- and cost-efficient way to obtain a snugly fitting customized case.
This document introduces the CAD files modelling the case, the printing, and the final finishing of the case.

### In-house or Out-Sourced Printing

Fused deposition modeling, which is available in many research labs and workshops, offers sufficient quality print to produce a functioning case for the electronics. Commercial 3D printing, based on laser sintering of polyamide, would produce a superior finish and look, but may come with higher cost and longer lead time. It is up to everyone to judge their situation and priorities. We have used an in-house Stratasys uPrint SE Plus fused deposition modelling printer with printed support to produce the case.

MATERIALS TEXT

## Materials

- 3D printer with material and accessories.
- M3 thread tapping set *(#4-40 UNC thread tapping set, where imperial threads are used).*
- Four M3×10 mm counter sunk screws *(four #4-40 UNC 3/8"-long counter sunk screws, where imperial threads are preferred).*
- Screwdriver or Allen key for the above screws.

SAFETY WARNINGS

*3D printing involves melting plastics. It can release fumes and the nozzle is hot. Operate the 3D printer safely according to instructions and local regulations. Use personal protective equipment if prescribed.*

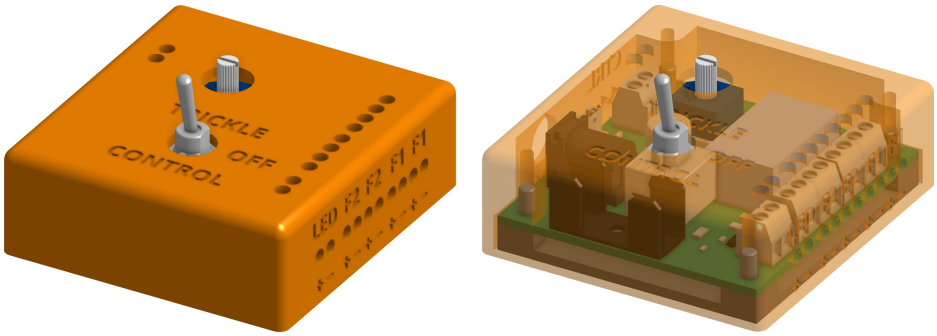
*Some 3D printers use support material, which is later removed by soaking the printed object in warm hydrogen peroxide. This is a strong*

*oxidizing agent, use personal protective equipment and follow instructions and local regulations to protect skin, eyes, and clothes from damage.*

*Cutting threads involves using thread taps. Thread taps and screwdrivers are sharp. The acts of cutting threads and screwing screws requires repetitive hand motion. The risk of injury is small. However, observe safe working practices to minimize the risk.*

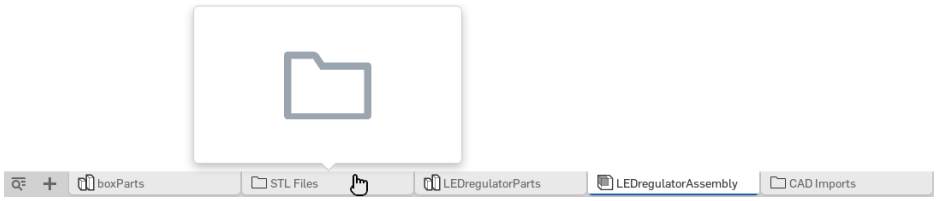
## 1 Obtain Source Files

The electronics circuit has been designed in KiCAD. KiCAD PCB files can be opened in FreeCAD. This in turn allows exporting the 3D render of the PCB into an industry-standard STEP file format. The STEP file can then be imported into Onshape, which is a 3D CAD tool. Onshape was then used to create a 3D model of a case to hold the electronics printed circuit boards with all its components. The case consists of two parts, the Top and the Bottom, which are fixed together by screws during the final assembly. The model of the case with the embedded electronics circuit is openly available on the LED regulator case project page.



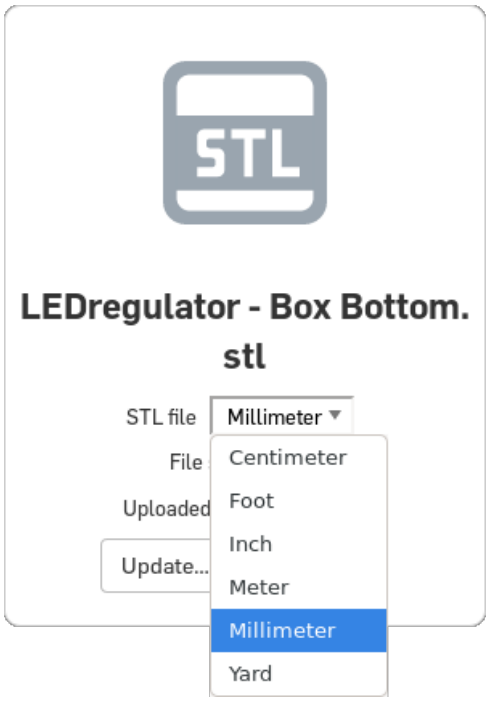

Assembled case for the LED controller circuit. (Left) the outside view of the case, (right) a transparent rendering of the case to show the electronics within.

3D printing, whether done in-house or outsourced, requires STL files to work from. The STL files can be found on the LED regulator case project page in a subfolder named **STL Files**, as shown in the screenshot below:




Click the STL Files tab on the LED regulator case project to access the STL files for 3D printing.

There are two files in this folder, named **LEDregulator - Box Top.stl** and **LEDregulator - BoxBottom.stl**. Download these files. During the download phase, ensure you select the desired units, matched to those specified for the 3D printing. In my case, that would be **Millimeter**, as in the image below:




Download the files scaled to the units used by your 3D printer.

Use the two downloaded files **LEDregulator - Box Top.stl** and **LEDregulator - BoxBottom.stl** to 3D print the two case parts.

## 2 3D Printing

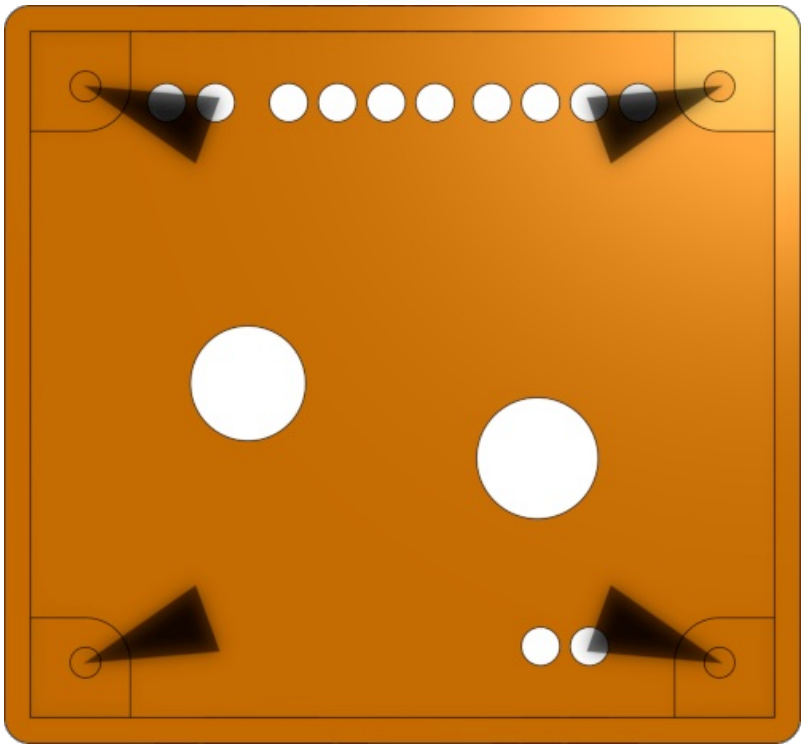
There is no general instruction on how to run a 3D printer. We used an in-house Stratasys uPrint SE Plus fused deposition modelling printer with printed support according to manufacturers instructions. The support material was subsequently dissolved by immersing the 3D printed parts in a warm hydrogen peroxide bath.

*This step is potentially hazardous. All local regulations and procedures were observed and personal protection equipment was used.*

Finally, the two parts were thoroughly washed with copious amounts of water and dried prior to further processing.

## 3 Tapping Threaded Holes in the 3D Printed Case

The Top part of the case is printed with four blind holes in each corner, highlighted by the black arrows in the image below:



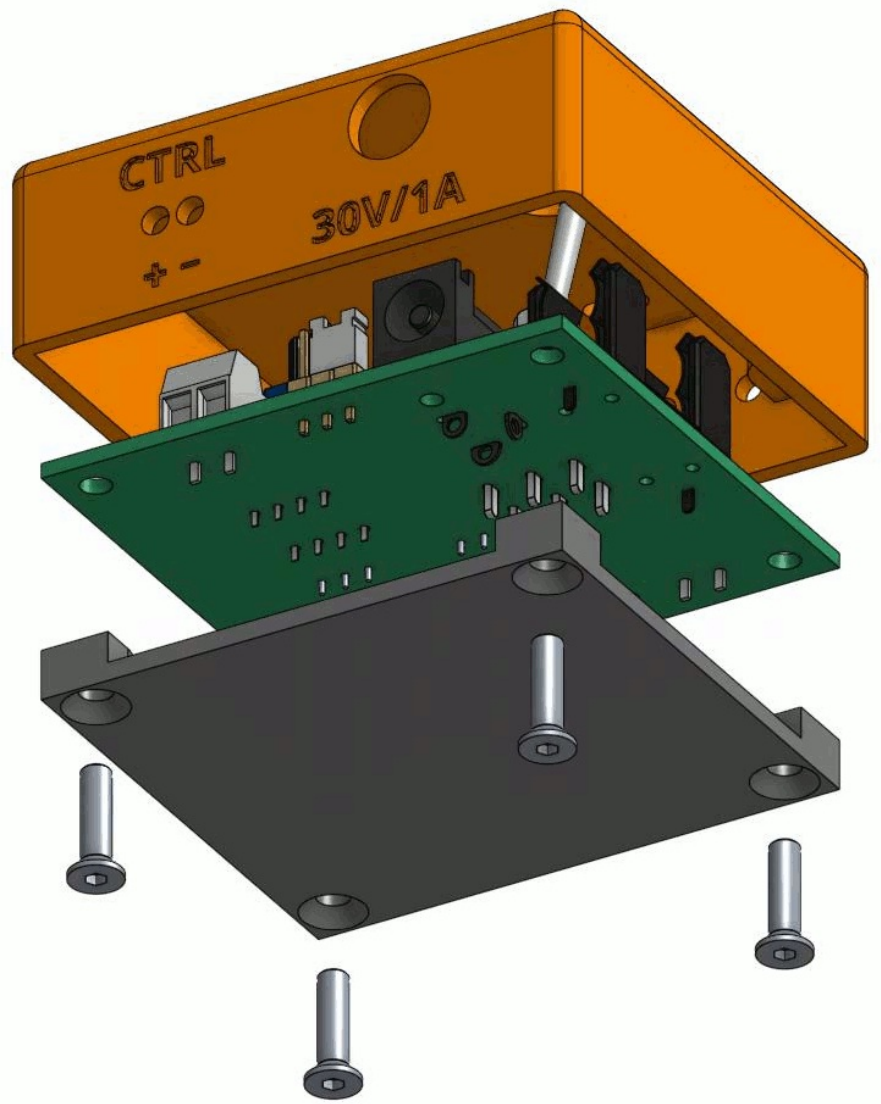
Four holes to be tapped with M3 (or#4-40 UNC) threads for screws holding the case closed.

Use an M3 thread tap to create M3 threaded holes in each corner. In areas, where Imperial thread sizes are in use, swap the M3 threads for locally common #4-40 UNC threads instead. They have similar diameter and due to their courser thread spacing, they are better suited for soft materials like plastic.
The thread is typically created in three steps using three thread taps with progressively deeper cutting threads. Start with the shallowest thread tap and finish with the deepest thread tap. Some tap manufacturers help identifying the order of taps by the number of engraved lines (see image below). First comes a tap with one line, followed by a tap with two lines, and finished with a tap with no lines. Use a tap wrench to do the thread tapping. An illustrative image of an M3 thread tap set and a tap wrench are in the image below:

Image of a set of M3 thread taps and a tap wrench.

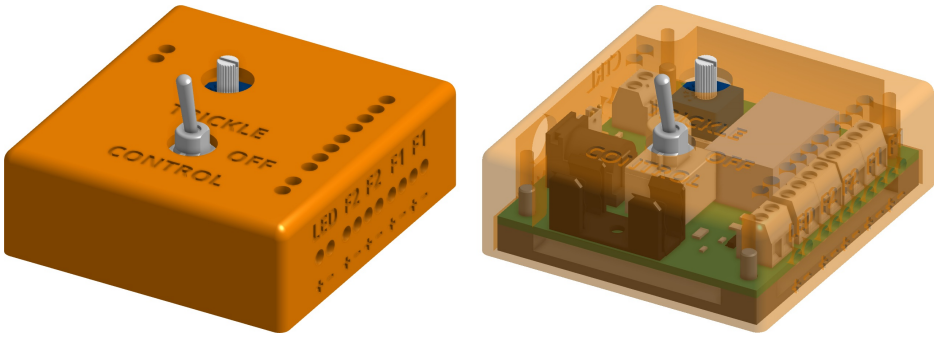
## 4 Assembling the Case

The document Assembling LED Controller Electronics explains how the electronics is assembled onto a printed circuit board (PCB). The PCB fits into the printed 3D case. The case is held together by four M3×10 mm counter sunk screws. Where imperial threads are common, four #4-40 UNC 3/8"-long countersunk screws should be used instead. The assembly is really trivial and only takes a screwdriver or an Allen key, depending on which screw head type is available. The image below should be sufficient to explain the assembly procedure:




Assembly steps for the LEC controller case. The PCB slides into the case. The bottom of the case goes over the PCB and is fastened with four M3×10 mm (#4-40 UNC × 3/8") screws.

The assembled LED Controller is shown as 3D render in the image below:




Assembled case for the LED controller circuit. (Left) the outside view of the case, (right) a transparent rendering of the case to show the electronics within.

5 ## Summary

This document described how to obtain STL files to print a case for the LED regulator electronics circuit. It explained the assembly steps. Once the electronics is inside the case, it is ready for use with the Cooled LED Illuminator, described in the next protocol.

6 ## References

- LED regulator case: Onshape project with STL files available for download for 3D printing the case for the LED regulator electronics.

7 **This document is part of the Illuminated Orbital Shaker for Microalgae Culture project:**

- Procuring Parts for Algal Shaker
- Assembling LED Controller Electronics
- 3D Printing Case for LED Controller *(this document)*
- Assembling Cooled LED Illuminator
- Cutting and Drilling Clear Acrylic Sheet
- Assembling Algal Shaker