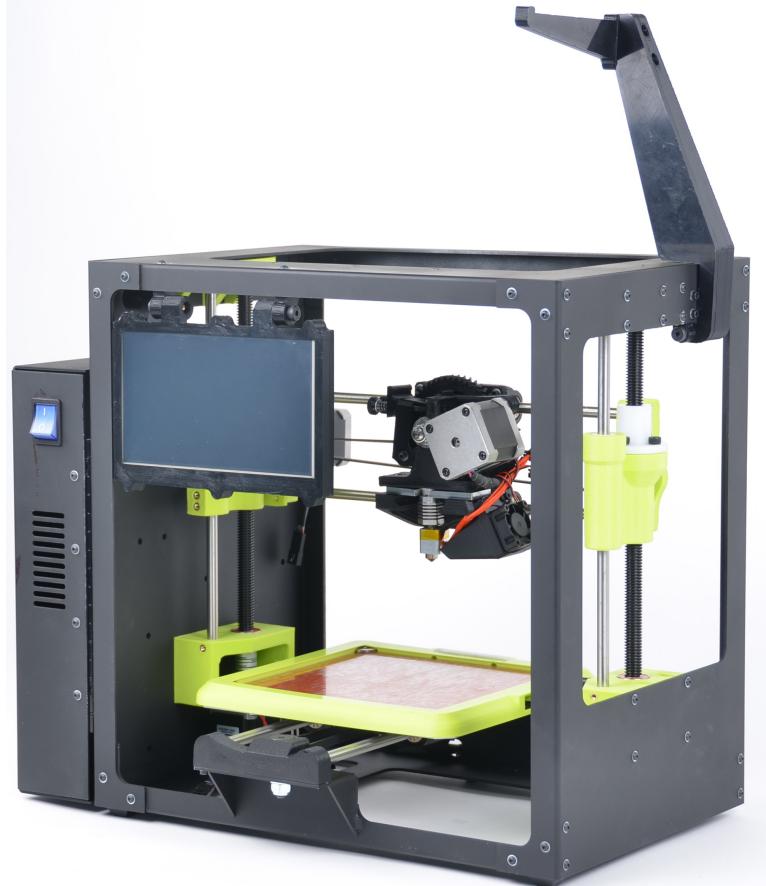


LULZBOT MINI DEVELOPER'S GUIDE



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

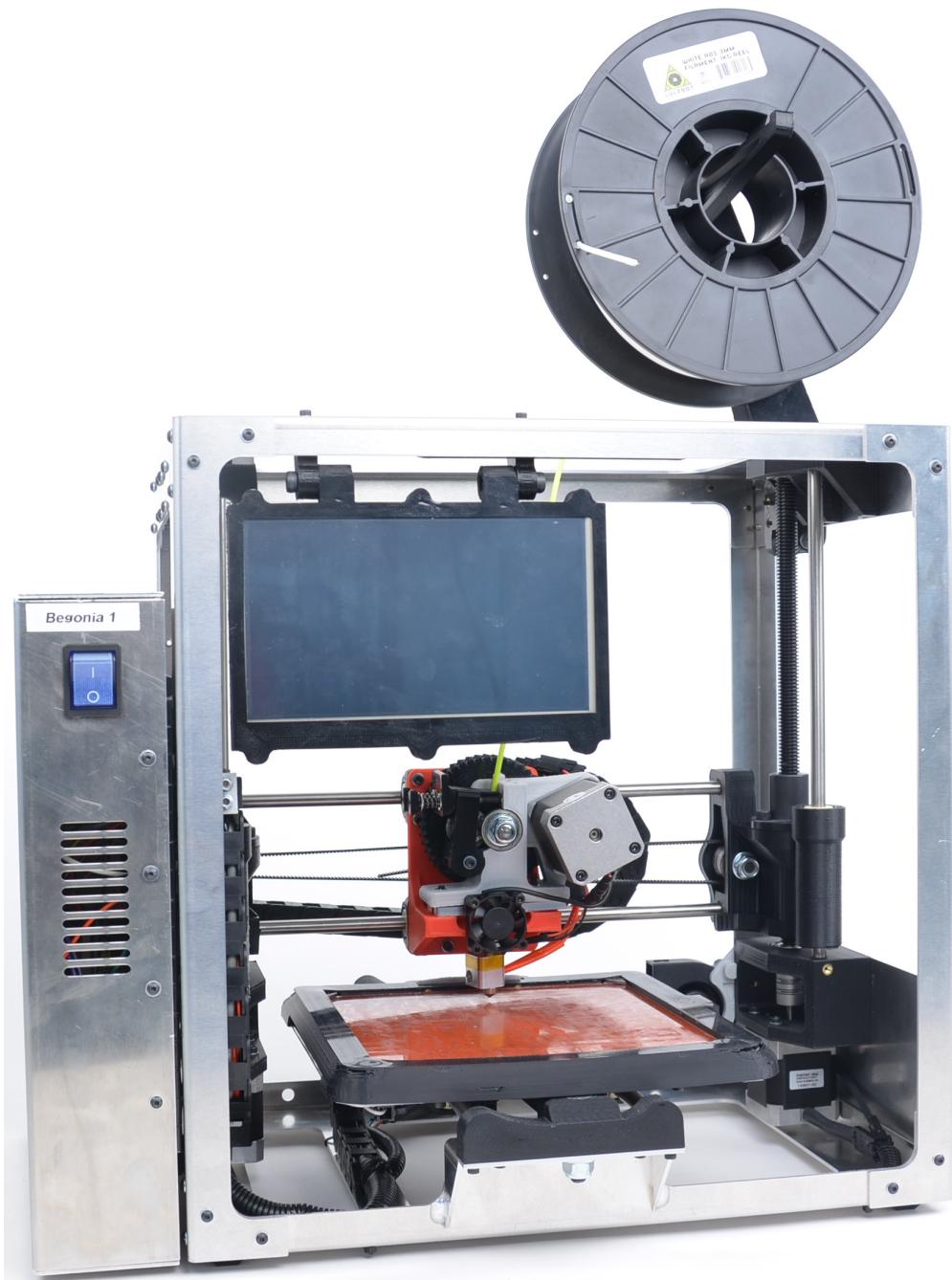


Figure 1.1: Begonia Front Photo

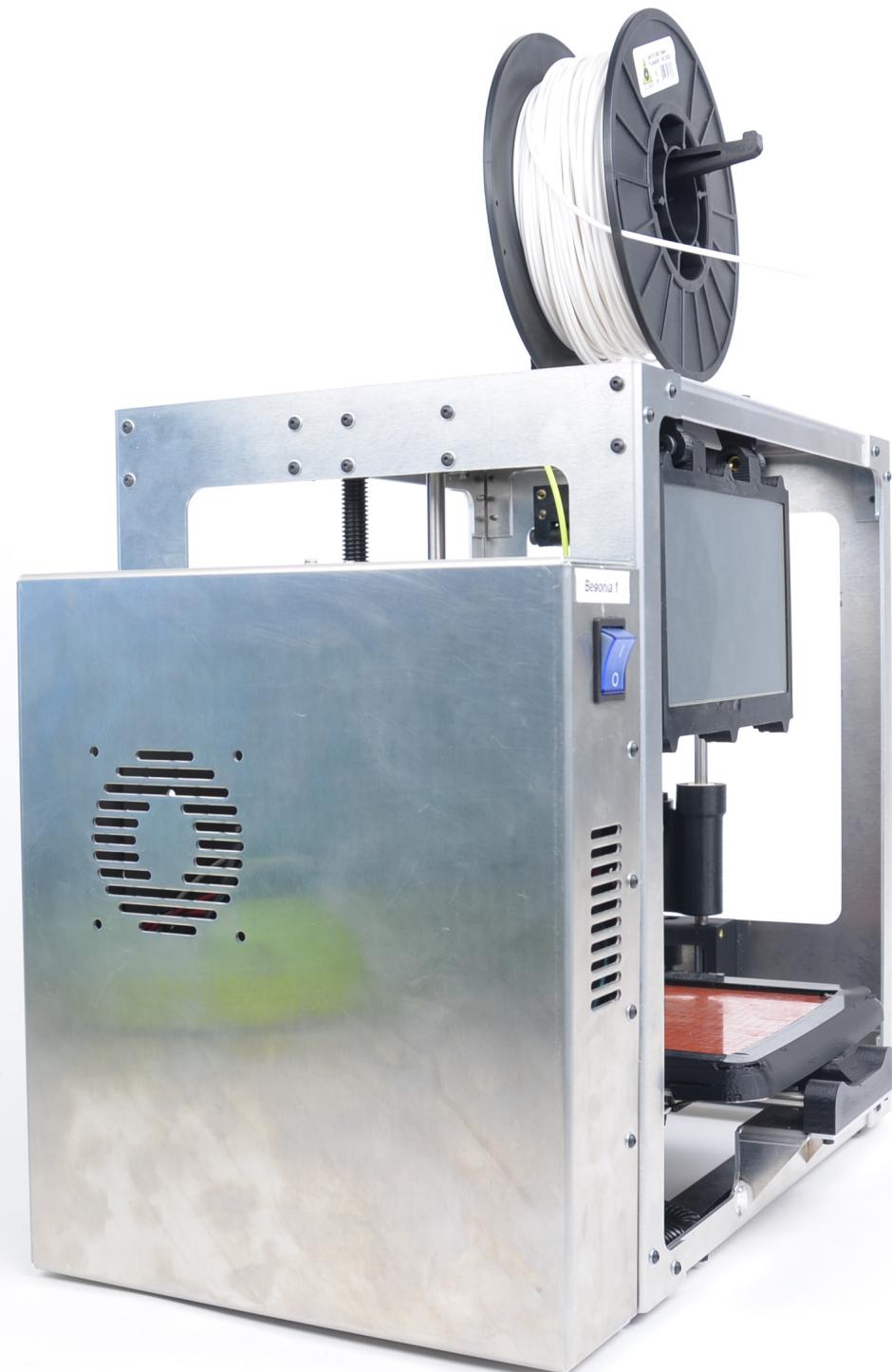


Figure 1.2: Begonia Left Photo

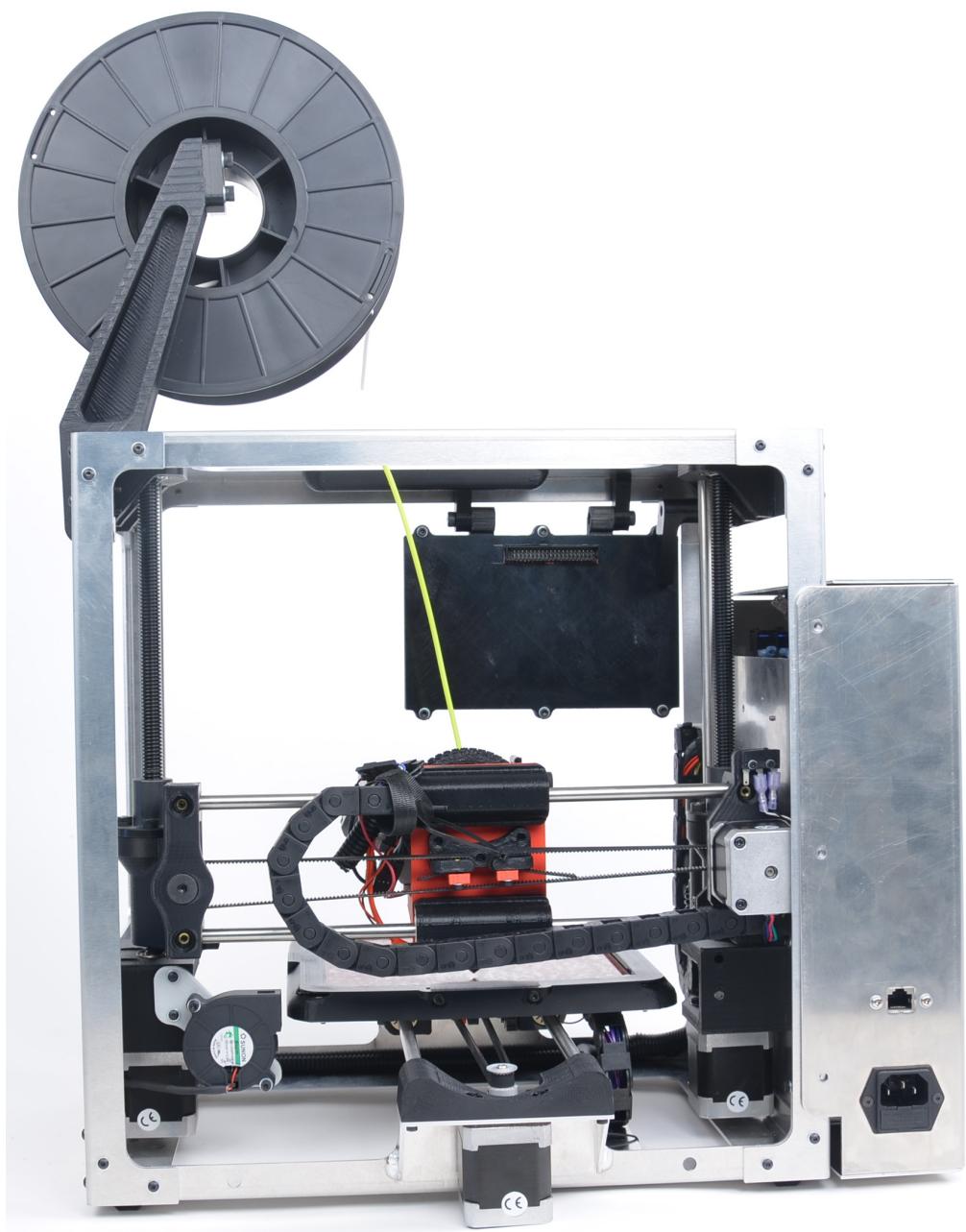


Figure 1.3: Begonia Back Photo

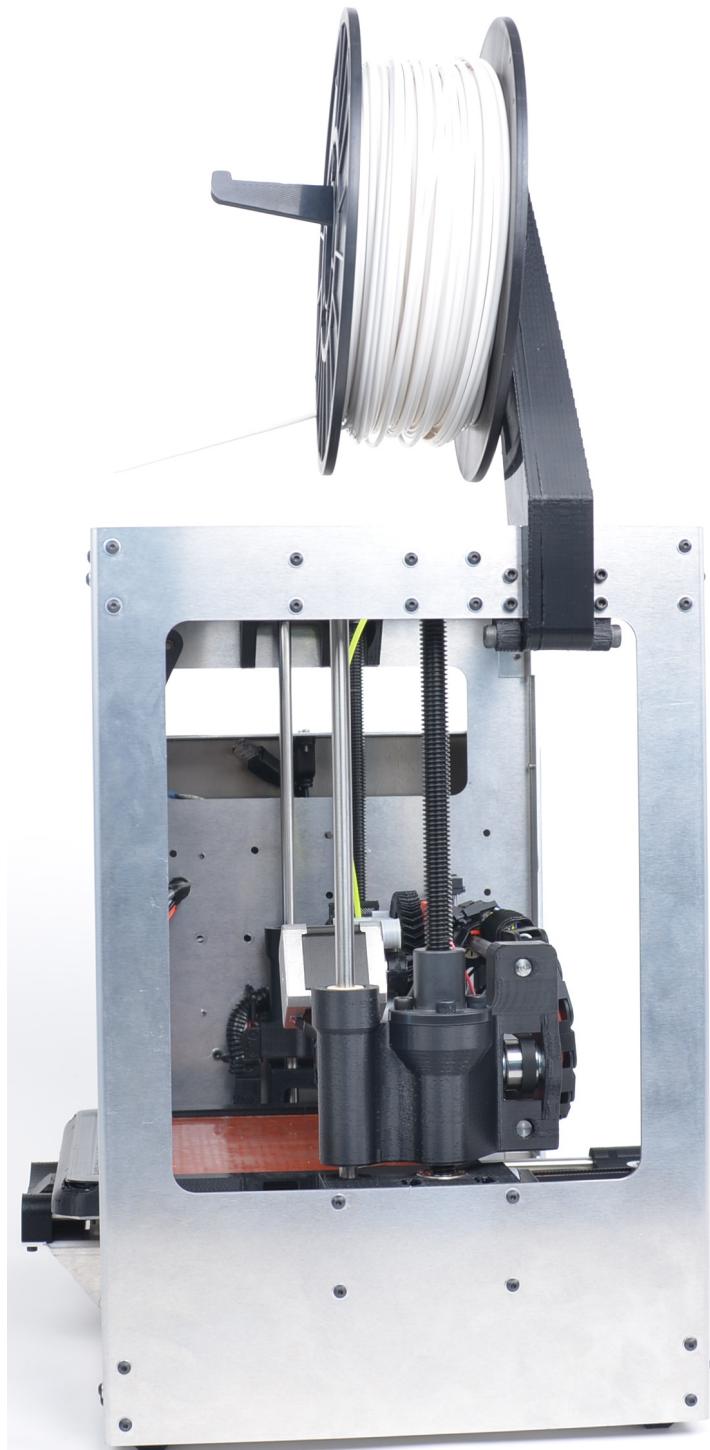


Figure 1.4: Begonia Right Photo

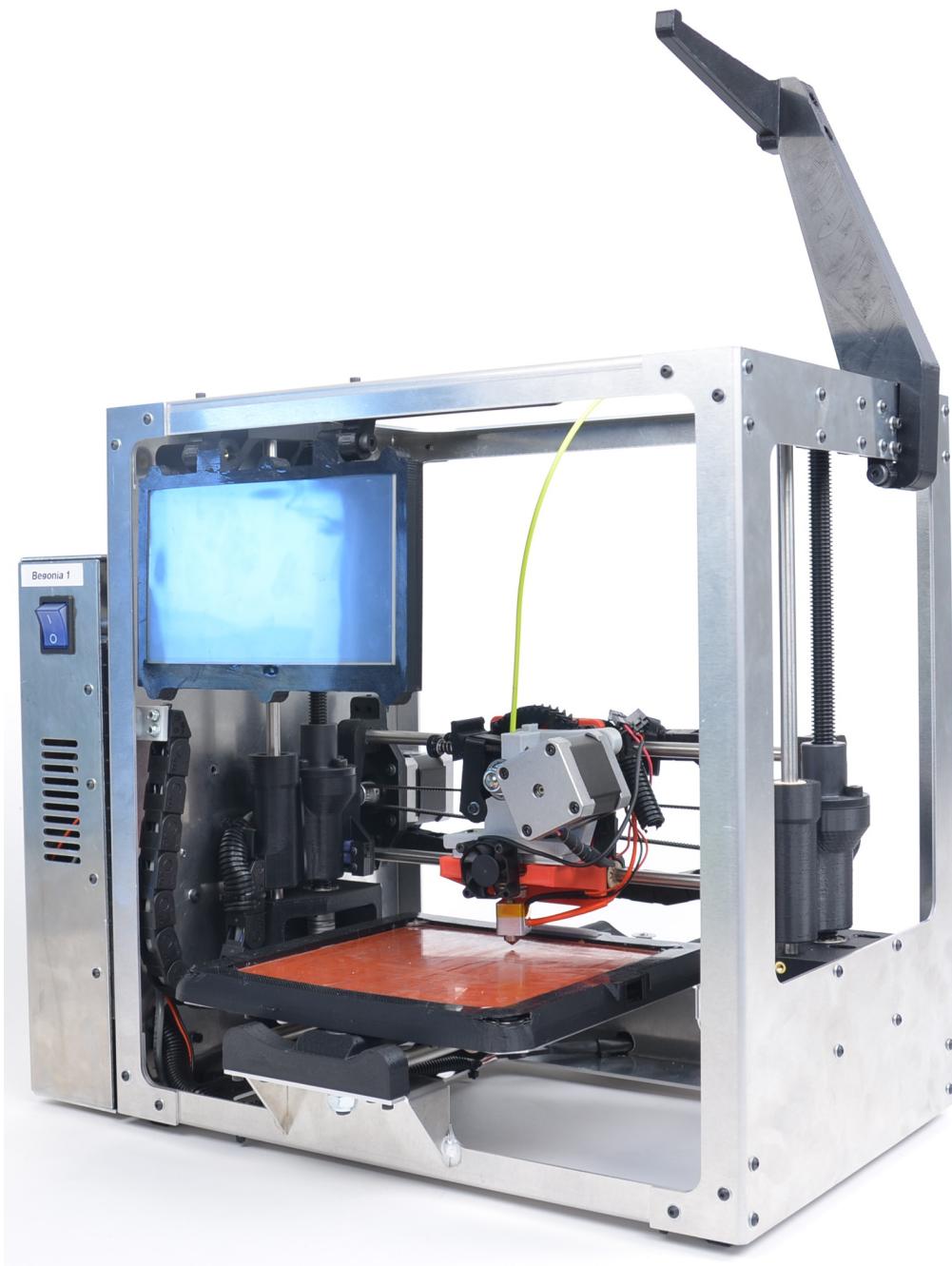


Figure 1.5: Begonia Spool Arm Up Photo

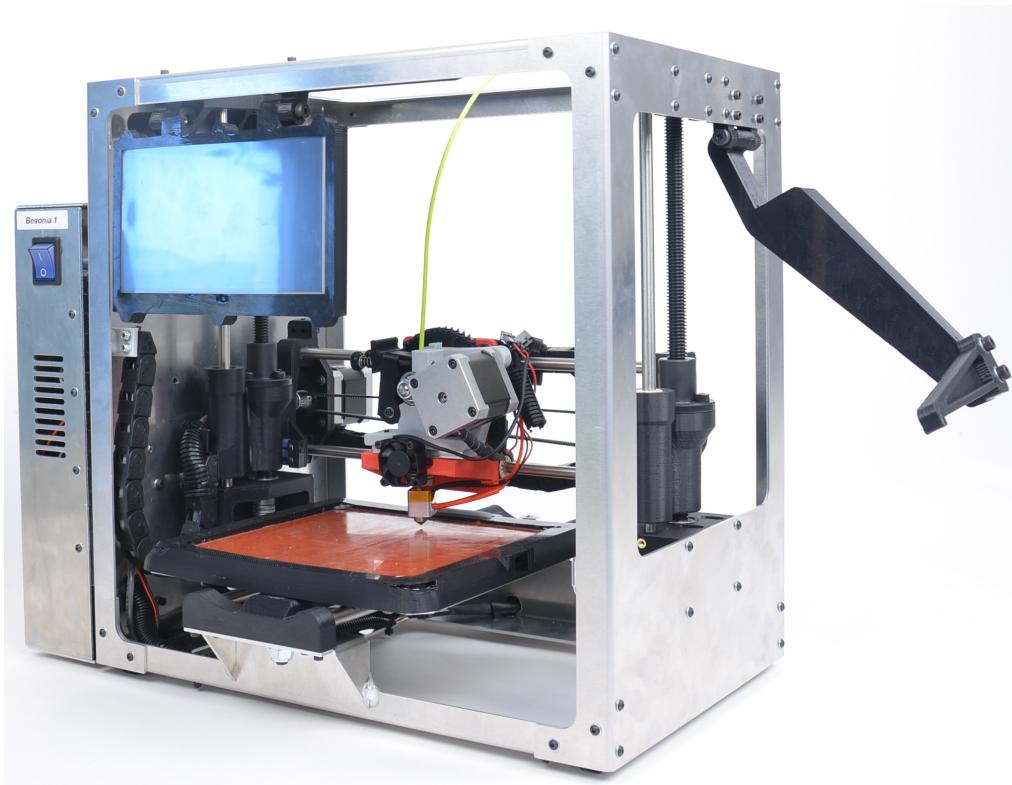


Figure 1.6: Begonia Spool Arm Down Photo



Figure 1.7: Begonia Green Color Scheme Photo

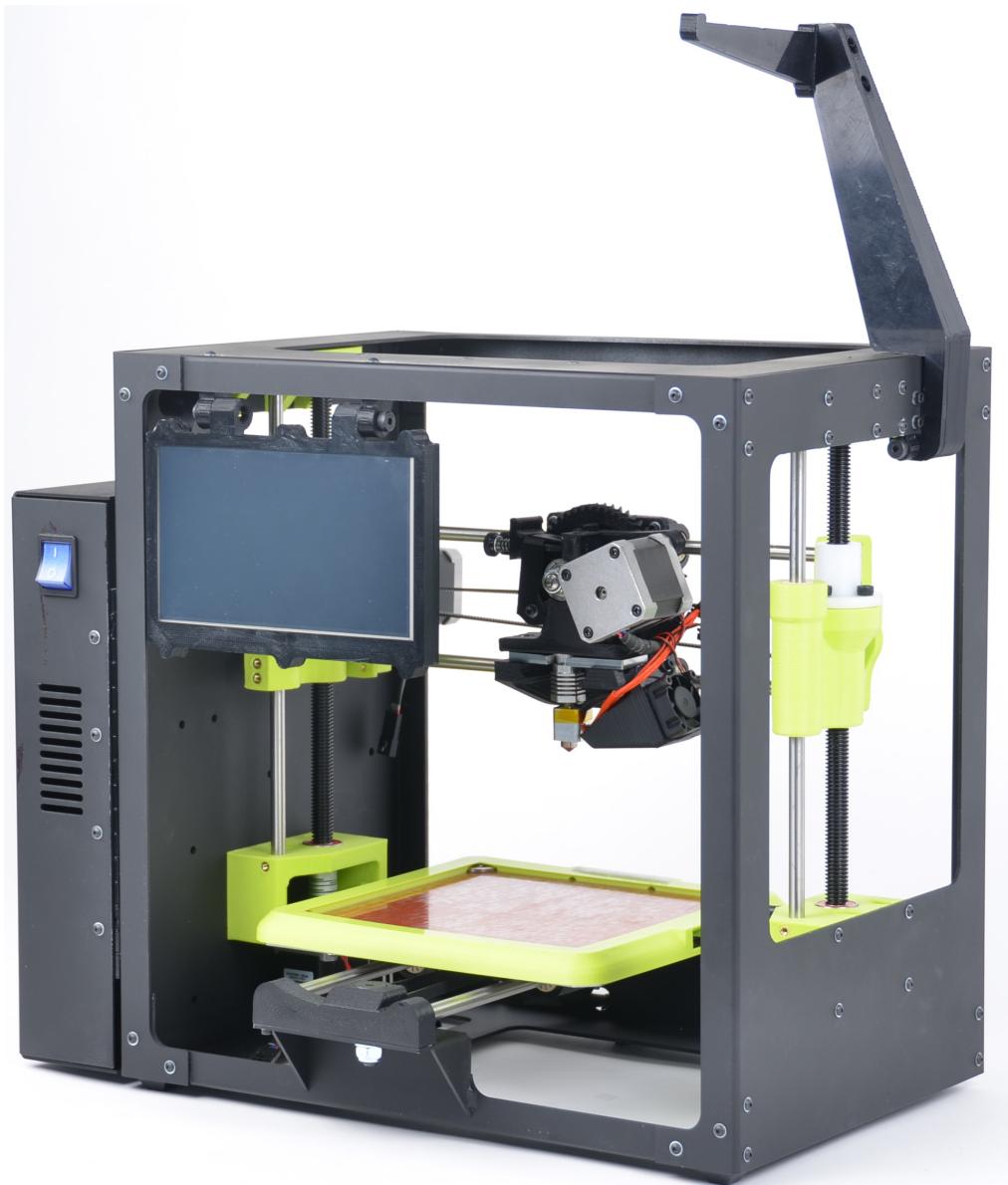


Figure 1.8: Begonia Black Green Color Scheme Photo

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/

Mechanical

Cartesian Bot in X, Y, Z

2.1 Intro

Mechanical hardware specs and parts are in these subdirectories:

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

2.2 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 Rod 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 #M3	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

EL-WR0122	16AWG Stranded - Green	C2055A-21.06	Digikey	mm	\$0.87	1000 ft
	16AWG Stranded - White	C2065A-21.02	Digikey	mm	\$6.11	2000 ft
	16AWG Stranded - Violet	C2065V-1.00-ND	Digikey	mm	\$1.36	4000 ft
	Ferrite Tubular Bead 19.00mm	C2055V-1.00-ND	Digikey	mm	\$0.34	
	Term Block Plus 4POS STR 5.08MM	240-2314-ND	Digikey	ea	\$0.335	
	Term Block Plus 2POS STR 5.08MM	WM7953-ND	Digikey	ea	\$1.22	
	Term Block Plus 2POS STR 5.08MM	WM7819-ND	Digikey	ea	\$0.46	
	20+POS .100 Dual (Black)	WM2527-ND	Digikey	ea	\$0.120	
	REEL - RING TONIQUE CONN 16-22 AWG #10 PIDG	A1062TR-ND	Digikey	ea	\$0.84	
	Reprap Modified Hexagon Holend, Lulzbot Edition, 3.0mm Filament	2-36154-2	Rapairdiscount	ea	\$23.00	
	Left Plate,	EPOCS	EPOCS	ea	\$23.00	
	Left Plate,	EPOCS	EPOCS	ea	\$19.50	
	Right Plate,	EPOCS	EPOCS	ea	\$12.75	
	Top Plate,	EPOCS	EPOCS	ea	\$21.00	
	Bottom Plate,	EPOCS	EPOCS	ea	\$22.50	
	Bed Mount Plate,	EPOCS	EPOCS	ea	\$8.25	
	Bed Mount Plate,	EPOCS	EPOCS	ea	\$8.25	
	Electronics cover.	EPOCS	EPOCS	ea	\$19.00	
	Mounting Brackets for .41" High x .39" Wide Interior Snap-Together Cable and Hose Carrier	06-30-028-02	IGUS	mm	\$16.47	2800 feet
	DYLAN 24VDC-Sleeve 5.75CM 40X40X100MM 6000RPM 1.44W 2 TE4010-24H-S	06-30-10-02	Kysan	mm	\$9.99	3030
	DYLN 24VDC BALL 31.60CFM 80x80x15 MM 1.00W	RJ01-01-08	Kysan	mm	\$24.00	12100
	DYLN 24VDC-Sleeve 5.75CM 40X40X100MM 6000RPM 1.44W 2 TE4010-24H-S	698666	Kysan	mm	\$1.55	1050
	FAN 24VDC-BALL 31.60CFM 80x80x15 MM 1.00W	TF-8015-24M-B	MKB	mm	\$2.55	1010
	8mm Smooth rod x 18-19mm	TF-8015-24M-B	MKB	mm	\$8.900	6060
	8mm Smooth rod x 18-19mm	TF-8015-24M-B	MKB	mm	\$4.60	1010
	Hobbed Bolt, M8 x 50mm Hex head, 26mm offset, Stainless Steel	Quattro	MBK	mm	\$5.87	1010
	Bed leveling Washer 303 SST	MBK	MBK	mm	\$2.900	1160
	EMIRFI-Sheild Head-Shink Tubing 3/16" ID Before, 3/32" ID Techflex	H2C0.19BK	Allicable	mm	\$0.96	285.4 ft pieces
	Inference-Shielding Head-Shink Tubing 3/16" ID Before, 3/7"Techflex	H2C0-38BK	Allicable	mm	\$2.97	103.4 ft pieces
	MEI-18-8 Stainless Steel External-Serrated-Lock-Washer, M3 Screw Size, 6mm OD, 0.4mm Thickness	H2C0-38BK	Allicable	mm	\$0.02	4100
	Firm White Polyester Felt Strip, 1/4" Thick, 1" Width, Plain Back	91120A120	McMaster	mm	\$0.001	900 ft
	Metric Universal Unthreaded Spacer, 4.5mm OD, 8mm Length, M3 Screw Size	880B8K311	McMaster	mm	\$0.350	4050
	Tubing, Corrugated Loom, 25"	946B9A15	McMaster	mm	\$0.000	50.20
	Panduit	708161	Fastenal	mm	\$0.12	24x100ft rolls
	Black Alloy Steel Flat-Head Socket Cap Screw, Class 10.9, M8 Size, 40mm Length, 1.25mm Pitch	Timbeline	Timbeline	mm	\$0.13	1020
	Black Alloy Steel Flat-Head Socket Cap Screw, Class 10.9, M8 Size, 45mm Length, 1.25mm Pitch	Timbeline	Timbeline	mm	\$0.13	13000
	Metric Black Heat-Set Insert for Plastics, Tapered, M2-.4 Internal Thread, 2.9MM Length	94180A307	McMaster	mm	\$0.134	6100
	Metric Class 12.9 Socket Head Cap Screw Alloy Steel, Black, M2 Thread, 10mm Length, 0.4mm Fastenal	Timbeline	Timbeline	mm	\$0.026	12000
	Steel Flat Washer, DIN 125 zinc-plated class 4.2M screw sz, 5mm OD,	40350	Fastenal	mm	\$0.00	12000
	M3-6 SHCS, Black-Oxide	11125985	Fastenal	mm	\$0.04	10500
	M3-5 3.8mm Heater Insert	11125987	Fastenal	mm	\$0.06	79000
	M5- 8 6.7mm Heater Insert	11125987	Fastenal	mm	\$1.94	13000
	M3 Nyloc Nut, Zinc Plated	9129A126	mcmaster	ea	\$0.040	
	M3 Nut, Zinc Plated	9205A181	mcmaster	ea	\$0.094	
	M3 Sae Screw (Grub Screw)	NS0310-0306/met	McMaster	ea	\$0.01	
	M3 Washer, Steel, Zinc Plated	91390A100	Timbeline	mm	\$0.02	
	M3 x 12 Bolt, SHCS, Black-Oxide	MTR-W3100321	Timbeline	mm	\$0.13	
	M3 x 12 Bolt, SHCS, Black-Oxide	39501	Fastenal	mm	\$0.00	
	M3 x 12 Bolt FHCS, SST	39501	Fastenal	mm	\$0.04	
	M3 x 8 Bolt, BHCS, Black-Oxide	9129A133	mcmaster	ea	\$0.065	
	M3 x 8 Bolt, BHCS, Black-Oxide	4	Timbeline	mm	\$1.10	
	M3 x 25 Bolt FHCS, SST	9129A138	mcmaster	ea	\$0.08	
	M3 x 25 Bolt FHCS, Black-Oxide	8050-0325	Timbeline	mm	\$4.00	
	M3 x 25 Bolt, SHCS, Black-Oxide	8050-0325	Timbeline	mm	\$0.03	
	M4 Nut,Zinc-Plated Steel	8100-0040	Timbeline	mm	\$0.02	

hardware	M4 Washer	SHCS Black-Oxide	8200-0040	\$0.00	\$0.02	ea	6		
hardware	M4 x 25 Bolt, SHCS Black-Oxide	91290A176	2	ea	\$0.137			6000	
hardware	M4 x 55 Bolt, SHCS Black-Oxide	N8805040455	2	ea	\$0.08			2020	
hardware	M5 Washer, Steel, Zinc Plated	91165A240	11	ea	\$0.022			2020	
hardware	M5 x 10 Bolt, SHCS Black-Oxide	Timberline	Timberline	Timberline	Timberline	Timberline	Timberline	11200	
hardware	M5 x 14 Bolt, SHCS Black-Oxide	8050-0510	6	ea	\$0.02			6000	
hardware	M5 Nyloc Nut, Zinc Plated	NOR-M805010450	5	ea	\$0.03			5000	
hardware	M8 Washer, Steel, Zinc Plated	GBO-986270004	3	ea	\$0.16			3000	
hardware	M8 Spring Steel Shim - DIN 988 0.5mm Thick, 8mm ID, 14mm OD	8200-0080	9	ea	\$0.01			9100	
hardware	Metric Spring Steel Shim - DIN 988 1.0mm Thick, 8mm ID, 14mm OD	Timberline	Timberline	Timberline	Timberline	Timberline	Timberline	10000	
hardware	Thumb Screw Knob for M4 SHCS, Black	Timberline	Timberline	Timberline	Timberline	Timberline	Timberline	10000	
hardware	Alloy Steel Shoulder Screw, 6mm Diameter x 10mm Long	92981A100	2	ea	\$0.10			2000	
hardware	Shoulder, M5 Thread Lock	McMaster	Timberline	AEH#02-00818-UVB	12	ea	\$1.030	\$2.06	
hardware	Wire Tie, 8"	Timberline	Timberline	7582K22	2	ea	\$0.02	\$0.28	
hardware	UV-Resistant Cable Tie Holder, Adhesive Back/Screw Mount, 4-Way, for 1/8" Maximum Tie, Bla	McMaster	McMaster	7604A55	0.5	g	\$0.249	\$0.50	
hardware	Ext-Refrigerant-Temperature Pipe Sealant & Threadlocker, 4 oz bottle, blue	McMaster	Thomson	Professional Plastics	2	ea	\$0.066	5 bottles	
hardware	Drive Rod 10mm	MTS10 x 2m	Thomson	G-SASL16-5-5	2	ea	\$28.100	5 bottles	
hardware	10mm x 2mm Flange mount superatut Coupling, Set Screw, M10mm G-SASL16-5-5	McMaster	Professional Plastics	S-13994	160	mm	\$6.780	2020	
hardware	Uiten PEI, 0.010" x 1.2" x 90ft rolls	Timberline	Timberline	5279	160	mm	\$7.50	2020	
hardware	3.3994 2M 468MP Adhesive Transfer Tape - 12" x 60 yards	McMaster	McMaster	QT1K321007-06	1	ea	\$0.034	10 rolls	
consumable	EL-C50040	6ft 1.8AWG Power Cord Cable w/ 3 Conductor PC Power Connector Socket (C13/15-15P) - Bla	Thomson	Monoprice	161-PF03063	1	ea	\$5.51	5 rolls
mechanical	HD-R20036	Drive Rod 10mm	Thomson	Monoprice	5765-0233007-MXP	1	ea	\$0.005	5 rolls
mechanical	HD-NT0047	10mm x 2mm Flange mount superatut Coupling, Set Screw, M10mm G-SASL16-5-5	McMaster	Monoprice	602-8861-100-03	185	mm	\$1.05	10 rolls
mechanical	HD-M50194	Uiten PEI, 0.010" x 1.2" x 90ft rolls	Thomson	Monoprice	879-132766-BK	2	ea	\$0.16	1010
mechanical	HD-M50255	3.3994 2M 468MP Adhesive Transfer Tape - 12" x 60 yards	Thomson	Monoprice	879-133276-BK	2	ea	\$0.10	1010
electronic	EL-C40030	6ft USB 2.0 A Male to B Male 28/24AWG Cable	Thomson	Monoprice	161-PF03063	1	ea	\$3.16	2050
electronic	EL-C40001	AC Power Entry Modules SC MT FUSED 25" TAB	Thomson	Monoprice	5765-0233007-MXP	1	ea	\$0.89	2050
electronic	PP-MP0028	Cartridge Fuses 15A 5x20 MAUL BC	Thomson	Monoprice	602-8861-100-03	185	mm	\$0.00	8 rolls
electronic	EL-M50096	Wire - Single Conductor 20AWG SOLID PTFE, RED	Thomson	Monoprice	879-132766-BK	2	ea	\$0.16	3020
electronic	EL-WR040	Heavy Duty Power Connectors HOUSING ONLY, BLACK POWERPOLE 15-45	Thomson	Monoprice	879-133276-BK	2	ea	\$0.20	2050
electronic	EL-M50008	Heavy Duty Power Connectors POWERPOLE 15A CONT	Thomson	Monoprice	161-PF03063	1	ea	\$27.95	On Order
electronics	PC-BD0029	Silicon Heater, 24V, 1.68mm x 1.68mm, Self Adhesive, w/ connectors	Thomson	National Plastic Heater	161-PF03063	1	ea	\$6.68	1050
electronics	EL-FA0020	RFB-2008 Micro Blower	Pelonis	Pelonis	161-PF03063	1	ea	\$1.70	1100
electronics	EL-SW0023	SWITCH ROCKER DPDST 20A 250V, illuminated red	Digikey	Changzhou FTMX Motors Co.	EG1535-ND	5	ea	\$7.50	On Order
electronics	EL-MT0001	NEMA 17 Stepper Motors	UltiMachine	UltiMachine	SY425TH47-1504A	1	ea	\$57.00	1020
electronics	PC-BD0049	Mini RAMBo, assembled board only with no LCD headers	vxb.com	Kit078	20140922SSA	1	ea	\$0.20	11000
electronics	HD-M50204	Labeled Skateboard/Line/Rollerblade Skate Bearing Ball Bearings	Shipper's Supply	Shipper's Supply	20140922SSA	1	ea	\$9.91	810
electronics	PP-FP0058	Laser Engraving Designs	Shipper's Supply	Shipper's Supply	20140922SSA	0.018	pc	\$20.53	1010
packaging	SH-PPG075	SH-PPG075 3 "# RECY & # CROSSLINK W/ 10030 CH URETHANE	1	ea	\$3.70			1010	
packaging	SH-PPG0076	22x17x9 275# dw white/ OUTSIDE PRINT 2 COLOR	1	ea	\$4.95			1010	
packaging	SH-PPG0085	3" x 55 yards x 1.1 Mill Ulne Clear Carton Sealing Tape 24 rolls/case	1	ea	\$0.09			1010	
packaging	Label,Lubrit Small Mini Barcode	Label,Lubrit Small Mini Barcode	1	ea	\$0.14			1010	
packaging	D-C-IB0029	Mini V1 serial numbers sticker	1	ea	\$0.01			1010	
packaging	RW-H10024	HFS, 1 meter Sample, Random Color	1	ea	\$0.03			1010	
packaging	SH-PPG0002	3 x 4" 2 Mil Reclosable Polypropylene Bags	1	ea	\$0.02			1010	
packaging	SH-PPG0083	9 x 12" 8 Mil Reclosable Bags	1	ea	\$0.29			1010	
packaging	SH-PPG0084	6 x 10" 6 Mil Reclosable Bags	1	ea	\$0.18			1010	
packaging	D-C-MS0028	Packing List, Mini L	1	ea	\$0.24			1010	
packaging	D-C-MS0029	Quality assurance record Mini 1.0	1	ea	\$0.72			1010	
tools	TU-MS0020	TU-MS0020 3.5" Stainless Steel/Straight Instrument Cleaner Brush	GORDON BRUSH MFG C	906501	1	ea	\$5.29	1020	
tools	EL-M50220	Swiss Style USB Flash drive, 4gb, black	USB Memory Direct	(DP-19) M S V	\$4.15			1020	
tools	EL-HD0046	Pro Dental Pick, 5 3/4" in	Image Supply	WEBRestaurant Store	\$1.87			1010	
tools	TU-HD0009	TU-HD0009 7 1/2" Nylon Handle Claw Knife	1	ea	\$2.03			1010	
					\$752.61				
					1.000	Needs something			
					Total Lulu				

2.3 Begonia Renders

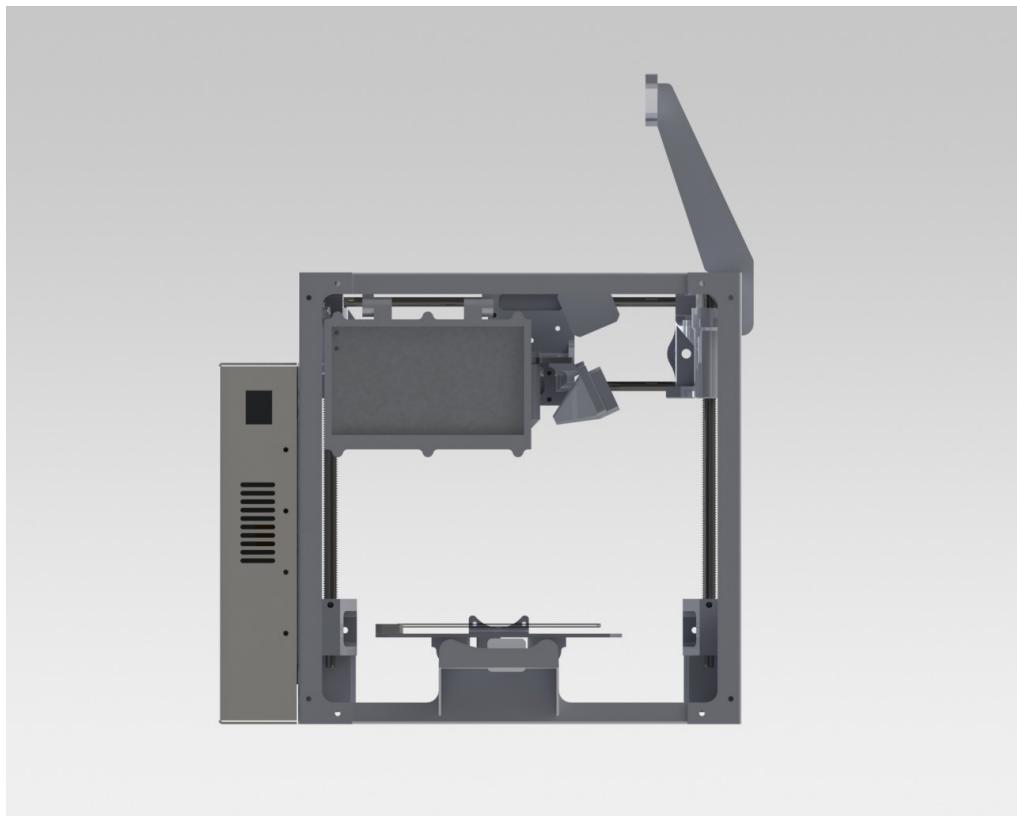


Figure 2.2: Begonia Front Render

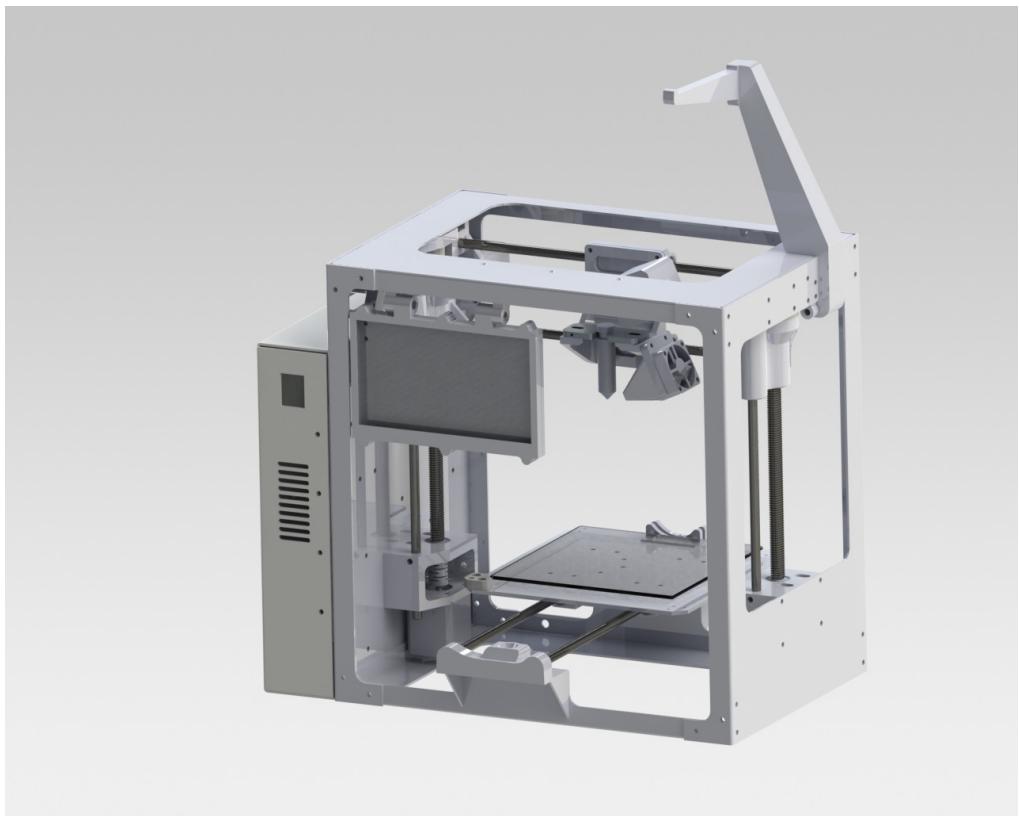


Figure 2.3: Begonia ISO Render

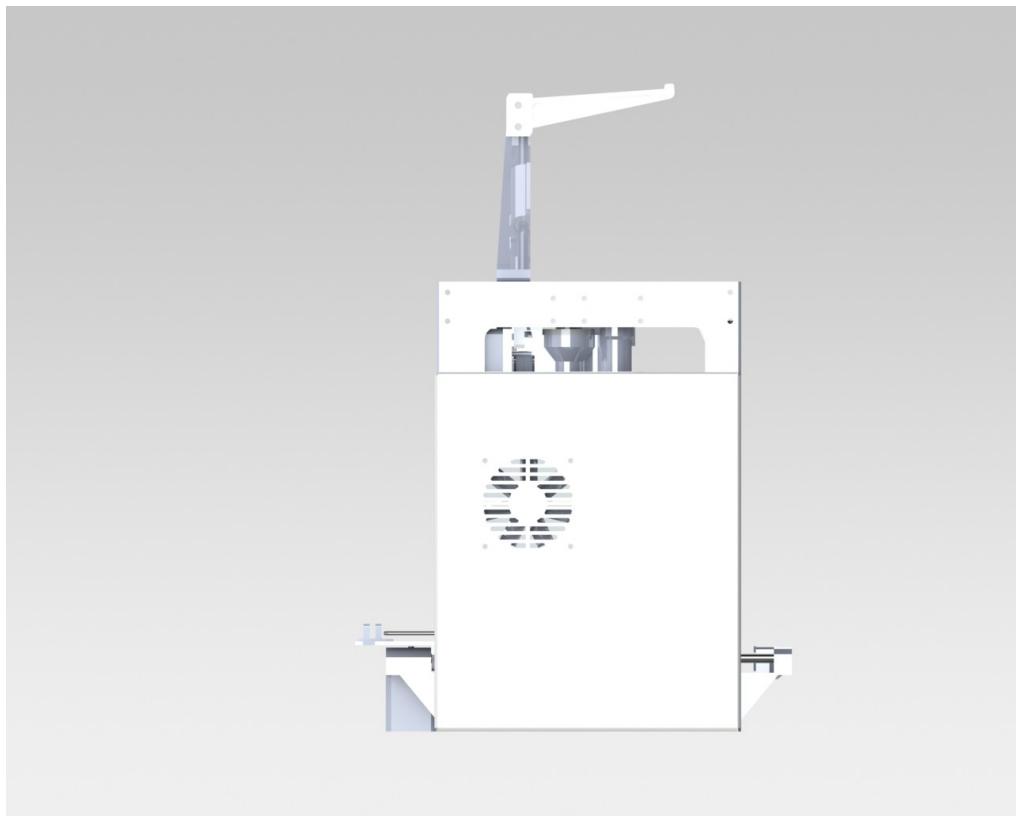


Figure 2.4: Begonia Left Render

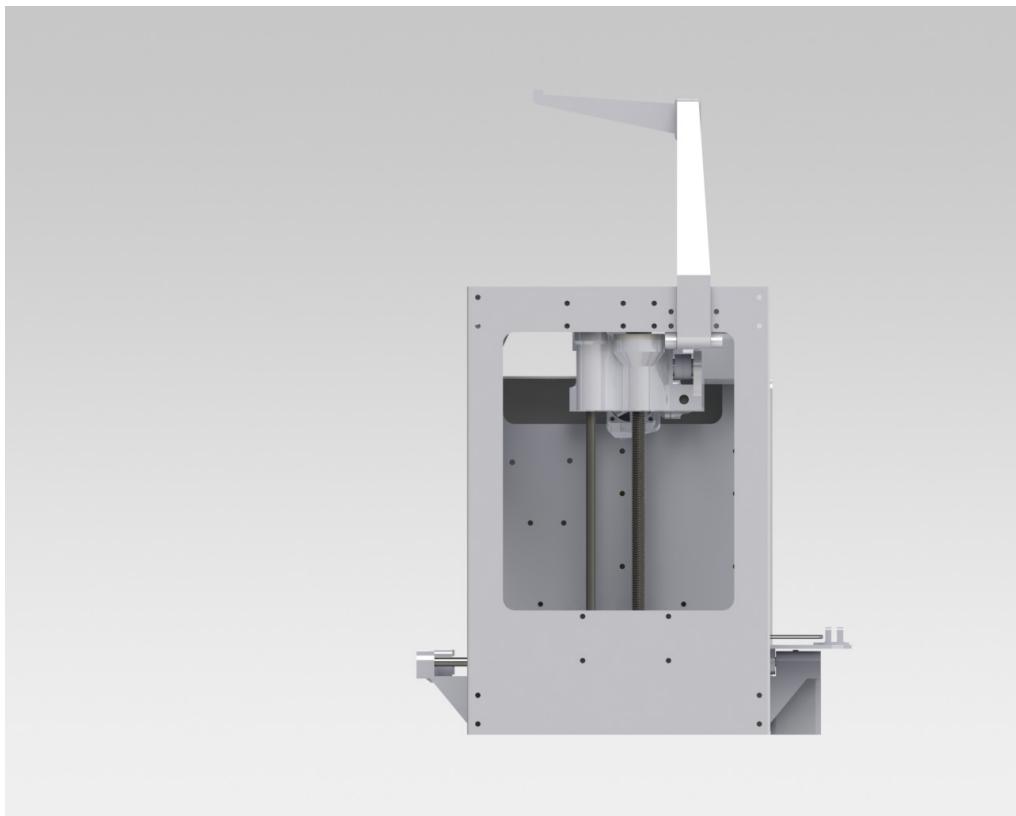


Figure 2.5: Begonia Right Render

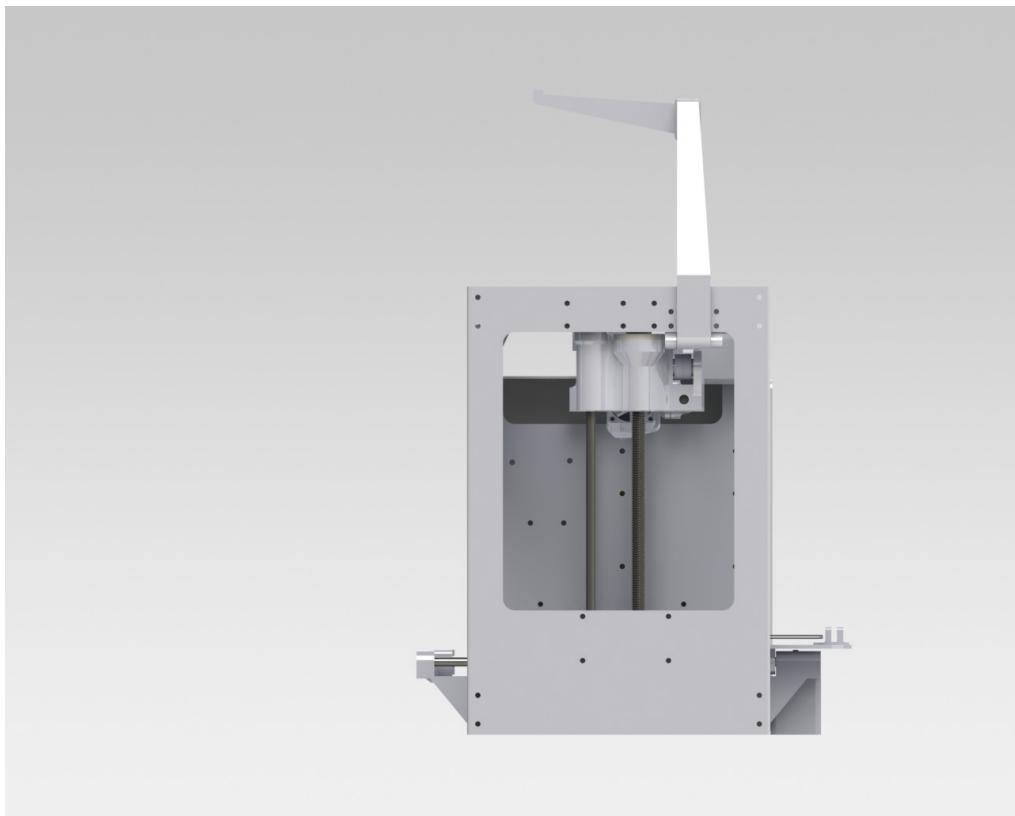


Figure 2.6: Begonia Right Render

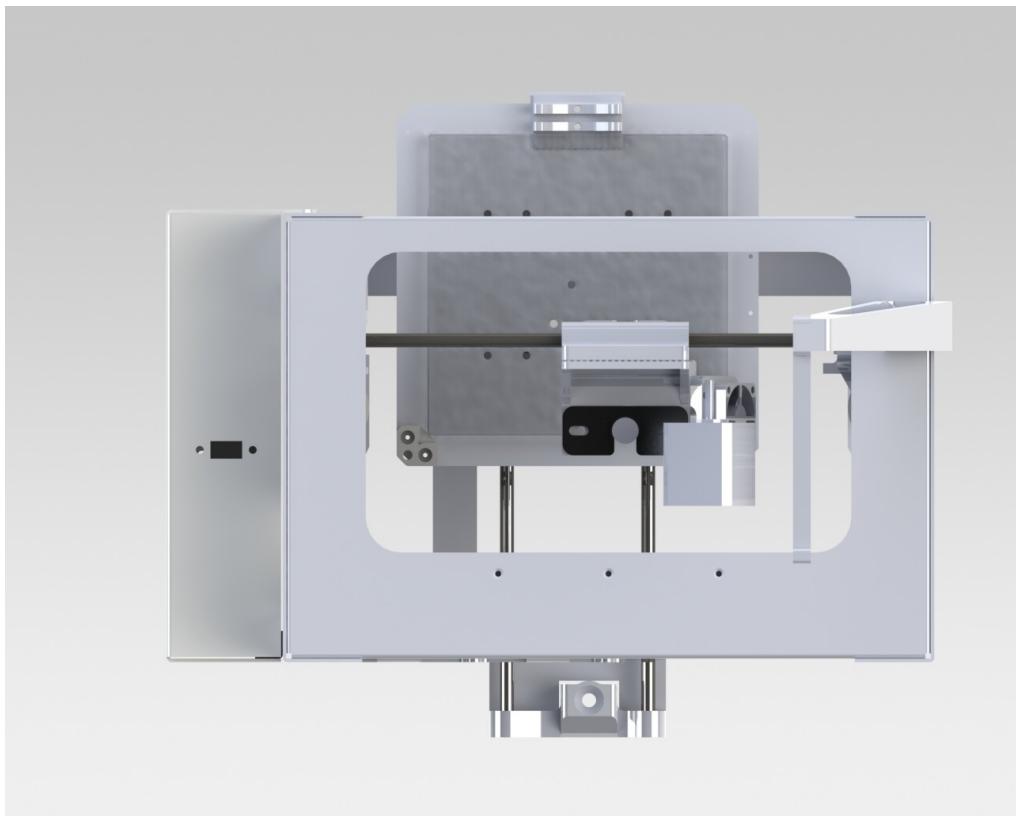


Figure 2.7: Begonia Top Render

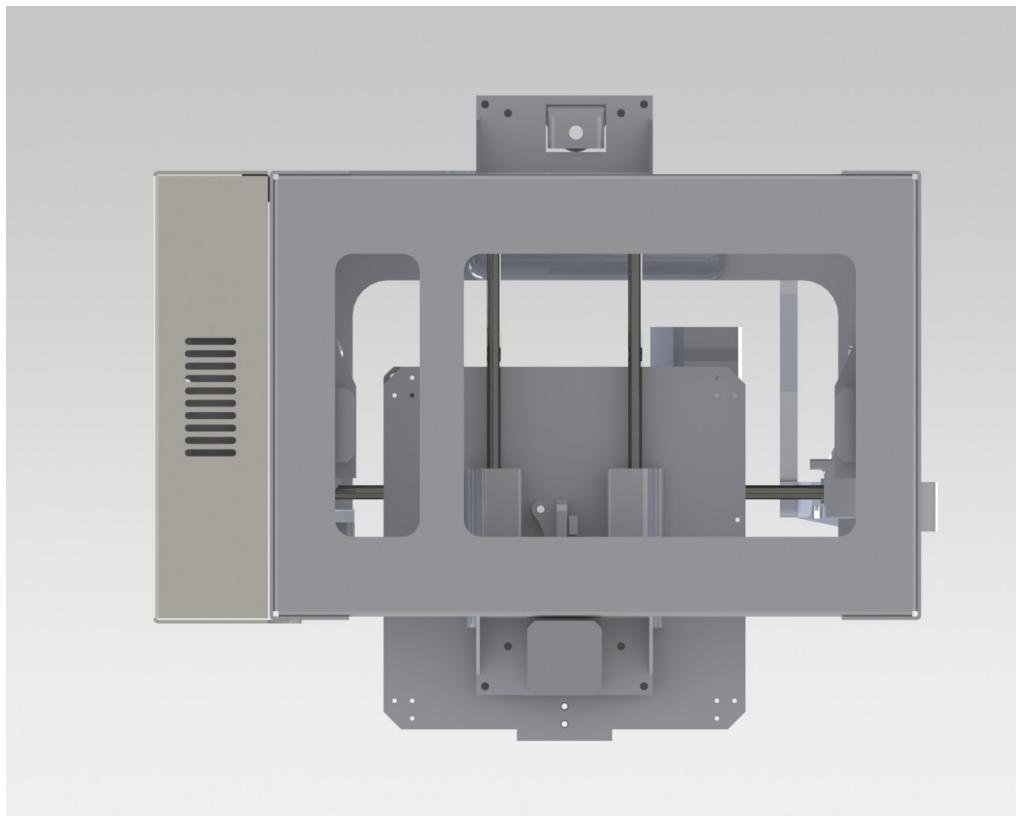


Figure 2.8: Begonia Bottom Render

2.4 Begonia 3D Printed Parts

2.5 Begonia Bed

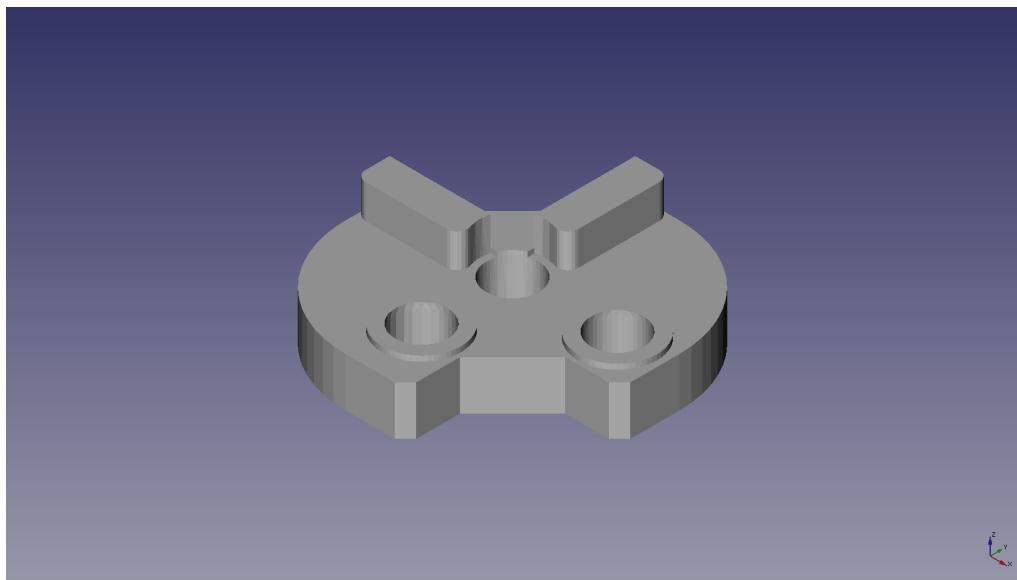


Figure 2.9: Begonia 3D Printed Bed Corner Render

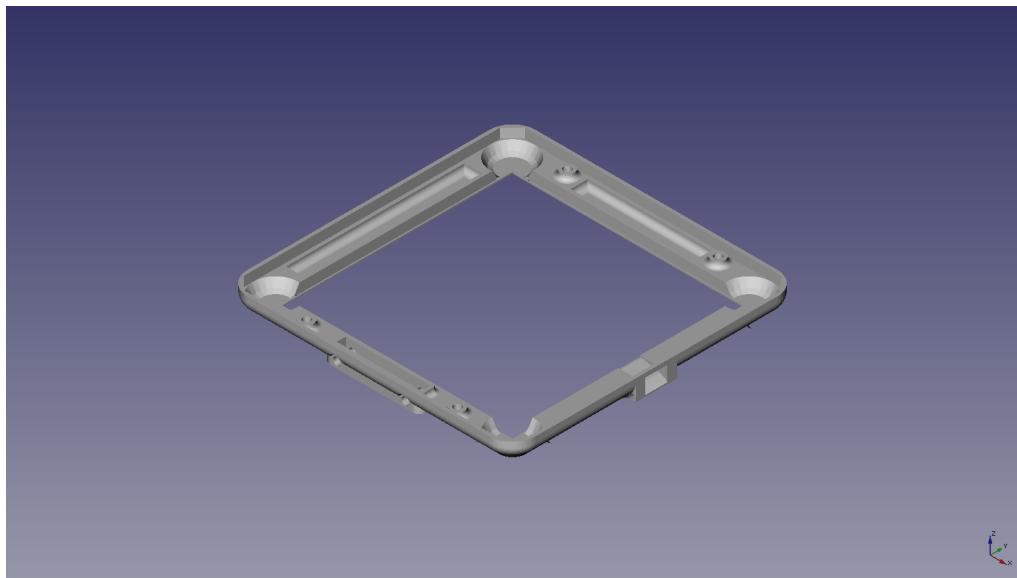


Figure 2.10: Begonia 3D Printed Bed Cover Render

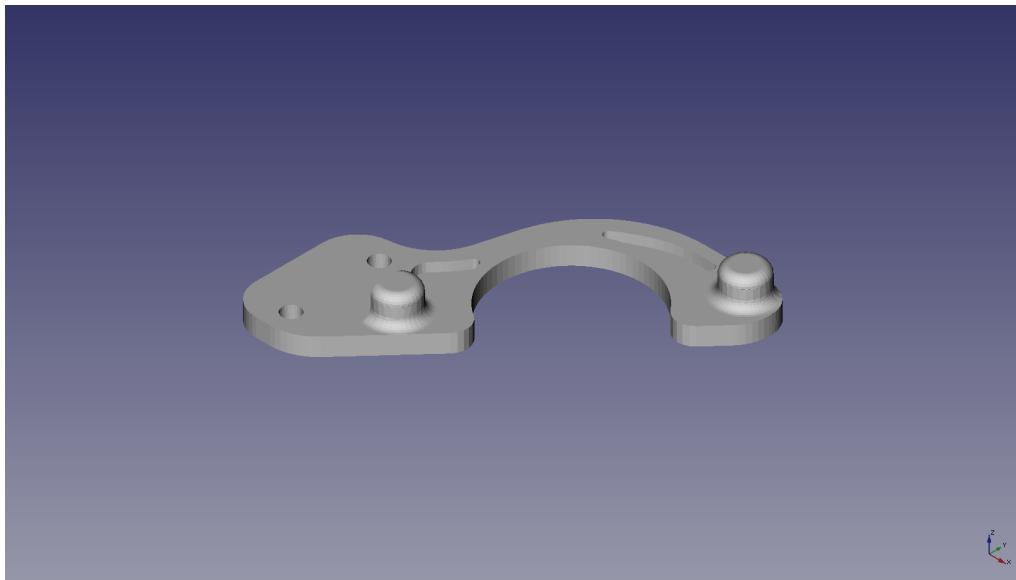


Figure 2.11: Begonia 3D Printed Bed Fan Mount Render

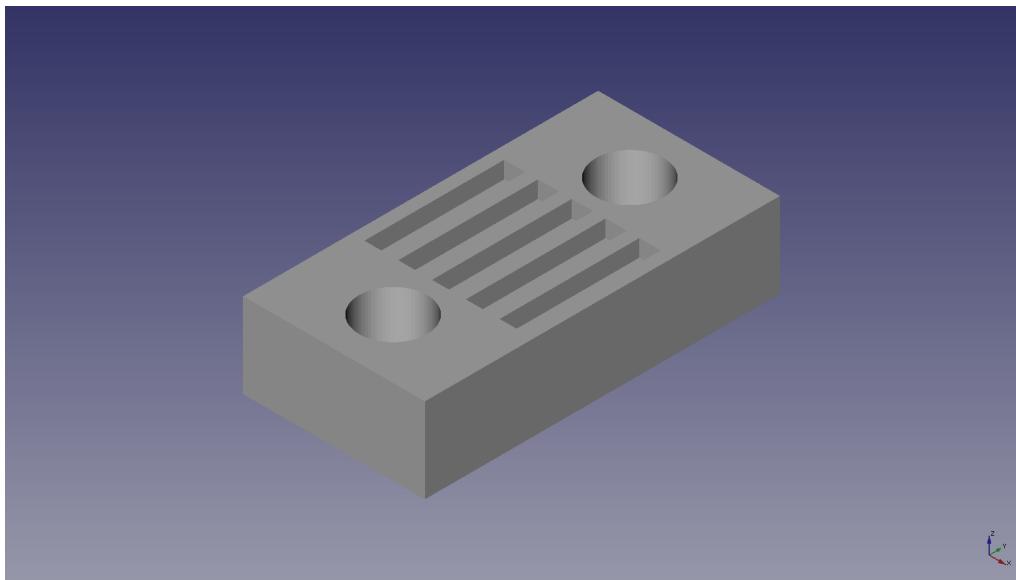


Figure 2.12: Begonia 3D Printed Belt Clamp Render

2.6. BEGONIA EXTRUDER

2.6 Begonia Extruder

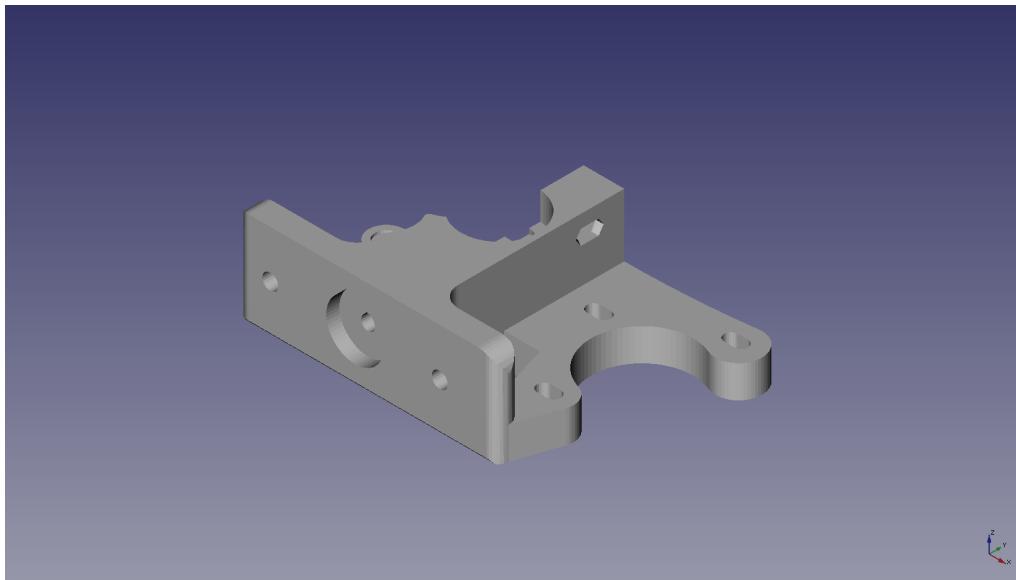


Figure 2.13: Begonia 3D Printed Extruder Body Hex Render

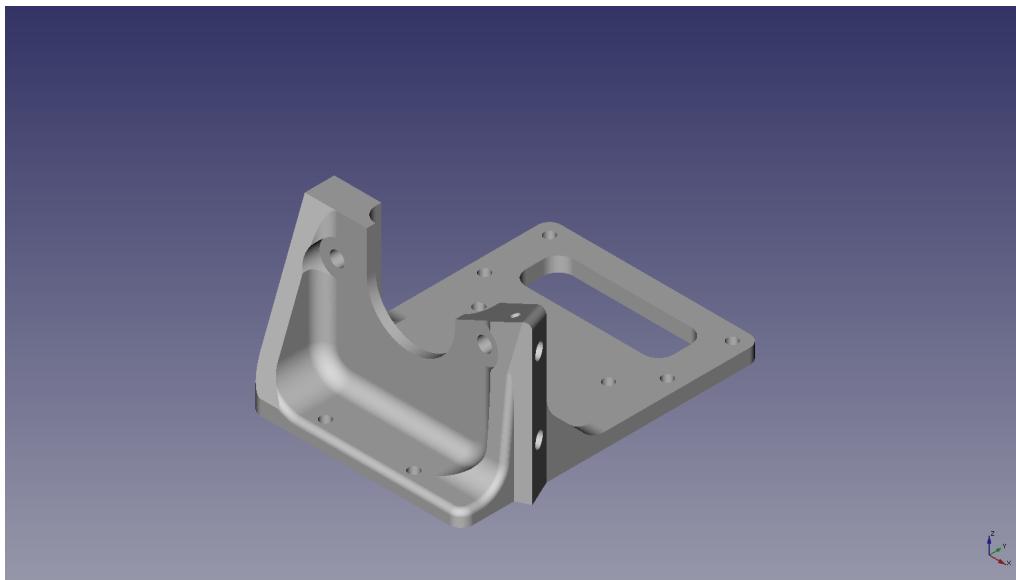


Figure 2.14: Begonia 3D Printed Extruder Mount Render

2.7 Begonia LCD

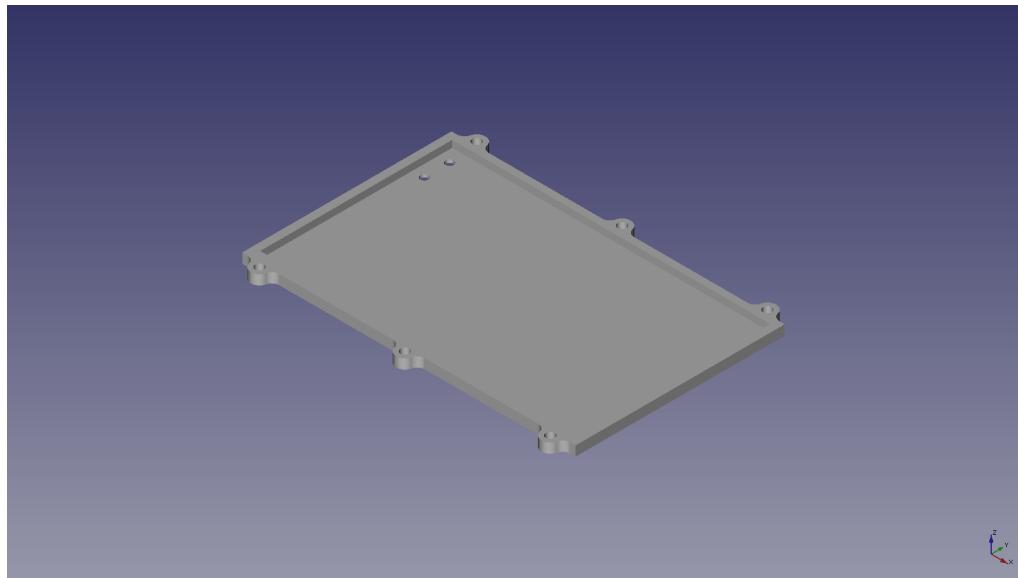


Figure 2.15: Begonia 3D Printed LCD Back Cover Render

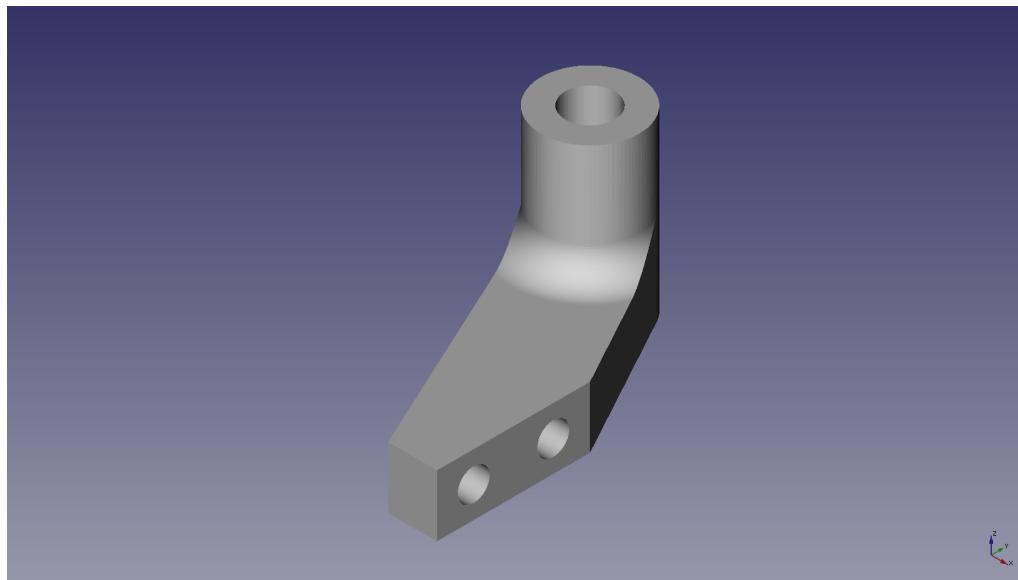


Figure 2.16: Begonia 3D Printed LCD Catch Render

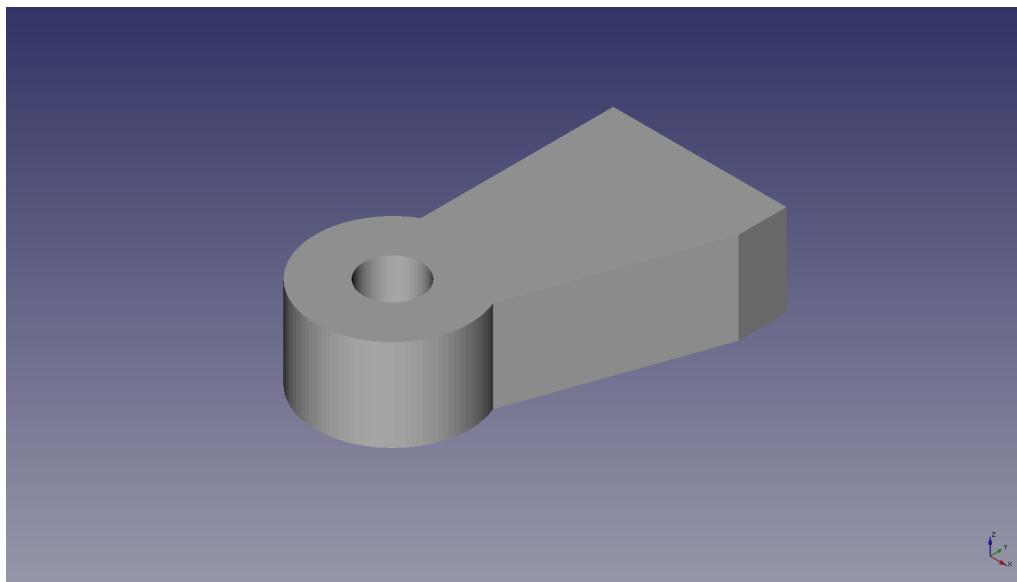


Figure 2.17: Begonia 3D Printed LCD Hinge Render

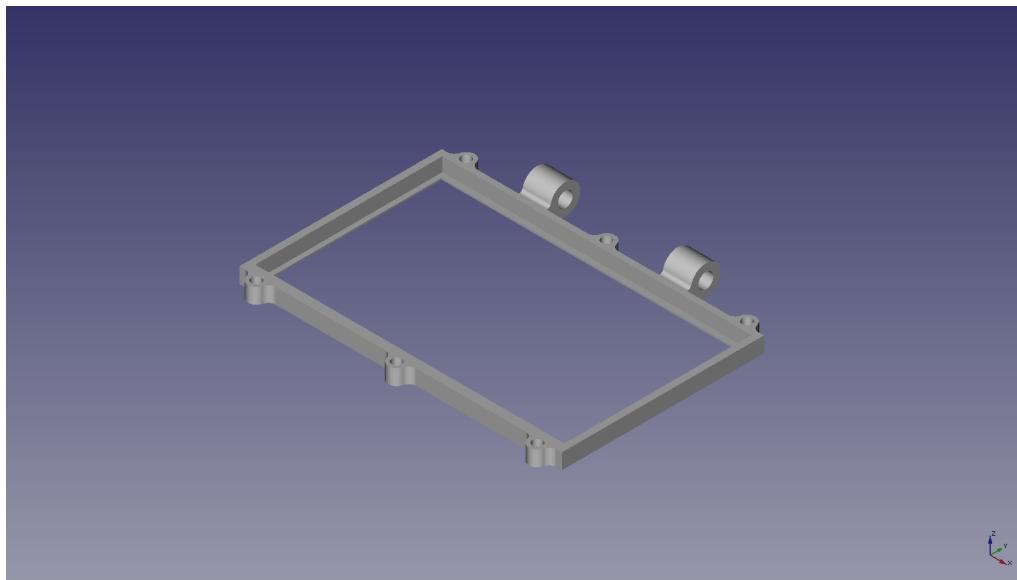


Figure 2.18: Begonia 3D Printed LCD Mount Render

2.8 Begonia Spool

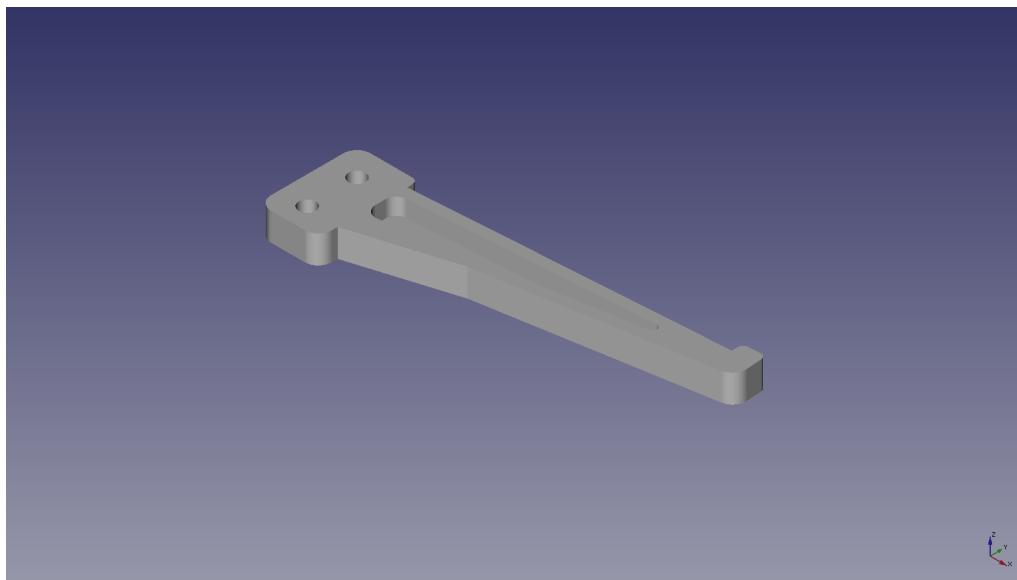


Figure 2.19: Begonia 3D Printed Spool Arm Render

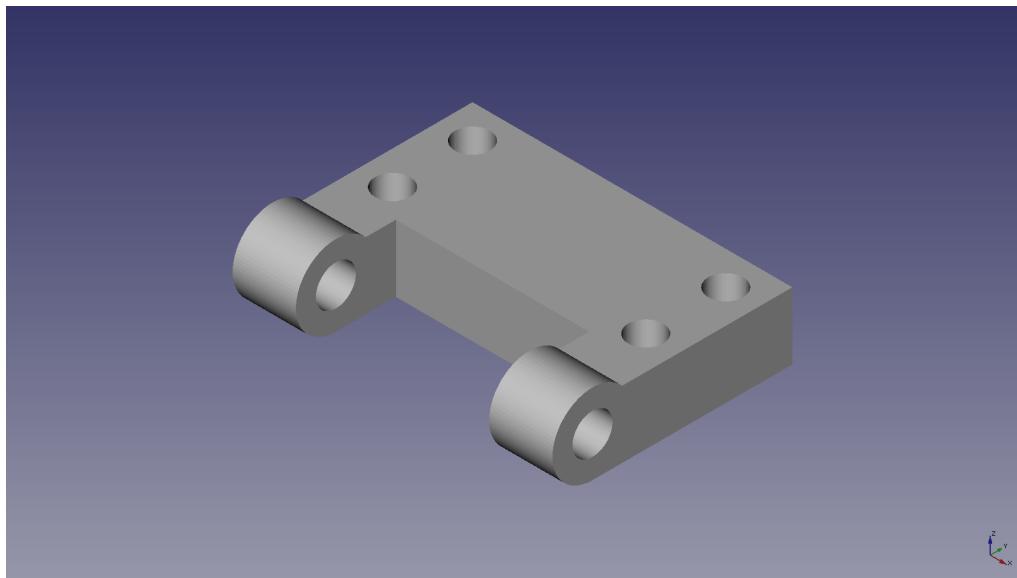


Figure 2.20: Begonia 3D Printed Spool Hinge Render

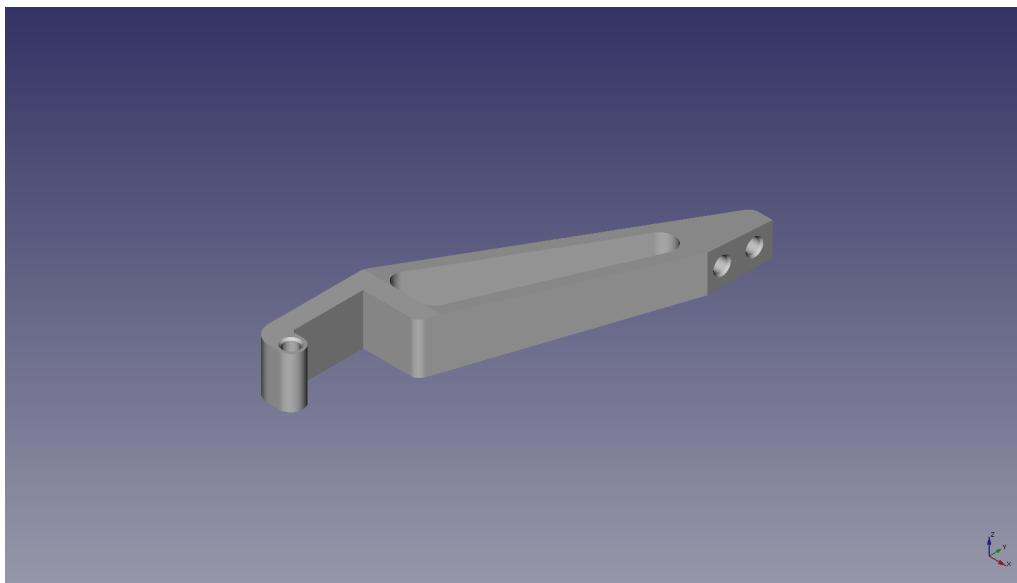


Figure 2.21: Begonia 3D Printed Spool Mount Render

2.9 Begonia X

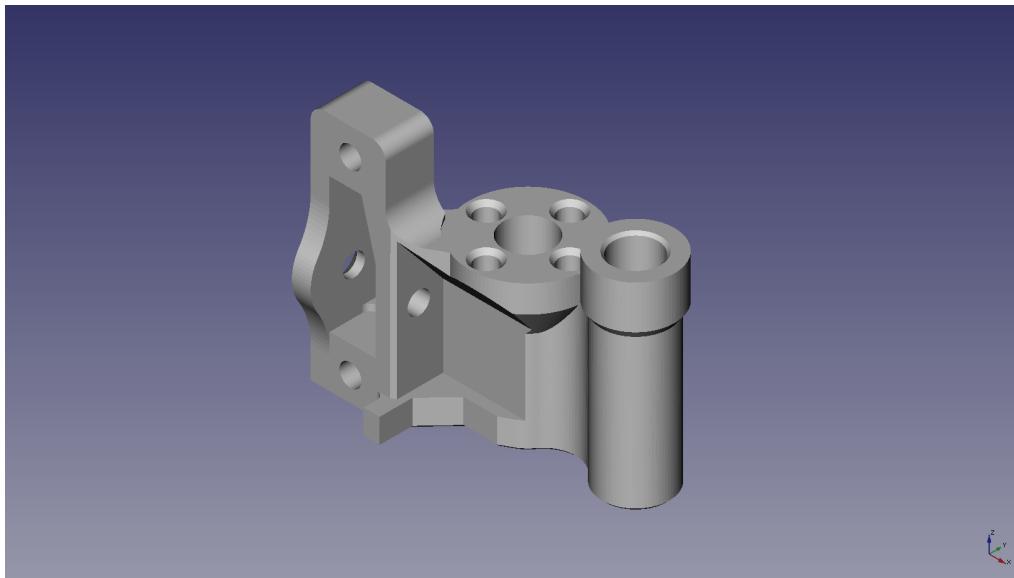


Figure 2.22: Begonia 3D Printed X End Idler Render

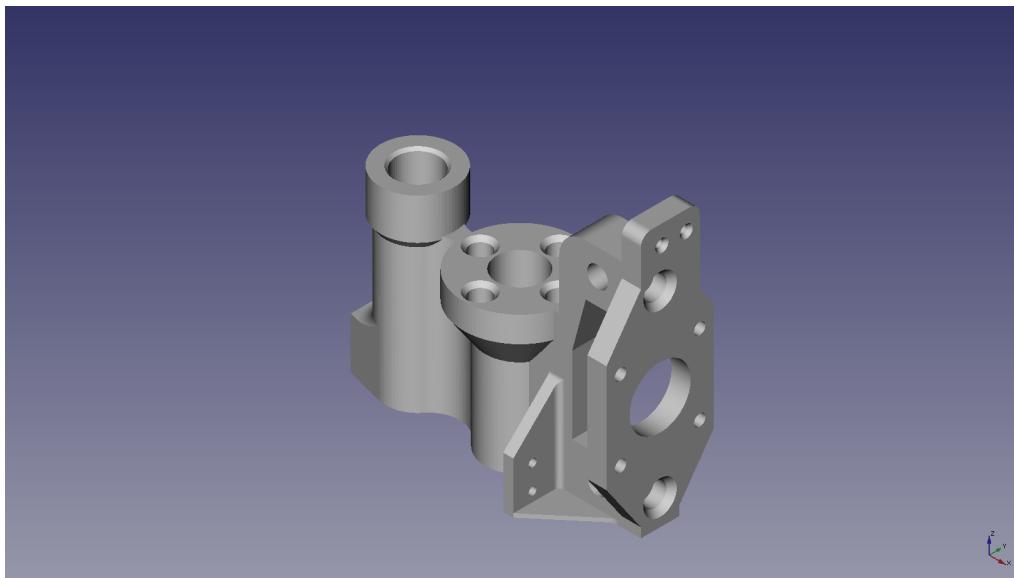


Figure 2.23: Begonia 3D Printed X End Motor Render

2.10 Begonia Y

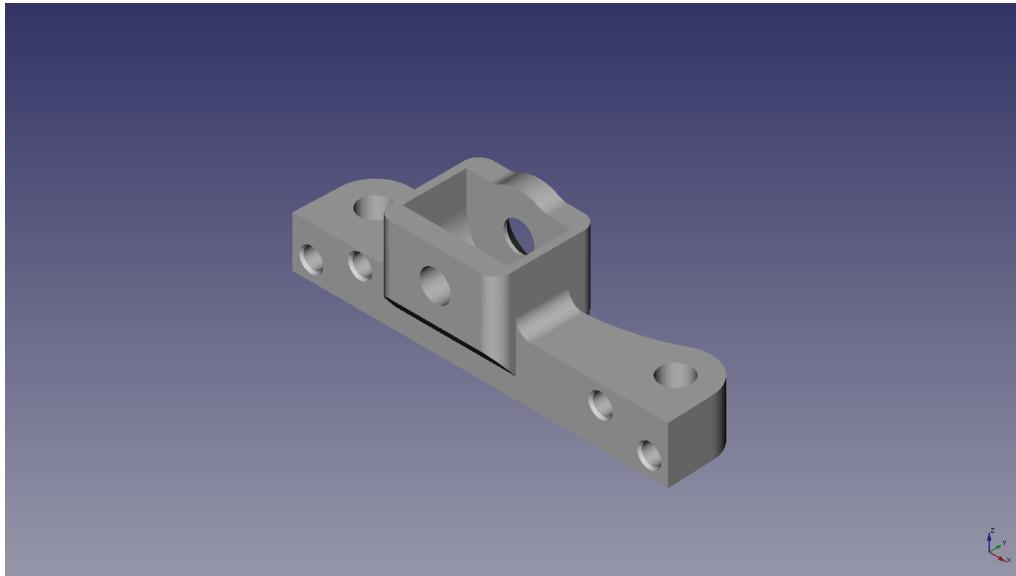


Figure 2.24: Begonia 3D Printed Y End Idler Render

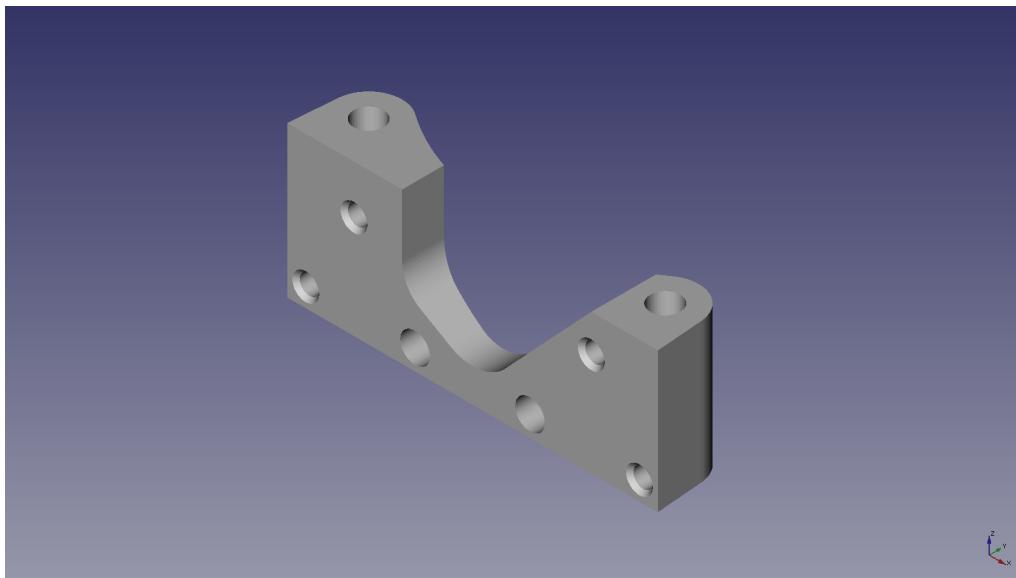


Figure 2.25: Begonia 3D Printed Y Rod Mount Render

2.11 Begonia Z

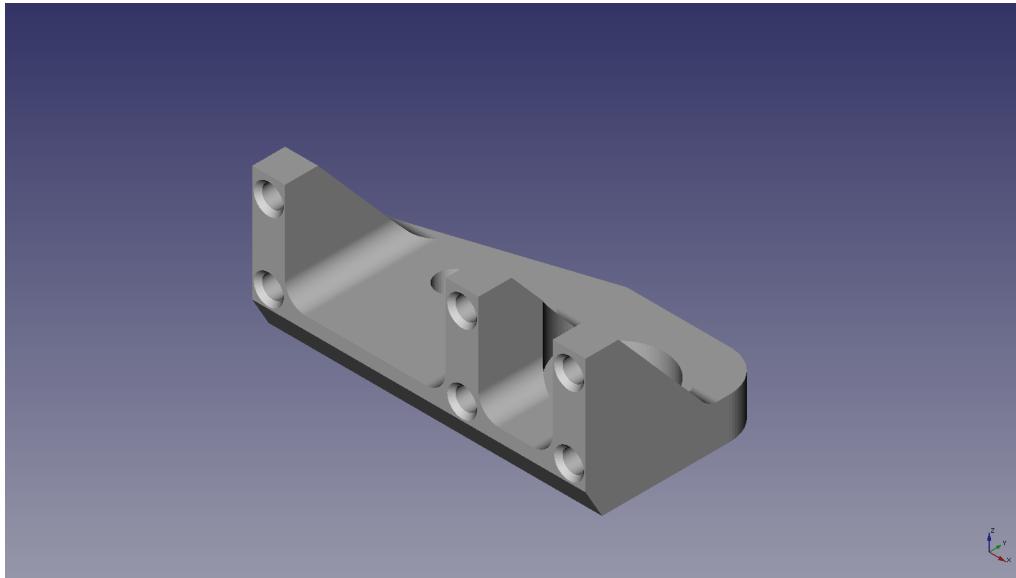


Figure 2.26: Begonia 3D Printed Upper Z Left Render

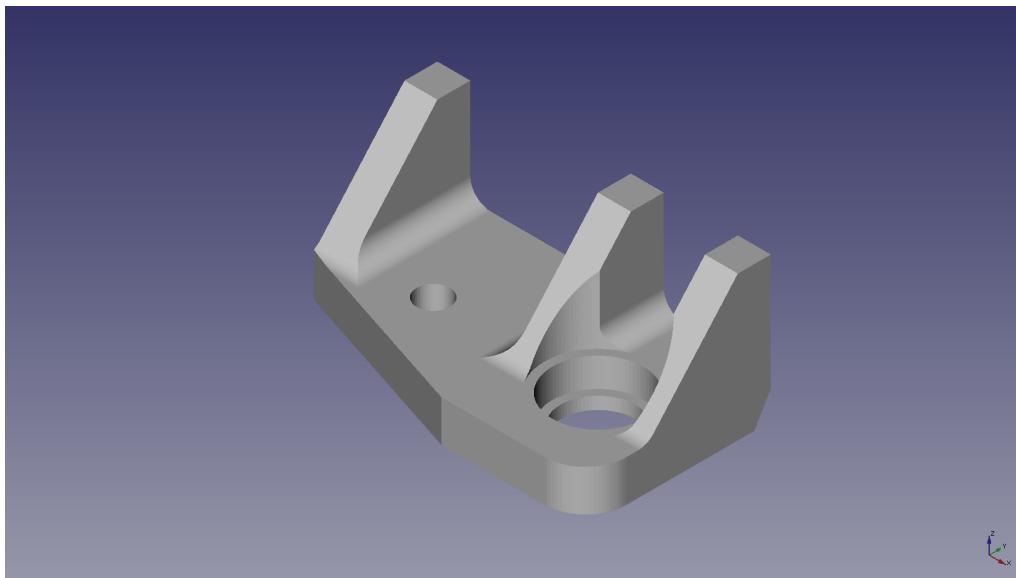


Figure 2.27: Begonia 3D Printed Upper Z Right Render

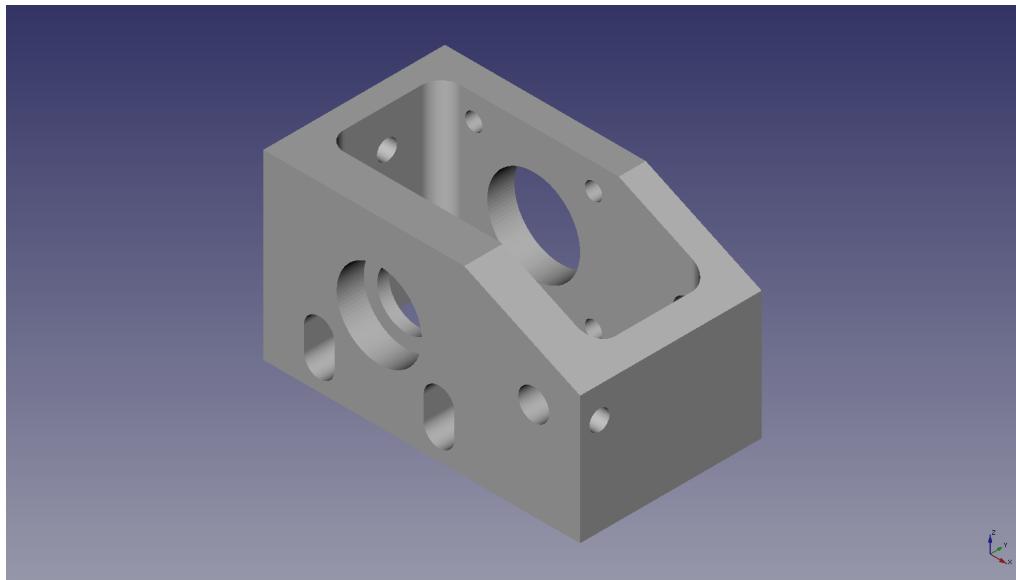


Figure 2.28: Begonia 3D Printed Lower Z Left Render

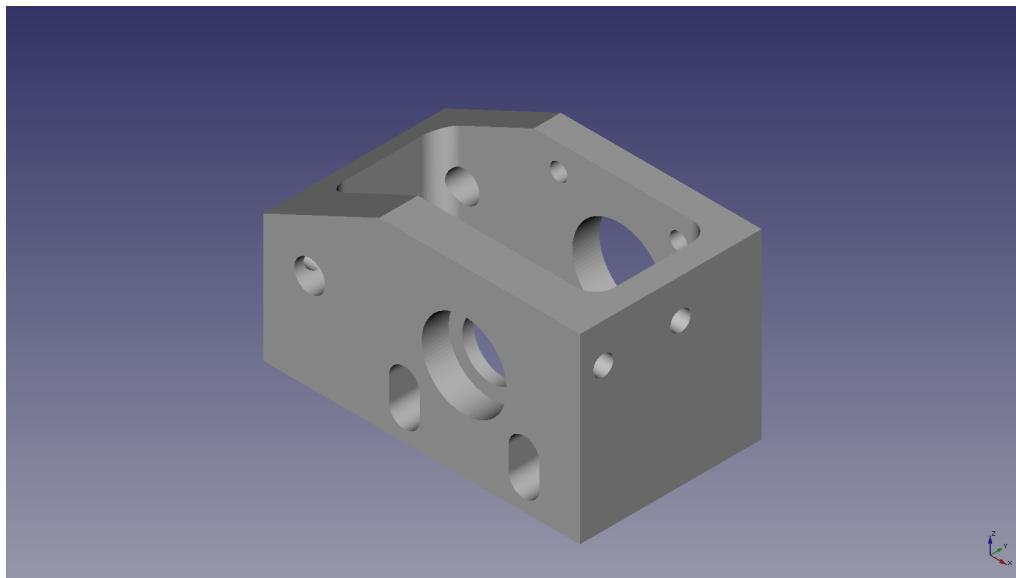


Figure 2.29: Begonia 3D Printed Lower Z Right Render

2.12 Begonia Misc

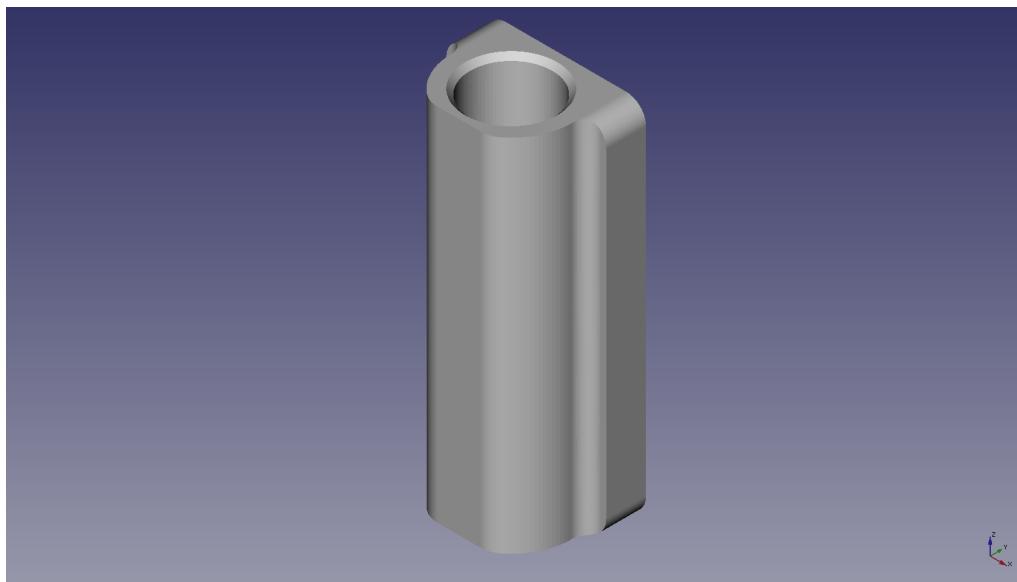


Figure 2.30: Begonia 3D Printed Double Bearing Holder Render

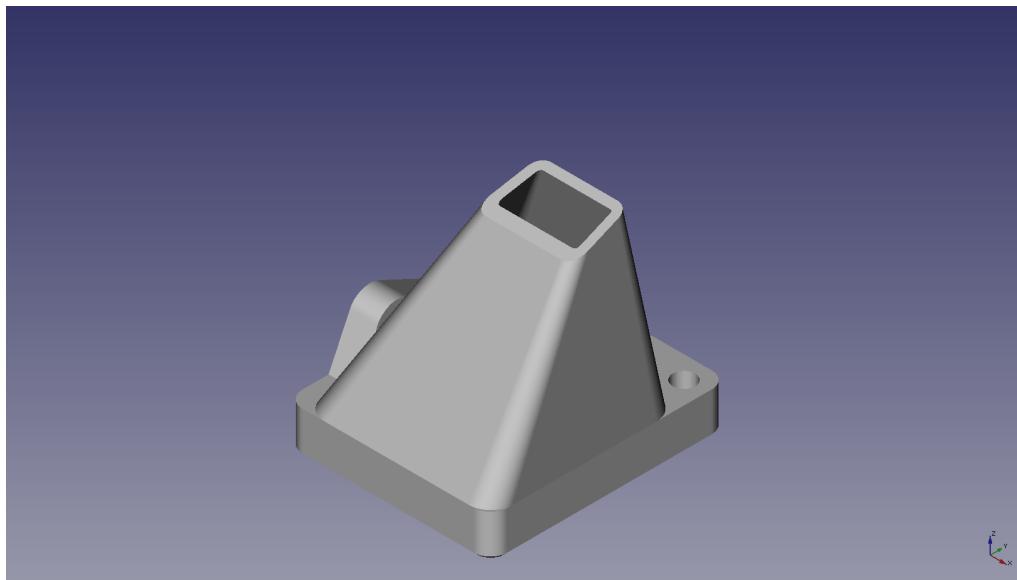


Figure 2.31: Begonia 3D Printed Fan Mount Render

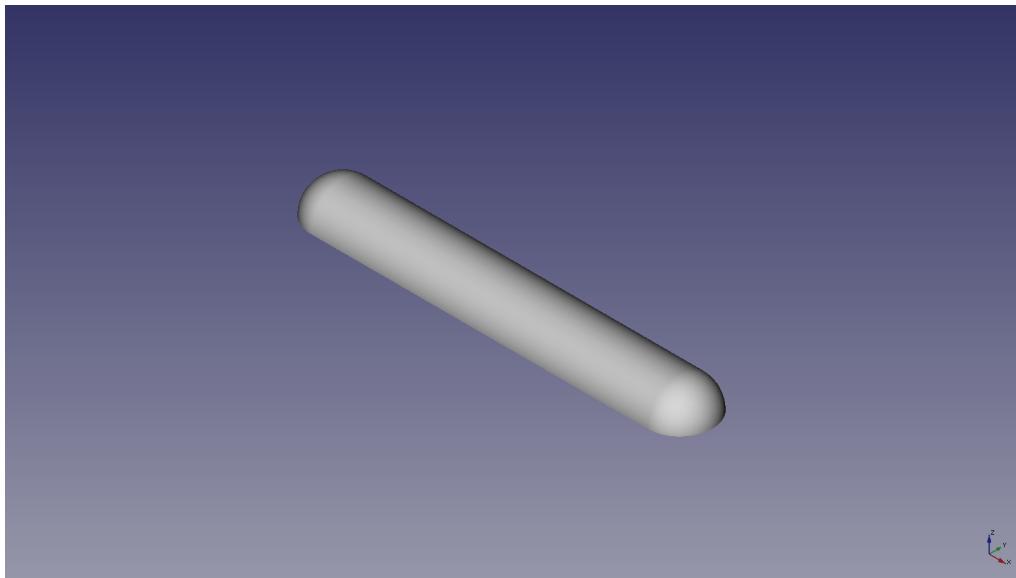


Figure 2.32: Begonia 3D Printed Handle Bar Render

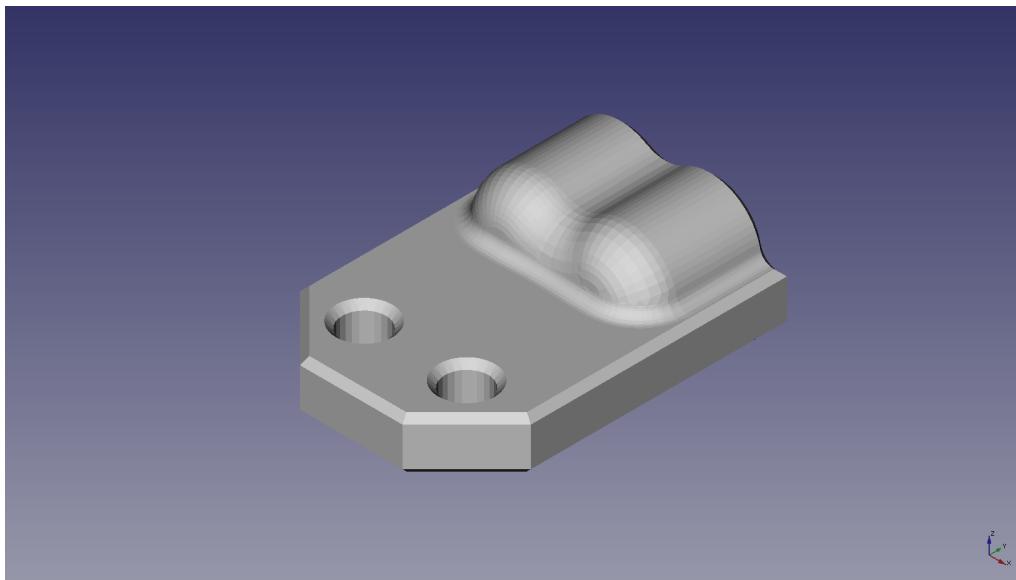


Figure 2.33: Begonia 3D Printed Cable Carrier Mount Render

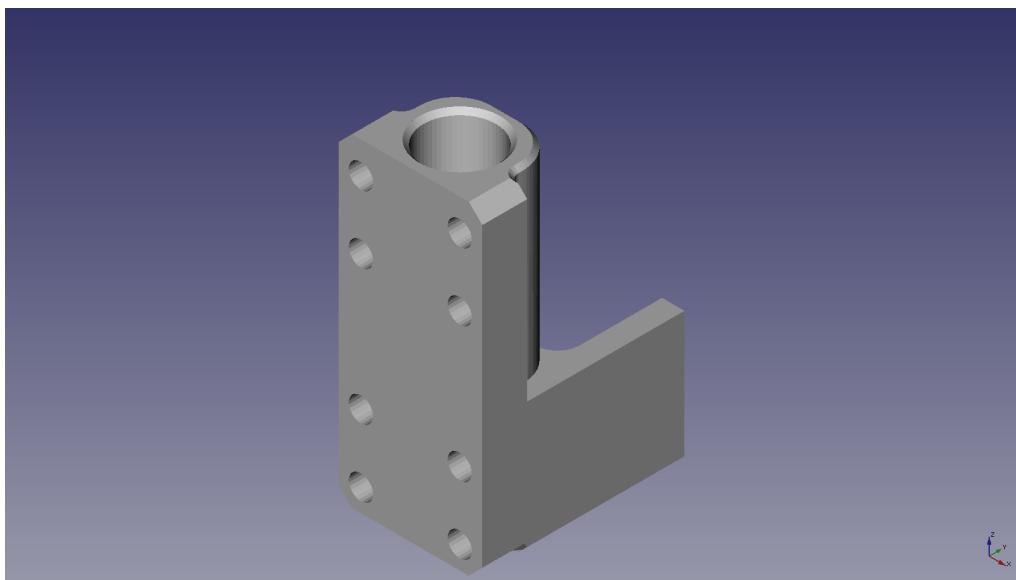


Figure 2.34: Begonia 3D Printed Extruder Mt Top Double Bearing Holder Render

2.13 Begonia Drawings

2.14 Camillia Drawings

Electrical

Power Supply, wiring

3.1 Electrical Layout

3D Printer Controller

Mini-RAMBo

4.1 Intro

The printer controller will be the RAMBo-Mini.

Contact

Phone, Email, Web, Location

5.1 Support

Email: support@alephobjects.com

Phone: +1-970-377-1111 x610

LulzBot Forum

<http://forum.lulzbot.com>

5.2 Sales

Email: sales@alephobjects.com

Phone: +1-970-377-1111 x600

5.3 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
