GALv3 Build Guide

KNACK Tactical

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Introduction

The GALv3 is the 3rd version of the GAL, or Gun Aiming Laser, an open-source, 3D printed **infrared-only** laser and illumination device.

This device is not a full powered LAM, and therefore should not be compared to other full powered LAMs on the market.

A huge thanks to the boys in the discord for their comments, opinions, complaints, advice, and the likes.

A special thanks to jcubed, zb, xorn, thockworks, and slim.

Specifications

- **Battery:** 1x CR123A or 16340
- **Activation:** On-board momentary pushbutton, Crane/Laser plug
- **IR Laser:** 5mW 850nm TTL Laser
- **IR Illumination:** 850 or 940nm LED
- **Height:** 1.3” (above rail)
- **Width:** 2.5”
- **Length:** 3.5”
- **Weight:** 4.7oz (135g) (with battery)
- **Battery Life:** ~7 hrs on DUAL HIGH (1550mAh CR123A)

Features

- Double-tap activation to toggle
- 5-minute automatic shutoff timer
- Low battery indication (slow blinking Indicator LED)
- Adjustable Illuminator beam angle: ~6° to ~26°
- Much less soldering than the v2
- VIS Laser removed due to inability to precisely collimate lasers
    - Feel free to design a solution and let me know!

Note: I am not responsible for any damage you incur from building or using this device.

Parts Kits and Printed Parts List

Parts Kits

Parts kits are available at knacktactical.com. These parts kits have everything you'll need to build the GAL including a pre-soldered, pre-programmed, and tested PCB. The only things you will need are the 3D printed parts and the tools for assembly.

Printed Parts

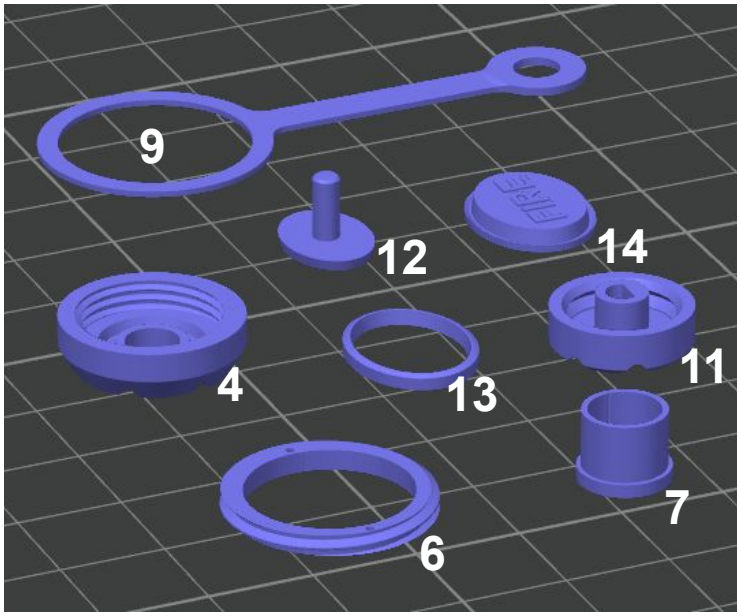
All printed parts can be found **for free** at github.com/knack-tactical/GAL. There are also community-submitted modified files, which have some nice upgrades and alternative builds that are worth checking out.

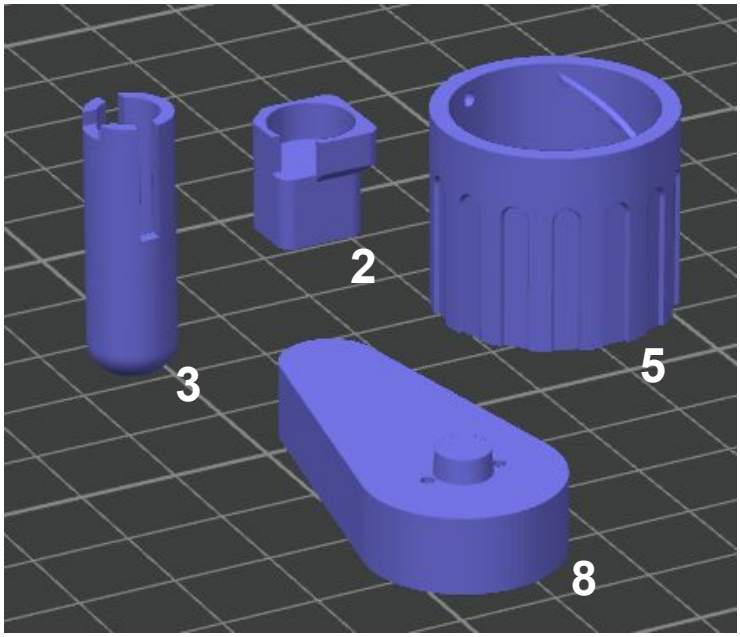
All printed parts should be printed with 4+ walls, 40+% infill, 0.1-0.2 layer height

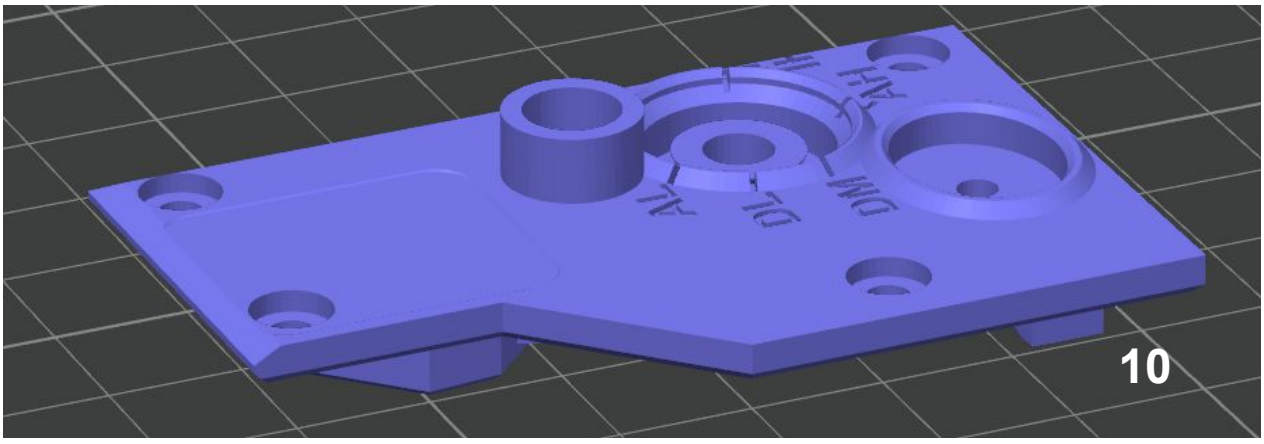
Part No.	File Name	Material	Support?
GAL BODY			
1	GAL_body	>= PLA+	X
2	laser_base	>= PLA+	X
3	laser_housing	>= PLA+	
4	laser_lens_cap	>= PLA+	
5	lens_cap	>= PLA+	
6	lens_locking_ring	>= PLA+	
7	crane_port_spacer	>= PLA+	
8	crane_port_installation_tool	>= PLA+	
9	battery_cap_retention_strap_TPU	TPU	
GAL LID			
10	GAL_lid	>= PLA+	X
11	selector_knob	>= PLA+	
12	button_post	>= PLA+	
13	button_retainer	>= PLA+	
14	FIRE_button_TPU	TPU	X

Print Orientation

Note: supports not shown here



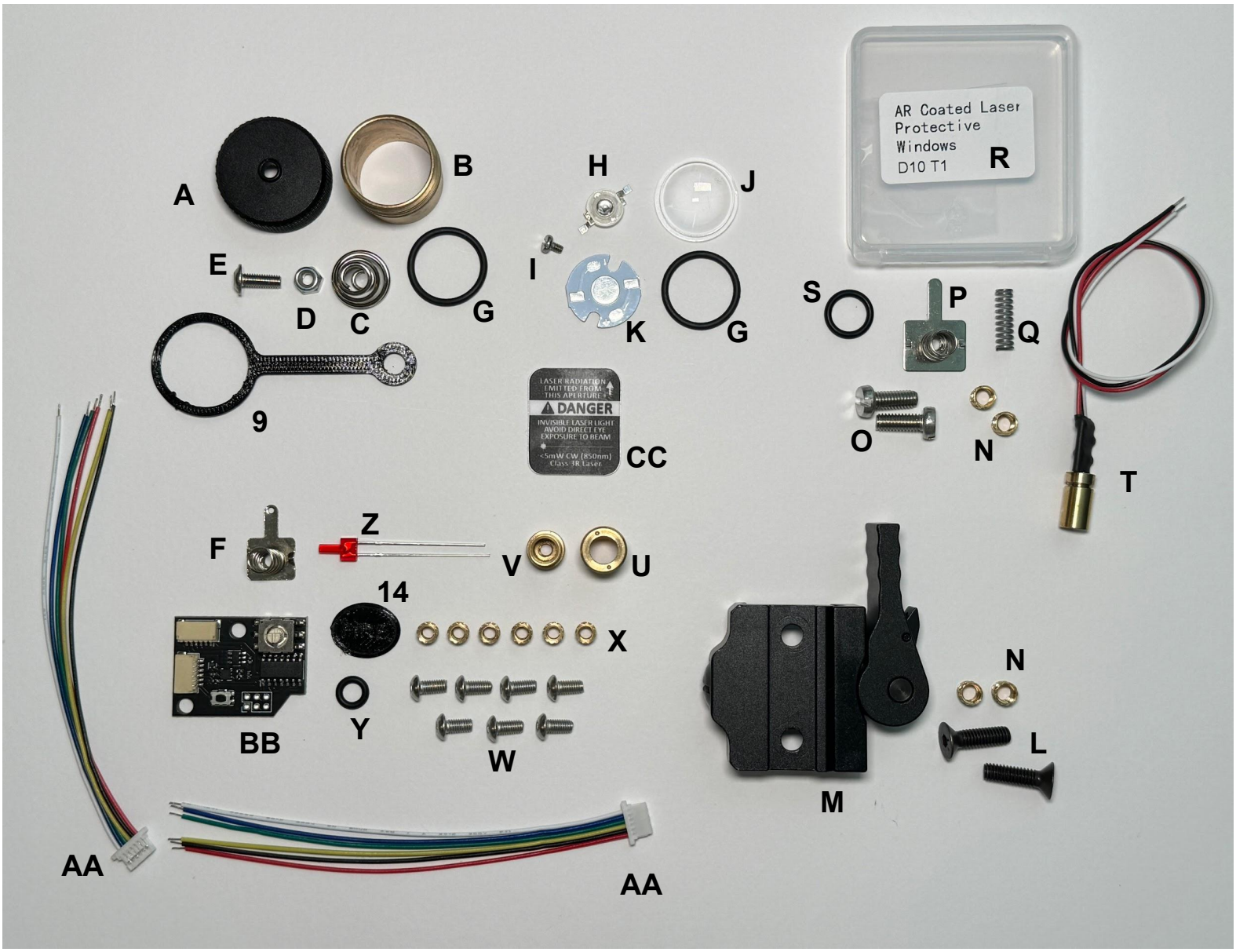




Hardware List

Part No.	Part	Qty	Assembly
A	Battery Cap (knurled)	1	Battery
B	Battery Body (brass)	1	Battery
C	Keystone 211-C	1	Battery
D	M3 Nylock Nut	1	Battery
E	M3x8mm Flanged Button Head Screw	1	Battery
F	AAA Negative Terminal	1	Battery
G	OD 15x1.5mm O-ring	2	Battery / Illuminator
H	850/940nm 3W LED	1	Illuminator
I	M2x3 Narrow Cheese Head Slotted Screw	1	Illuminator
J	18x6.3mm Convex Lens	1	Illuminator
K	16mm 3W LED Heatsink	1	Illuminator
L	M4x14 Hex Drive Flat Head Screw	2	Pic Rail
M	DBAL Mount (Full Metal Version)	1	Pic Rail
N	M4x4x5 Heatset Insert	4	Pic Rail / Laser
O	M4x7 Narrow Cheese Head Slotted Screw	2	Laser
P	AA Negative Terminal	1	Laser
Q	0.5” Compression Spring	1	Laser
R	AR Coated Lens	1	Laser
S	OD 10x1.5mm O-ring	1	Laser
T	850nm TTL Laser (ask mfr. to fix to 50m)	1	Laser
U	Crane Port Stage 1	1	Crane Port
V	Crane Port Stage 2	1	Crane Port
W	M3x6 Button Head Screw	7	Crane Port / Lid / Body
X	M3x4x4.5 Heatset Insert	6	Lid / Body
Y	OD 7x1.5mm O-ring	1	Lid
Z	Indicator LED	1	Body
AA	6pin JST SH Cable	2	Body
BB	GALv3 PCB	1	Body
CC	Safety Sticker	1	Body

Hardware List



PCB and Tools for Assembly

PCB

If purchasing a parts kit, a PCB is included. If not, all the files needed for a fab house to make the PCBs are included under the PCB folder.

ATtiny84 Programming

If purchasing a parts kit, these parts are not needed as the PCB will already be programmed.

(1) Any Arduino with SPI capabilities (Nano, Uno, Micro, Due, etc.) (knockoffs will work)
(1) Breadboard
(1) 10 to 22 µF Electrolytic Capacitor
(6) Jumper Cables/wires (will need to temporarily solder 4 of them to the PCB)

Tools for Assembly

- Soldering Iron and Solder
- Needle Nose Pliers
- Tweezers
- Wire Strippers
- Bench Vise/Hammer and patience
- Metric Drill Bits (an entire metric drill bit set is nice to have for many FOSSCAD projects)
- Super Glue
- Hot Glue
- Epoxy/Silicone Caulk
- Multipurpose Synthetic Grease
- 2x Thumb Tacks

Programming your PCB

If you purchased a parts kit, you can skip this section.

Programming the ATtiny84 on the PCB is required for the device to function. To program the ATtiny, you will need your Arduino, breadboard, capacitor, and jumper wires. The program can be found on GitHub.

A majority of the steps can be found in this guide, however, steps 1, 2, 5, and 6 will be different.

Step 1: Go Get Stuff

We will be working with the ATtiny84, not the ATtiny85, but that difference will be accounted for later. You will also not need the LEDs or resistors.

Step 2: Wire the Circuit

Since our ATtiny is not on a breadboard (and also is surface mounted), we cannot use a breadboard to program it. Instead, we will use the pin headers. The pinouts listed below are accurate for the Arduino Uno and Nano. If using something else, ensure you use the correct pins for SS, MOSI, MISO, and SCK. The connections are as follows:

- Arduino +5V → Pin 6
- Arduino GND → Pin 1
- Arduino Pin 10 (SS) → Pin 5
- Arduino Pin 11 (MOSI) → Pin 4
- Arduino Pin 12 (MISO) → Pin 3
- Arduino Pin 13 (SCK) → Pin 2

Step 3: Program the Arduino

This step is unchanged. The reason we need to do this step is to tell the Arduino that it will be used as a programmer rather than an executor of the code we give it.

Step 4: Filter Capacitor

This step is unchanged. The purpose of the capacitor is to prevent the Arduino from restarting itself. Be mindful of the polarity on the capacitor if using a polarized capacitor!

Step 5: Add ATtiny Boards to IDE

The guide is outdated on this step and there is a much easier way to do it now.

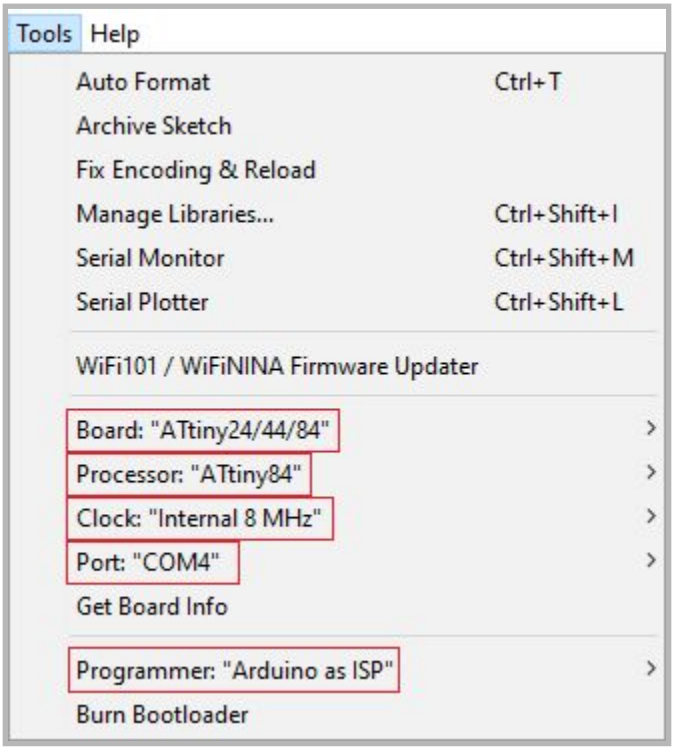
1. Open ‘File>Preferences’ in the Arduino IDE.
2. Paste the following link into the ‘Additional Boards Manager URLs’ section:
   - https://raw.githubusercontent.com/damellis/attiny/ide-1.6.x-boards-manager/package_damellis_attiny_index.json
   - Sidenote: If you already have something in this field, add a comma after the current entry or click the icon next to the entry and add the link below what is currently there.
3. Click OK, close the Arduino IDE, and reopen the Arduino IDE for the changes to take effect.

Programming your PCB

Step 6: Program the ATtiny84

With everything connected properly, you should now be able to program the ATtiny. First, ensure that the options under tools are correct. They should be:

Board: "ATtiny24/44/84"
Processor: "ATtiny84"
Clock: "Internal 8 MHz"
Port: Whatever port your Arduino is
Programmer: "Arduino as ISP"



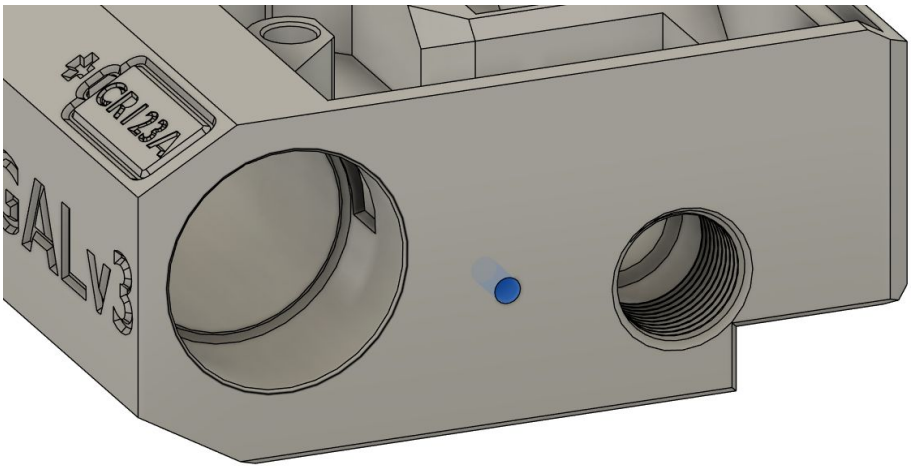
Click ‘Burn Bootloader’ and it will burn the bootloader to the ATtiny. **If you miss this step,** the ATtiny will not run correctly. Ensure the ‘Burn Bootloader’ step completes. If not, make sure your connections are correct and try again.

Open the ‘firmware.ino’ file in the Arduino IDE, double-check the ‘Tools’ settings are correct, and upload the code to the ATtiny. Congrats, the ATtiny is now programmed!

Assembly

Printed Parts

- Drill out the Indicator LED Hole with a 2mm drill bit
  - Run the drill bit in reverse to avoid over drilling the diameter



- Remove the heatshrink from the IR Laser
  - Check the fit of the IR Laser (**Part T**) in the laser_housing (Part 3)
  - If it doesn't fit, use a 6mm drill bit in reverse to ream the inside
- Drilling in reverse, drill out the laser exil hole (highlighted area on the right picture) with the smallest drill bit you have, 1/16" or 1.5mm or less
  - The smaller the hole, the less likely there will be a ghosted dot from the reflection off the AR Lens (**Part R**)

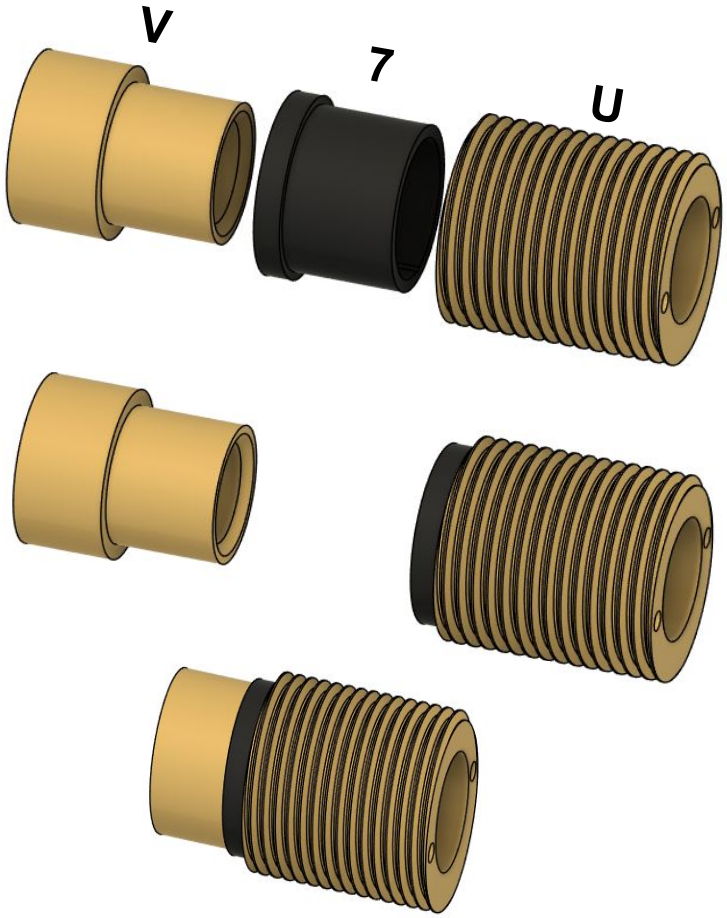
Assembly

Ensure that all of your printed parts work together. The main ones to check:

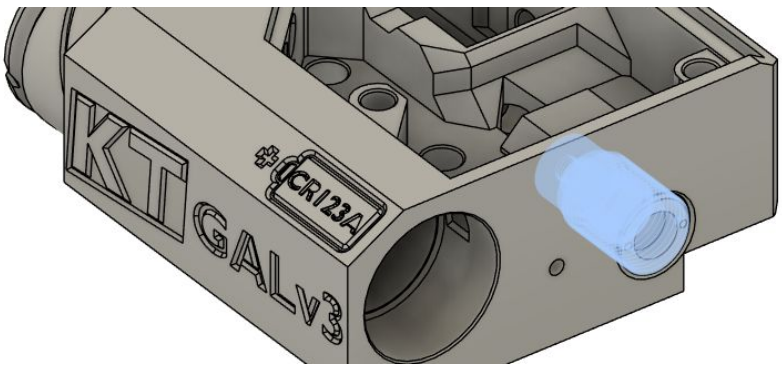
- GAL_lid and GAL_body
  - Should sit relatively flush in the slot
- lens_cap and GAL_body
  - Should spin all the way to the bottom
- laser_lens_cap and GAL_body
- Battery Body and GAL_body
  - Should be a pretty tight fit, might need a bit of sanding on the GAL_body part
- Crane Port and GAL_body
  - Should thread all the way in

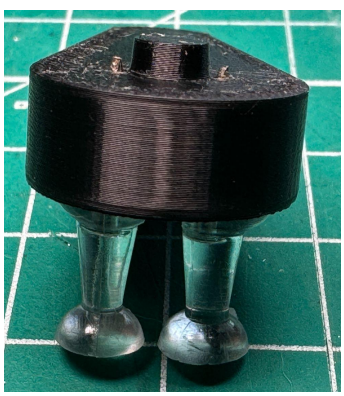
Crane Port

The crane port spacer (**7**) should fit into the back of the crane port stage 1 (**U**). Then using a vise or a hammer and some patience, press the stage 2 (**V**) into **‘7’** until it is snugly inserted. Visually inspect the assembly; everything should be nicely together.



Insert the 2 Thumb Tacks into the **crane_port_installation_tool**. You may have to trim the edges of the Thumb Tacks for them to fit next to each other. Also trim the tips of the tacks with wire cutters so they sit better in the holes on the face of **‘U’**. Using the tool, thread the **Crane Port** into the **GAL_body** until it sits flush.

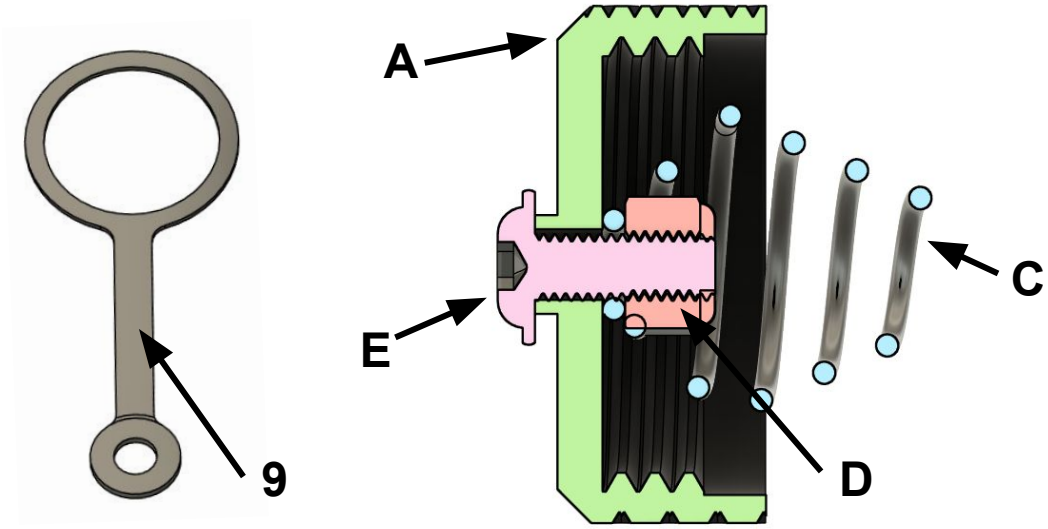




Assembly

Battery Cap

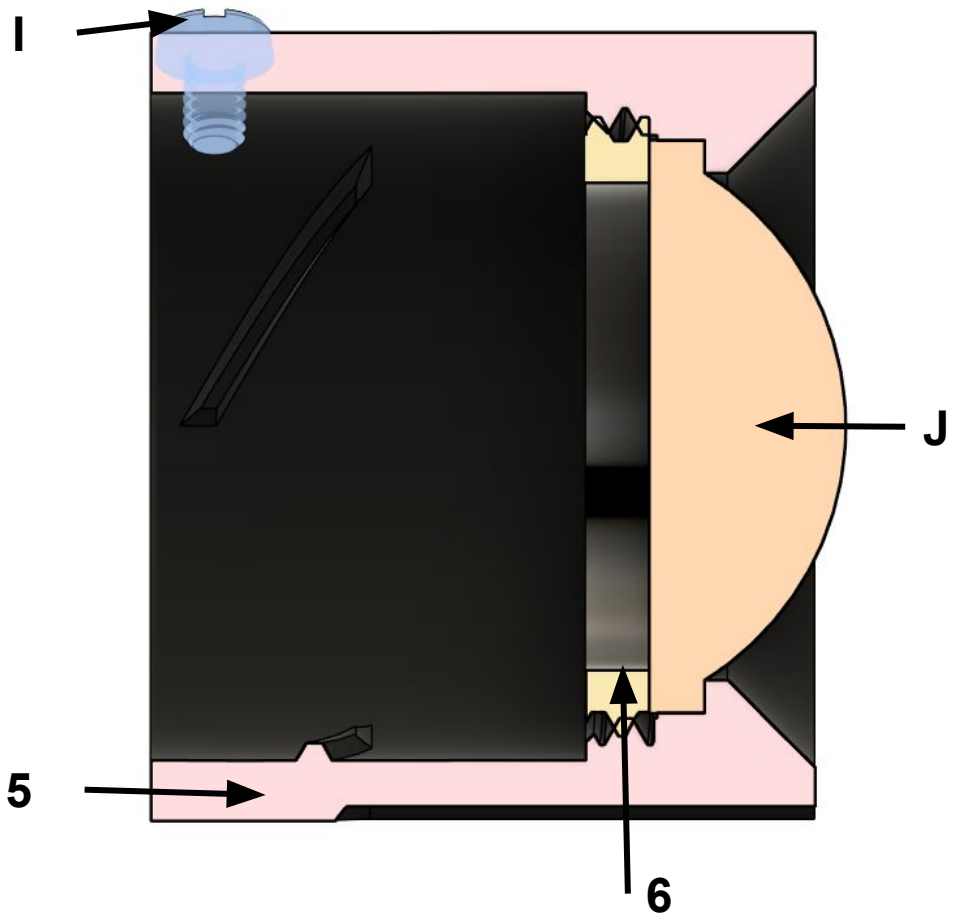
Waterproofing can be done by either filling the hole that the M3 Flanged Button Head screw (**E**) goes into with grease, silicone caulk, or hot glue. Epoxy is not recommended. Thread the battery cap retention strap (**9**) onto **'E'**. Put **'E'** through the back of the Battery Cap (**A**). Using needle nose pliers, hold onto the M3 nylock nut (**D**) and pass it inside of the 211-C Spring (**C**) through the coil. Using the pliers to hold **'D'** steady, use an appropriate hex allen key to tighten **'E'** until it is very tight. Use the needle nose pliers to bend back the very end of **'C'** so that the burr will not scratch your batteries. You can also kiss the end of the spring with a dremel to deburr it.



Lens Cap

Press the 18mm convex lens (**J**) into place inside the lens cap (**5**). Using tweezers in the small holes in the lens locking ring (**6**), screw **‘6’** into **‘5’** until it is flush. This part can be frustrating to get the locking ring on; applying even pressure helps. Ensure that **‘6’** is fully seated by putting the assembly onto the GAL_body. It should almost flush (there may be a very small gap). The M2x3 slotted screw (**I**) is used to keep the assembly fixed to the GAL_body, so will be installed later.

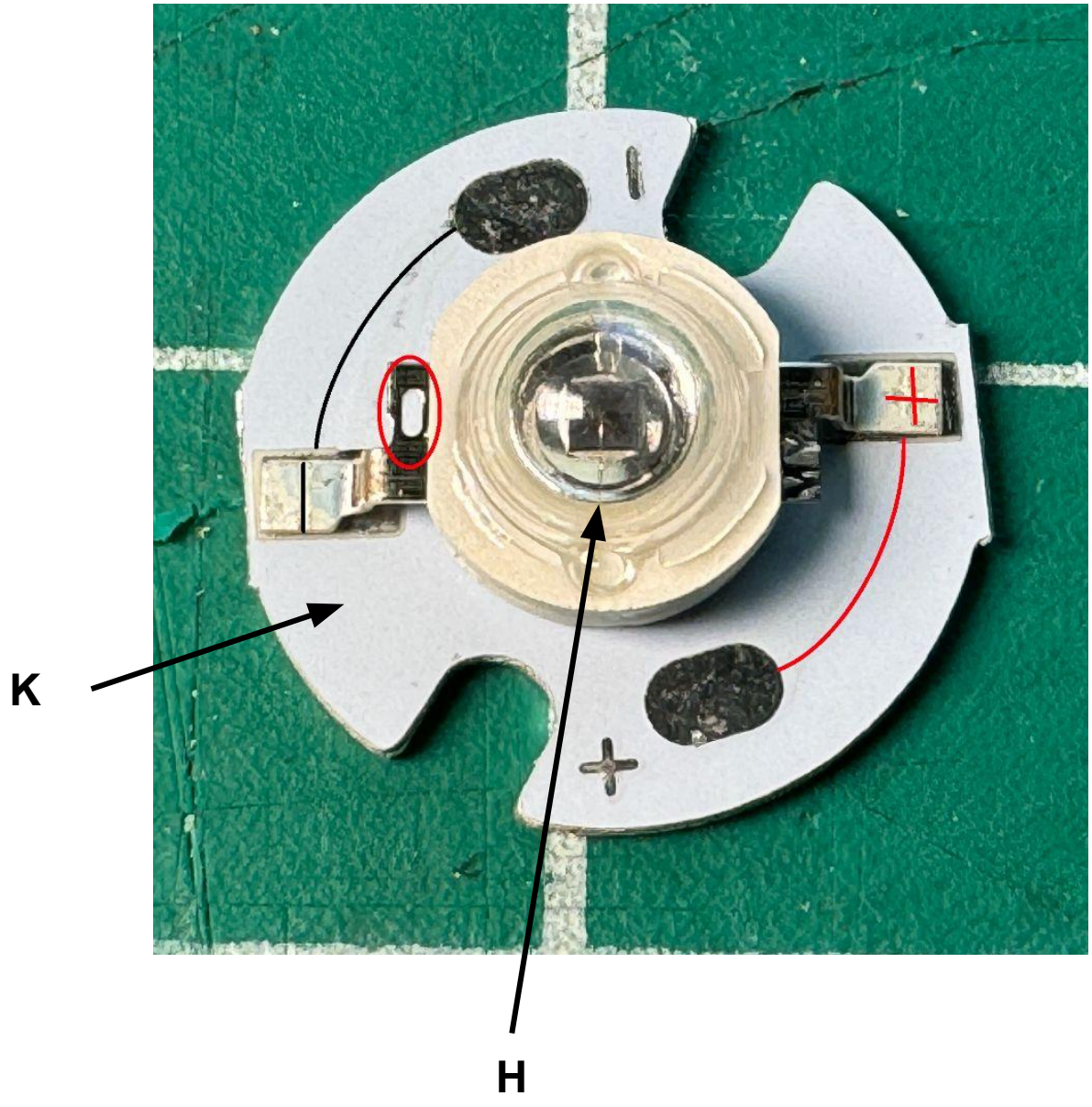
Rougher filaments like PA6, CF filled, etc. can cause trouble when installing **‘6’**, so it may need to be printed in a slipperier filament, such as PLA+ or PETG. Also, printing it with a very small layer height will help with the threads.



Assembly

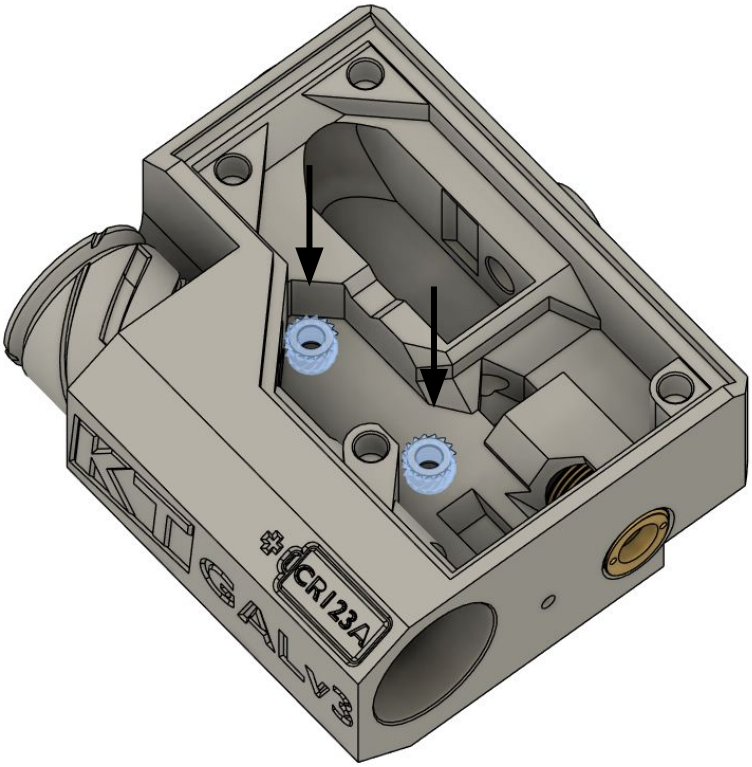
Illuminator LED and Heatsink

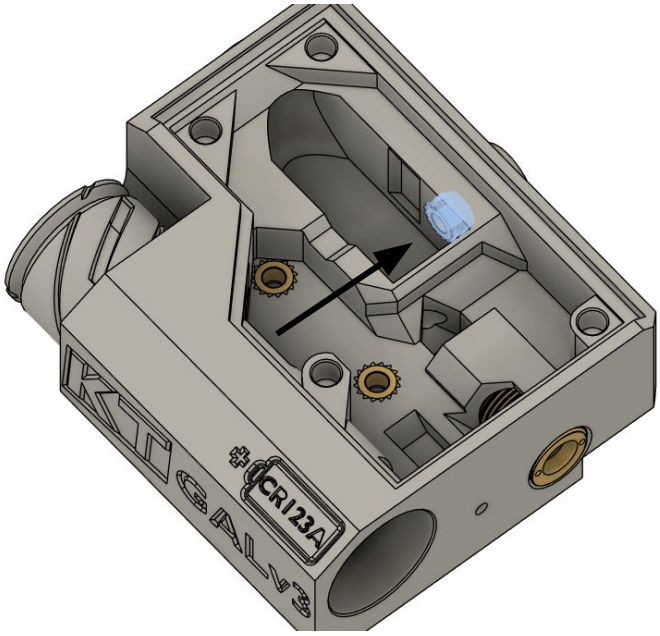
Solder the 3W LED (**H**) to the LED Heatsink (**K**). The orientation is important (however, if you mess it up, you can just switch which wires go to which port later). On **‘H’**, there is a positive and negative solder tab. The positive tab is marked with a very small ‘+’ (drawn over in red). Make sure the positive tab is on the same side of the heatsink as the positive ‘+’ solder pad. The negative solder tab is easier to identify due to hole in the leg (circled in red).

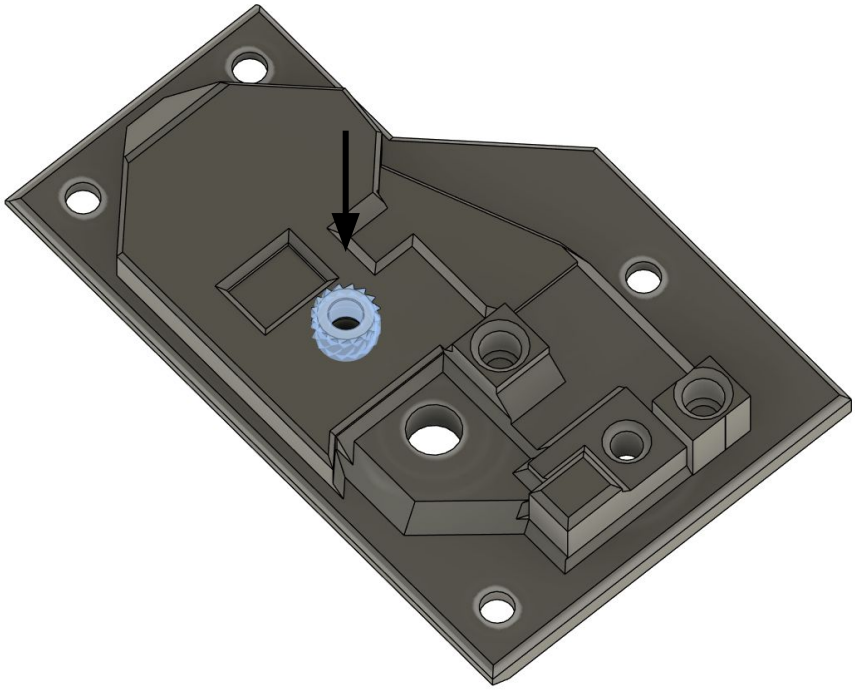


Assembly

Using a soldering iron (and preferably heatset soldering tips), insert the M4 heatsets (**N**). In the laser area (top right image), you will have to use the side of the soldering iron to insert the heatset rather than push it straight down. Arrows denote direction of insertion.

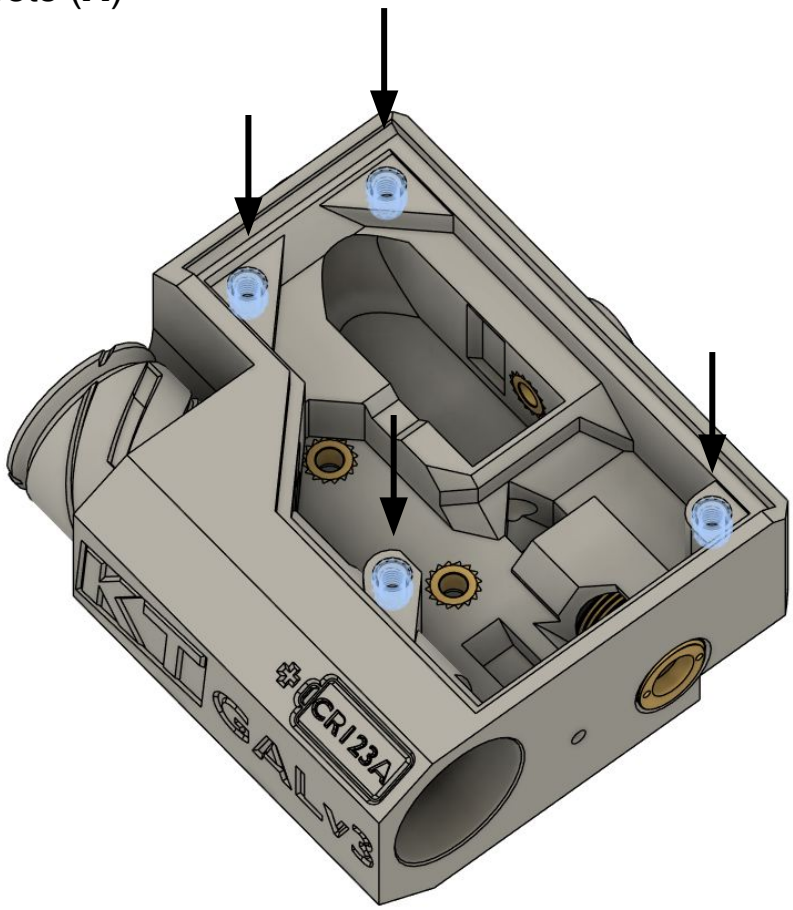


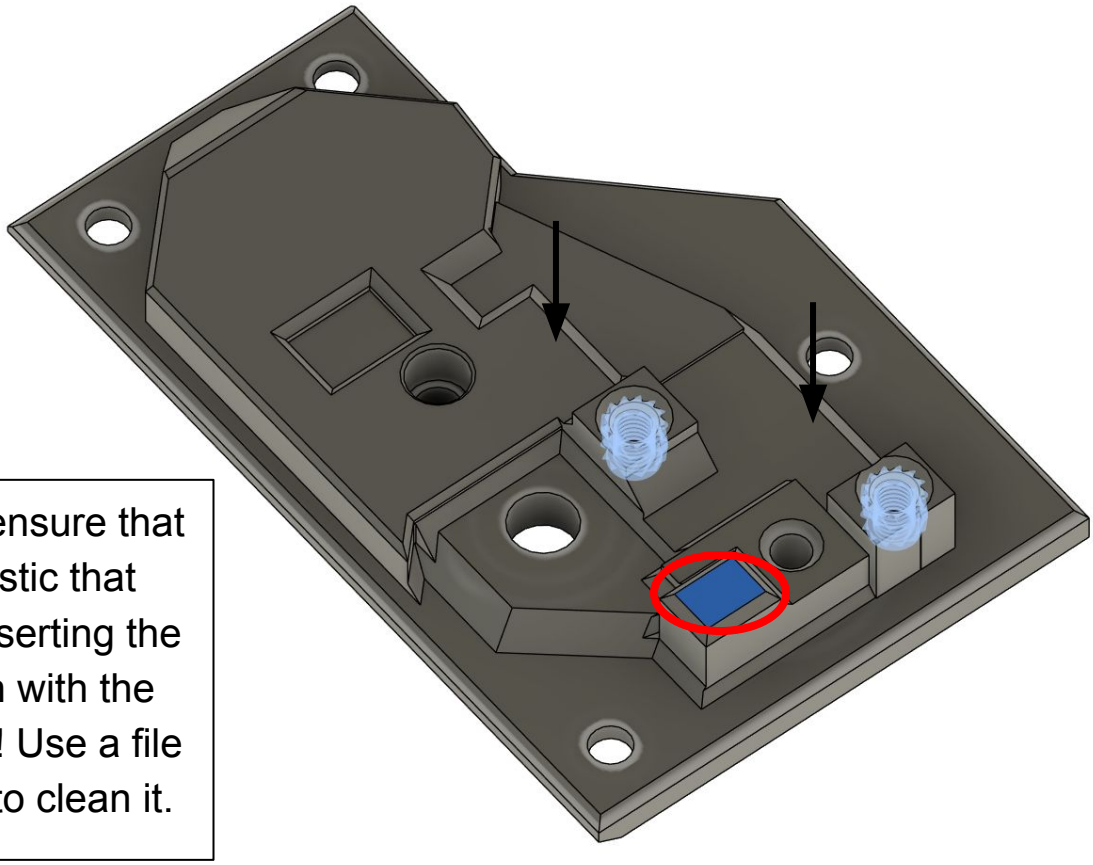




Assembly

Insert the M3 heatsets (**X**)

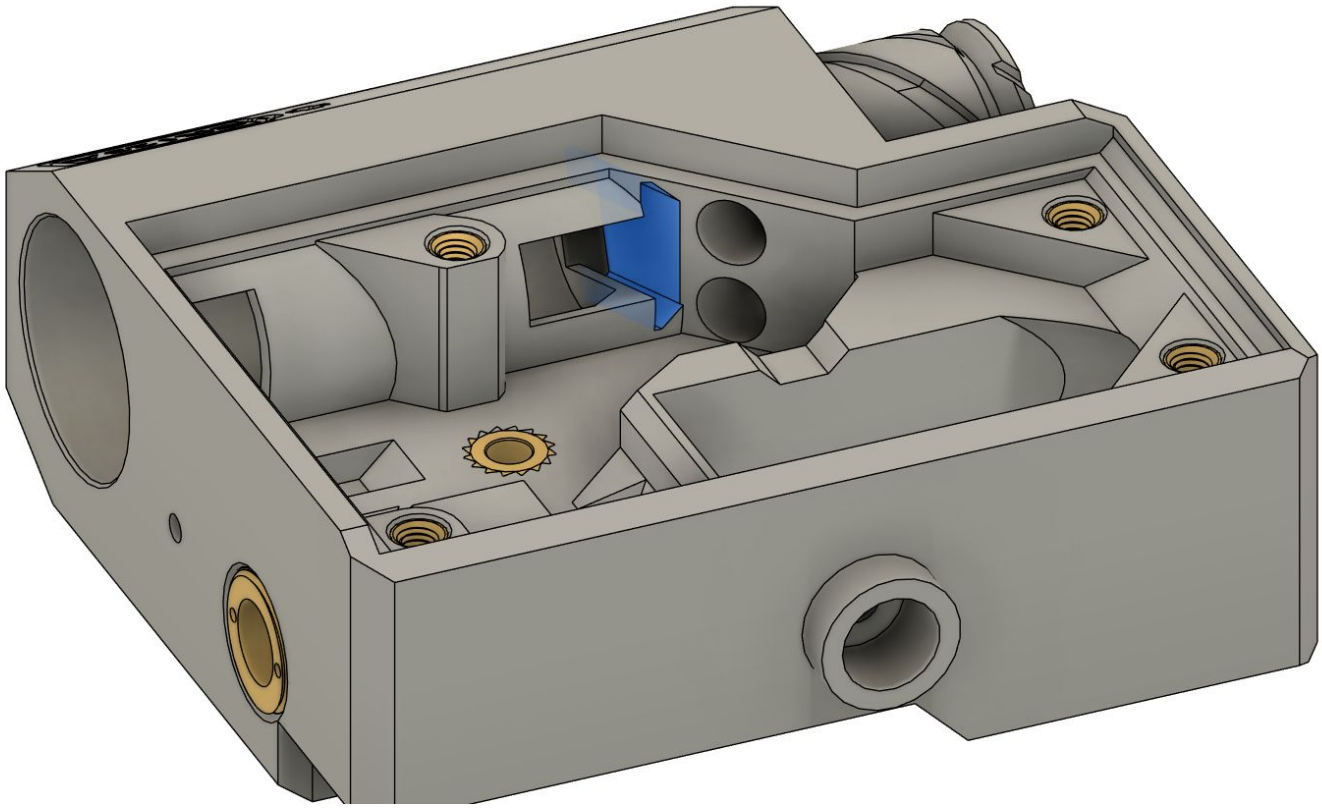


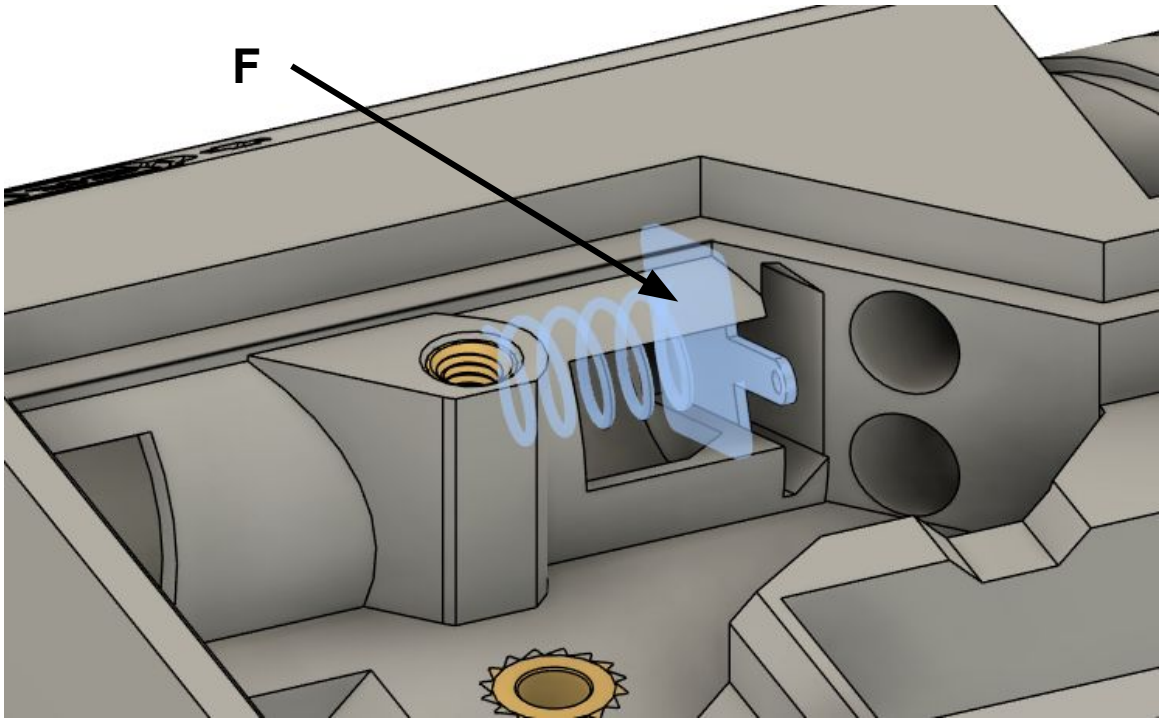


On the GAL_lid, ensure that any melted plastic that protrudes from inserting the heatsets is flush with the highlighted plane! Use a file or a razor blade to clean it.

Assembly

Using needle nose pliers, insert the AAA Negative Terminal (**F**) into the slot in the GAL_body. The AAA Negative Terminal will be smaller than the AA Negative Terminal (**P**).

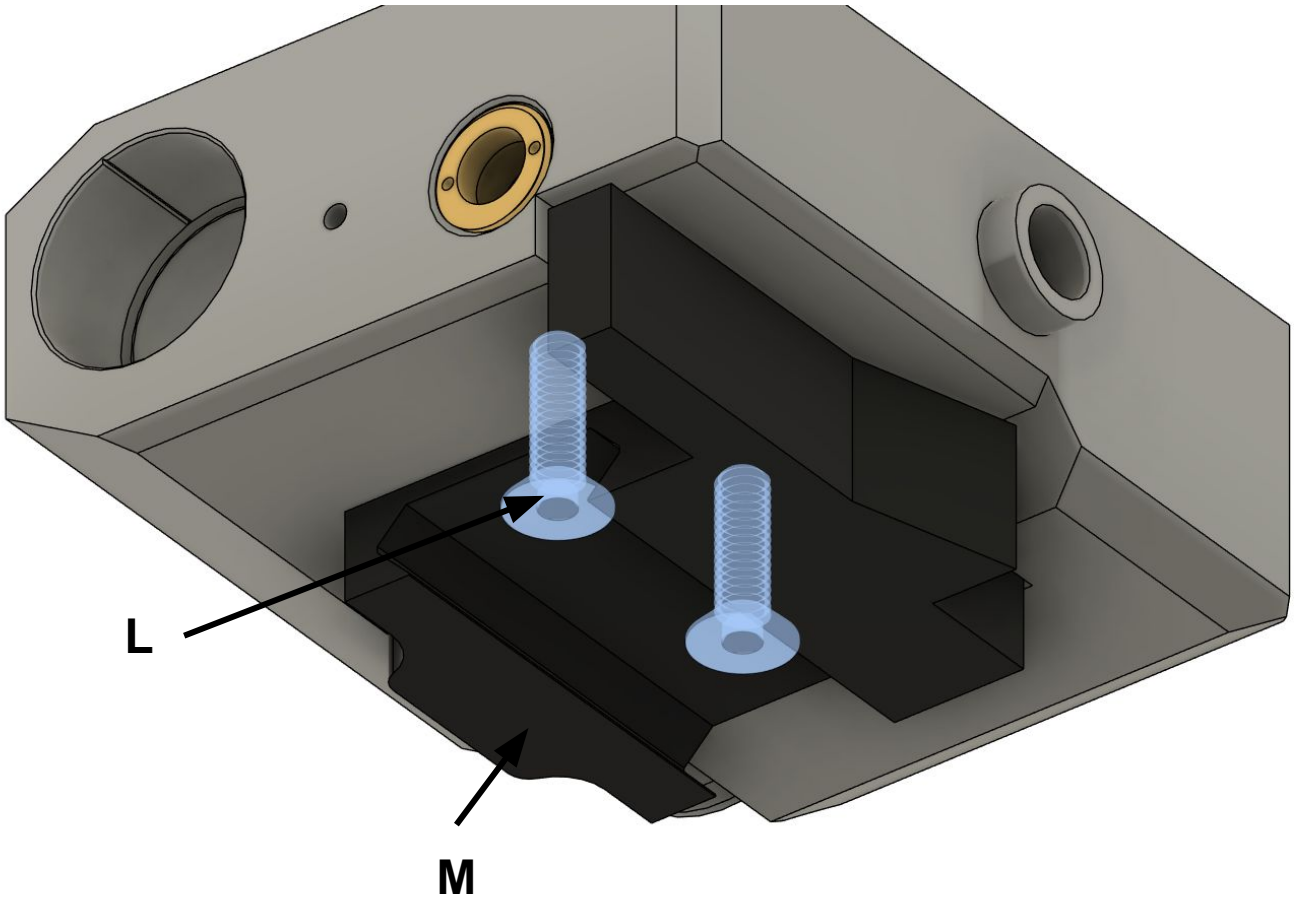




Assembly

Pic Rail

When unpacking your DBAL mount (**M**), the locking arm may be in the wrong orientation. To fix this, loosen the screw on it until you can spin the locking arm around. Using two M4 hex drive flat head screws (**L**), install **‘M’** into the two holes. You can put Synthetic Grease into the hole before installing **‘M’** to improve watertightness.



Assembly

Battery Body (brass)

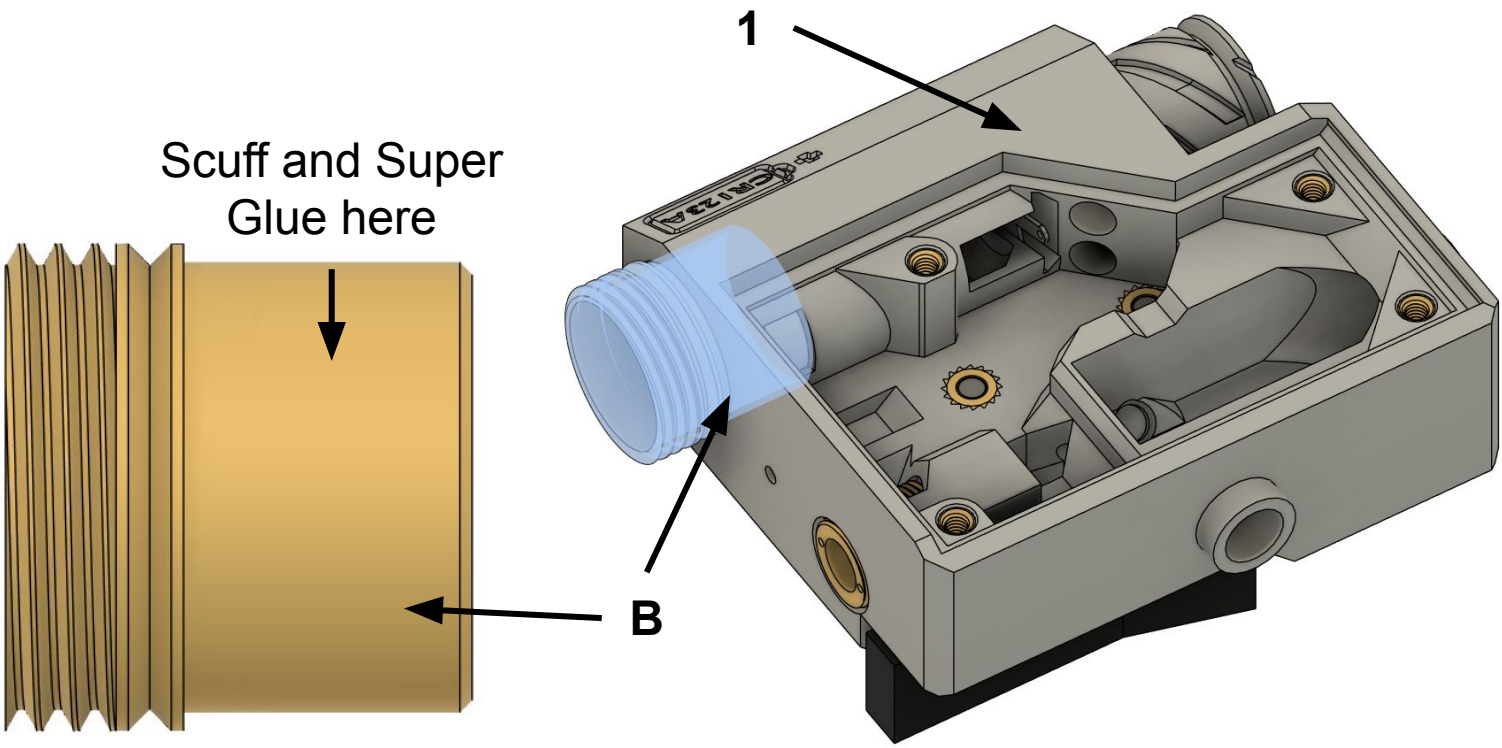
Insert the battery body (**B**) into the GAL body (**1**). This can be done a number of ways depending on how tight the fit is. Before doing it, scuff the outside of the brass with sandpaper to promote adhesion with **‘1’**. Test that **‘B’** can go into **‘1’**.

- If you can press it in by itself
  - Do that
- else
  - Thread the battery cap (**‘A’** and spring/screw/nut) assembly on to **‘B’**
  - Use the full Battery assembly to push/screw/wiggle **‘B’** in

  or
  - Gently tap the assembly into place with a nylon hammer

Once you’ve confirmed that it goes together, remove **‘B’** and put Super Glue on the outside of the tube part of **‘B’** (the part that goes into **‘1’**). Don’t use too much, it should hold really well with a small amount.

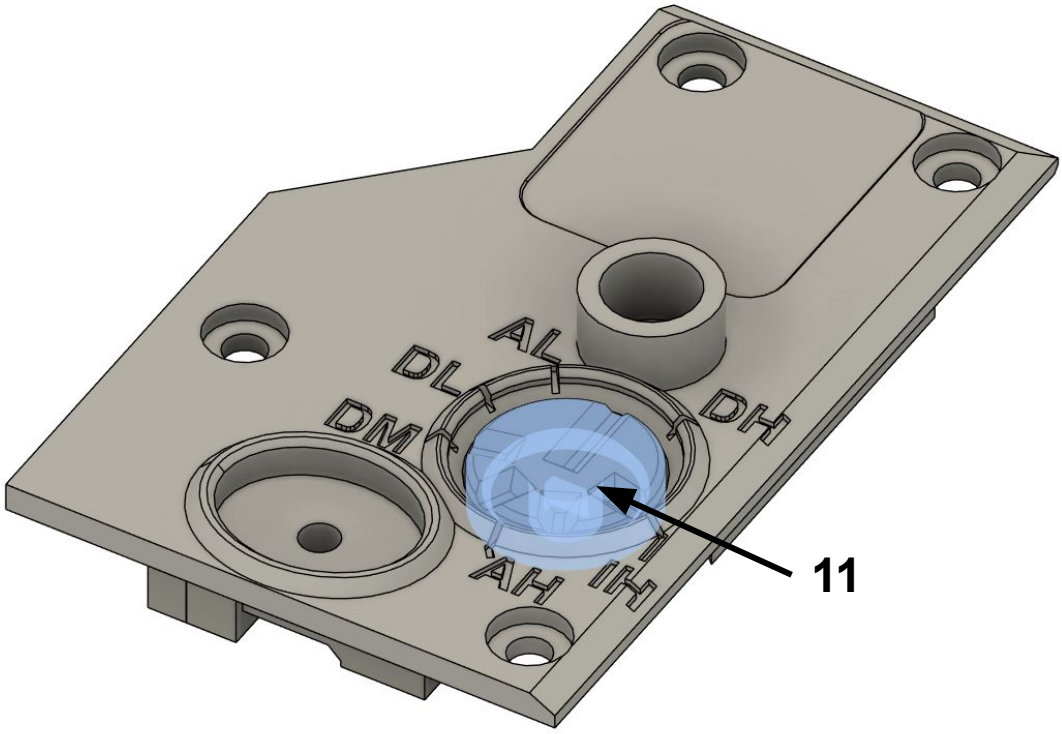
If you are having trouble with this step, use sandpaper to make the receiving end of the battery assembly (receiving end being the GAL body, part **1**) a bit larger.

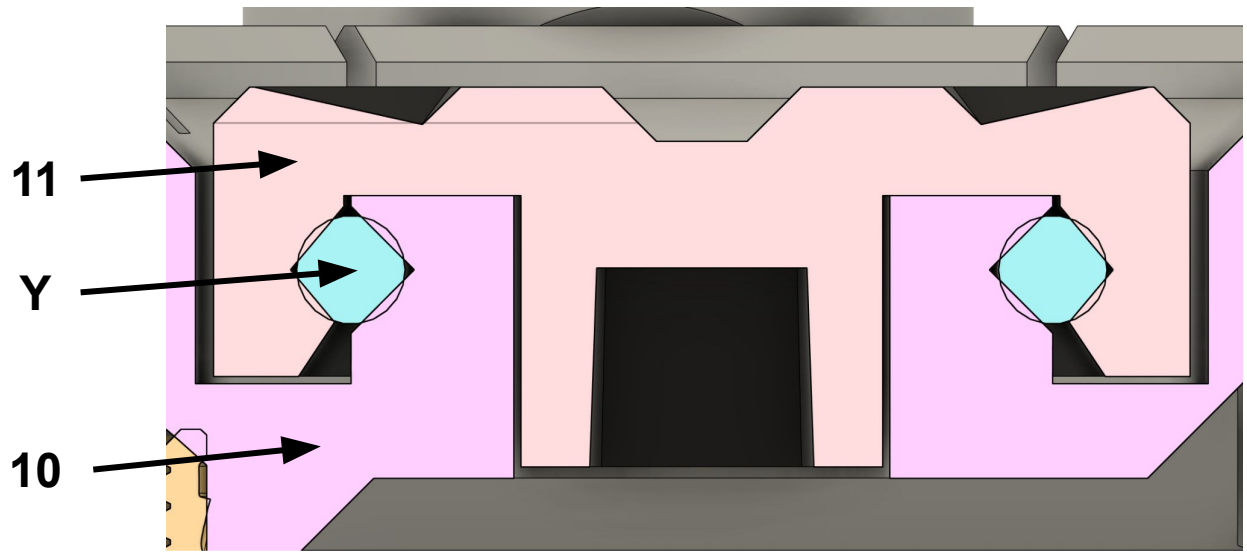


Assembly

Selector Knob

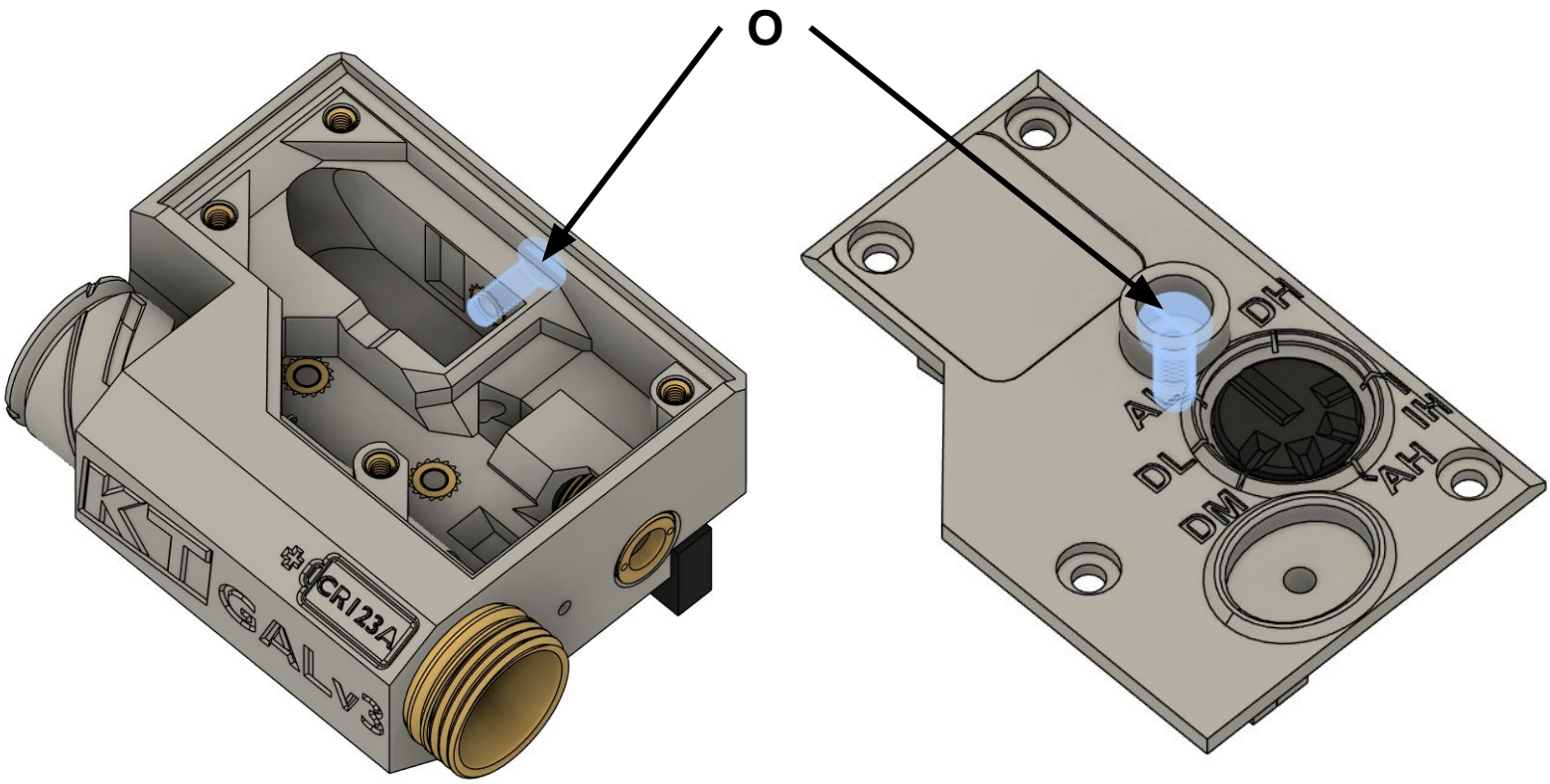
First, ensure that your selector knob (**11**) fits into its slot and can spin freely without any resistance. If it does not, make sure to clear any interferences. Then, put 7x1.5mm o-ring (**Y**) into its slot around the post in the lid (**10**) (see cross-section diagram). Ensure you are using the 7mm o-ring and **not** the 10mm o-ring, as the 10mm o-ring will make the **‘11’** installation **very** hard. Apply synthetic grease into the slot for lubrication and water tightening. Now, install **‘11’** by pressing it into the slot while spinning it. Using tweezers or an O-ring pick tool helps here. **‘11’** will be fully seated when the bottom portion is almost flush with the bottom of **‘10’**, is level to the top of **‘10’**, and can spin freely.





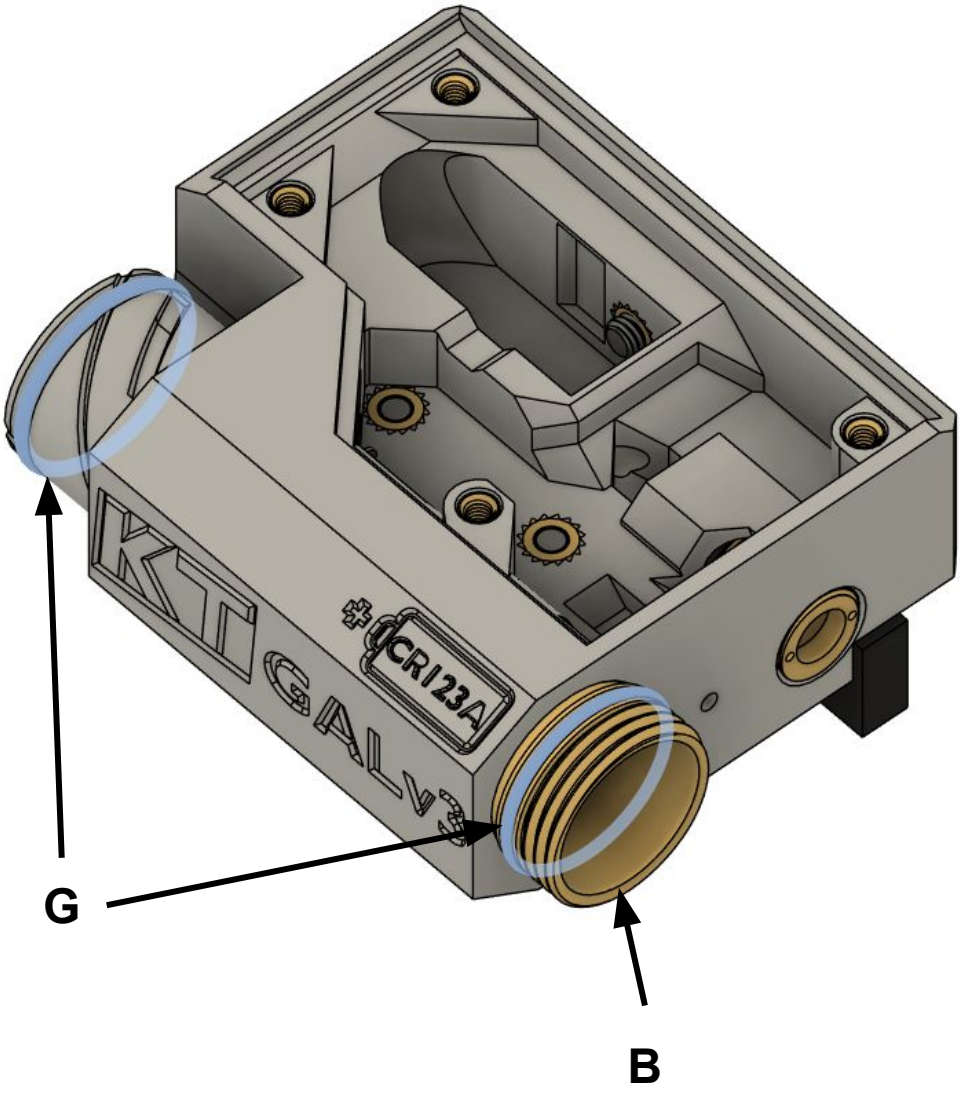
Laser Adjustment Screws

Insert synthetic grease into the laser adjustment turrets for water tightness. Install the two M4x7mm Narrow Cheese Head Slotted Screws (**O**). The plastic between the heatset inserts and the outside of the turret acts as both water tightening and a nylock nut, helping with zero retention. It may help to thread your screws in backwards (so from the heatset side first) to pre-form the threads in the plastic. For the laser assembly installation, leave the adjustment screws flush with the heatsets for now.



Battery and Lens Cap O-rings

Install the two 14mm o-rings (**G**) onto the lens cap area as well as the Battery Body (**B**).



Assembly

Wire Harnesses

This part is very easy to mess up, so I recommend paying very careful attention here. There are two 6pin JST SH cables (**AA**); we will call them the Battery Harness and the Output Harness. While the order of the colors may change depending on where you buy the cables from, the output order will not. In this guide, I will use the colors shown in the picture below. Adapt your build to the order of colors on your harness. If you're colorblind and having issues with this, hit me up.

Battery Harness:

White: Battery Negative (to **Part B**)

Blue: Battery Positive (to **Part F**)

Green: Indicator LED Negative (to **Part Z**)

Yellow: Indicator LED Positive (to **Part Z**)

Black: Crane Port Negative (to **Part U/V**)

Red: Crane Port Positive (to **Part V/U**)

Output Harness:

White: Laser Negative (to **Part T**)

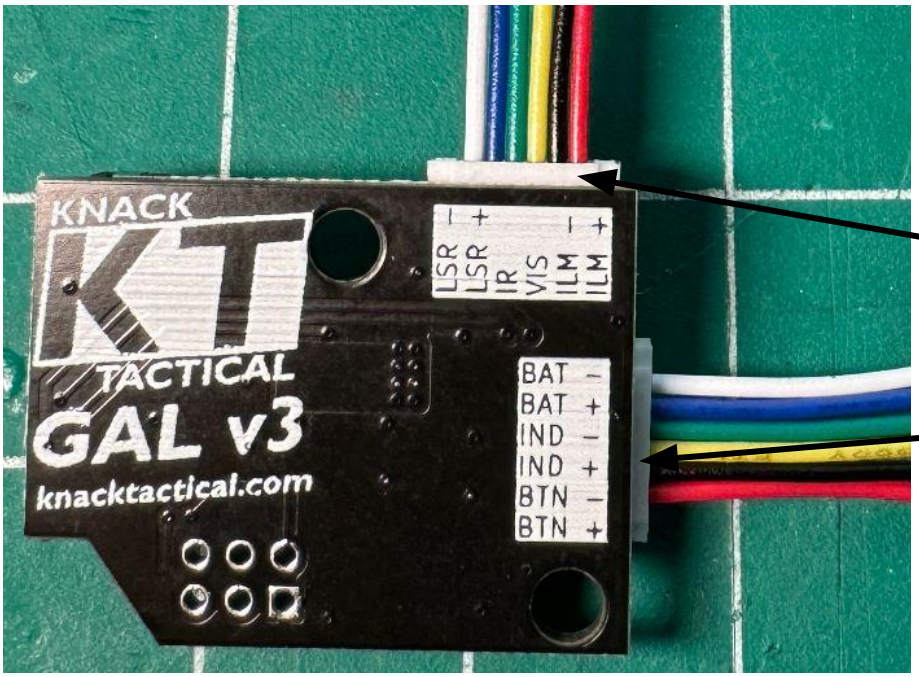
Blue: Laser Positive (to **Part T**)

Green: IR Laser Activation (to **Part T**)

Yellow: VIS Laser Activation (not used)

Black: Illuminator LED Negative (to **Part K**)

Red: Illuminator LED Positive (to **Part K**)



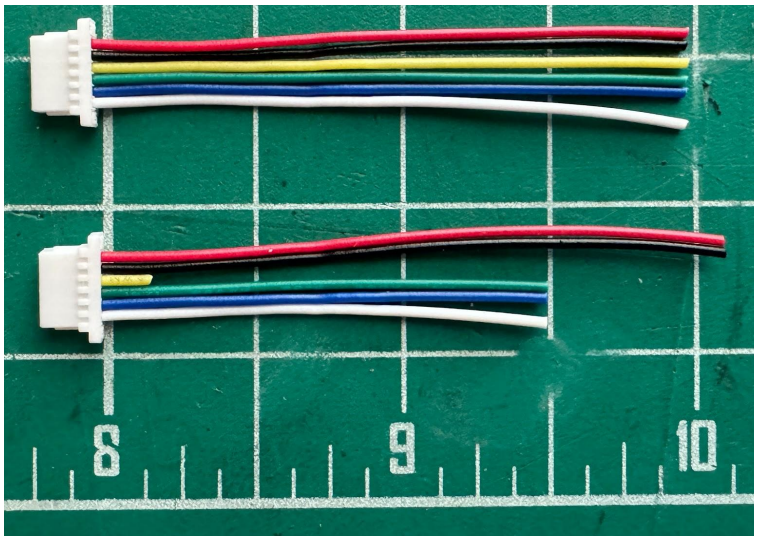
Assembly

Wire Harnesses (cont.)

The harnesses will need to be trimmed before they are attached to anything. Reminder that it is much easier to shorten the wires than it is to lengthen them. Leave them a little long now so you can dial them in later.

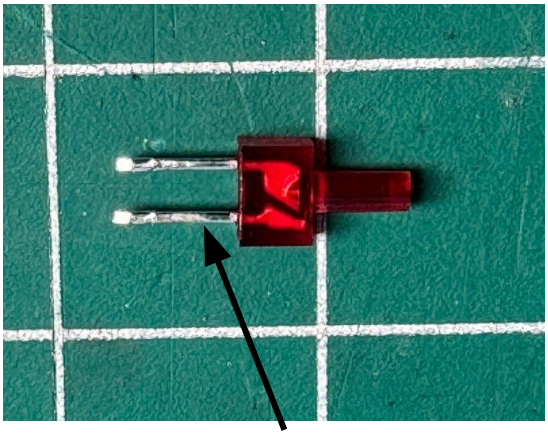
Using scissors or wire cutters, trim all of the wires on both harnesses to 2”.

Trim the **LASER** wires (White, Blue, and Green from the previous slide) to 1.5”. Double check that you are cutting the correct wires. Put the cable into the PCB and triple check that you are about to cut the right wires. Since the Yellow VIS laser wire will not be used (but was left in the design for potential future use or remixing purposes), it can be trimmed very short.

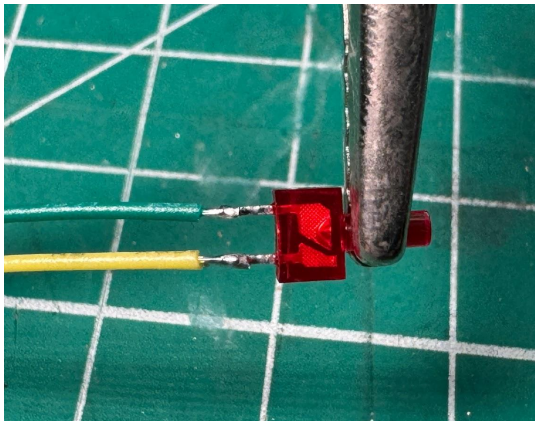


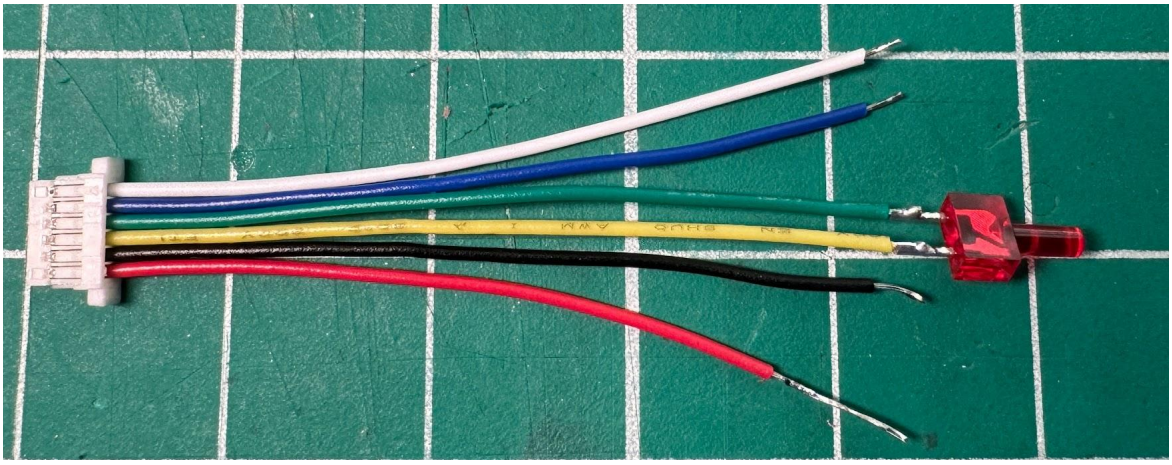
Indicator LED

First, take note of the polarity of the Indicator LED (**Z**); the longer leg is the anode (positive lead). Then, trim the legs of **'Z'** to around a ¼". If you forgot which leg is which after cutting them to the same length, the leg attached to the smaller of the two pieces of metal inside the plastic is the positive leg. The Green and Yellow wires on the Battery Harness need to be stripped and soldered to the appropriate legs. You can also take this time to strip and tin the remaining legs on the Battery Harness. Strip one of the Crane Port wires (in this case, I chose the Red wire) extra long, about ½".



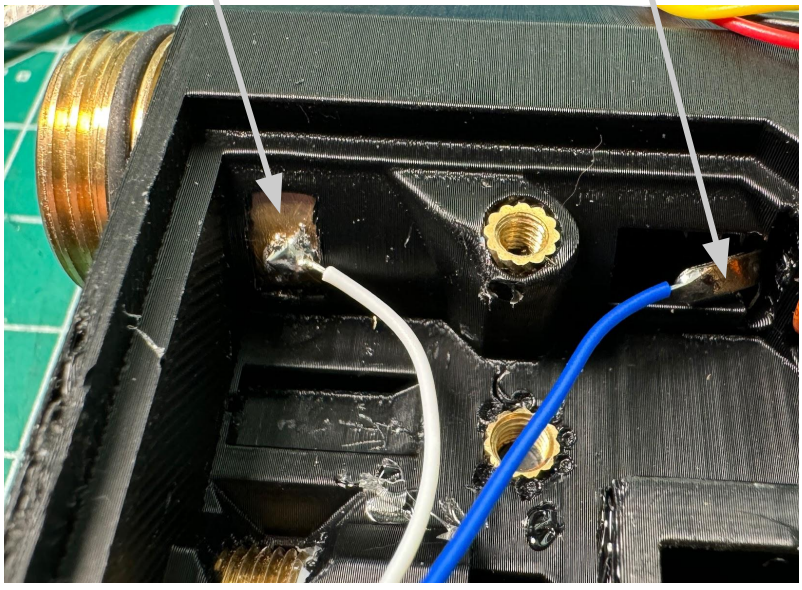
Positive Leg

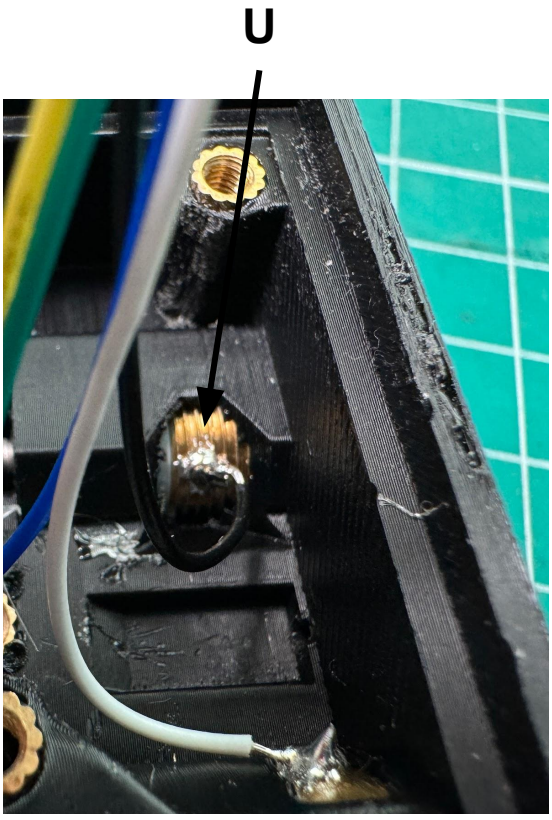




Soldering the Battery Harness

Solder the White wire to the Battery Body (**B**). Make sure to hold your soldering iron on the brass for a while. It will take a while for the brass to heat up. If you're having trouble with this, turn your soldering iron temperature up. Once the solder sticks, do not move the battery tube, as the plastic around it may deform. Solder the Blue wire to the AAA Negative Terminal (**F**). Solder the Black wire to the Crane Port Stage 1 (**U**). This is another large mass of brass, so the same issues will persist from **'B'**.

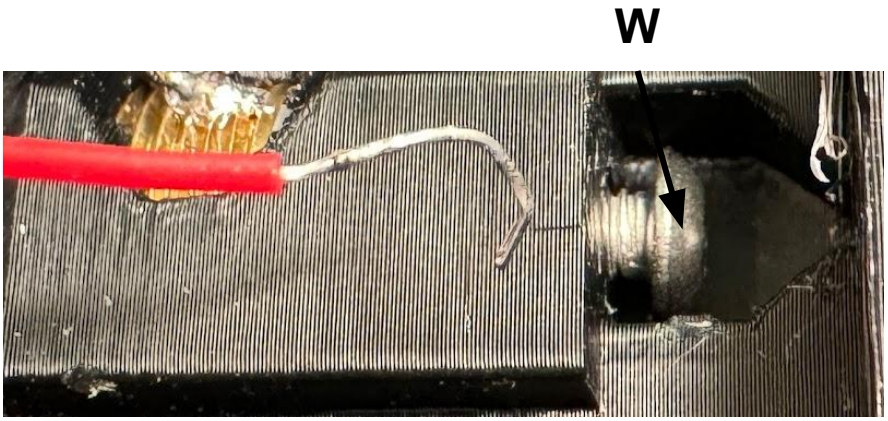


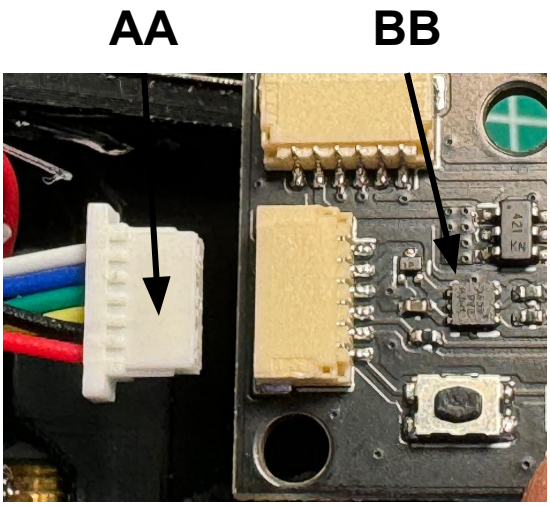


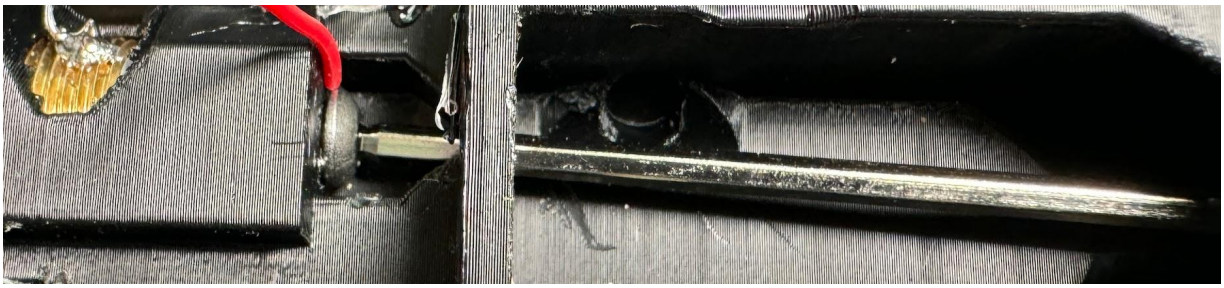
Soldering the Battery Harness (cont.)

Using tweezers, guide one of the M3x6 Button Head Screws (**W**) into the slot behind the crane port. Bend the Red wire into a bit of a hook. Feed the hook of the Red wire around **'W'**. Guide a 2mm Hex Key Allen Wrench through the Laser Lens window, through the hole in the back of the Laser area and screw in **'W'**. Make sure that the hook in the Red wire is captured. Loctite should be used in this instance to ensure the screw does not back out.

Now is a good time to test that the harness is working correctly. Insert your CR123A battery into the battery compartment (positive side in first, like in the diagram on the side of the body). Screw on the Battery Cap assembly. **GENTLY** insert the JST SH connector into the female slot closest to the button on the PCB (**BB**). The visible metal on the connector will be down when inserting the connector. Pressing the button on the PCB should light up the Indicator LED. Also test your Crane Switch by inserting it into the Crane Port. If the Indicator LED doesn't light, ensure the Indicator LED polarity is correct, same with the battery. If still not, jump to the Troubleshooting (TODO: link) section before continuing.

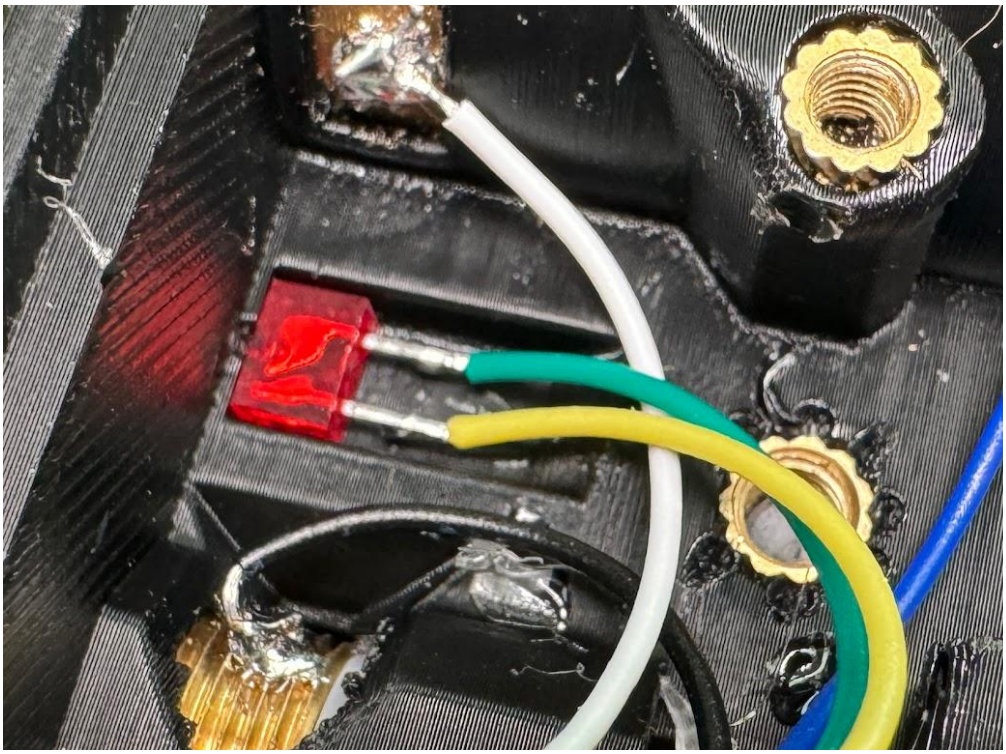


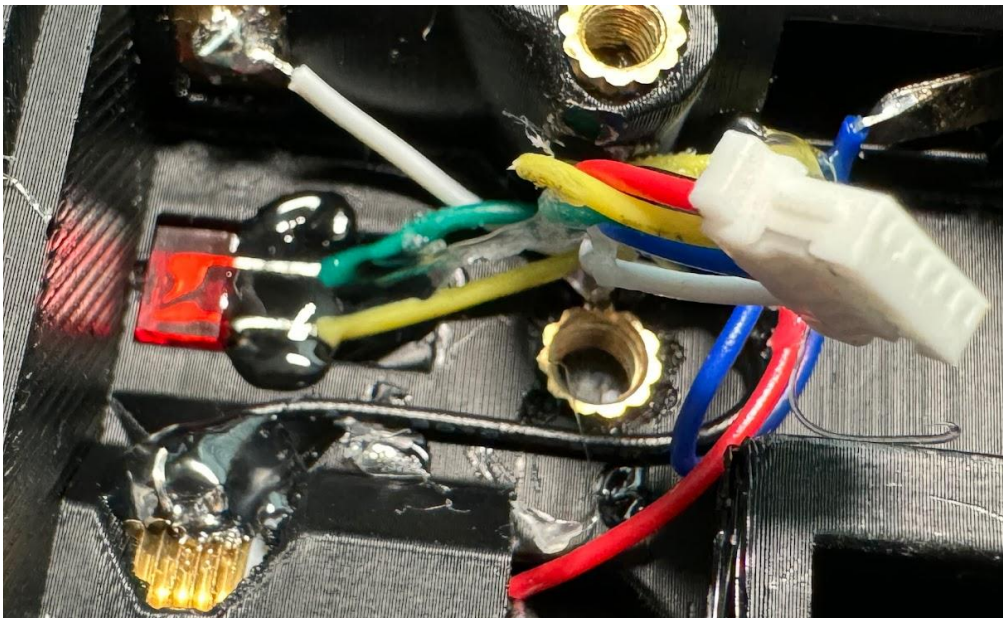




Soldering the Battery Harness (cont.)

Using the tweezers, insert the Indicator LED (**Z**) into its slot. Hot glue **‘Z’** into its slot. You can also hot glue the rest of the wires in place for strain relief, if you’d like to.



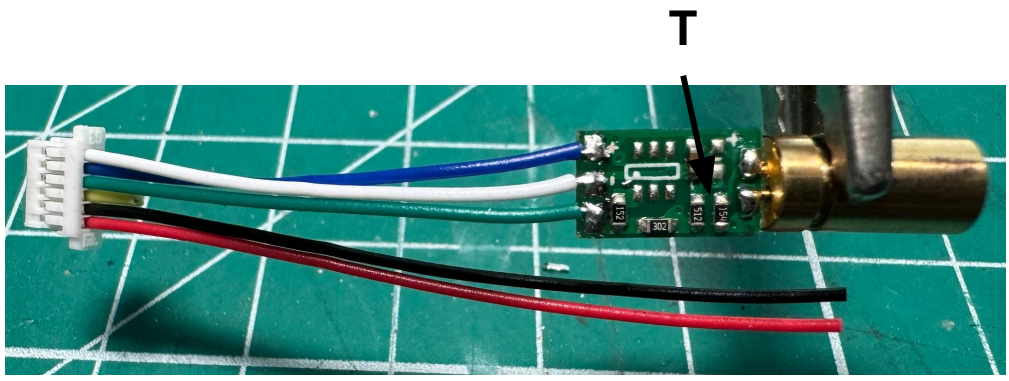


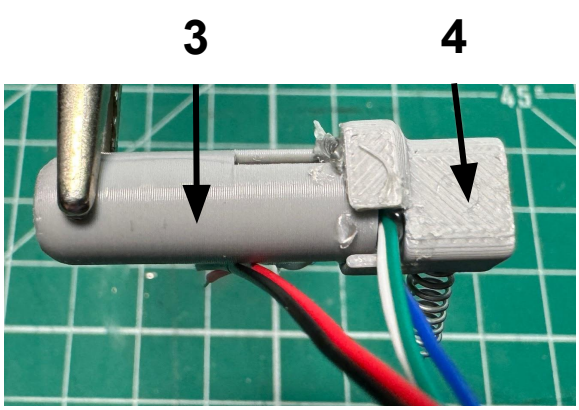
Assembly

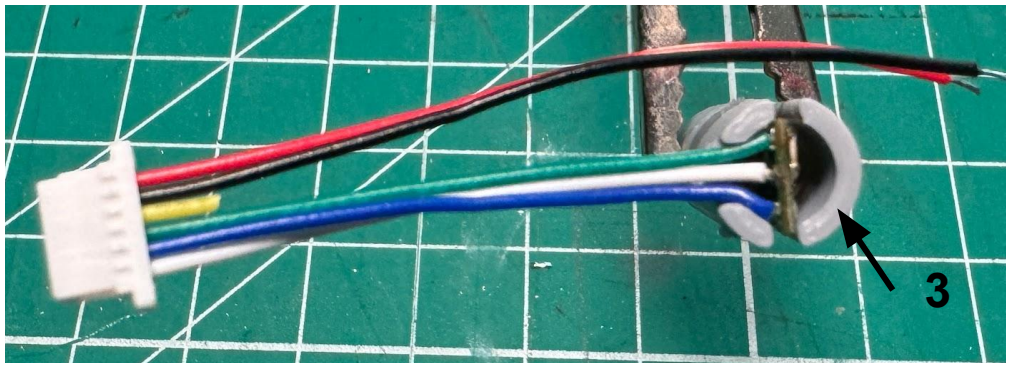
Laser Assembly

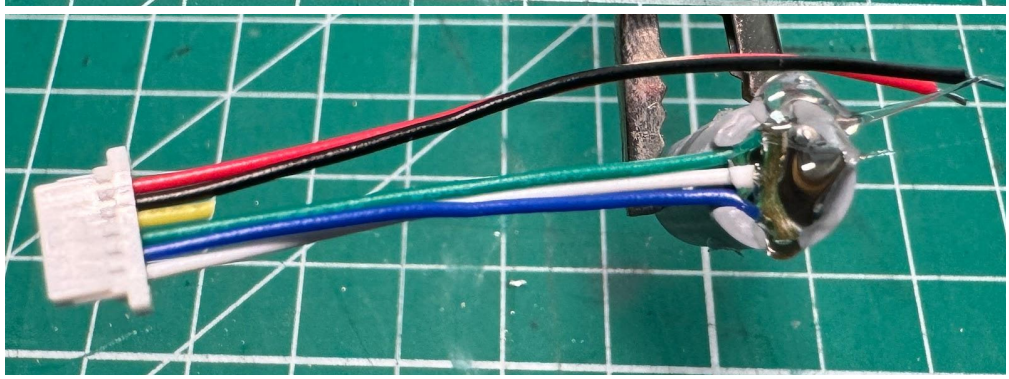
Carefully remove the heatshrink on the 850nm IR laser (**T**). Unlike in the v2, the IR lasers from the parts kit is fixed to 50m by the manufacturer, so there will be no need to focus it. **‘T’** will have 3 wires: red, black, and white. The red is positive, black is negative, and white is the activation wire. In the Output Harness, Blue is positive, White is negative, and Green is the activation wire (note the orientation in the first image below). Strip and tin the Blue, White, and Green wires. Using your soldering iron, remove one wire from **‘T’** at a time, replacing it with the corresponding wire from the harness, to prevent mixups.

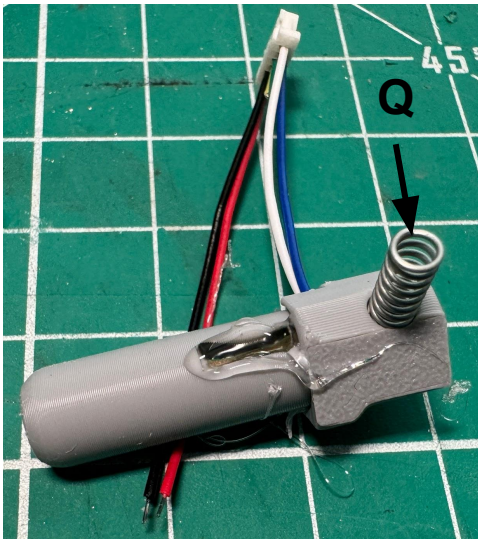
Bend the Blue, White, and Green wires 90° away from **‘T’**s PCB. Insert **‘T’** into the laser housing (**3**) so that the wires sit in the slot. Make sure **‘T’** is fully inserted into **‘3’**. Fill the back with hot glue and quickly press the laser base (**4**) into place. Place the 0.5” Compression Spring (**Q**) into its slot in **‘4’**. A dab of hot glue can be put in this hole to hold **‘Q’** in place, if needed. Fill the side slots of **‘3’** with hot glue to ensure **‘T’** doesn’t move.







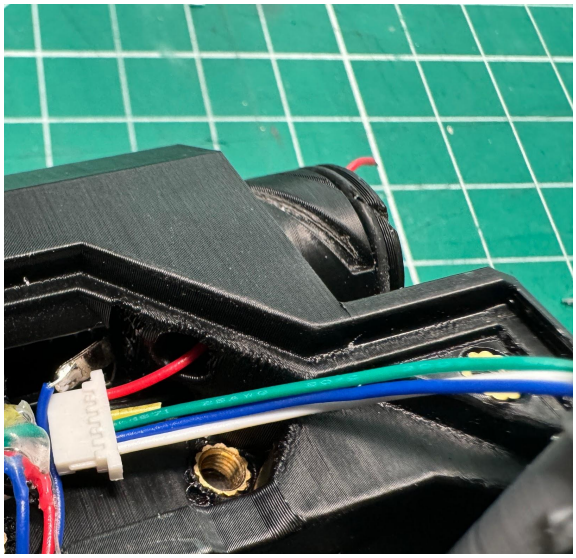


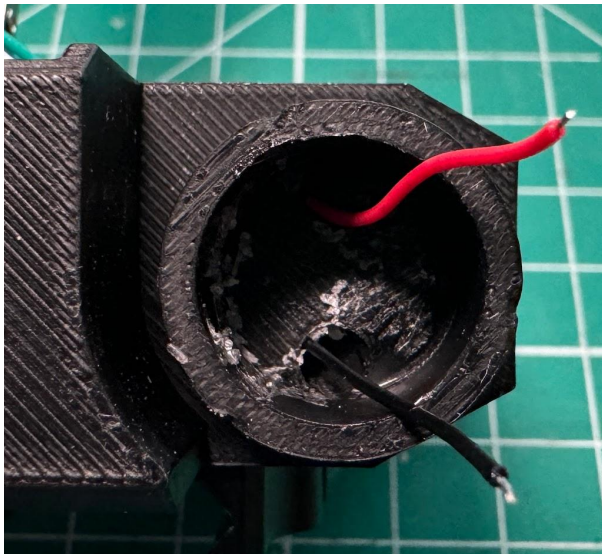


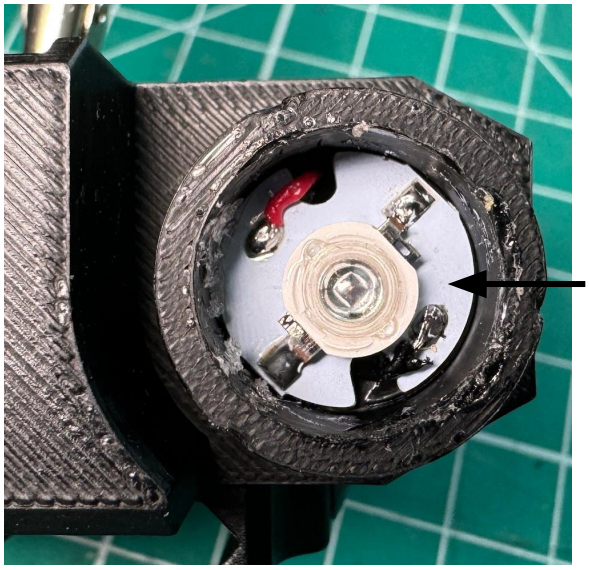
Assembly

Illuminator LED Installation

Pass the Red and Black wires from the Output Harness through the holes that lead to the Illuminator area. It doesn't matter which wire goes into which hole. Solder the Red wire to the '+' tab on the LED Heatsink (**K**) and the Black wire to the '-' tab. Put a dab of hot glue, silicone caulk, or epoxy on the back of **'K'** and press **'K'** into the base of the illuminator area. Make sure the cutouts in **'K'** are pointed up and down so that the two wires aren't pinched. You can also cover the contacts and holes with hot glue or caulk for water tightness and strain relief.



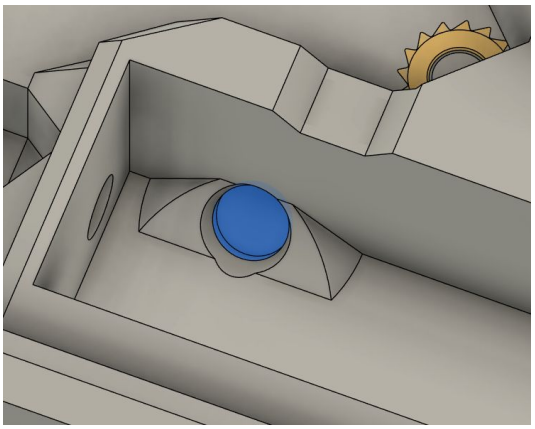


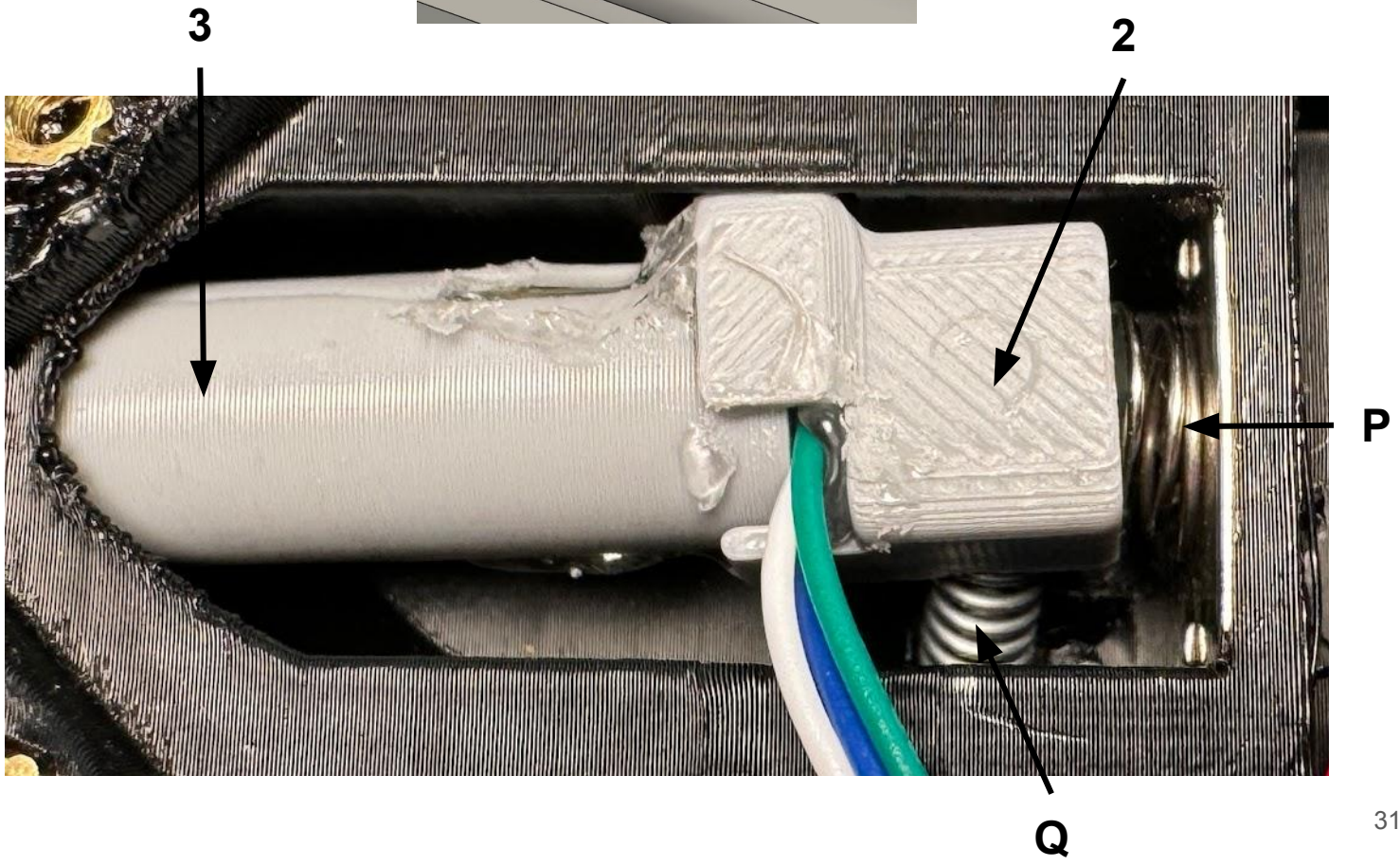


Assembly

Installing the Laser Assembly

Using side cutters, cut the solder tab off of the AA Negative Terminal (**P**) so the base is just a rectangle. Place the laser assembly into the laser slot. The front (laser emitting side) will need to go in first. Then push **'P'** against the back of the laser assembly while pushing the rest of the assembly into the slot. Make sure that **'Q'** is in its slot (highlighted), which can be moved into place with tweezers. Now is a good time to do a full functionality test. You can move the rotary switch on the PCB by hand and press the button on the PCB to check that all of the modes work as intended.

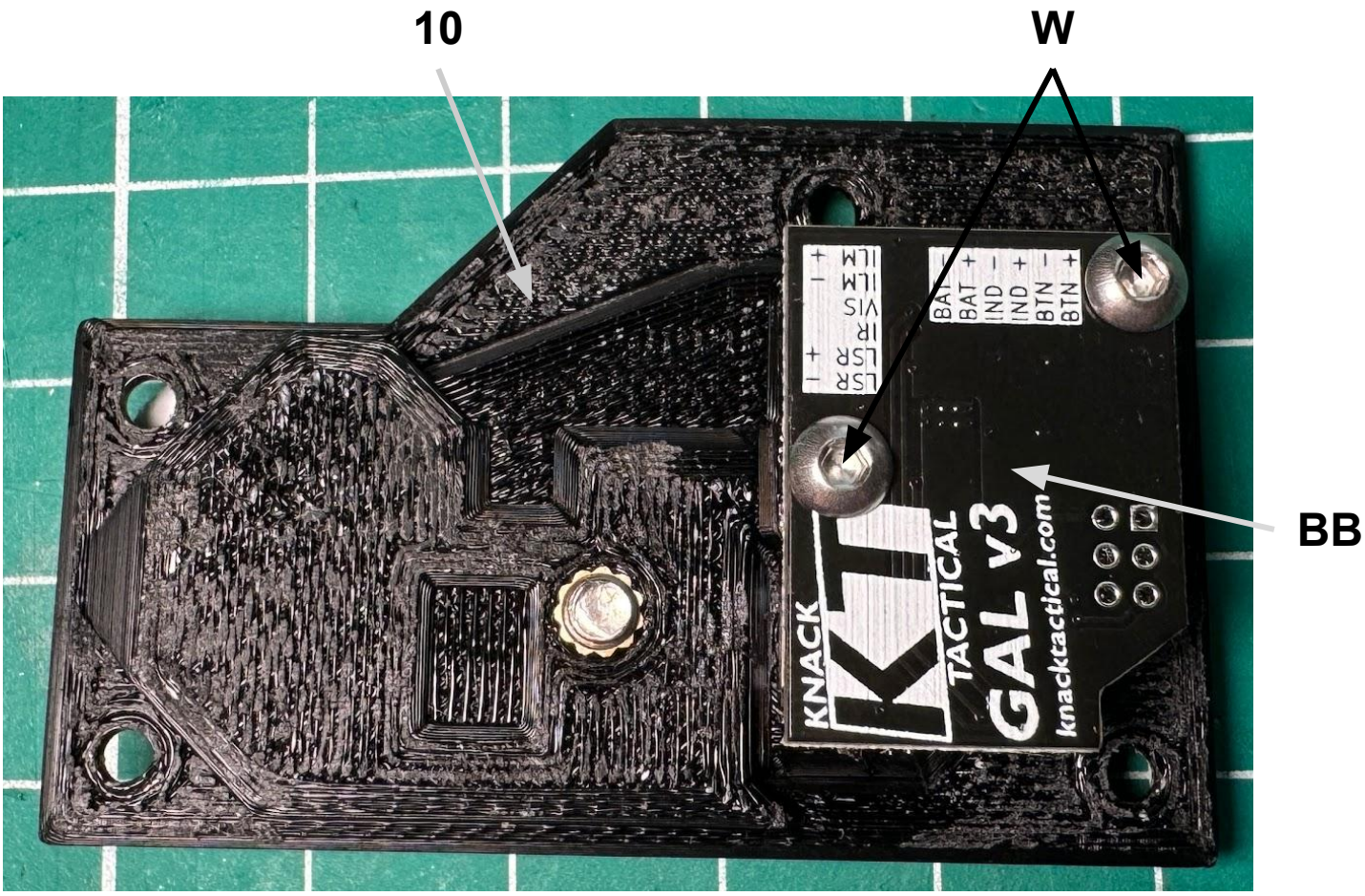




Assembly

Lid

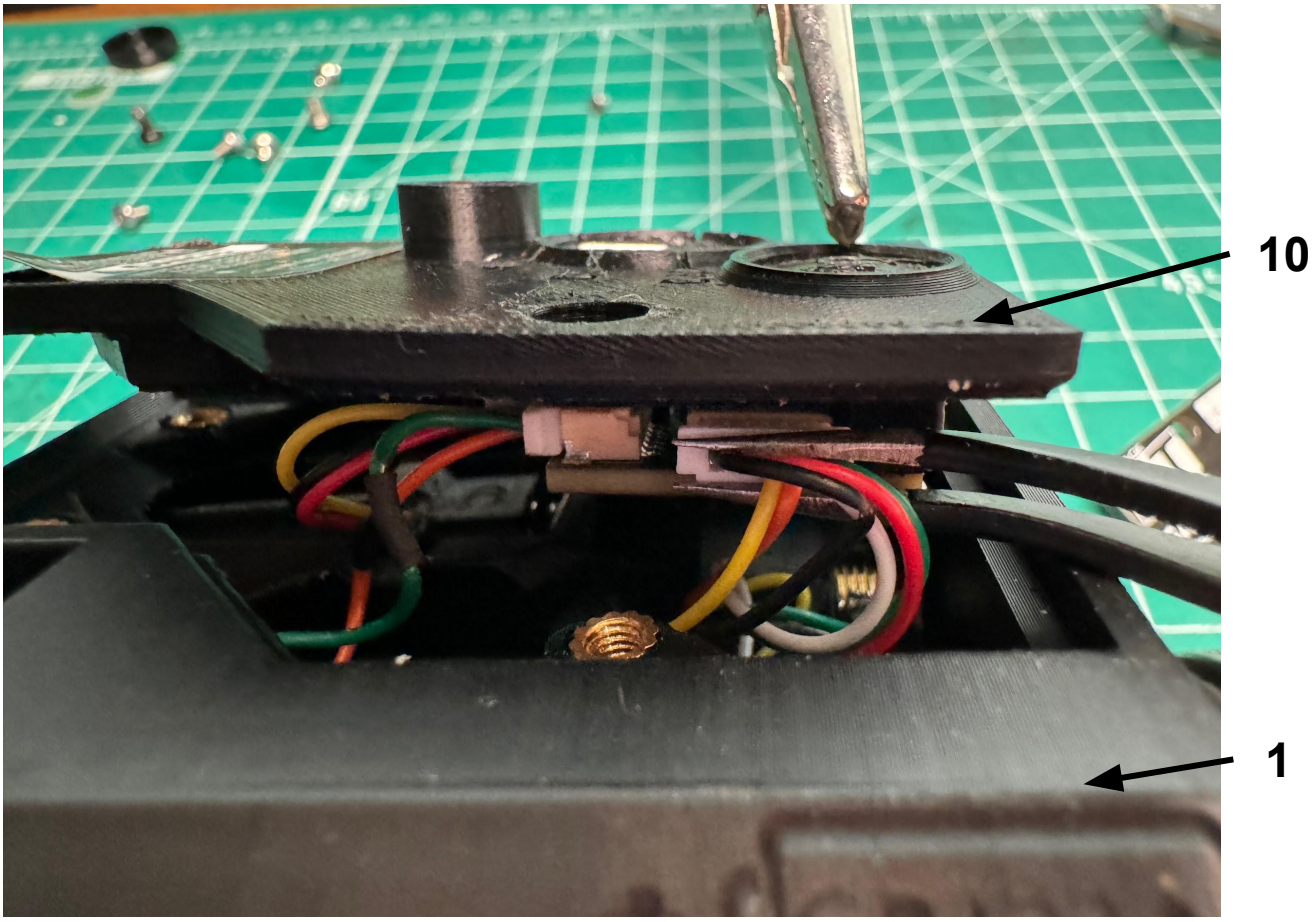
Using two M3x6 Button Head Screws (**W**), screw the PCB (**BB**) into the lid (**10**). Make sure the selector knob (**11**) lines up with the rotary switch on the PCB. Loctite should be used on the screws to ensure they don't back out.



Closing It Up

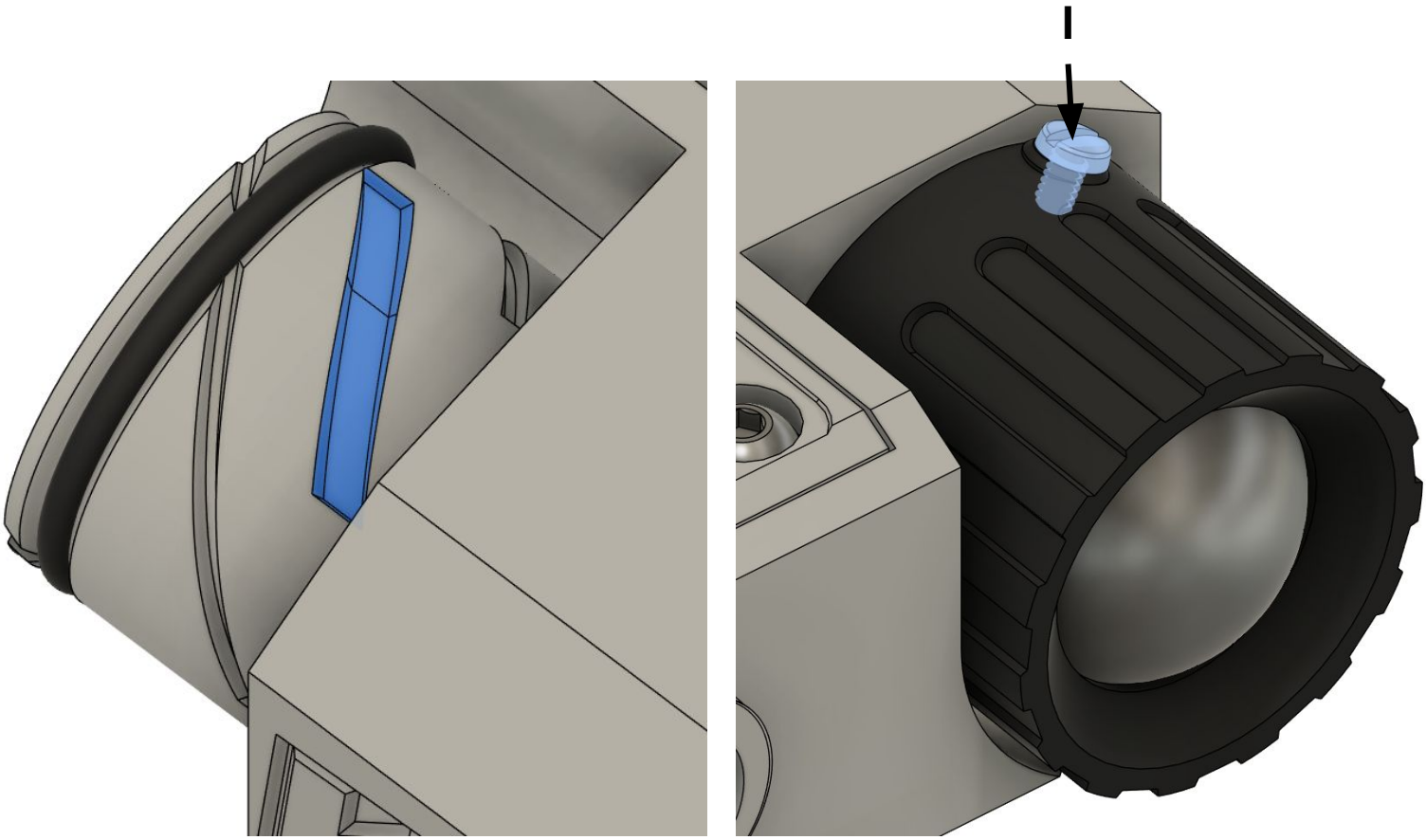
Using tweezers, grab each cable harness right behind the connector and push them into the female ports on the PCB. I recommend starting with the Output Harness, then do the Battery Harness from the angle in the picture below.

Making sure that no wires get pinched, close the lid (**10**) on the body (**1**). Using the remaining four M3x6 Button Head Screws (**W**), screw the lid into the body. Loctite should be used on the screws to ensure they don't back out.



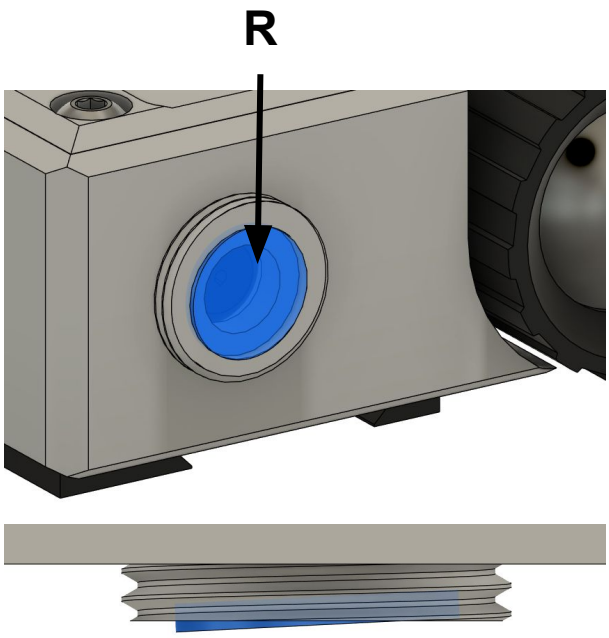
Lens Cap Installation

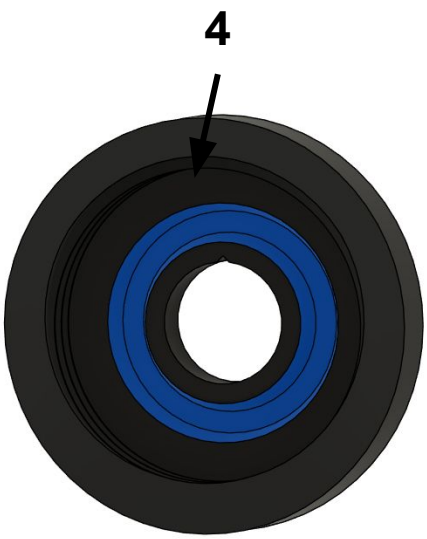
Line up the Lens Cap Assembly so that the small hole at the base of the Lens Cap lines up with the highlighted slot. Thread the Lens Cap assembly on. When it is fully seated, gently screw the M2x3 Narrow Cheese Head Slotted Screw (**I**) in the small hole at the base. Be careful not to strip this hole, as this screw prevents the Lens Cap assembly from coming off.

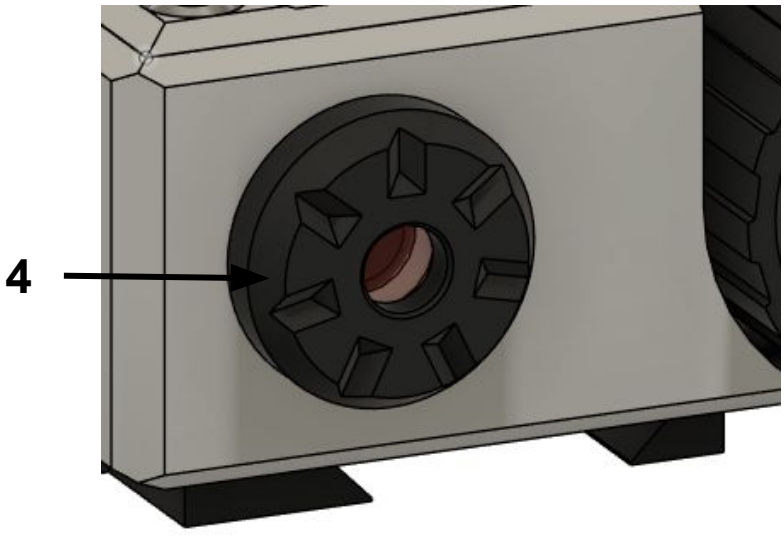


Laser Lens and Laser Lens Cap

Remove the AR Coated Lens (**R**) from its container. Remove one of the plastic films from one side. Without getting your nasty greasy hands on the lens, press **'R'** into the slot in front of the laser assembly. The lens will be slightly angled. This is done to prevent a ghosting of the laser beam at shallow angles to the lens. Place the 10x1.5mm O-ring (**S**) inside the laser lens cap (**4**) in the highlighted groove and screw it on over **'R'**.





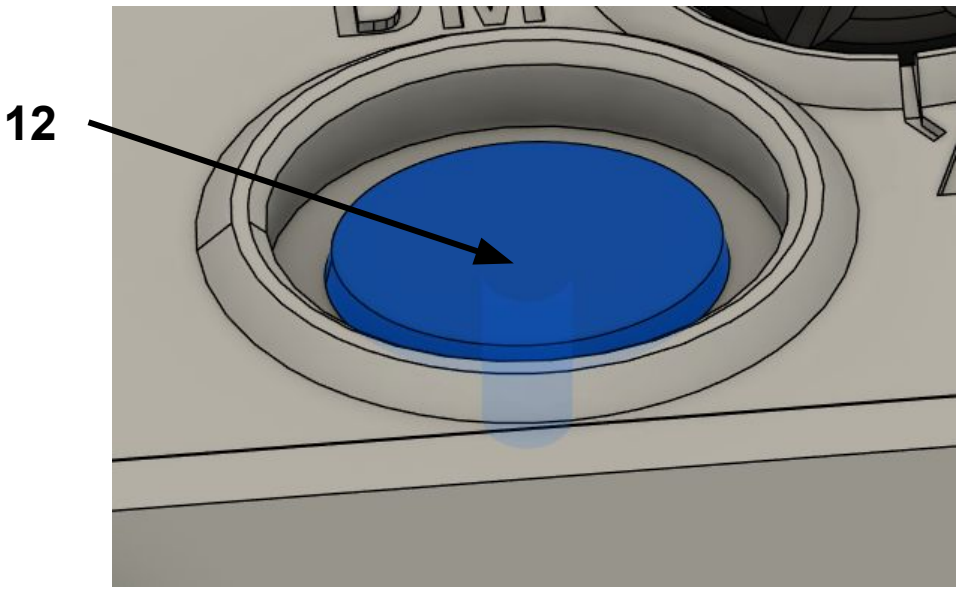


Battery Cap and Retention Strap

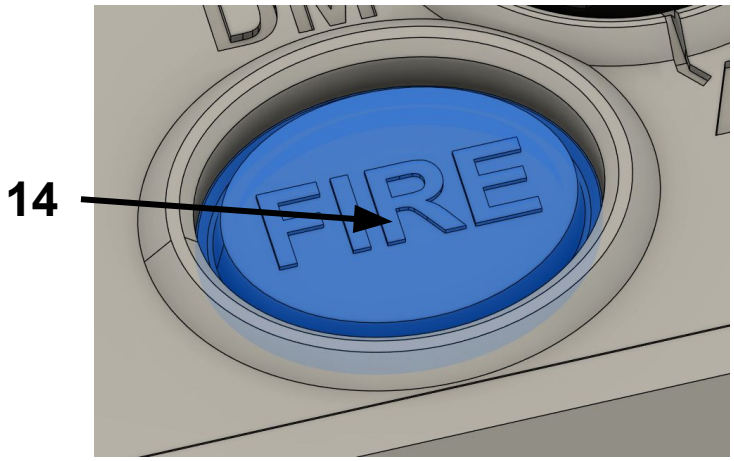
Stretch the battery cap retention strap (**9**) (not pictured) over the battery base (**B**) and screw the battery cap assembly (**A**) on.

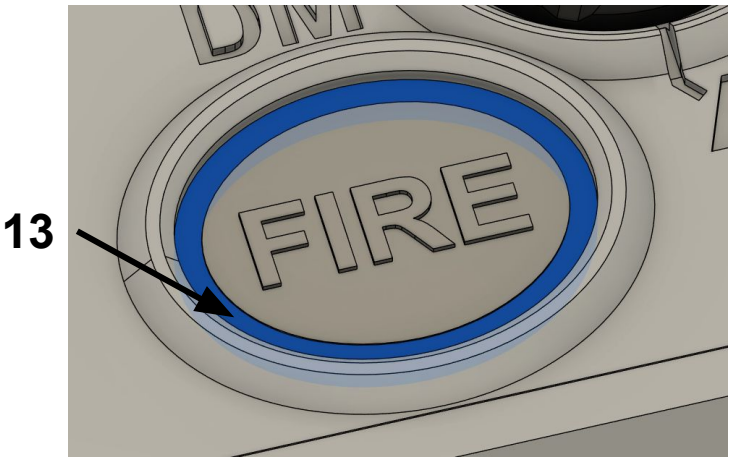
FIRE Button

Finally, we are ready for the last piece! Place the button post (**12**) into the FIRE slot. If a battery is in the battery compartment, pressing **‘12’** should activate the device. If it does not, then the post needs to be longer, which can be done in CAD using the .STEP file included in the files. More than likely, the post will be too long, so will require some trimming.



To know how much to trim, install the FIRE button (**14**). The edges of **‘14’** should touch the bottom of the slot while also touching the top of **‘12’**. The button retainer (**13**) should be pressed into the slot around **‘14’**. As you press **‘13’** into the slot, the button will likely activate, which is not wanted. If this happens, take **‘13’** and **‘14’** out, and trim a small amount off the post on **‘12’**. Repeat until **‘14’** is full seated without activating the device and make sure you can activate the device pressing the FIRE button. Lock **‘13’** in with a few dabs of superglue.





Assembly

Safety Sticker

And for the cherry on top, place the safety sticker (**CC**) on the lid in the highlighted spot. The safety sticker is **NOT** optional!!!!! Without it, this device is suuuuper dangerous!!!!!! Your GALv3 is now done :)

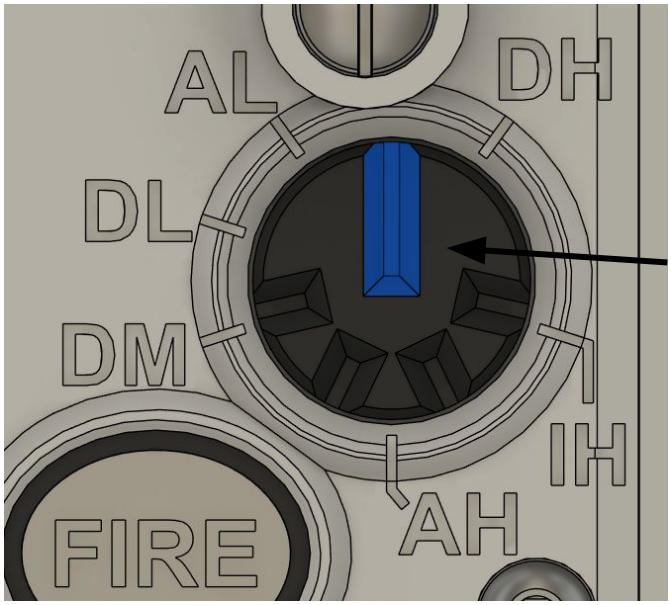
What Happens When I Press the Button?

There are 7 modes of the GALv3

Mode	Laser Output (mW)	Illuminator Output (mW)	Current Draw (mA) @ 3.5V
OFF	-	-	4.2 (1 when idle)
AIM LOW (AL)	0.25	-	5
DUAL LOW (DL)	0.25	98	37.5
DUAL MEDIUM (DM)	2.5	245	92
AIM HIGH (AH)	5	-	18
ILLUMINATOR HIGH (IH)	-	490	168
DUAL HIGH (DH)	5	490	179

The selected mode is denoted by the longer divot on the selector knob (**11**). Around **11** are the 6 marked modes, as well as the remaining 4 positions, which are all ‘OFF’. When the FIRE button is pressed (or the Crane Switch attached through the Crane port), the device will activate with the output depending on the mode selected. Regardless of the mode selected, the Indicator LED will light to show that the device is active.

Double-tapping the button will toggle the device on; pressing again will deactivate it. There is an approximate 5 minute timeout timer, which will automatically deactivate the device. If the battery gets to ~2.75V, the Indicator LED will blink when activated, warning the user that the battery is low and should be replaced.



A Few Things to Note

Why Is The Laser Only 5mW?

Firstly, I don't have a way to test the power of the lasers, but the IR laser can be seen under NODs hundreds of meters away. Secondly, I don't really like Chinese deathbeam lasers. I've seen enough StyroPyro videos to know not to mess with them. "But KNACK, I can't see my laser 1000 meters away during a full moon!" Good, now you won't commit war crimes by giving the 14-year-old kid on the other team Lasik. The beauty of open source is that if you reaaaaallly want to blind yourself looking at your cool new GAL in the mirror, I cannot stop you.

Water Resistance

This design takes waterproofing into mind in numerous places. All of the main entry/exit points (battery, illum, laser, lid, crane port, pic rail) have either O-rings or nylock-ish nuts. Synthetic grease, hot glue, silicone caulk, Loctite, or epoxy can be used in various ways to resist the entry of water into the device. Potting is a popular solution to prevent electric damage, but is messy, makes fixing impossible and quite honestly, is completely overkill in most cases, especially this one. Conformal coating (nail polish) is a great way to resist water on PCBs, but is hard to remove when doing repairs. Synthetic (non-conductive) grease is a great way as well, and is easy to repair/clean. If you've made it this far, you're smart enough to figure out how much water resistance your device needs. Whatever you do, make sure that you don't get any hot glue/epoxy in the laser compartment, as that will make zeroing impossible.

Zeroing

Zeroing the laser can be done using the two M4x7 Slotted Screws (**O**). The screw on the lid adjusts the vertical and the screw in the body adjusts the horizontal. Clockwise screwing will move the laser up and right, respectively. Blue Loctite can be used to lock the screws in place, but you will need to zero both turrets at the same time, since due to the rudimentary nature of the mechanism, one turret slightly affects the other when adjusted. For the same reason, there is no MOA or clicking adjustments. Another good idea is to use a paint pen to mark where the screws should be set when zeroed, which will help notice if the screws have shifted.

Troubleshooting

Since the GALv3 only has IR output, any troubleshooting of the output will require optics that can see IR. When testing, use the DUAL LOW mode and **DO NOT POINT THE DEVICE DIRECTLY INTO YOUR NIGHT VISION OPTICS**. Point it at a wall as to not damage your optics. **Do not point the laser at your face**. You can't see it with your eyeballs and could damage yourself. Regardless of the selected mode, when powered, the Indicator LED should light. If it doesn't, check:

1. Voltage of the battery; should be >2.8V
2. Voltage of AAA Negative Terminal (**F**) and Battery Base (**B**) with the battery installed; should be same as above
3. Voltage between GND and VCC pin holes on the PCB should be 3V or battery voltage if <3V (see page 7 for pinout); if not, PCB is dead, hit me up
4. JST SH connector should be fully seated (see page 32 for example)
5. Wires to Indicator LED were severed when closing the Lid; fix that
6. Indicator LED polarity is reversed; remove battery and test polarity with multimeter diode tester
7. Indicator LED is fried somehow; idk how do you did that, hit me up

The only problems that should happen other than above will be the illuminator or IR laser not working as expected. Make sure you are on a mode that outputs as you expect when testing. This is most likely a wiring issue. Double check that you wired everything up correctly (see here).

Illuminator LED

Double check the polarity of the illuminator LED as described in step 6 above. If it doesn't show a voltage either direction, your LED might be fried, hit me up. If it does and it's backwards, you'll need to flip either the wires on the heatsink or the LED. Either way, flip one of those.

IR Laser

Double check the wiring. The most likely problem is that the wiring is mixed up, so the laser is not activating. If this is not the problem, then your laser could be dead; hit me up.

Changelog

7/19/24	Initial Release
8/3/24	- Changed part **‘G’** from ‘14x1.5mm O-ring’ to ‘OD 15x1.5mm O-ring’ - Added ‘OD’ clarification to parts **‘S’** and **‘Y’** - Added additional instructions for the **crane_port_installation_tool**; trimming the tips of the thumb tacks so they fit better in the holes in the face of part **‘U’**
8/24/24	- Fixed typo on page 27 - Added additional instructions for the selector knob (**11**) installation to prevent from using the incorrect diameter o-ring
1/2/25	- Added blurb about files being free and plug for community mods on page 3