

STATIAL.b

ADJUSTABLE MOUSE - BUILD INSTRUCTIONS

v01.00 - 09/06/2024

The Statial.b is an open source DIY mouse design. This concept has adjustable surfaces that can be moved and locked in position to create a wide range of new ergonomics for any grip style. Files for ambidextrous builds are included.

Knowledge of 3D printing, basic electronics & soldering skills as well as the ability to upload code to an Arduino are needed for this build. The design is based around a 16,000 DPI optical sensor in the [PMW3389](#) and driven by an Arduino compatible [PRO MICRO](#) controller.

This is a fairly complex project. I tried to cover all the assembly details in the in this PDF and on YouTube, but some problem solving skills are still going to be required.

The finished design is a functioning prototype that requires a lot of adjusting to get it dialed in and is more fragile than a normal commercially produced product. It's also a heavy mouse weighing up to a hefty 130 grams (depending on components used).

Not trying to put anyone off the build, just important to have realistic expectations about the end product. All that said, it works great and is super fun to use. There's really nothing else like it out there if you're looking to explore mouse ergonomics.

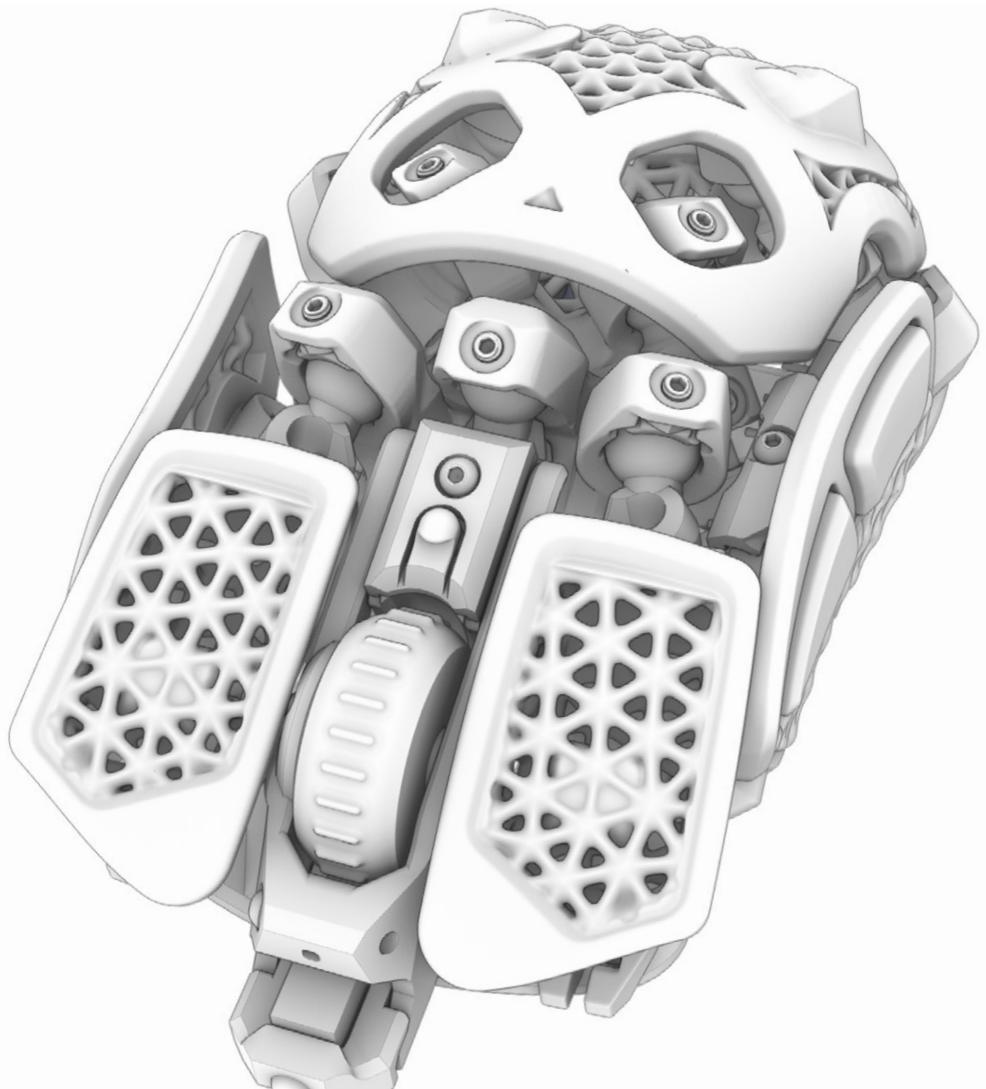
All 3D printed parts need to be made in a "Tough" or "ABS like" resin material. Resin print color is up to you. **This project requires resin printed parts.**

It will not work if parts are 3D printed with the FDM process.

Current (2024) project materials costs are around **\$200** (not including tools). This is a rough guess so you have an idea of what you're getting into.

GitHub Project Repository
<http://>

YouTube Design and Assembly Walkthrough:
<http://>



BOM - 3D PRINTS



All STL file units in MM. Slicer files for Preform & Lychee also available at GitHub repository. Requires ~170mL of resin for all parts. Complete print sets fit within approx 220mm x 125mm build areas but can be broken up into multiple batches for smaller printers.

Best results in Formlabs Tough 2000. Had good (although more fragile) results with Anycubic ABS-Like Pro 2 line of resins. Did not test but Sunlu ABS-Like and Siraya Tech lines would probably be fine as well.

STL Filename syntax: All matching "SBv##" files work together. The "A##" (letter/number) sections are individual component version IDs. Qty-## are number of print copies needed for a single build. Preform & Lychee files in repo should be have most up to date versions of all files.

ID	NAME	FILE NAME	QTY	MATERIAL	NOTE
3DP.01	BODY - LOWER	body-lower_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.02	BODY - UPPER	body-upper_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.03	ARM - STATIC	arm-static_SBv10A01_qty-03.stl	3	tough / abs like resin	Duplicate parts in slicer
3DP.04	ARM - ADJUSTABLE - A	arm-adj-A_SBv10A01_qty-04.stl	4	tough / abs like resin	Duplicate parts in slicer
3DP.05	ARM -ADJUSTABLE -B	arm-adj-B_SBv10A01_qty-04.stl	4	tough / abs like resin	Duplicate parts in slicer
3DP.06	MOUSE BUTTON - L	mb-L_SBv10A01_qty-01.stl	1	tough / abs like resin	Keep interior supports during post-cure to prevent warpage
3DP.07	MOUSE BUTTON - R	mb-R_SBv10A01_qty-01.stl	1	tough / abs like resin	Keep interior supports during post-cure to prevent warpage
3DP.08	MIDDLE - WHEEL	mid-wheel_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.09	MIDDLE - CRADLE	mid-cradle_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.10	MIDDLE - FLEX	mid-flex_SBv10A01_qty-01.stl	1	tough / abs like resin	Fragile part, careful when removing from supports
3DP.11	MIDDLE - ROTOR CAP	mid-rotor_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.12	MIDDLE - DPI CAP	mid-dpi_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.13	REAR SURFACE	mid-rotor_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.14	SIDE SURFACE - SWITCH	side-switch_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.15	LEFT SURFACE	side-L-std_SBv10A01_qty-01.stl	1	tough / abs like resin	Left/Right side surface parts skipped for left handed build
3DP.16	RIGHT SURFACE	side-R-std_SBv10A01_qty-01.stl	1	tough / abs like resin	-
3DP.17	ALT-L - LEFT SURFACE	side-L-flip_SBv10A01_qty-01.stl	1	tough / abs like resin	Optional prints for Left/Right handed build - found in "extras" folder
3DP.18	ALT-L - RIGHT SURFACE	side-R-flip_SBv10A01_qty-01.stl	1	tough / abs like resin	Optional prints for Left/Right handed build - found in "extras" folder
3DP.19	CUTTING JIG	cutting-jig_32mm	1	tough / abs like resin	Optional jig for cutting 1/8" tube stock to 32mm in "extras" folder

ID	PART	VENDOR	PART NO	QTY	PRICE (est)	LINK	NOTE
HW-01	M2 NUT - STANDARD	MCMASTER	91828A111	13	\$ 8.00	AMAZON	Generic parts, McMaster Carr for reference
HW-02	M2 X 4MM - BUTTON HEAD SCREW	MCMASTER	91239A703	10	\$ 12.00	AMAZON	Sets available - 1.3mm hex wrench
HW-03	M2 X 8MM - BUTTON HEAD SCREW	MCMASTER	97763A408	2	-	-	-
HW-03	M2 X 16MM - BUTTON HEAD SCREW	MCMASTER	97763A411	3	-	-	-
HW-04	M2.5 NUT - STANDARD	MCMASTER	90591A270	18	\$ 6.00	AMAZON	-
HW-05	M2.5 X 4MM - CUP HEAD SET SCREW	MCMASTER	97763A412	16	\$ 7.00	AMAZON	1.3mm hex wrench
HW-06	1/8" ROD OR TUBE STOCK - CUT TO 32MM LENGTH	Misc	n/a	~1'	\$ 6.00	AMAZON	Rec. aluminum tube. Available at most hardware stores.
HW-08	MOUSE FEET FOR LOGITECH G-PRO	Misc	n/a	-	\$ 7.00	AMAZON	Any 3rd party glides for G-Pro are ok
EL-01	ARDUINO PRO MICRO (5v) - NO SOLDERED HEADERS	Misc	n/a	1	\$ 14.00	AMAZON	Any clone is fine, must be 5 volt ver.
EL-02	PMW3389 MOTION SENSOR	TINDIE	n/a	1	\$ 30.00	TINDIE	Supplied by Joe's Sensors and Sundry
EL-03	(A) PCB - CUSTOM BRIDGE BOARD / (B) MIDDLE BUTTONS	JLPCB / PCBWAY	n/a	1	\$ 14.00	LINK	D/L Gerber file from Statial.b GitHub and order through PCB fab house (usually x5 min order)
EL-04	8, 8, 12 PIN - SURFACE MOUNT HEADER - GULL WING - 2.54MM	DIGIKEY	HDR100IMP40M-G-V-SM-ND	1	\$ 1.00	DIGIKEY	Come as 40 pin headers, cut to length
EL-05	5'-6' MICRO USB CABLE OR REPLACEMENT MOUSE CABLE & USB MICRO COMPONENT END	Misc	n/a	1	\$ 10.00	AMAZON	Any Micro USB will work OR order a mouse cable (AMAZON) + micro usb end (AMAZON)
EL-06	MOUSE MICRO SWITCHES	Misc	n/a	5	\$ 20.00	AMAZON	can find cheaper but these look cool
EL-07	PUSH BUTTON MOMENTARY SWITCH - 6mm x 6mm x 5mm	Misc	n/a	1	\$ 6.00	AMAZON	must be 4.5mm (5mm) high version
EL-08	TTC ROTARY ENCODER - FOR GLADIUS III OR RAZER MAMBA	Misc	n/a		\$ 8.00	AMAZON	8mm x 8mm encoder only
EL-09	NEOPIXEL 5050 RGB LED	ADAFRUIT	1655	1	\$ 5.00	ADAFRUIT	-
EL-10	2 PIN - JST PH - 2.0MM PITCH - THROUGH HOLE - RIGHT ANGLE	DIGIKEY	S2B-PH-K-S	2	\$ 10.00	AMAZON	Generic JST-PH sets available
EL-11	2 PIN - JST PH - 2.0MM PITCH - MALE CABLE PLUG	DIGIKEY	PHR-2	2	\$ 10.00	AMAZON	PA-09 crimp required (see tools)
EL-12	3 PIN - JST PH - 2.0MM PITCH - THROUGH HOLE - RIGHT ANGLE	DIGIKEY	S3B-PH-K-S	1	-	-	-
EL-13	3 PIN - JST PH - 2.0MM PITCH - MALE CABLE PLUG	DIGIKEY	PHR-3	1	-	-	-
EL-14	5 PIN - JST PH - 2.0MM PITCH - THROUGH HOLE - RIGHT ANGLE	DIGIKEY	S5B-PH-K-S	1	-	-	-
EL-15	5 PIN - JST PH - 2.0MM PITCH - MALE CABLE PLUG	DIGIKEY	PHR-5	1	-	-	-
EL-16	28 GA WIRE - SILICONE	-	n/a	~6'	\$ 13.00	AMAZON	Rec. 6 wire ribbon cable

BOM - TOOLS

PYOTTDESIGN

NAME	NOTE	PRICE	LINK
RESIN BASED 3D PRINTER & TOUGH OR ABS LIKE RESIN	Resin print only. STL, Preform & Lychee Print files available via Github link. Req. ~150mL of resin	-	-
SOLDERING IRON & SOLDER	Attaching headers, ProMicro, PMW sensor and PH ports to bridge board	-	-
WIRE CUTTERS	Used for clearing supports & wiring	-	-
NEEDLE NOSE PLIERS	Used for clearing supports	-	-
XACTO KNIFE	Used for clearing supports & cleanup	-	-
CRIMPING PLIERS FOR JST PH - PA09	Needs to have 1.4mm and 1.6mm connector crimp slots - 4mm thick - PA-09 (or knock off) only. Annoyingly expensive.	\$35.00	AMAZON
LITHIUM GREASE	Highly recommend for lubricating axle of 3D printed scroll wheel	\$8.00	AMAZON
HAND HOBBY SAW	Used for cutting adjustable arm metal tube stock to length. Any metal hand saw or Dremel will work	\$8.00	AMAZON
HEAT SHRINK TUBE (MISC. SIZES)	Will be visible when build is complete so choose a color you like	\$8.00	AMAZON
HOT GLUE / HOT GLUE GUN	Attaching Neopixel to board & securing nuts in slots for easier assembly	-	-
NEEDLE FILE SET	Optional - cleaning up prints	-	-
LOC TIGHT - BLUE	Optional - securing attachment screws in place to prevent loosening up over time	\$9.00	AMAZON
MULTIMETER	Multimeter or continuity tester for checking switches and trouble shooting. Doesn't need to be fancy.		
HEX ALLEN WRENCH - 1.3MM	Hex L-key wrench for M2 button head screws - fixed parts		
HEX ALLEN WRENCH - 1.5MM	Hex L-key wrench for M2.5 button head screws - adjustment parts		

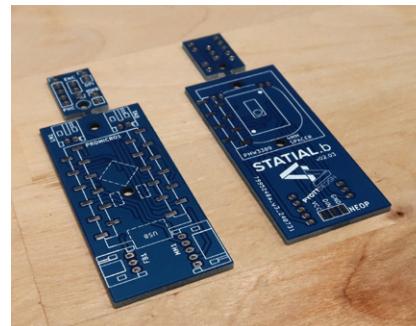
CUSTOM PCB

The Statial-b uses a custom printed circuit board (EL-03) to connect the Pro Micro (EL-01) and PMW3389 sensor (EL-02). The design has the main bridge board and a smaller middle mouse wire routing board connected by a snap off tab.

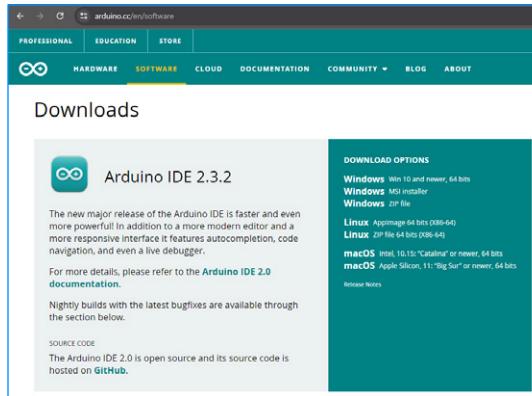
Gerber files can be downloaded as a ZIP file from the GitHub repository and ordered through any PCB fabrication house. I would recommend [JLCPCB](#) or [PCBWAY](#) for low cost boards.

Upload the Statial-b Gerber ZIP file for instant quote order. **Make sure to specify "2 design board" when ordering.**

Select alternate PCB color if desired. The board is a simple dual layer design and all other settings can be left as default (cheapest) for ordering. Most fabrication houses will have a 5 piece minimum order.



Before starting build, load controller software onto Pro Micro (5v). This is to check that the control board is good before getting to far into assembly process (some of the clone Pro Micros can be a bit sketchy on the reliability front).



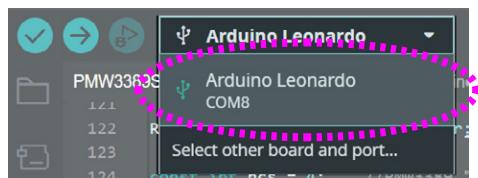
A ARDUINO IDE

Download and install the Arduino IDE for your OS

B STATIAL.B SKETCH

Download the STATIAL.b Arduino Sketch from GitHub and open in the Arduino IDE.

```
PMW3389SB_Mouse_03.ino | Arduino IDE 2.3.2
File Edit Sketch Tools Help
File Edit Sketch Tools Help
Arduino Leonardo
PMW3389SB_Mouse_03.ino SIRCOM_PMW3389.ho
1 // rotary encoder
2 rotaryEncoder* encoder = nullEncoder;
3
4 const int ncs = 4; // //PMW3389_S5 pin
5 const int read = 3; // //PMW3389_WRT pin
6
7 int bte_pins[NUMBER] = {NC, NC, NC, NC, NC, NC, NC, NC};
8 int bte_buttons[NUMBER] = {false, false, false, false, false, false, false, false};
9 uint8_t bte_buffer[NUMBER] = {0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF};
10 char bte_val[NUMBER] = {MOUSE_LEFT, MOUSE_RIGHT, MOUSE_MIDDLE, MOUSE_FORWARD, MOUSE_BACK};
11
12 int key_pins[NUMBER] = {R6Pin};
13 bool key[NODENUM] = {false}; // button state indicator
14 uint8_t key_buffer[NODENUM] = {0x00}; // button debounce buffer
15 char key_val[NODENUM] = {0x00}; // button value
16
17 // colors that represent the CPI/PI setting: Red, Orange, Yellow, Green, Blue, Purple
18 int display[NUMBER] = {{255, 0, 0, 0}, {255, 55, 0, 0}, {340, 115, 0, 0}, {4, 155, 100, 0}, {0, 55, 200, 0}, {0, 0, 170, 0}};
19
20 unsigned long colors[NUMBER] = {400, 600, 800, 1000, 1200, 1400, 1600};
21
22 target_set();
23
24 bool target_set() {
25
26
27 }
```



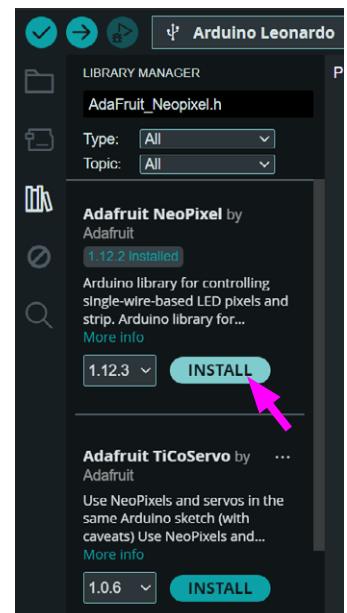
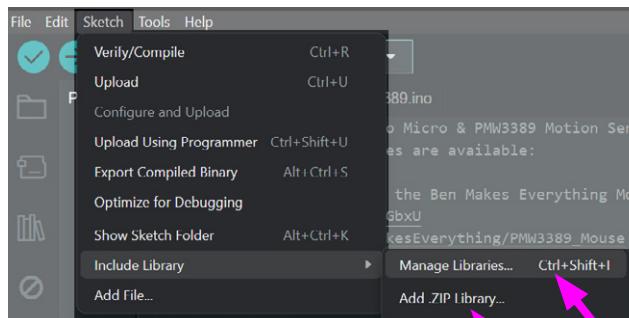
C PRO MICRO

Plug in Pro Micro board using Micro USB cable. Device should appear as "Arduino Leonardo".

D LIBRARIES

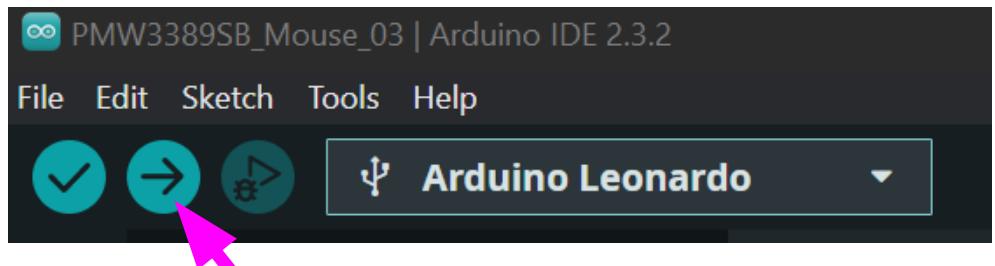
Add required libraries: Mouse.h, Keyboard.h, Adafruit_Neopixel.h, RotaryEncoder.h, AdvMouse.h*

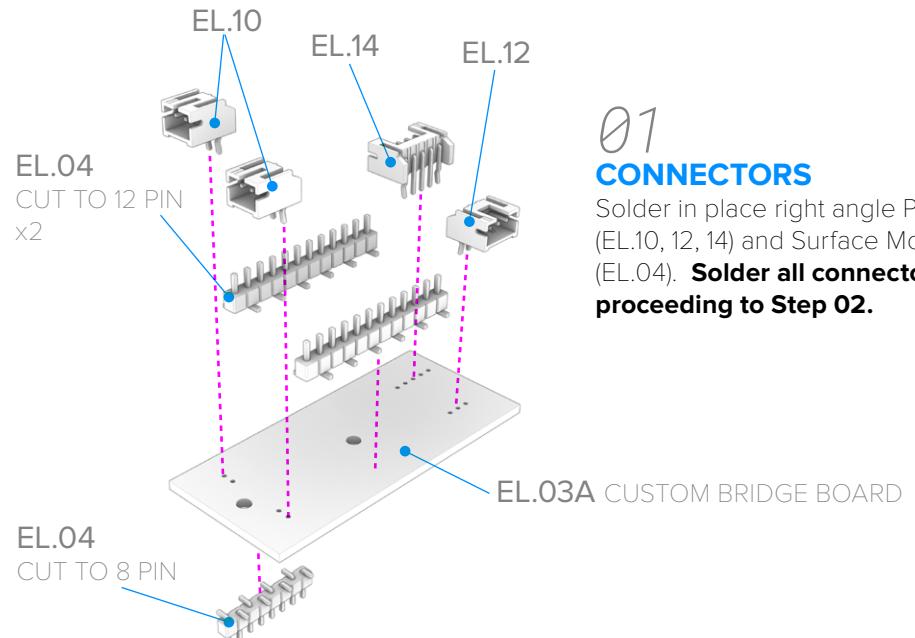
*AdvMouse.h can be downloaded from Ploopy's GitHub repository and added manually as zip file:
[GITHUB.COM/PLOOPYCO](https://github.com/ploopyco)



E INSTALL

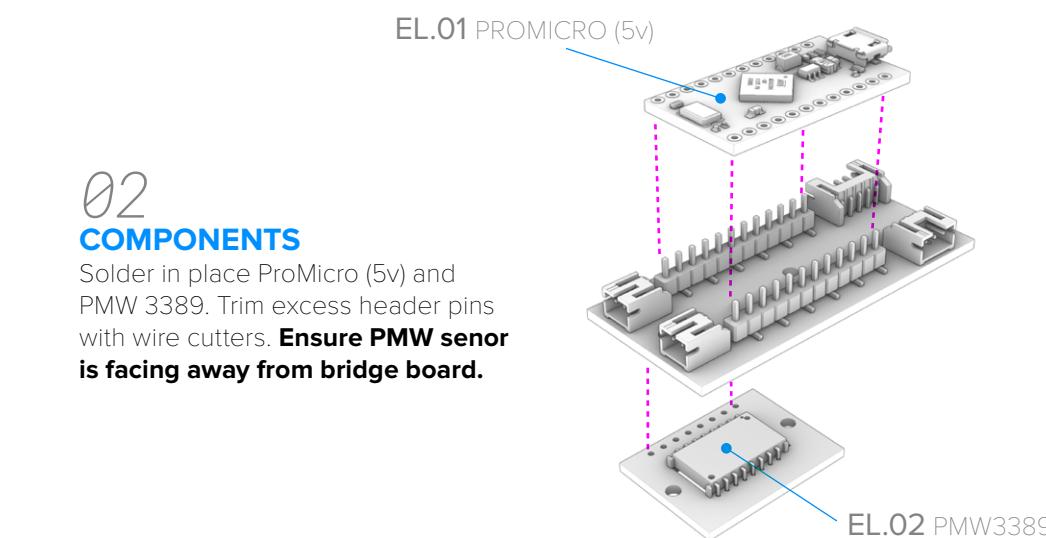
Upload sketch to Pro Micro & confirm the board is working. Mouse settings like LED brightness, DPI presets, button mapping, etc. can be adjusted once the Statial.b is fully assembled.





01 CONNECTORS

Solder in place right angle PH connectors (EL.10, 12, 14) and Surface Mount Headers (EL.04). **Solder all connectors before proceeding to Step 02.**

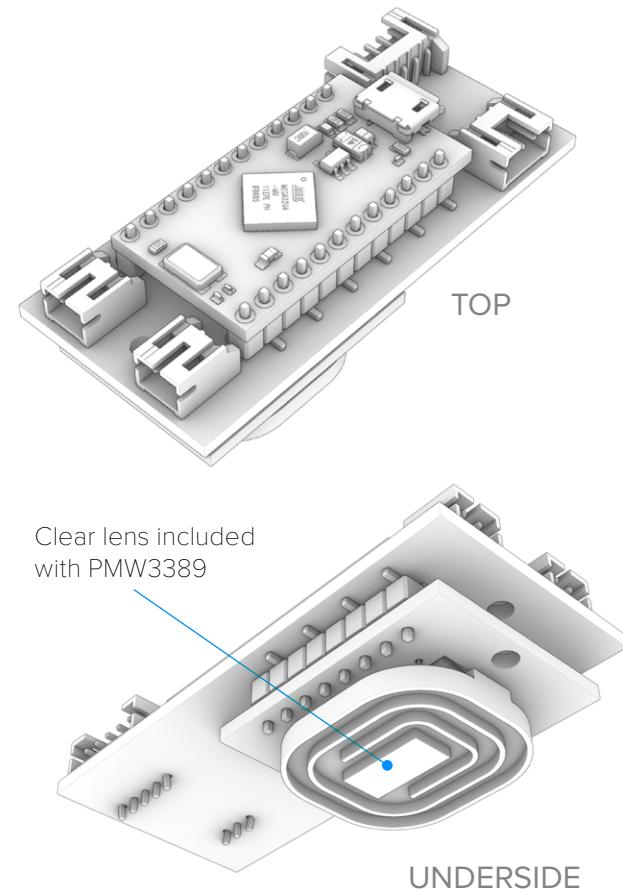


02 COMPONENTS

Solder in place ProMicro (5v) and PMW 3389. Trim excess header pins with wire cutters. **Ensure PMW senor is facing away from bridge board.**

Finished electronics, sensor should be working. Plug in the micro USB connector again to check that mouse tracking is working. Cursor should move when you move the electronics assembly on a surface.

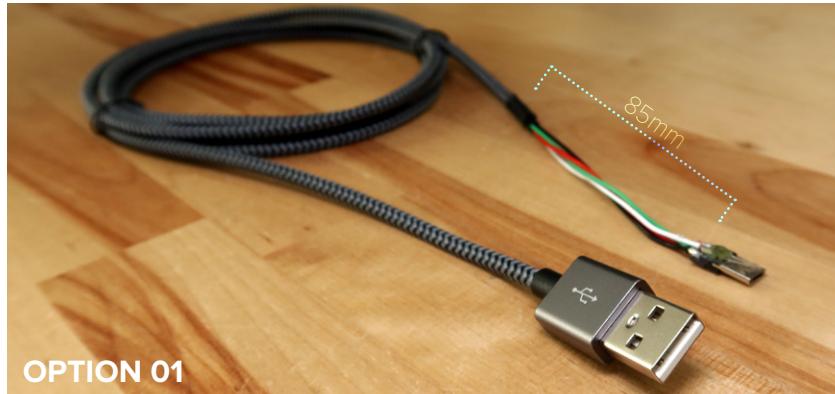
The focusing lens on PMW3389 is loose at this point so be careful while testing and keep it in safe place while continuing assembly.



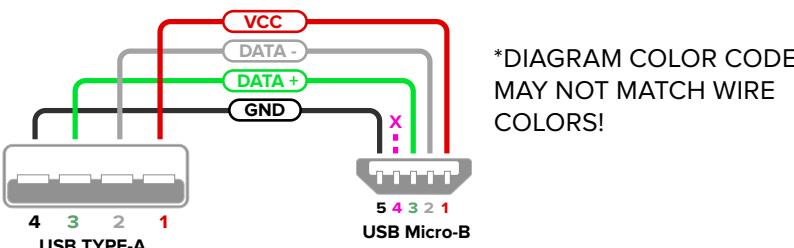
03

PREPARE MICRO USB CABLE

Carefully remove connector cover & 85mm of sheathing from end of a common Micro USB cable using exacto knife. Cover end of cable with heat shrink.

**OPTION 01**

Alternatively, you can order a standard mouse replacement cable and micro usb plug component & resolder. This will give you a thinner more flexible USB cable.

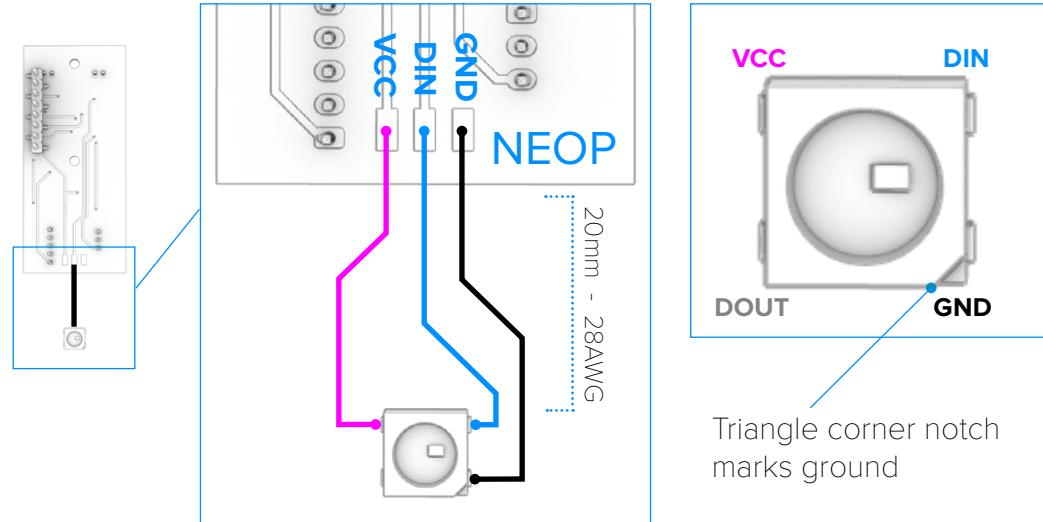
**OPTION 02**

BUILD INSTRUCTIONS V01.00

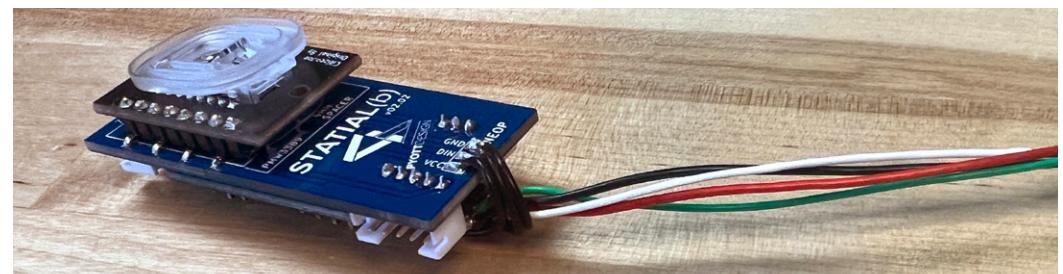
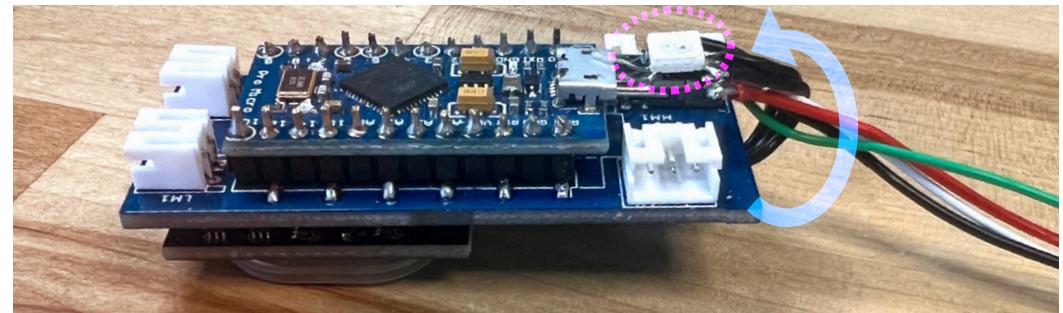
04

WIRE NEO PIXEL

Solder NeoPixel to PCB using 28 gauge wire. Hot glue or double stick tape the LED to top of micro USB plug facing upwards.

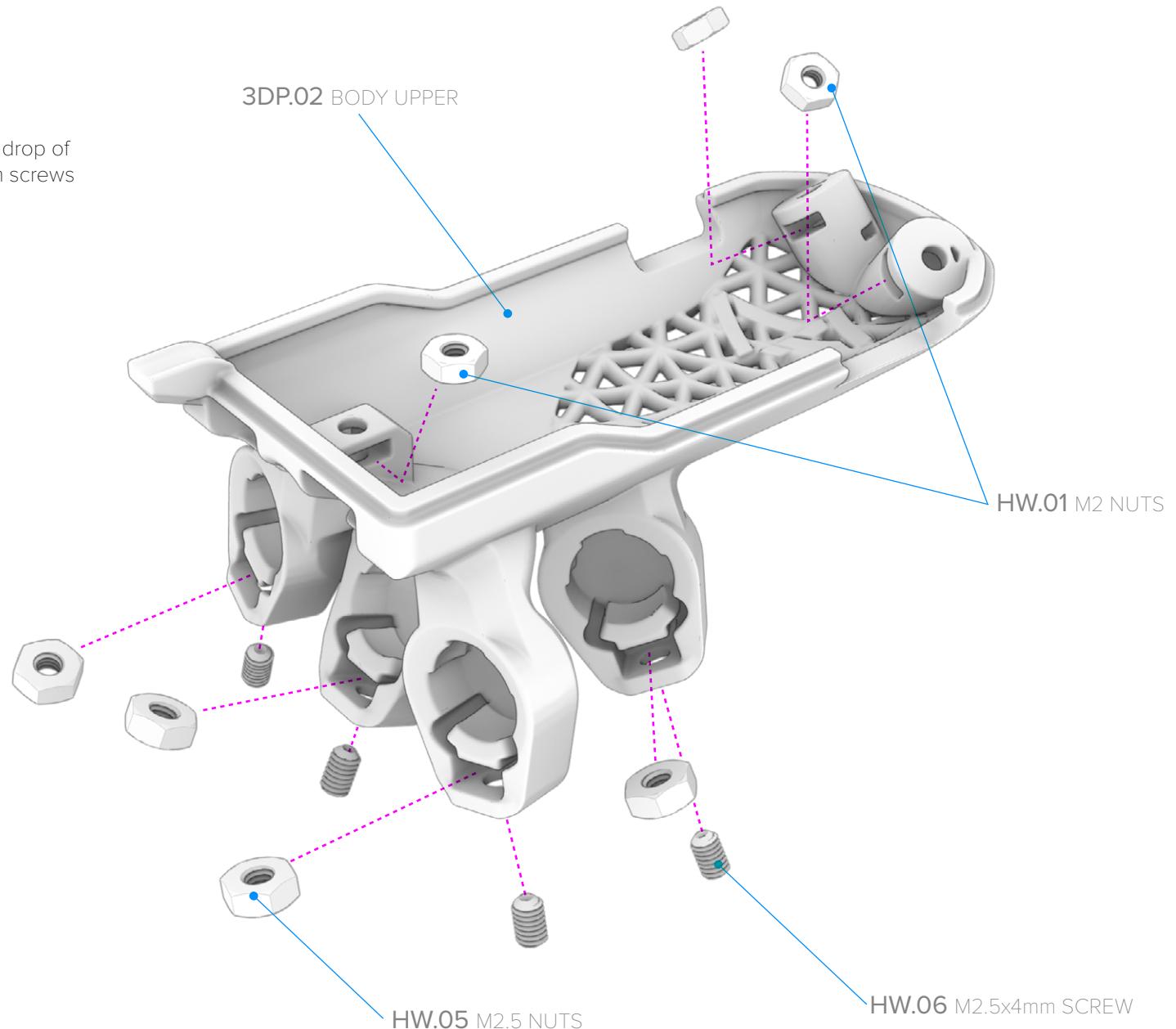


Triangle corner notch
marks ground



**05
NUTS**

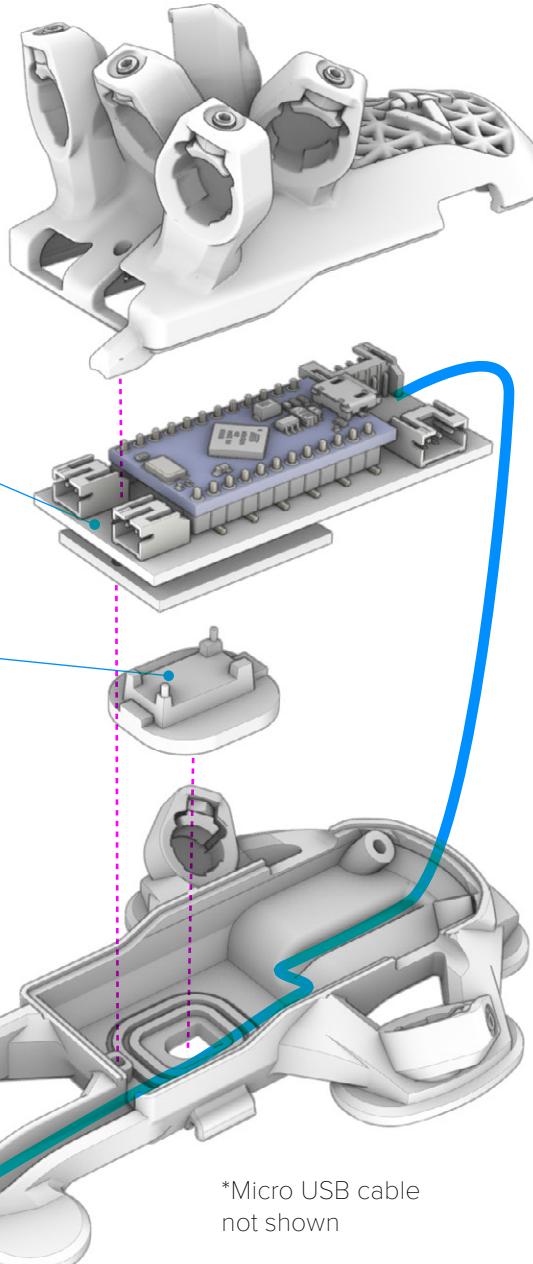
Seat nuts into holders. Secure with drop of hot glue if loose. Install m2.5 x 4mm screws into ball joint ends.



06

ENCLOSURE

Set board with PMW3389 lens into base. Unsheathed section of usb cable should wrap under board and out front of enclosure



Pro Micro, bridge board and PMW3389 assembly

Clear lens included with PMW3389

Micro USB cable path indication

*Micro USB cable not shown

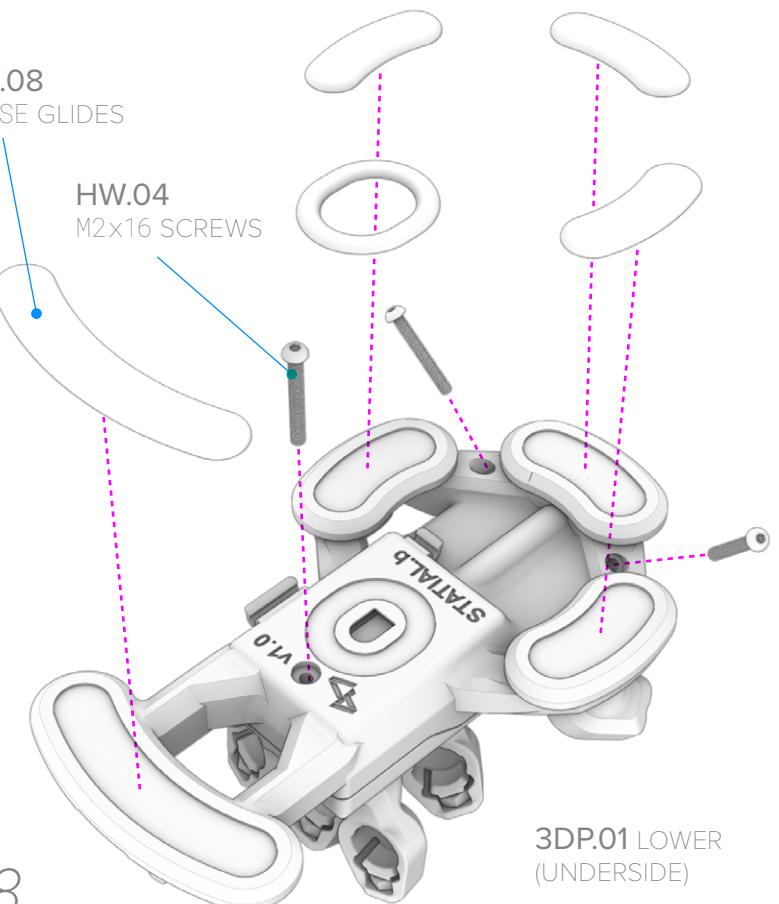
07

GLIDES

Sand down any bumps in glide recesses and ensure surface is clean. Press adhesive backed mouse feet (HW.08) onto enclosure base. Glides must be for the newer generation Logitech G-Pro but can be from any 3rd party vendor.

HW.08
MOUSE GLIDES

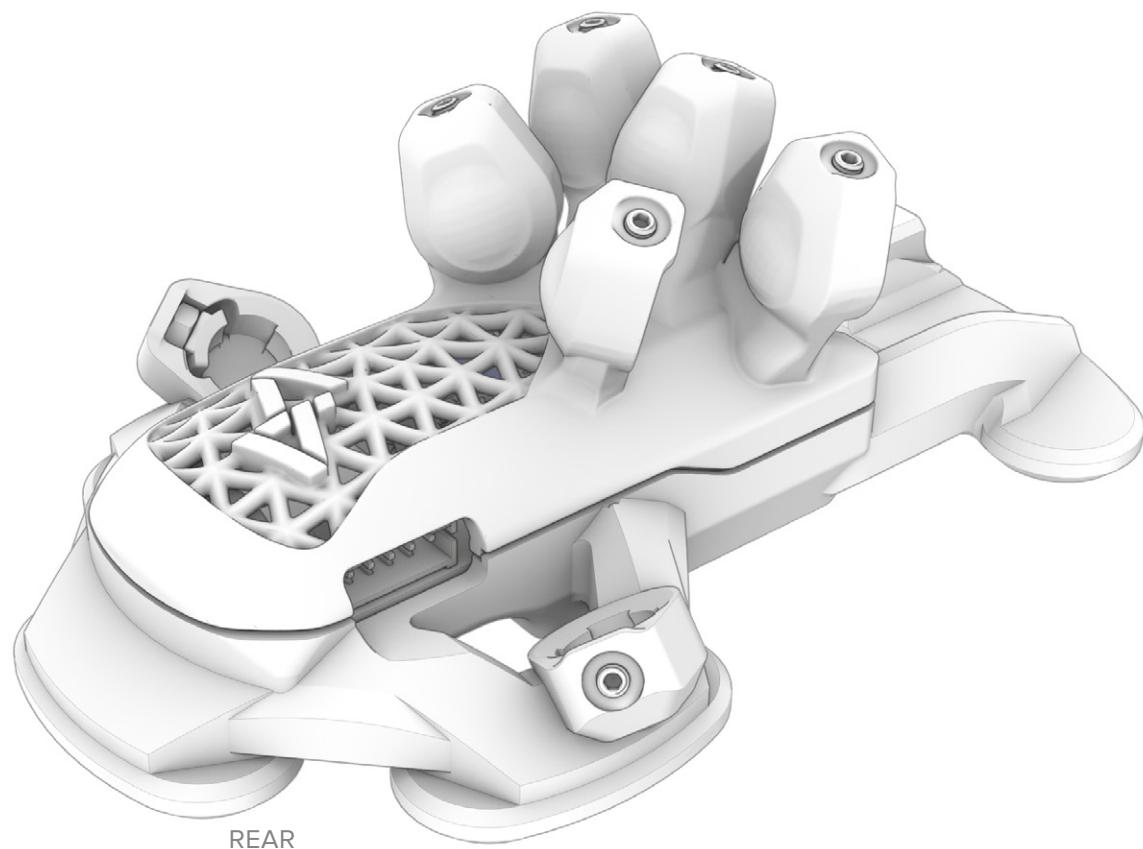
HW.04
M2x16 SCREWS



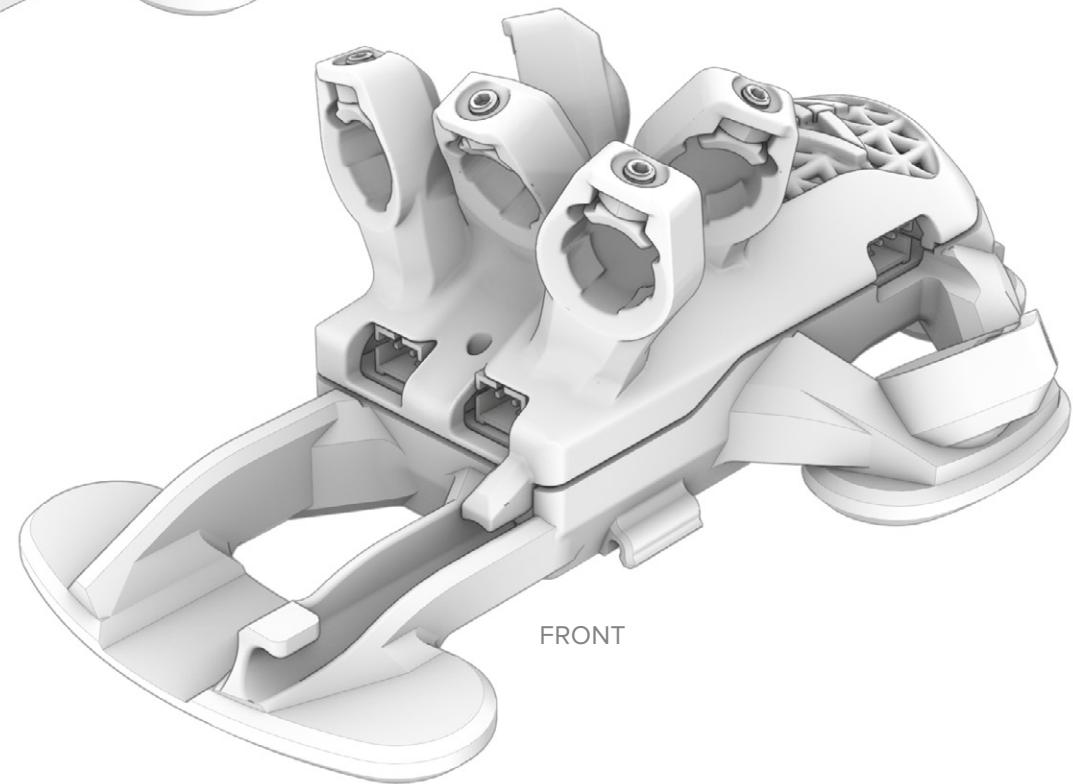
3DP.01 LOWER
(UNDERSIDE)

08
SCREWS

Install m2 x 16mm screws (HW.04) to secure enclosure parts together.



REAR



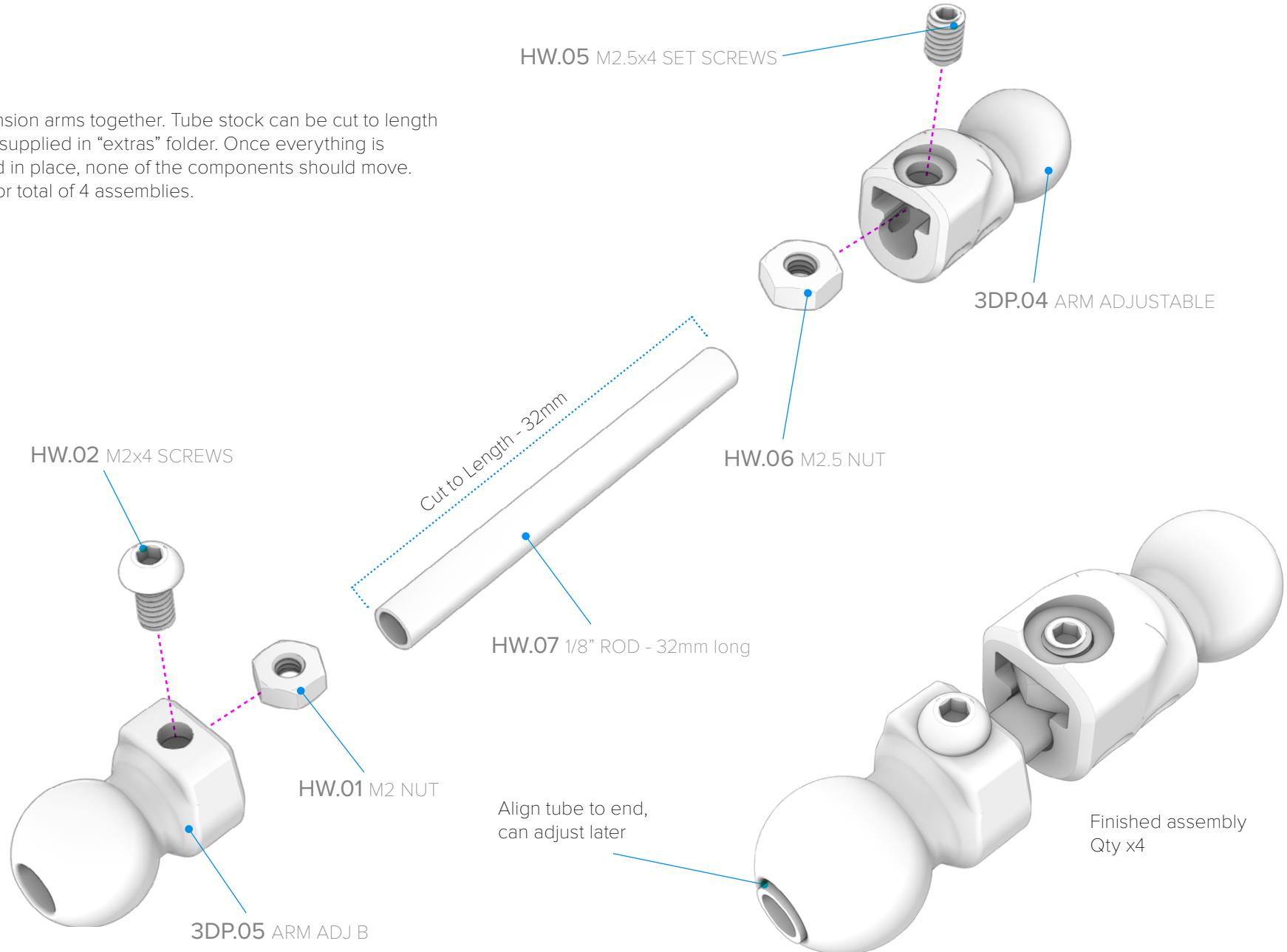
FRONT

*Micro USB connection
cable not shown

09

ARMS

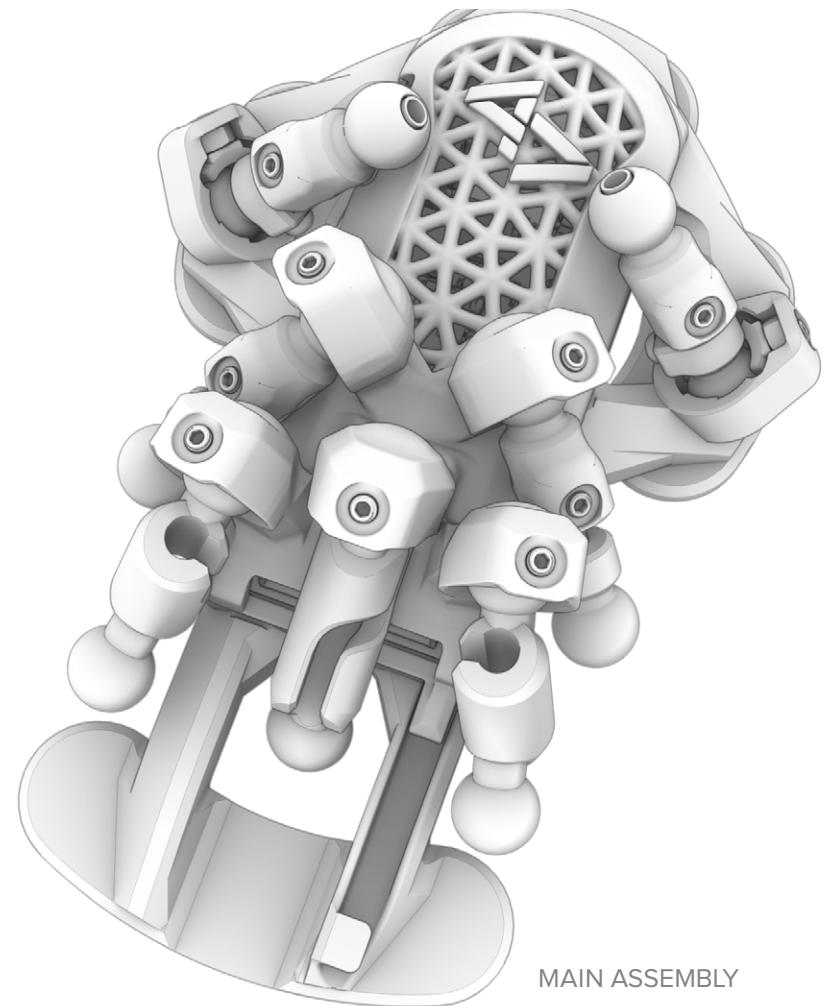
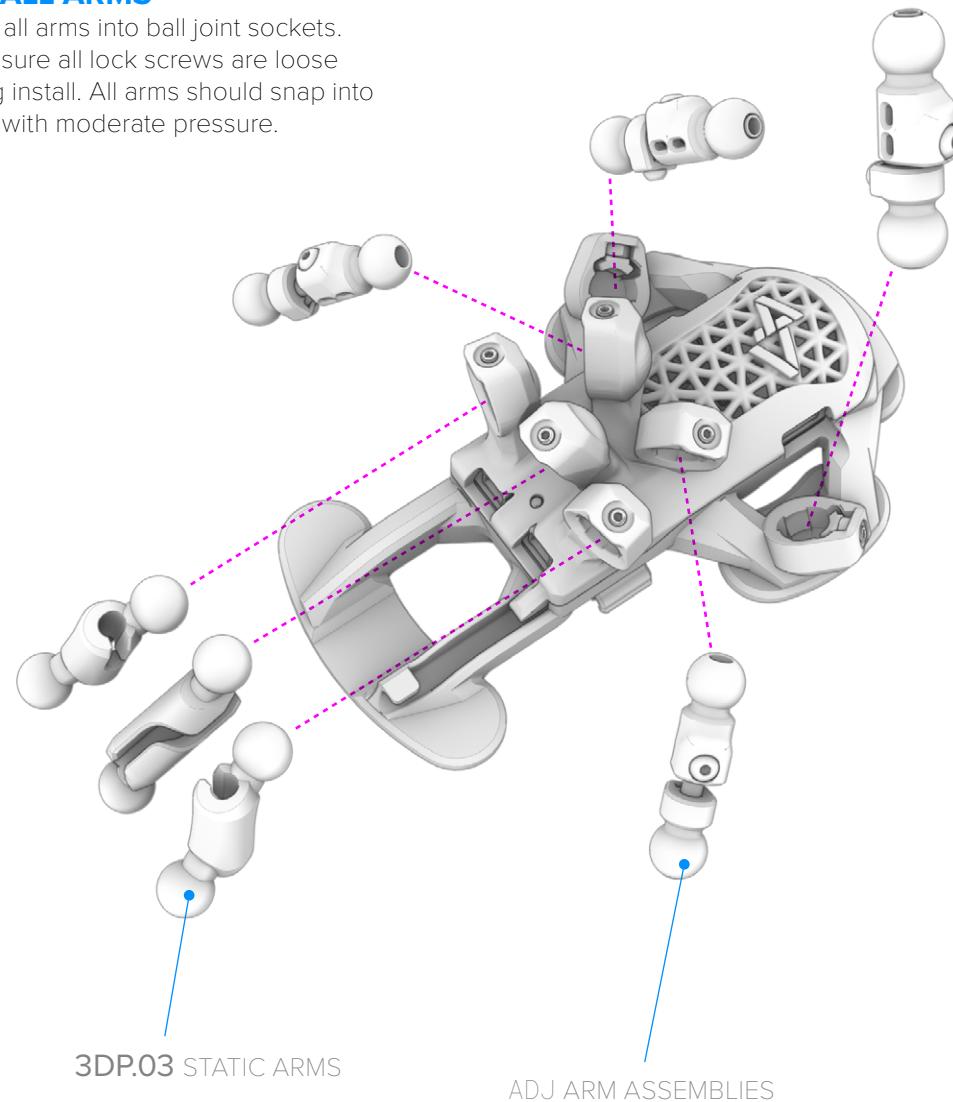
Put extension arms together. Tube stock can be cut to length using jig supplied in "extras" folder. Once everything is tightened in place, none of the components should move. Repeat for total of 4 assemblies.



10

INSTALL ARMS

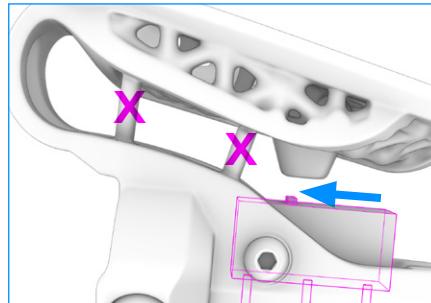
Install all arms into ball joint sockets.
Make sure all lock screws are loose
during install. All arms should snap into
place with moderate pressure.



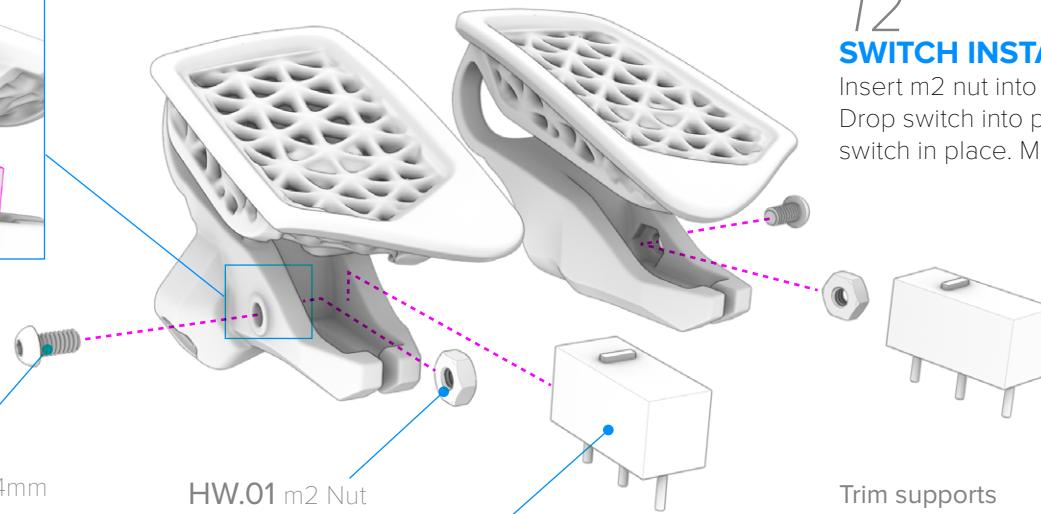
3DP.03 STATIC ARMS

ADJ ARM ASSEMBLIES

MAIN ASSEMBLY



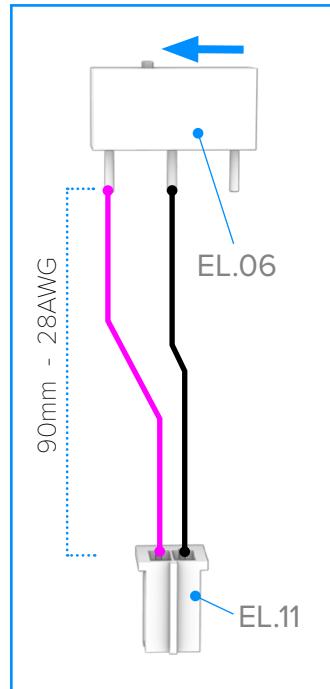
TRIM SUPPORTS AFTER CURE,
MOUSE SWITCH FACES BACK



12

SWITCH INSTALL

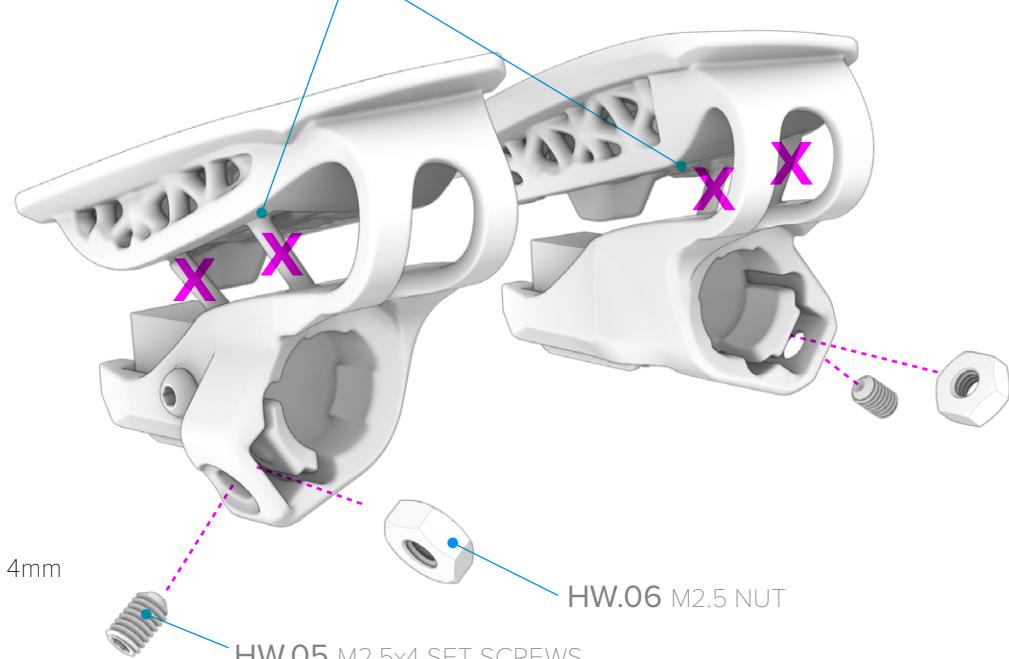
Insert m2 nut into capture pocket on inside of switch holder. Drop switch into pocket holder, screw in m2x4mm to secure switch in place. Make sure button is triggering when pressed.



11

WIRE SWITCH

Solder leads to middle and switch-side posts. Crimp other wire ends and install into JST PH 2 pin plug. Which leads go into which plug post doesn't matter on this set.



13

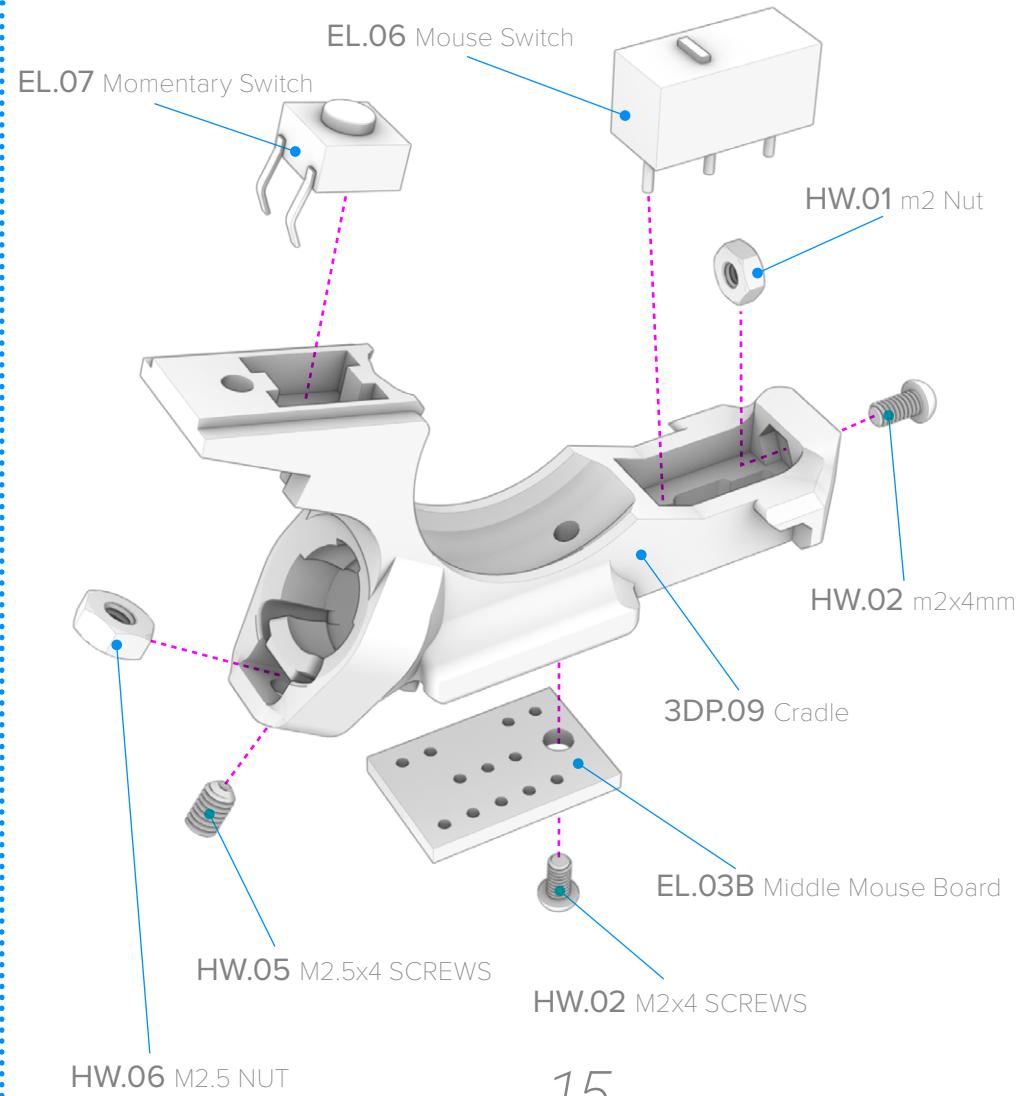
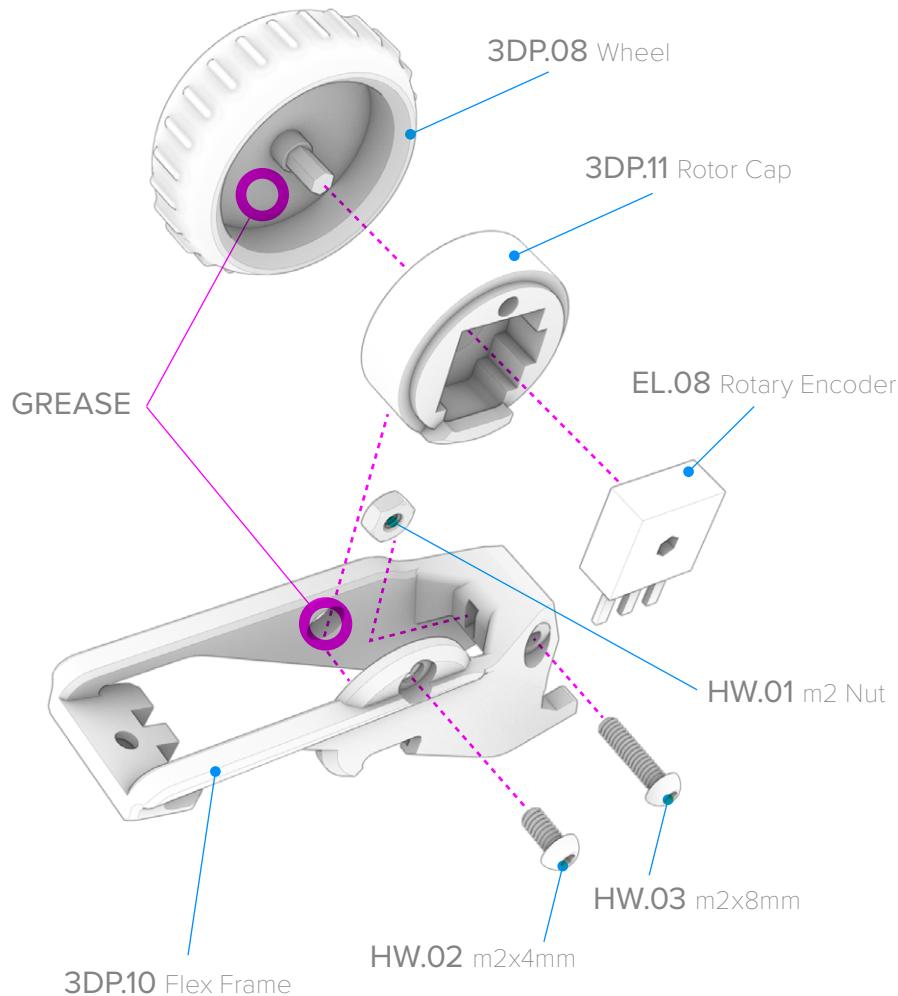
BALL JOINT

Install m2.5 nuts and m2.5 x 4mm screws into ball joint ends.

14

ROTOR ASSEMBLY

Press fit rotary encoder into rotor cap. Slide scroll wheel onto encoder and cap. Affix to flex frame using m2x8mm screw. Apply small dab of lithium grease on wheel axle/pivot area. **The Flex Frame is very fragile before being fully assembled. Be careful with it when removing print supports.**



15

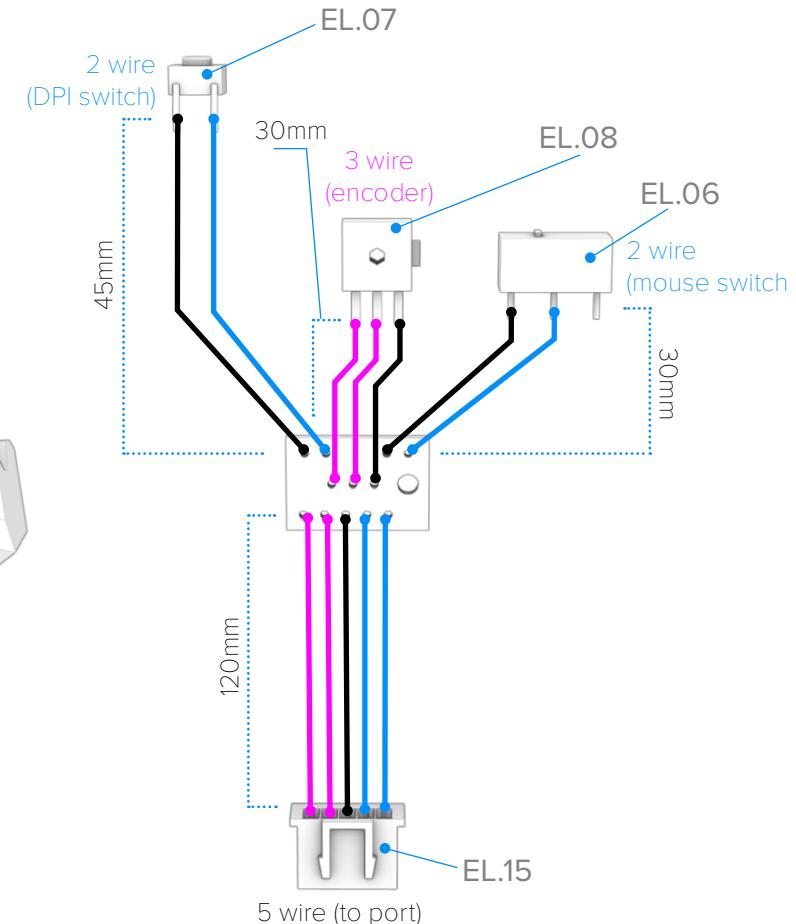
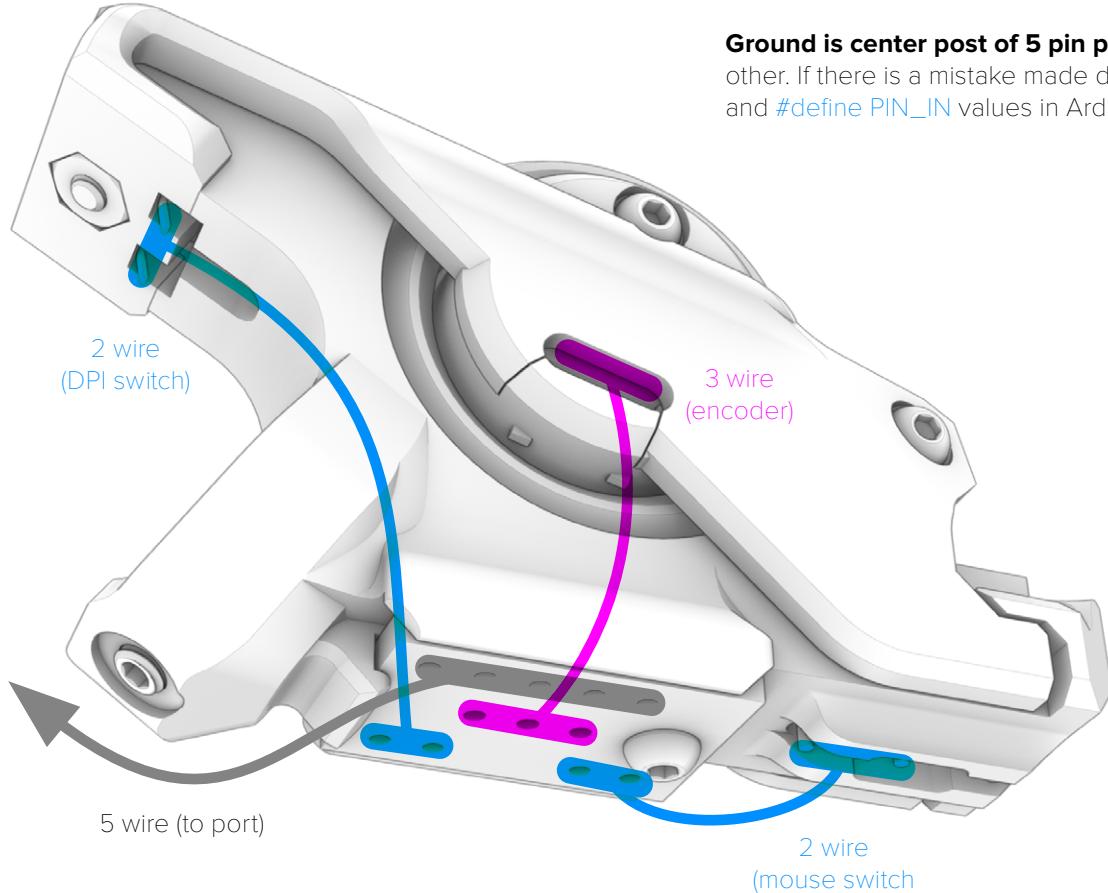
SWITCH INSTALL

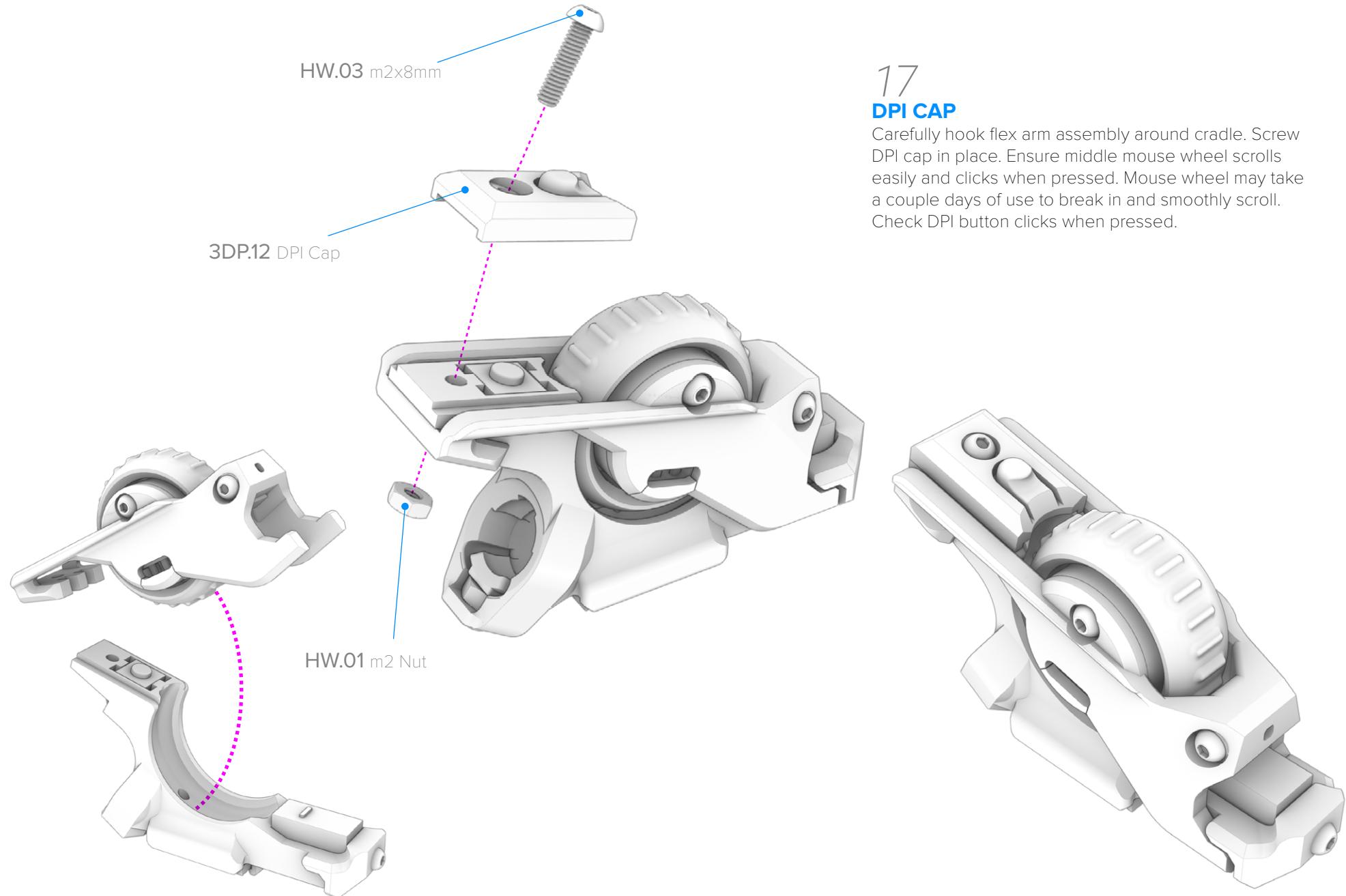
Trim unused posts on DPI switch and seat into wheel frame. Install mouse switch retention screw and ball joint retention screw & nut.

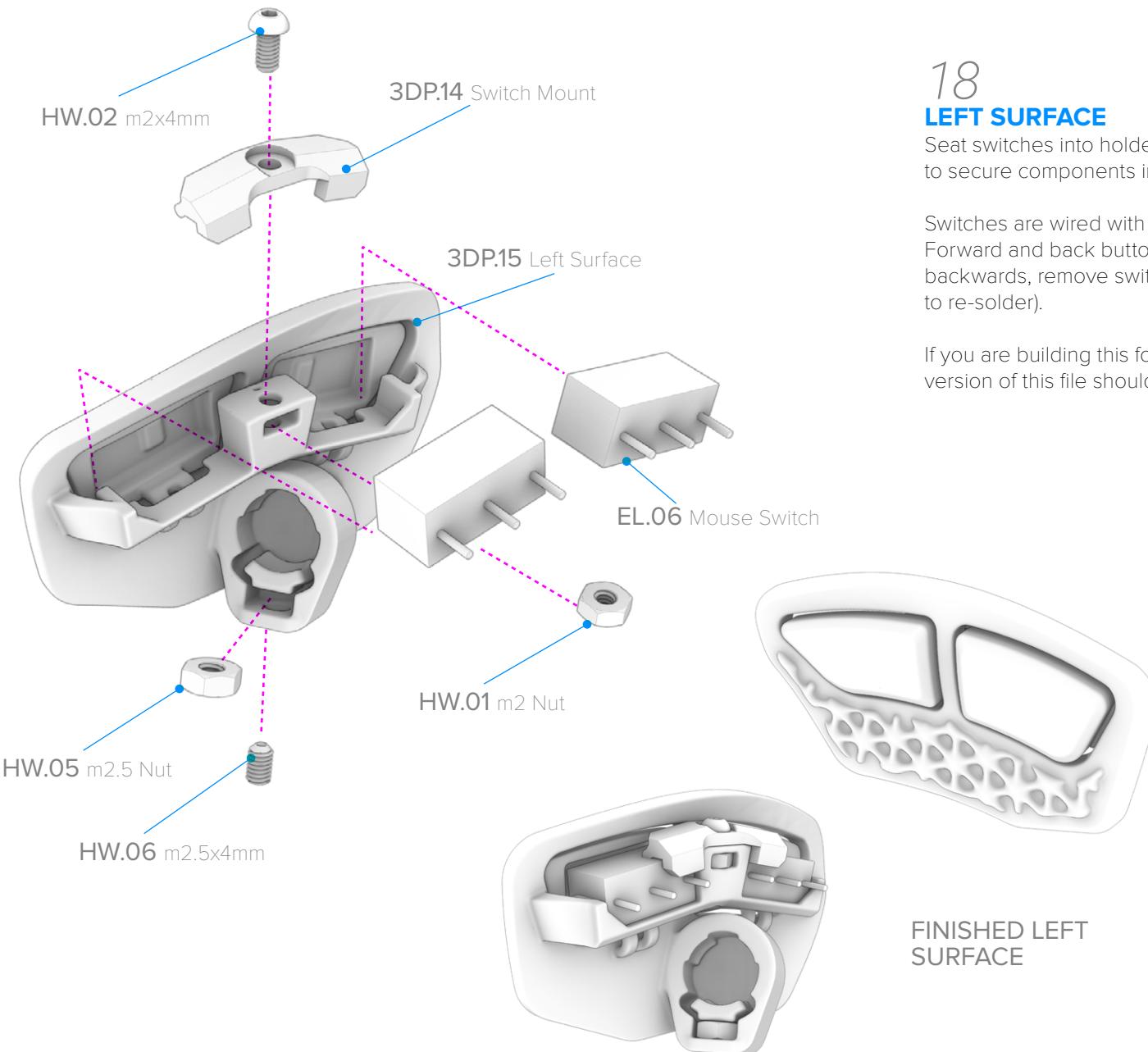
16

WIRE MIDDLE

This is the most complicated area to wire on the whole build. Rotary encoder, DPI button and Mouse Switch all route into mini PCB. Please note recommended wire lengths connecting each component. **DPI switch and front mouse button wires must be fed through wheel cradle before final soldering.**





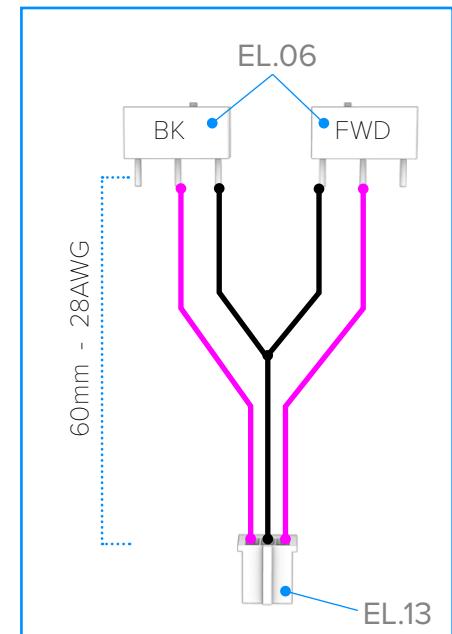


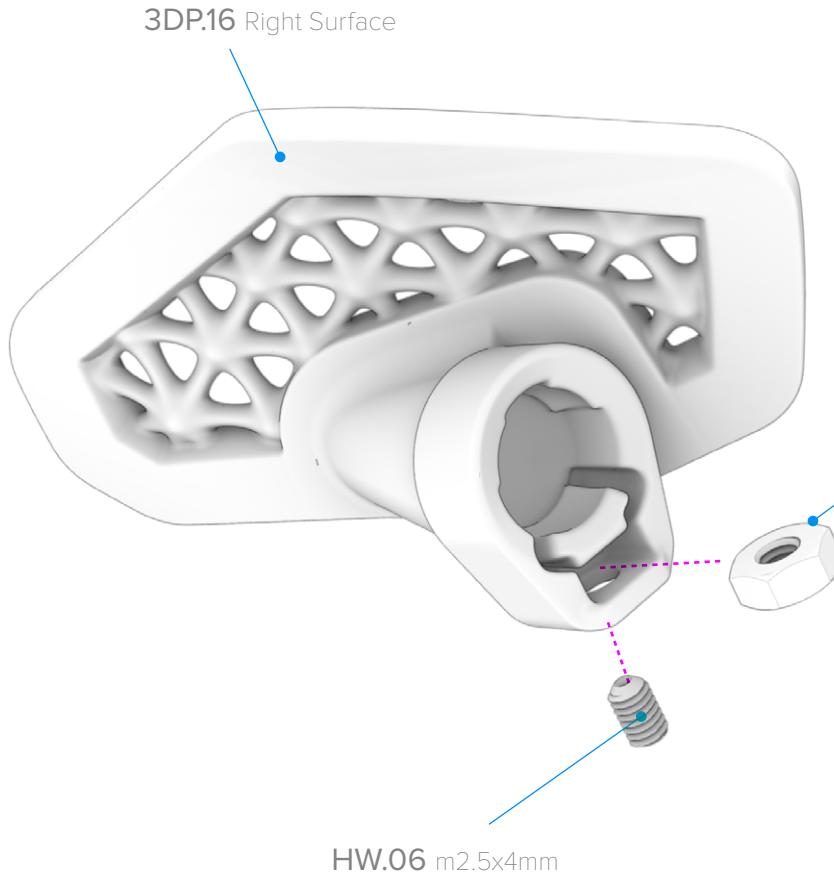
18 LEFT SURFACE

Seat switches into holders and m2 nut into slot. Attach Switch Mount to secure components in place. Assemble ball joint clamp.

Switches are wired with shared ground going into center pin of plug. Forward and back buttons are on either side. If button pins are wired backwards, remove switch mount and swap switch locations (no need to re-solder).

If you are building this for left handed use, the alternate mirrored version of this file should be used (found in the extras folder).

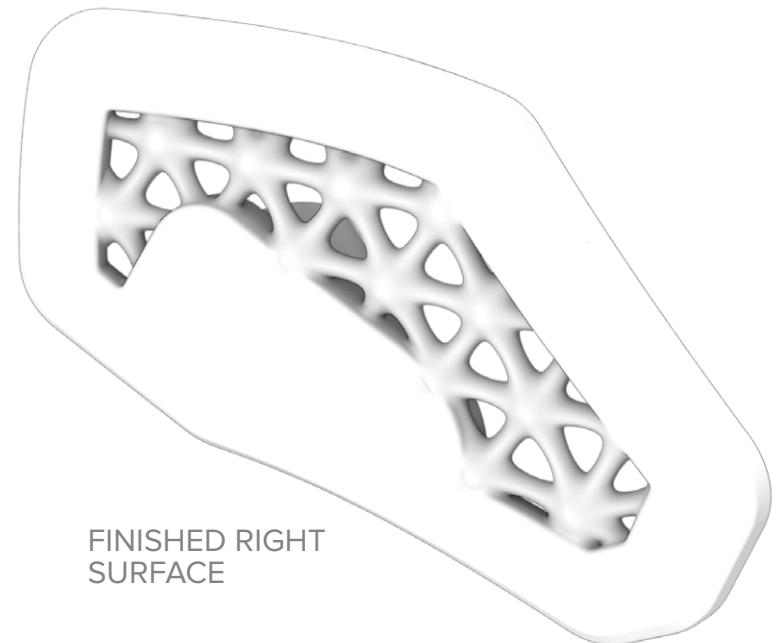


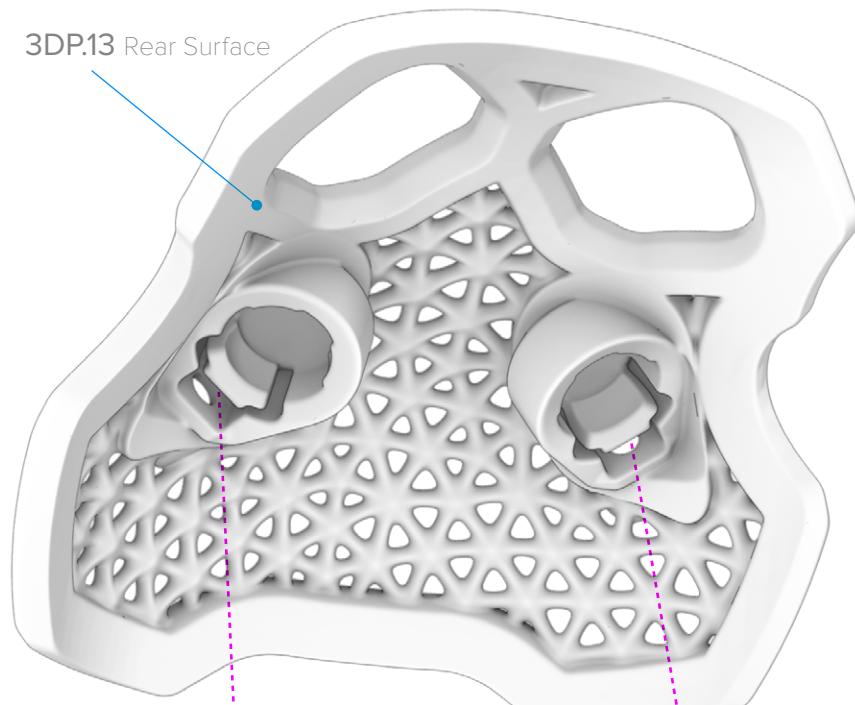


19 RIGHT SURFACE

Assemble ball joint clamp with normal screw/nut combo.

If you are building this for left handed use, the alternate mirrored version of this file should be used (found in the extras folder).

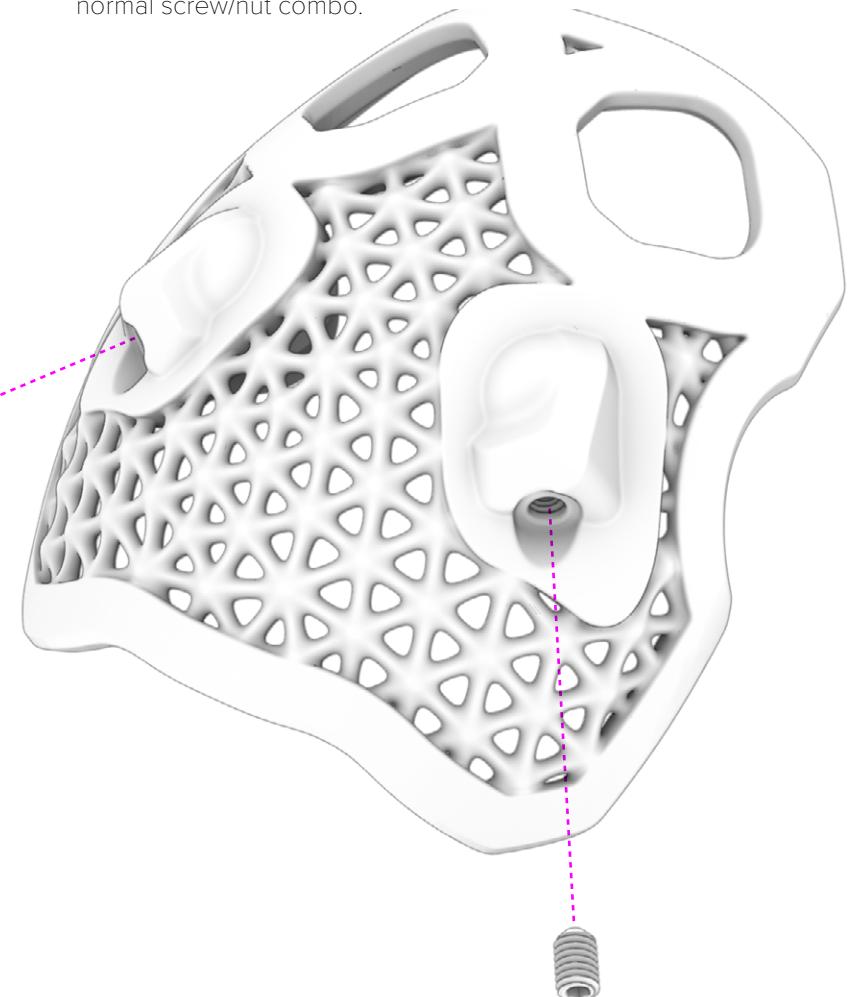


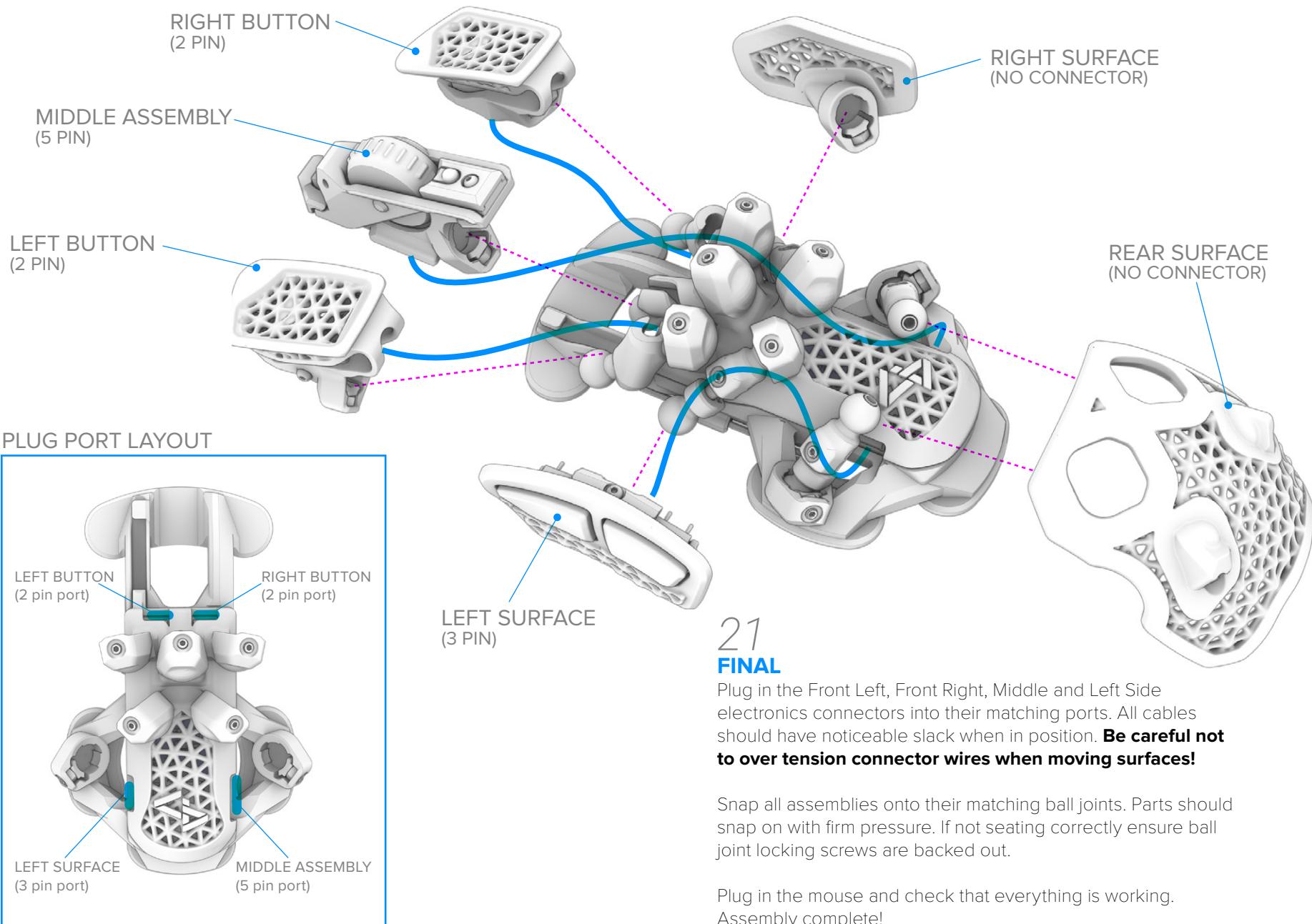


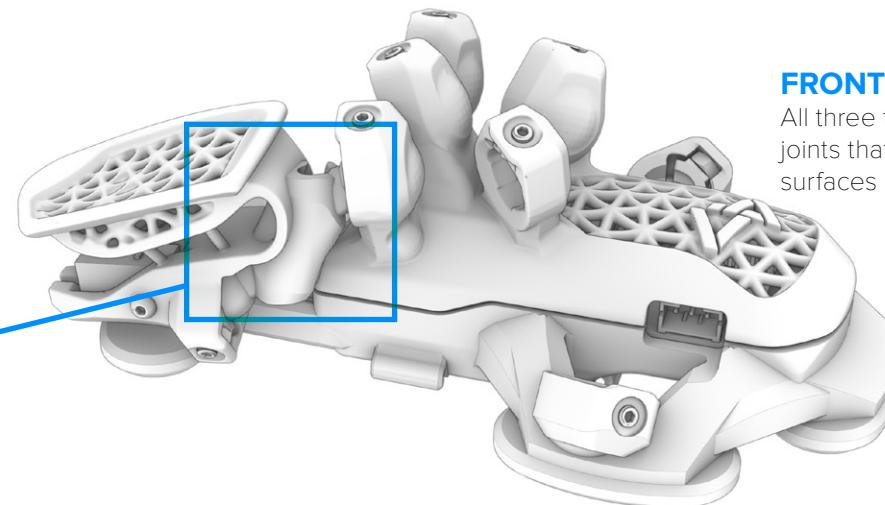
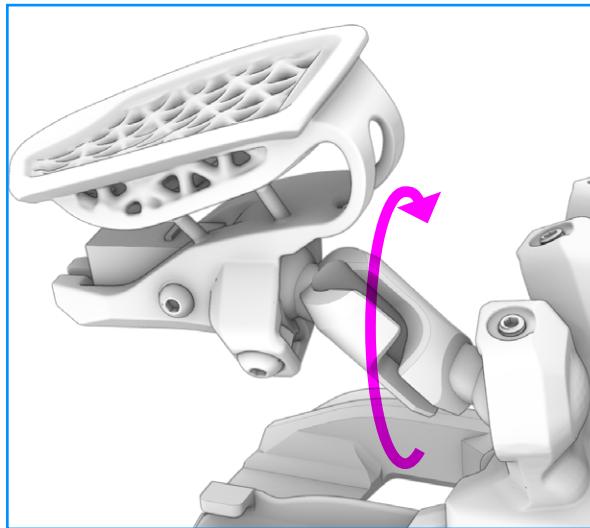
20

REAR

Assemble ball joint clamp with normal screw/nut combo.

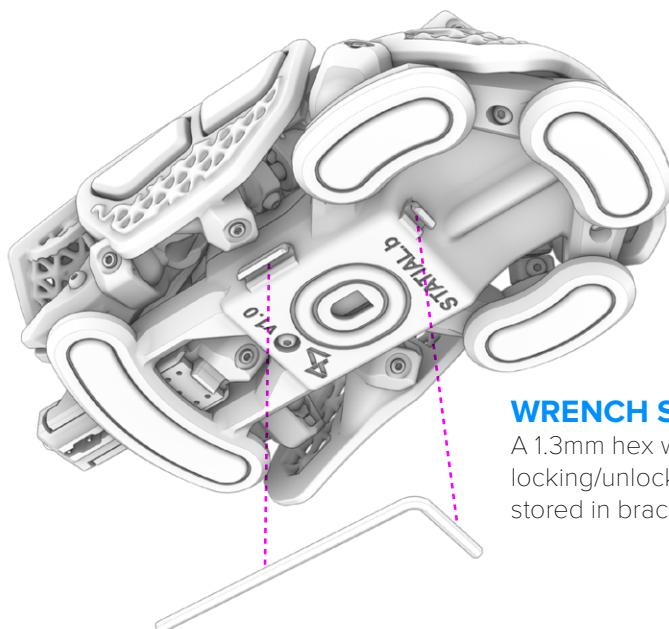






FRONT ARMS

All three front arms have asymmetrical joints that will shift the connected surfaces up when rotated.

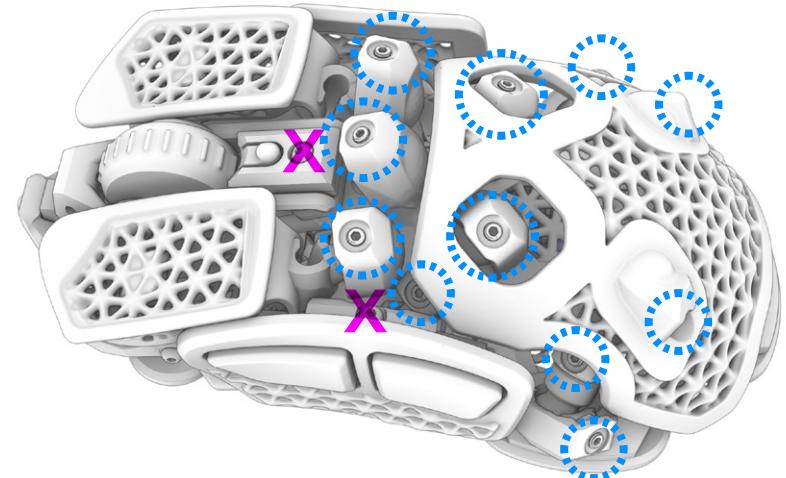


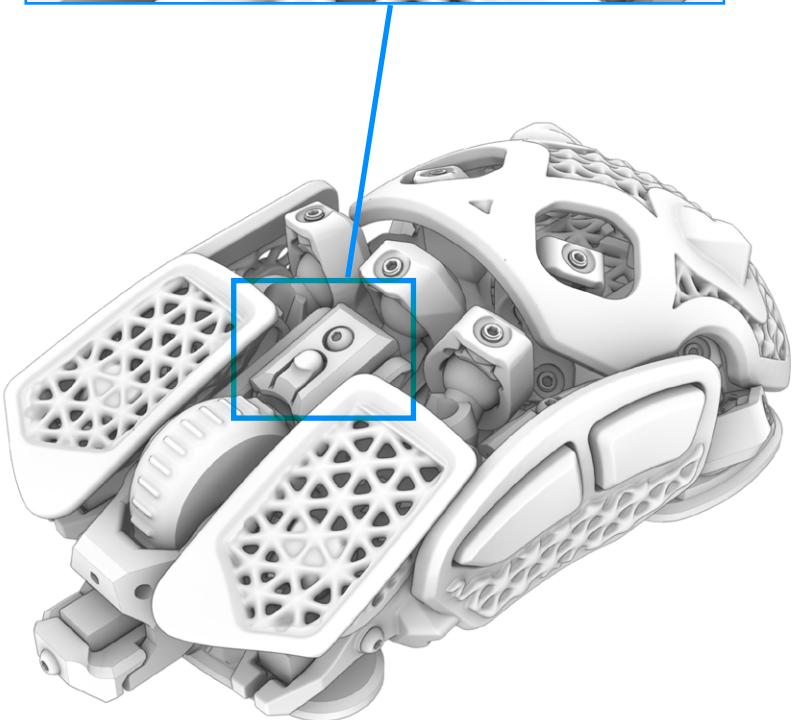
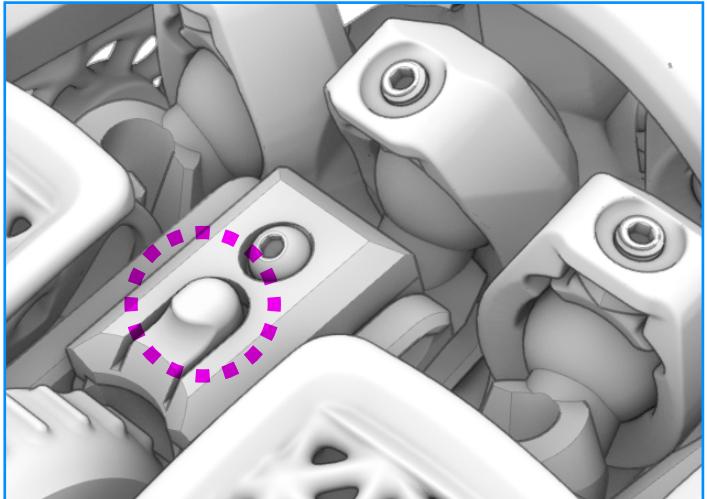
WRENCH STORAGE

A 1.3mm hex wrench used for locking/unlocking surfaces can be stored in bracket under Statial.b

1.3MM WRENCH

It takes some practice to get familiar with which screws release which surfaces for adjustment. Both the 2mm button head screws and 2.5mm set screws use the same size 1.3mm hex wrench. The set screws are always used for adjustable surfaces, the 2mm button head screws are always for “permanent” parts.





DPI TOGGLE

The button above the wheel toggles DPI with matching LED color switching. Default startup setting is 2,000 DPI / Purple. Pressing button switches between:

- 400 / Yellow
- 800 / Green
- 1,600 / Teal
- 2,000 / Blue
- **2,300 / Purple (default)**
- 2,600 / Red
- 3,600 / Orange

Key assignments, DPI Presets and LED behavior can be all be altered via the Arduino IDE.

```

127 int Btn_pins[NUMBTN] = {Btn1_Pin, Btn2_Pin, Btn3_Pin, Btn4_Pin, Btn5_Pin};
128 bool Btns[NUMBTN] = {false, false, false, false, false}; // button state indicator
129 uint8_t Btn_buffers[NUMBTN] = {0xFF, 0xFF, 0xFF, 0xFF, 0xFF}; // button debounce buffer
130 char Btn_keys[NUMBTN] = { MOUSE_LEFT, MOUSE_RIGHT, MOUSE_MIDDLE, MOUSE_FORWARD, MOUSE_BACK };

131
132 int Key_pins[NUMBTN] = { Btn6_Pin };
133 bool Keys[NUMBTN] = { false }; // button state indicator
134 uint8_t Key_buffers[NUMBTN] = { 0xFF }; // button debounce buffer
135 char Key_keys[NUMBTN] /*= {240}*;

136
137 //Colors that represent the CPI/DPI setting: .Yellow=0, .Green=1, .Teal=2, .Blue=3, .Purple=4, .Red=5
138 int Dpi_color[NUMCPI][6] = {{-140,-115,0,0},{-0,-255,0,0},{-0,-155,-100,0},{-0,-55,-55},{-0,-155,-100,0},{-0,-55,-55}};

139
140 unsigned long Cpis[NUMCPI] = {-400,-800,-1200,-1600,-2000,-2600,-3600};

141 struct CpiUpdater {
142     bool target_set;
143     bool updated;
144     uint8_t target_cpi_index;
145 };
146
147 CpiUpdater CpiUpdate = { false, false, 4 }; // Default Dpi = Cpis[2]
148
149 byte initComplete = 0;
150 bool inBurst = false; // in burst mode
151 bool reportSQ = false; // report surface quality
152 int16_t dx, dy;
153
154 unsigned long lastTS;
155 unsigned long lastButtonCheck = 0;
156 unsigned long curTime;
```

CONFIGURATIONS

Modern mouse grip styles have grown out of players adapting to the shape of a mouse. The Statial.b creates the opportunity for new mouse shapes to grow out of grip styles. Below are some common grip type configurations for the Statial.b as starting points for further adjustment.

PALM

When fully collapsed the Statial.b is slightly smaller than a normal high performance mouse. Surfaces can be moved out significantly for XL hands.

STUBNOSE CLAW

Unlike a normal mouse, the buttons on the Statial.b can pitch forward for different grip types. This allows claw grip users to position buttons perpendicular to pressing motion.

VERTICAL

Surfaces can be configured to +50° angle to mimic the fit of a vertical mouse. Fixed ends of rear surface arms can be extended or longer sections of tube can be cut for even steeper angles.

BACKLESS FINGER

Surfaces can be configured to experiment with alternate grip methods. Finger grip users can remove back surface entirely.