

Free and Open Source Software Tools for Making Open Source Hardware

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Embedded Linux Conference Europe 2017
23-25 October, Prague, Czech Republic

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Group

Agenda

- ❑ **Open source hardware**
- ❑ **Free and open source software for designing PCB**
- ❑ **Free and open source CAD software and 3D printing**

What is Open Source Hardware? **Konsulko** Group

- ❑ **Design of physical objects that is publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design**

Open Source Hardware Licenses

- ❑ **GNU General Public License (GPL)**
- ❑ **Creative Commons Attribution-ShareAlike**
- ❑ **CERN Open Hardware License (OHL)**
- ❑ **TAPR Open Hardware License (OHL)**
- ❑ **FreeBSD**
- ❑ **MIT**
- ❑ **Other**

OSHW Benefits

Open source hardware is good for:

- ❑ **Giving confidence that the design will be available if the original manufacturer stops production**
- ❑ **Putting pressure on the price to be low**
- ❑ **Enabling customizations for 3rd party products**
- ❑ **Sharing knowledge, educating students and getting feedback from the community**

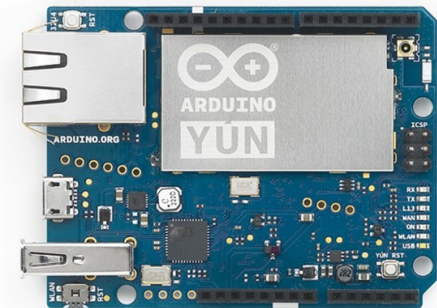
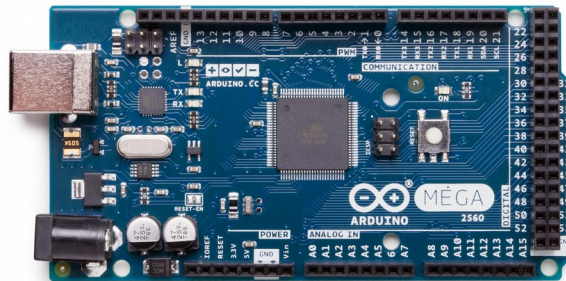
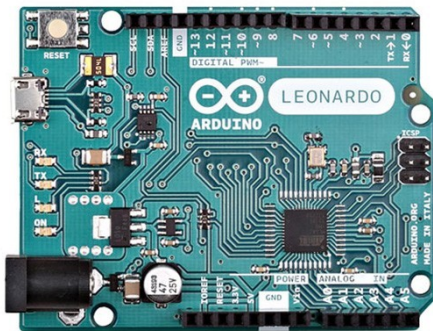
Who is making OSHW?

- ❑ **Arduino**
- ❑ **Olimex**
- ❑ **SparkFun**
- ❑ **Adafruit**
- ❑ **Intel**
- ❑ **Google**
- ❑ **IBM**
- ❑ **And many more...**

Arduino

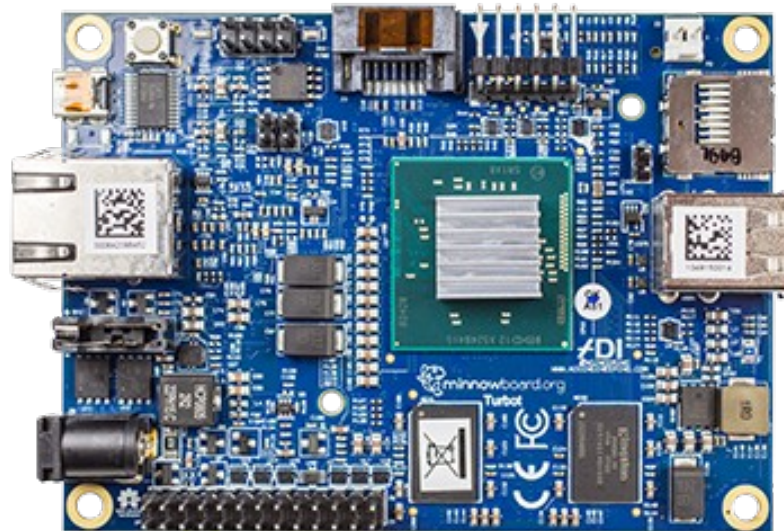
Just a few Arduino products:

- ❑ **Arduino Leonardo**
- ❑ **Arduino MEGA 2560**
- ❑ **Arduino YUN**



MinnowBoard Turbo

- ❑ **Open source hardware development boards with Intel Atom CPU**



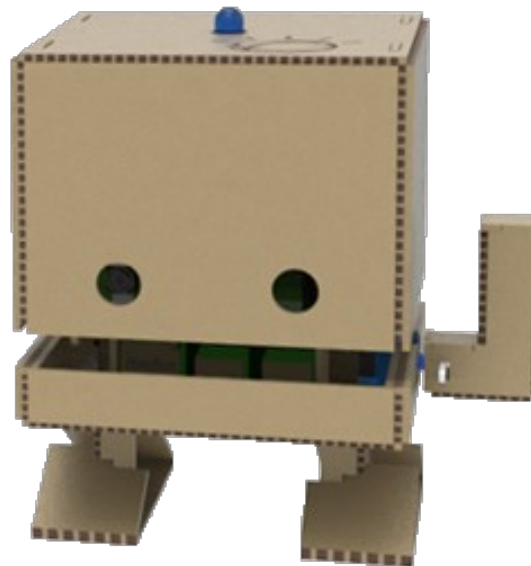
Google Cardboard

- ❑ **Affordable way to experience virtual reality through a smartphone and an open source cardboard case**



- ❑ **<https://vr.google.com/cardboard/manufacturers/>**

- ❑ **An open source hardware case for building a robot using Raspberry Pi and Watson services**

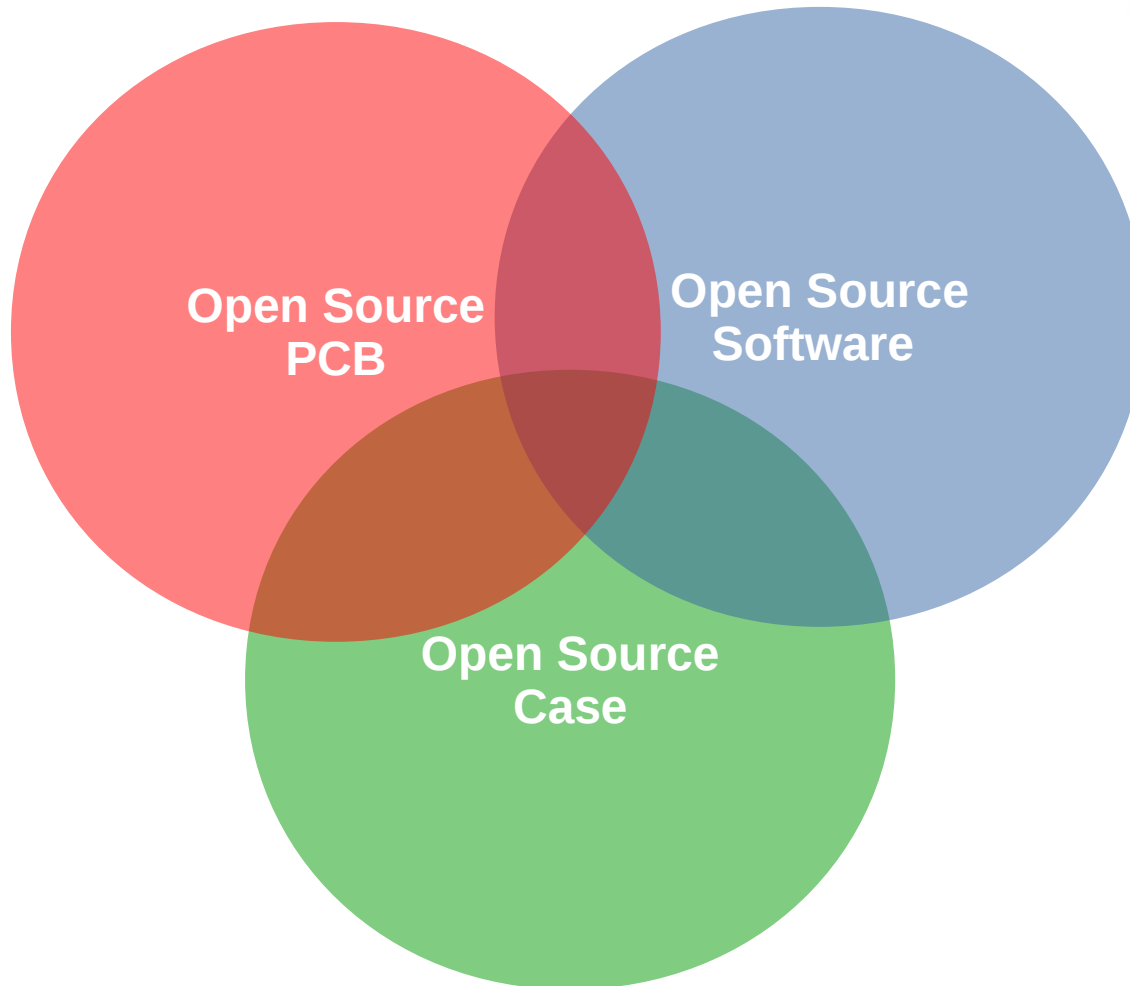


Olimex TERES-I

- ❑ **Do-It-Yourself open source hardware laptop**
- ❑ **Allwinner A64 64-bit ARM SoC**
- ❑ **2GB DDR3L memory**
- ❑ **16GB eMMC flash memory**
- ❑ **11.6" LCD display**
- ❑ **WiFi, camera, etc.**



Open Source Physical Product



**Is it worth designing
open source hardware
with expensive
proprietary software
tools?**

PCB Proprietary EDA

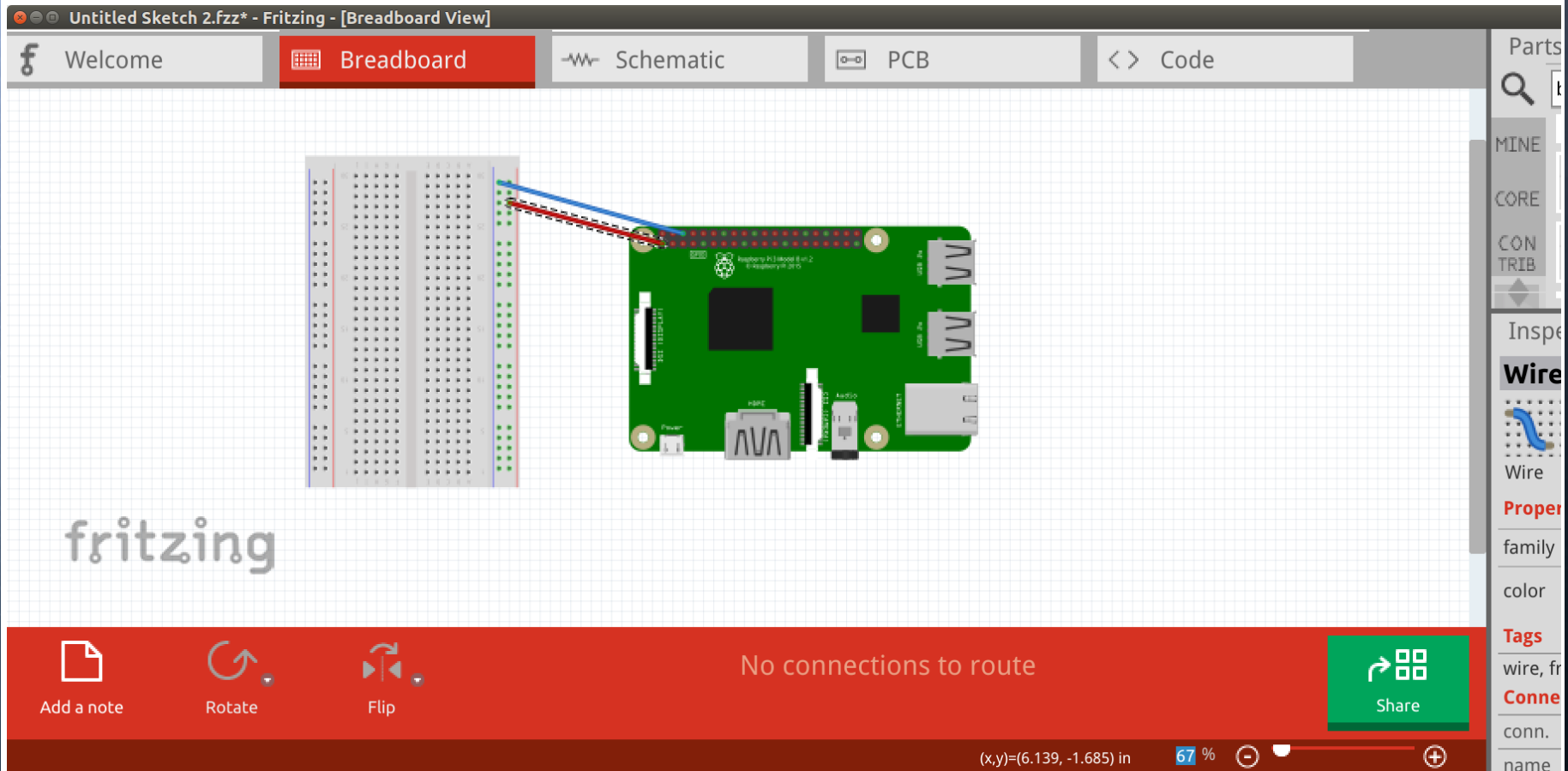
- ❑ **EAGLE** - free for small 2 Layer PCB, free for students, paid subscription;
- ❑ **Altium** (formerly known as Protel) - free trials, paid subscription
- ❑ **OrCad** - free trials, free student version, paid licensing
- ❑ **SolidWorks Electrical** - online product trial, trial software for a class and curriculum development, paid licensing

Popular FOSS EDA

- ❑ **Fritzing**
- ❑ **gEDA**
- ❑ **KiCAD**

- ❑ **Free & open source software (GNU GPLv3)**
- ❑ **Cross platform (works on GNU/Linux distributions, MS Windows and Mac OS X)**
- ❑ **PCB view for designing single layer PCB**
- ❑ **Widely used by the community for sketching hobby projects with Arduino, ESP8266, Raspberry Pi, etc.**
- ❑ **Written in C++ with Qt, source in GitHub**

Fritzing

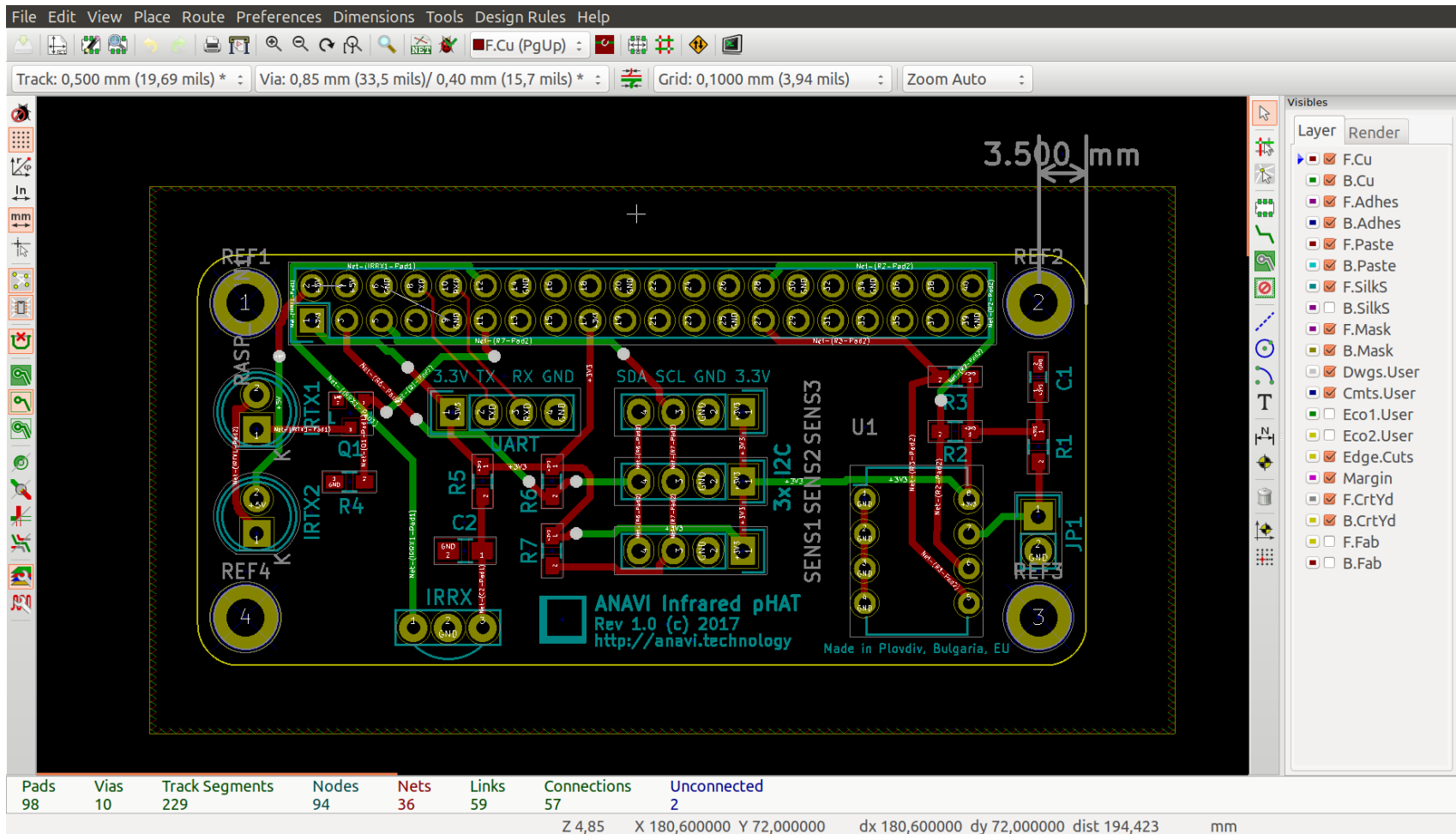


- ❑ **Free & open source software (GNU GPLv2)**
- ❑ **Cross platform (works on GNU/Linux distributions, MS Windows and Mac OS X)**
- ❑ **Supports PCB with multiple layers**
- ❑ **Written in C/C++ with GTK+, source in Git repositories**

KiCAD EDA

- ❑ **Free & open source software (GNU GPLv3)**
- ❑ **Cross platform (works on GNU/Linux distributions, MS Windows and Mac OS X)**
- ❑ **Supports PCB with multiple layers and integrated 3D viewer**
- ❑ **Contributions from CERN developers**
- ❑ **Already well adopted by the industry**
- ❑ **Written in C++, source in Git repositories**

KiCAD Pcbnew



- ❑ **Online tool for designing PCB in a web browser**
- ❑ **Free & open source software (GNU AGPLv3)**
- ❑ **Written in JavaScript, python and Go, source in GitHub**
- ❑ **<https://meowcad.com/>**

Recommendations

- ❑ **Comply with the minimum requirements of the PCB manufacturer for trace spaces, drills and angular rings**
- ❑ **Keep in mind the complexity of the assembly process while designing the PCB**
- ❑ **Consider the design of the case simultaneously with the design of the PCB**


Prototypes

PCB printing services from:

- ❑ **OSHPark (made in the USA)**
- ❑ **Local European factories**
- ❑ **China**




OSH Park

Upload your design




You can upload your design as

- an Eagle **.brd** board file
- a KiCAD **.kicad_pcb** board file
- a **.zip** file containing Gerber CAM files



We support the default CAM filenames for most CAD packages. See our [design submission guidelines](#) or [design tool help](#) for more information.

 **Select a file on your computer**

Designed and developed by Rabid.

3D CAD Software

- ❑ **OpenSCAD**
- ❑ **QCAD**
- ❑ **FreeCAD**
- ❑ **Blender**

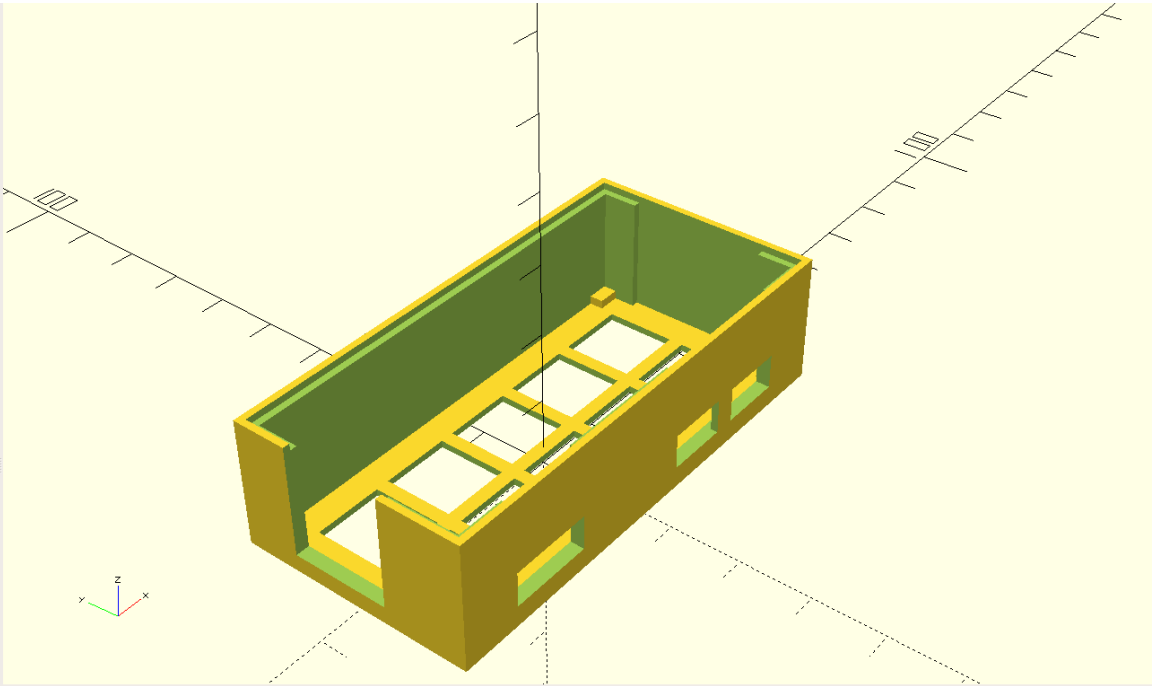
OpenSCAD

- ❑ **Software for creating solid 3D CAD objects**
- ❑ **Script-only based modeller with its own language**
- ❑ **Free & open source software (GNU GPLv2)**
- ❑ **Cross platform (works on GNU/Linux distributions, MS Windows and Mac OS X)**
- ❑ **Written in C++ with Qt, source in GitHub**

OpenSCAD

Editor

```
1 //Bottom
2 translate([0,0,2])
3 {
4   //Drill holes at the bottom
5   difference()
6   {
7     cube([69,34,1], true);
8     for (y=[-6:12:6])
9     {
10      for (x=[-24:12:24])
11      {
12        translate([x,y,0])
13        cube([10,10,2], true);
14      }
15    }
16  }
17 }
18
19 //Sides
20 translate([0,0,11])
21 {
22   difference()
23   {
24     cube([69,34,18], true);
25     cube([65,30,18], true);
26
27     //Edge
28     translate([0,0,8.5])
29     cube([67,32,1], true);
30
31     //Place for the miniHDMI
32     translate([-19.5,-16,-4])
33     cube([12,2,5], true);
34
35     translate([-19.5,-15.5,1.5])
36     cube([12,1,16], true);
37
38     //Place for the 1st microUSB
39     translate([21.5,-16,-4])
40     cube([9,2,5], true);
41   }
42 }
```



Console

```
Simple: yes
Vertices: 188
Halfedges: 564
Edges: 282
Halfacets: 188
Facets: 94
Volumes: 2
Rendering finished.
```

Viewport: translate = [21.36 11.21 1.61], rotate = [54.30 0.00 308.00], distance = 237.09

OpenSCAD 2015.03

- ❑ **2D CAD software**
- ❑ **Free & open source software (GNU GPLv3)**
- ❑ **Cross platform (works on GNU/Linux distributions, MS Windows and Mac OS X)**
- ❑ **Written in C++ with Qt, source in GitHub**

- ❑ **General purpose software for 3D modelling based on OpenCASCADE**
- ❑ **Free & open source software (GNU LGPL2+)**
- ❑ **Cross platform (works on GNU/Linux distributions, MS Windows and Mac OS X)**
- ❑ **Written in C++ & Python with Qt, source in GitHub**

Blender

- ❑ **Professional 3D computer graphics suite for creating animated movies, visual effects and 3D models**
- ❑ **Free & open source software (GNU GPLv2)**
- ❑ **Cross platform (works on GNU/Linux distributions, MS Windows and Mac OS X)**
- ❑ **Written in C, C++ & Python with OpenGL, source in Git repository**

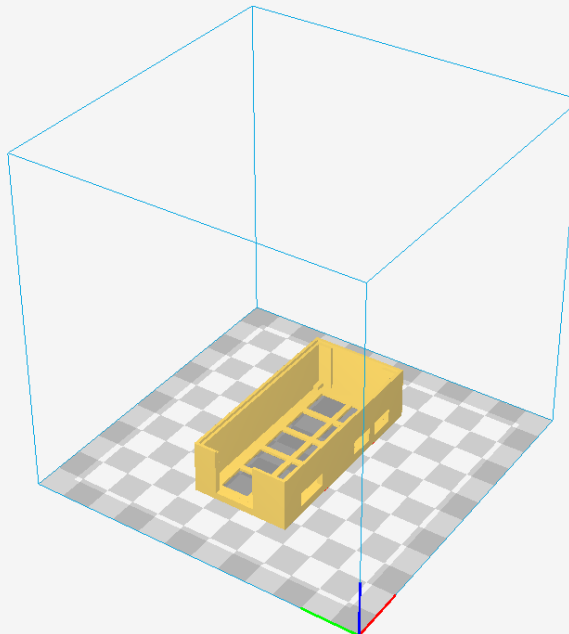
Ultimaker Cura

- ❑ **3D printer slicing application**
- ❑ **Supports Ultimaker and many other 3D printers**
- ❑ **Free & open source software (GNU LGPLv3)**
- ❑ **Cross platform (works on GNU/Linux distributions, MS Windows and Mac OS X)**
- ❑ **Written in Python with QML, source in GitHub**

Ultimaker Cura

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File Edit View Settings Extensions Preferences Help



PP_rpi0-anavi-infrared-bottom

69.0 x 34.0 x 18.5 mm

01h 38min 1.14 m / ~ 9 g

PrimaCreator P120

Material: PLA

Profile: Normal Quality - 0.1mm

Print Setup

Recommended Custom

Infill



Enable Support



Build Plate Adhesion



Need help improving your prints? Read the [Ultimaker Troubleshooting Guides](#)

Ready to Save to File

Save to File

cura.

Conclusions

- ❑ **Open source hardware is a viable business model**
- ❑ **High quality free and open source software tools for designing open source hardware are available**

... and one more thing

**Share your hardware and
software under open
source licenses :)**

Thank You!

Useful links:

- ❑ <http://fritzing.org/>
- ❑ <http://www.geda-project.org/>
- ❑ <http://kicad-pcb.org/>
- ❑ <http://www.openscad.org/>
- ❑ <https://www.freecadweb.org/>
- ❑ <http://www.qcad.org/en/>
- ❑ <https://www.blender.org/>
- ❑ <https://ultimaker.com/en/products/ultimaker-cura>

