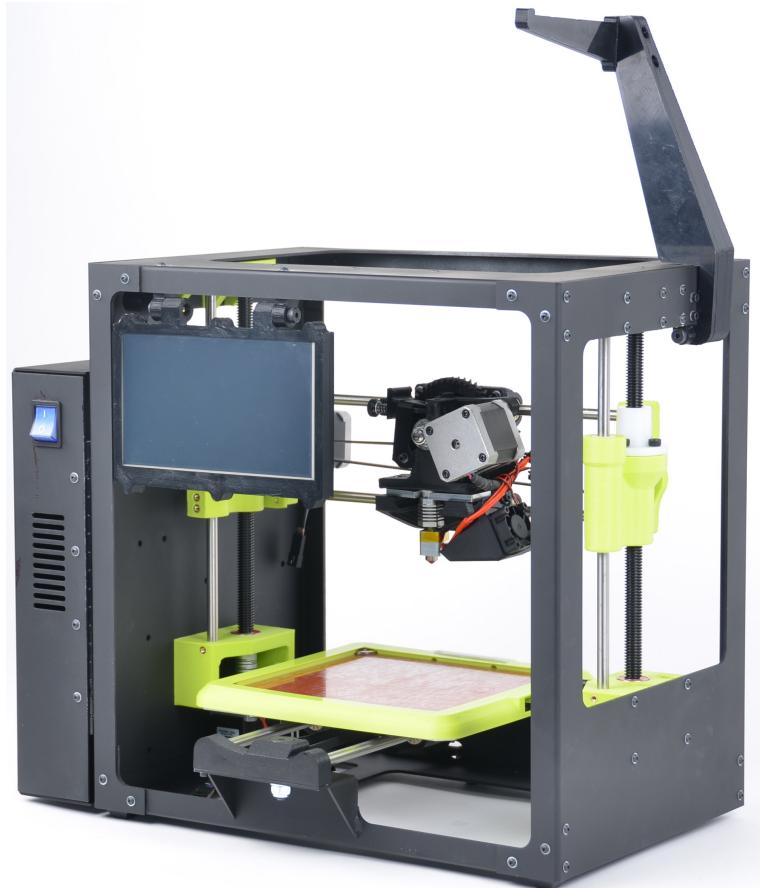


LULZBOT MINI DEVELOPER'S GUIDE



LulzBot Mini Developer's Guide

by Aleph Objects, Inc.

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Published by Aleph Objects, Inc., 626 West 66th Street, Loveland, Colorado, 80538 USA.

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20141117

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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

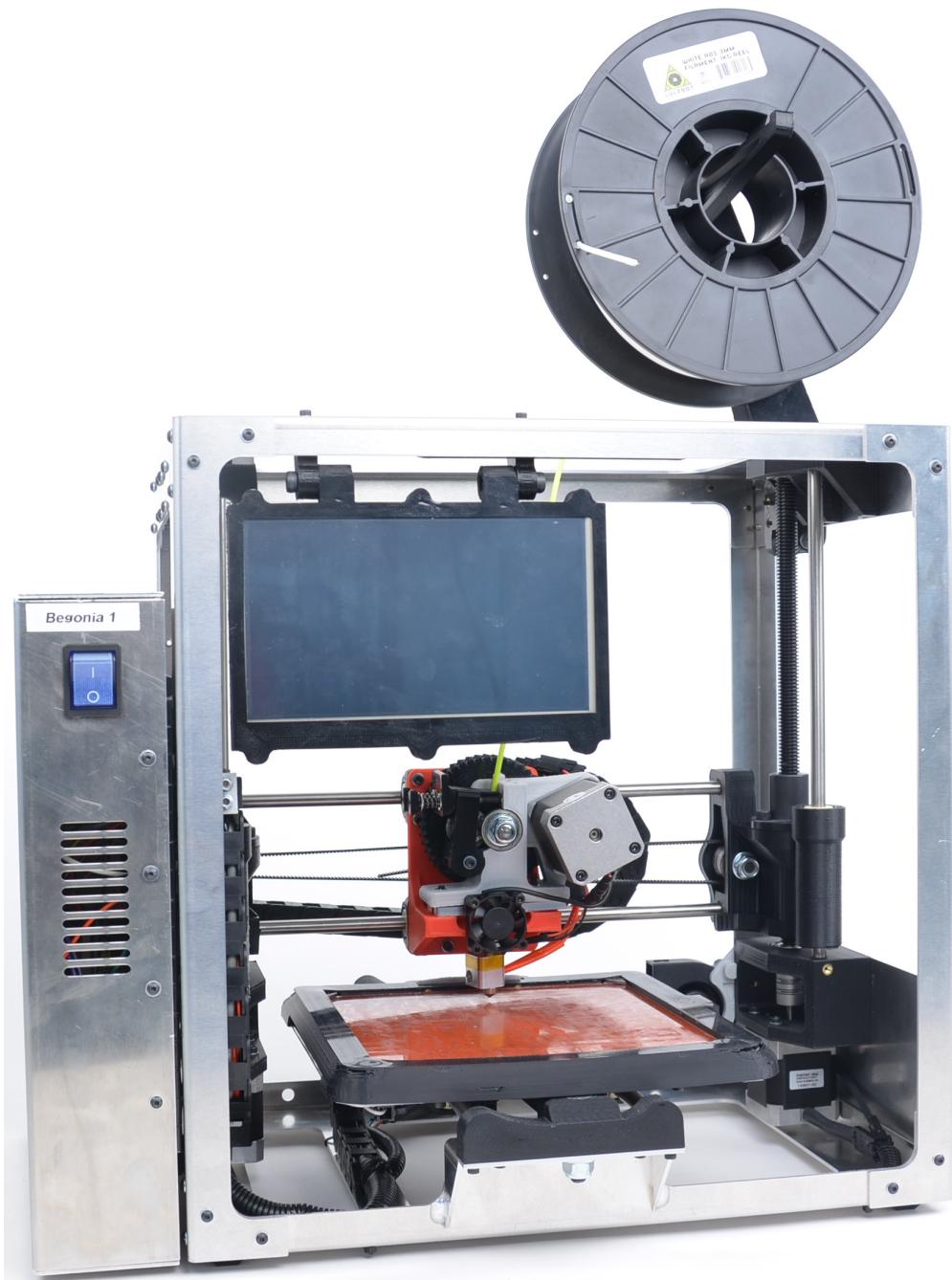


Figure 1.1: Begonia Front Photo

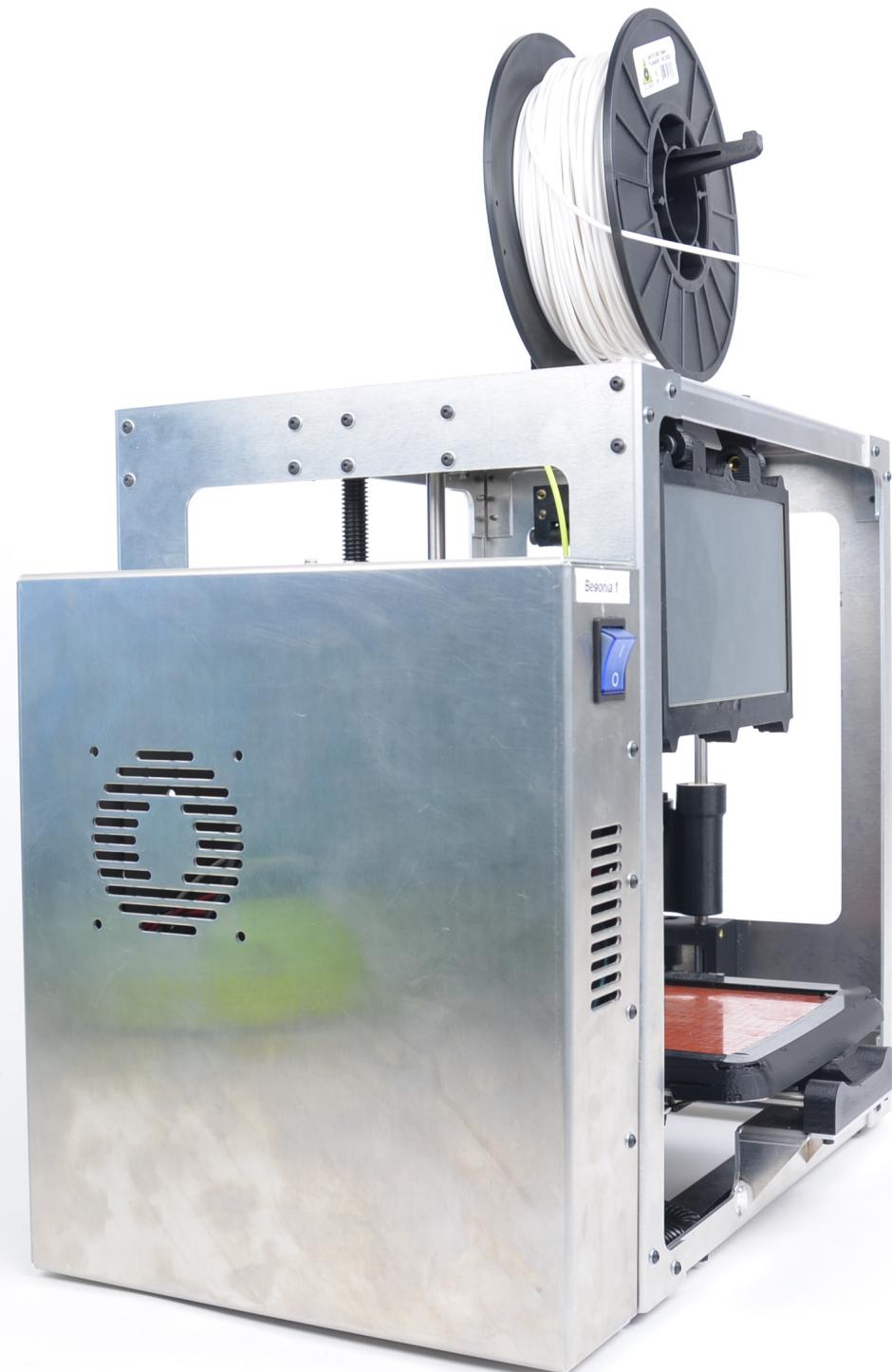


Figure 1.2: Begonia Left Photo

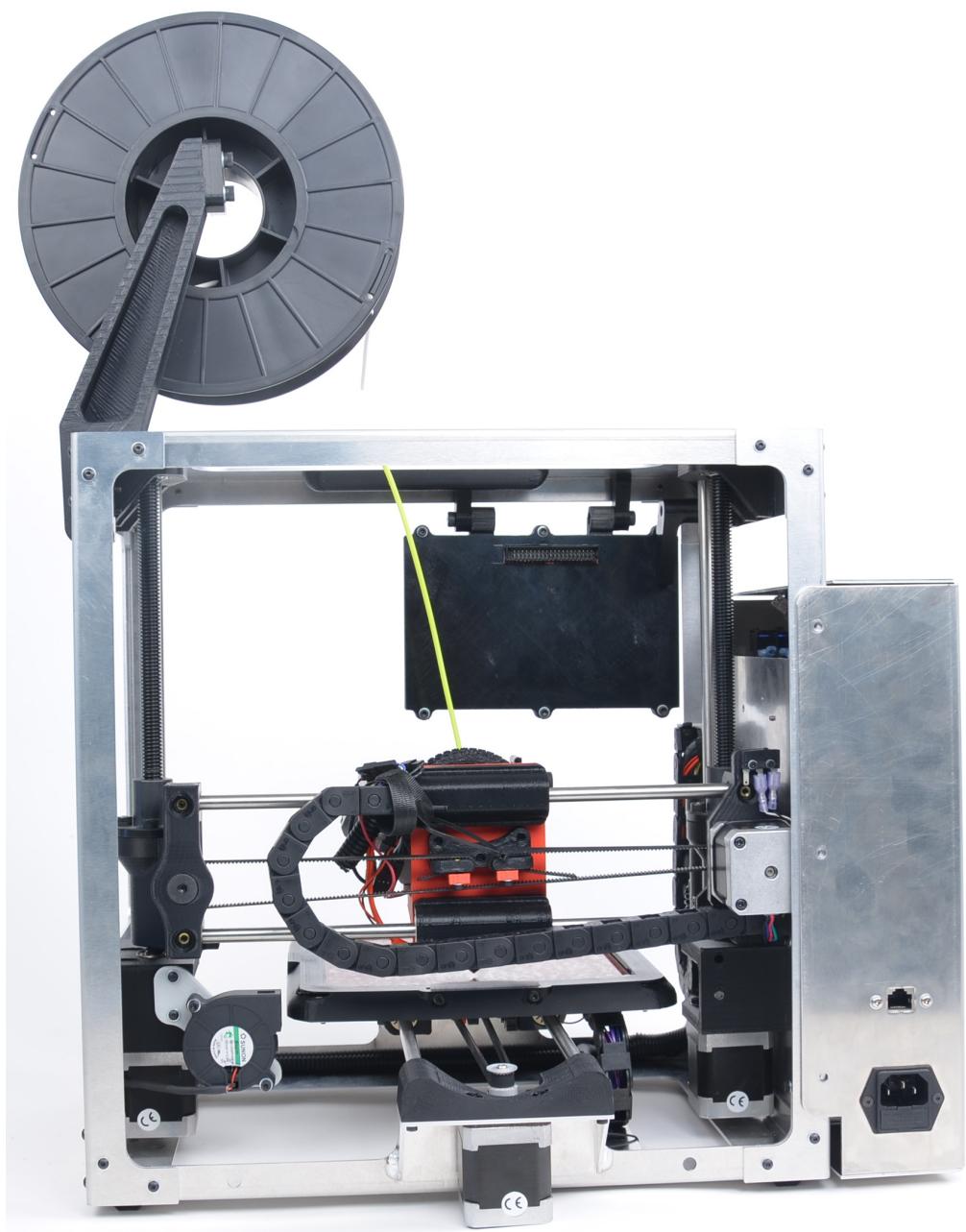


Figure 1.3: Begonia Back Photo

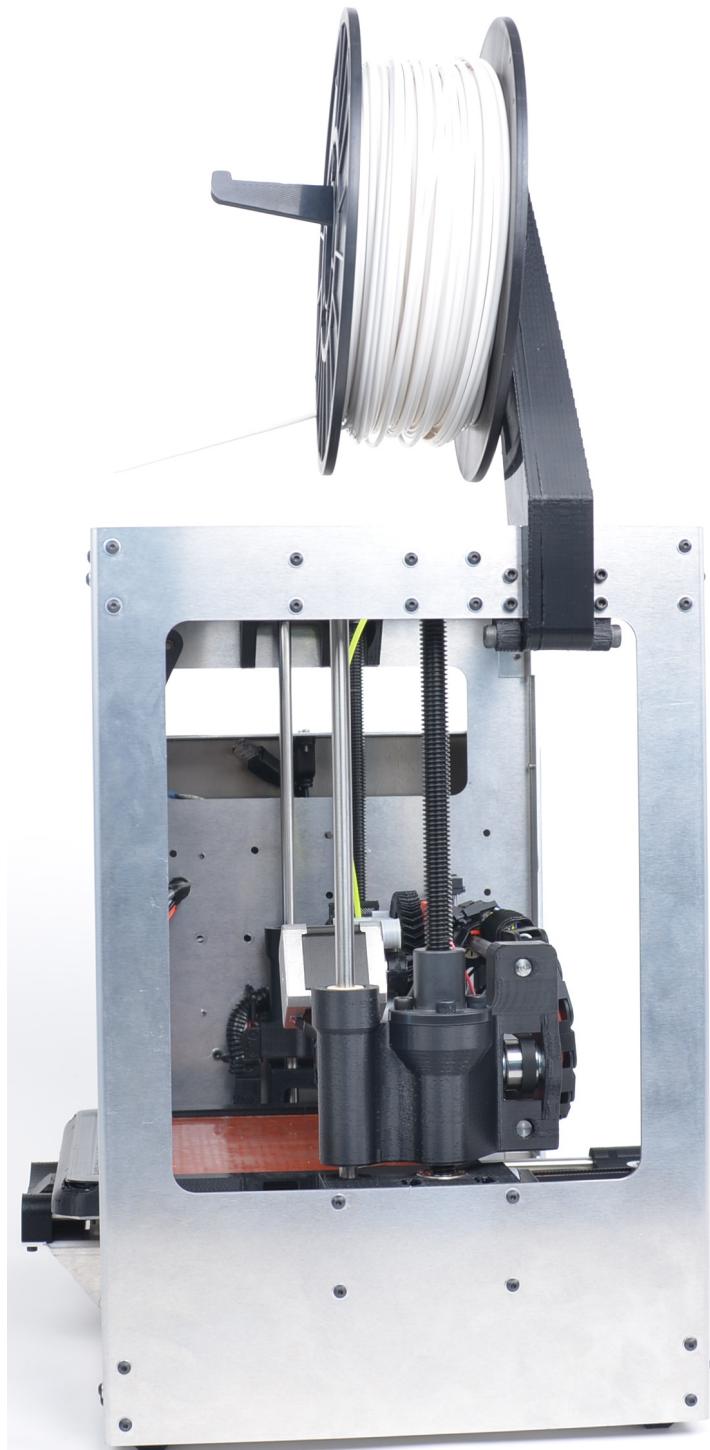


Figure 1.4: Begonia Right Photo

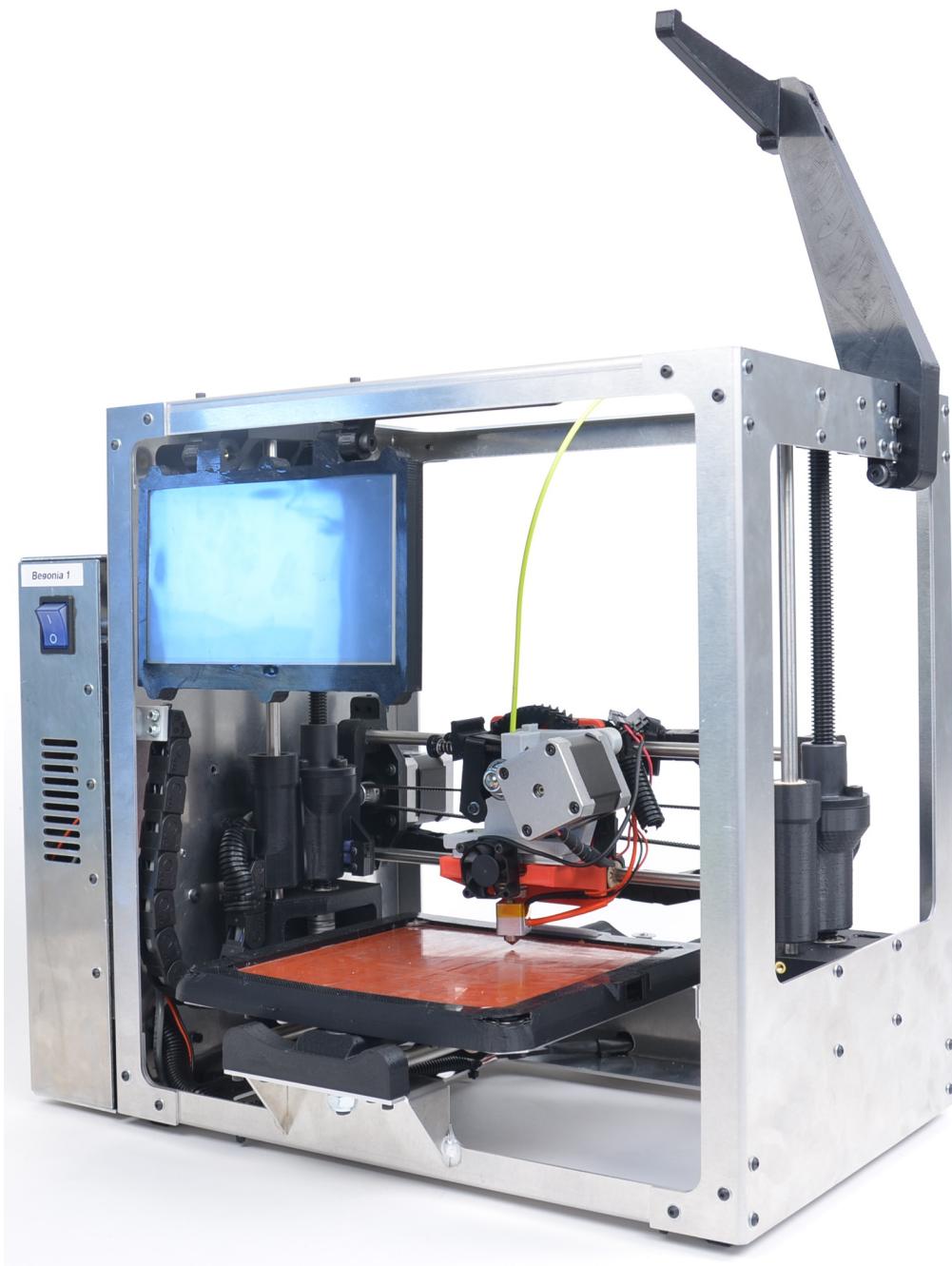


Figure 1.5: Begonia Spool Arm Up Photo

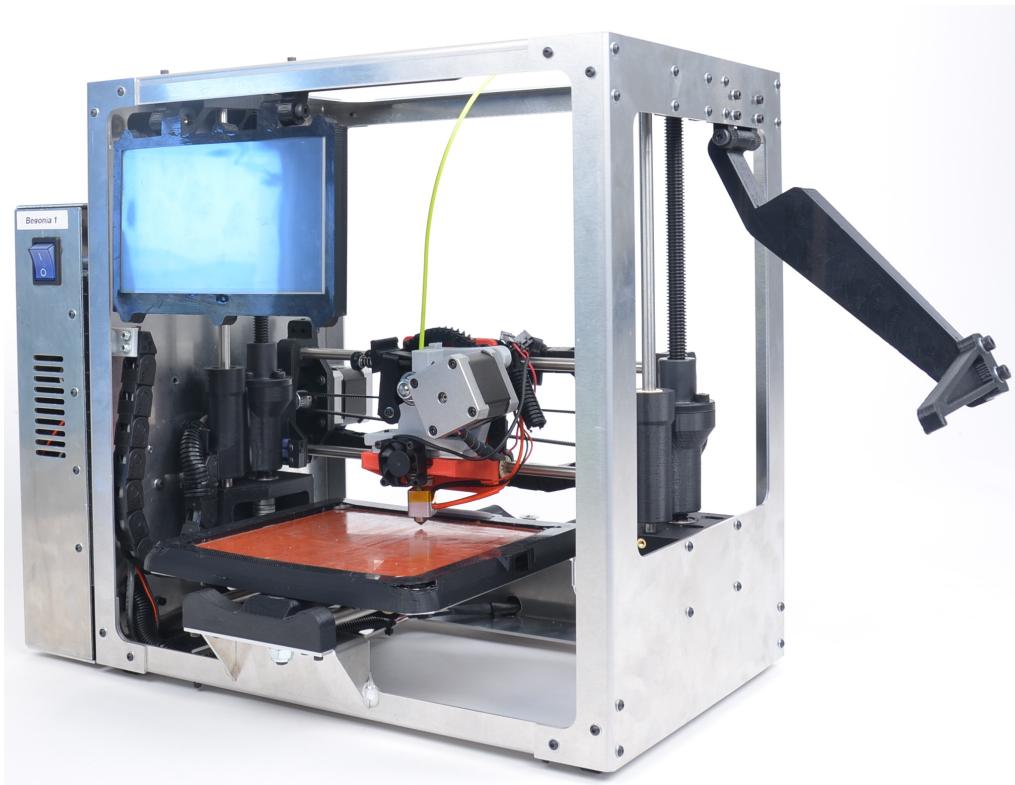


Figure 1.6: Begonia Spool Arm Down Photo



Figure 1.7: Begonia Green Color Scheme Photo

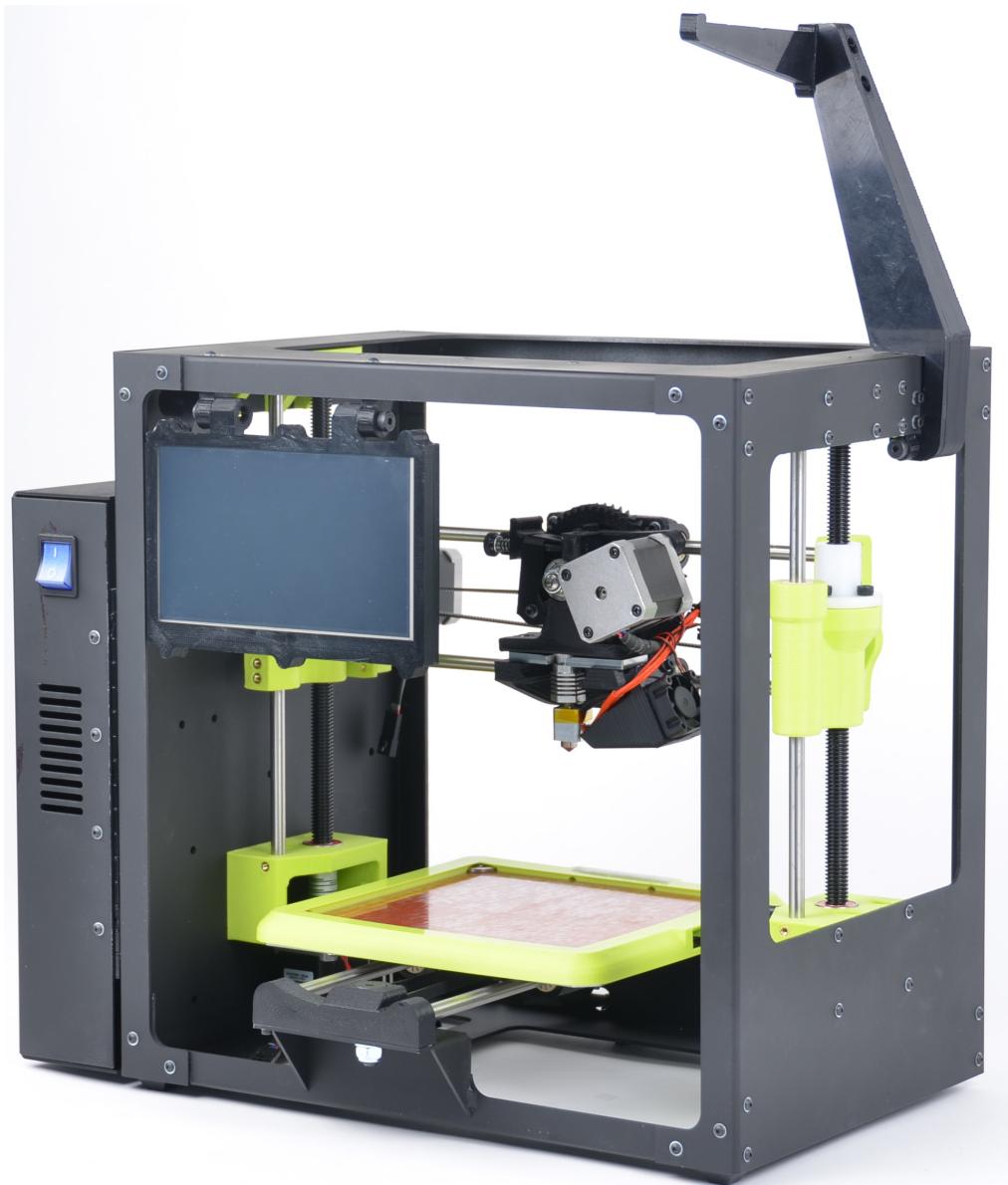


Figure 1.8: Begonia Black Green Color Scheme Photo

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 Bill of Materials

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 Double bearing holder v1.2, Mini	Printed	PP-GP0189	Aleph Objects	V10F87-903130	2	ea	\$3.00	\$6.02	2	ea	\$3.00	\$6.02	\$0.35	42 Sheets of 98
Printed	PP-GP0188	X carriage cover v2.3, Mini	Printed	PP-GP0187	Aleph Objects		1	ea	\$1.750	\$1.75	1	ea	\$1.750	\$1.75	\$0.35	42 Sheets of 98
Printed	PP-GP0191	Herringbone Large Gear, Lulzbot green	Printed	PP-GP0192	Aleph Objects		1	ea	\$2.230	\$2.23	1	ea	\$2.230	\$2.23	\$0.35	42 Sheets of 98
Printed	PP-GP0060	Herringbone Small Gear, Lulzbot green	Printed	PP-GP0186	Aleph Objects		1	ea	\$0.290	\$0.29	1	ea	\$0.290	\$0.29	\$0.35	42 Sheets of 98
Printed	PP-GP0059	Wade Reloaded Bearing Washer	Printed	PP-GP0058	Aleph Objects		1	ea	\$0.020	\$0.02	1	ea	\$0.020	\$0.02	\$0.35	42 Sheets of 98
Printed	PP-GP0057	Wade extruder body for Hex nozzle v1.0	Printed	PP-GP0056	Aleph Objects		1	ea	\$3.790	\$3.79	1	ea	\$3.790	\$3.79	\$0.35	42 Sheets of 98
Printed	PP-GP0055	Wade Reloaded idle Block	Printed	PP-GP0054	Aleph Objects		1	ea	\$0.900	\$0.90	1	ea	\$0.900	\$0.90	\$0.35	42 Sheets of 98
Printed	PP-GP0053	extruder_latch	Printed	PP-GP0052	Aleph Objects		1	ea	\$0.260	\$0.26	1	ea	\$0.260	\$0.26	\$0.35	42 Sheets of 98
Printed	PP-GP0185	X end idler v2.3, Mini	Printed	PP-GP0184	Aleph Objects		1	ea	\$7.870	\$7.87	1	ea	\$7.870	\$7.87	\$0.35	42 Sheets of 98
Printed	PP-GP0183	X carriage mount v2.4, Mini	Printed	PP-GP0182	Aleph Objects		1	ea	\$3.690	\$3.69	1	ea	\$3.690	\$3.69	\$0.35	42 Sheets of 98
Printed	PP-GP0181	X carriage v1.0, Mini	Printed	PP-GP0180	Aleph Objects		1	ea	\$5.150	\$5.15	1	ea	\$5.150	\$5.15	\$0.35	42 Sheets of 98
Printed	PP-GP0179	X end motor v1.6, Mini	Printed	PP-GP0178	Aleph Objects		1	ea	\$8.740	\$8.74	1	ea	\$8.740	\$8.74	\$0.35	42 Sheets of 98
Printed	PP-GP0177	X end mount v1.0, Mini	Printed	PP-GP0176	Aleph Objects		1	ea	\$0.290	\$0.29	1	ea	\$0.290	\$0.29	\$0.35	42 Sheets of 98
Printed	PP-GP0175	Bed mount v1.0, Mini	Printed	PP-GP0174	Aleph Objects		1	ea	\$2.230	\$2.23	1	ea	\$2.230	\$2.23	\$0.35	42 Sheets of 98
Printed	PP-GP0173	Z upper left v1.2, Mini	Printed	PP-GP0172	Aleph Objects		1	ea	\$3.010	\$3.01	1	ea	\$3.010	\$3.01	\$0.35	42 Sheets of 98
Printed	PP-GP0171	Z upper right v1.2, Mini	Printed	PP-GP0170	Aleph Objects		1	ea	\$1.550	\$1.55	1	ea	\$1.550	\$1.55	\$0.35	42 Sheets of 98
Printed	PP-GP0169	Z lower left v1.1, Mini, Lulzbot green	Printed	PP-GP0168	Aleph Objects		1	ea	\$7.090	\$7.09	1	ea	\$7.090	\$7.09	\$0.35	42 Sheets of 98
Printed	PP-GP0167	Z lower right v1.1, Mini, Lulzbot green	Printed	PP-GP0166	Aleph Objects		1	ea	\$1.070	\$1.07	1	ea	\$1.070	\$1.07	\$0.35	42 Sheets of 98
Printed	PP-GP0165	Bed corner v2.2, Mini	Printed	PP-GP0164	Aleph Objects		1	ea	\$2.040	\$2.04	1	ea	\$2.040	\$2.04	\$0.35	42 Sheets of 98
Printed	PP-GP0163	Y idle mount v1.2, Mini	Printed	PP-GP0162	Aleph Objects		1	ea	\$0.680	\$0.68	1	ea	\$0.680	\$0.68	\$0.35	42 Sheets of 98
Printed	PP-GP0161	Y rod mount v1.1, Mini	Printed	PP-GP0160	Aleph Objects		1	ea	\$1.170	\$1.17	1	ea	\$1.170	\$1.17	\$0.35	42 Sheets of 98
Mechanical	HD-MS0211	Spool hinge v1.3, Mini	Mechanical	HD-MS0211	Associated Spring	C0240-032-0380-M	2	ea	\$0.190	\$0.19	1	ea	\$0.190	\$0.19	\$0.35	42 Sheets of 98
Mechanical	HD-MS0227	Spool arm v1.0, Mini	Mechanical	HD-MS0227	B & B Manufacturing, Inc	744-254-5WM BORE ALL	2	ea	\$6.750	\$6.75	1	ea	\$6.750	\$6.75	\$0.35	42 Sheets of 98
Mechanical	HD-BL0015	Spool mount v1.2, Mini	Mechanical	HD-BL0015	Associated Spring	IM6-CAS 5WM BORE ALL	2	ea	\$3.440	\$3.44	1	ea	\$3.440	\$3.44	\$0.35	42 Sheets of 98
Mechanical	HD-MS0033	Relief mount v1.3, Mini	Mechanical	HD-MS0033	Associated Spring	PNC-24V150W1AA DELTA	2	ea	\$2.290	\$2.29	1	ea	\$2.290	\$2.29	\$0.35	42 Sheets of 98
Electronic	EL-PS0025	G12 Timing Pulley, 5mm Bore Aluminum	Electronic	EL-MS0025	Associated Spring	PMC-24V150W1AA DELTA	1	ea	\$28.600	\$28.60	1	ea	\$28.600	\$28.60	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	POWER SUPPLY 150W 24V 6.25A PNL MT	Electronic	EL-MS0025	Associated Spring	22-28AWG	1	ea	\$0.077	\$0.077	1	ea	\$0.077	\$0.077	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	Conn Fast Reception 14-16 AWG - 250	Electronic	EL-MS0025	Associated Spring	WM-2517 TR-ND	25	ea	\$0.38	\$0.38	1	ea	\$0.38	\$0.38	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	CONN TERM MALE 22-24AWG TIN	Electronic	EL-MS0025	Associated Spring	MOL16-02-0108	73	ea	\$0.11	\$0.11	1	ea	\$0.11	\$0.11	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	CONN TERM FEMALE 22-24AWG TIN	Electronic	EL-MS0025	Associated Spring	WM2510TR-ND	73	ea	\$0.032	\$0.032	1	ea	\$0.032	\$0.032	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	G12 Timing Pulley, 5mm Bore Aluminum	Electronic	EL-MS0025	Associated Spring	WM12535-ND	3	ea	\$0.140	\$0.14	1	ea	\$0.140	\$0.14	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	POWER SUPPLY 150W 24V 6.25A PNL MT	Electronic	EL-MS0025	Associated Spring	WM12902-ND	8	ea	\$0.112	\$0.112	1	ea	\$0.112	\$0.112	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	Conn TERM MALE 22-24AWG TIN	Electronic	EL-MS0025	Associated Spring	WM12900-ND	5	ea	\$0.062	\$0.062	1	ea	\$0.062	\$0.062	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	CONN PIN 24-30AWG CRIMP TIN	Electronic	EL-MS0025	Associated Spring	WM12901-ND	6	ea	\$0.060	\$0.060	1	ea	\$0.060	\$0.060	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	CONN TERM FEMALE 22-24AWG TIN	Electronic	EL-MS0025	Associated Spring	A27793-ND	12	ea	\$0.109	\$0.109	1	ea	\$0.109	\$0.109	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	Conn Female housing with latch	Electronic	EL-MS0025	Associated Spring	P22-4R-M	6	ea	\$0.52	\$0.52	1	ea	\$0.52	\$0.52	\$0.35	42 Sheets of 98
Electronic	EL-MS0025	CONN TERM FASTON 22-26AWG #10	Electronic	EL-MS0025	Associated Spring	WM12901CT-ND	2	ea	\$0.087	\$0.087	1	ea	\$0.087	\$0.087	\$0.35	42 Sheets of 98
Electronic	EL-SW0022	Term Ring Ins 26-22AWG #4	Electronic	EL-SW0022	Digikey	SW-66-RD	6	ea	\$3.12	\$3.12	1	ea	\$3.12	\$3.12	\$0.35	42 Sheets of 98
Electronic	EL-WR0099	CONN TERM MALE 22-24AWG	Electronic	EL-WR0099	Digikey	W504-1000-ND	2470	mm	\$0.001	\$0.001	1	ea	\$0.001	\$0.001	\$0.35	42 Sheets of 98
Electronic	EL-WR0105	24AWG Stranded - Black	Electronic	EL-WR0105	Digikey	C2015B-100-ND	6025	mm	\$0.000	\$0.000	1	ea	\$0.000	\$0.000	\$0.35	42 Sheets of 98
Electronic	EL-WR0107	24AWG Stranded - White	Electronic	EL-WR0107	Digikey	C2015W-100-ND	1100	mm	\$0.000	\$0.000	1	ea	\$0.000	\$0.000	\$0.35	42 Sheets of 98
Electronic	EL-WR0109	24AWG Stranded - Yellow	Electronic	EL-WR0109	Digikey	C2015Y-100-ND	2090	mm	\$0.000	\$0.000	1	ea	\$0.000	\$0.000	\$0.35	42 Sheets of 98
Electronic	EL-WR0103	24AWG Stranded - Red	Electronic	EL-WR0103	Digikey	C2015R-100-ND	3825	mm	\$0.000	\$0.000	1	ea	\$0.000	\$0.000	\$0.35	42 Sheets of 98
Electronic	EL-WR0104	24AWG Stranded - Orange	Electronic	EL-WR0104	Digikey	C2015A-21.01	2820	mm	\$0.000	\$0.000	1	ea	\$0.000	\$0.000	\$0.35	42 Sheets of 98
Electronic	EL-WR0105	24AWG Stranded - Blue	Electronic	EL-WR0105	Digikey	C2015B-21.01	460	mm	\$0.000	\$0.000	1	ea	\$0.000	\$0.000	\$0.35	42 Sheets of 98
Electronic	EL-WR0107	24AWG Stranded - Green	Electronic	EL-WR0107	Digikey	C2015G-21.01	520	mm	\$0.000	\$0.000	1	ea	\$0.000	\$0.000	\$0.35	42 Sheets of 98
Electronic	EL-WR0109	24AWG Stranded - Purple	Electronic	EL-WR0109	Digikey	C2015V-21.01	1210	mm	\$0.000	\$0.000	1	ea	\$0.000	\$0.000	\$0.35	42 Sheets of 98
Electronic	EL-WR0106	16AWG Stranded - Red	Electronic	EL-WR0106	Digikey	C206SR-100-ND	400	mm	\$0.007	\$0.007	1	ea	\$0.007	\$0.007	\$0.35	42 Sheets of 98
Electronic	EL-WR0121	16AWG Stranded - Black	Electronic	EL-WR0121	Digikey	C206SB-100-ND	1280	mm	\$0.007	\$0.007	1	ea	\$0.007	\$0.007	\$0.35	42 Sheets of 98

Electronic	EL-WR0122	16AWG Stranded - Green	C2065A21.06	Digikey	C2065A21.02	\$6.11	\$0.87	1000 ft
Electronic	EL-WR0123	16AWG Stranded - White		Digikey		\$0.007		
Electronic	EL-WR0108	16AWG Stranded - Violet		Digikey		\$0.001		
Electronic	EL-MS0216	Ferrite Tubular Bead 19.0mm		Digikey				
Electronic	PC-CN0046	Term Block Plug 4PQS STR 5.08MM		TII	240-2314-ND	1		
Electronic	PC-CN0032	Term Block Plug 2PQS STR 5.08MM		TII	WN7953-ND	1		
Electronic	EL-MS0074	20-POS_1.00 Dual (Black)		TII	WN7819-ND	2		
Electronic	EL-MS0211	REEL - RING TONGUE CONN 16-22 AWG 410 PIDS	TE	Digikey	WN2527-ND	2		
Hardware	HE-SH0031	Repli-Modifed Hexagon Holed, Luzbot Edition, 3.0mm Filament		Repli-discount	A1062TR-ND	7		
Mechanical	PP-FP0055	Left Plate,	EPOCS					
Mechanical	PP-FP0052	Right Plate,	EPOCS					
Mechanical	PP-FP0051	Top Plate,	EPOCS					
Mechanical	PP-FP0053	Bottom Plate,	EPOCS					
Mechanical	PP-FP0054	Bed Mount Plate,	EPOCS					
Mechanical	PP-FP0056	Electronics cover,	Rapid Sheet Metal					
Mechanical	PP-FP0055	Left Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0052	Right Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0051	Top Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0053	Bottom Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0054	Bed Mount Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0056	Electronics cover,	Rapid Sheet Metal					
Hardware	EL-MS0165	Snaps-Together Cable and Hose Carrier, Feed-Through, 0.41" High x 0.39" Wide Interior SIGUS	Rapid Sheet Metal					
Hardware	EL-MS0166	Mounting Brackets for .41" High x .39" Wide Interior Snap-Together Cable and Hose Carriers	Rapid Sheet Metal					
Mechanical	HD-BU00143	EMI/RFI-Shield Heat-Shrink Tubing - Solid polymer bearing R/W:0L_8mm	IGUM					
Electronic	EL-FA0011	FAN 24VDC, Sleeve 5.75CFM, 10x40x10MM, 60mA, 6000RPM, 1.44W, 2 TF-4010-24H-S	Kysan					
Electronic	EL-FA0012	FAN 24VDC, BAL 31.60CFM, 80x80x15 MM, 100mA	TF8015-24M-B					
Mechanical	HD-RB0035	8mm Smooth Rod, 31.5mm	Kysan					
Mechanical	HD-RB0044	304 Stainless Steel	MBK					
Hardware	HD-BT0108	Holurbed Bolt, M8 x 50mm Hex head, 26mm offset, Stainless Steel	Quattro					
Hardware	PP-MF0082	Bed leveling washer, 2013 SST	MBK					
Electronics	TL-CS0083	EMI/RFI-Shield Heat-Shrink Tubing, 3/16" ID Before, 3/32" ID After, 3/8" ID Before, 3/16" ID After	TECflex					
Electronics	TL-CS0129	Interference-Shielding Heat-Shrink Tubing, 3/8" ID Before, 3/16" ID After	TECflex					
Hardware	HD-WA0035	Metric 18-8 Stainless Steel External Serrated Loc. Washer, M3 Screw Size, 6mm OD, 0.4mm ID	McMaster					
Hardware/tools	HD-MS0244	Firm White Polyester Felt Strip, 1/4" Thick, 1" Width, Plain Back	McMaster					
Hardware	HD-MS0235	Metric Aluminum Unthreaded Spacer, 4.5mm OD, 8mm Length	Fastenal					
Electronics	EL-MS0273	Tubing, Corrugated Loom, 25"	708161					
Hardware	HD-BT0117	Black Alloy Steel Flat-Head Socket Cap Screw, Class 10.9, M8 Size, 40mm Length	Timberline					
Hardware	HD-BT0131	Black Alloy Steel Flat-Head Socket Cap Screw, Class 10.9, M8 Size, 45mm Length	Timberline					
Hardware	PP-MF0066	Metric Brass Heat-Sel-Insert for Plastics, Tapered, M2-4 Internal Thread, 2.96MM Length	McMaster					
Hardware	HD-BT0107	Metric Class 12.9 Socket Head Cap Screw Alloy Steel, Black, M2 Thread, 10mm Length, 0.4mm Fastener	McMaster					
Hardware	HD-WA0012	Steel Flat Washer, DIN 125 zinc-plated class 4/N2 screw sz, 5mm OD, 40350	Fastenal					
Hardware	HD-MS0230	M2 x 6 SHCS, Black-Oxide	Timberline					
Hardware	HD-MS0030	M3-.5 3.8mm Heatset Insert	11125995					
Hardware	HD-MS0158	M5-.8 6.7mm Heatset Insert	11125997					
Hardware	HD-NT0004	M3 Nyloc Nut, Zinc Plated	Timberline					
Hardware	HD-NT0004	M3 Nut, Zinc Plated	Timberline					
Hardware	HD-BT0012	M3 Set Screw (Grub Screw)	McMaster					
Hardware	HD-WA0001	M3 Washer, Steel, Zinc Plated	Timberline					
Hardware	HD-BT0044	M3 x 5 Bolt, SHCS Black-Oxide	39501					
Hardware	HD-BT0128	M3 x 6 Bolt, FHCS Black-Oxide	39501					
Hardware	HD-BT0104	M3 x 8 Bolt, BHCS SST	91294A126					
Hardware	HD-BT0137	M3 x 8 Bolt, BHCS, Black-Oxide	92095A181					
Hardware	HD-BT0039	M3 x 12 Bolt, SHCS Black-Oxide	91294A133					
Hardware	HD-BT0118	M3 x 14 Bolt FHCS, Black-Oxide	91294A138					
Hardware	HD-BT0136	M3 x 12 Bolt FHCS, SST	8050-0325					
Hardware	HD-BT0135	M3 x 8 Bolt FHCS, Black-Oxide	8050-0341					
Hardware	HD-BT0041	M3 x 25 Bolt, SHCS Black-Oxide	8050-0345					
Hardware	HD-NT0011	M4 Nut, Zinc-Plated Steel	8100-0040					
Electronic	C2065G-1000-ND	16AWG Stranded - Green	C2065A21.06	Digikey	C2065W-1000-ND	880	\$0.007	1000 ft
Electronic	EL-WR0123	16AWG Stranded - White		Digikey	C2065V-1000-ND	1100		
Electronic	EL-WR0108	16AWG Stranded - Violet		Digikey	240-2314-ND	1		
Electronic	EL-MS0216	Ferrite Tubular Bead 19.0mm		Digikey	WN7953-ND	1		
Electronic	PC-CN0046	Term Block Plug 4PQS STR 5.08MM		TII	WN7819-ND	2		
Electronic	PC-CN0032	Term Block Plug 2PQS STR 5.08MM		TII	WN2527-ND	2		
Electronic	EL-MS0074	20-POS_1.00 Dual (Black)		TII	A1062TR-ND	7		
Hardware	HE-SH0031	Repli-Modifed Hexagon Holed, Luzbot Edition, 3.0mm Filament		Repli-discount				
Mechanical	PP-FP0055	Left Plate,	EPOCS					
Mechanical	PP-FP0052	Right Plate,	EPOCS					
Mechanical	PP-FP0051	Top Plate,	EPOCS					
Mechanical	PP-FP0053	Bottom Plate,	EPOCS					
Mechanical	PP-FP0054	Bed Mount Plate,	EPOCS					
Mechanical	PP-FP0056	Electronics cover,	EPOCS					
Mechanical	PP-FP0055	Left Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0052	Right Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0051	Top Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0053	Bottom Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0054	Bed Mount Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0056	Electronics cover,	Rapid Sheet Metal					
Hardware	EL-MS0165	Snaps-Together Cable and Hose Carrier, Feed-Through, 0.41" High x 0.39" Wide Interior SIGUS	Rapid Sheet Metal					
Hardware	EL-MS0166	Mounting Brackets for .41" High x .39" Wide Interior Snap-Together Cable and Hose Carriers	Rapid Sheet Metal					
Mechanical	HD-BU00143	EMI/RFI-Shield Heat-Shrink Tubing - Solid polymer bearing R/W:0L_8mm	IGUM					
Electronic	EL-FA0011	FAN 24VDC, Sleeve 5.75CFM, 10x40x10MM, 60mA, 6000RPM, 1.44W, 2 TF-4010-24H-S	Kysan					
Electronic	EL-FA0012	FAN 24VDC, BAL 31.60CFM, 80x80x15 MM, 100mA	TF8015-24M-B					
Mechanical	HD-RB0035	8mm Smooth Rod, 31.5mm	Kysan					
Mechanical	HD-RB0044	304 Stainless Steel	MBK					
Hardware	HD-BT0108	Holurbed Bolt, M8 x 50mm Hex head, 26mm offset, Stainless Steel	Quattro					
Hardware	PP-MF0082	Bed leveling washer, 2013 SST	MBK					
Electronics	TL-CS0083	EMI/RFI-Shield Heat-Shrink Tubing, 3/16" ID Before, 3/32" ID After, 3/8" ID Before, 3/16" ID After	TECflex					
Electronics	TL-CS0129	Interference-Shielding Heat-Shrink Tubing, 3/8" ID Before, 3/16" ID After	TECflex					
Hardware	HD-WA0035	Metric 18-8 Stainless Steel External Serrated Loc. Washer, M3 Screw Size, 6mm OD, 0.4mm ID	McMaster					
Hardware/tools	HD-MS0244	Firm White Polyester Felt Strip, 1/4" Thick, 1" Width, Plain Back	McMaster					
Hardware	HD-MS0235	Metric Aluminum Unthreaded Spacer, 4.5mm OD, 8mm Length	Fastenal					
Electronics	EL-MS0273	Tubing, Corrugated Loom, 25"	708161					
Hardware	HD-BT0117	Black Alloy Steel Flat-Head Socket Cap Screw, Class 10.9, M8 Size, 40mm Length	Timberline					
Hardware	HD-BT0131	Black Alloy Steel Flat-Head Socket Cap Screw, Class 10.9, M8 Size, 45mm Length	Timberline					
Hardware	PP-MF0066	Metric Brass Heat-Sel-Insert for Plastics, Tapered, M2-4 Internal Thread, 2.96MM Length	McMaster					
Hardware	HD-BT0107	Metric Class 12.9 Socket Head Cap Screw Alloy Steel, Black, M2 Thread, 10mm Length, 0.4mm Fastener	McMaster					
Hardware	HD-WA0012	Steel Flat Washer, DIN 125 zinc-plated class 4/N2 screw sz, 5mm OD, 40350	Fastenal					
Hardware	HD-MS0230	M2 x 6 SHCS, Black-Oxide	Timberline					
Hardware	HD-MS0030	M3-.5 3.8mm Heatset Insert	11125995					
Hardware	HD-MS0158	M5-.8 6.7mm Heatset Insert	11125997					
Hardware	HD-NT0004	M3 Nyloc Nut, Zinc Plated	Timberline					
Hardware	HD-NT0004	M3 Nut, Zinc Plated	Timberline					
Hardware	HD-BT0012	M3 Set Screw (Grub Screw)	McMaster					
Hardware	HD-WA0001	M3 Washer, Steel, Zinc Plated	Timberline					
Hardware	HD-BT0044	M3 x 5 Bolt, SHCS Black-Oxide	39501					
Hardware	HD-BT0128	M3 x 6 Bolt, FHCS Black-Oxide	39501					
Hardware	HD-BT0104	M3 x 8 Bolt, BHCS SST	91294A126					
Hardware	HD-BT0137	M3 x 8 Bolt, BHCS, Black-Oxide	92095A181					
Hardware	HD-BT0039	M3 x 12 Bolt, SHCS Black-Oxide	8050-0312					
Hardware	HD-BT0118	M3 x 14 Bolt FHCS, Black-Oxide	91294A133					
Hardware	HD-BT0136	M3 x 12 Bolt FHCS, SST	39501					
Hardware	HD-BT0135	M3 x 6 Bolt, FHCS, Black-Oxide	91294A138					
Hardware	HD-BT0041	M3 x 25 Bolt, SHCS Black-Oxide	8050-0341					
Hardware	HD-NT0011	M4 Nut, Zinc-Plated Steel	8100-0040					
Electronic	C2065G-1000-ND	16AWG Stranded - Green	C2065A21.06	Digikey	C2065W-1000-ND	880	\$0.007	1000 ft
Electronic	EL-WR0123	16AWG Stranded - White		Digikey	C2065V-1000-ND	1100		
Electronic	EL-WR0108	16AWG Stranded - Violet		Digikey	240-2314-ND	1		
Electronic	EL-MS0216	Ferrite Tubular Bead 19.0mm		Digikey	WN7953-ND	1		
Electronic	PC-CN0046	Term Block Plug 4PQS STR 5.08MM		TII	WN7819-ND	2		
Electronic	PC-CN0032	Term Block Plug 2PQS STR 5.08MM		TII	WN2527-ND	2		
Electronic	EL-MS0074	20-POS_1.00 Dual (Black)		TII	A1062TR-ND	7		
Hardware	HE-SH0031	Repli-Modifed Hexagon Holed, Luzbot Edition, 3.0mm Filament		Repli-discount				
Mechanical	PP-FP0055	Left Plate,	EPOCS					
Mechanical	PP-FP0052	Right Plate,	EPOCS					
Mechanical	PP-FP0051	Top Plate,	EPOCS					
Mechanical	PP-FP0053	Bottom Plate,	EPOCS					
Mechanical	PP-FP0054	Bed Mount Plate,	EPOCS					
Mechanical	PP-FP0056	Electronics cover,	EPOCS					
Mechanical	PP-FP0055	Left Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0052	Right Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0051	Top Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0053	Bottom Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0054	Bed Mount Plate,	Rapid Sheet Metal					
Mechanical	PP-FP0056	Electronics cover,	Rapid Sheet Metal					
Hardware	EL-MS0165	Snaps-Together Cable and Hose Carrier, Feed-Through, 0.41" High x 0.39" Wide Interior SIGUS	Rapid Sheet Metal					
Hardware	EL-MS0166	Mounting Brackets for .41" High x .39" Wide Interior Snap-Together Cable and Hose Carriers	Rapid Sheet Metal					
Mechanical	HD-BU00143	EMI/RFI-Shield Heat-Shrink Tubing - Solid polymer bearing R/W:0L_8mm	IGUM					
Electronic	EL-FA0011	FAN 24VDC, Sleeve 5.75CFM, 10x40x10MM, 60mA, 6000RPM, 1.44W, 2 TF-4010-24H-S	Kysan					
Electronic	EL-FA0012	FAN 24VDC, BAL 31.60CFM, 80x80x15 MM, 100mA	TF8015-24M-B					
Mechanical	HD-RB0035	8mm Smooth Rod, 31.5mm	Kysan					
Mechanical	HD-RB0044	304 Stainless Steel	MBK					
Hardware	HD-BT0108	Holstered Bolt, M8 x 50mm Hex head, 26mm offset, Stainless Steel	Quattro					
Hardware	PP-MF0082	Bed leveling washer, 2013 SST	MBK					
Electronics	TL-CS0083	EMI/RFI-Shield Heat-Shrink Tubing, 3/16" ID Before, 3/32" ID After	TECflex					
Electronics	TL-CS0129	Interference-Shielding Heat-Shrink Tubing, 3/8" ID Before, 3/16" ID After	TECflex					
Hardware	HD-WA0035	Metric 18-8 Stainless Steel External Serrated Loc. Washer, M3 Screw Size, 6mm OD, 0.4mm ID	McMaster					
Hardware/tools	HD-MS0244	Firm White Polyester Felt Strip, 1/4" Thick, 1" Width, Plain Back	McMaster					
Hardware	HD-MS0235	Metric Aluminum Unthreaded Spacer, 4.5mm OD, 8mm Length	Fastenal					
Electronics	EL-MS0273	Tubing, Corrugated Loom, 25"	708161					
Hardware	HD-BT0117	Black Alloy Steel Flat-Head Socket Cap Screw, Class 10.9, M8 Size, 40mm Length	Timberline					
Hardware	HD-BT0131	Black Alloy Steel Flat-Head Socket Cap Screw, Class 10.9, M8 Size, 45mm Length	Timberline					
Hardware	PP-MF0066	Metric Brass Heat-Sel-Insert for Plastics, Tapered, M2-4 Internal Thread, 2.96MM Length	McMaster					
Hardware	HD-BT0107	Metric Class 12.9 Socket Head Cap Screw Alloy Steel, Black, M2 Thread, 10mm Length, 0.4mm Fastener	McMaster					
Hardware	HD-WA0012	Steel Flat Washer, DIN 125 zinc-plated class 4/N2 screw sz, 5mm OD, 40350	Fastenal					
Hardware	HD-MS0230	M2 x 6 SHCS, Black-Oxide	Timberline					
Hardware	HD-MS0030	M3-.5 3.8mm Heatset Insert	11125995					
Hardware	HD-MS0158	M5-.8 6.7mm Heatset Insert	11125997					
Hardware	HD-NT0004	M3 Nyloc Nut, Zinc Plated	Timberline					
Hardware	HD-NT0004	M3 Nut, Zinc Plated	Timberline					
Hardware	HD-BT0012	M3 Set Screw (Grub Screw)	McMaster					
Hardware	HD-WA0001	M3 Washer, Steel, Zinc Plated	Timberline					
Hardware	HD-BT0044	M3 x 5 Bolt, SHCS Black-Oxide	39501					
Hardware	HD-BT0128	M3 x 6 Bolt, FHCS Black-Oxide	39501		</			

Hardware	HD-WA0005	M4 Washer	Timberline	8200-0040	\$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	8200-0680	\$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	7528k22	\$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

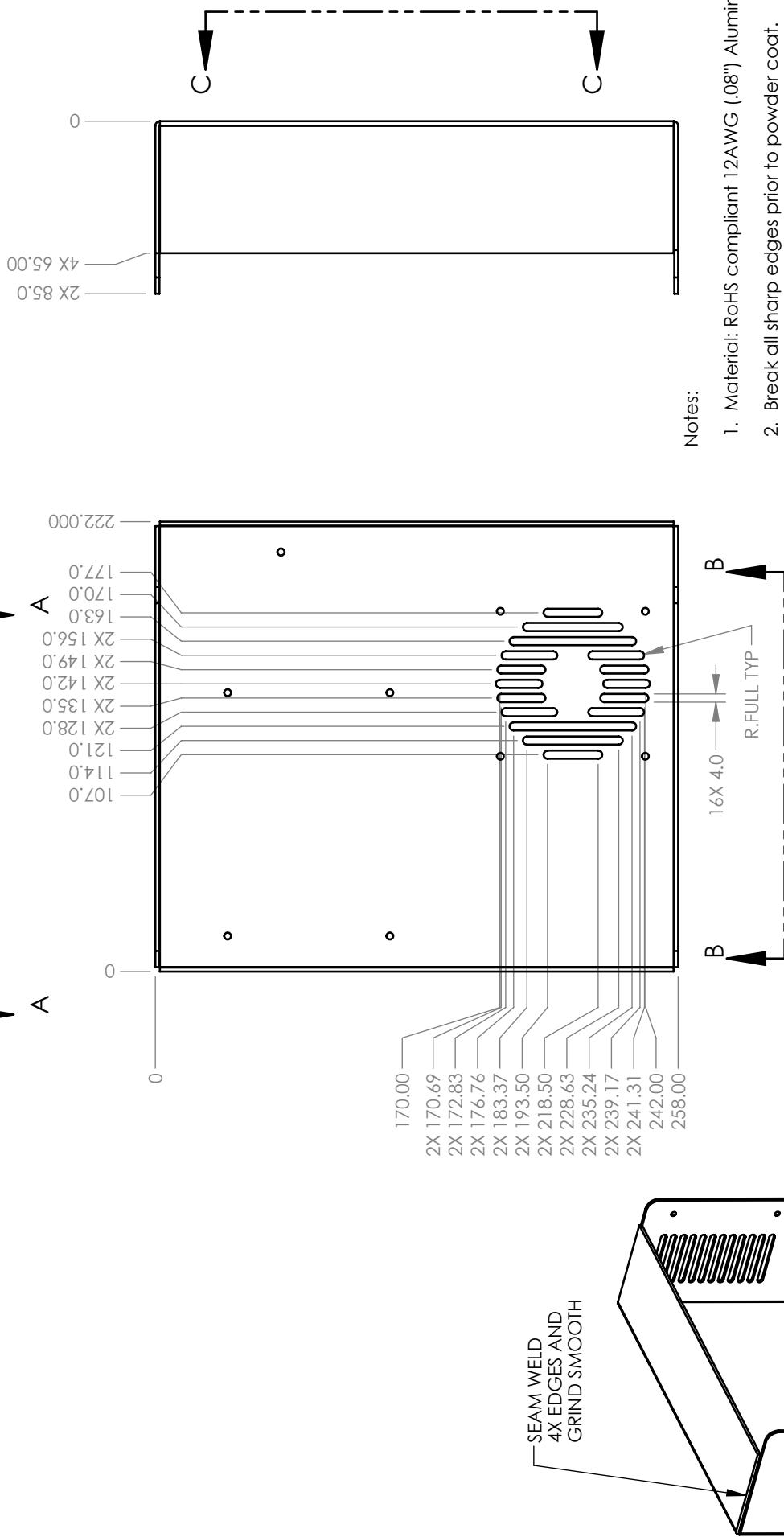
\$732.61

1.00 Needs something

Good to Order

Ordered

3.3 Drawings



Sinnema Design Services	
seth.sinnema@gmail.com	REV. C
Phone: (303) 250-8218	
Fax: 1-267-393-7872	
Electronics Case, Mini	
DRAWN BY SINNEMA	7/18/14
MATERIAL SEE NOTES	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS. TOLERANCES ARE: DECIMALS ANGLES $X \pm .75$ $X^\circ \pm 1^\circ$	
.XXX ± .25	63
.XXXX ± .050	
BREAK EDGES .005/.020 FILLET RADIUS .005/.020	
SIZE A	DWG NO.
SCALE 1:3	PP-FP0056
DO NOT SCALE DRAWING	
SHEET 1 OF 2	

FH-M3-10ZI Insert
Install from this side—

R.FULL TYP

2X FEX-M3 Inserts
Install from other side

SECTION A-A

SECTION B-B

199.75
155.30
126.00
84.9
68.4
60.5
52.25
32.00
47.2
56.6
62.4
3X 74.00

3X Ø 3.40 THRU
3X < Ø 6.30

SECTION C-C

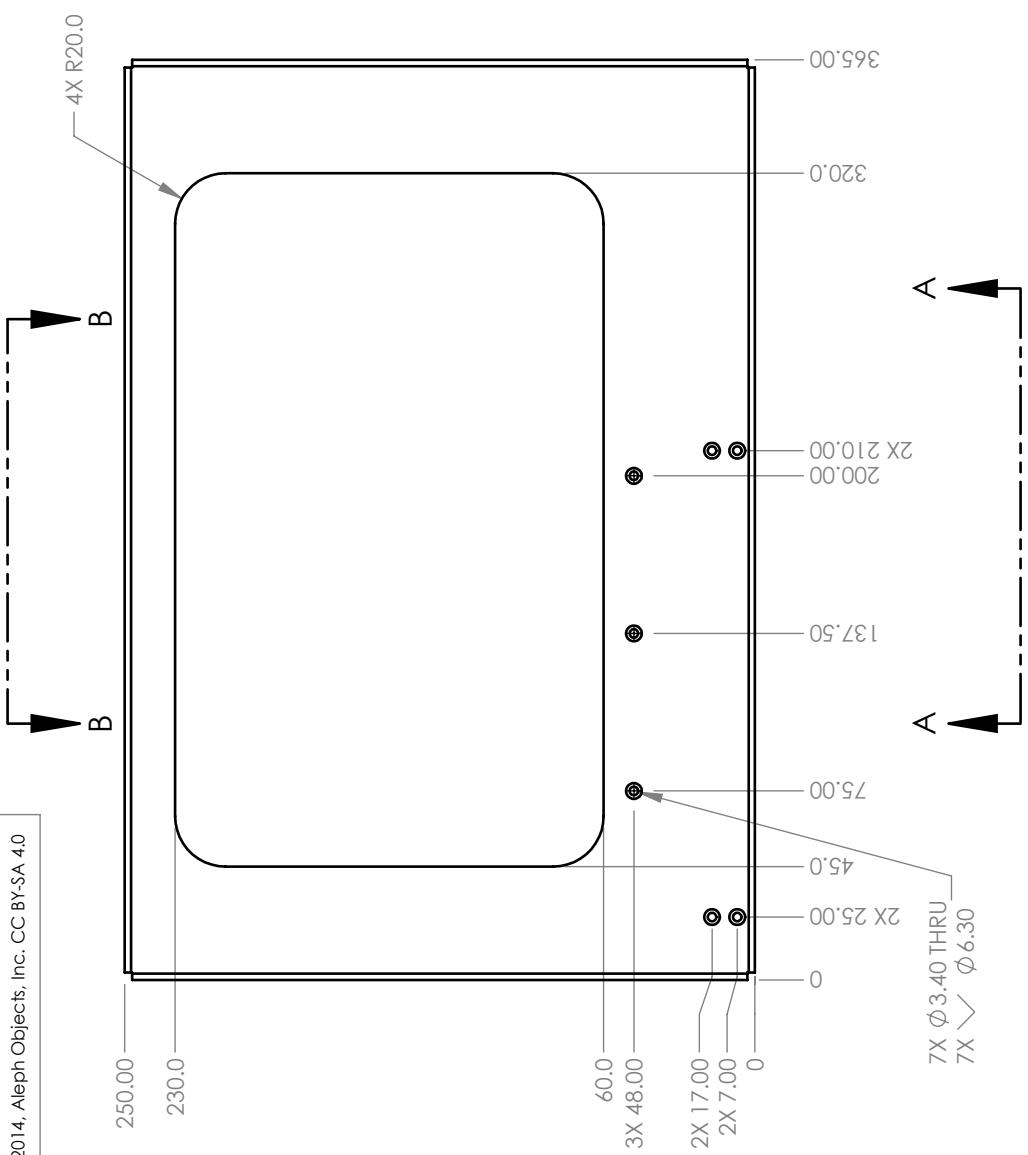
2X 170.25
2X 241.75

8X Ø 3.40 THRU
8X < Ø 6.30

SECTION B-B

Electronics Case, Mini

TITLE		Electronics Case, Mini		REV.	
SIZE	DWG NO.	PP-FP0056	C		
A					
SCALE	1:3	DO NOT SCALE DRAWING	SHEET	2 OF 2	



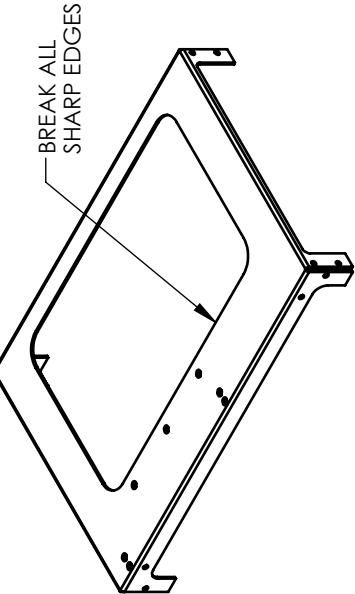
Notes:

1. Material: RoHS compliant 12AWG (.08") Aluminum
2. Break all sharp edges prior to powder coat.
3. Part is to be powder coated with Cardinal color C241-BK109. Mask all threads prior to coating.

Sinnema Design Services
seth.sinnema@gmail.com
Phone: (303) 250-8218
Fax: 1-267-393-7872

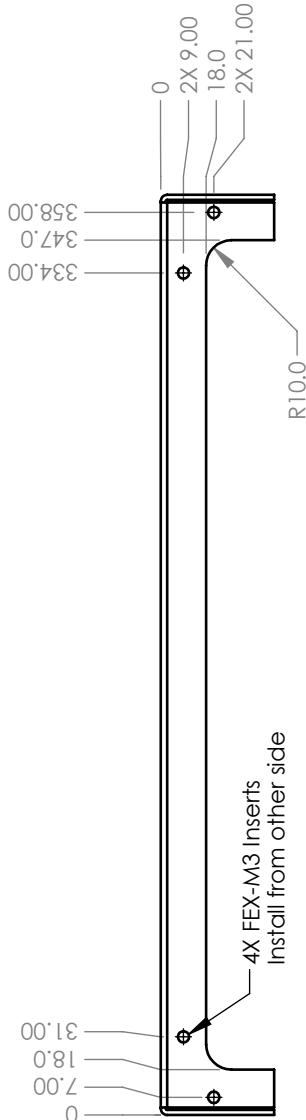
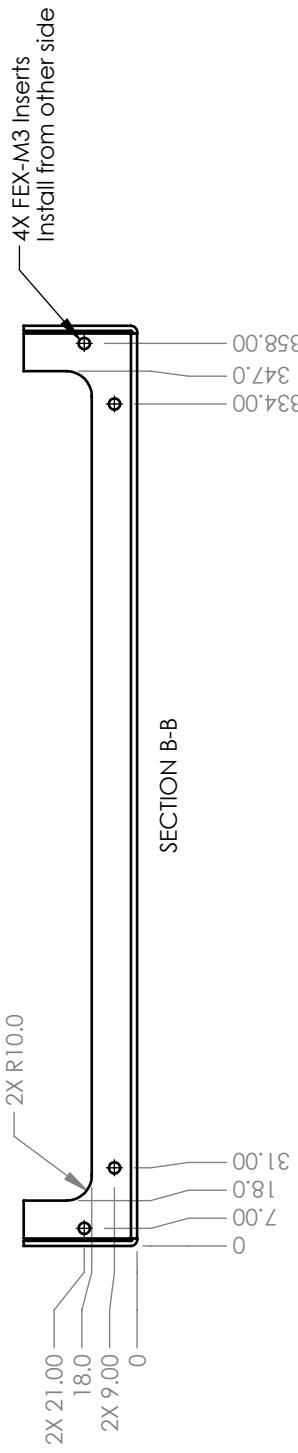


TITLE	
DRAWN BY SINNEMA	7/18/14
MATERIAL See Notes	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS. TOLERANCES ARE: DECIMALS ANGLES X±.75 X°±1° XX±.25 XXXX±.050 63°	
BREAK EDGES .005/.020 FILLET RADIUS .005/.020	



Top Plate, Mini
PP-FP0051
1 OF 2

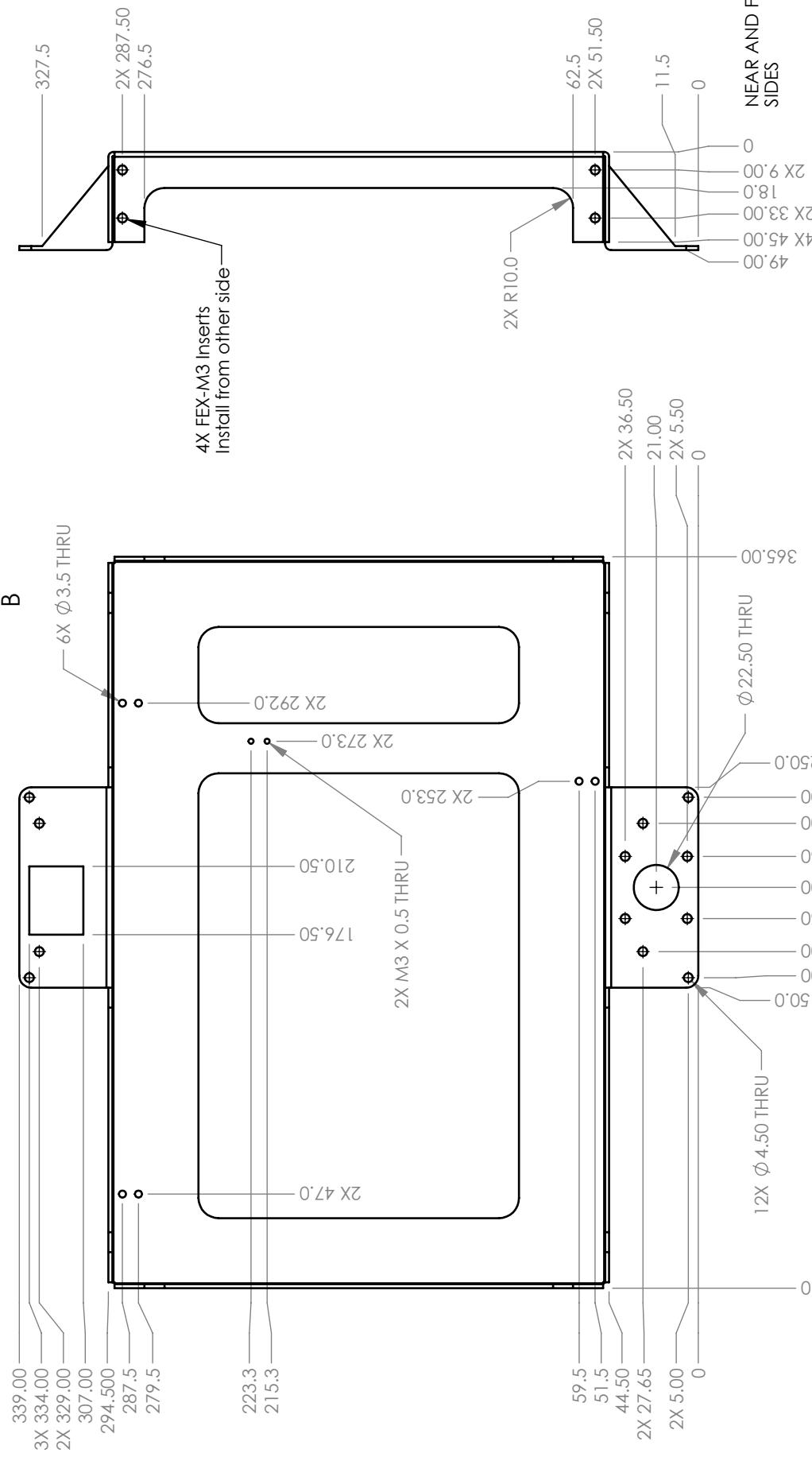
REV.
A



Top Plate, Mini

TITLE	PP-FP0051		
SIZE	DWG NO.	SCALE	SHEET
A	PP-FP0051	1:3	DO NOT SCALE DRAWING

REV.
A
2 OF 2

**Sinnema Design Services**

seth.sinnema@gmail.com
Phone: (303) 250-8218
Fax: 1-267-393-7872

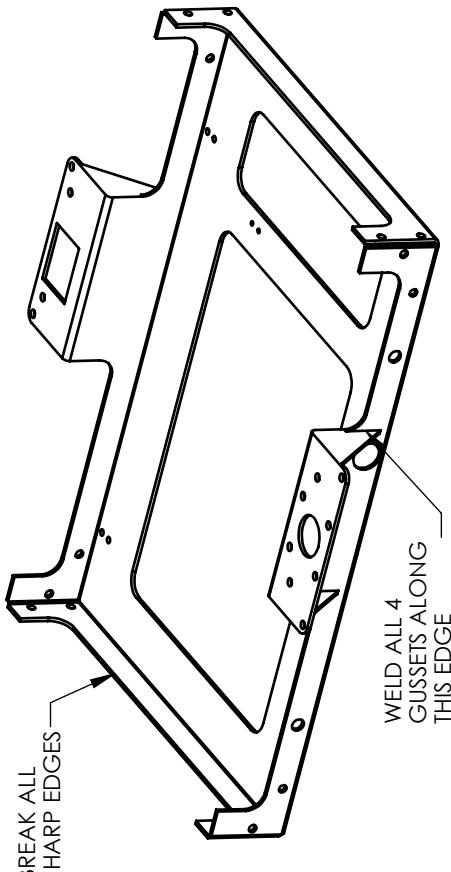
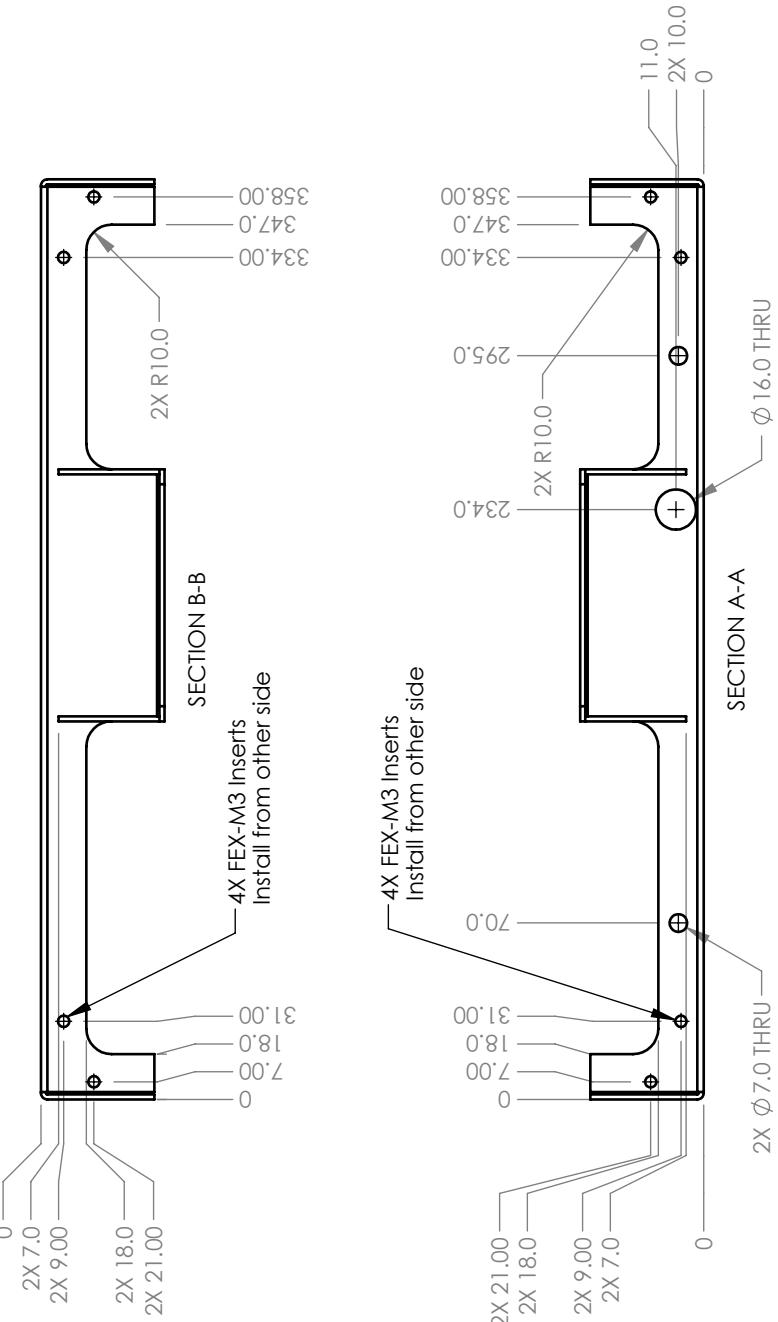


TITLE	
DRAWN BY SINNEMA	7/18/14
MATERIAL See Notes	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS. TOLERANCES ARE:	
DECIMALS $X \pm .75$ $XX \pm .25$ $XXX \pm .050$	ANGLES $X^\circ \pm 1^\circ$ 63

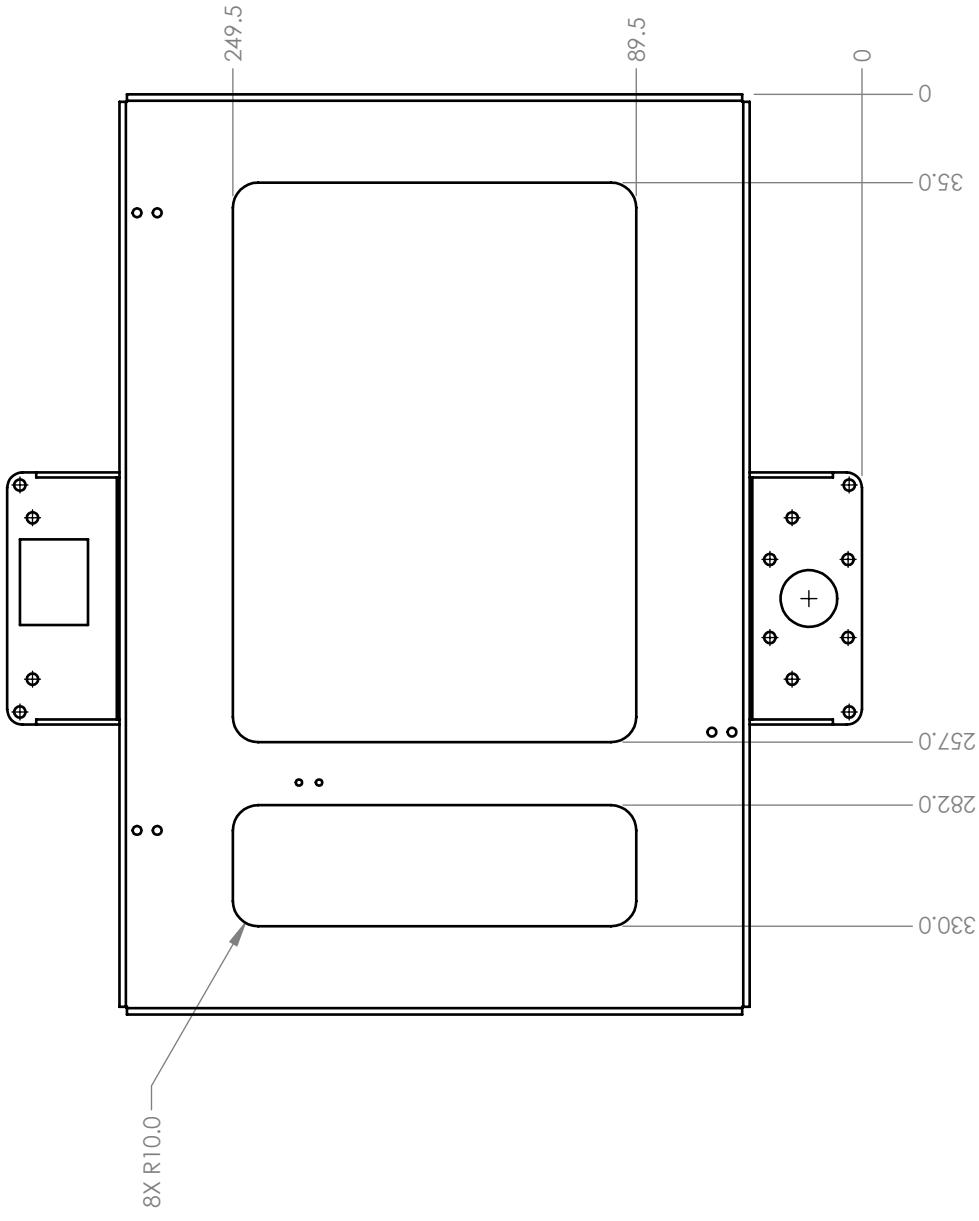
REV.
A
PP-FP0053
Bottom Plate, Mini

SHEET 1 OF 3
DO NOT SCALE DRAWING
SCALE 1:3
REV. A

- Notes:
1. Material: RoHS compliant 12AWG (.08") Aluminum
 2. Break all sharp edges prior to powder coat.
 3. Part is to be powder coated with Cardinal color C241-BK109. Mask all threads prior to coating.

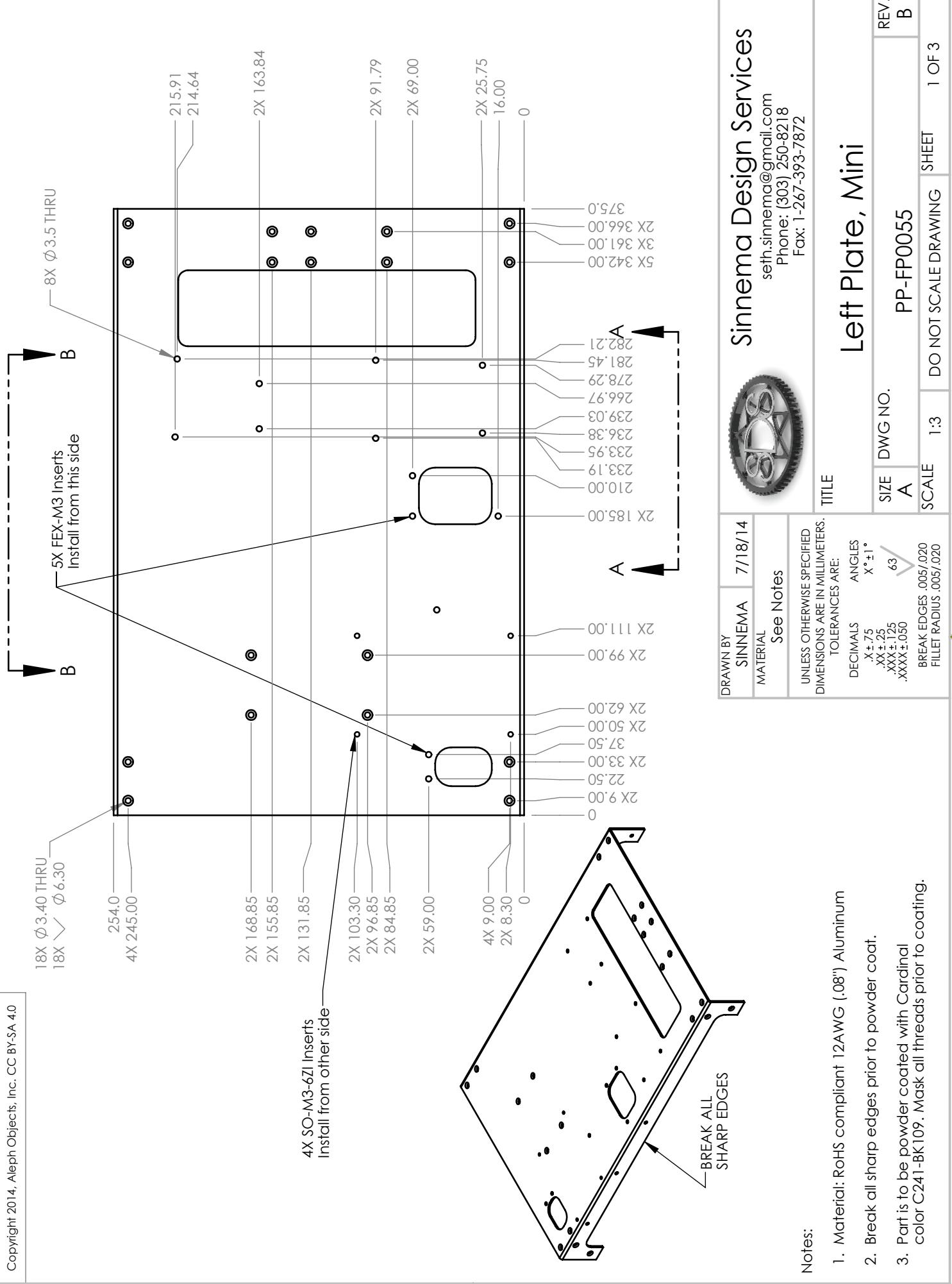


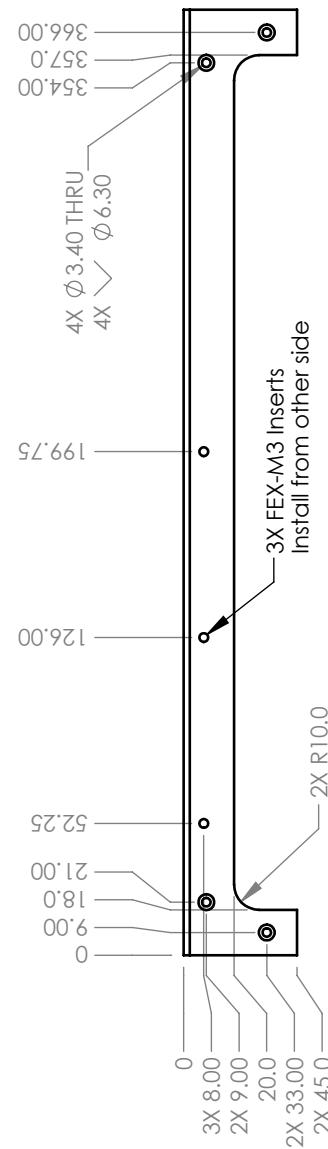
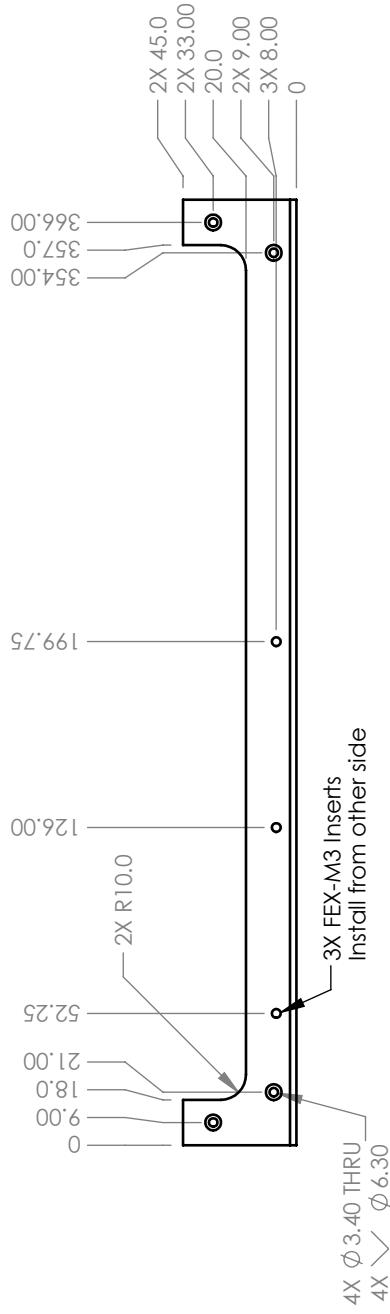
TITLE		Bottom Plate, Mini			REV.	
SIZE A	DWG NO. PP-FP0053			SHEET	2 OF 3	
SCALE	1:3	DO NOT SCALE DRAWING				



Bottom Plate, Mini

TITLE	Bottom Plate, Mini		
SIZE	DWG NO.	PP-FP0053	REV. A
A			
SCALE	1:3	DO NOT SCALE DRAWING	SHEET 3 OF 3





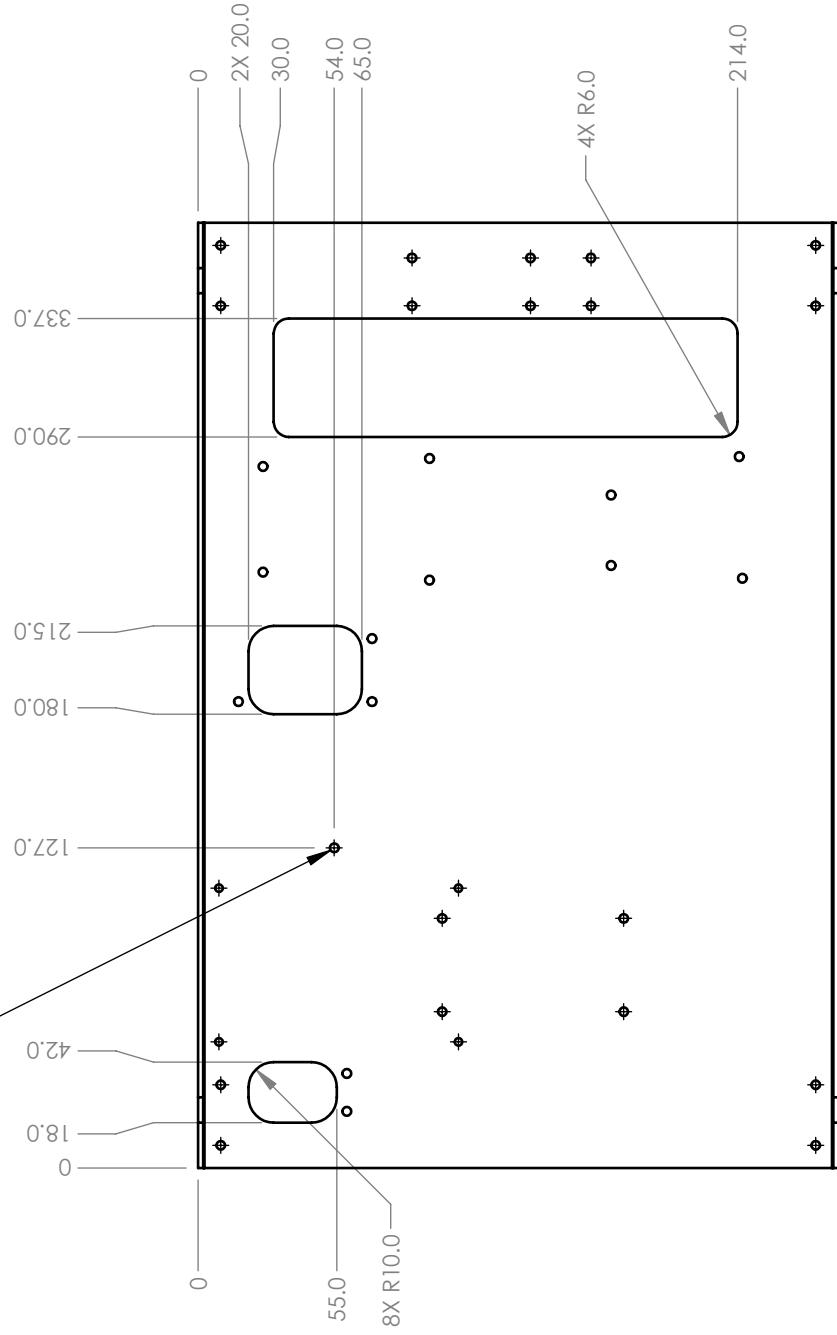
Left Plate, Mini

TITLE	PP-FP0055		
SIZE	DWG NO.	SCALE	SHEET
A		1:3	DO NOT SCALE DRAWING

REV.
B

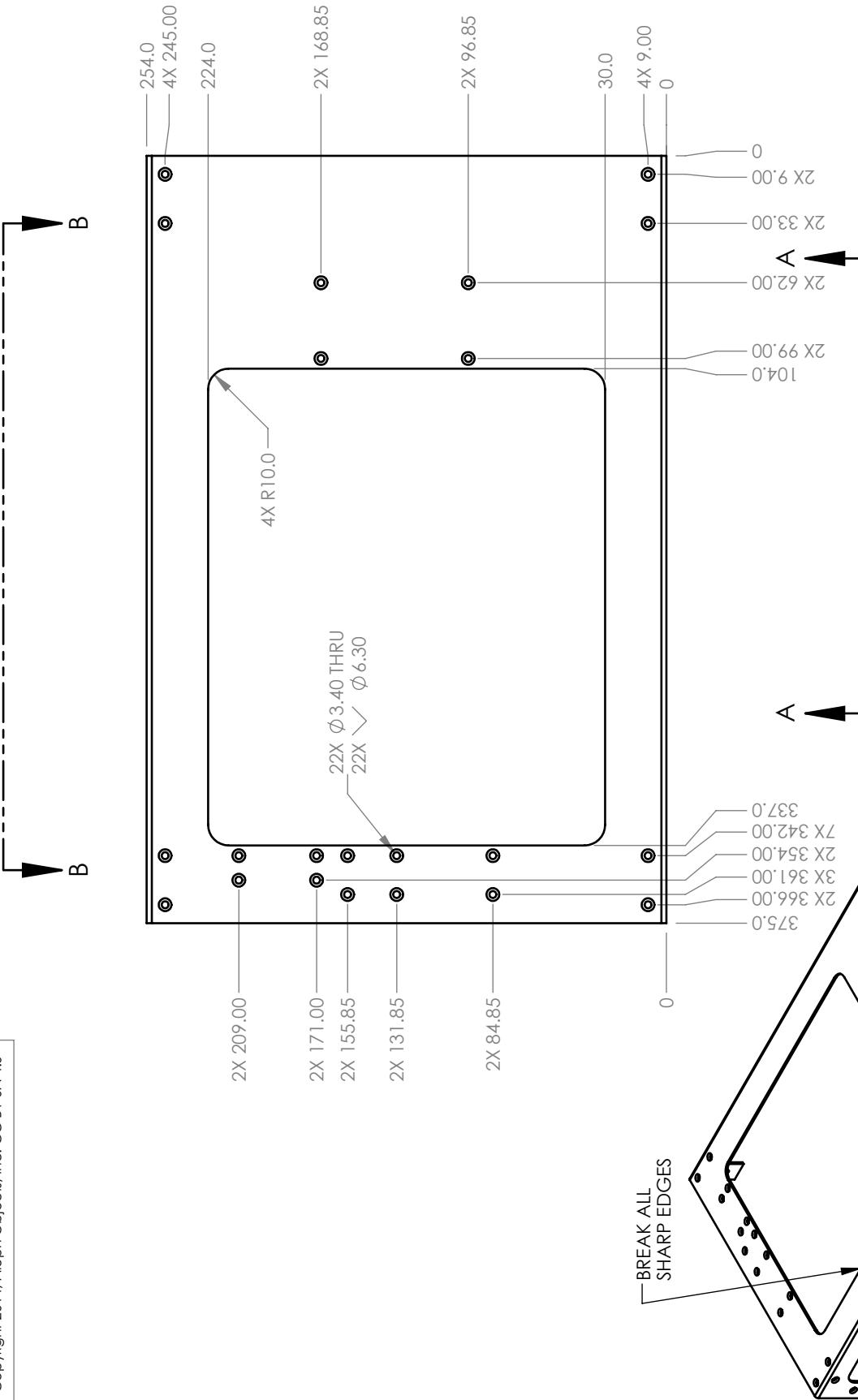
2 OF 3

FH-M3-10ZI Insert
Install from this side



Left Plate, Mini

TITLE	Left Plate, Mini		
SIZE A	DWG NO. PP-FP0055	REV. B	SCALE 1:3 DO NOT SCALE DRAWING SHEET 3 OF 3



Sinnema Design Services
seth.sinnema@gmail.com
Phone: (303) 250 9219



DRAWN BY SINNEMA	7/18/14
MATERIAL	See Notes
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS.	
TOLERANCES ARE:	
DECIMALS	
$.X \pm .75$ $.XX \pm .25$ $.XXX \pm .125$ $.XXXX \pm .050$	$X \pm 1^{\circ}$  63°  BREAK EDGES .005/.020
FILLET RADIUS .005/.020	

Right Plate, Mini

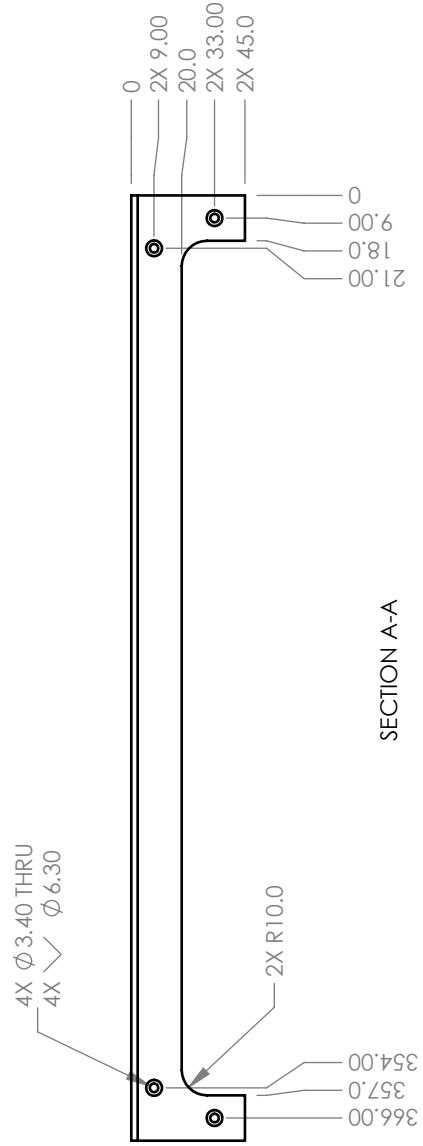
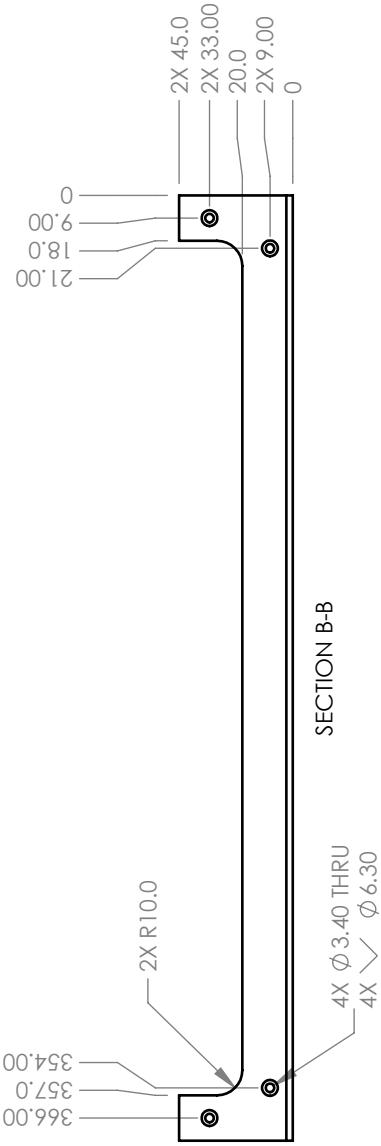
PP-FP0052		SHEET	
SIZE	DWG NO.	SCALE	DO NOT SCALE DRAWING
A	63	1:3	

2. Break all sharp edges prior to powder coat.

3. Part is to be powder coated with Cardinal color C241-BK109. Mask all threads prior to coating.

.XXX±.25
.XXX±.125
.XXX±.050

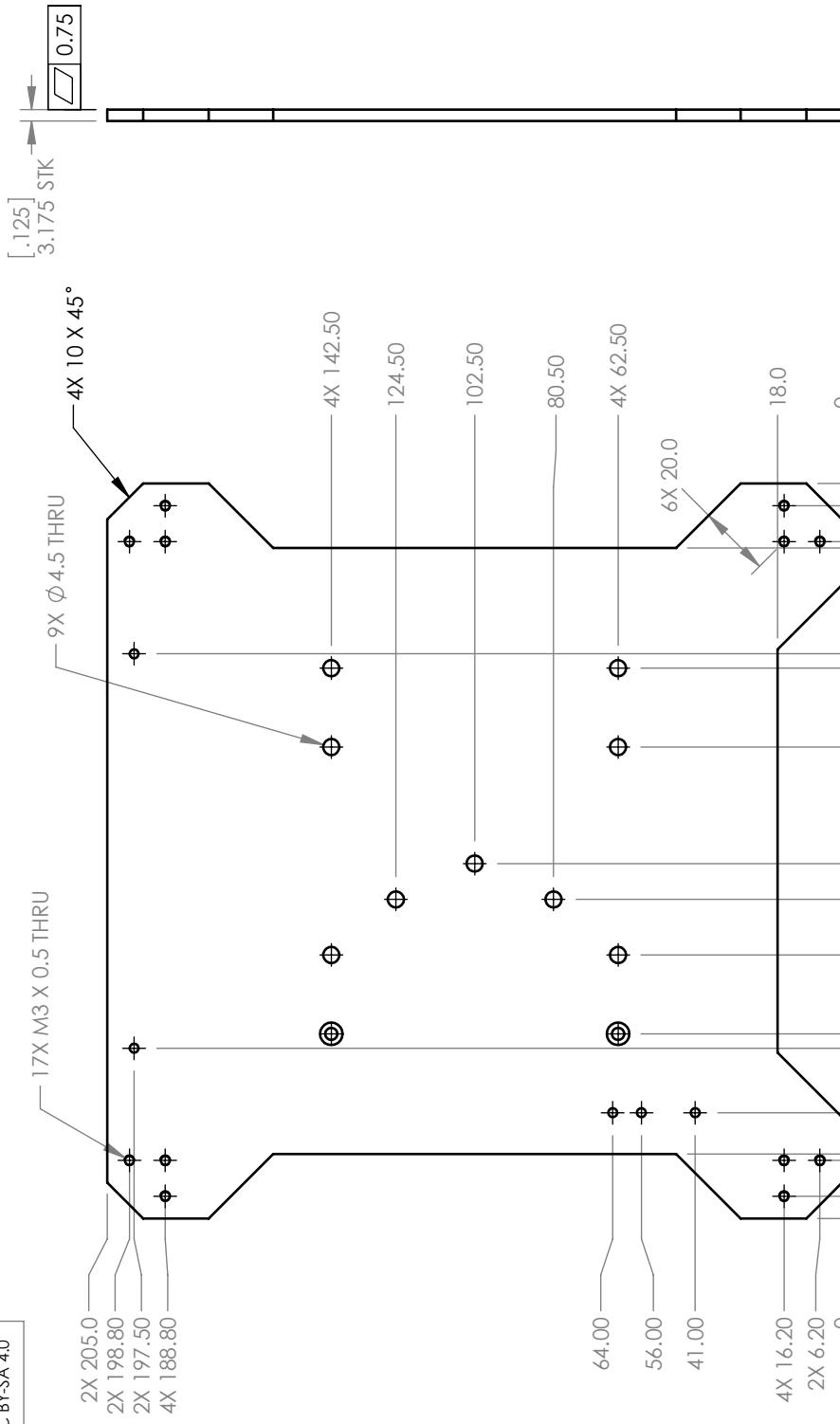
BREAK EDGES .005/.020
FILLET RADIUS .005/.020



Right Plate, Mini

TITLE	Right Plate, Mini		
SIZE A	DWG NO. PP-FP0052	SCALE 1:3	DO NOT SCALE DRAWING SHEET 2 OF 2

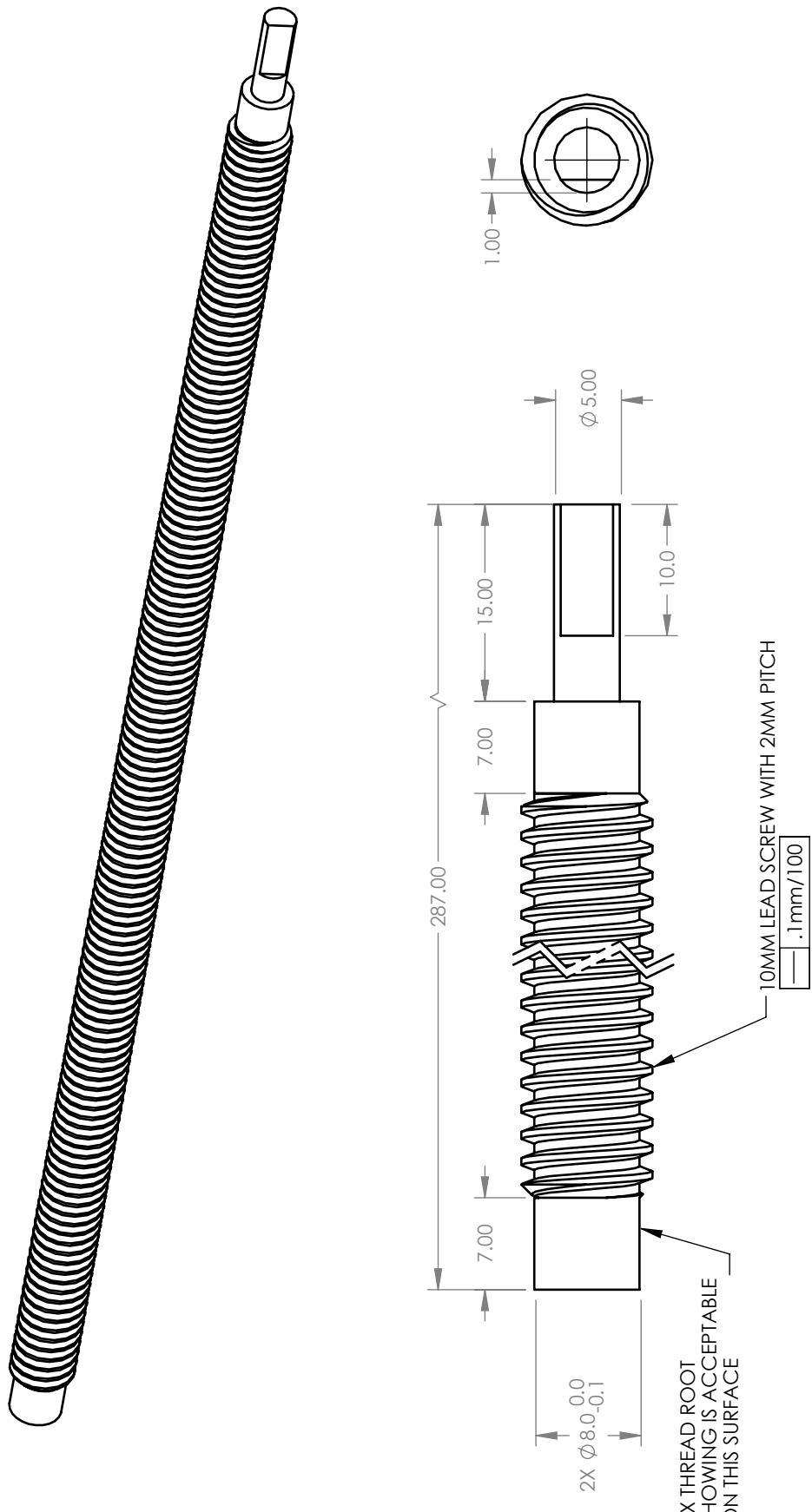
REV.
A



NOTES:

1. Parts must be RoHS compliant.
 2. Material: 5052 H-32 Aluminum
 3. Break all sharp edges.

DRAWN BY SINNEMA	7/18/14	Sinnema Design Services		REV. A
MATERIAL See Notes		seth.sinnema@gmail.com Phone: (303) 250-8218 Fax: 1-267-393-7872		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS. TOLERANCES ARE: DECIMALS ANGLES $X \pm .75$ $XX \pm .25$ $XXX \pm .125$ $XXXX \pm .050$	TITLE Bed Mount Plate, Mini	DWG NO. PP-FP0054	SHEET 1 OF 1	
	SIZE A	SCALE .005/.020 .005/.020	DO NOT SCALE DRAWING	



DRAWN BY SINNEMA	9/1/14	Sinnema Design Services
MATERIAL	Stainless Steel	seth.sinnema@gmail.com Phone: (303) 250-8218 Fax: 1-267-393-7872
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS. TOLERANCES ARE:		
DECIMALS	X ± .75	ANGLES X° ± 1°
	.XX ± .25	63°
	.XXXX ± .050	
		BREAK EDGES .005/.020
		FILLET RADIUS .005/.020
TITLE	Drive Rod 10mm	
SIZE	DWG NO.	
A	HD-RD0036	
SCALE	2:1	DO NOT SCALE DRAWING
		SHEET
		1 OF 1

3.4. 3D PRINTED PARTS

3.4 3D Printed Parts

3.5 Bed

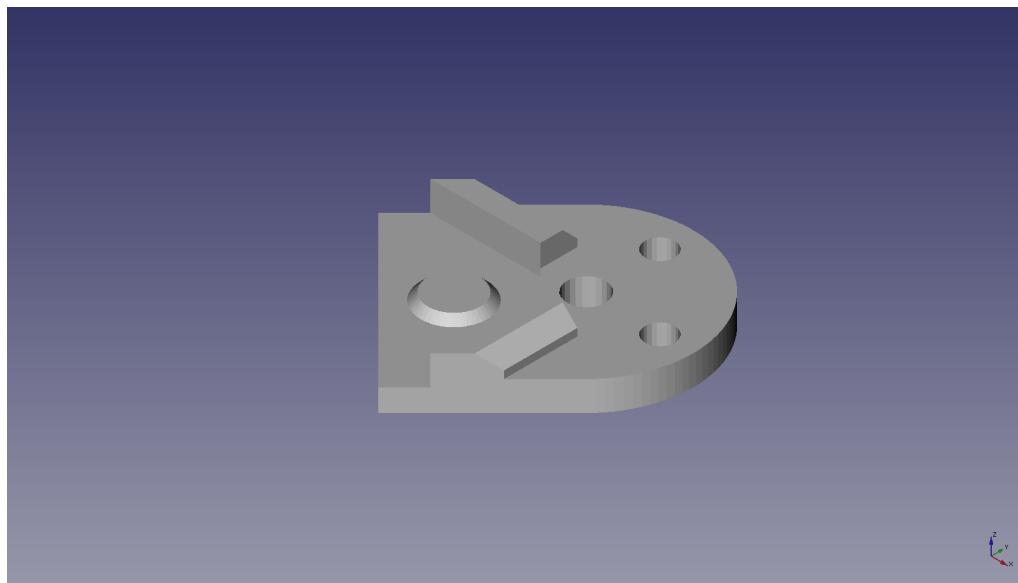


Figure 3.9: 3D Printed Bed Corner Render

3.6 Extruder

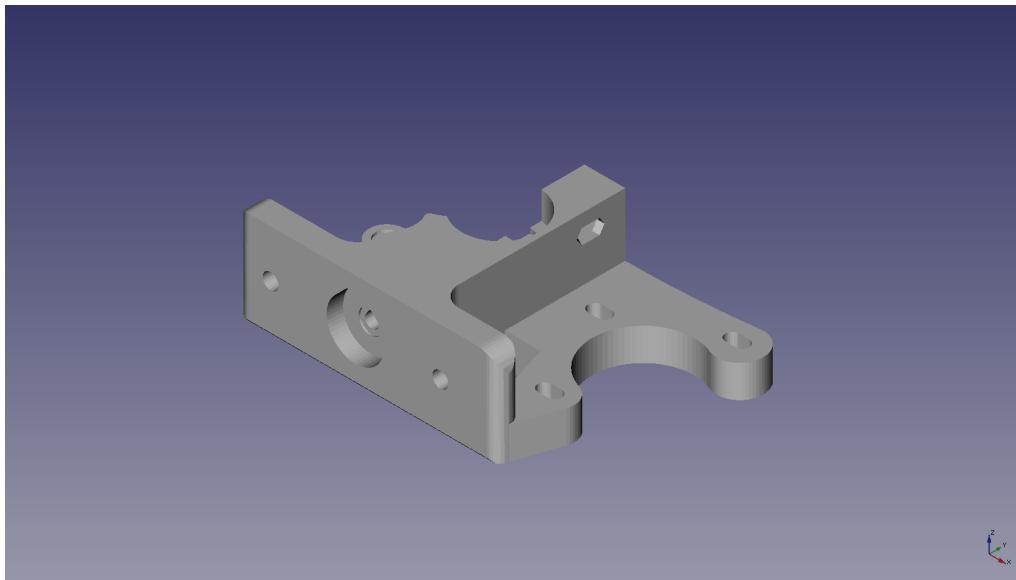


Figure 3.10: 3D Printed Extruder Body Render

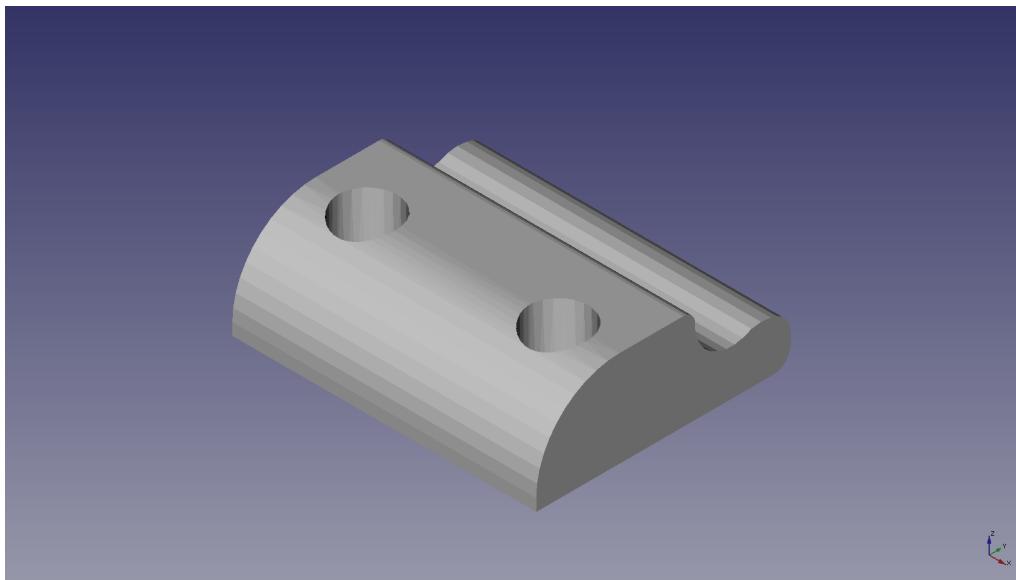


Figure 3.11: 3D Printed Extruder Latch Render

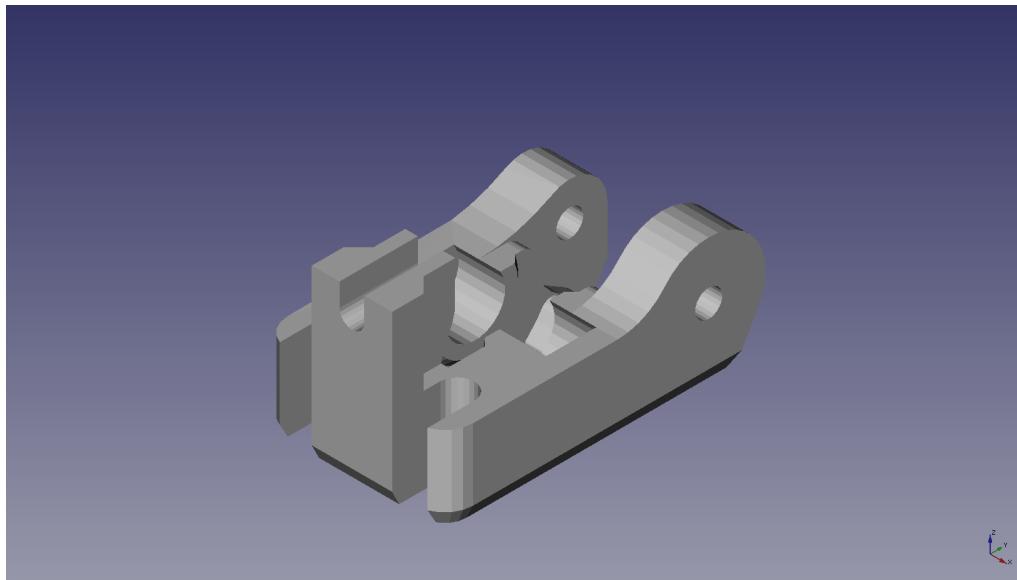


Figure 3.12: 3D Printed Idler Render

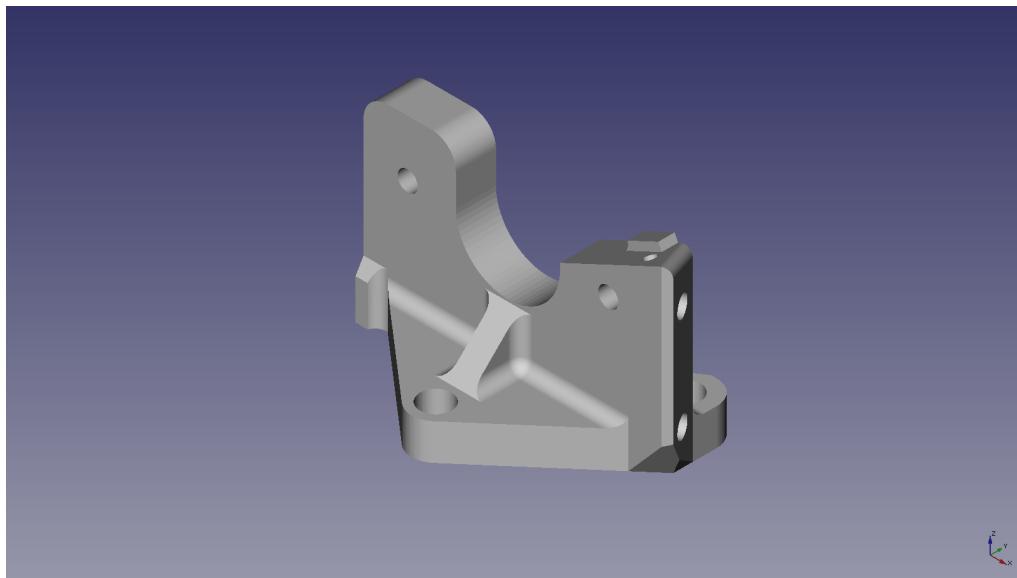


Figure 3.13: 3D Printed Extruder Mount Render

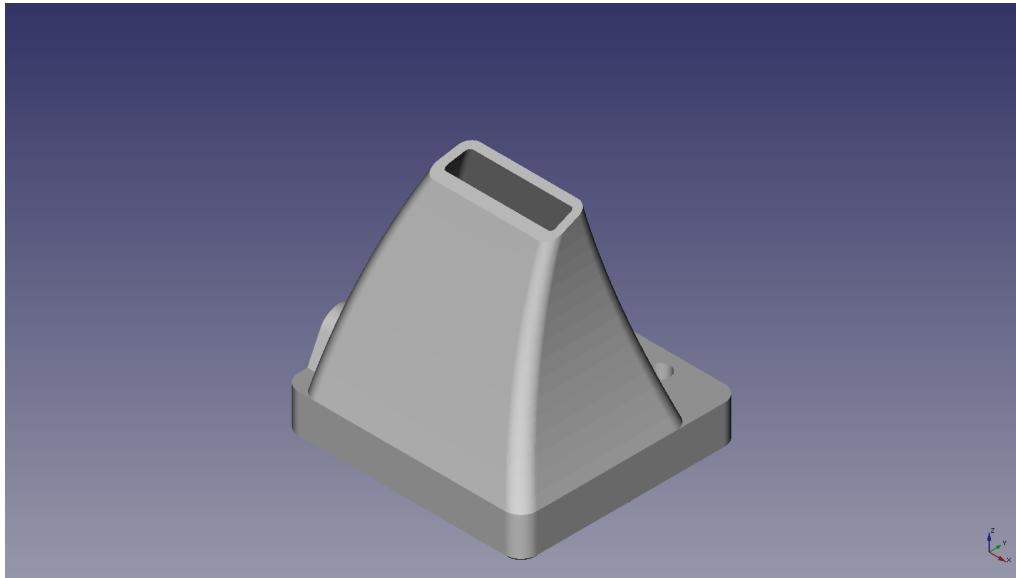


Figure 3.14: 3D Printed Fan Mount Render

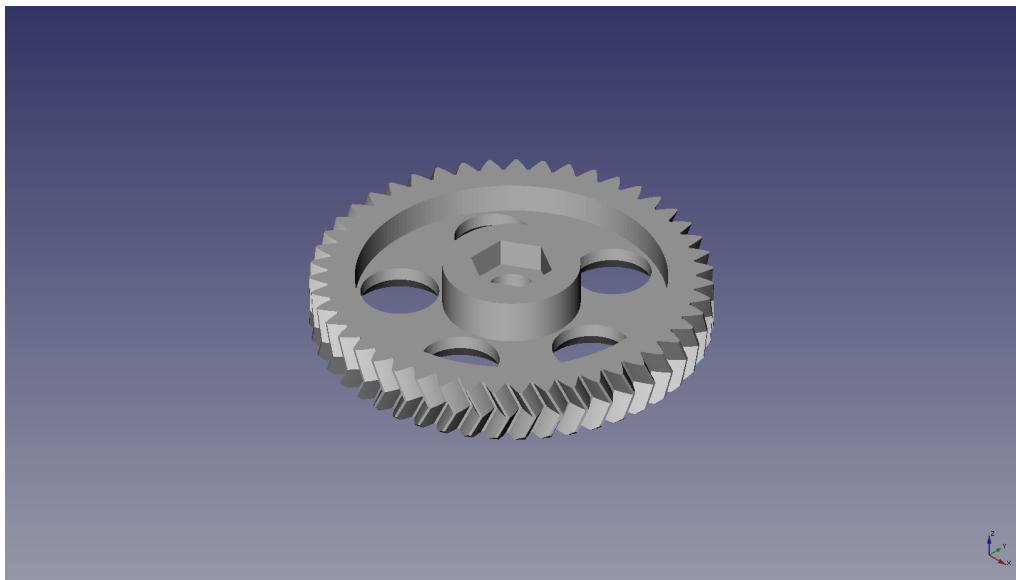


Figure 3.15: 3D Printed Large Gear Render

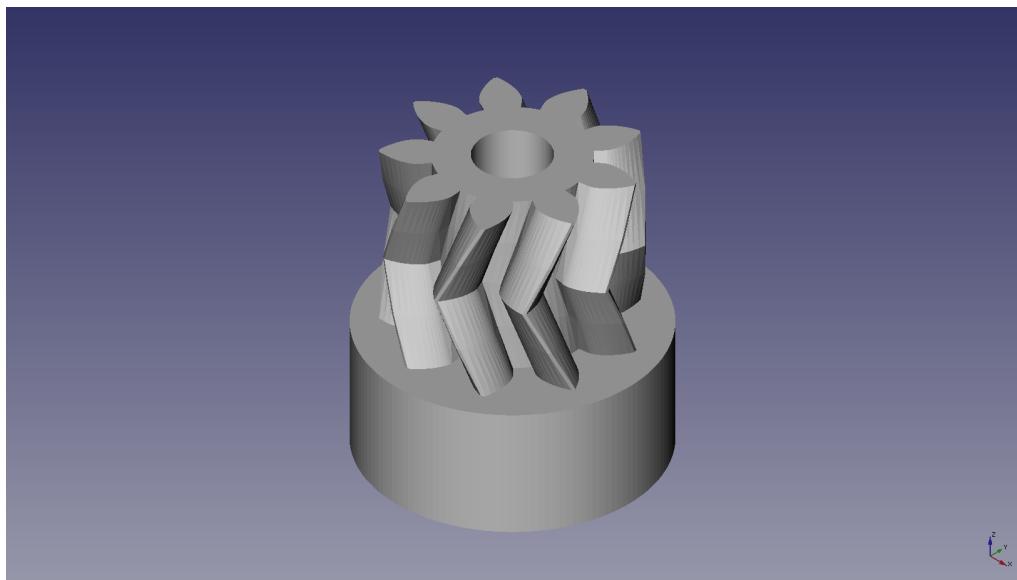


Figure 3.16: 3D Printed Small Gear Render

3.7 Spool

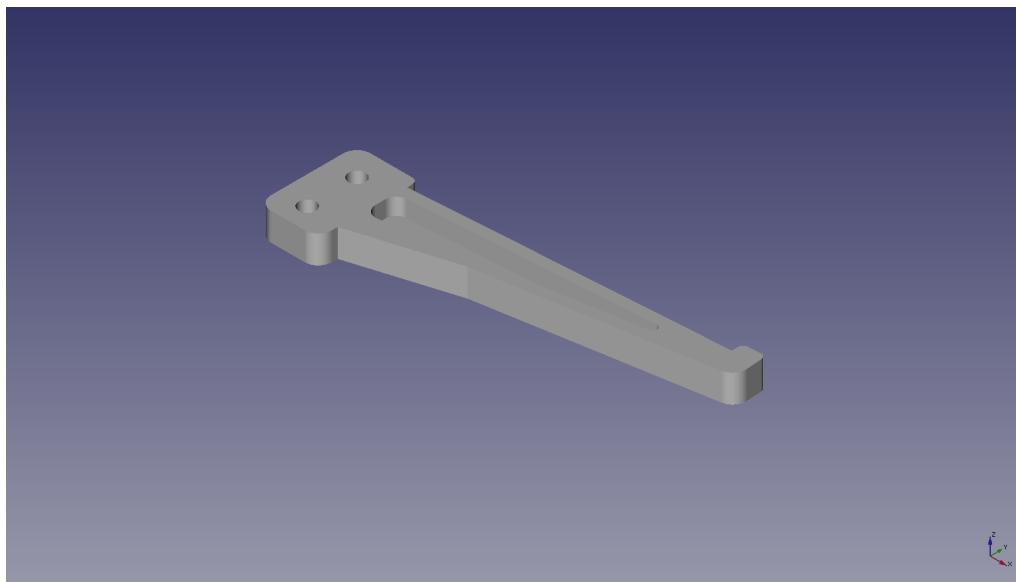


Figure 3.17: 3D Printed Spool Arm Render

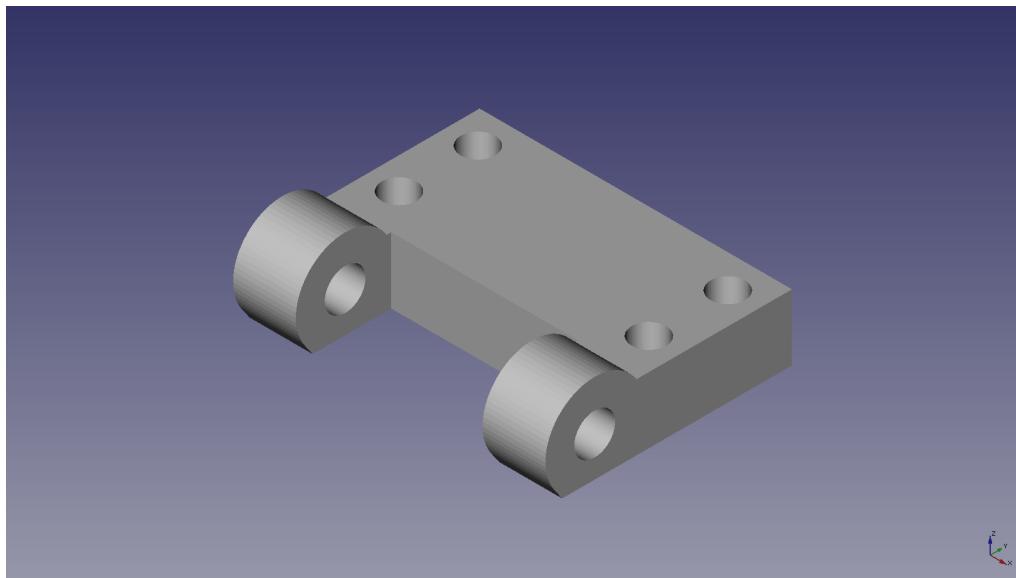


Figure 3.18: 3D Printed Spool Hinge Render

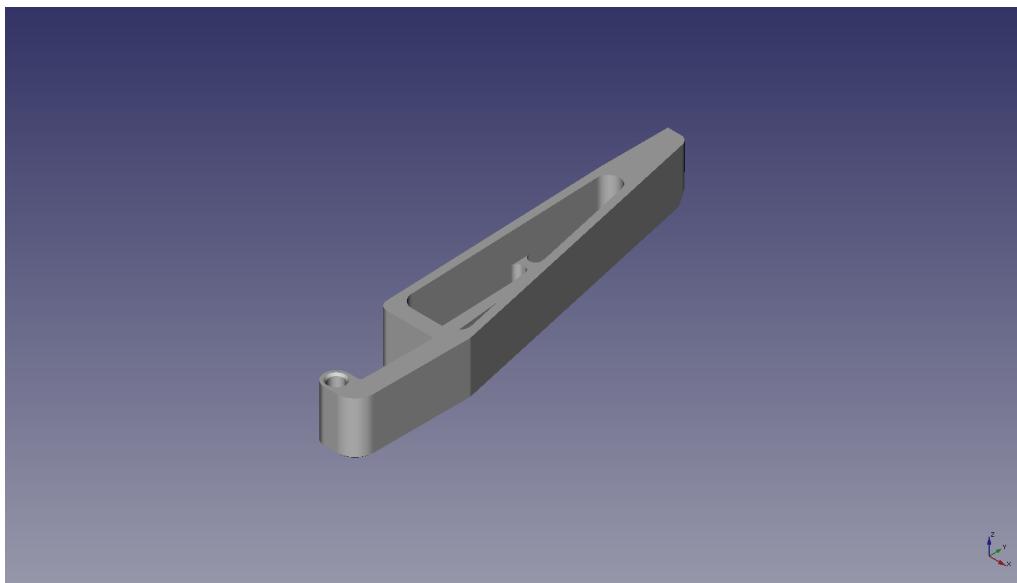


Figure 3.19: 3D Printed Spool Mount Render

3.8 X

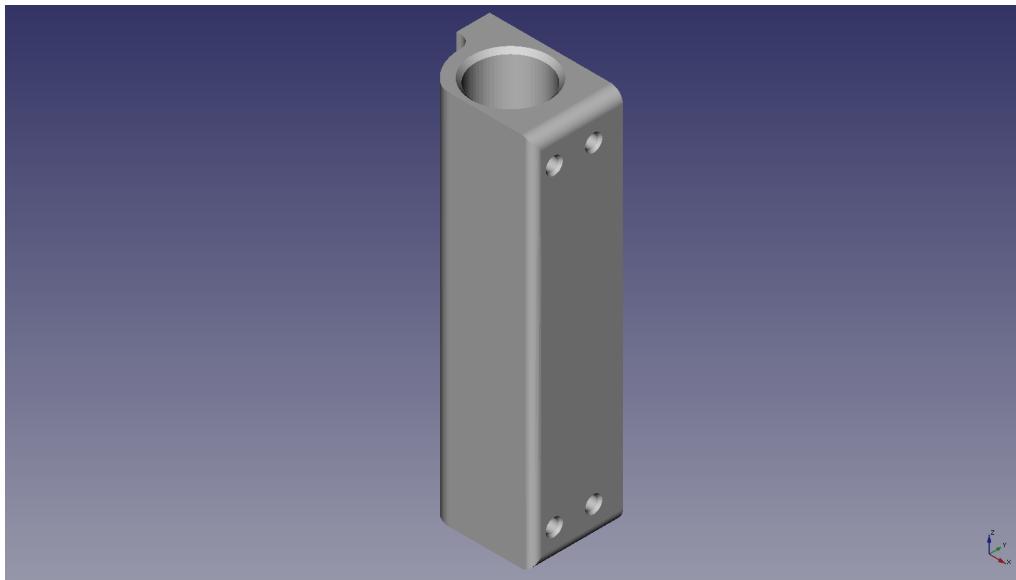


Figure 3.20: 3D Printed Double Bearing Holder Render

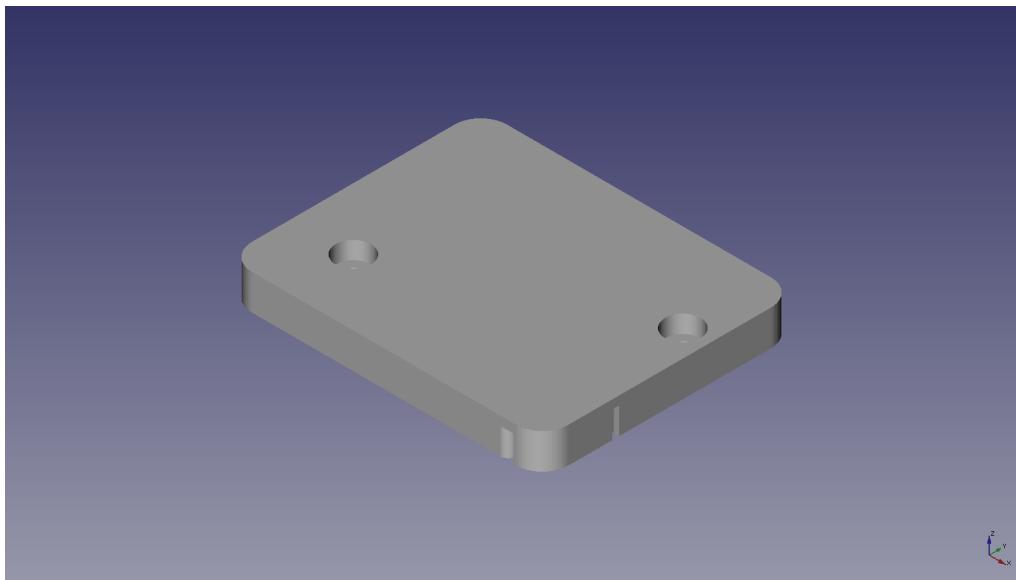


Figure 3.21: 3D Printed X Carriage Cover Render

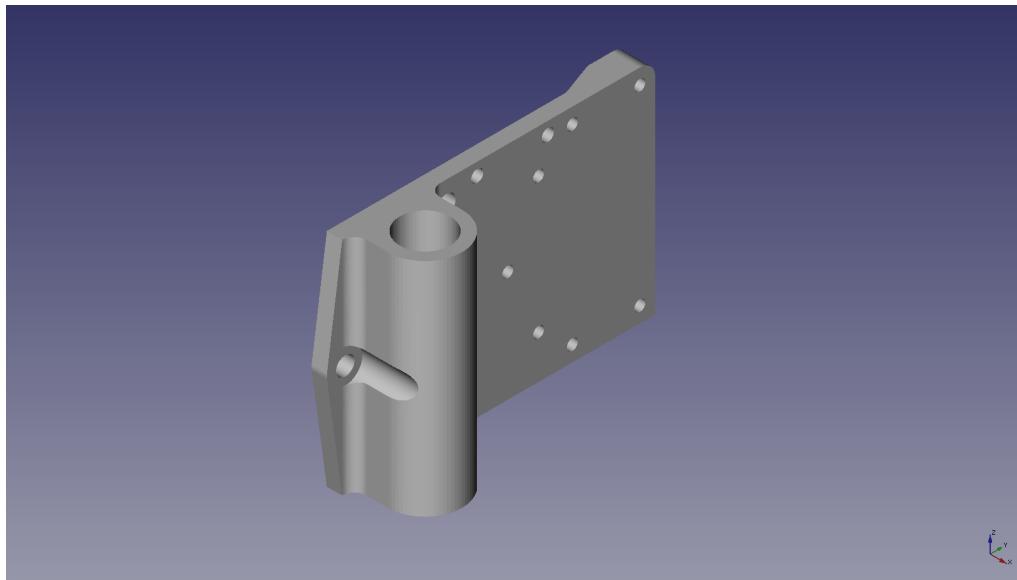


Figure 3.22: 3D Printed X Carriage Render

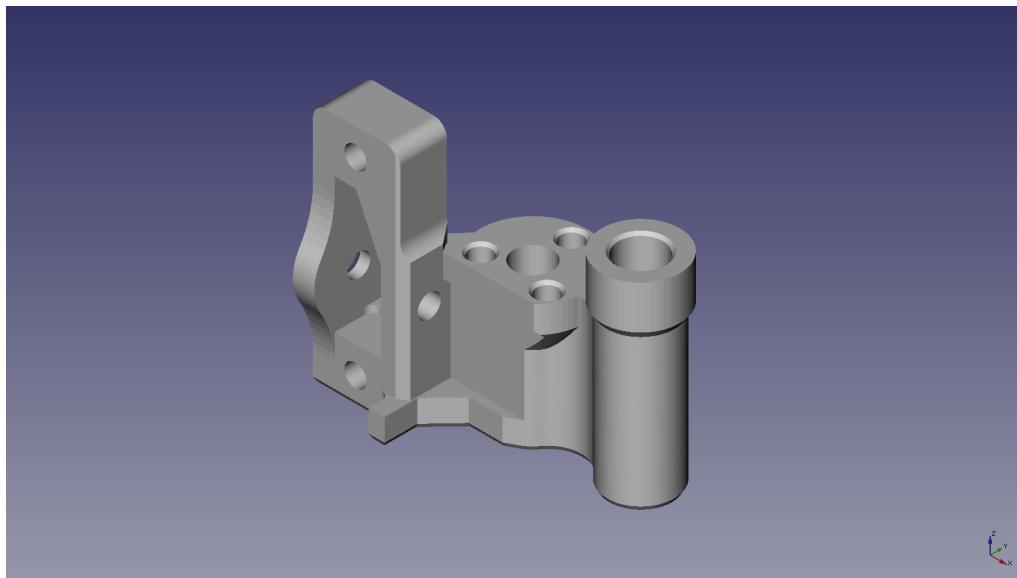


Figure 3.23: 3D Printed X End Idler Render

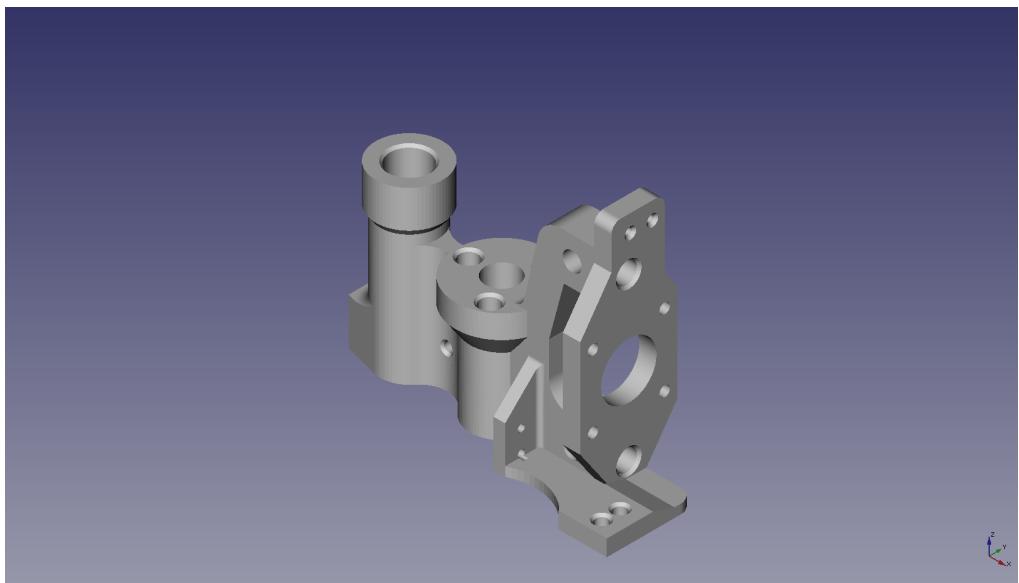


Figure 3.24: 3D Printed X End Motor Render

3.9. Y

3.9 Y

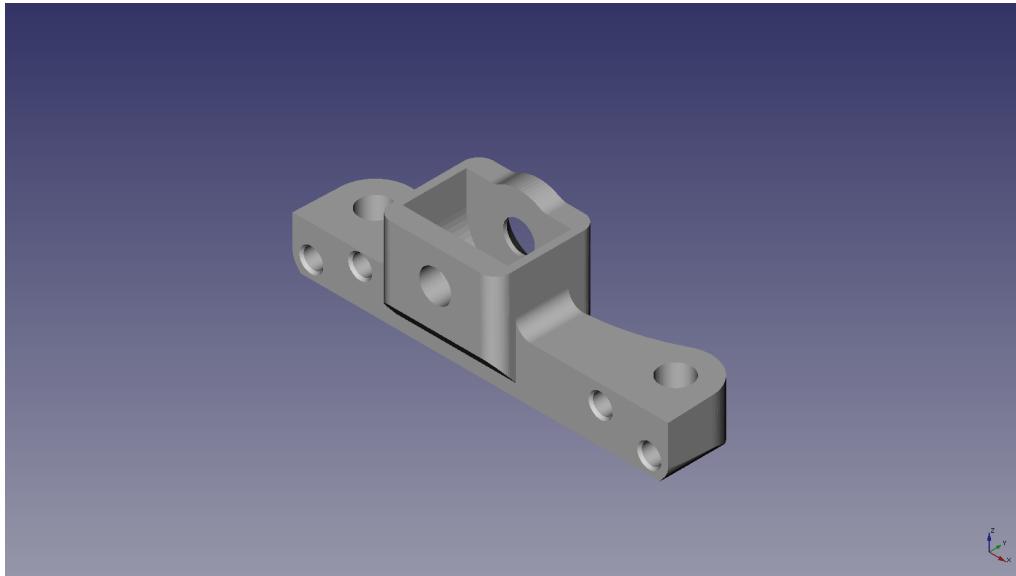


Figure 3.25: 3D Printed Y End Idler Render

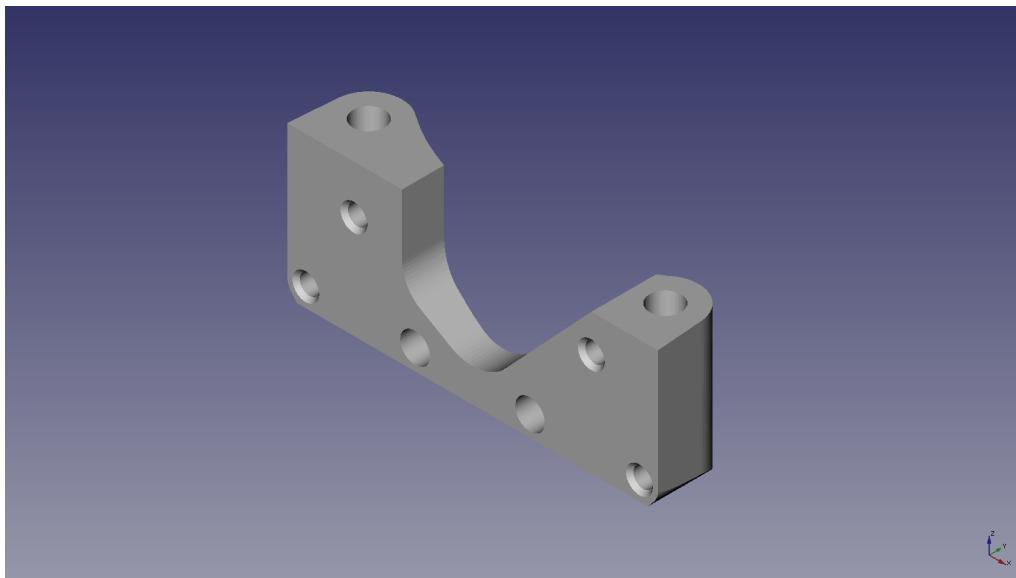


Figure 3.26: 3D Printed Y End Rod Mount Render

3.10 Z

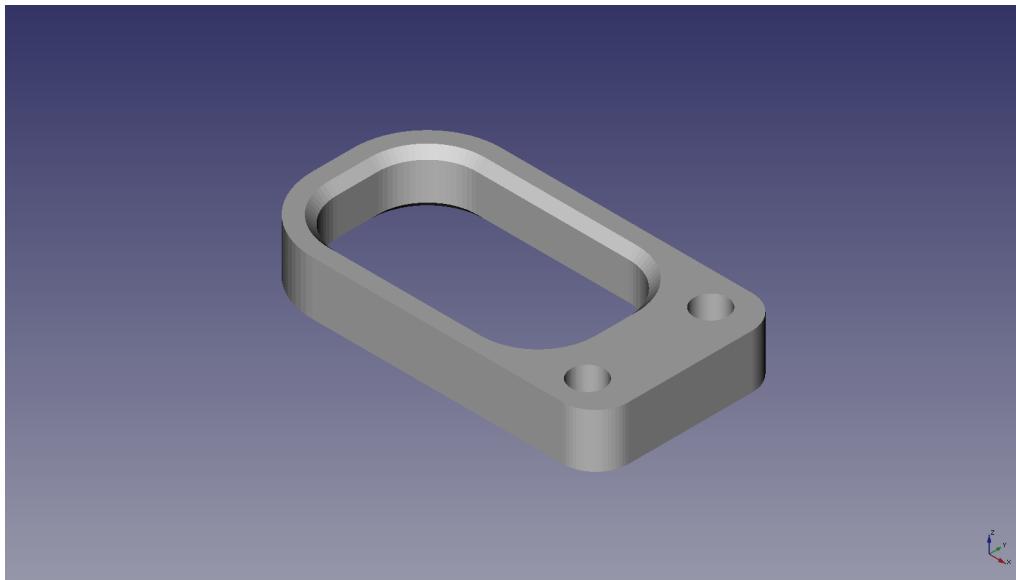


Figure 3.27: 3D Printed Lower Relief Render

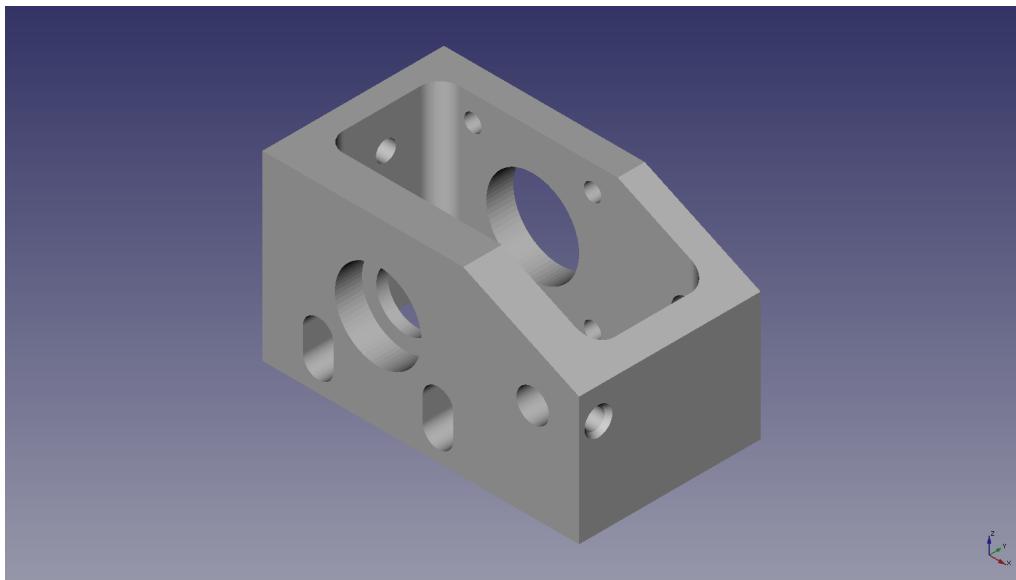


Figure 3.28: 3D Printed Lower Z Left Render

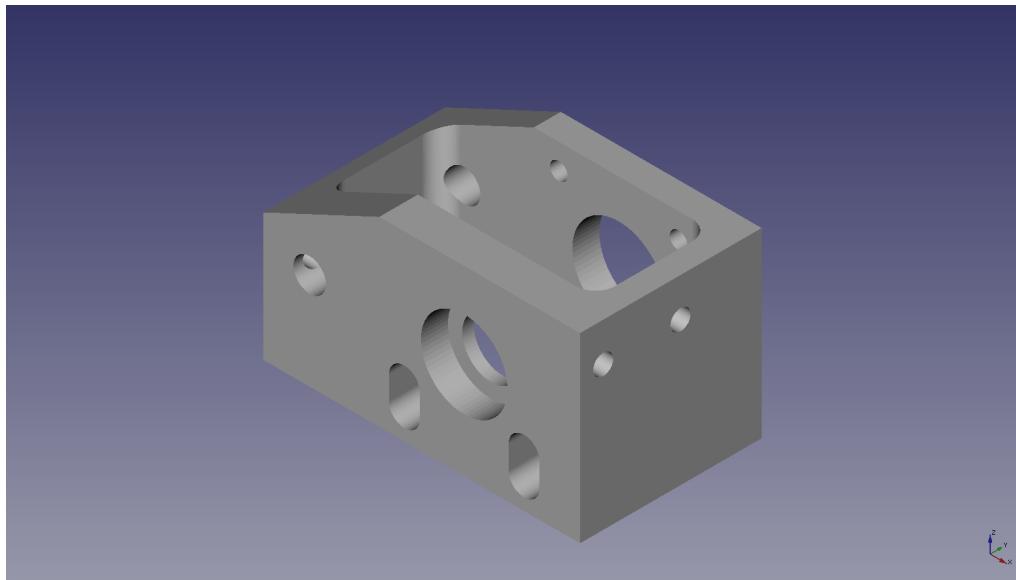


Figure 3.29: 3D Printed Lower Z Right Render

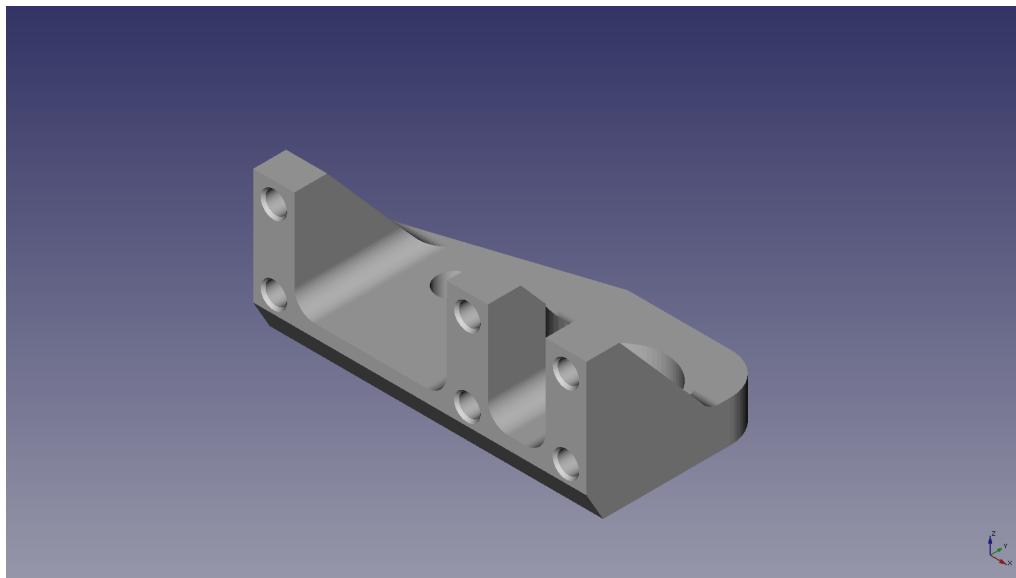


Figure 3.30: 3D Printed Upper Z Left Render

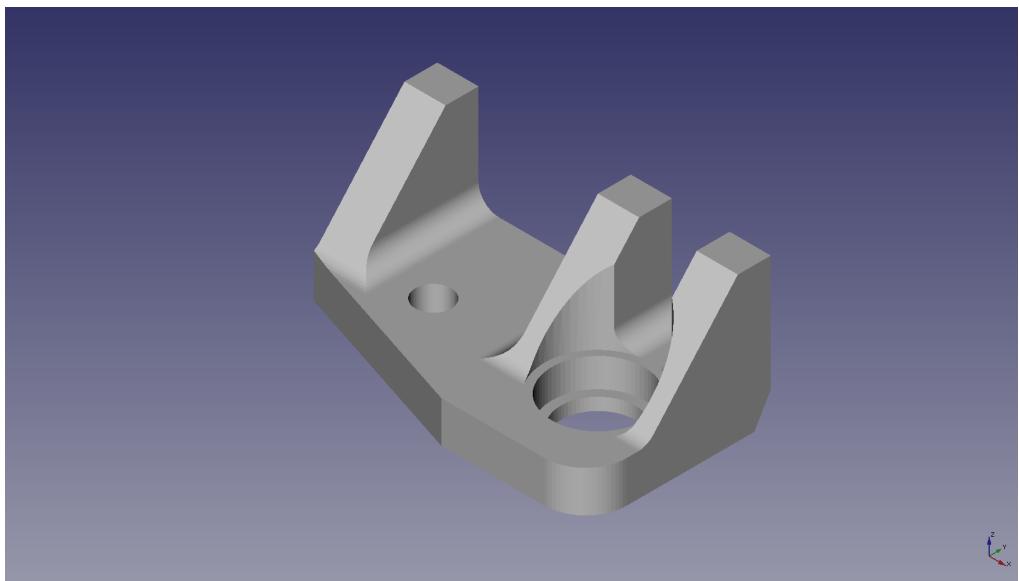


Figure 3.31: 3D Printed Upper Z Right Render

3.11 Misc

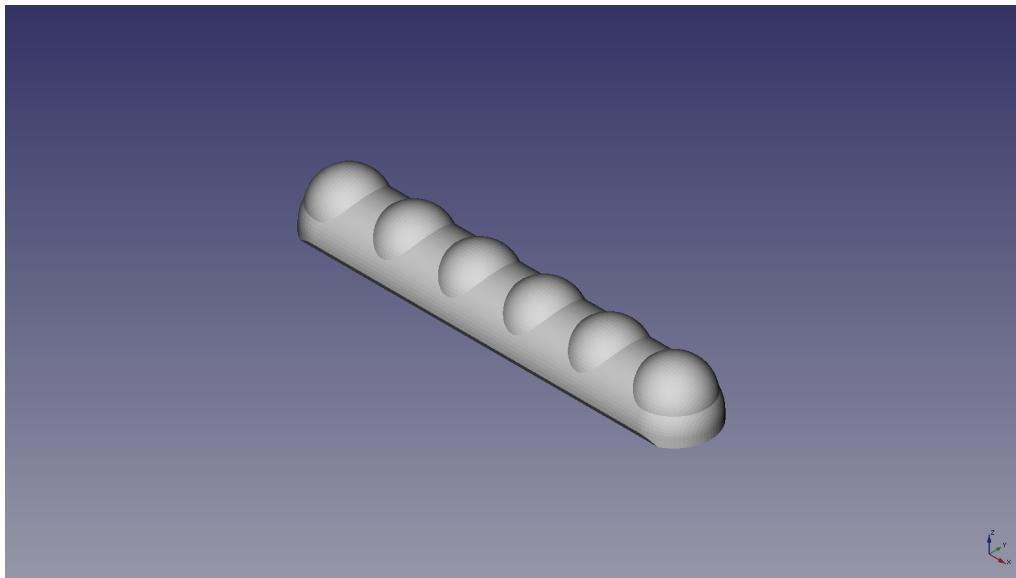


Figure 3.32: 3D Printed Handle Bar Render

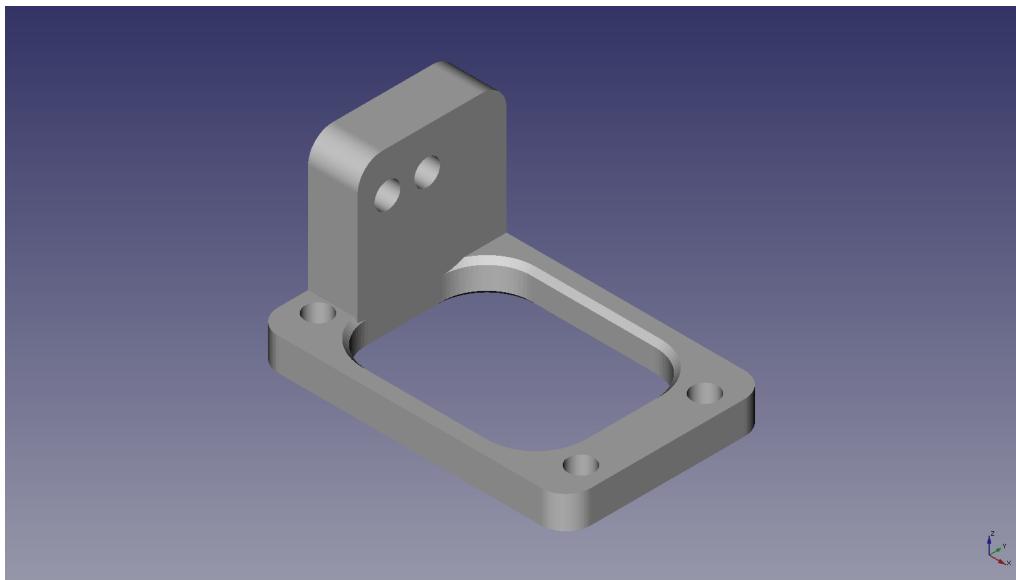


Figure 3.33: 3D Printed Relief Mount Render

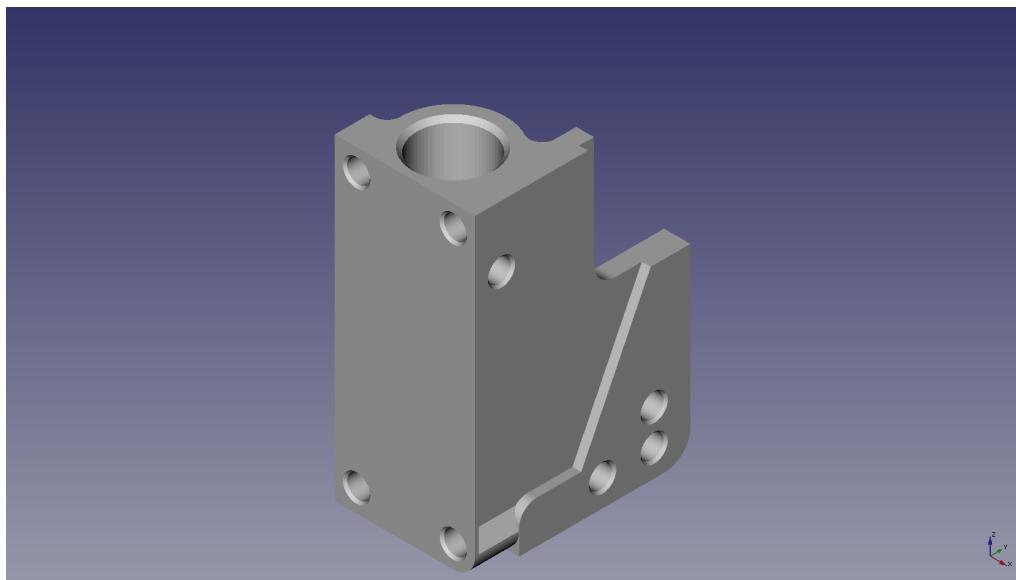


Figure 3.34: 3D Printed Upper Bearing Holder Render

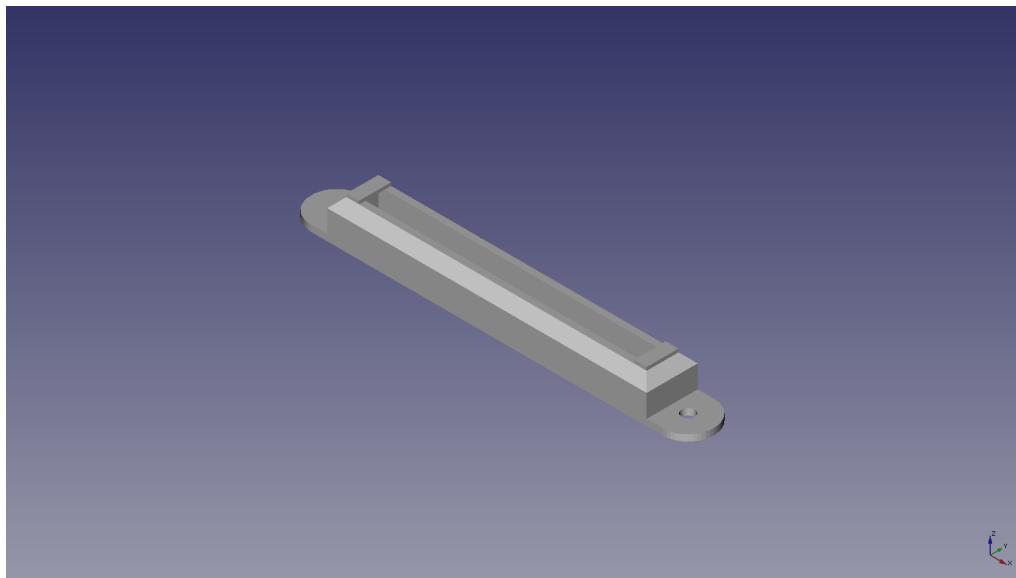


Figure 3.35: 3D Printed Wiper Mount Render

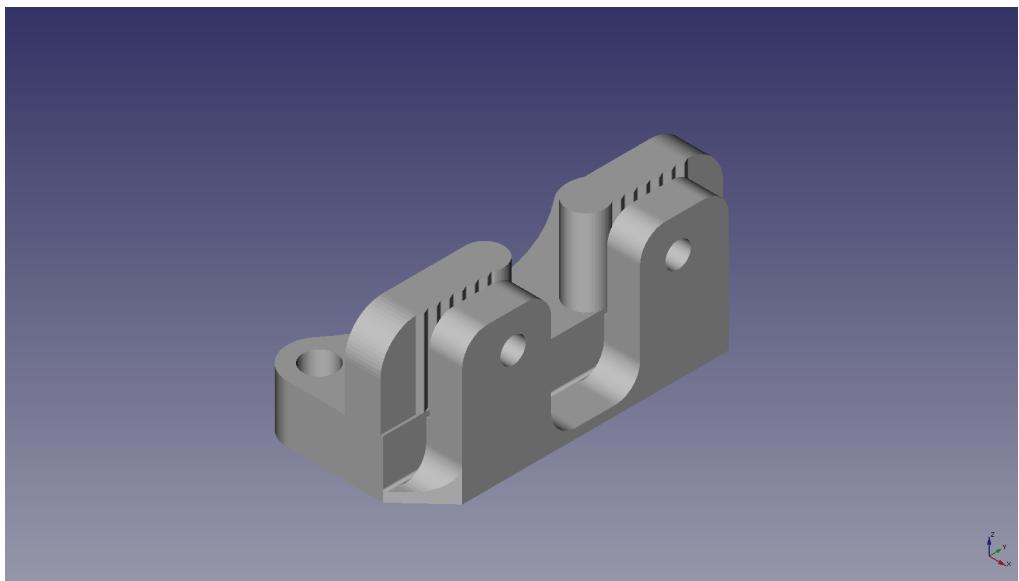


Figure 3.36: 3D Printed Belt Mount Render

Electrical

Power Supply, wiring

4.1 Electrical Layout

4.2 Wire Harness List

Camellia Wire List - V1.0

Harness	Program #	Type	Length	Strip Left	Strip Right	Quantity	Notes
X/Extruder Harness		Blue 24 AWG	500	6	4	1	upped from 460 for better reach
		Black 24 AWG	500	6	4	1	upped from 460 for better reach
		Grey 4 cond	500	50	30	1	upped from 470 for better reach
		Green 24 AWG	550	6	4	1	upped from 520
		Black 24 AWG	550	6	4	1	upped from 520
		Orange 24 AWG	650	6	4	1	upped from 620
		Black 24 AWG	650	6	4	1	upped from 620
		Grey 4 cond	1080	50	30	1	
		Red 24 AWG	1100	6	4	2	
		Orange 24 AWG	1100	4	4	2	
		Yellow 24 AWG	1100	4	4	1	
		Black 24 AWG	1100	4	4	1	
		White 24 AWG	1100	4	4	1	
		Black 24 AWG	1100	4	4	1	
		Purple 24 AWG	1100	4	4	1	
		Black 24 AWG	1100	4	4	1	
		Red 24 AWG	1125	4	4	1	upped from 1100
Bed Harness		Black 24 AWG	525	6	4	3	
		Red 24 AWG	525	6	4	1	
		Yellow 24 AWG	500	4	4	2	upped from 495
		Black 24 AWG	500	4	4	1	upped from 490
		Purple 16 AWG	550	6	6	2	upped from 525
Hexagon Hotend wires		Cartridge wires	180	4	4	2	
		Thermistor wires	180	4	4	2	
		5V nozzle lead	200	4	4	1	
X-max switch		Purple 24 AWG	160	6	4	1	
		Black 24 AWG	160	6	4	1	
Fans		Mini 5V blower	180	blower attached	4	2	
		40mm extrusion fan	120	fan attached	4	2	
		Case fan	160	fan attached	4	2	
Motors		Z-left motor	220	motor	4	4	200mm small shielding, 30mm large shielding
		Ext motor	200	motor	4	4	70mm small shielding
		X motor	120	motor	4	4	105mm small shielding, 30mm large shielding
		Z-right, Ymotor	60	motor	4	8	45 small shielding, 35 large shielding
Motor Extensions							
Z-right motor		Grey 4 cond	500	Trim shielding 20mm, all wires 4mm	Trim shielding 55 with lug, all wires 4mm	1	390 conduit wrap
Y-motor		Grey 4 cond	410	Trim shielding 20mm, all wires 4mm	Trim shielding 55 with lug, all wires 4mm	1	305 conduit wrap
Power Box							
		Red 16 AWG	200	6	6	2	PS to rambo
		Black 16 AWG	200	6	6	2	PS to rambo
		Green 16 AWG	80	6	4	1	Ground plug to post
		Green 16 AWG	50	6	4	1	Post to PS ground
		Black 16 AWG	320	6	6	1	Plug to switch
		White 16 AWG	320	6	6	1	Plug to switch
		Black 16 AWG	250	6	6	1	Switch to PS
		White 16 AWG	250	6	6	1	Switch to PS

3D Printer Controller

Mini-RAMBo

5.1 Intro

The printer controller will be the RAMBo-Mini.

Quality Assurance

Quality Assurance

6.1 Quality Assurance



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?

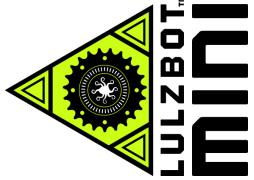
Y Axis:

- 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?



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QUALITY ASSURANCE RECORD

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.

Page 3 of 3

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Packing

If It Shakes It Breaks

7.1 Packing List

Pack it well.



PACKING LIST

Page 1 of 1

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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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>

Colophon

Created with 100% Free Software

GNU/Linux

\LaTeX Memoir
