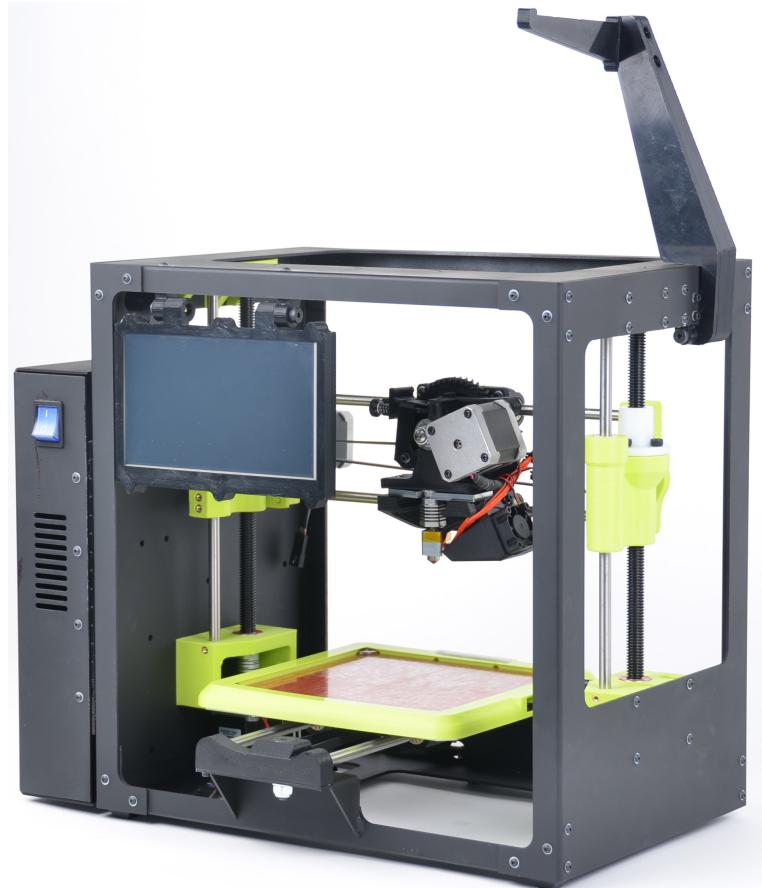


LULZBOT MINI DEVELOPER'S GUIDE



LulzBot Mini Developer's Guide

by Aleph Objects, Inc.

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For more information, call +1-970-377-1111 or visit www.alephobjects.com.

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Introduction

Welcome Aboard

Audience

This is a developer's guide to hacking on the LulzBot Mini 3D Printer. It is meant for developers, not users, of the printer.

Open Source Hardware, Free Software

Aleph Objects, Inc. is a Loveland, Colorado, USA company that manufactures Open Source Hardware using Free Software.

For more info, visit <http://www.alephobjects.com>.

LulzBot Mini

Developer Overview

1.1 LulzBot Mini

The LulzBot Mini is a 3D Printer currently under development. The abbreviated name is mini-dev.

The source files are available here:

<http://devel.lulzbot.com/mini/>

1.2 Versions

Each new version of the mini-dev has a new name, with the next letter in the alphabet.

- Azalea - First Prototype
- Begonia - Second Prototype, being built now
- Camellia - Third Prototype
- Daffodil - First Production batch

1.3 Begonia Photos

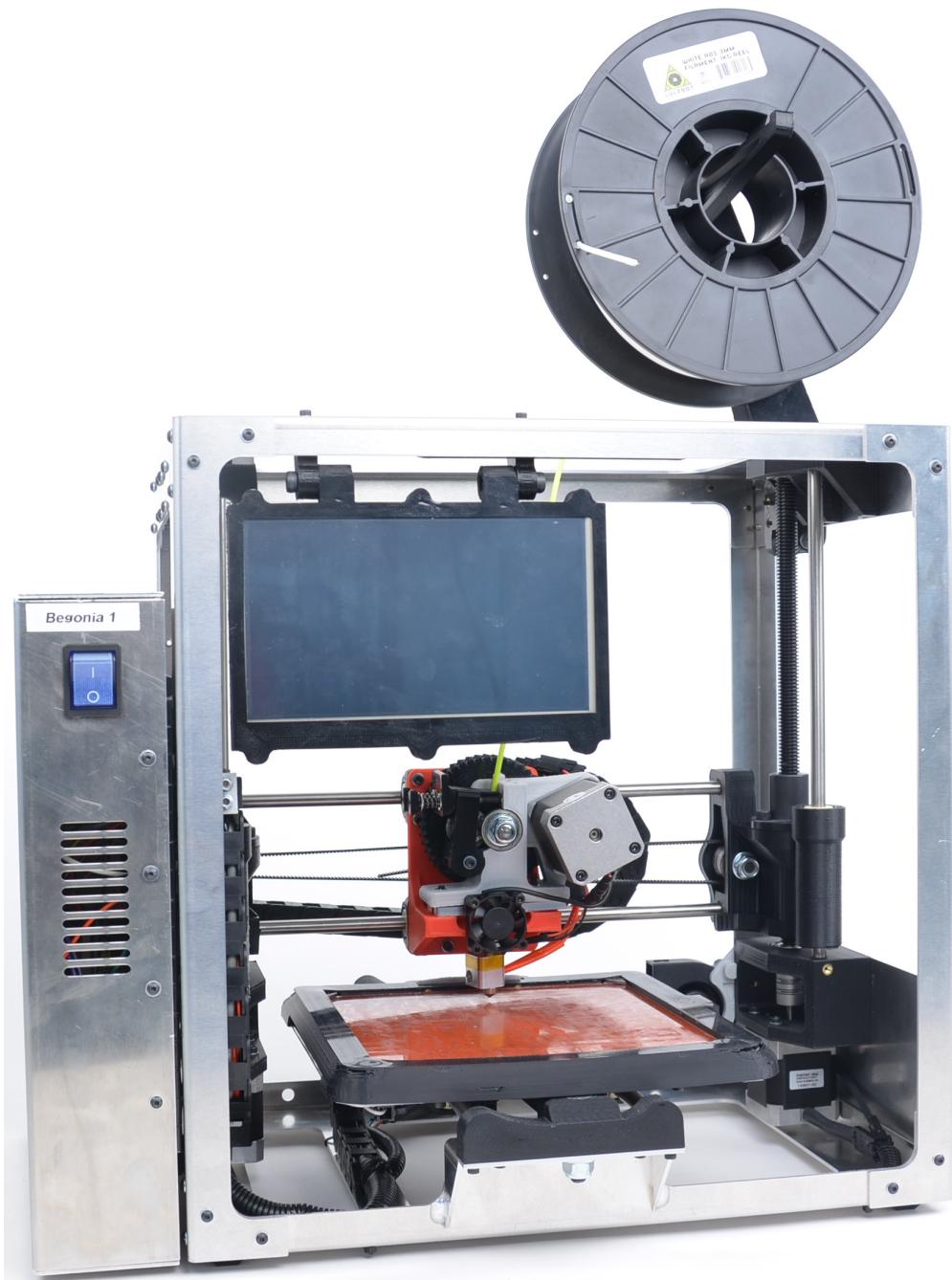


Figure 1.1: Begonia Front Photo

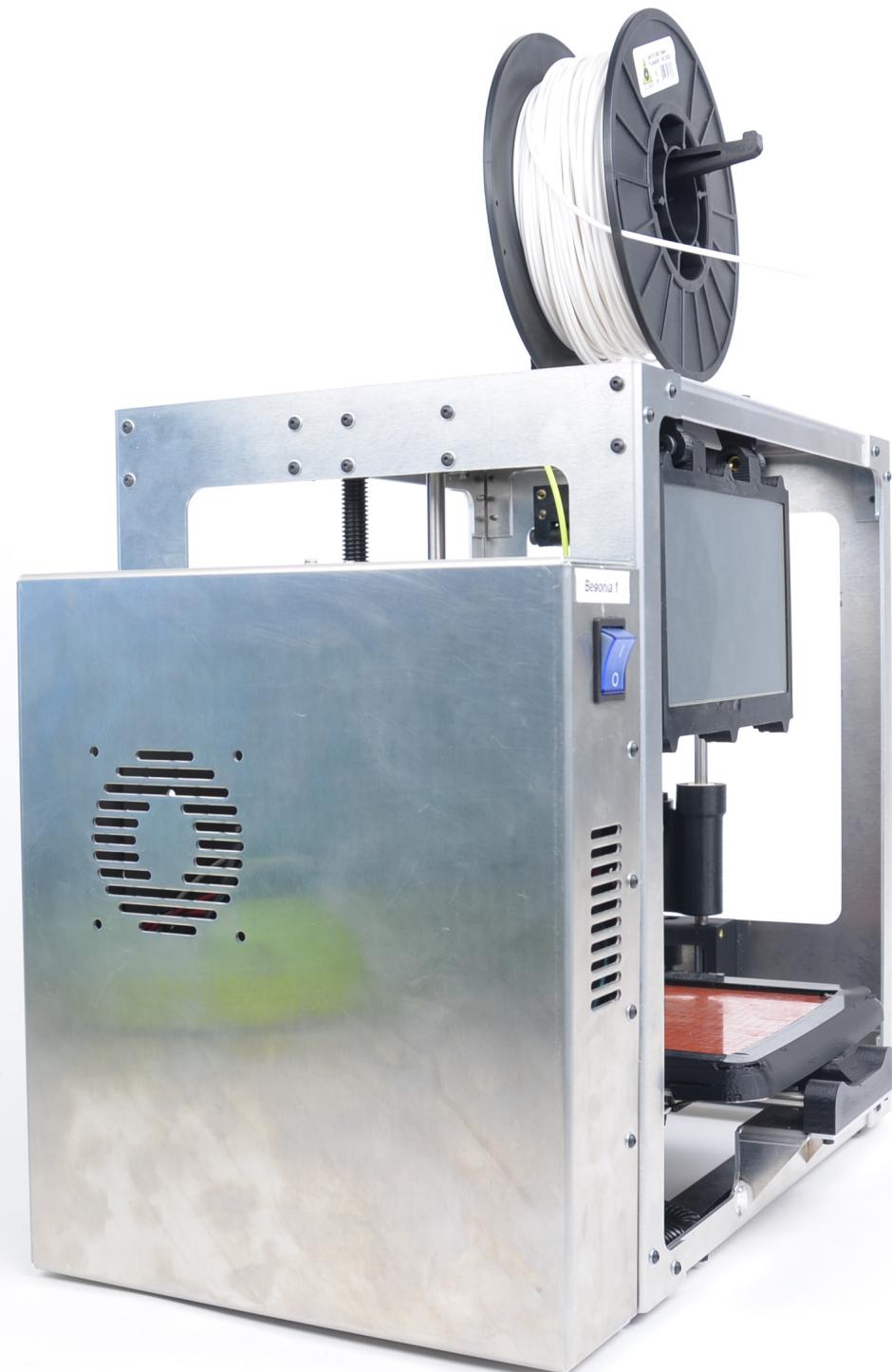


Figure 1.2: Begonia Left Photo

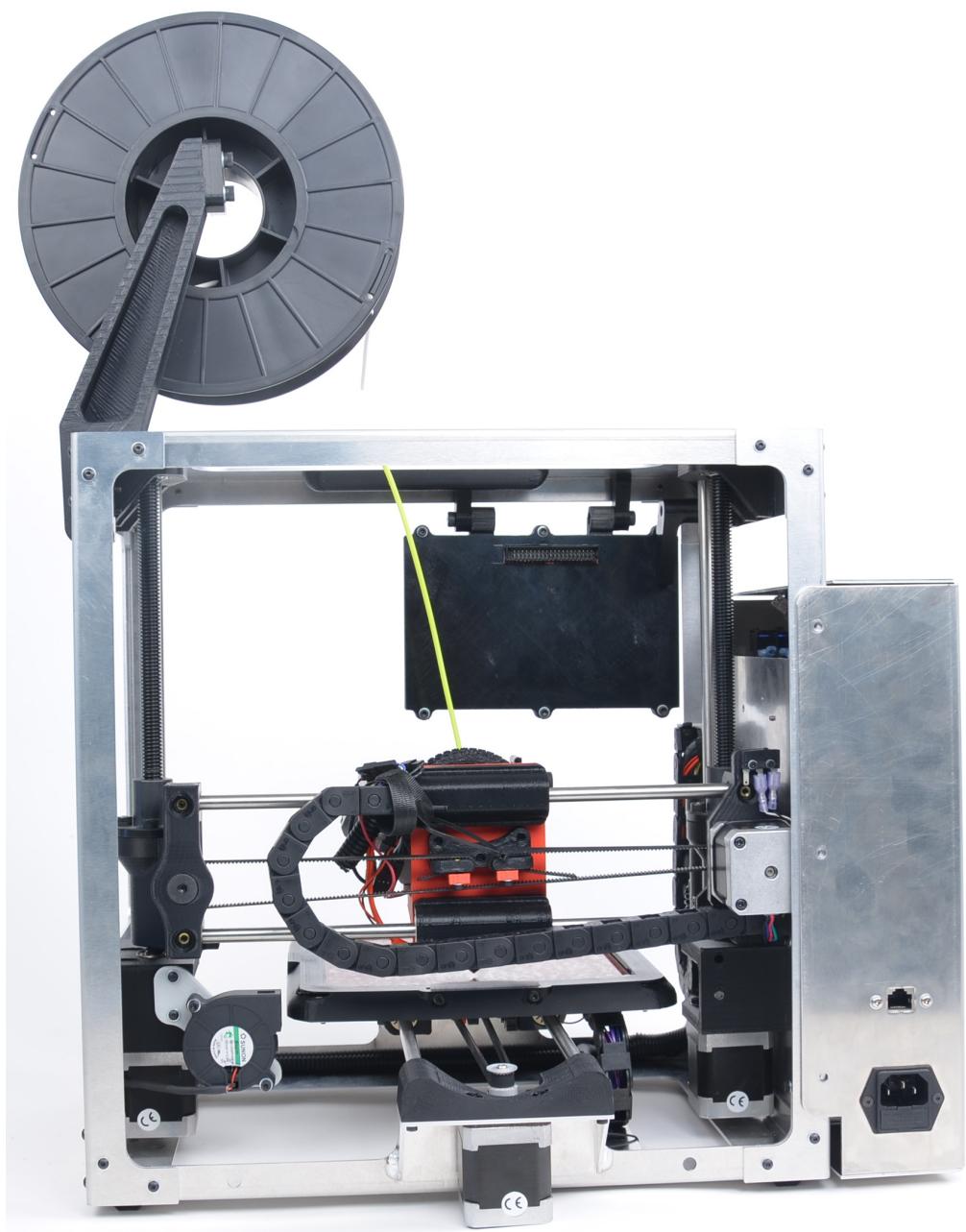


Figure 1.3: Begonia Back Photo

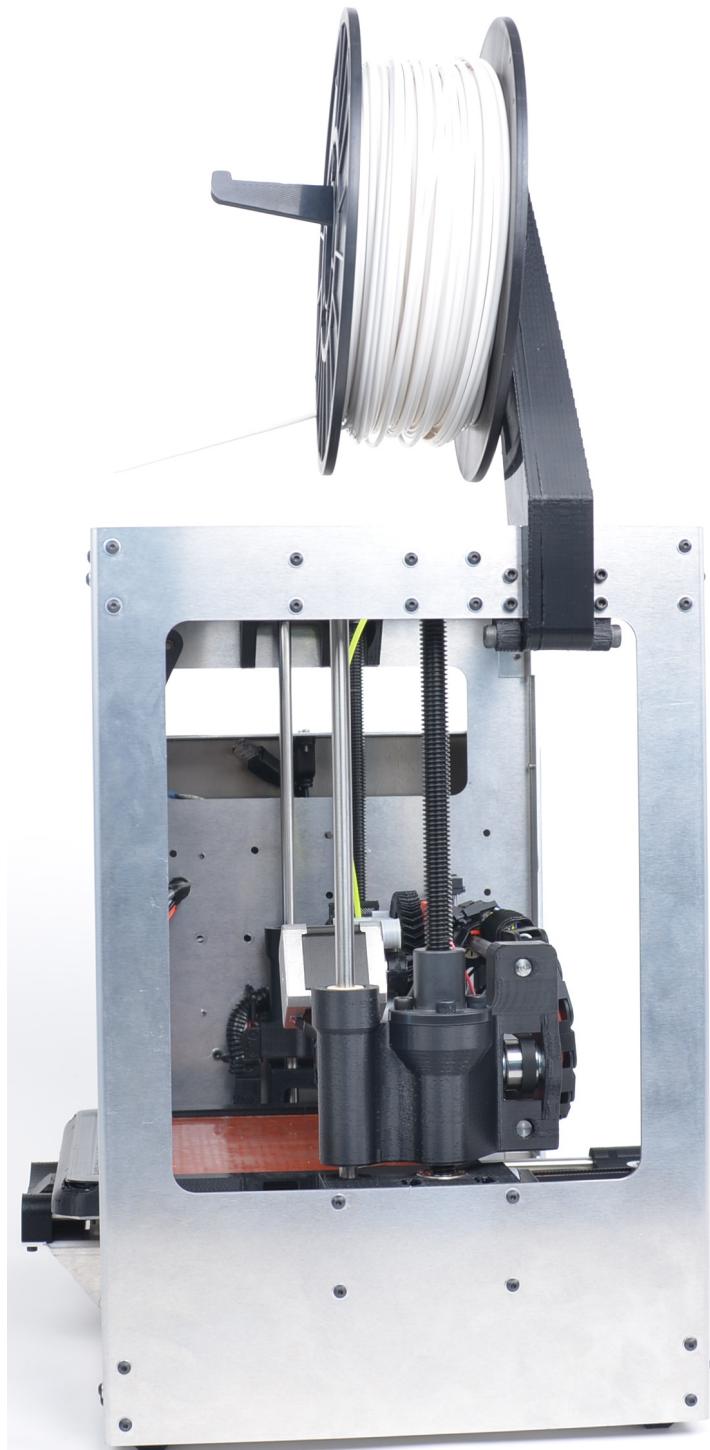


Figure 1.4: Begonia Right Photo

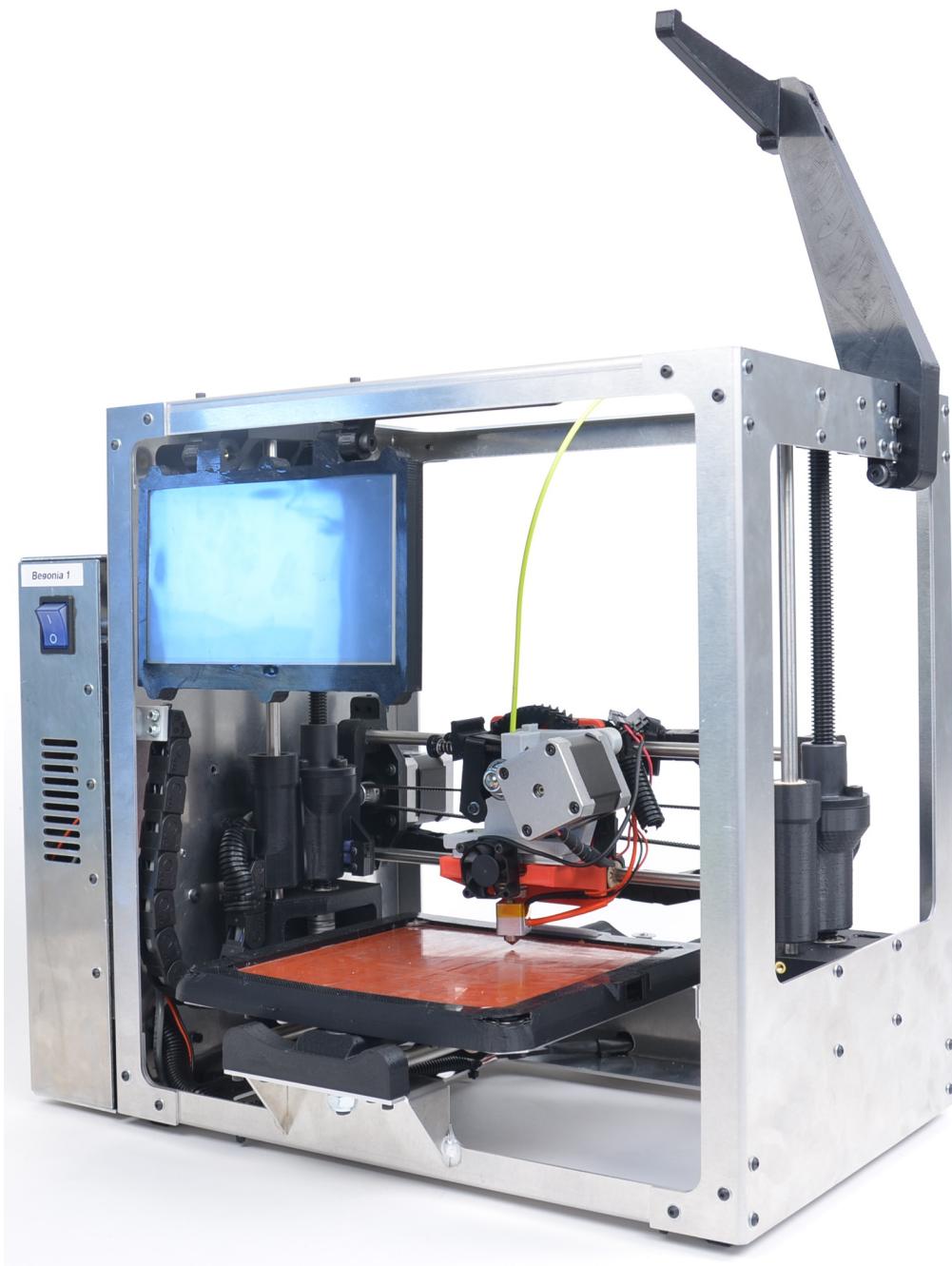


Figure 1.5: Begonia Spool Arm Up Photo

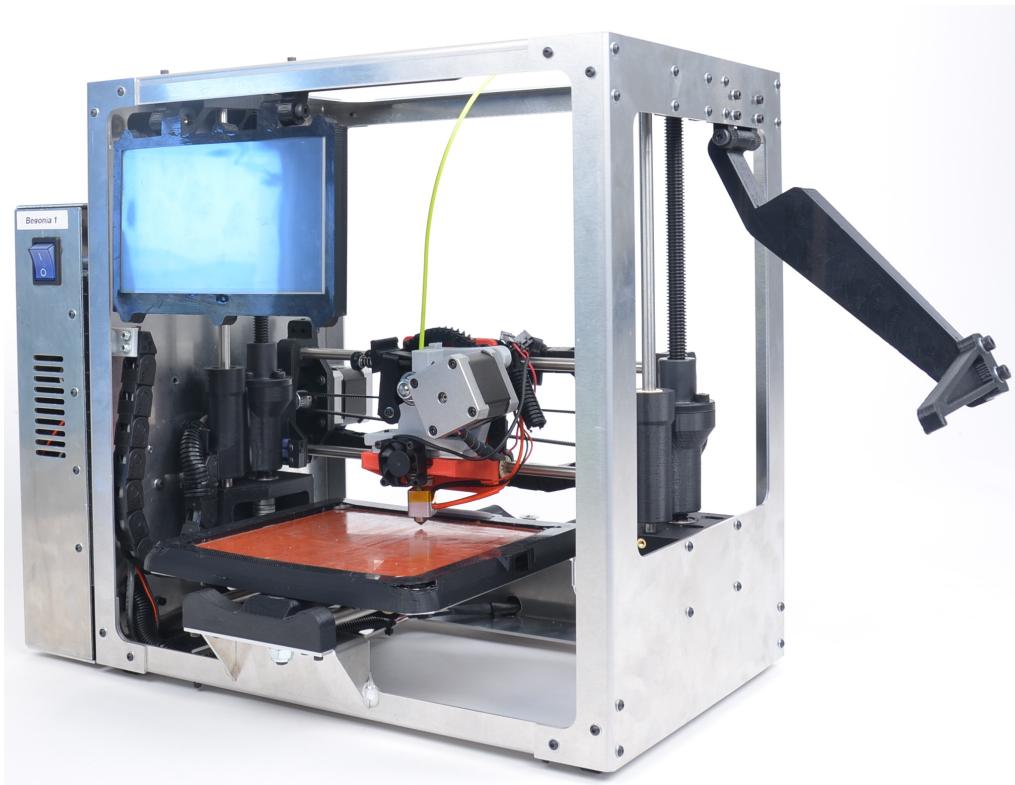


Figure 1.6: Begonia Spool Arm Down Photo



Figure 1.7: Begonia Green Color Scheme Photo

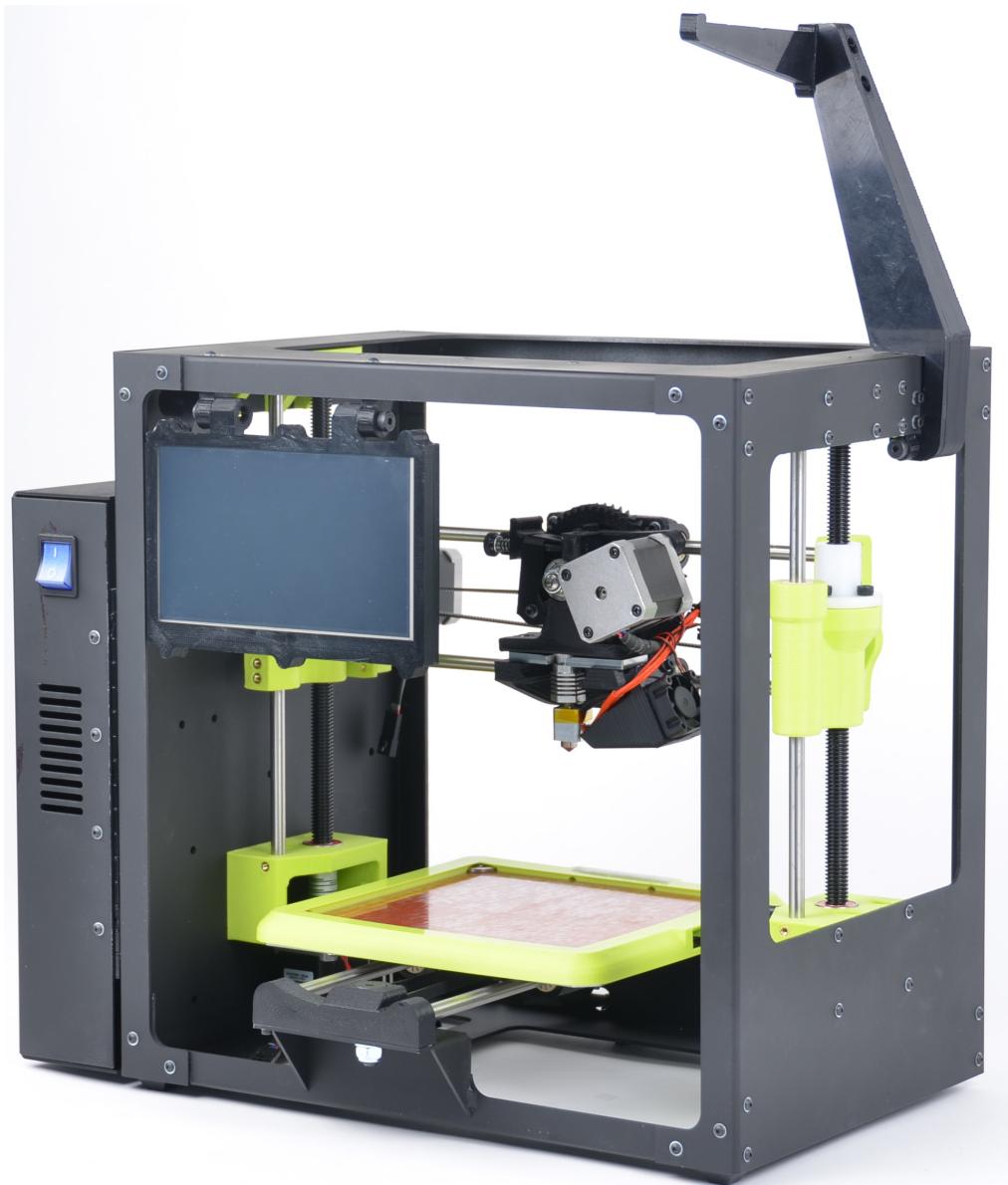


Figure 1.8: Begonia Black Green Color Scheme Photo

1.4. SCHEDULE

1.4 Schedule

The schedule is updated weekly. It is in Libre Office spreadsheet format.
The latest version is available here:

http://devel.lulzbot.com/mini/program_management/

Specs

Specifications

2.1 Specifications

Printing

- Print Surface: Heated Borosilicate glass bed covered with PEI film
- Print Area: 155mm x 155mm x 155mm (6.1in x 6.1in x 6.1in)
- Print Volume: 3,726cm³ (227.4 in³) of usable space
- Top Print Speed: 275mm/sec (10.8in/sec)
- Print Tolerance: 0.1mm (0.0039in) in X and Y axes. Z axis is dependent on layer thickness
- Layer Thickness: 0.075mm to 0.50mm (0.003in - 0.020in)
- Supported Materials: ABS, PLA, HIPS, PVA, wood filled filaments, Polyester (Tritan), PETT, filled PLA, Bronze and copper filled filaments, Polycarbonate, Nylon, PETG, Conductive PLA and ABS, UV luminescent filaments, PCTPE, PC-ABS, and more every day.
- Usable Filament Sizes: standard 3mm (0.1in)

Physical Dimensions

- Overall Dimensions: 435mm x 340mm x 385mm (17.1in x 13.4in x 15.2in)
- Weight: 8.55kg (18.85lbs)

Electrical

- Power Requirements: 100 - 240 VAC
- Power Supply: 24V 150W
- US, UK, and EU electrical plugs available

2.1. SPECIFICATIONS

Temperature

- Temperature: Maximum operating temperature (Extruder), 300C (572F)
- Temperature: Maximum operating temperature (Heated Bed), 120C (248F)

Mechanical

Cartesian Bot in X, Y, Z

3.1 Intro

Mechanical hardware specs and parts are in these subdirectories:

<http://devel.lulzbot.com/mini/>

3.2 Daffodil Bill of Materials

Daffodil is the first production run of units for retail.

3.3 Begonia Renders

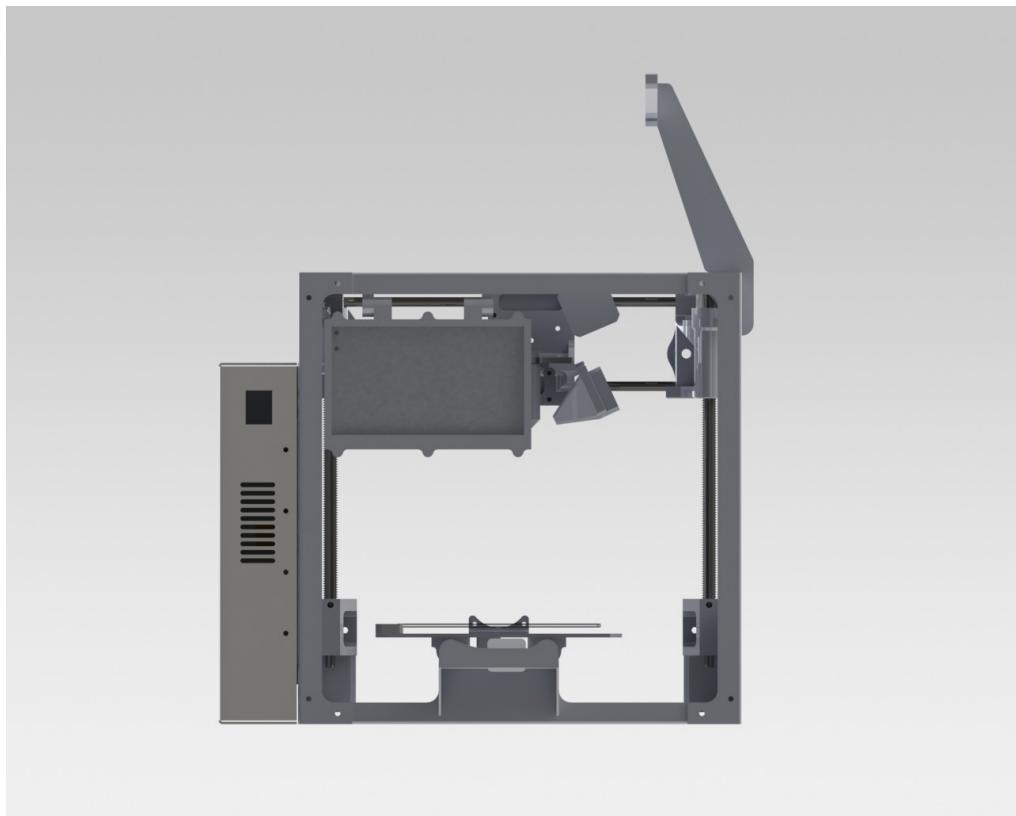


Figure 3.2: Begonia Front Render

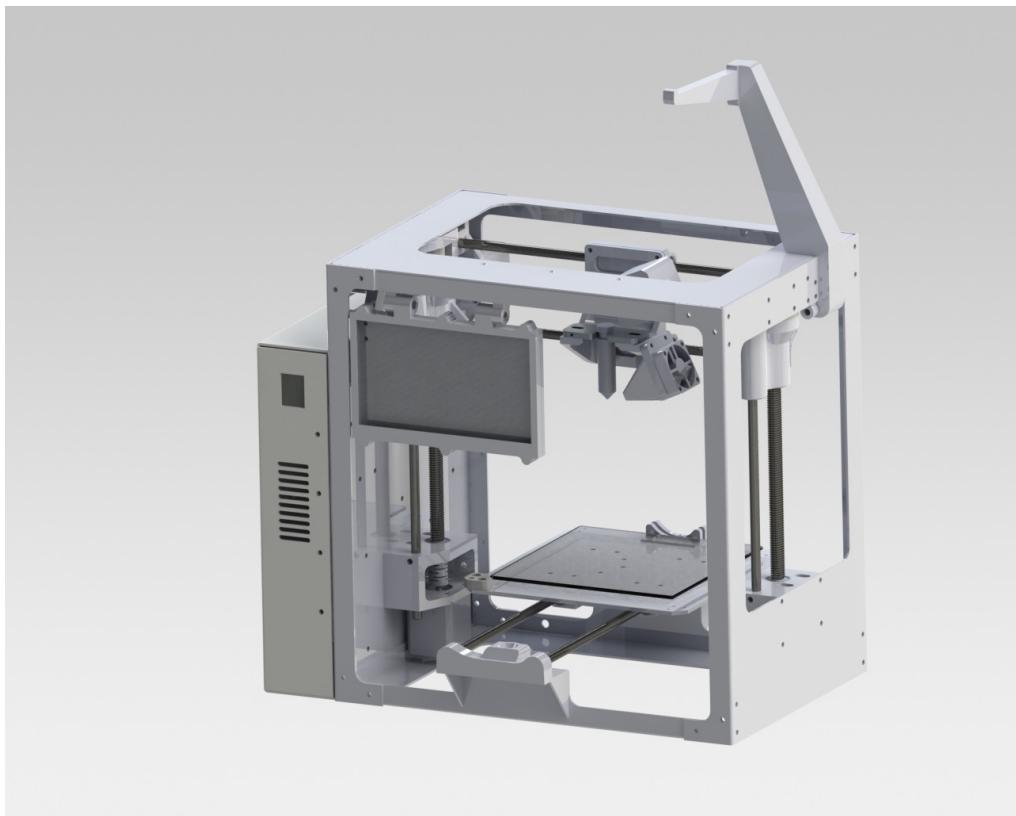


Figure 3.3: Begonia ISO Render

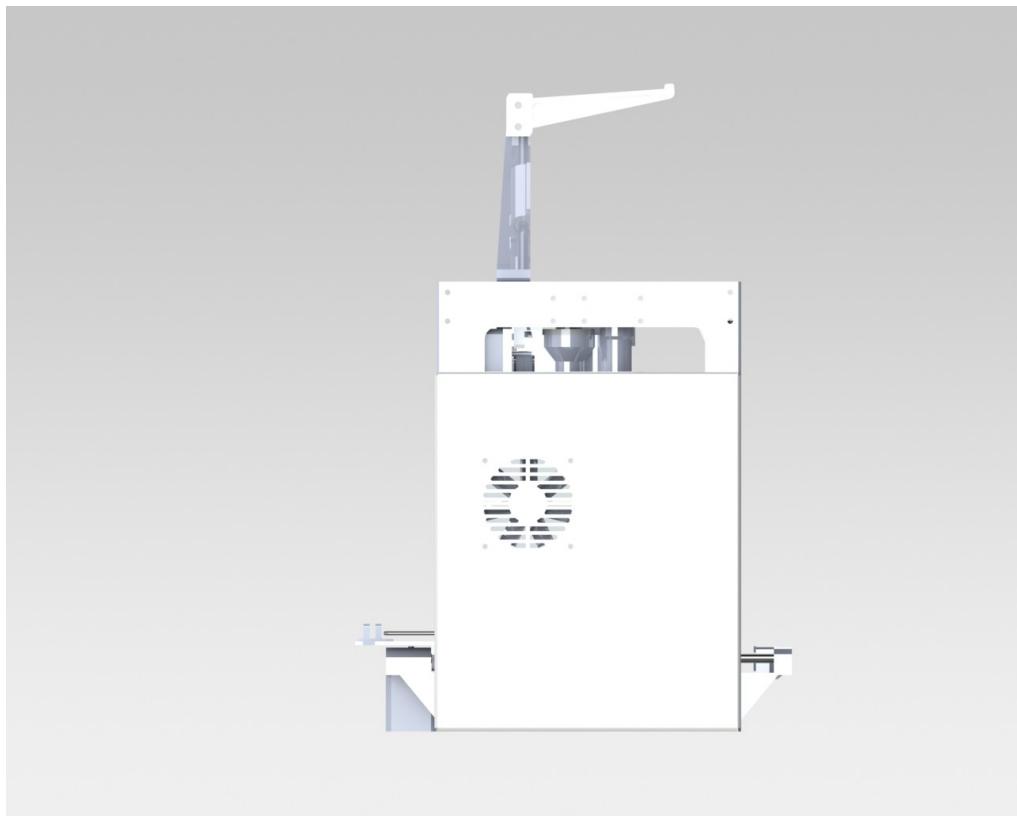


Figure 3.4: Begonia Left Render

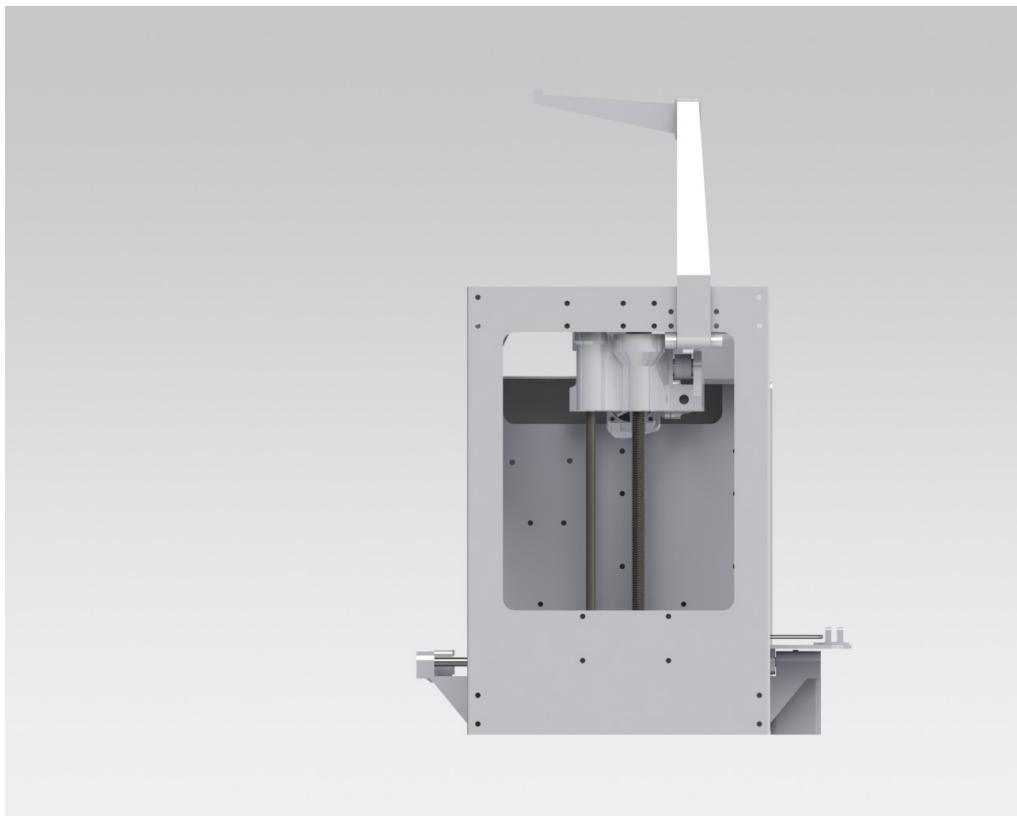


Figure 3.5: Begonia Right Render

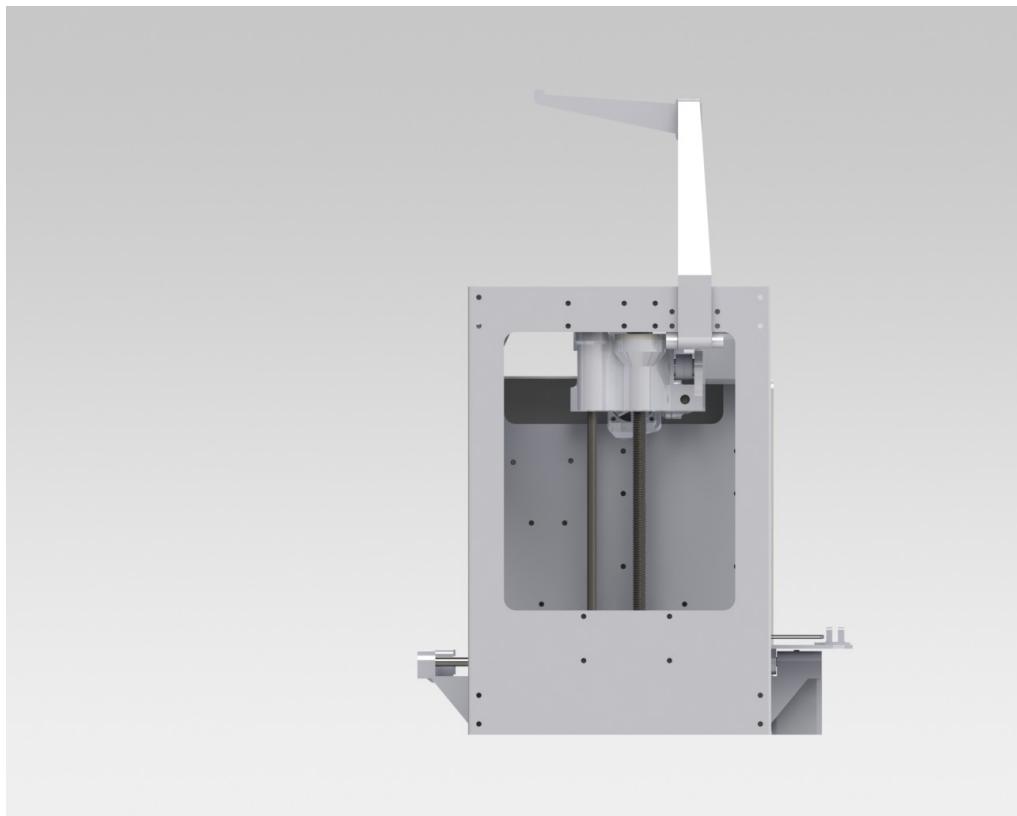


Figure 3.6: Begonia Right Render

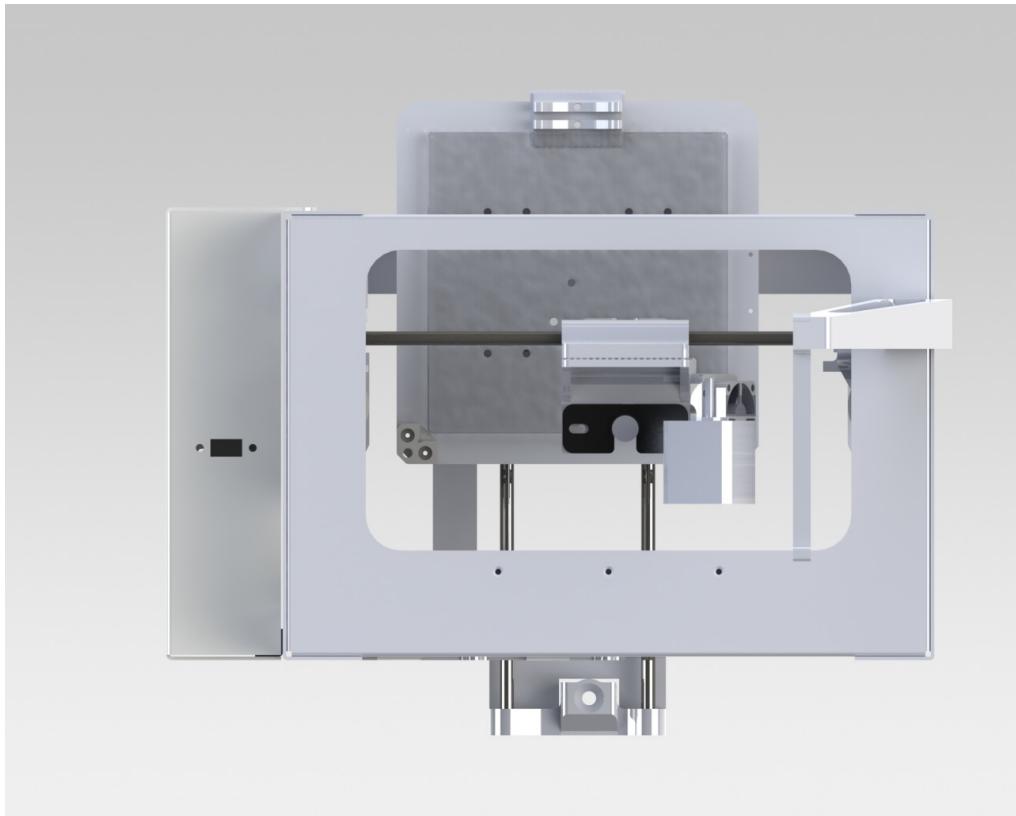


Figure 3.7: Begonia Top Render

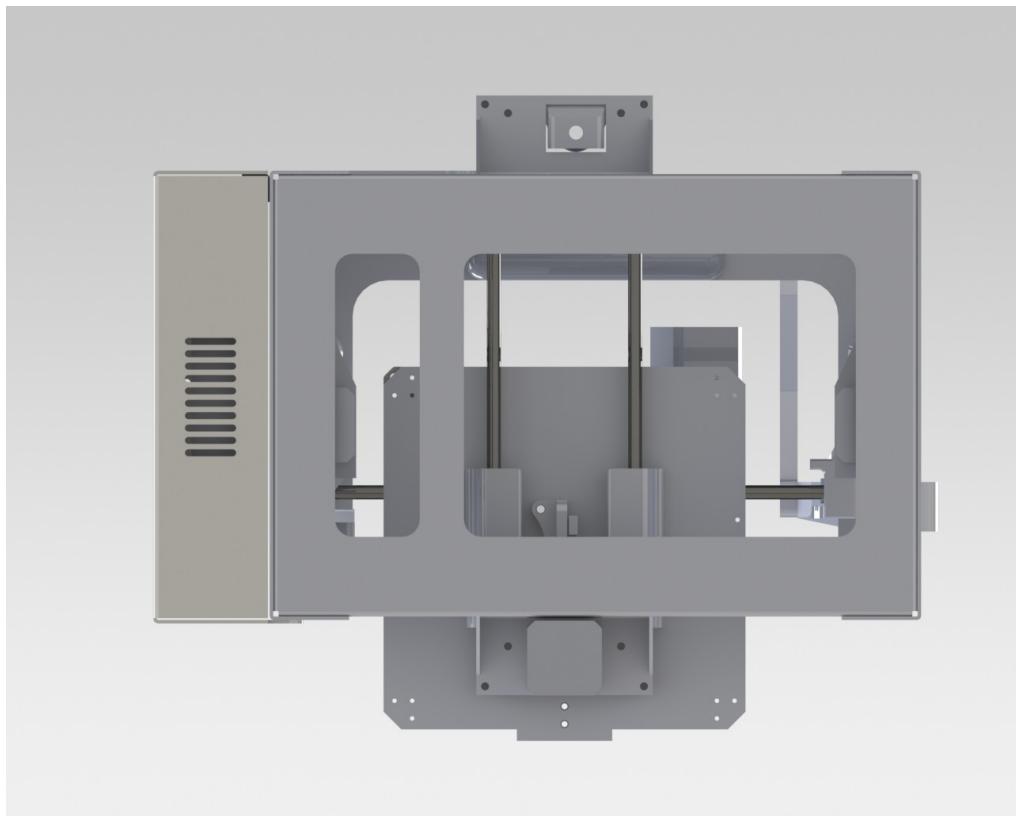


Figure 3.8: Begonia Bottom Render

3.4 Begonia 3D Printed Parts

3.5 Begonia Bed

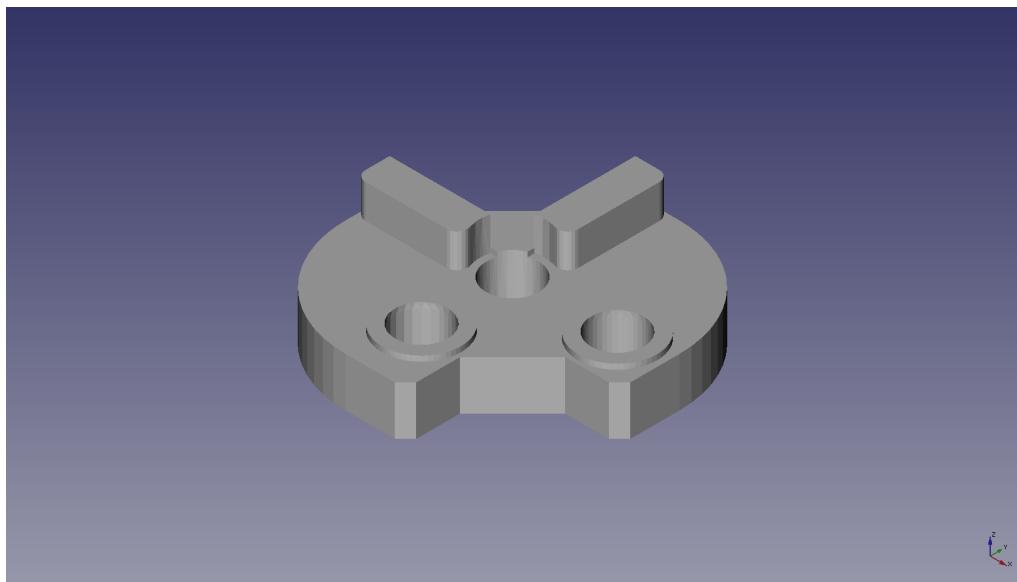


Figure 3.9: Begonia 3D Printed Bed Corner Render

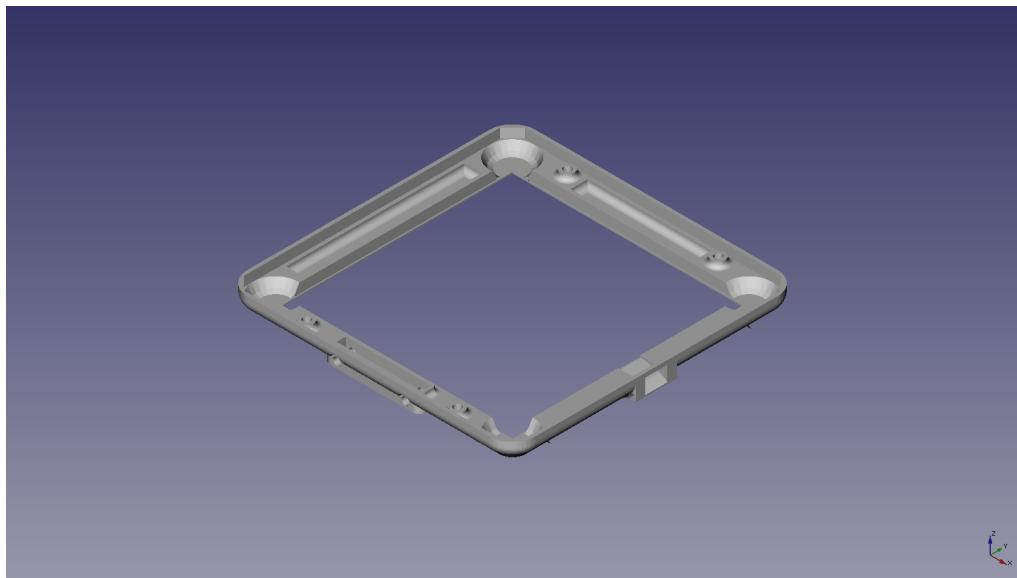


Figure 3.10: Begonia 3D Printed Bed Cover Render

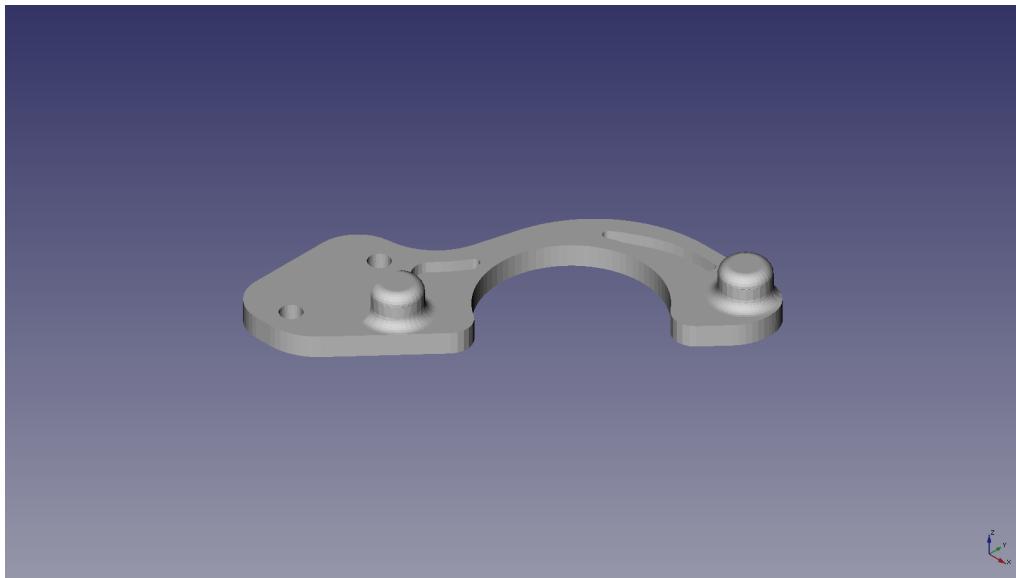


Figure 3.11: Begonia 3D Printed Bed Fan Mount Render

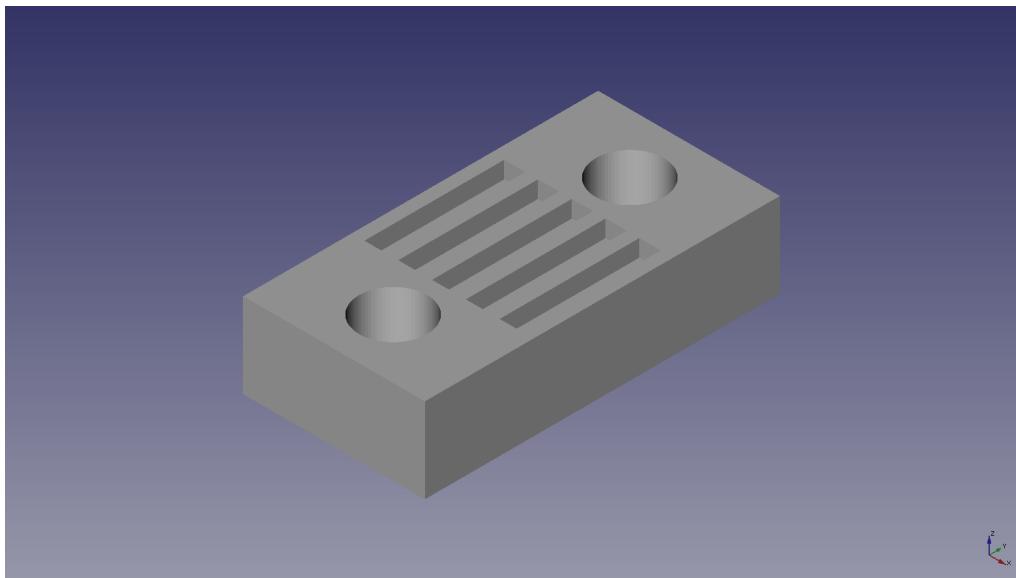


Figure 3.12: Begonia 3D Printed Belt Clamp Render

3.6. BEGONIA EXTRUDER

3.6 Begonia Extruder

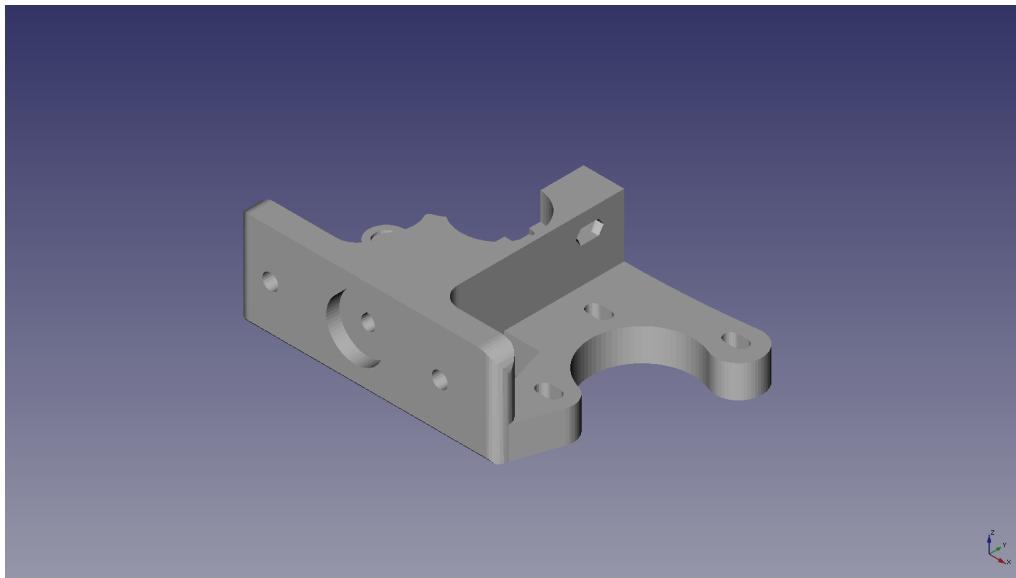


Figure 3.13: Begonia 3D Printed Extruder Body Hex Render

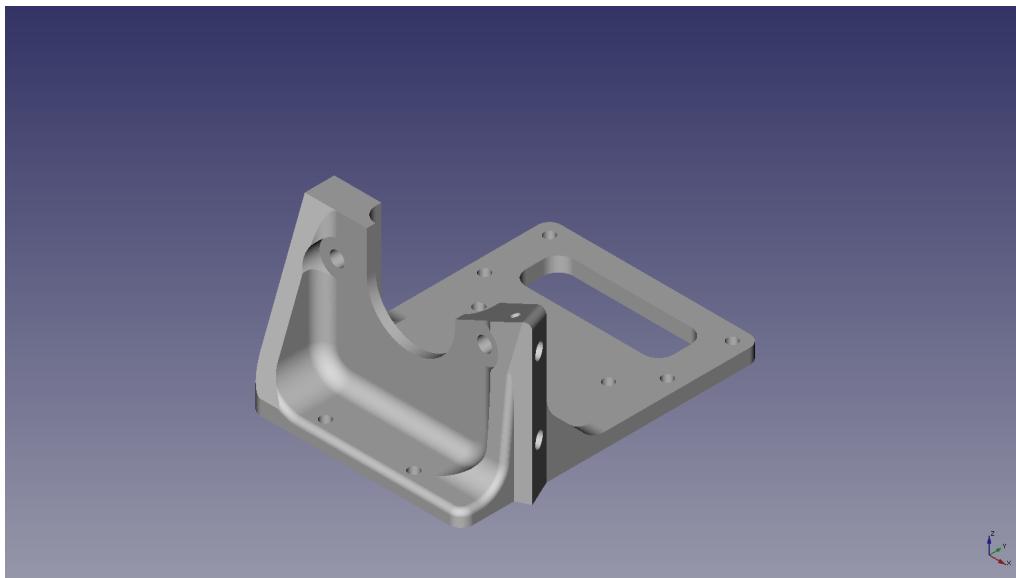


Figure 3.14: Begonia 3D Printed Extruder Mount Render

3.7 Begonia LCD

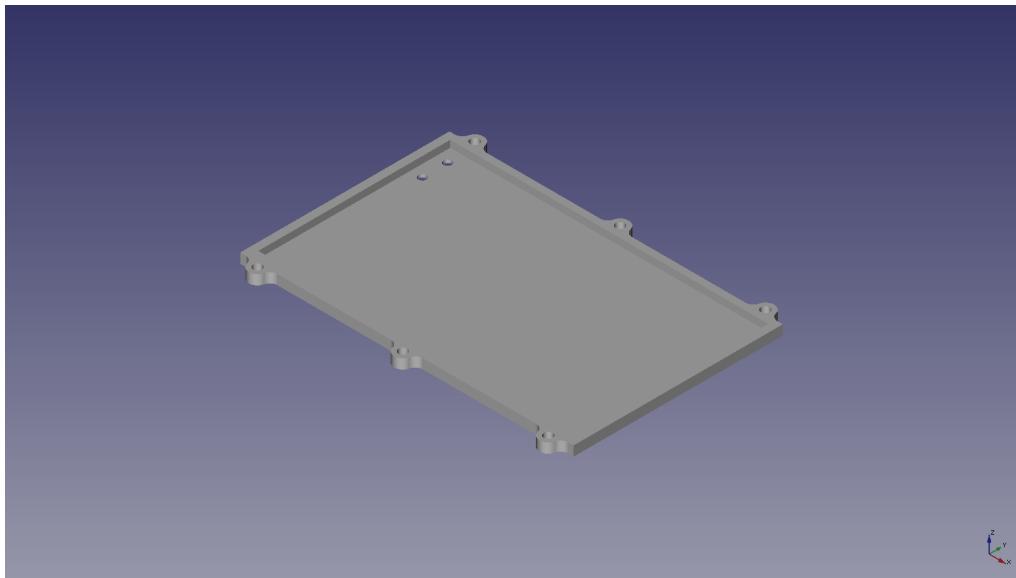


Figure 3.15: Begonia 3D Printed LCD Back Cover Render

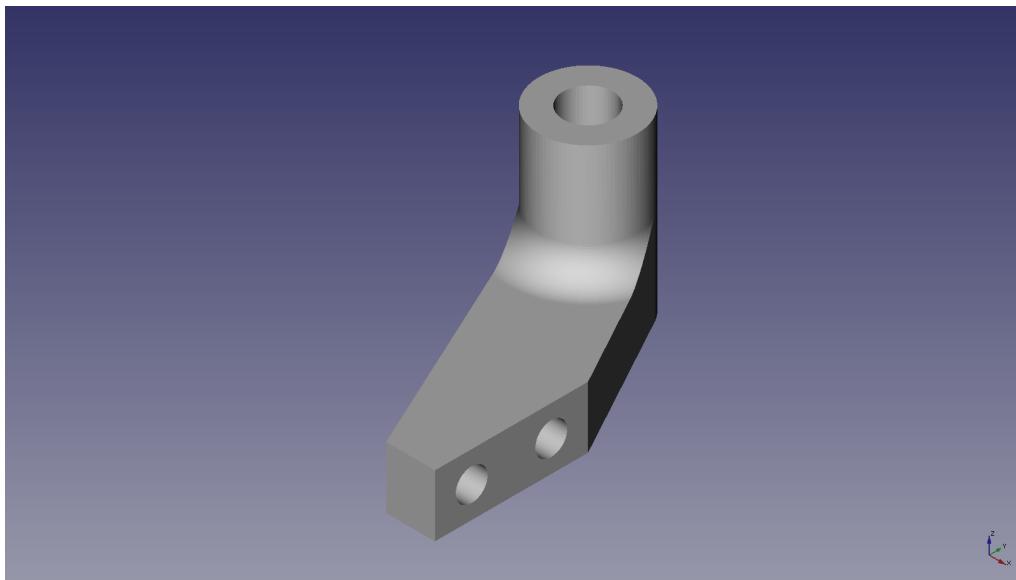


Figure 3.16: Begonia 3D Printed LCD Catch Render

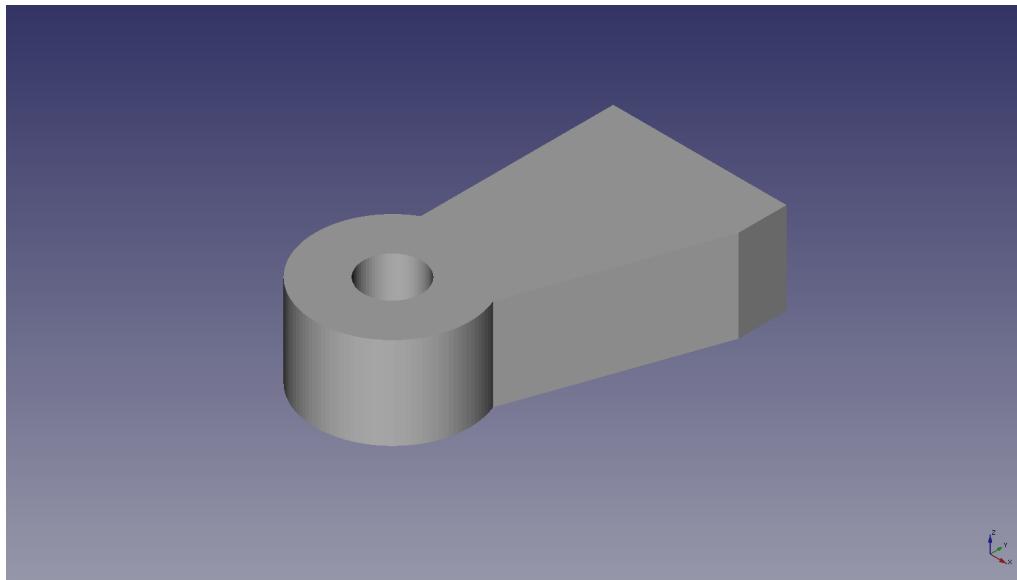


Figure 3.17: Begonia 3D Printed LCD Hinge Render

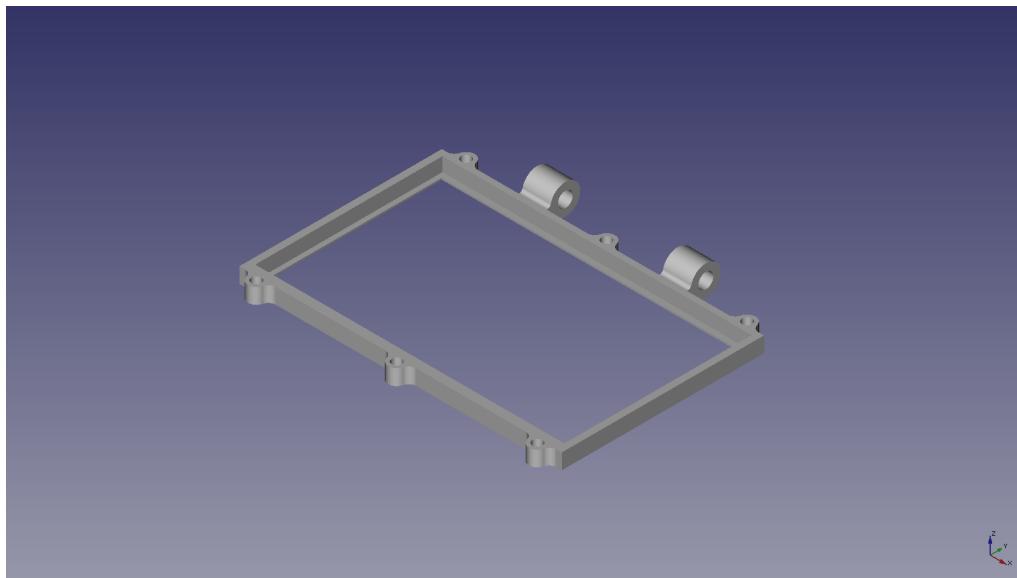


Figure 3.18: Begonia 3D Printed LCD Mount Render

3.8 Begonia Spool

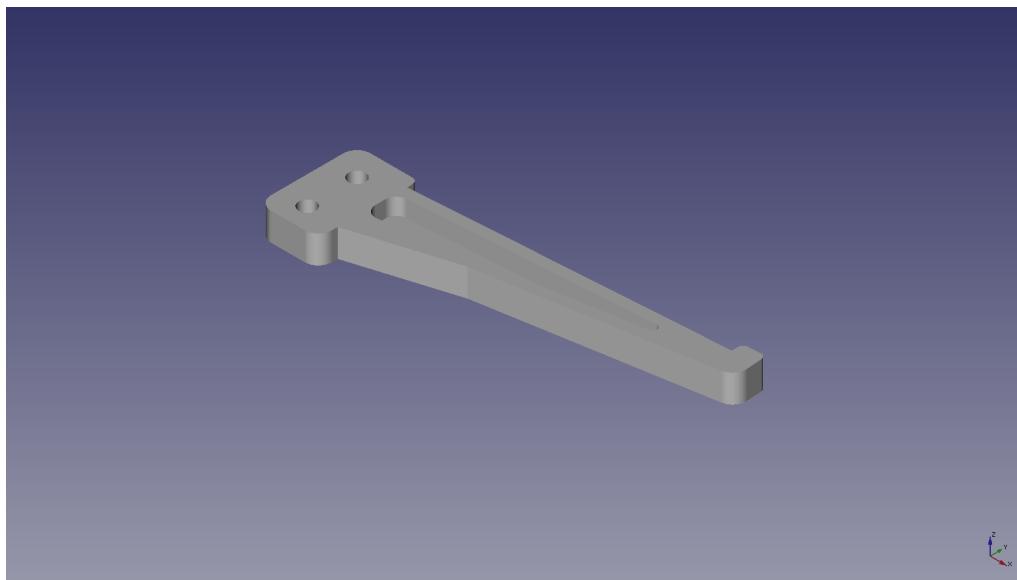


Figure 3.19: Begonia 3D Printed Spool Arm Render

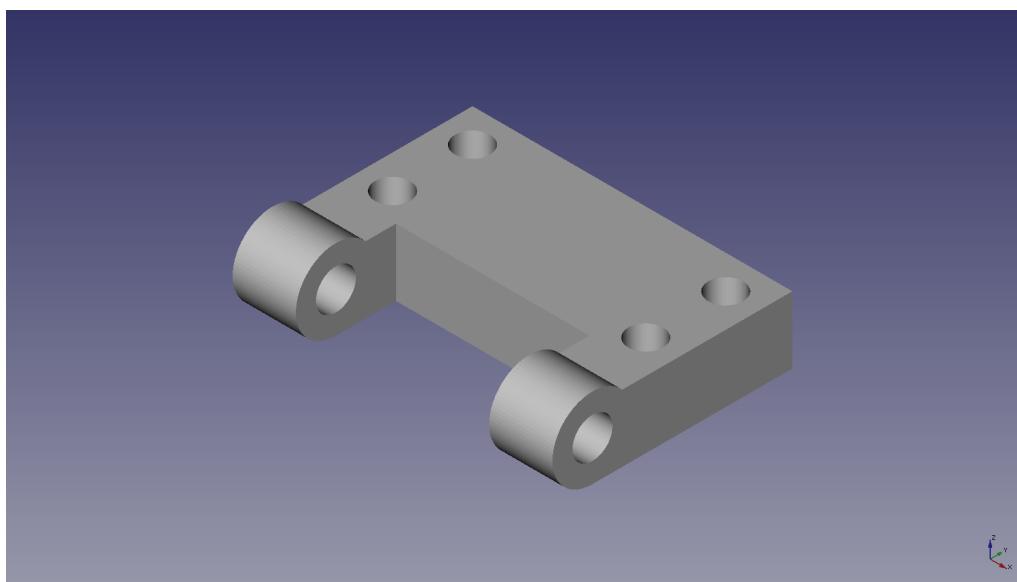


Figure 3.20: Begonia 3D Printed Spool Hinge Render

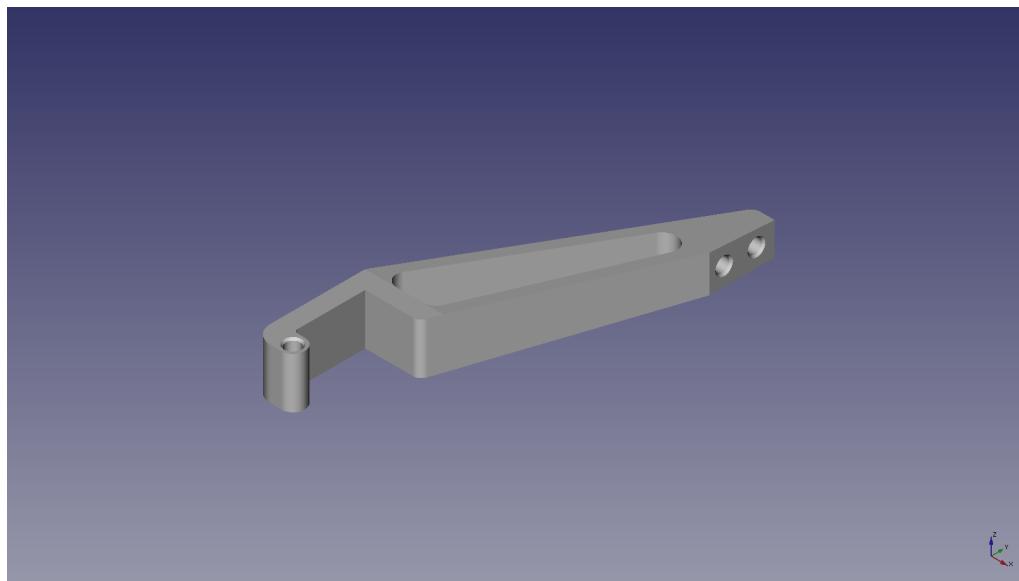


Figure 3.21: Begonia 3D Printed Spool Mount Render

3.9 Begonia X

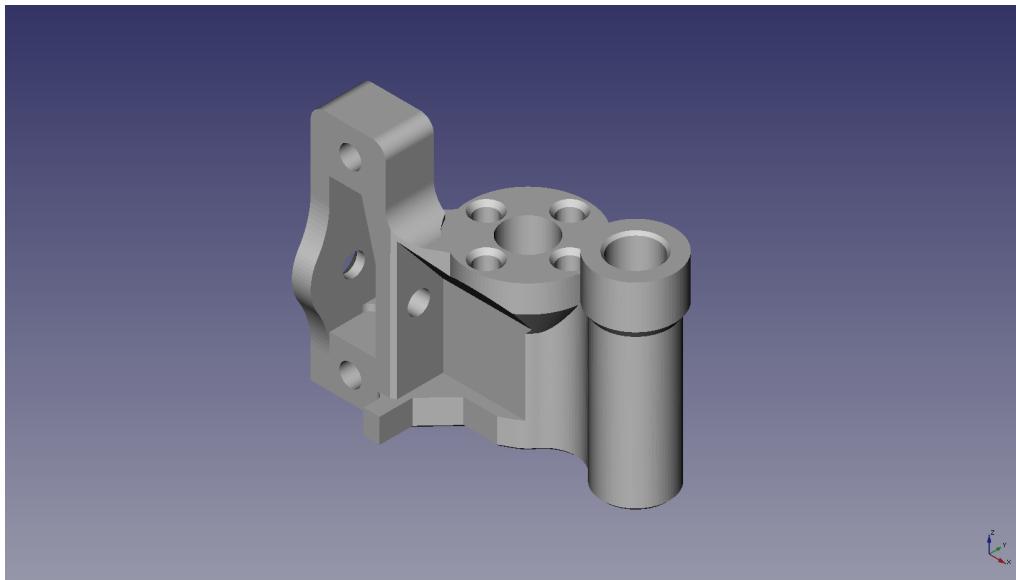


Figure 3.22: Begonia 3D Printed X End Idler Render

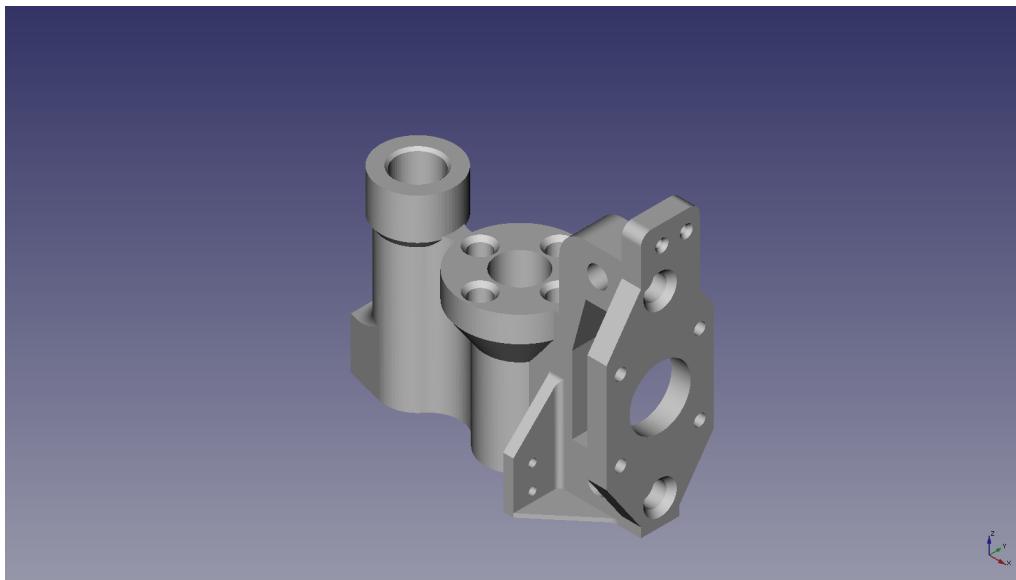


Figure 3.23: Begonia 3D Printed X End Motor Render

3.10 Begonia Y

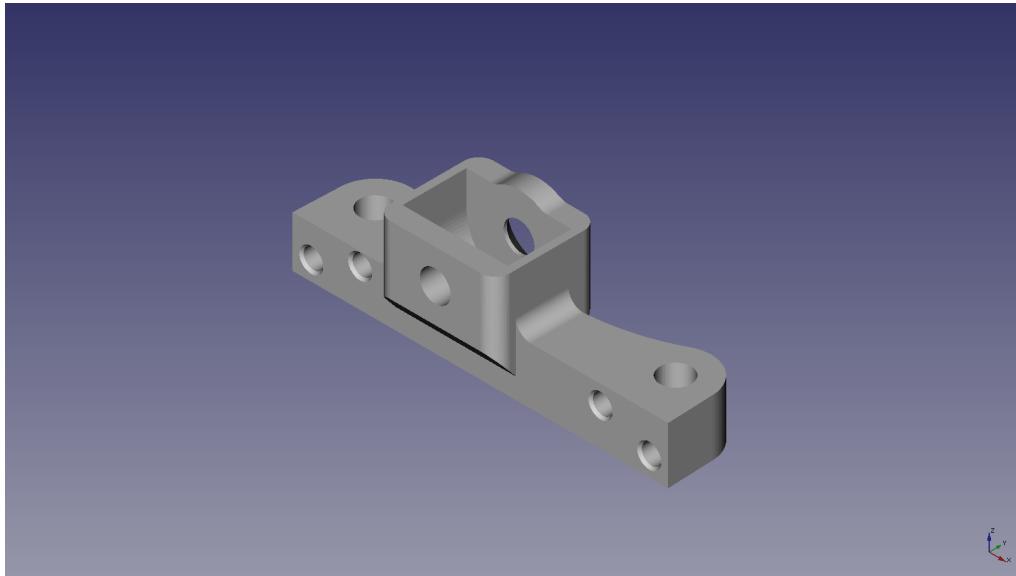


Figure 3.24: Begonia 3D Printed Y End Idler Render

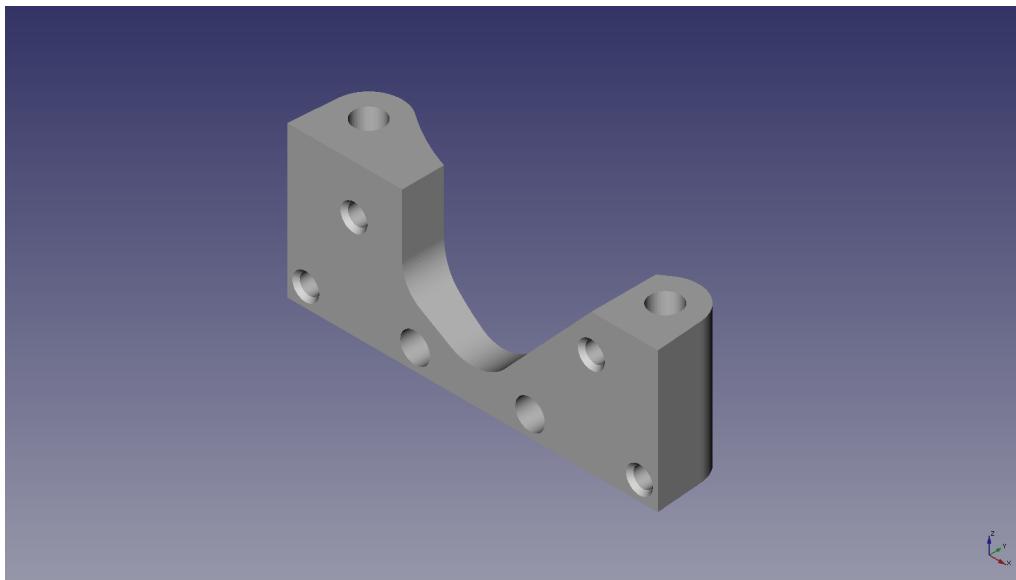


Figure 3.25: Begonia 3D Printed Y Rod Mount Render

3.11 Begonia Z

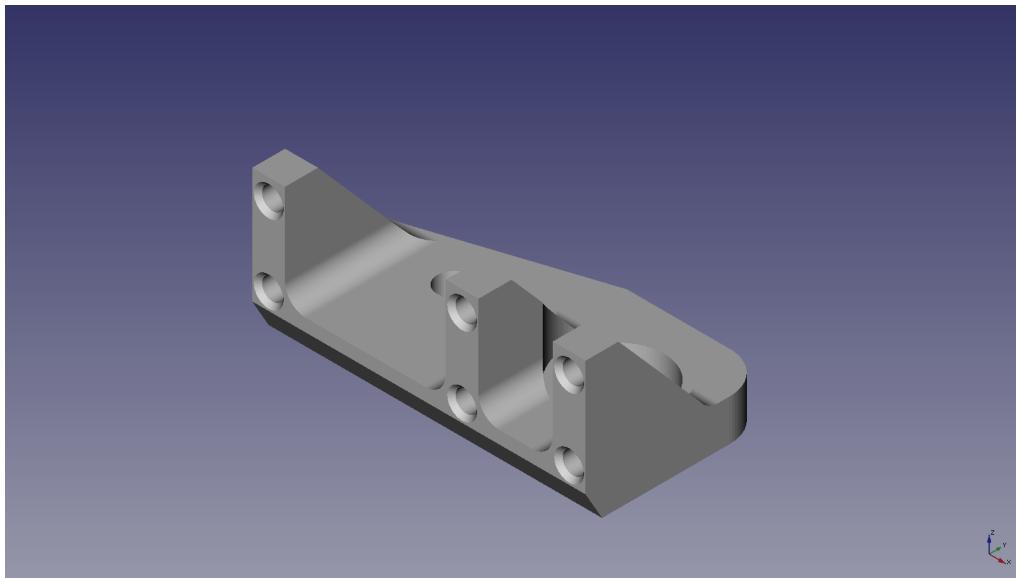


Figure 3.26: Begonia 3D Printed Upper Z Left Render

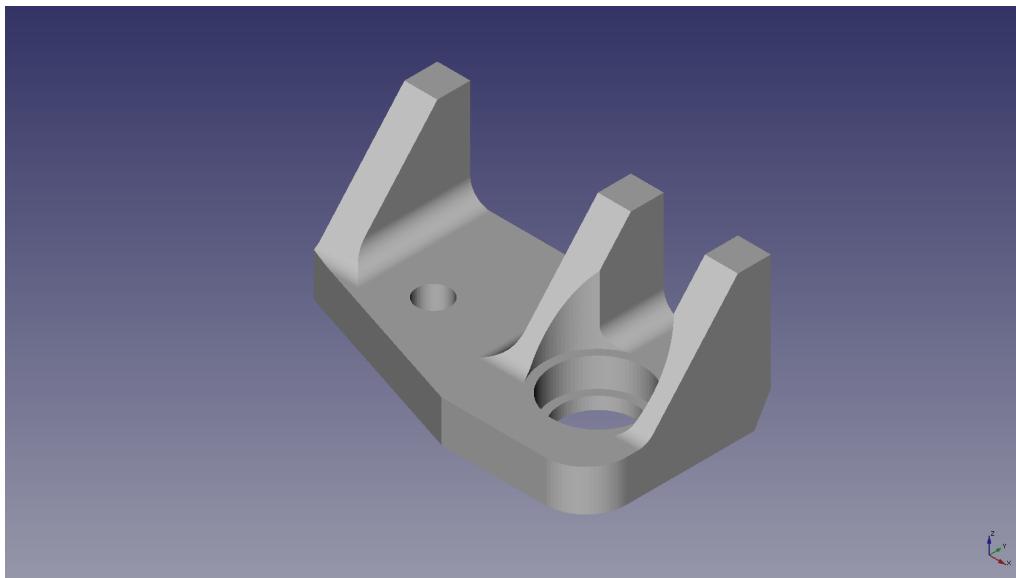


Figure 3.27: Begonia 3D Printed Upper Z Right Render

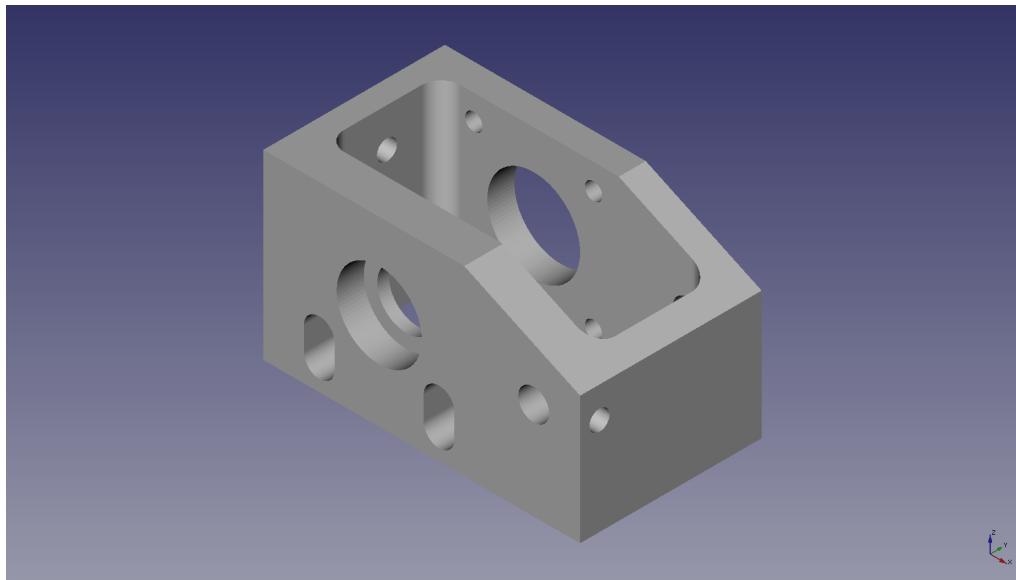


Figure 3.28: Begonia 3D Printed Lower Z Left Render

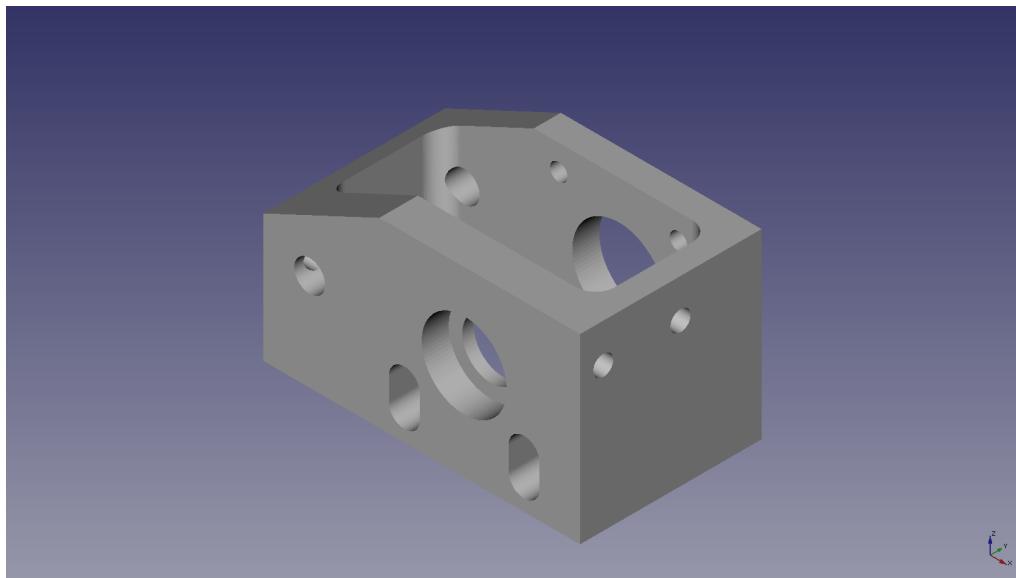


Figure 3.29: Begonia 3D Printed Lower Z Right Render

3.12 Begonia Misc

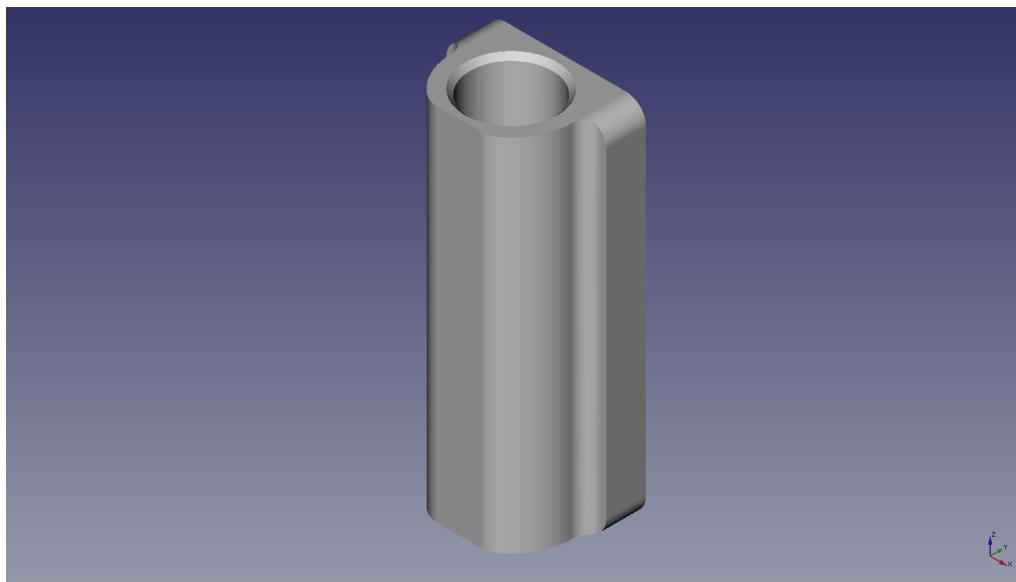


Figure 3.30: Begonia 3D Printed Double Bearing Holder Render

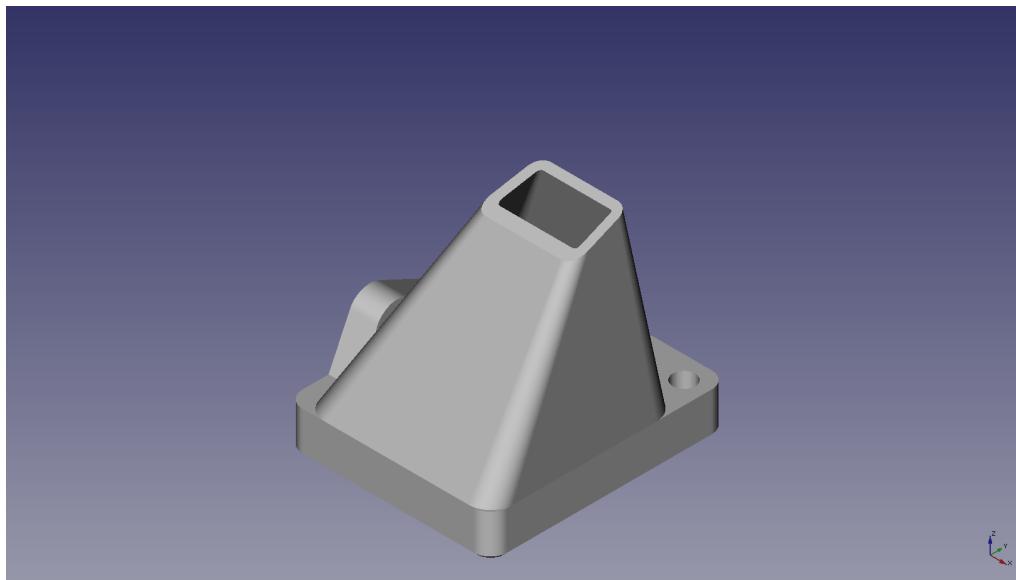


Figure 3.31: Begonia 3D Printed Fan Mount Render

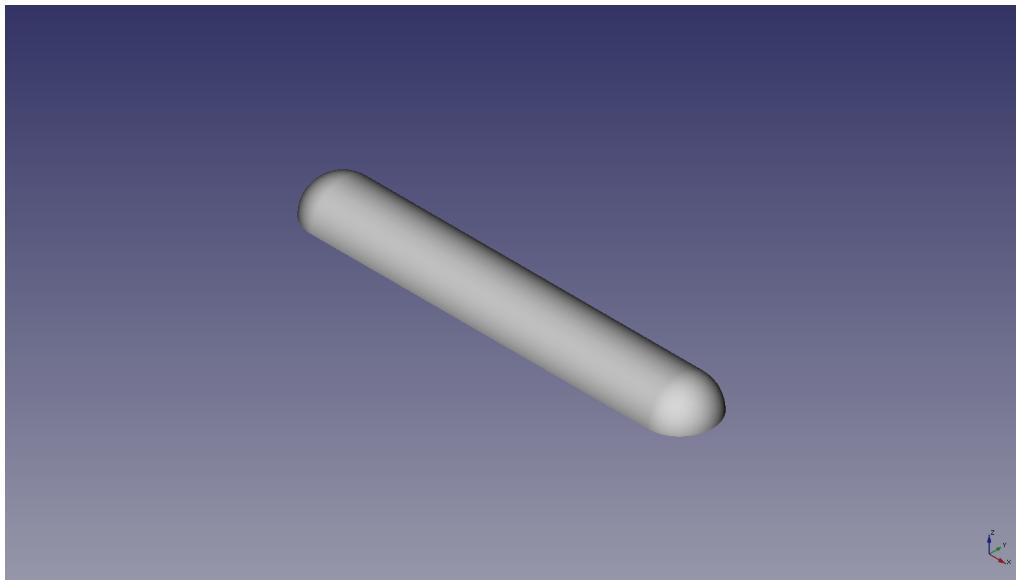


Figure 3.32: Begonia 3D Printed Handle Bar Render

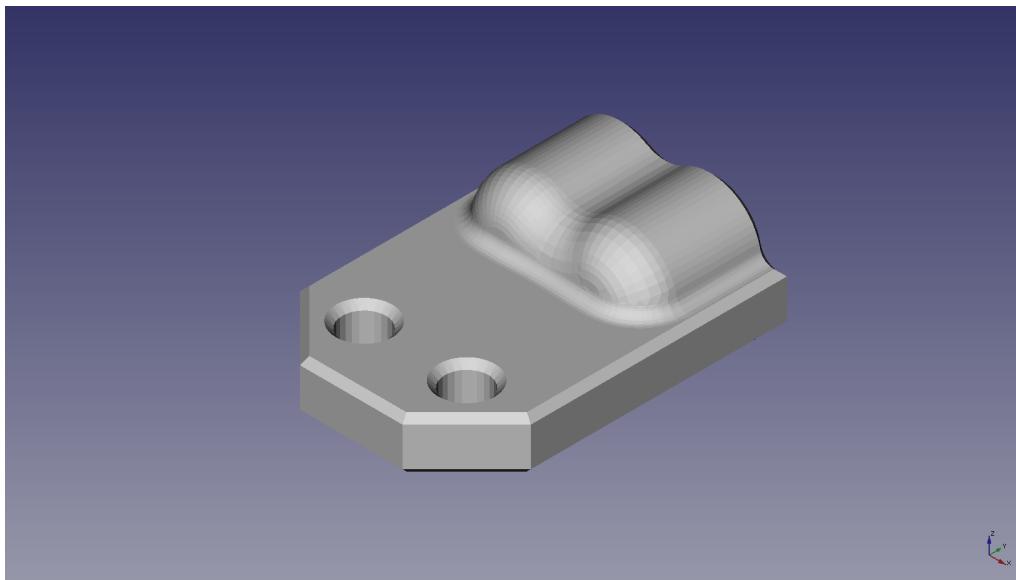


Figure 3.33: Begonia 3D Printed Cable Carrier Mount Render

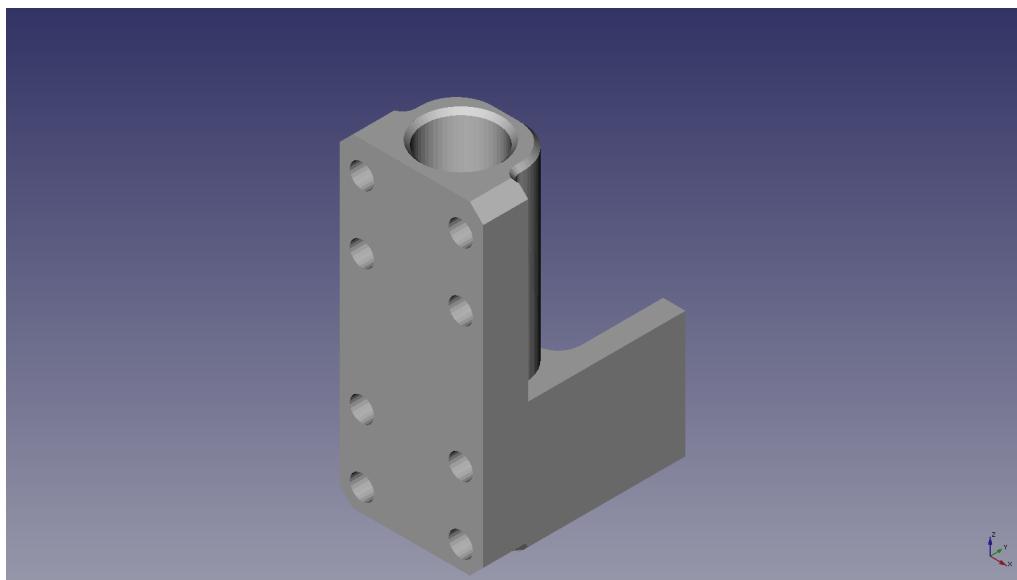


Figure 3.34: Begonia 3D Printed Extruder Mt Top Double Bearing Holder Render

3.13 Begonia Drawings

3.14 Camillia Drawings

Electrical

Power Supply, wiring

4.1 Electrical Layout

3D Printer Controller

Mini-RAMBo

5.1 Intro

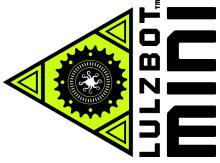
The printer controller will be the RAMBo-Mini.

Quality Assurance

Quality Assurance

6.1 Quality Assurance

Pack it well.



QUALITY ASSURANCE RECORD

Model: LulzBot Mini 1.0 3D Printer

Page 1 of 3

Serial Number: _____

Date Completed:
Tested by:

Configuration:

Electronics: Mini-RAMBo 1.0a

Firmware: Marlin for Mini 2014-Q4

Nozzle: 0.5mm diameter nozzle

Settings:

Stepper Motor	Steps/mm	Max Length	Microstep Mode	Digipot
X	100.5	155	16	175
Y	100.5	155	16	175
Z	1600	155	16	220
E0	833	NA	16	135

General:

- Are all the screws and zip ties tight?
- Are the current version of parts being used?
- Is the Spool Mount properly mounted so it flips up and sits securely?
- Is the Finger Clip properly mounted with the taller side on the left?
- Are the switches tight? They shouldn't wiggle side to side.
- Are all 4 rubber feet installed?
- Is the PEI tape free of bubbles and wrinkles?
- Is the heat bed adhesive smooth and consistent with no finger prints?

Y Axis:

- Does the Y bed move freely back and forth?
- Is the belt mounted in the correct orientation?
- Is the Y bed tight side to side from motion and twisting?
- Are all the screws on the bearing holders tight?
- Does the Y belt rub the bottom of the y-idler by the bearings?
- Is the Y pulley tight?
- Is one of the set screws on the Y pulley aligned with the flat on the motor shaft?
- Are both pulley set screws tightened?
- Is the level of the Y pulley at the same height as where the belt mounts on the belt holder?
- Is the Y belt tight?
- Are the four bed leveling washers tight?
- Are the belts trimmed far enough to not interfere with the pulley or bearing?



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QUALITY ASSURANCE RECORD

X Axis:

- Is the X pulley tight?
- Is one of the set screws on the X pulley aligned with the flat on the motor shaft?
- Are both pulley set screws tightened?
- Is the belt mounted in the correct orientation?
- Is the belt free from rubbing anywhere during motion?
- Is the X belt tight?
- Does the X axis move freely end to end?
- Are the X bars flush with the right side?
- Are the set screws that hold the X bars tight?
- Are the belts trimmed far enough to not interfere with the pulley or bearing?

Z Axis:

- Do the Z drive rods rotate smoothly with no up and down movement between the bearings?
- Are the set screws that hold the Z bars tight?
- Are the coupler set screws tight?
- Are the drive rods and motor shafts aligned so the couplers are not bent?

Extruder:

- Can you adjust the extruder springs?
- Are the V grooves on the extruder gears lined up?
- Is the extruder mount secure on the X carriage?
- Is the extrusion fan mounted correctly?
- Is the extruder blower mounted correctly?
- Does the idler bearing stick out of the idler block?
- Is the hobbing aligned to the hole in the extruder?
- Is the set screw in the small gear tight and on the flat of the motor shaft?
- Can you feed filament about 100mm from the top of the extruder?
- Are the gears tight with no back-lash?
- Do the extruder gears turn smoothly for several rotations?

Electronics:

- Are all connections to the Mini-Rambo plugged in correctly?
- Can you plug in USB cable from the outside of the enclosure?
- Is the case fan plugged in?
- Are all cables free from contacting any moving parts?



QUALITY ASSURANCE RECORD

Page 3 of 3

Test and Verification Results:

- Verify case fan is running.
- Verify extruder blower is running.
- Verify control of the extrusion fan.
- Nozzle temperature control verified.
- Nozzle re-tightened during first heat cycle.
- Extruder control verified.
- X, Y, and Z min and max stop switches verified.
- X and Y homing are making contact with bed leveling washer.
- Bed leveling is functioning properly.
- Bed temperature control verified.
- Bearing conditioning complete.
- X, Y, and Z motion smooth over full range and speeds.
- Test print (Rocktopus^{*}) successful.
- Print head moved to shipping position.

^{*}Rocktopus by Kent Johnson is licensed under CC BY-SA 4.0 and derived from work by dietzl and yeoldebian - lulzbot.com/rocktopus



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Packing

If It Shakes It Breaks

7.1 Packing List

Pack it well.



PACKING LIST

Model: LulzBot Mini 1.0 3D Printer

Serial Number: _____

Date Completed: _____

Completed by: _____

Items to include:

Printer and Cables:

- LulzBot Mini 1.0 3D printer
- 6ft 18AWG Power Cord Cable (5279)
- 6ft 18AWG England Power Cord Cable (7691) (If applicable)
- 6ft 18AWG European Power Cord Cable (7692) (If applicable)
- USB cable

Supplies:

- USB drive with source files
- 3 meter sample of LulzBot HIPS 3D printer filament
- Dental pick
- Brush
- Clam knife
- 5x replacement wiping pads

Final Print:

- Rocktopus* printed by this LulzBot Mini 3D Printer

Documentation:

- Quick Start Guide
- Quality Assurance Record document
- Packing List document



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Contact

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8.1 Support

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Phone: +1-970-377-1111 x610

LulzBot Forum

<http://forum.lulzbot.com>

8.2 Sales

Email: sales@alephobjects.com

Phone: +1-970-377-1111 x600

8.3 Websites

Aleph Objects, Inc.

<http://www.alephobjects.com>

LulzBot 3D Printers

<http://www.lulzbot.com>

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