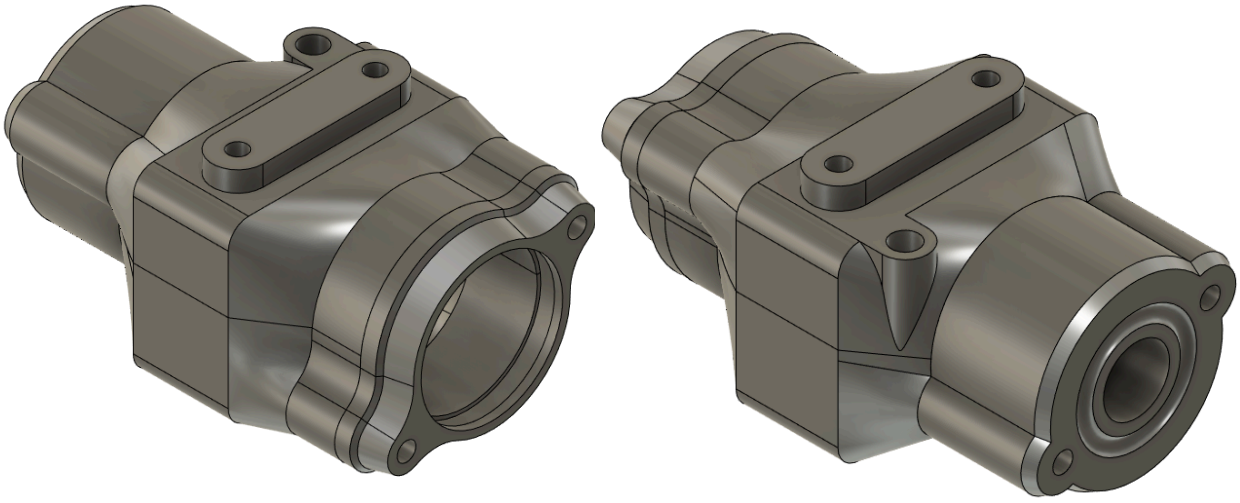
COX Cheap Universal Monocular - Page 5 Starts Instructions



A sub $150 digital viewfinder based IR monitor

I developed this night vision system based on the ideas set forth by both the BPNVG and PVS69. As such, this is not a unique idea, however, I expect that this system is the simplest available on the 3D printable model marketplace today. The reasoning behind 3D printed nods is purely cost driven, as even the simplest single tube system can cost in excess of $1800. The system shown in this readme offers performance that is perfectly acceptable for nighttime adventuring and hunting, although they are probably not useful in many operational circumstances where an opponent might also have a system capable of viewing IR signatures.

Starting in 2016 I would often hunt coyotes at night using scent and sound bait. Often this was for animal populus control around local farms in Appalachia. Those who live in and around Appalachia know that you cannot rely on moonlight due to the landscape and tree cover. As well as understanding the majority of shots you would be taking would be much less than 150 yards. Simple digital night vision is very useful in this range and often the first step into night vision that many of my friends would take. These would be systems like the Sionyx Aurora. Sionyx, although cheaper than an $1800 Wolf or AGM monocular, is still in the $450-$600

range; a huge step considering the comparative value that a new sight or gun could bring to daytime shooting.

I would often hunt in groups with some friends and often we would extend offers to others whom we shared social circles with. This caused an immediate response of, “but I don’t have night vision”. So much so that we pooled money in order to buy a used PVS14, to act as a loaner device and allow us to influence more people into night time adventuring. I decided at that time to develop a 3D printable night vision system that could be printed quickly and would offer comparable performance to other middle market digital night vision. I should also mention, I do not wish to disparage the PVS69 or the BPNVG, as they were a true inspiration for this project.

DISCLAIMER: I AM NOT RESPONSIBLE FOR WHAT YOU CHOOSE TO DO WITH THE INFORMATION INCLUDED IN THIS INSTRUCTIONAL GUIDE

Advantages	Disadvantages
Uses commonly available electronic components shared with FPV drones and CCTV equipment	Low resolution display makes positive identification of targets past 150 yards difficult
Four totally flat sides allows for a large amount of mounting options and reference surfaces	Requires IR illumination, creates a very large IR signature
A single viewer will fit entirely into the print envelope of 200x200mm	Automatic gain, while useful is not fast and will often overshoot its goal, leading to a blurry image up close
Designed to feature no high angle print areas, or vertically unsupported curves, allowing prints in materials like ASA or ABS	No automatic focus options at this time
Can be made entirely waterproof easily	Much higher power consumption than traditional image intensifier tube based equipment

Instructional Guide and Assembly

Purchased Parts Glossary:

- **6x M4 Nuts**
- **4x 1.5in M4 Bolts**
- **2x 0.5in M4 Bolts**

  https://www.amazon.com/gp/product/B08Z7GQVQ9/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1
- Electrical Tape/Heat Shrink
- Liquid Electrical Tape
- **1x 12v LiPo Battery**

  https://www.amazon.com/dp/B01M7Z9Z1N?ref=nb_sb_ss_w_as-reorder-t1_ypp_rep_k1_1_10&amp=&crid=1LCM98M9BHPUG&amp=&sprefix=talencell+
- **1x Foxeer Micro Night Cat 3 (ACCEPTABLE) or Runcam Night Eagle 3 (BEST)**

  https://www.amazon.com/RunCam-Night-Camera-1000TVL-Support/dp/B09JVG2D5W

  https://www.amazon.com/Camera-Foxeer-1200TVL-Starlight-Version/dp/B08YJM6BY2/ref=asc_df_B08YJM6BY2/?tag=hyprod-20&linkCode=df0&hvadid=532264129191&hvpos=&hvnetw=g&hvrand=18269617691742280319&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9015893&hvtargid=pla-1457765313588&psc=1
- **1x Eisco Labs Double Convex 38mm Lens**

  https://www.amazon.com/Eisco-Labs-Glass-Lenses-Diameter/dp/B01F9KXRX2/ref=asc_df_B01F9KXRX2/?tag=hyprod-20&linkCode=df0&hvadid=533569884196&hvpos=&hvnetw=g&hvrand=17421257220302603976&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9015893&hvtargid=pla-1433339617896&psc=1

- **1x NTSC/PAL 1.5” Display**

  https://www.adafruit.com/product/910?gclid=CjwKCAiAuaKfBhBtEiwAht6H73BhqQJnrVtZlSRwMnLciBqbX9lu-s3oQICrhE7PcoC5mKbb3_VwxRoCOs8QAvD_BwE

Printed Parts Glossary:

- 1x NVG Body Lower
- 1x NVG Body Upper
- 1x NVG Camera Retainer
- 1x NVG Display Holder
- 1x NVG Lens Ring Outer
- 1x NVG PCB Holder

The following print settings are for a medium quality, easily sealable print using PLA+ and a 0.4mm nozzle:

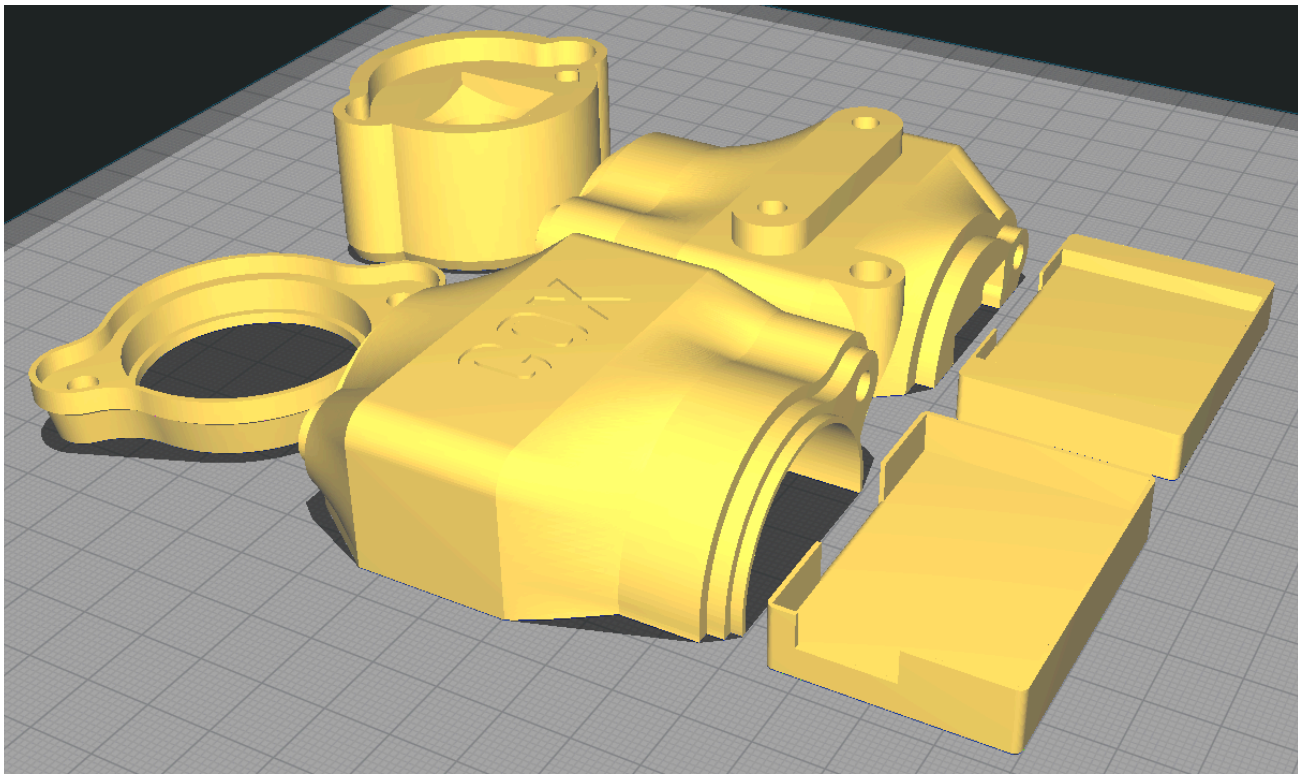
- 0.3mm Layer Height
- 0.4mm Layer Width
- 4 Walls, 3 Floors, 3 Roofs
- Lines Top and Bottom Pattern
- 40% Infill
- 220C Nozzle
- 70C Bed
- 82 Degree Overhang Angle
- Conical Support
- 20 Degree Conical Support Angle
- Support Z Gap 0.3mm
- Brim

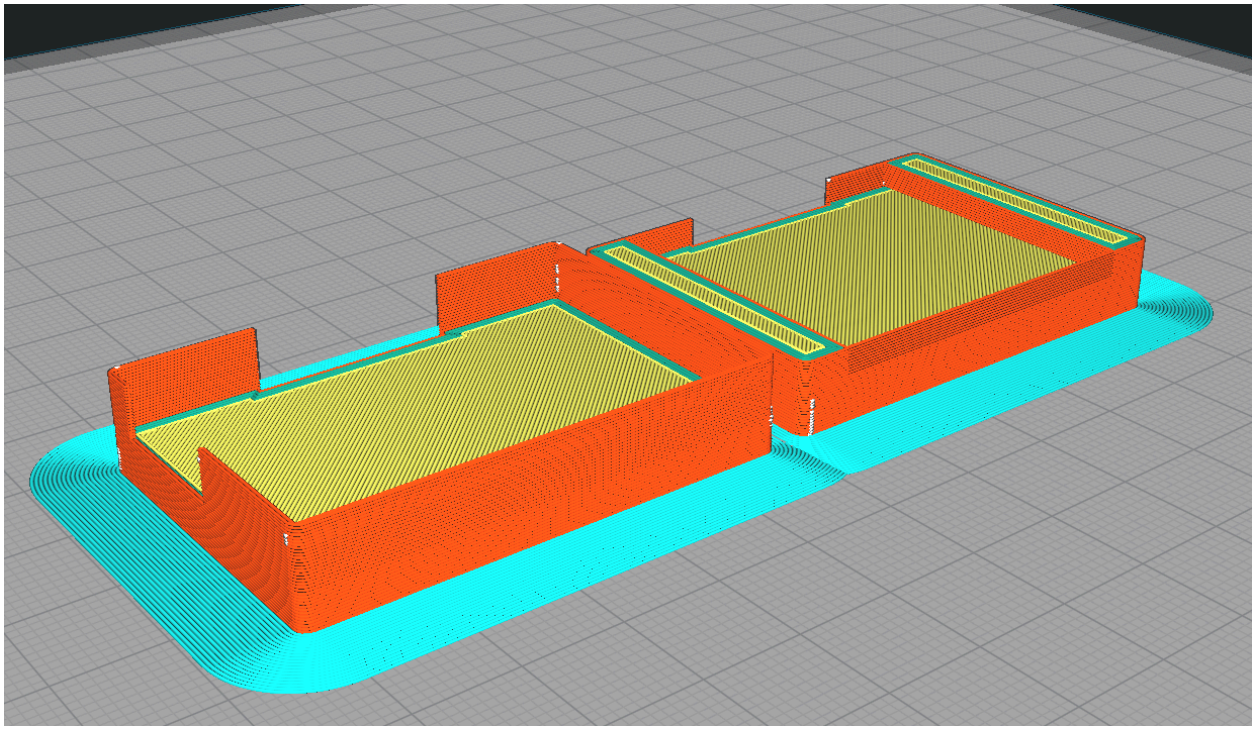
Instructional Guide

As an impatient person, I find it easiest to order the parts at the first inkling that I might begin to pursue a project. Then, in the worst case scenario I would find myself with a rainy day project to keep my attention whilst working on other things.

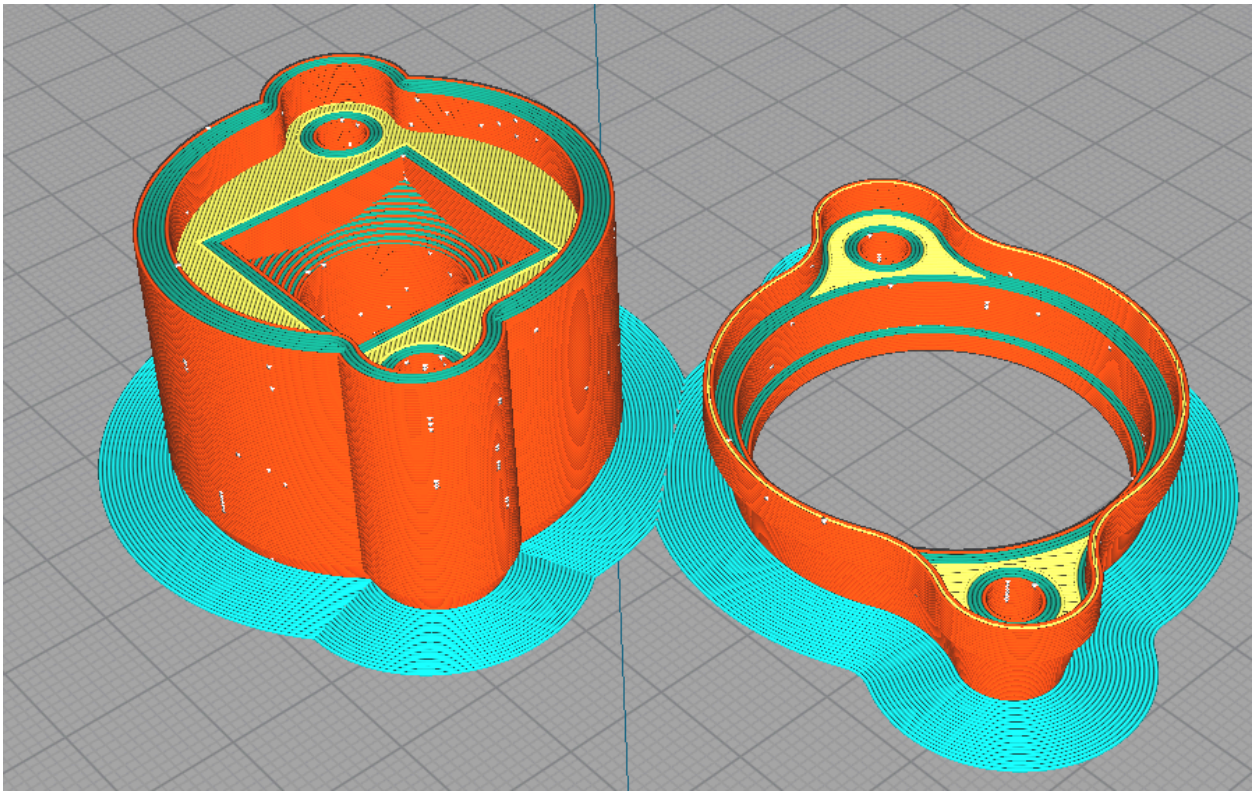
Step 1: Best Printing Practices

Before printing, ensuring that your printer is capable of producing mostly dimensionally accurate parts is quite important as the lens ring and camera holder are fairly close tolerance fitting parts. A single eye viewer will fit easily onto a 235x235 build space and should be placed in the orientation as shown below:

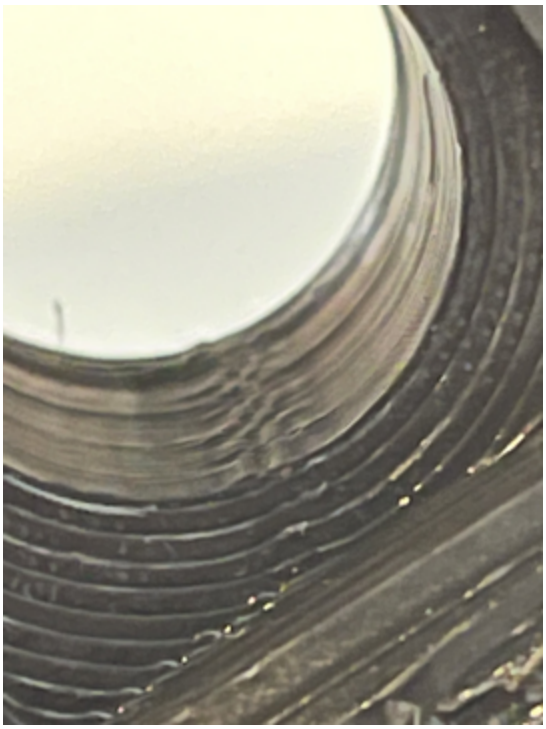


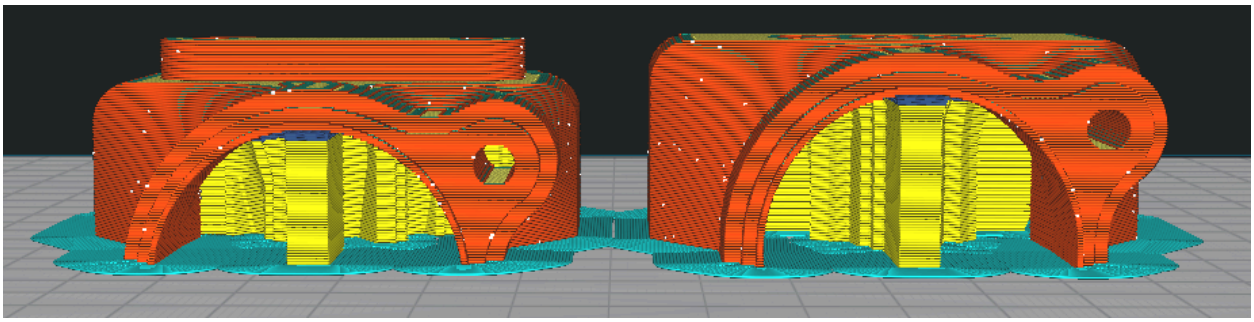


The rears of the PCB Holder and Display Holder will be glued together and once inside the housing things are a little snug. Ensure that there is no warpage on the back of the holders and that the thin walls around the perimeter are straight.



The Camera and Lens Retainers are very dimensionally sensitive and in order to reduce post processing work, you should ensure that your printer is producing dimensionally accurate parts. The lens retainer will be tight on the lens after printing, if you have trouble assembling it, heat the retainer slightly and cool the lens in a freezer before assembling. It should retain the lens without glue. **Make sure you set Z seam alignment to RANDOM for these two parts.** If not, this will happen and the camera will not fit.





Most importantly, make sure that the cavities that contain supports generate correctly using the conical support settings. This will give you clean cavities that will allow for easy support removal and will not obfuscate the installation of the nuts used for assembly. Additionally, ensure that you do not generate supports in the holes that the long assembly screws travel through.

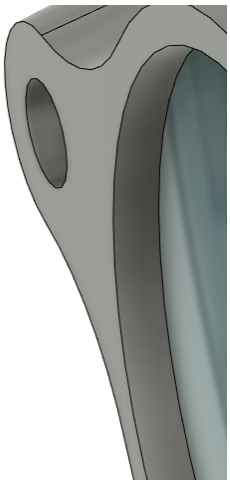
Step 2: Post Processing

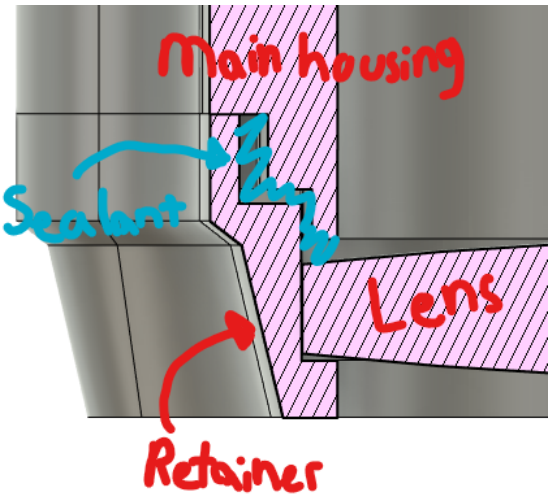
Assuming the parts are printed well, you should only need to trim the brims and break the supports off of the man body housings. You'll also want to check the sockets where the nuts

are to be installed in the main cavity. There should be six total M4 nuts in the center of the cavity, Four to tie all of the components together and two in the top housing to act as mounting points for attachment to common helmet drop arms. The bottom edges of the main housings also have four 1/8in holes in them for alignment pins, these are optional and only need be installed if you intend to seal the two halves together to achieve watertightness.

Step 3: Assembly

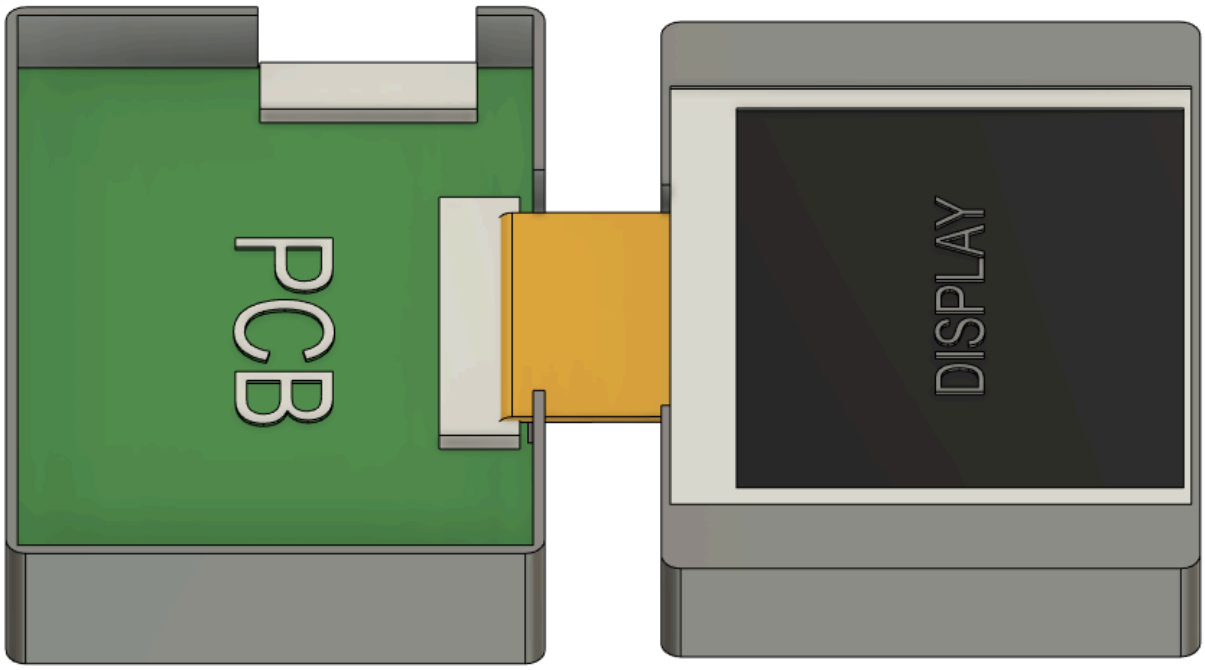
Let's get the easy stuff out of the way first. Place a clean, non-abrasive cloth on your workbench, keep your work on this so as not to scratch the lens. Take the objective lens out of the bubble wrap and place it into the lens housing, it should **NOT** just drop into the housing. Assuming it doesn't, take the lens back out, place it on the cloth on your workbench. Using a heat gun, evenly heat the lens retainer from the side that faces the operator when installed, **DO NOT HEAT THE LENS,** be very careful as the outer lip that mates it to the body housings is very thin and easily warped. After a very small amount of heat, attempt to fit the lens again, it should pop into place quite easily. Ensure that it is fully seated against the rear inside edge of the housing. Otherwise the lens retainer will not tighten up against the main body housings. Additionally, this is done to ensure that we have room to seal the lens to the housing later



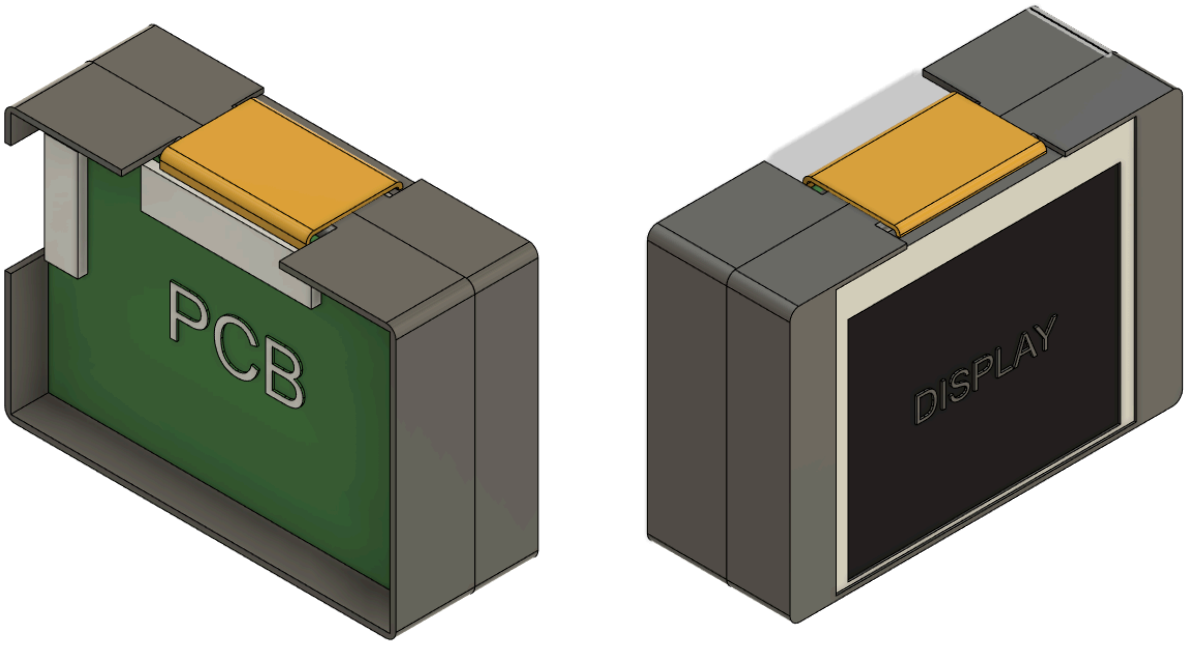


If your lens just drops in without any resistance: Your lens housing might be a little oversized, just hold it in with some super glue around the outer perimeter of the lens.

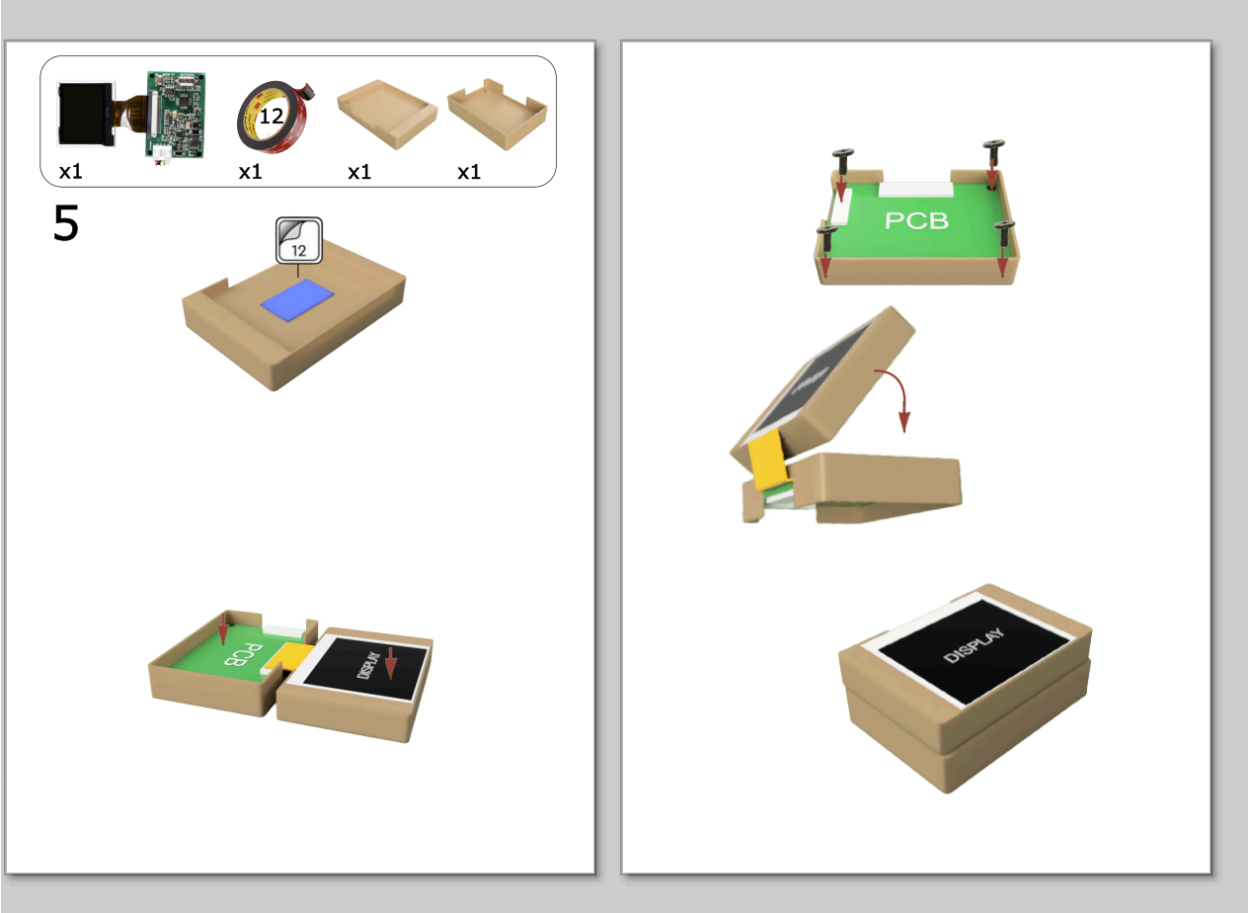
If your lens does not fit: Your print might be a little undersized, a few swipes with 220 grit sandpaper around the inside of the retainer should be enough to open it up.



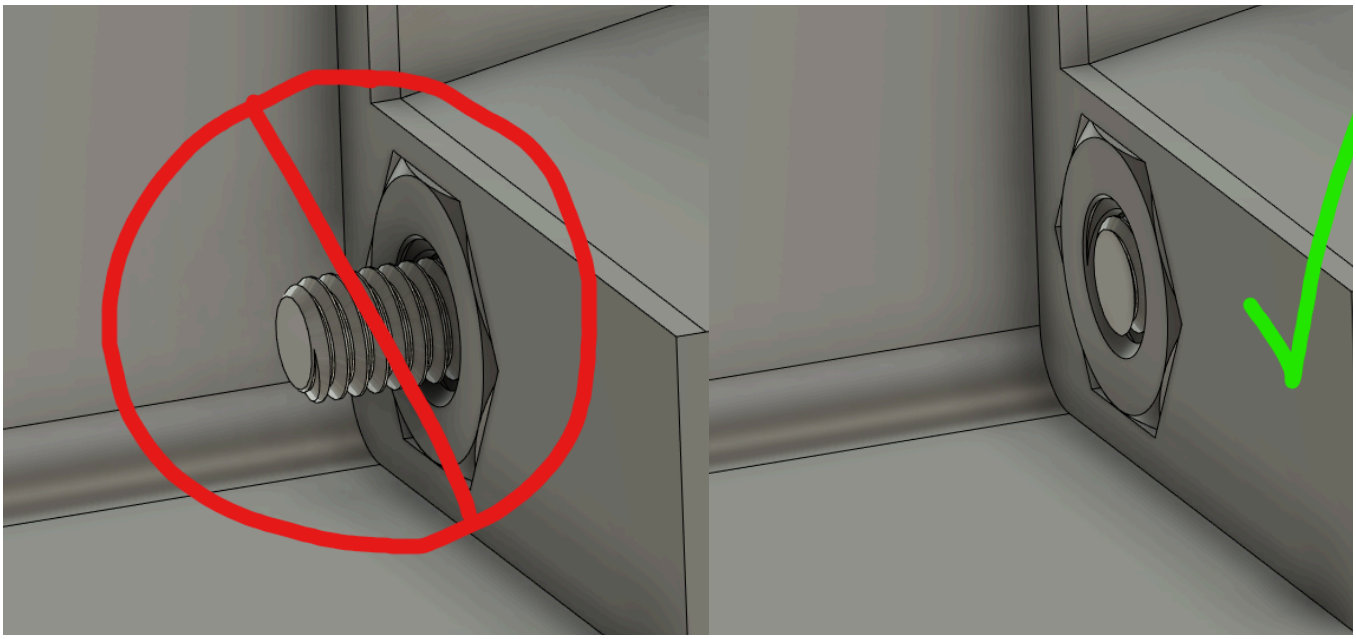
Then fold them in half, leaving the ribbon cable to exit through the gap on the tops of the display and PCB. Ensure they are oriented correctly and once folded, the cable should be flat across the two housings.



Alternatively they can be assembled using double sided tape and fitting screws into the driver board as shown below, this is much less permanent and allows for a bit of shrinkage and cushion for the display:



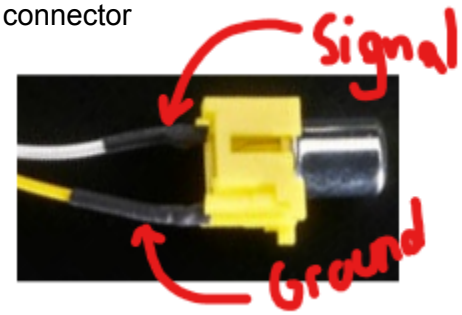
Now with the hard work out of the way, let's look at preparing the main housings. This project uses four very long M4 screws. The channels that the screws travel down must be clean in order to prevent binding; most printers will produce pretty straight holes, however, you can use a drill bit to clean these holes up. Additionally, make sure the pockets required for holding the nuts are clean and you can go ahead and install the nuts. Ensure your M4 bolts are trimmed to the correct length, if you don’t you'll end up shorting out the PCB or scratching the display. A good file and vise will make quick work of the bolts.



In addition to cutting the bolts down, it is in best practice to coat the faces of the nuts and bolts facing the internal cavity with liquid electrical tape. This ensures the electronics inside cannot short out against them even in the event that the housing is damaged. The end of the screws are within 100 thou of the face of the display but should have a minimum clearance of 90 thou.

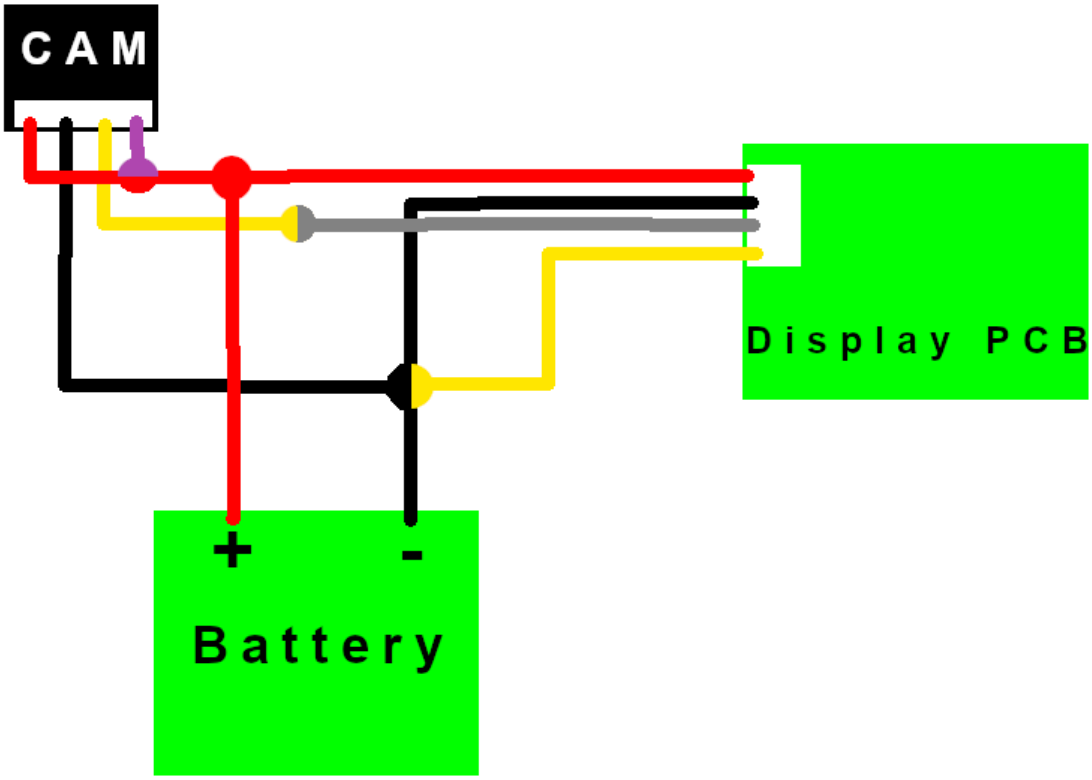
Step 4: Soldering Reference Guide (Not Applicable to All Drone Cameras Proceed With Caution)

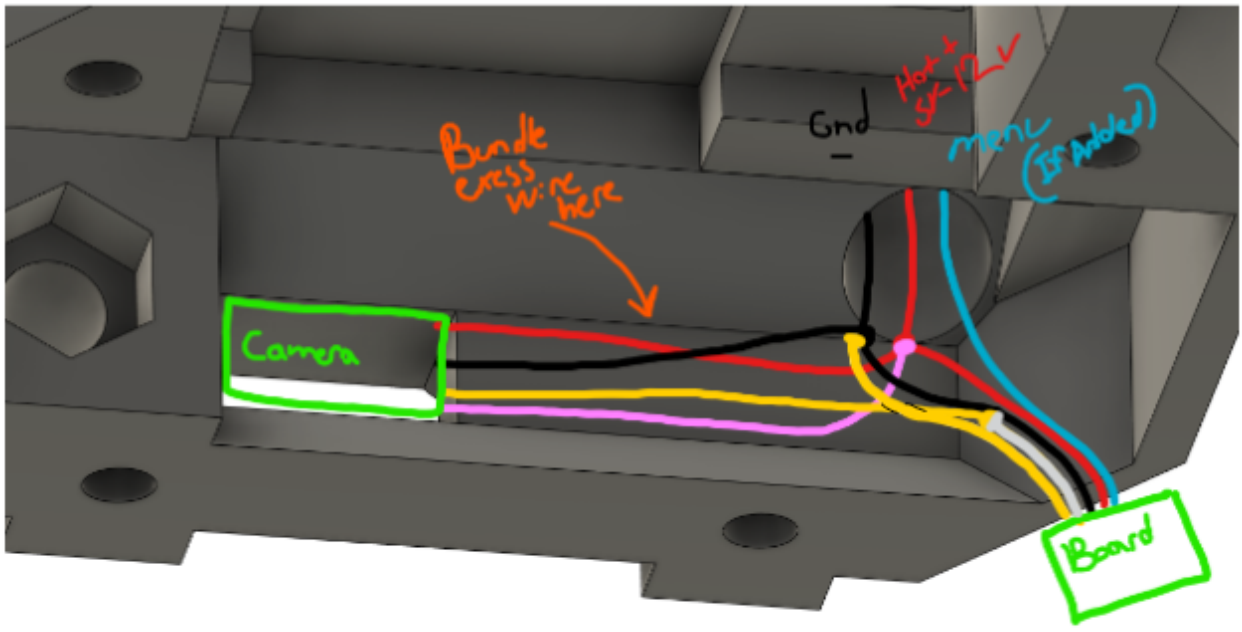
The wires are pretty small in terms of any soldering that you may have done prior and in my experience the insulation is easily damaged outside of the area where the soldering connection is being made. Be aware that there are two primary wiring schemes for these displays and during testing we determined that sometimes the yellow and white wires may be swapped. Understand that the video connector included with the screen has two connections, with the central connection being the video signal and the outer being the ground. Make note of the orientation of these wires before cutting the connector. The wiring diagrams below show the gray as the signal connector



General Rules:

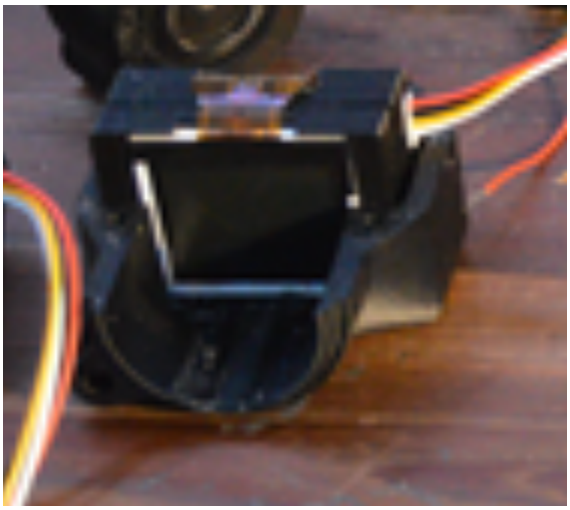
- Black and yellow (from the display board) wires are connected, this provides ground for the circuit. Additionally, this tells the controller for the display that it has an open signal.
- Red and pink wires are connected, this provides power for the circuit and informs the camera of the voltage it is operated on.
- Lastly, the yellow wire coming from the video camera and the gray from the display controller should be connected. This is the data connection that provides the incoming video.
- Insulate the solder connections with heat shrink or electrical tape

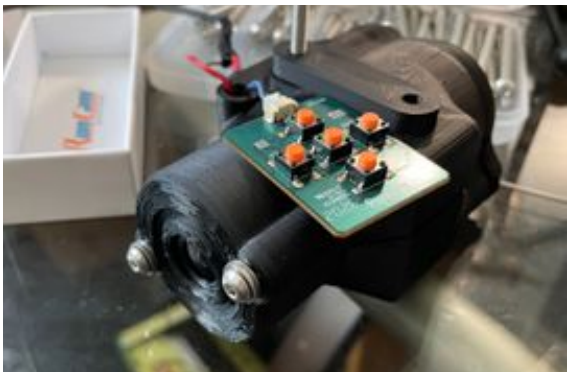

CAM
Display PCB
+
-
Battery


Bundle cross wire here
Gnd
Camera
Board

Step 5: Final Assembly and Preparations

Place the display and driver boards in the upper housing, then, add their pigtails onto the board placing them in the lower housing. Place the camera in the front of the upper housing and run its wires through the rectangular hole as shown in the picture from the last chapter. As far as the wires are concerned, you'll want to ensure the wires are tucked into the front of the cavity behind the camera. This is the cavity in the upper housing behind the camera, this is the favored layout for the wires in the front of the display. After tucking the wires, placing the RED, BLACK, and MENU wires through the hole in the upper housing, hot glue the wires in place in the hole. The menu wires should allow enough length that the pigtail can still be connected to the menu board. **DO NOT PAIR UP THE MENU WIRES FROM TWO DIFFERENT CAMERAS**





Typical Assembly Order:

- PCB into holder
- Display into holder
- Stick holders together
- PCB, display, and holders into bottom housing
- Camera in front of bottom housing
- Camera wires into hole on top housing
- Make final wiring connections if required

- Top housing placed over PCB, display, and holders, bundling the wires in front
- Place external leads out the hole in the top housing and glue them in place
- Add front camera retainer and lens retainer, being placed over the lips of the top and bottom housing
- Place screws into housings and snug them up, add sealant just before this if you intend to make them water tight.

Special Modifications, such as additional illumination mounts, rifle mounts, and 30mm mounts can be found in the included file sets.

Step 6: Contributors

I'd like to thank everyone that took part in the Det Disp Beta, the collective development brought to the project is far more than I could have done on my own. A special thank you to Kenny, Sparquah, RubyGB, Swarm Tech, Hoffman, Dr. Death and Zona

The following are the contributors of the beta, names redacted at user request: