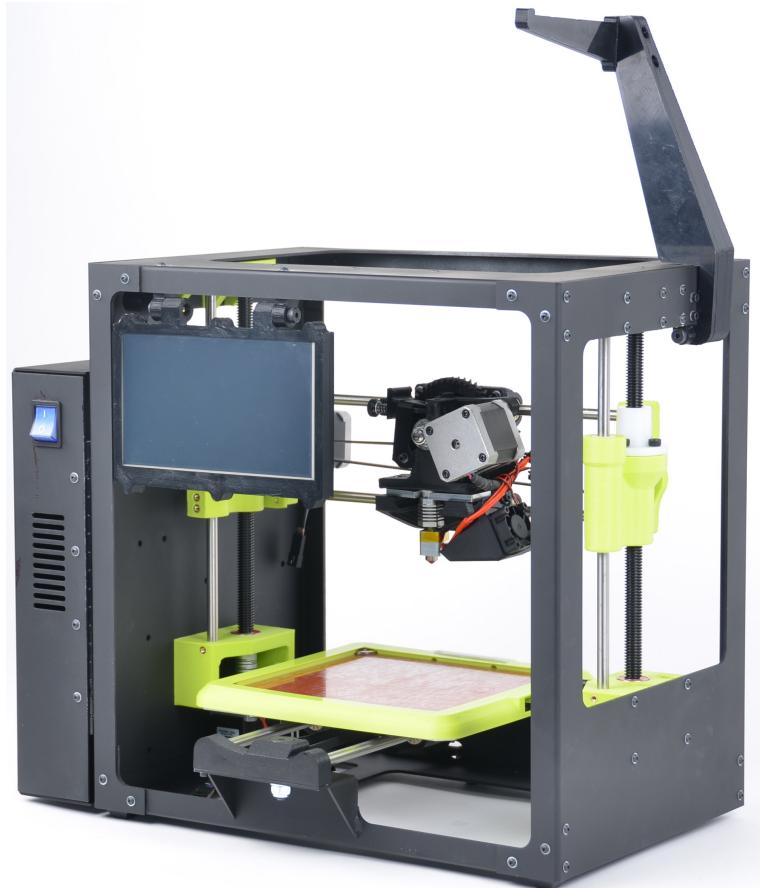


LULZBOT MINI DEVELOPER'S GUIDE



LulzBot Mini Developer's Guide

by Aleph Objects, Inc.

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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

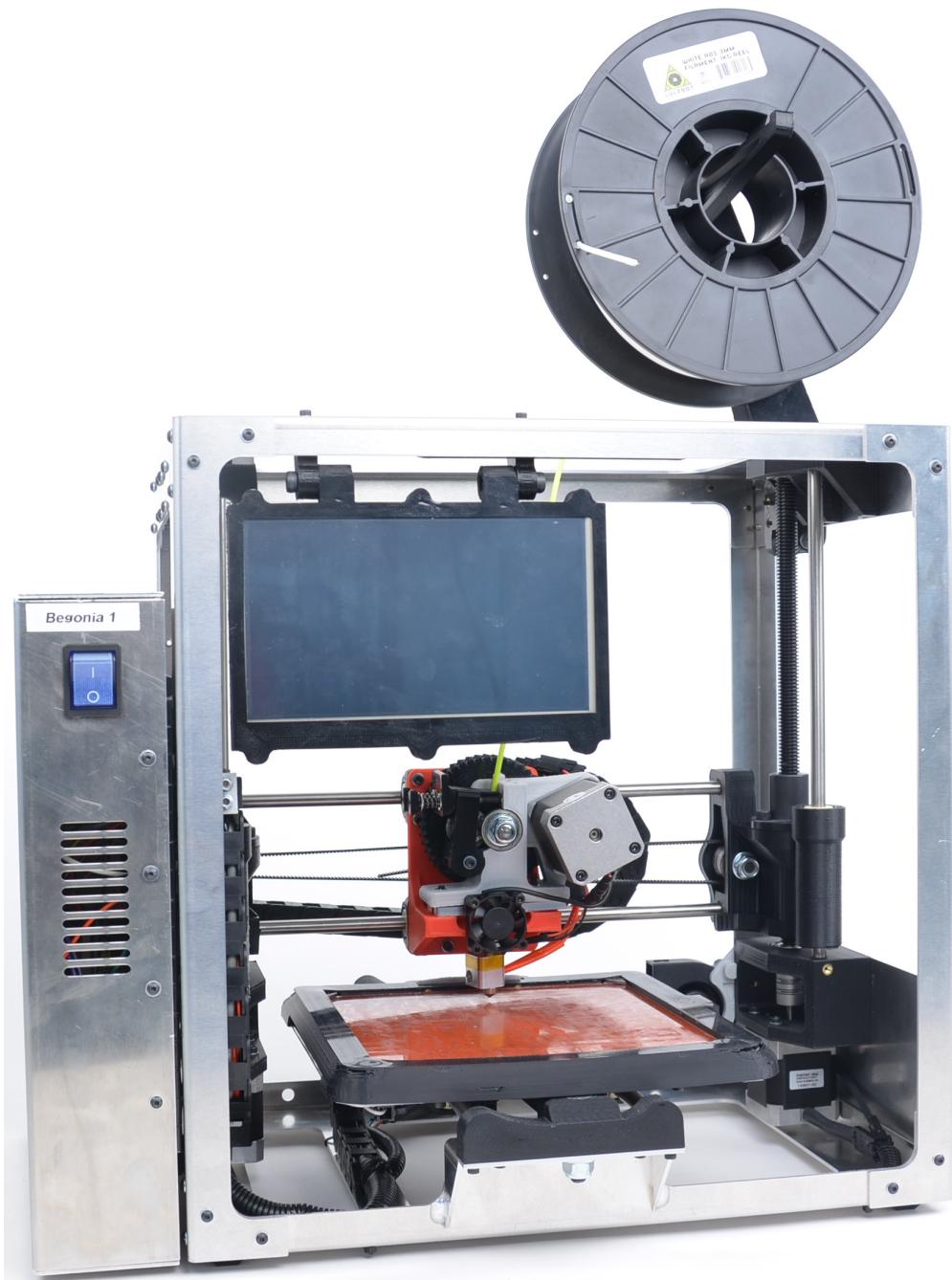


Figure 1.1: Begonia Front Photo

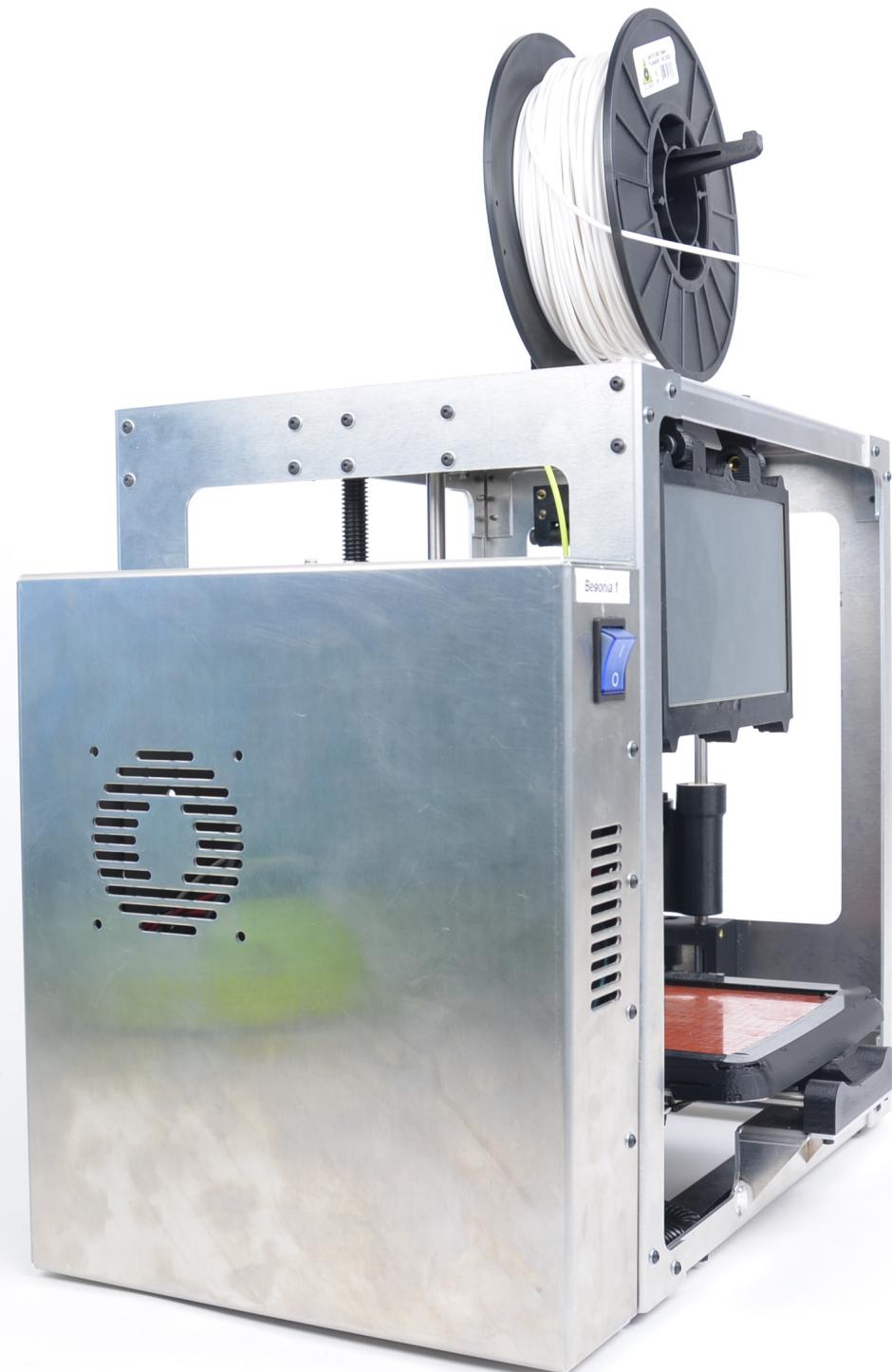


Figure 1.2: Begonia Left Photo

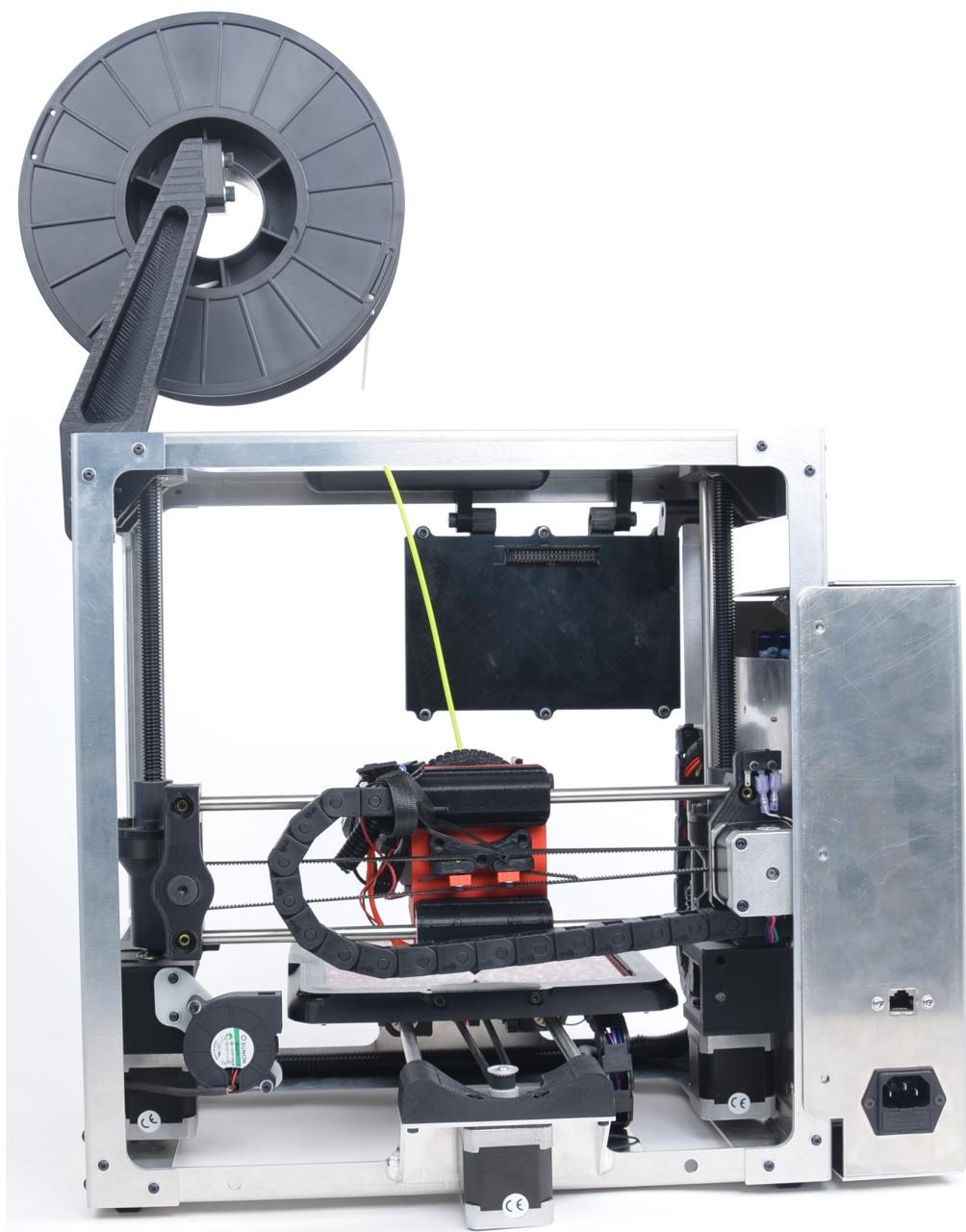


Figure 1.3: Begonia Back Photo

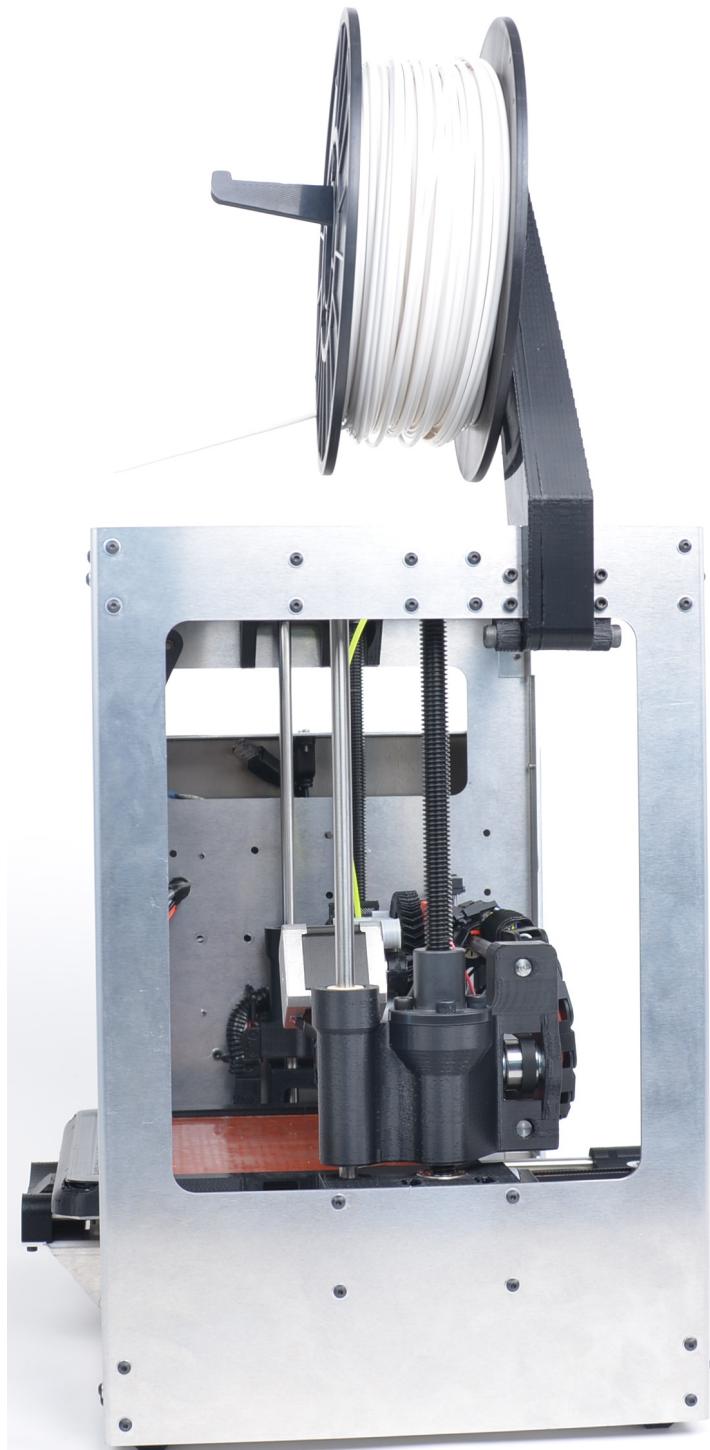


Figure 1.4: Begonia Right Photo

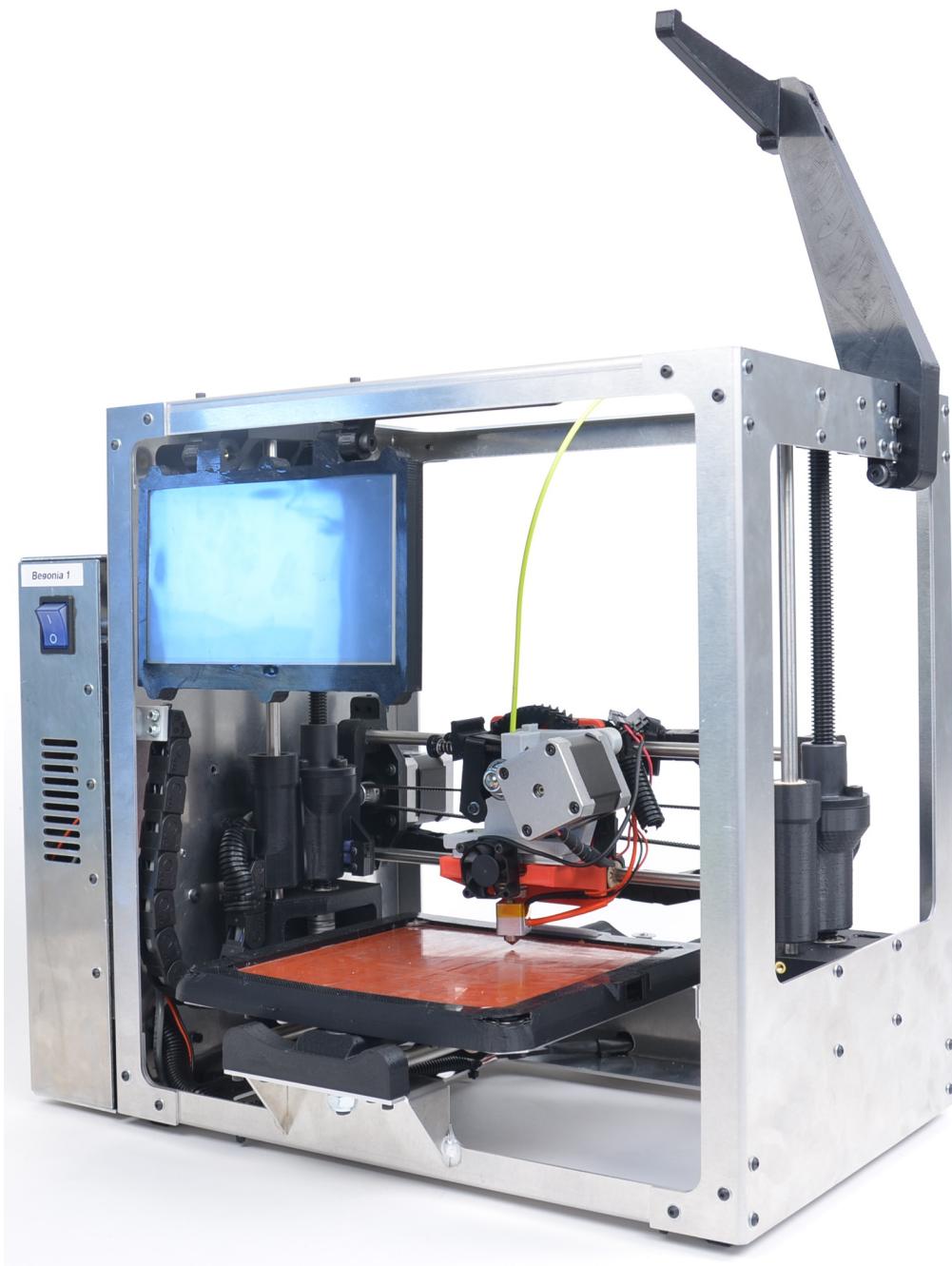


Figure 1.5: Begonia Spool Arm Up Photo

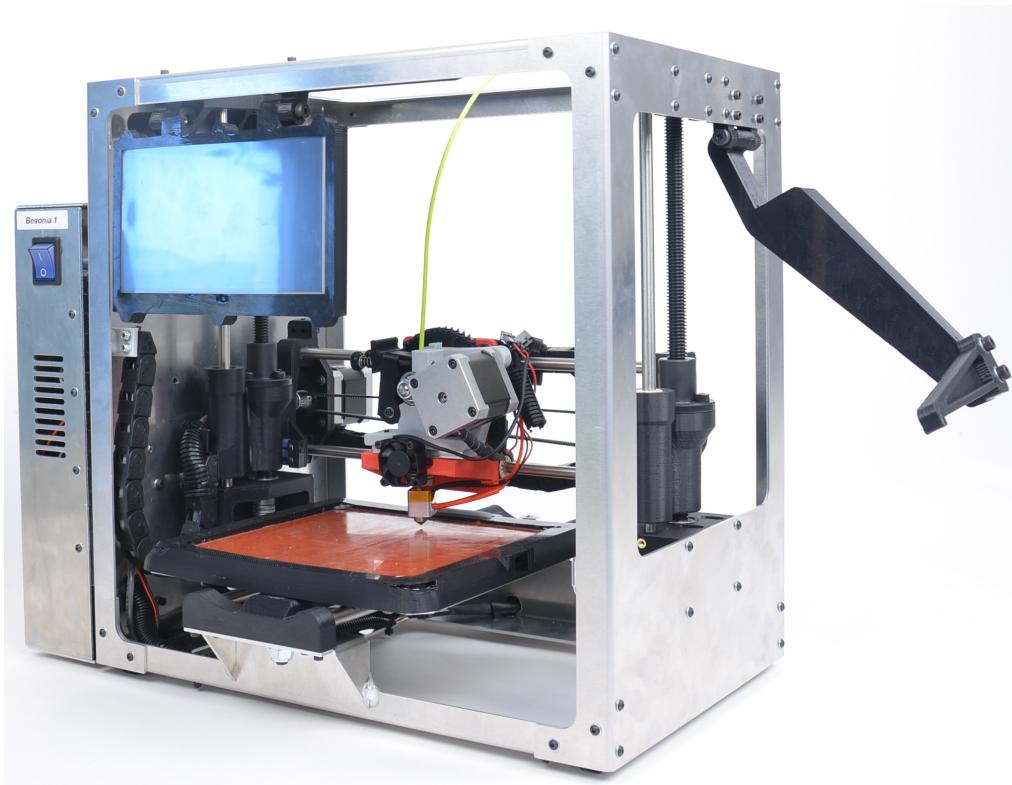


Figure 1.6: Begonia Spool Arm Down Photo



Figure 1.7: Begonia Green Color Scheme Photo

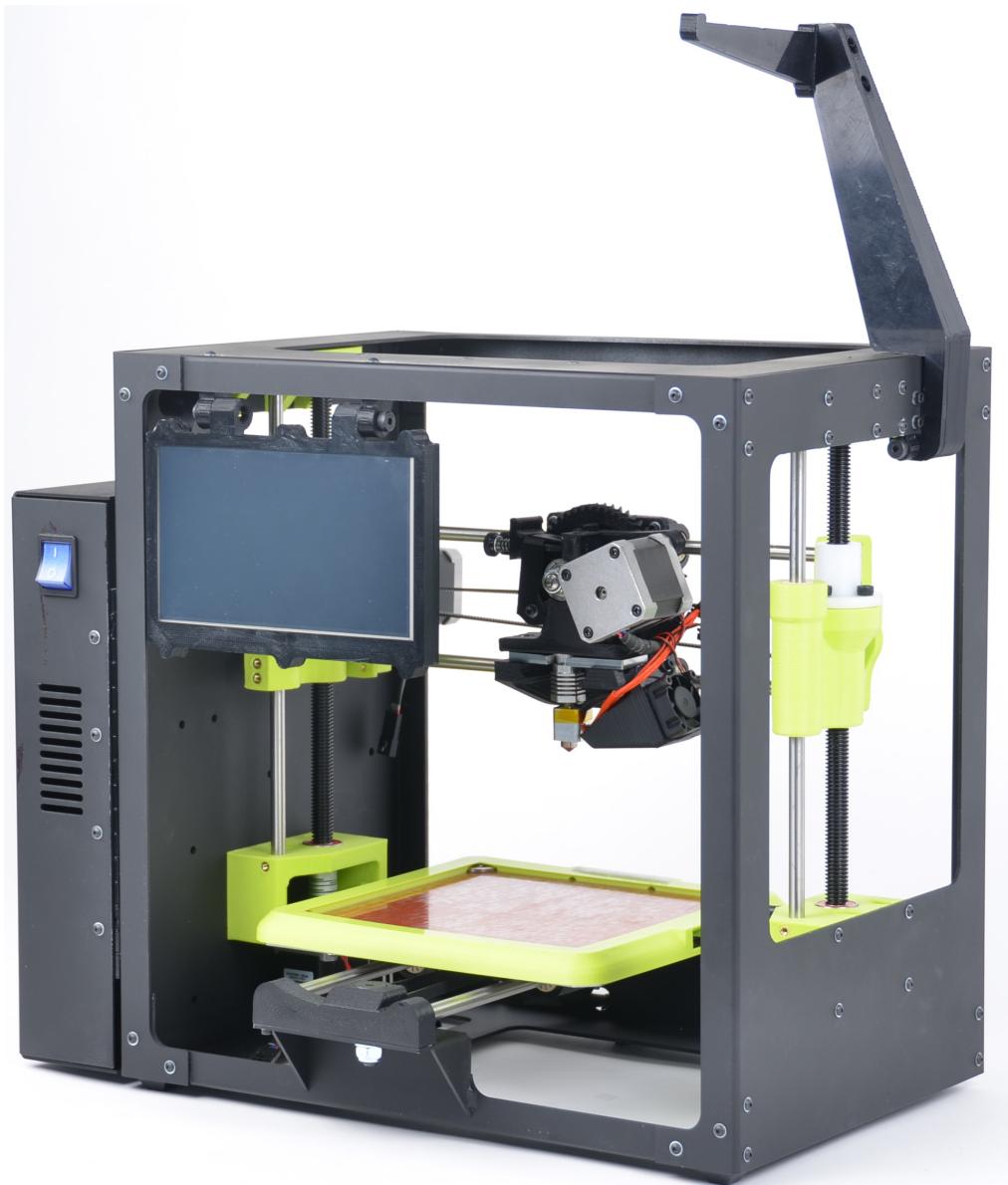


Figure 1.8: Begonia Black Green Color Scheme Photo

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.

Category	AO Part #	Description	Manufacturer	Manufacturer PN	Distributor	SKU	Distributor co	Advanced Antivibration co	Distributor	SKU	Qty Per	UOM	Price Per Unit	Price Total	Qty to Order
Hardware	HD-MS054	Square Bumper									2	ea	\$0.09	\$0.35	42 Sheets of 98
Printed	PP-GP0189	Double bearing holder v1.2, Mini	Aleph Objects								1	ea	\$3.00	\$6.02	
Printed	PP-GP0188	Upper bearing holder v1.1, Mini	Aleph Objects								1	ea	\$3.30	\$3.30	
Printed	PP-GP0187	X carriage cover v2.3, Mini	Aleph Objects								1	ea	\$1.750	\$1.75	
Printed	PP-GP0191	Herringbone Large Gear, Lulzbot green	Aleph Objects								1	ea	\$2.230	\$2.23	
Printed	PP-GP0192	Herringbone Small Gear, Lulzbot green	Aleph Objects								1	ea	\$0.290	\$0.29	
Printed	PP-GP0060	Wade Reloaded Bearing Washer	Aleph Objects								1	ea	\$0.020	\$0.02	
Printed	PP-GP0186	Wade extruder body for Hex nozzle v1.0	Aleph Objects								1	ea	\$3.790	\$3.79	
Printed	PP-GP0059	Wade Reloaded idle Block	Aleph Objects								1	ea	\$0.900	\$0.90	
Printed	PP-GP0091	extruder_latch	Aleph Objects								1	ea	\$0.260	\$0.26	
Printed	PP-GP0185	X end idler v2.3, Mini	Aleph Objects								1	ea	\$7.870	\$7.87	
Printed	PP-GP0184	Extruder mount v2.4, Mini	Aleph Objects								1	ea	\$3.690	\$3.69	
Printed	PP-GP0183	X carriage v1.0, Mini	Aleph Objects								1	ea	\$5.150	\$5.15	
Printed	PP-GP0182	X end motor v1.6, Mini	Aleph Objects								1	ea	\$8.740	\$8.74	
Printed	PP-GP0181	Beltmount v1.0, Mini	Aleph Objects								1	ea	\$1.260	\$1.26	
Printed	PP-GP0179	Z upper left v1.2, Mini	Aleph Objects								1	ea	\$3.010	\$3.01	
Printed	PP-GP0180	Z upper right v1.2, Mini	Aleph Objects								1	ea	\$3.010	\$3.01	
Printed	PP-GP0177	Z lower left v1.1, Mini, Lulzbot green	Aleph Objects								1	ea	\$5.150	\$5.15	
Printed	PP-GP0178	Z lower right v1.1, Mini, Lulzbot green	Aleph Objects								1	ea	\$7.090	\$7.09	
Printed	PP-GP0176	Bed corner v2.2, Mini	Aleph Objects								1	ea	\$1.070	\$1.07	
Printed	PP-GP0175	Bed corner v1.2, Mini	Aleph Objects								1	ea	\$2.230	\$2.23	
Printed	PP-GP0174	Y idle mount v1.1, Mini	Aleph Objects								1	ea	\$0.310	\$0.31	
Printed	PP-GP0173	Y rod mount v1.1, Mini	Aleph Objects								1	ea	\$0.870	\$0.87	
Printed	PP-GP0172	Spool hinge v1.3, Mini	Aleph Objects								1	ea	\$1.550	\$1.55	
Printed	PP-GP0171	Spool arm v1.0, Mini	Aleph Objects								1	ea	\$7.090	\$7.09	
Printed	PP-GP0170	Spool mount v1.2, Mini	Aleph Objects								1	ea	\$2.040	\$2.04	
Printed	PP-GP0169	Handle bar v2.4, Mini	Aleph Objects								1	ea	\$0.680	\$0.68	
Printed	PP-GP0168	Wiper mount v1.0, Mini	Aleph Objects								1	ea	\$1.170	\$1.17	
Printed	PP-GP0167	Fan Mount v1.3, Mini	Aleph Objects								1	ea	\$0.190	\$0.19	
Mechanical	HD-MS0211	Lower relief v1.0, Mini	Alien Scientific								1	ea	\$7.750	\$7.75	
Mechanical	HD-MS0227	Bonoblock Glass Bed 170mm x 170mm	Associated Spring								2	ea	\$0.27	\$0.27	
Mechanical	HD-BL0015	Spring, Extruder, 6mm OD, 0.8mm WD, 9.7mm FL	B & B Manufacturing, Inc								2	ea	\$3.440	\$6.88	
Mechanical	HD-MS0033	GT2 Timing Pulley, 5mm Bore Aluminum	IM6-CAS 5MM BORE ALL								2	ea	\$10.20	\$10.20	
Electronic	EL-PS0025	POWER SUPPLY 150W 24V 6.25A PNL MT	PMC-24V150W1AA DELTA								1	ea	\$28.600	\$28.60	
Electronic	EL-MS0143	Conn Fast Receptacle 1.6 AWG - 250	22-28AWG								7	ea	\$0.077	\$0.54	
Electronic	EL-MS0205	CONN TERM MALE 22-24AWG TIN	WM251TR-ND								25	ea	\$0.038	\$0.96	2 reeels
Electronic	EL-MS0212	CONN PIN 24-30AWG CRIMP TIN	MOL16-02-0108								73	ea	\$0.056	\$3.26	4 reeels
Electronic	EL-MS0059	CONN TERM FEMALE 22-24AWG TIN	WM2510TR-ND								3	ea	\$0.140	\$0.42	
Electronic	EL-MS0061	Connector, 4 pin Male housing with latch	WM2535-ND								8	ea	\$0.112	\$0.90	
Electronic	EL-MS0062	PC-CH0015 2POS 1.00 W/LATCH	Digikey								5	ea	\$0.062	\$0.31	
Electronic	PC-CN0001	CONN HOUSING 3POS 1.00 W/LATCH	WM2900-ND								6	ea	\$0.060	\$0.36	
Electronic	PC-CN0003	CONN HOUSING 3POS 1.00 W/LATCH	WM2901-ND								12	ea	\$0.109	\$1.31	
Electronic	EL-MS0142	CONN RECEPT FASTON 22-26AWG .110	A27795-ND								6	ea	\$0.52	\$200	
Electronic	EL-MS0141	Term Ring Nins 26-22AWG #4	P22-4R-M								2	ea	\$0.087	\$0.18	
Electronic	EL-MS0210	CONN RING UNINS 15-20AWG #43	A1071500CT-ND								6	ea	\$0.090	\$0.540	
Electronic	EL-SW0022	SWITCH BASIC SPDT 3A .10QC 125V	SW766-ND								6	ea	\$0.520	\$3.12	61.00
Electronic	EL-WR0099	Shielded 4Cond 22AWG	C0762A-41.10								2470	mm	\$0.001	\$3.02	9000 ft
Electronic	EL-WR0105	24AWG Stranded - Black	C2015B-100-ND								6025	mm	\$0.000	\$1.54	22000 ft
Electronic	EL-WR0107	24AWG Stranded - White	C2015W-100-ND								1100	mm	\$0.000	\$0.28	40000 ft
Electronic	EL-WR0109	24AWG Stranded - Yellow	C2015Y-100-ND								2090	mm	\$0.000	\$0.54	8000 ft
Electronic	EL-WR0103	24AWG Stranded - Red	C2015R-100-ND								3825	mm	\$0.000	\$0.98	14000 ft
Electronic	EL-WR0104	24AWG Stranded - Orange	C2015A-21.01								2820	mm	\$0.000	\$0.72	11000 ft
Electronic	EL-WR0108	24AWG Stranded - Blue	C2015A-21.02								460	mm	\$0.000	\$0.14	2000 ft
Electronic	EL-WR0119	24AWG Stranded - Green	C2015A-21.06								520	mm	\$0.000	\$0.16	2000 ft
Electronic	EL-WR0120	24AWG Stranded - Purple	C2015A-21.10								1210	mm	\$0.000	\$0.31	5000 ft
Electronic	EL-WR0106	16AWG Stranded - Red	C2065A-21.03								400	mm	\$0.007	\$2.78	2000 ft
Electronic	EL-WR0121	16AWG Stranded - Black	C2065A-21.01								1280	mm	\$0.007	\$8.89	4000 ft

Hardware	HD-WA0005	M4 Washer	Timberline	8206-0040	\$0.02	6000
Hardware	HD-MS0229	M4 x 25 Bolt, SHCS Black-Oxide	mcmaster	91290A176	\$0.137	2
Hardware	HD-BT0052	M4 x 55 Bolt, SHCS Black-Oxide	mcmaster	NS050-055	\$0.08	2
Hardware	HD-WA0007	M5 Washer, Steel, Zinc Plated	mcmaster	91166A240	\$0.022	\$0.24
Hardware	HD-BT0048	M5 x 10 Bolt, SHCS Black-Oxide	Timberline	8050-0510	\$0.02	6000
Hardware	HD-BT0049	M5 x 14 Bolt, SHCS Black_Oxide	Timberline	NOR-M60051014SO	\$0.03	5000
Hardware	HD-NT0002	M8 Nyloc Nut, Zinc Plated	Timberline	GBO-946270004	\$0.05	3000
Hardware	HD-WA0006	M8 Washer, Steel, Zinc Plated	Timberline	8206-0680	\$0.01	9100
Hardware	HD-WA0008	Metric Spring Steel Shim - DIN 988 0.5mm Thick, 8mm ID, 14mm OD	Timberline	1	\$0.11	1000
Hardware	HD-WA0009	Metric Spring Steel Shim - DIN 988 1.0mm Thick, 8mm ID, 14mm OD	Timberline	1	\$0.05	1000
Hardware	HD-MS0381	Thumb Screw Knob for M4 SHCS, Black	Timberline	1	\$0.06	1000
Hardware	HD-BT0120	Alloy Steel Shoulder Screw, 6mm Diameter x 10mm Long	McMaster	7130k32	\$1.030	2000
Hardware	HD-MS058	Shoulder, M5 Thread	Timberline	AEH#02-00818-UVB	\$0.02	12000
Hardware	HD-MS0249	Wire Tie, 8"	McMaster	7526k22	\$0.249	2050
Hardware	TL-CS0040	UV-Resistant Cable Tie Holder, Adhesive Back/Screw Mount, 4-Way, for 4.8" Maximum Tie, Blk	McMaster	7604A55	\$0.066	5 bottles
Consumable	HD-RB0036	Extreme-Temperature Pipe Sealant & Threadlocker, 4 oz bottle, blue	Thomson	2	\$0.03	2020
Mechanical	HD-NT0047	Drive Rod 10mm	MTS10 x 2m	2	\$66.20	2020
Mechanical	HD-MS0194	10mm x 2mm Flange mount supermount	McMaster	767.80	\$13.56	2050
Mechanical	HD-MS0255	Coupling, Set Screw, Misumi GSASL16-5-5	GSASL16-5-5	2	\$7.50	2050
Mechanical	HD-MS0254	Ultim PEI 0.010" x 12" x 30ft rolls	Professional Plastics	160 mm	\$0.034	10 rolls
Electrical	EL-CA0030	S-139394	Uline	160 mm	\$0.78	51 rolls
Electrical	EL-CA0001	6t 18AWG 3M 480MP Adhesive Transfer Tape - 12" x 60 yards	Monoprice	1	\$1.65	1010
Electrical	PP-MF0028	6t USB 2.0 Male to B Male 28/24AWG Cable	Heilind	1	\$1.05	1010
Electrical	EL-MS0096	AC Power Entry Modules SC MT FUSED 25' TAB	Mousei	1	\$3.16	1010
Electrical	EL-WF0240	Cartridge Fuses 125V 7A 6X20 MA UL LBC	Mousei	2	\$0.45	2050
Electrical	EL-MS0098	Wire - Single Conductor 20AWG SOLID PTFE, RED	Mousei	185 mm	\$0.00	8 rolls
Electrical	EL-MS0010	Heavy Duty Power Connectors POWERPOLE 15A CONT	Mousei	2	\$0.16	2050
Electronics	PC-BD0029	Silicon Heater, 24V, 168mm x 168mm, Self Adhesive, w/ connectors	National Plastic Heater	2	\$0.10	2050
Electronics	EL-FP0020	RFB200 Micro flower	Peltons	1	\$27.95	On Order
Electronics	EL-SW0023	SWITCH H ROCKER DPST 20A 250V, illuminated red	Digkey	6.68	\$6.68	1050
Electronics	EL-MT0001	NEEMA 17 Stepper Motors	Changzhou FTX Motors Cr	1	\$1.702	1100
Electronics	PC-BB0049	PC-BB0049, assembled board only with no LCD headers	UltiMachine vbx.com	5	\$7.50	On Order
Mechanical	HD-MS0204	Sealed Skateboardinle/Rollerblade Skate Bearing Ball Bearings	Klit708	1	\$7.00	11000
Etching	PP-FP0058	Laser Engraving Designs	Shipper's Supply	1	\$9.91	810
Packaging	SH-PG0075	1.5# RECYCLED POLYPROPYLENE BAGS	Shipper's Supply	1	\$20.53	1010
Packaging	SH-PG0076	22x17x4.275ft dw/OUTSIDE PRINT 2 COLOR	Shipper's Supply	1	\$3.70	1010
Packaging	SH-PG0085	3" x 55 yards 3.1 Mil Uline Clear Carton Sealing Tape 24 rolls/case	0.018 pc	\$4.95	\$0.09	1010
Packaging	DC-LB0028	Label Labelbot Mini Barcode	1	\$0.14	\$0.14	1010
Packaging	DC-LB0029	Min 1/1 serial number sticker	1	\$0.01	\$0.01	1010
Packaging	RW-HB0024	HIPS, 1 meier Sample, Random Color	1	\$0.03	\$0.03	1010
Packaging	SH-PG0002	3 x 4" 2 MIL Redlosable Polypropylene Bags	1	\$0.02	\$0.02	1010
Packaging	SH-PG0083	9 x 12" 3 MIL Redlosable Bags	1	\$0.29	\$0.29	1010
Packaging	SH-PG0084	6 x 10" 6 MIL Redlosable Bags	1	\$0.18	\$0.18	1010
Packaging	DC-M50028	Packing List, Mini 1.0	1	\$0.24	\$0.24	1010
Packaging	DC-M50029	Quality Assurance Record Mini 1.0	1	\$0.72	\$0.72	1010
Tools	TL-MS0020	.003 Stainless Steel/Straight Instrument Cleaner Brush	GORDON BRUSH MF&C	1	\$5.29	1020
Tools	EL-NS0220	SWM Style USB Flash drive, 4gb, black	USB Memory Direct	1	\$4.15	1020
Tools	TL-HD0046	Pro Dental Pick, 5 3/4 in	Image Supply	1	\$1.87	1010
Tools	TL-HD0009	7 1/2" Nylon Handle Clam Knife	WEBstaurant Store	1	\$2.03	2.03

Total Lutz

\$732.61

1.00 Needs something

Good to Order

Ordered

3.3 Begonia Renders

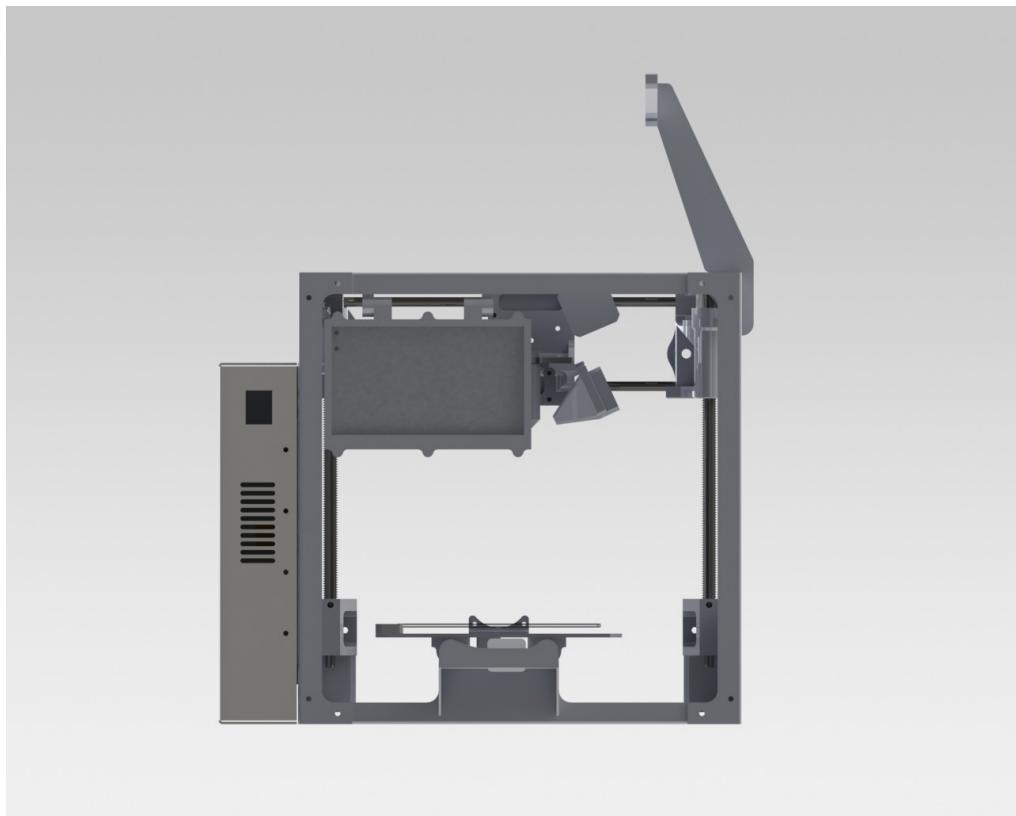


Figure 3.2: Begonia Front Render

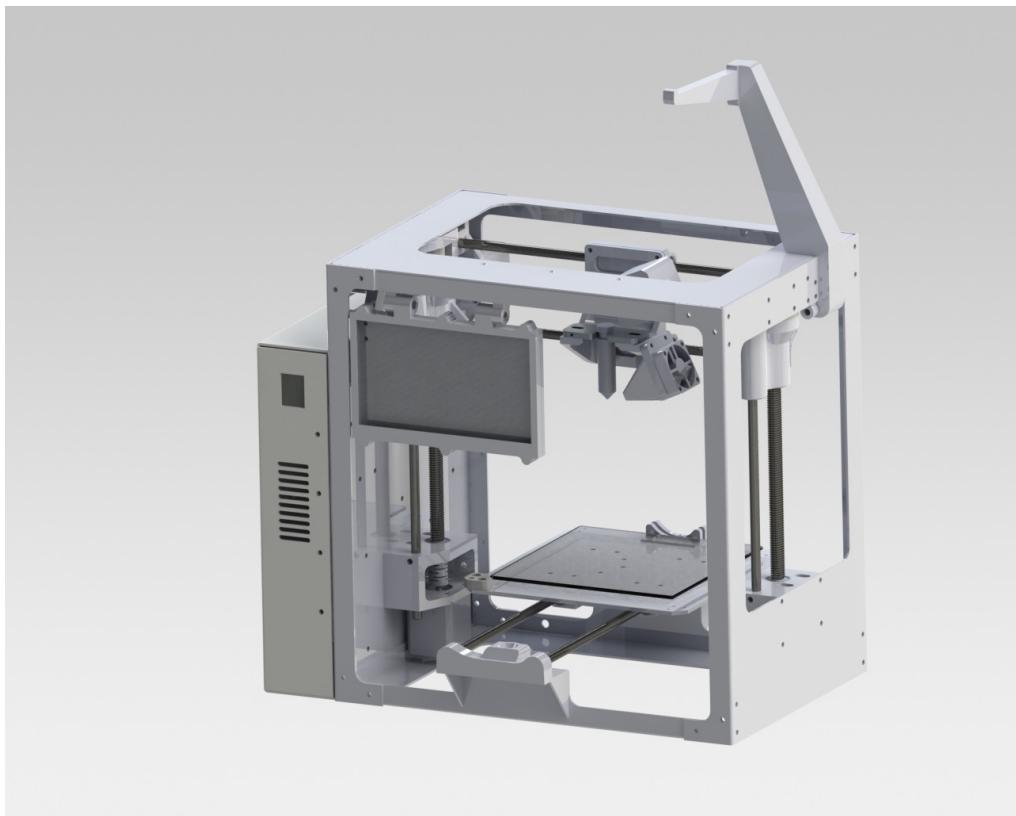


Figure 3.3: Begonia ISO Render

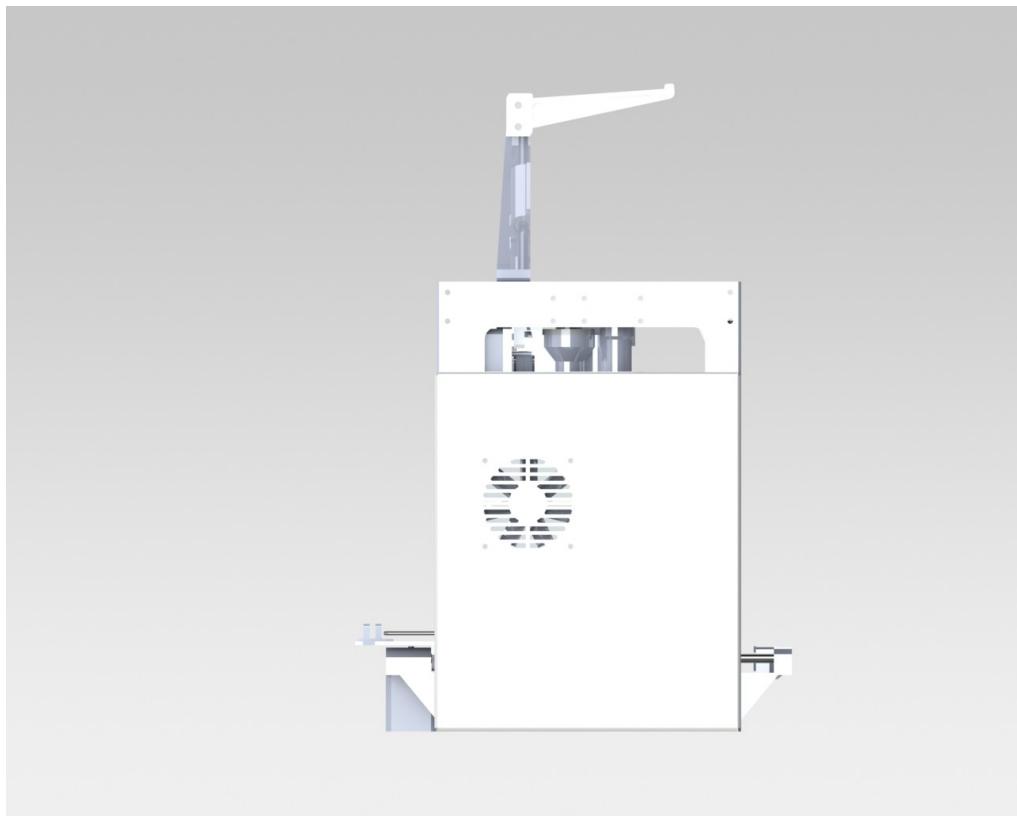


Figure 3.4: Begonia Left Render

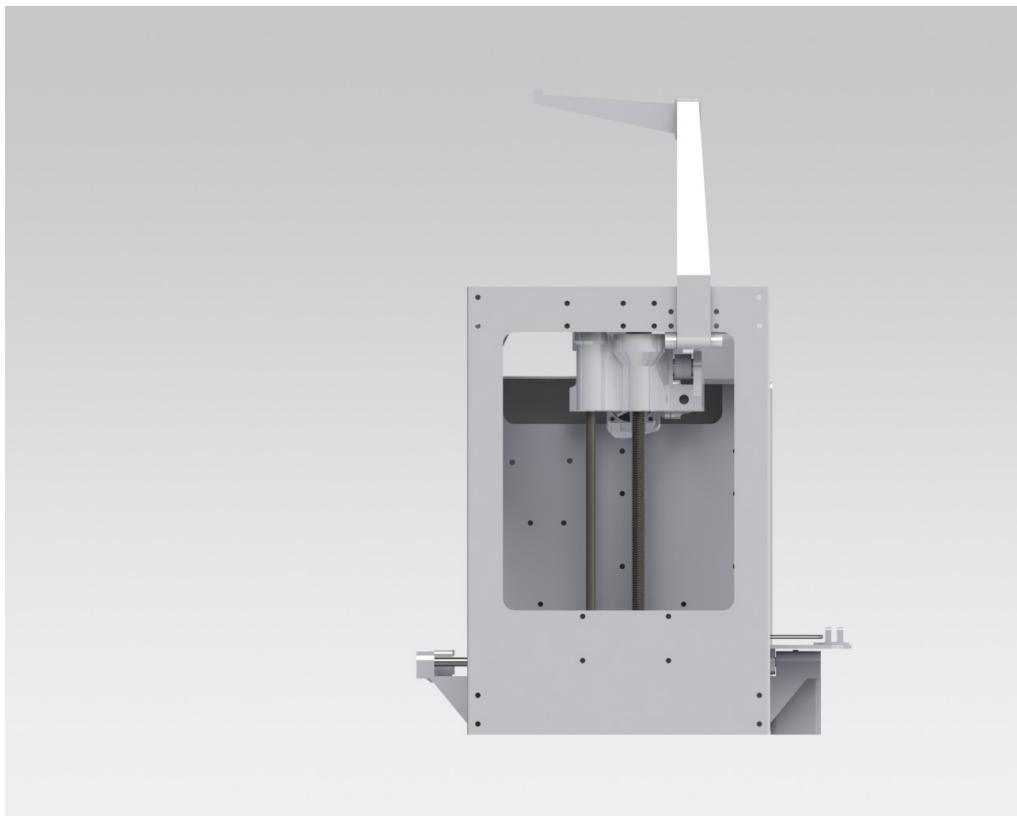


Figure 3.5: Begonia Right Render

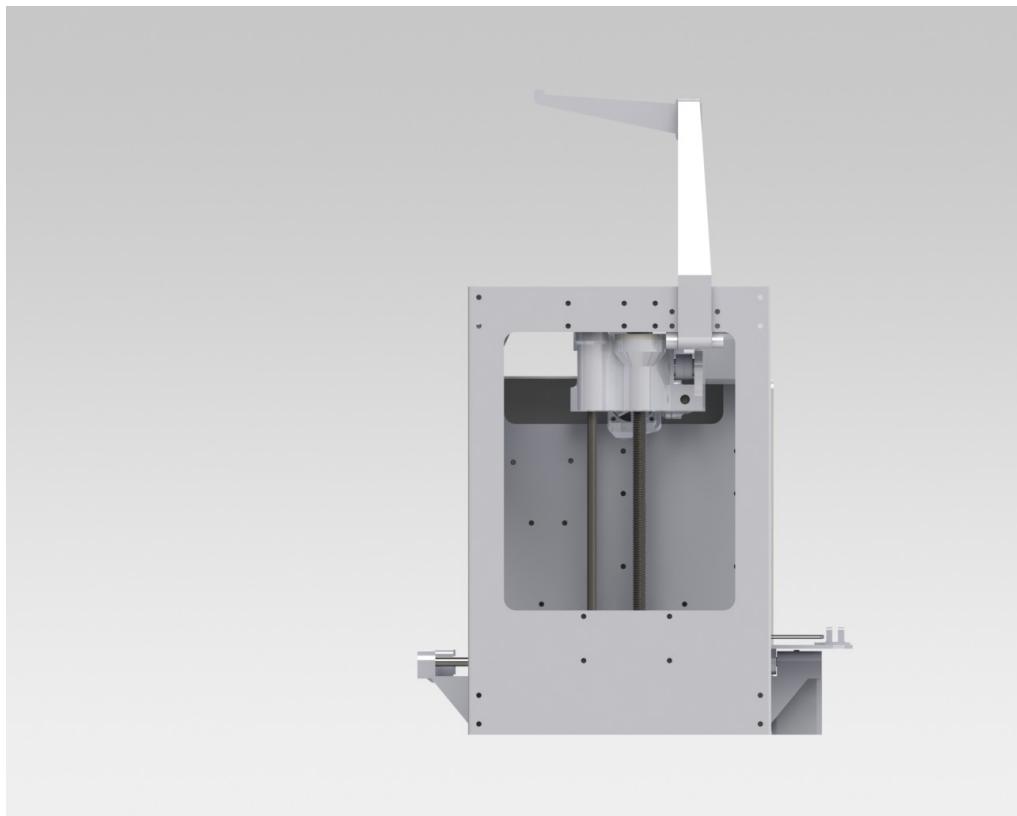


Figure 3.6: Begonia Right Render

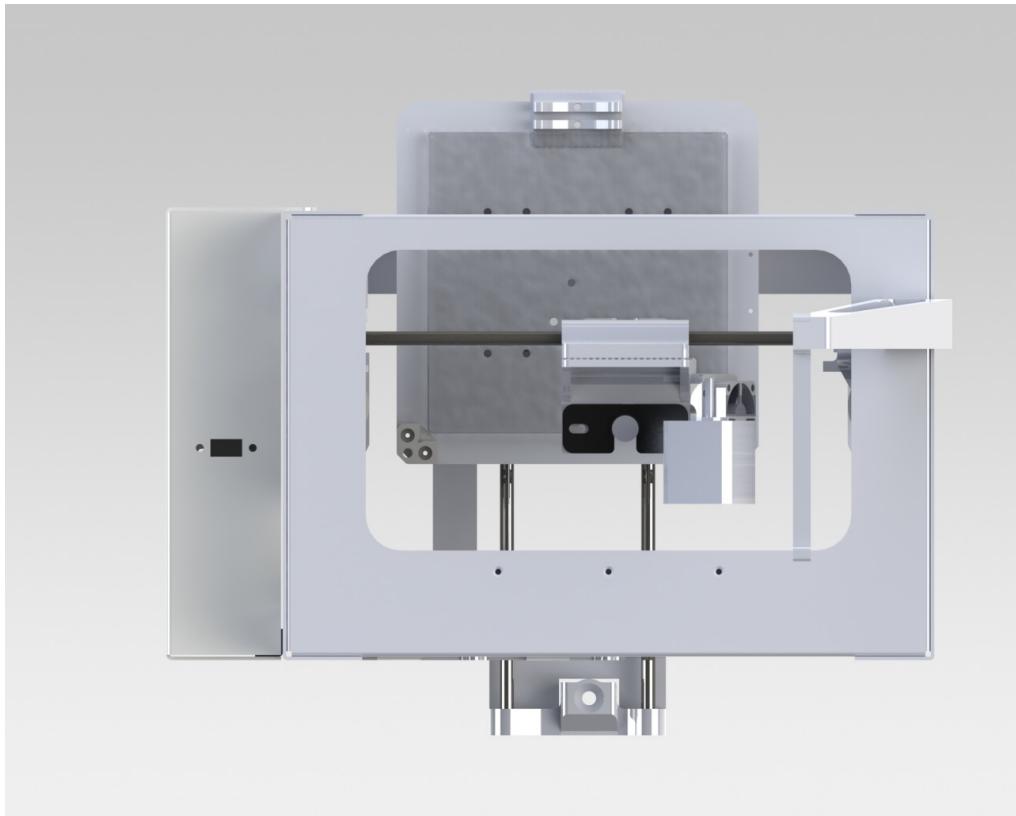


Figure 3.7: Begonia Top Render

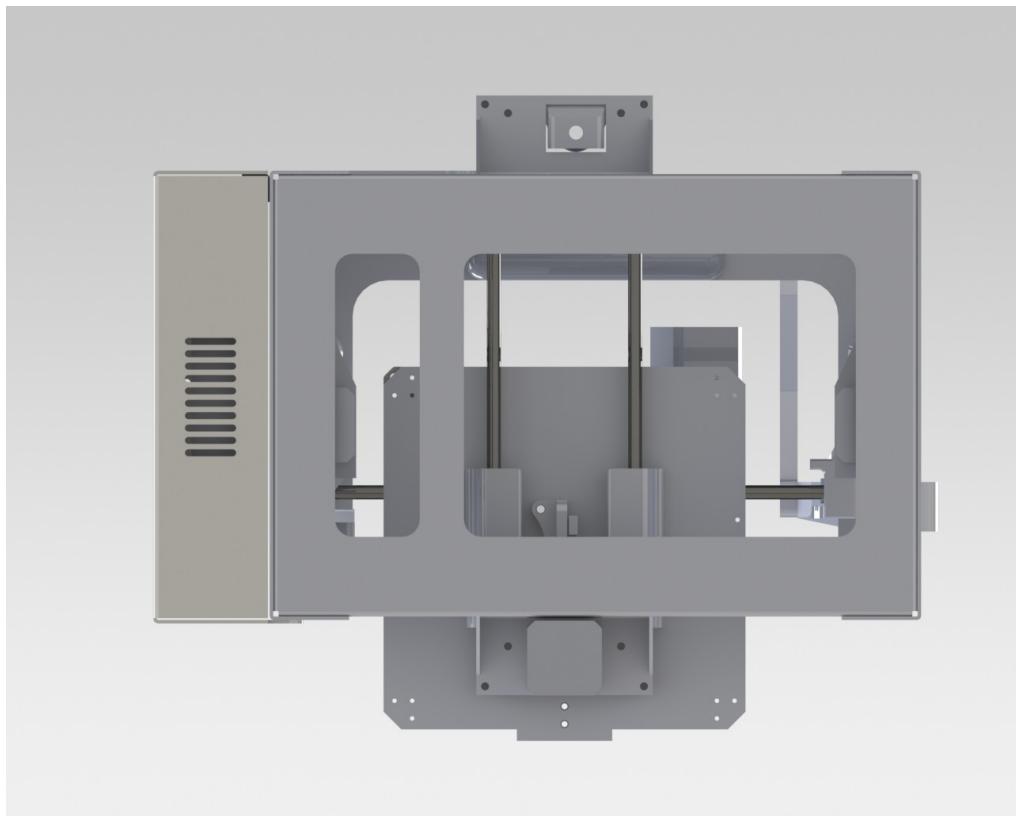


Figure 3.8: Begonia Bottom Render

3.4 Begonia 3D Printed Parts

3.5 Begonia Bed

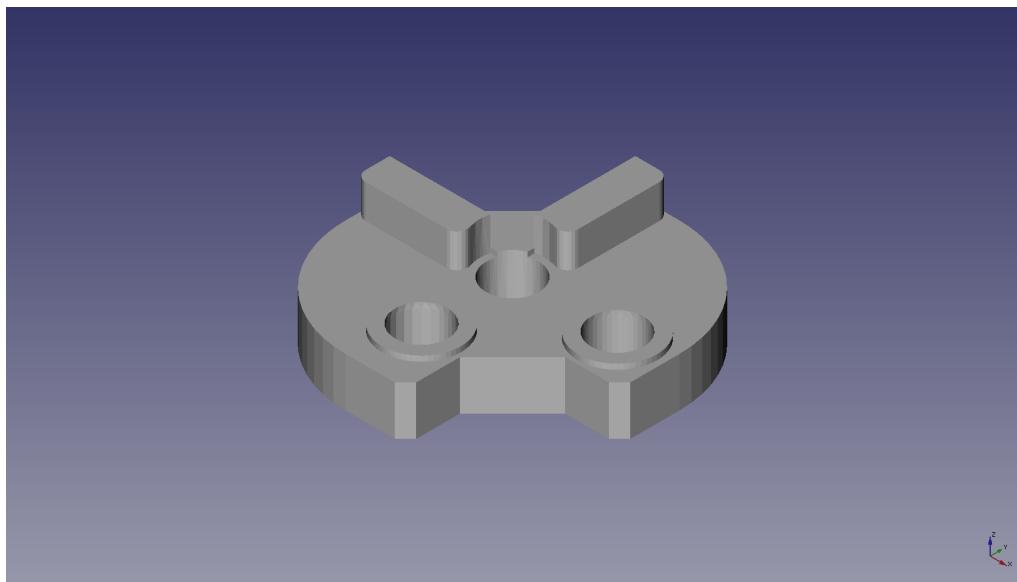


Figure 3.9: Begonia 3D Printed Bed Corner Render

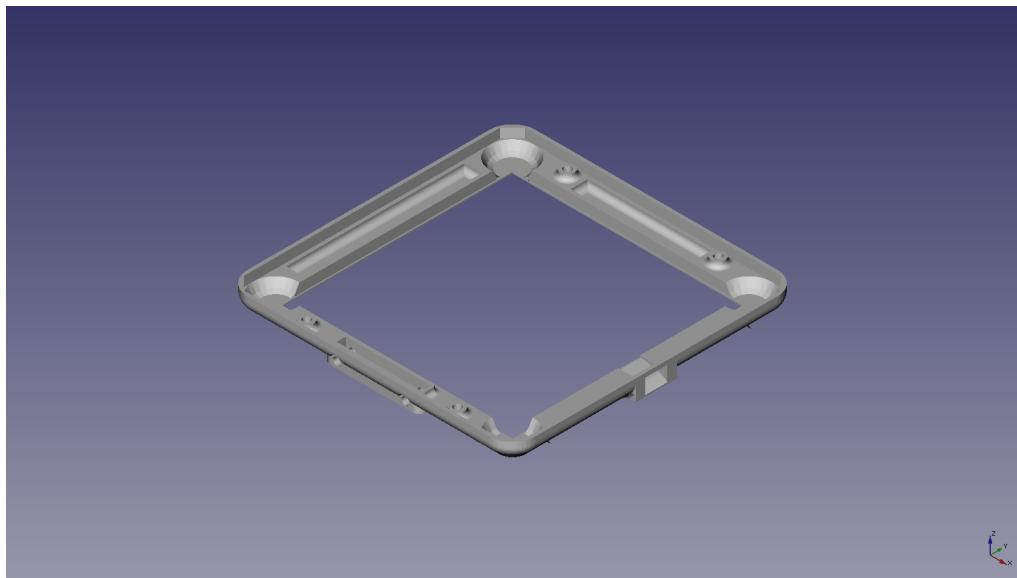


Figure 3.10: Begonia 3D Printed Bed Cover Render

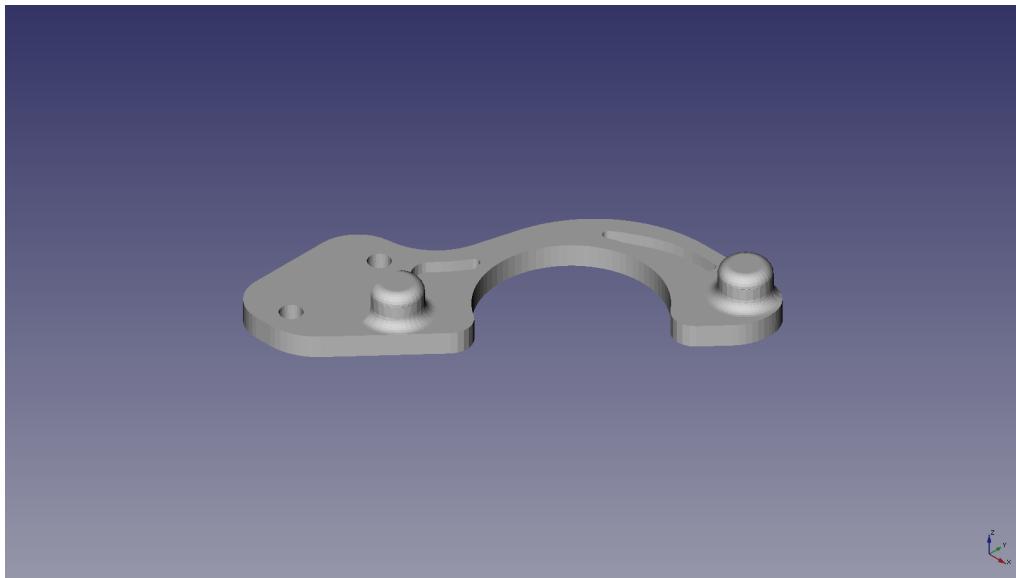


Figure 3.11: Begonia 3D Printed Bed Fan Mount Render

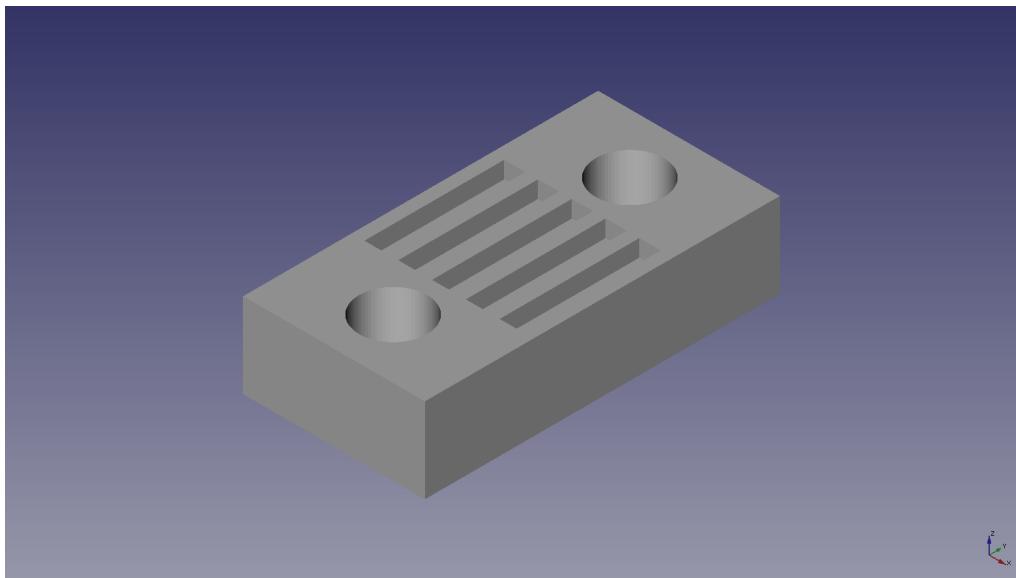


Figure 3.12: Begonia 3D Printed Belt Clamp Render

3.6. BEGONIA EXTRUDER

3.6 Begonia Extruder

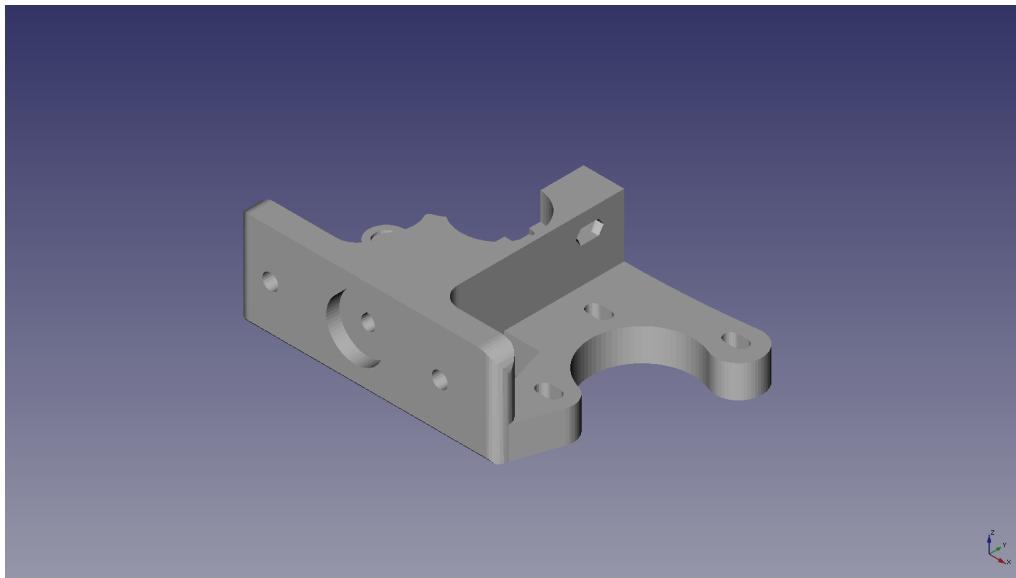


Figure 3.13: Begonia 3D Printed Extruder Body Hex Render

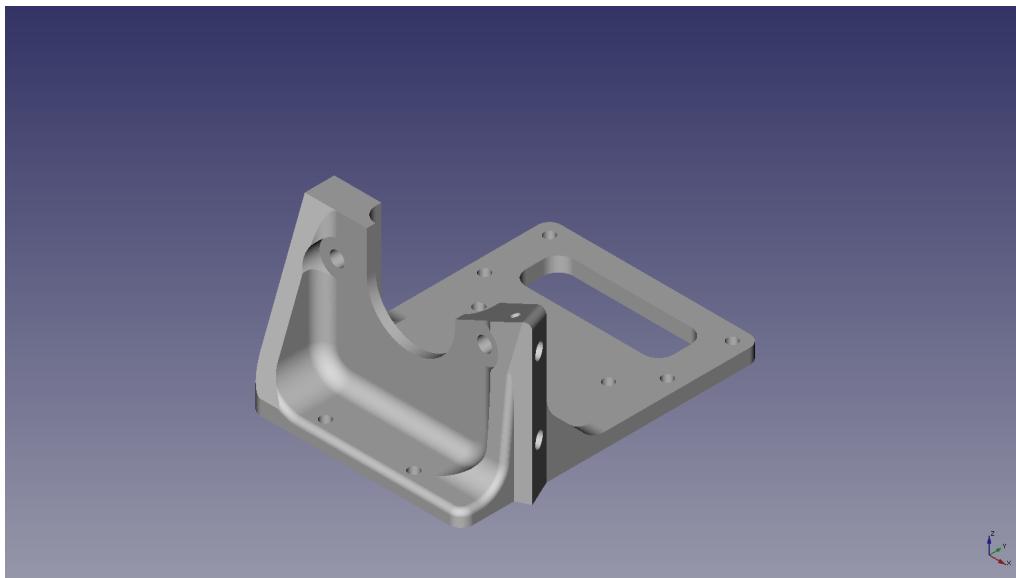


Figure 3.14: Begonia 3D Printed Extruder Mount Render

3.7 Begonia LCD

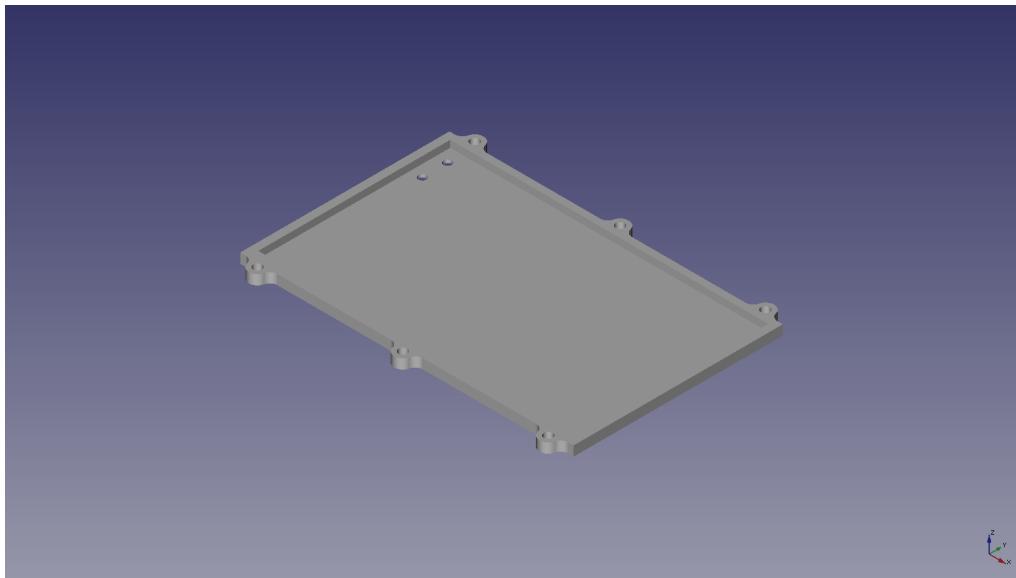


Figure 3.15: Begonia 3D Printed LCD Back Cover Render

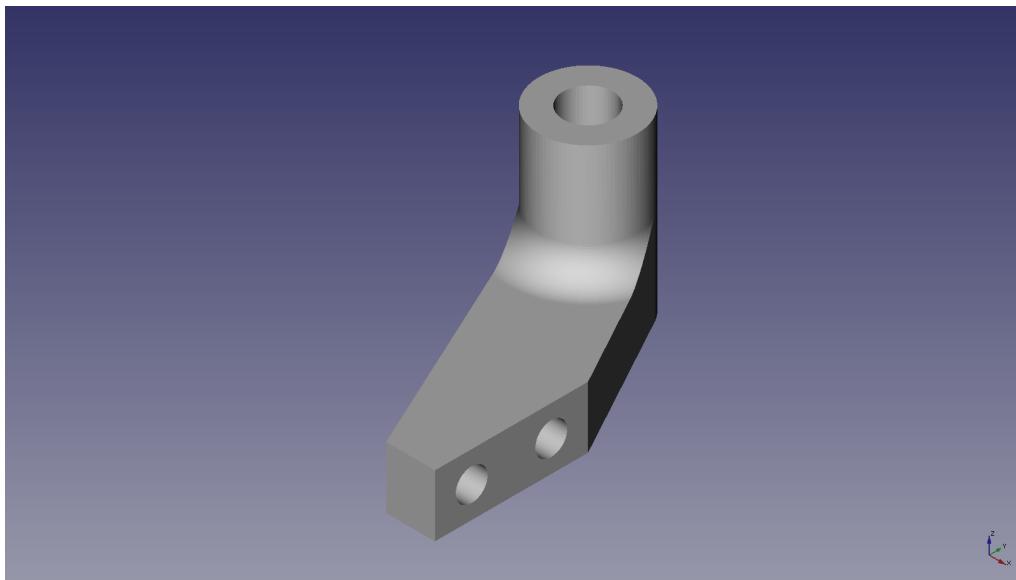


Figure 3.16: Begonia 3D Printed LCD Catch Render

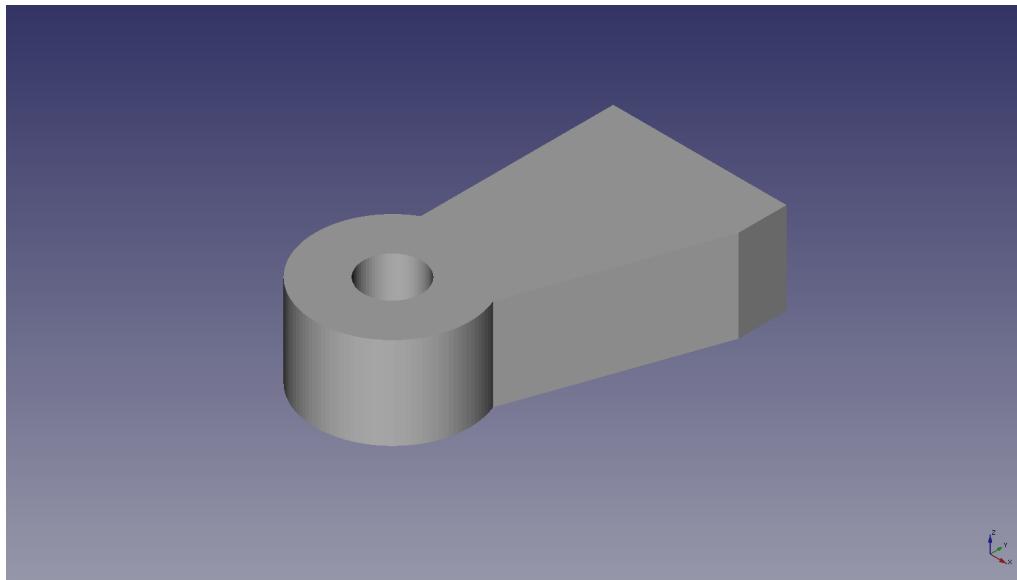


Figure 3.17: Begonia 3D Printed LCD Hinge Render

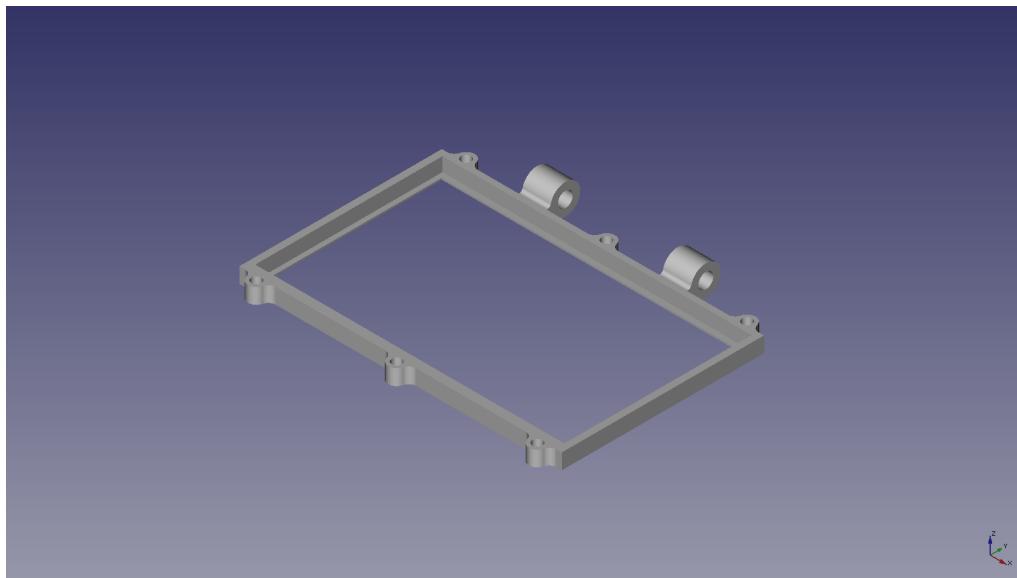


Figure 3.18: Begonia 3D Printed LCD Mount Render

3.8 Begonia Spool

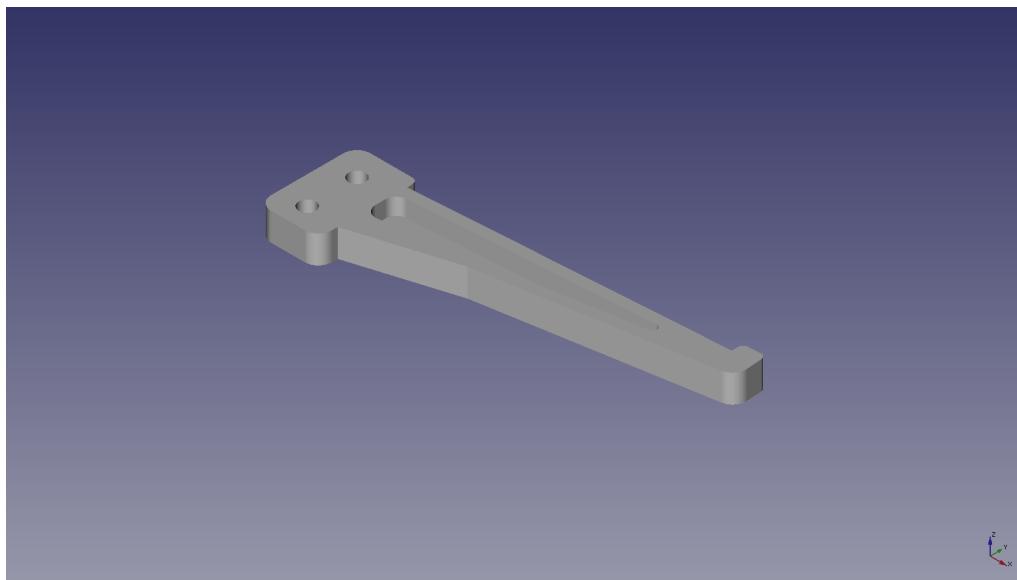


Figure 3.19: Begonia 3D Printed Spool Arm Render

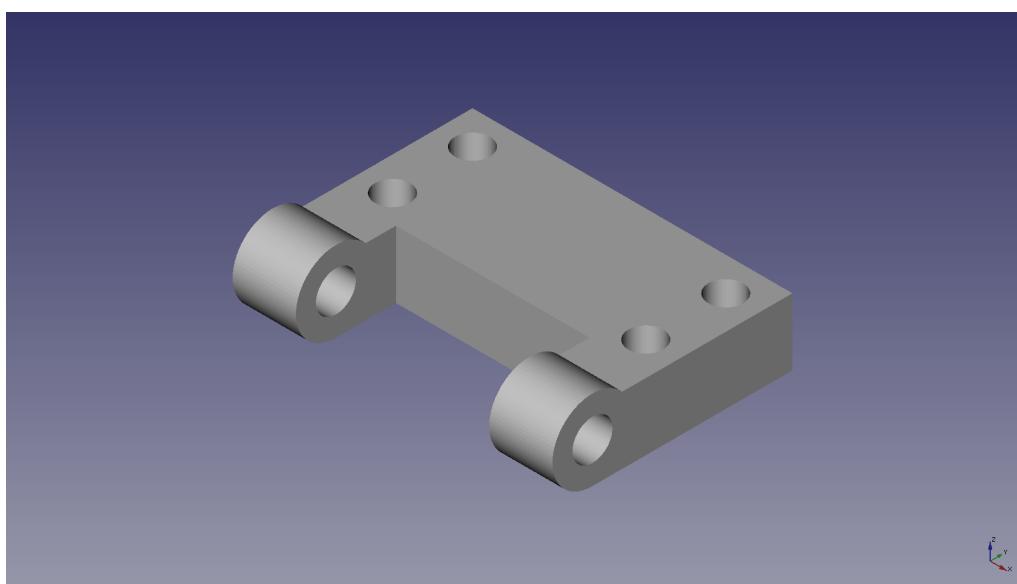


Figure 3.20: Begonia 3D Printed Spool Hinge Render

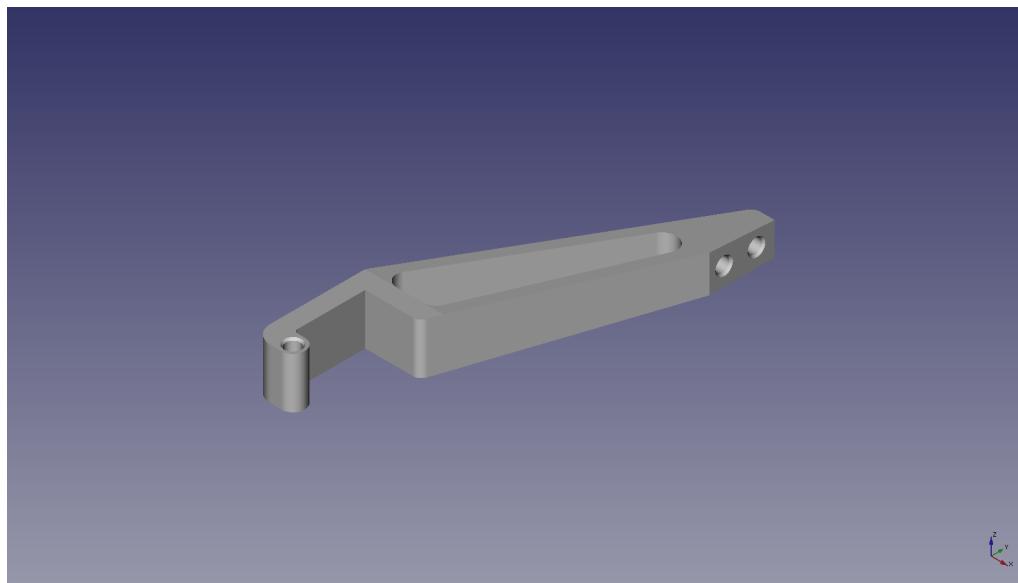


Figure 3.21: Begonia 3D Printed Spool Mount Render

3.9 Begonia X

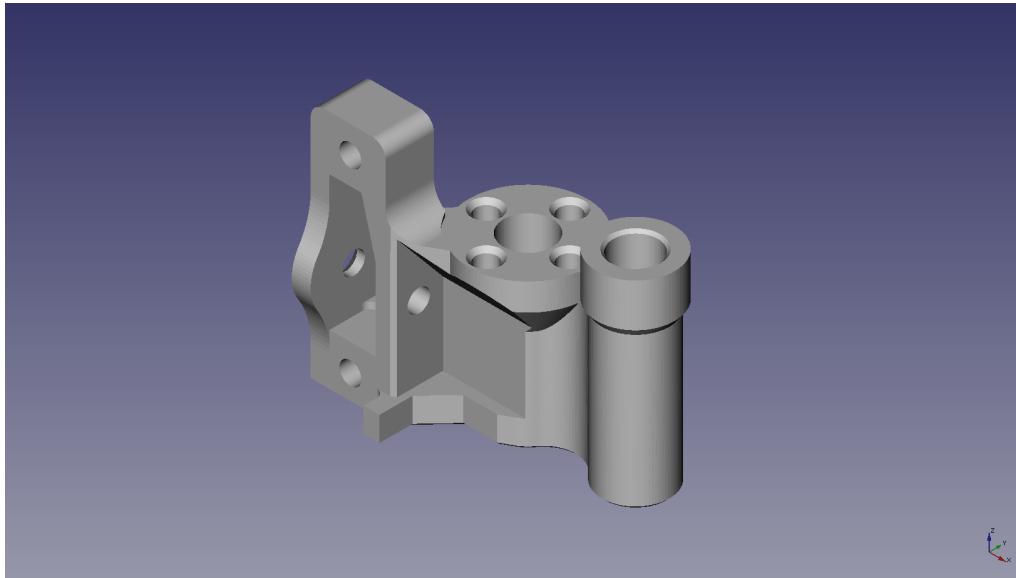


Figure 3.22: Begonia 3D Printed X End Idler Render

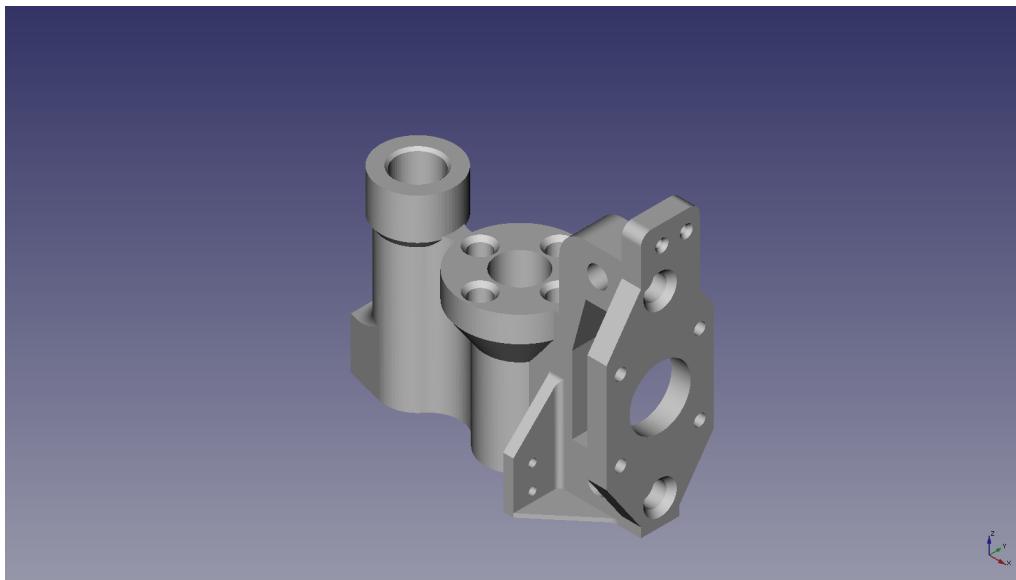


Figure 3.23: Begonia 3D Printed X End Motor Render

3.10 Begonia Y

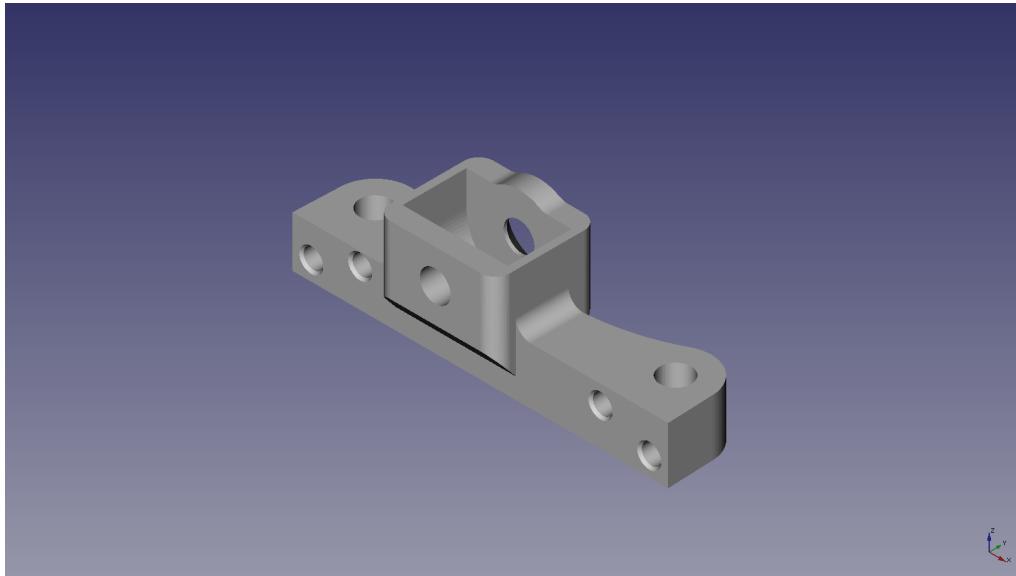


Figure 3.24: Begonia 3D Printed Y End Idler Render

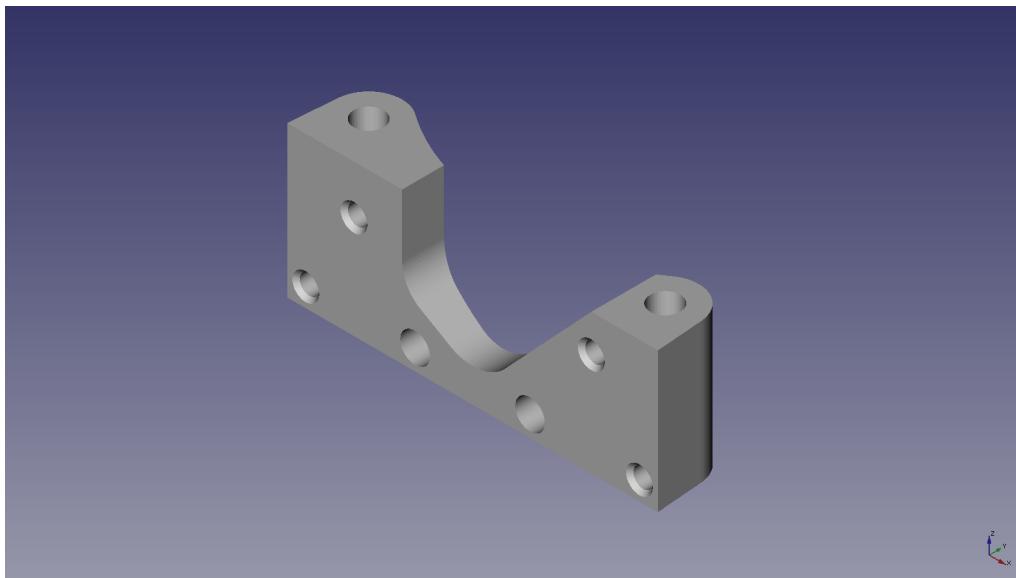


Figure 3.25: Begonia 3D Printed Y Rod Mount Render

3.11 Begonia Z

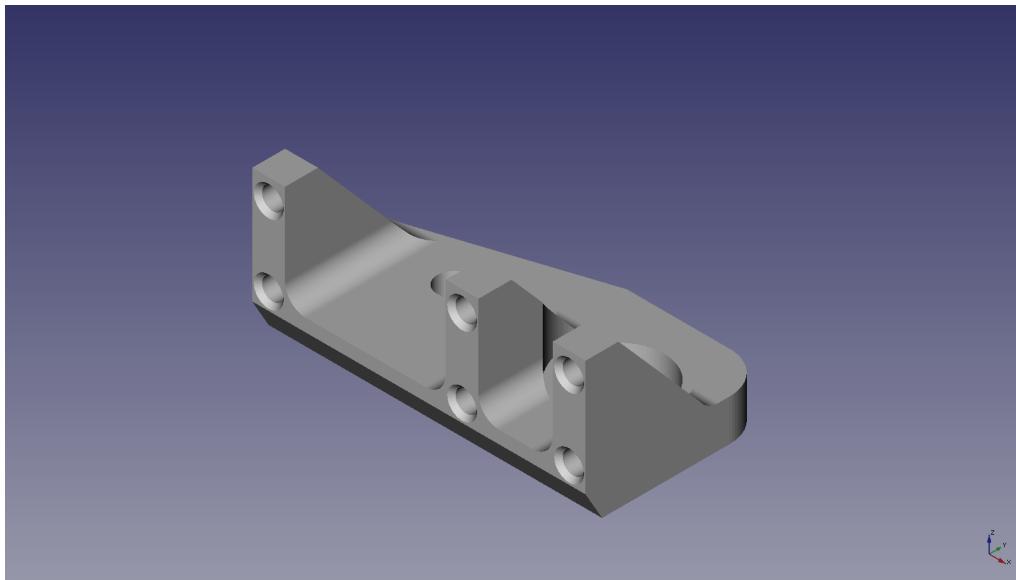


Figure 3.26: Begonia 3D Printed Upper Z Left Render

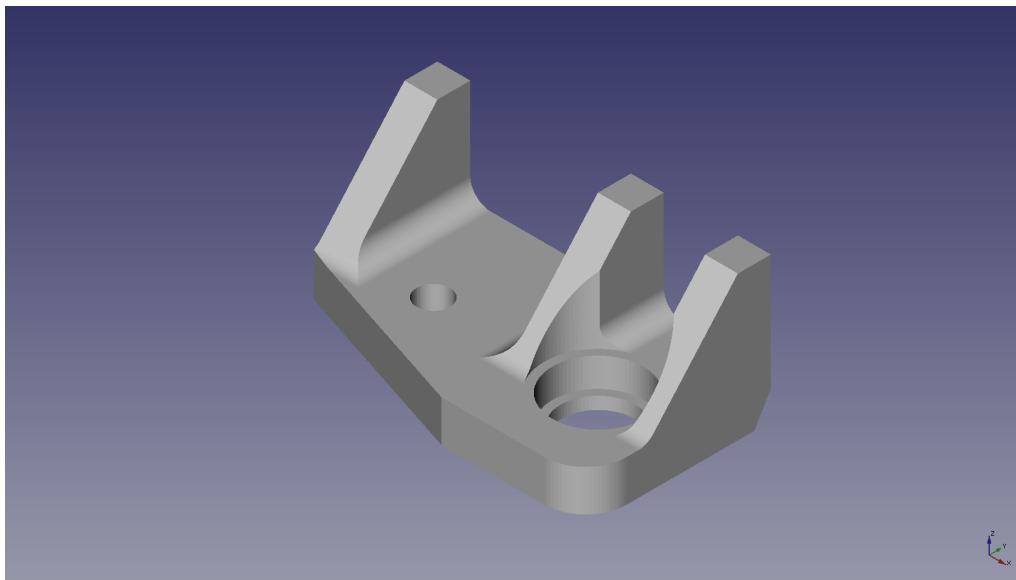


Figure 3.27: Begonia 3D Printed Upper Z Right Render

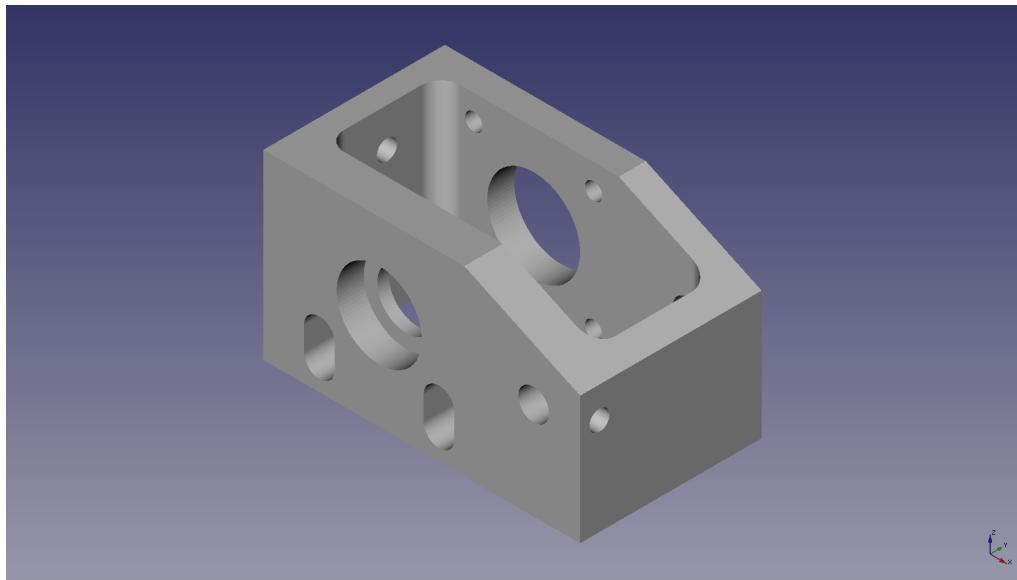


Figure 3.28: Begonia 3D Printed Lower Z Left Render

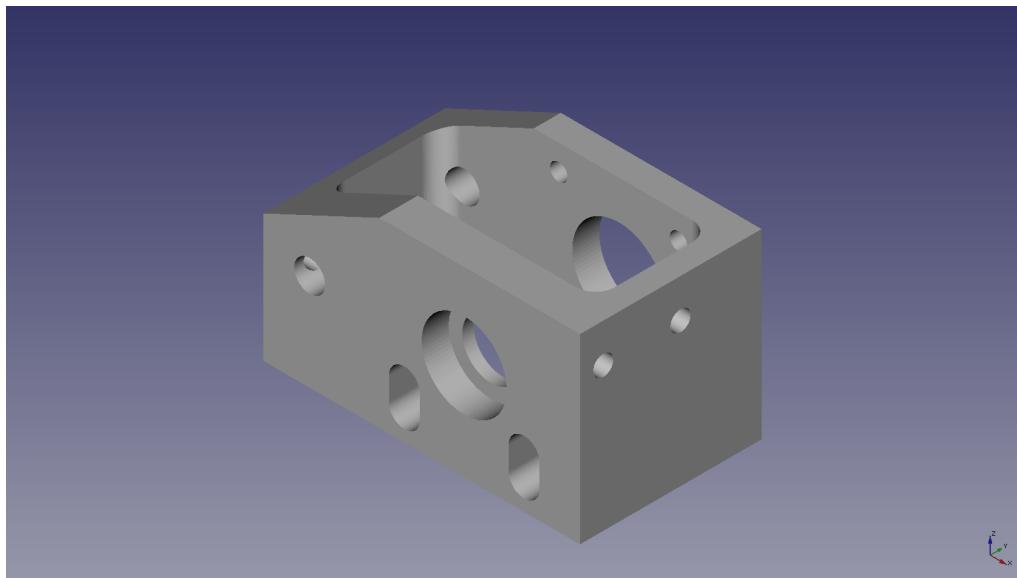


Figure 3.29: Begonia 3D Printed Lower Z Right Render

3.12 Begonia Misc

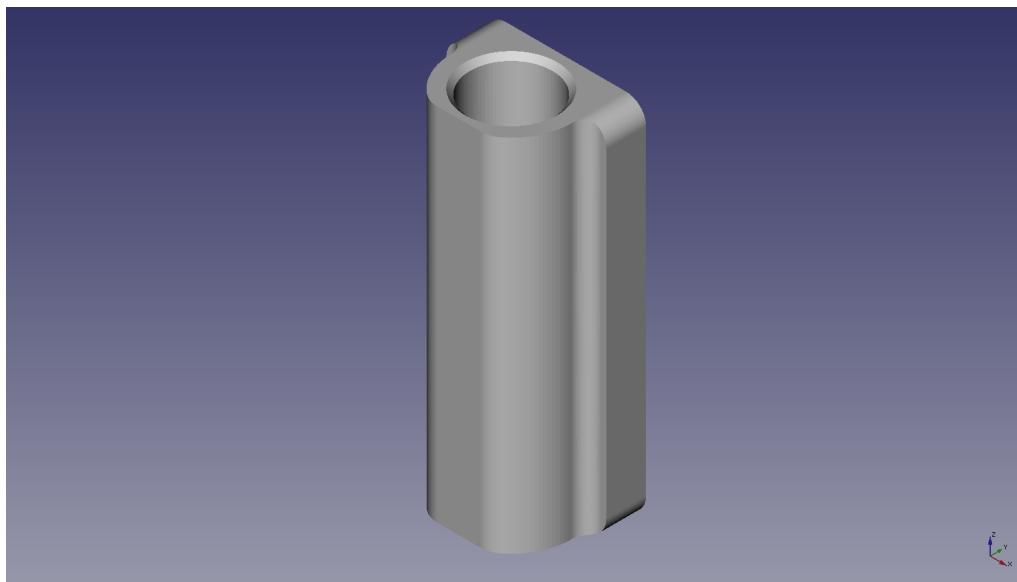


Figure 3.30: Begonia 3D Printed Double Bearing Holder Render

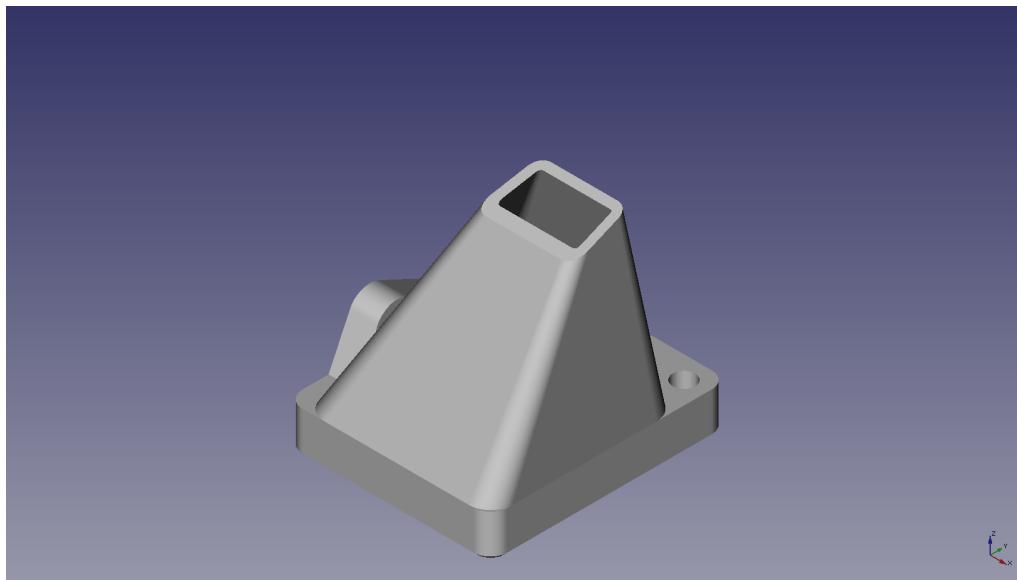


Figure 3.31: Begonia 3D Printed Fan Mount Render

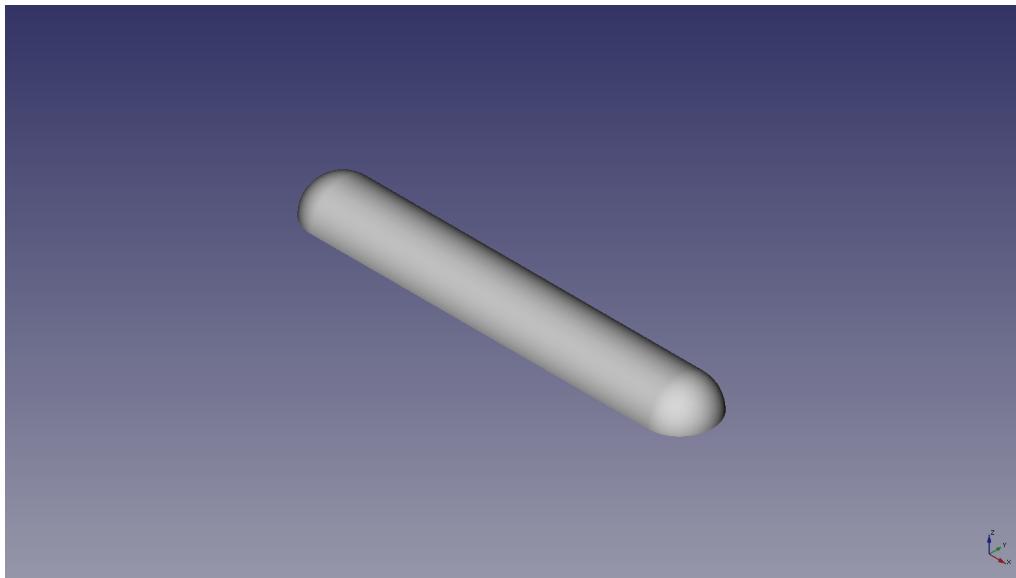


Figure 3.32: Begonia 3D Printed Handle Bar Render

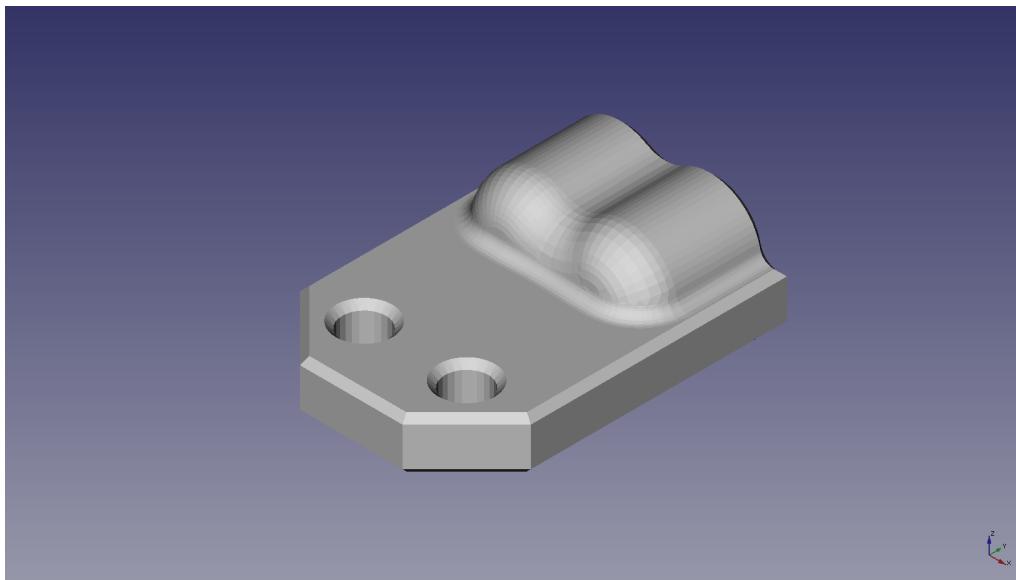


Figure 3.33: Begonia 3D Printed Cable Carrier Mount Render

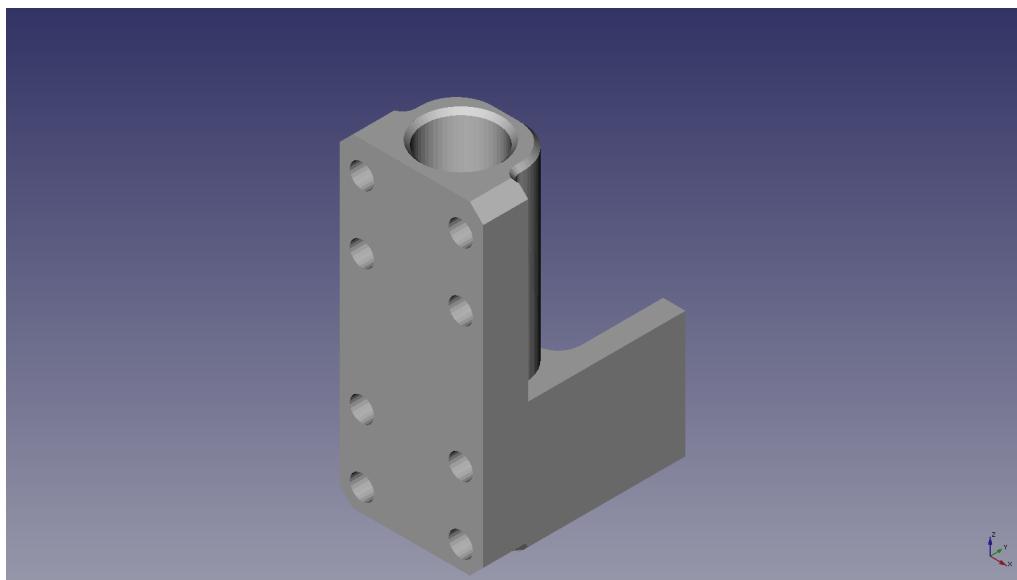


Figure 3.34: Begonia 3D Printed Extruder Mt Top Double Bearing Holder Render

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.

Packing

If It Shakes It Breaks

6.1 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

*Rocktopus by Kent Johnson is licensed under CC BY-SA 4.0 and derived from work by dietz1 and yeoldebrian - lulzbot.com/rocktopus



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7.2 Sales

Email: sales@alephobjects.com

Phone: +1-970-377-1111 x600

7.3 Websites

Aleph Objects, Inc.

<http://www.alephobjects.com>

LulzBot 3D Printers

<http://www.lulzbot.com>

Colophon

Created with 100% Free Software

GNU/Linux

\LaTeX Memoir
