Streaming Video Payload Setup

Includes instructions on computer downloads and configuration

BE AWARE: ESD Sensitive Components!

- ESD – Electrostatic discharge

Electrostatic discharge (ESD) is the sudden flow of electricity between two electrically charged objects caused by contact, an electrical short, or dielectric breakdown. A buildup of static electricity can be caused by tribocharging or by electrostatic induction. The ESD occurs when differently-charged objects are brought close together or when the dielectric between them breaks down, often creating a visible spark.

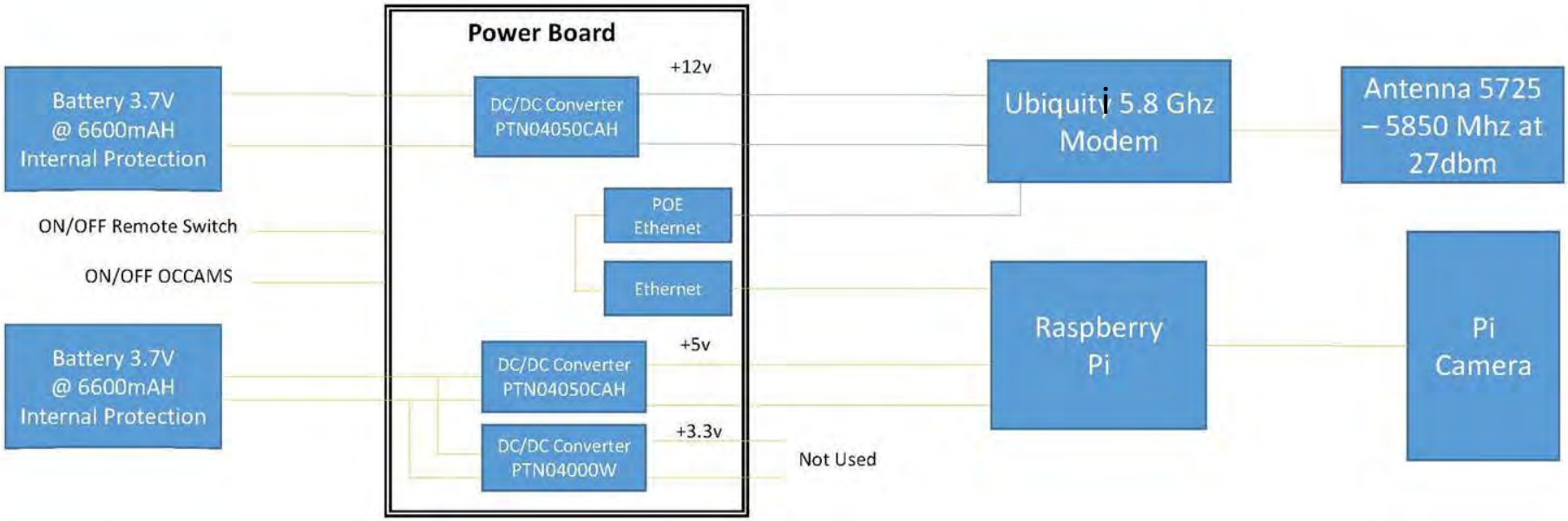
ESD can cause a range of harmful effects of importance in industry, including gas, fuel vapour and coal dust explosions, as well as failure of solid state electronics components such as integrated circuits. These can suffer permanent damage when subjected to high voltages. Electronics manufacturers therefore establish electrostatic protective areas free of static, using measures to prevent charging, such as avoiding highly charging materials and measures to remove static such as grounding human workers, providing antistatic devices, and controlling humidity.

- Use grounding straps when handling/touching components such as the Pi, RFD 900+ modems, modems, power boards, etc. and place them on the ESD rubber mat when not in use.

Overview:

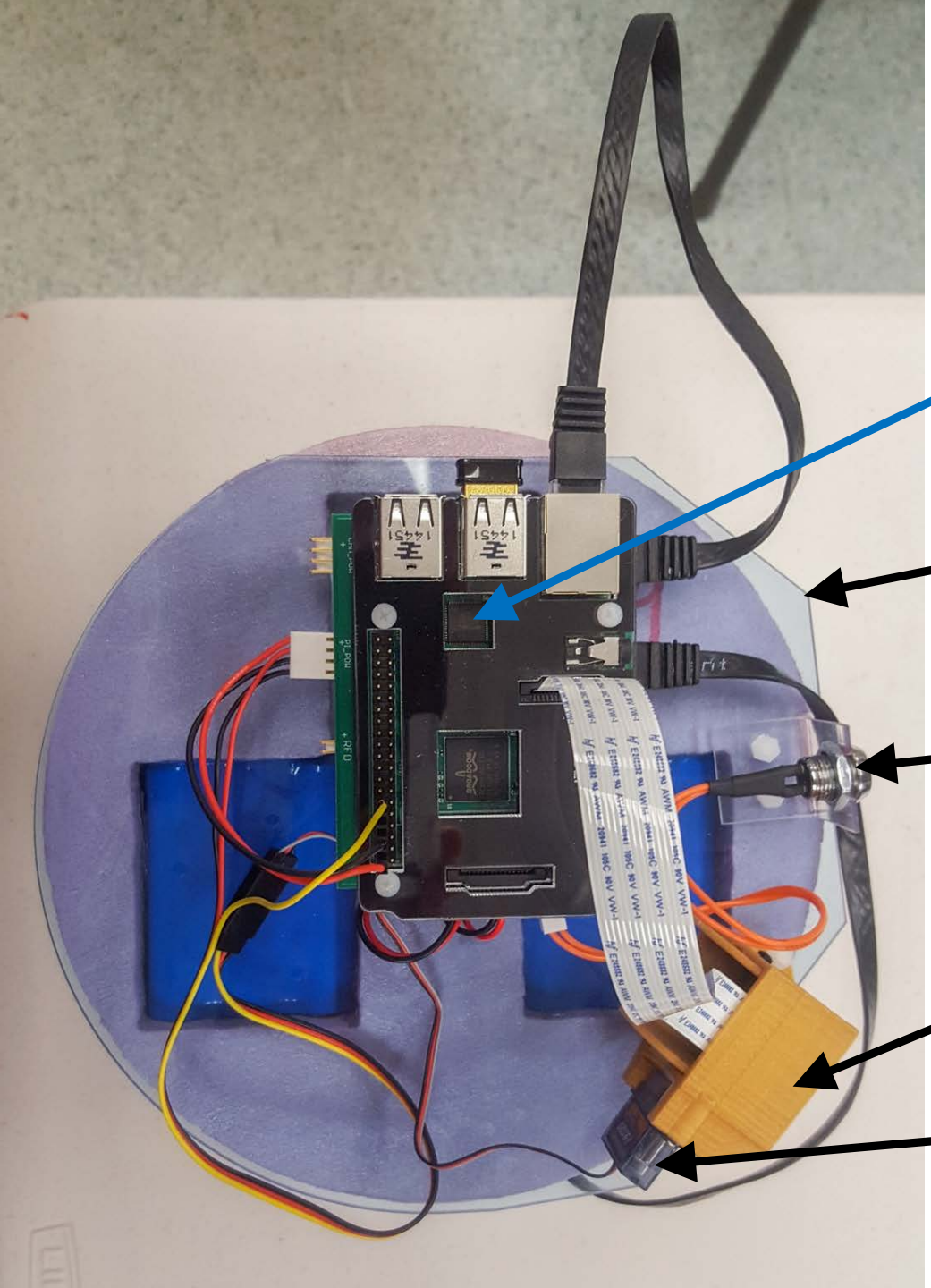
- The Streaming Video Payload System will:
  - Capture (not record) video during the balloon flight
  - Process video for transmission
  - Transmit video to the ground station continuously through the flight
- Set Local Area Network to Static IP – example using Windows 7
- Connecting and powering video payload and ground station radio
- Using PuTTY to connect ground station computer to video payload
- Streaming video via VLC video player

Functional Block Diagram:



Basic Primary Payload Video Streaming Block Diagram Rev 2 (11-19-15)

Completed Video System:



Pi/Power Board Stack

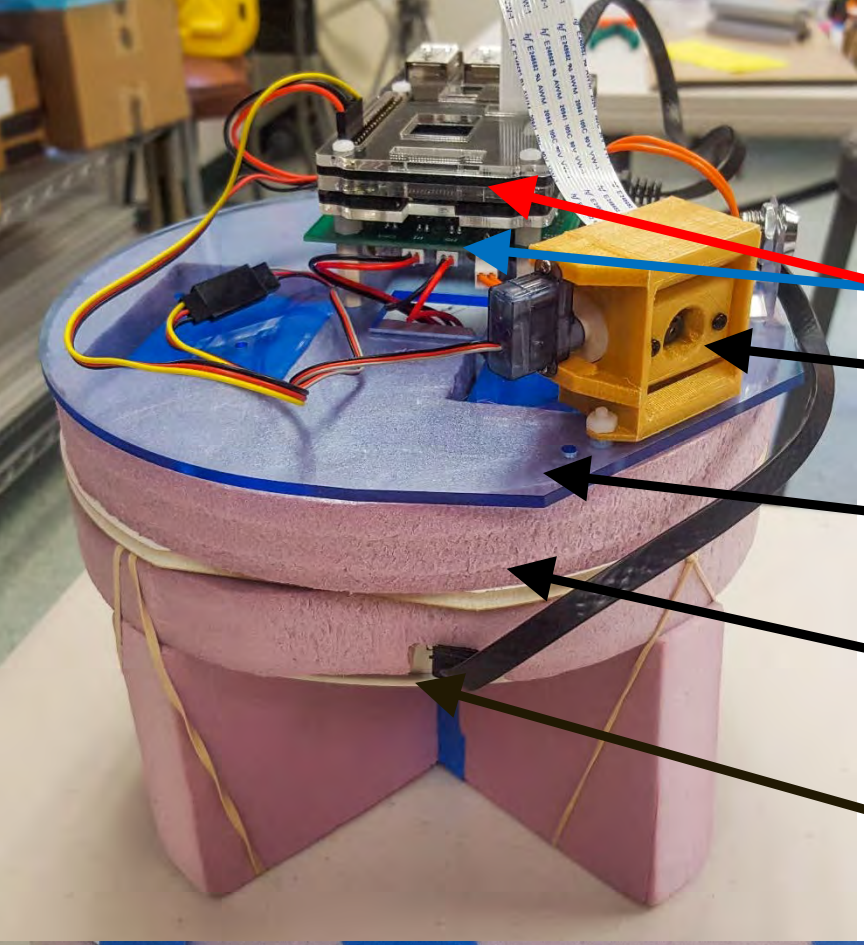
Acrylic Base Plate with 3.7V batteries and battery enclosure below

On/Off Key Switch

Pi Video Camera in 3D Printed Camera Housing

Vertical Camera Movement Motor

Completed Video System:



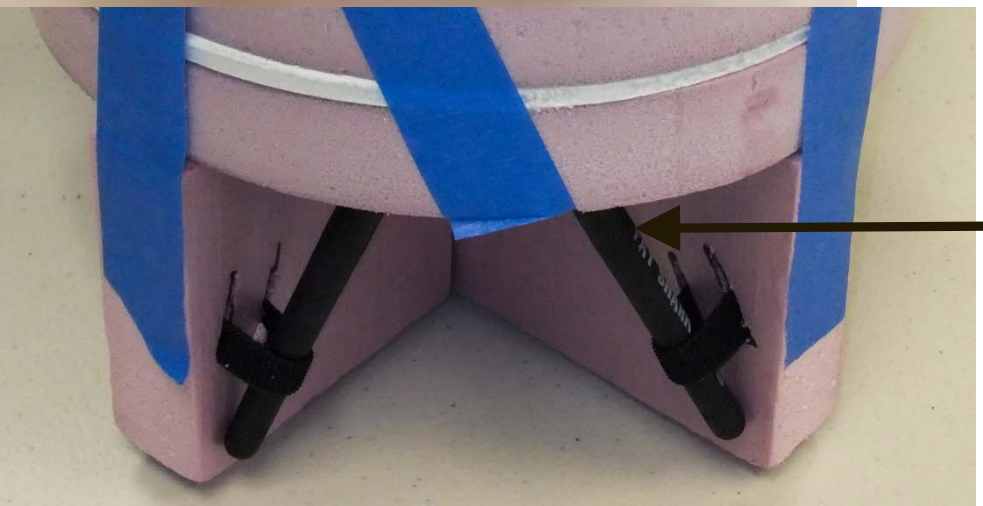
Power Board and **Pi**

Pi Video Camera in 3D Printed Camera Housing

Acrylic Base Plate
Power Board

Batteries and Battery Enclosure

M5 Modem



M5 Modem (Hidden) and Fat Shark Antennas

Video Payload Part Inventory Part 1

3.7V Lithium Batteries (x2) – F1

8 inch Pi Camera Ribbon Cable – F2

Flat Ethernet Cables (x2) – F3

Pi Video Camera – F7

Fat Shark Antennas (x4) – F11

Raspberry Pi – F4

Pi Wi-Fi USB Adapter – F5

Pi Case – F6

64GByte Memory Card – F8

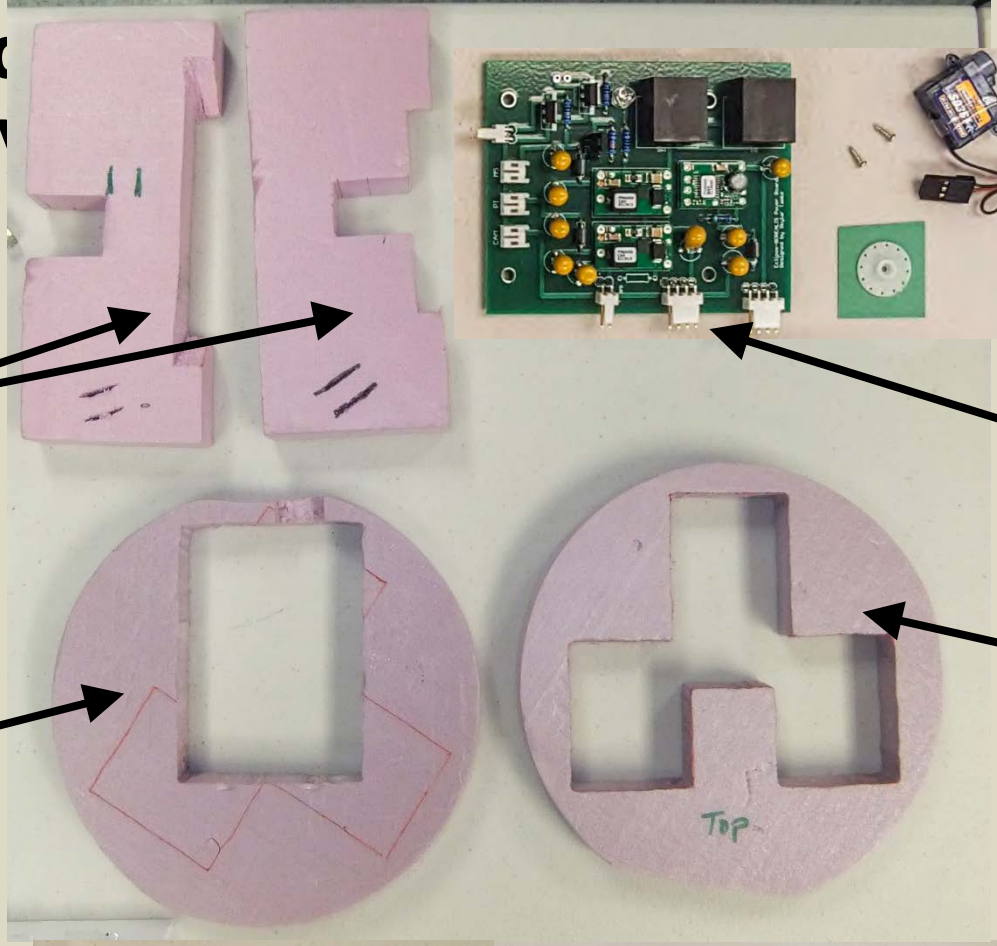
UBIQUITI M5 Modem (Air side) – F9

Fat Shark Antenna connectors (x4) – F10

Velcro (Tool Kit) – F22

Pi Camera 3D Printed Housing – F26

Video Payload Part Inventory Part 2



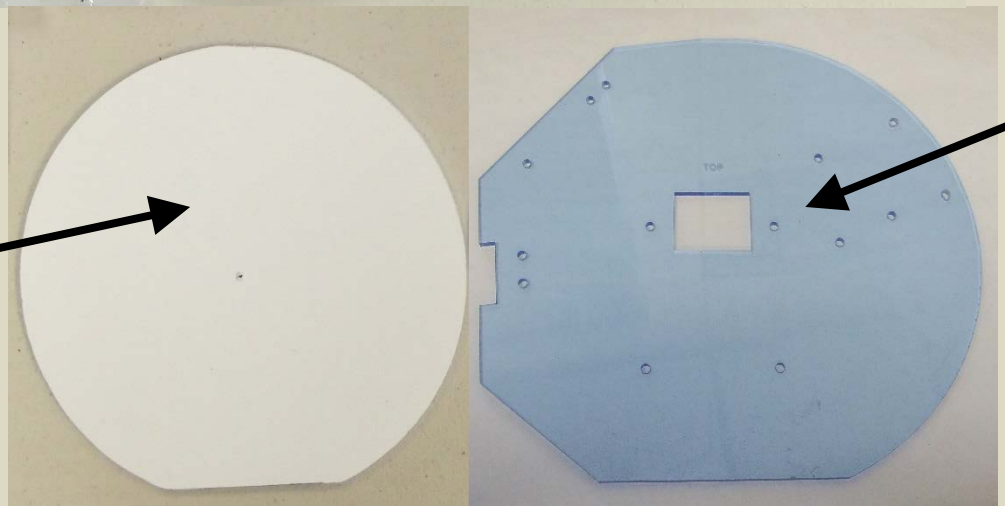
Pi Camera Vertical Tilt servo and hardware – F13

UBIQUITI Foam Base – F19

Power Board – F14

Battery Housing – F18

UBIQUITI Foam Housing – F20



Acrylic Base Plate – F23

Foam Core Battery Plate – F18

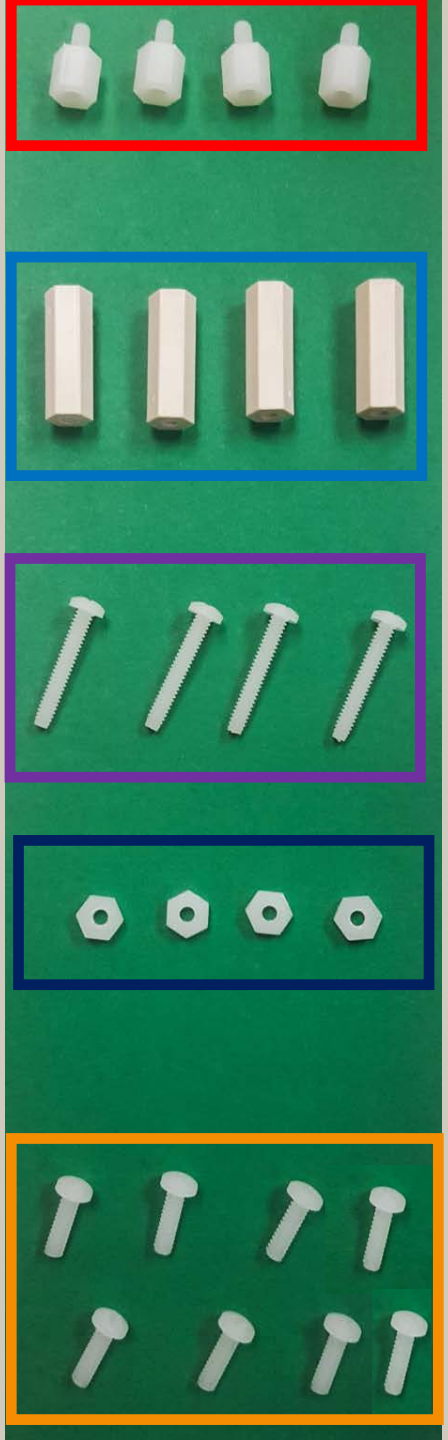
Video Payload Part Inventory Part 3

Rubber Bands (Took Kit)

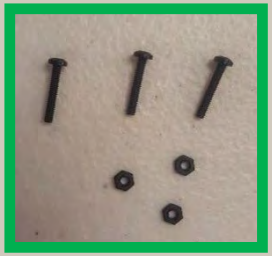
Pi Cable – F12

Key and On/Off Key Switch – F32

Key Switch Mounting Bracket – F24

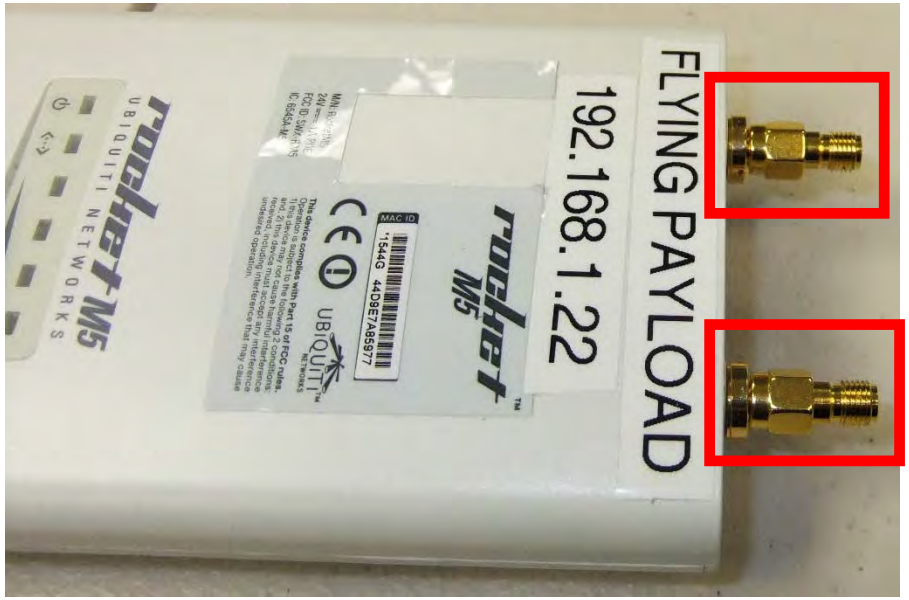


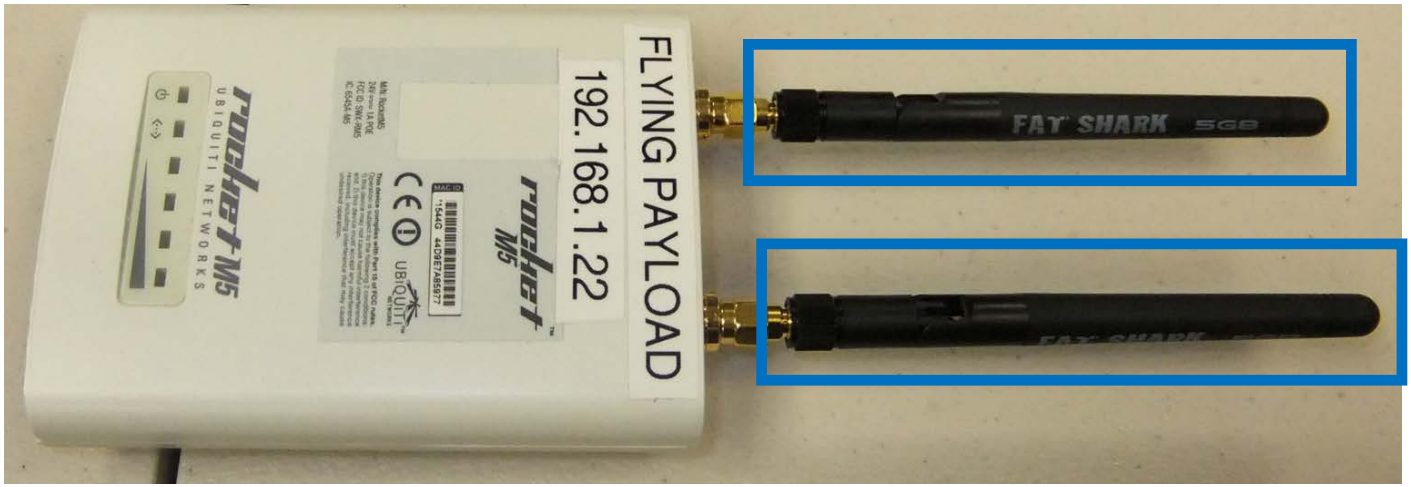
- F15 – 4-40 Nylon hex standoff 1/4 in. (x4)
- F16 – Nylon hex standoff 3/4 in. (x4)
- F17 – 4-40 Nylon screw 3/4 inch (x4)
- F21 – Nylon Screw 3/8 inch (x8)
- F25 – 4-40 Nylon Nut
- F27 & F28 – Camera mount pan head screw and nut (x3)
- F29 – Pan head self tapping screw motor mount
- F – Camera Mount Washer (METAL!)



The Video Payload Base: UBIQUITI M5 Modem and Battery Housing

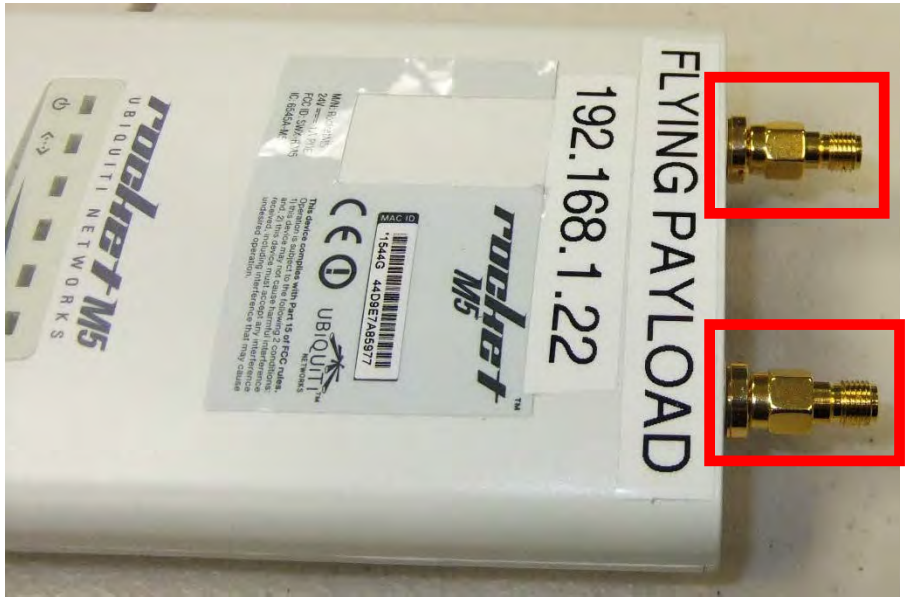
Begin by taking the air side UBIQUITI M5 Modem – F9 (it has the base cut off to make it more compact) and screwing on the **Fat Shark Antenna connectors (F10)**. Then screw on the **Fat Shark Antennas (F11)**.

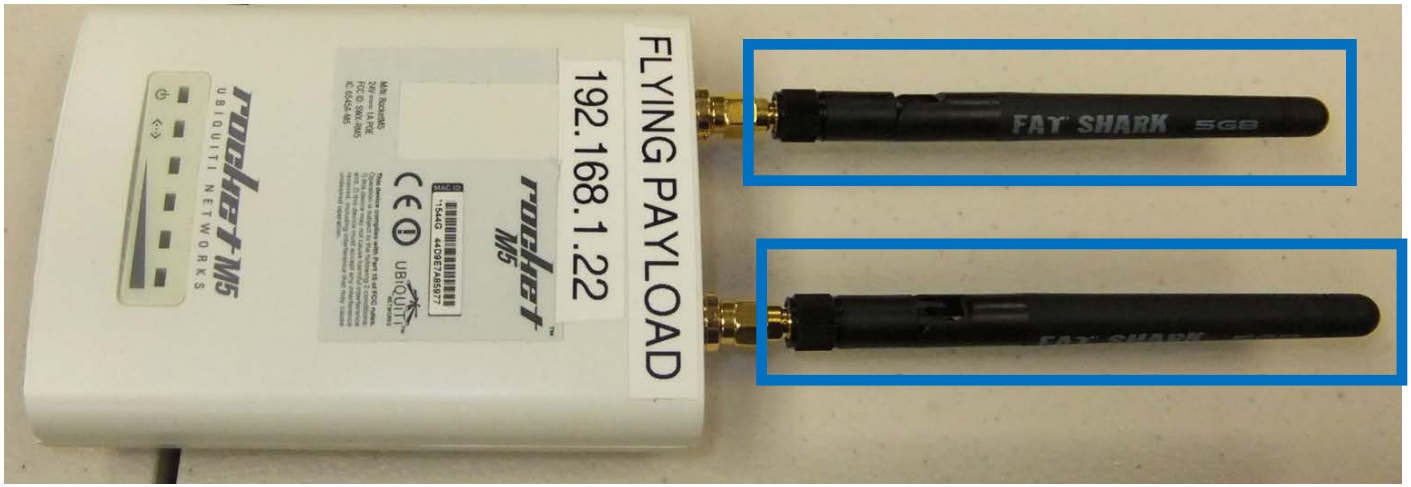




The Video Payload Base: UBIQUITI M5 Modem and Battery Housing

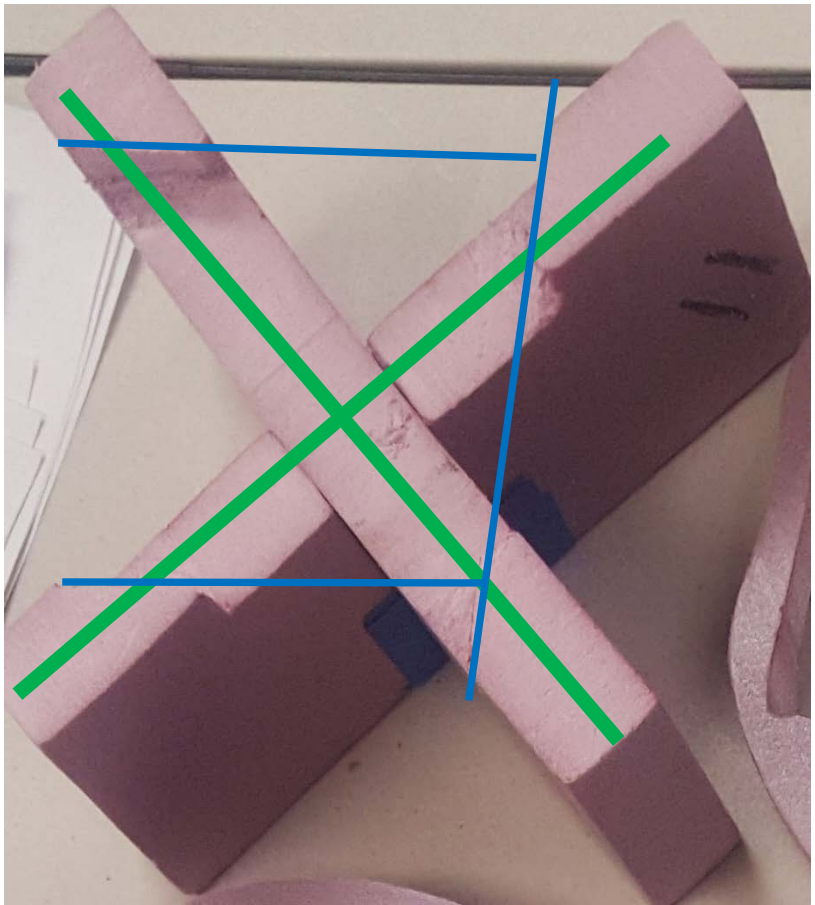
NOTE: You have two additional Fat Shark Antenna connectors (F10) and **Fat Shark Antennas (F11) for testing purposes**.





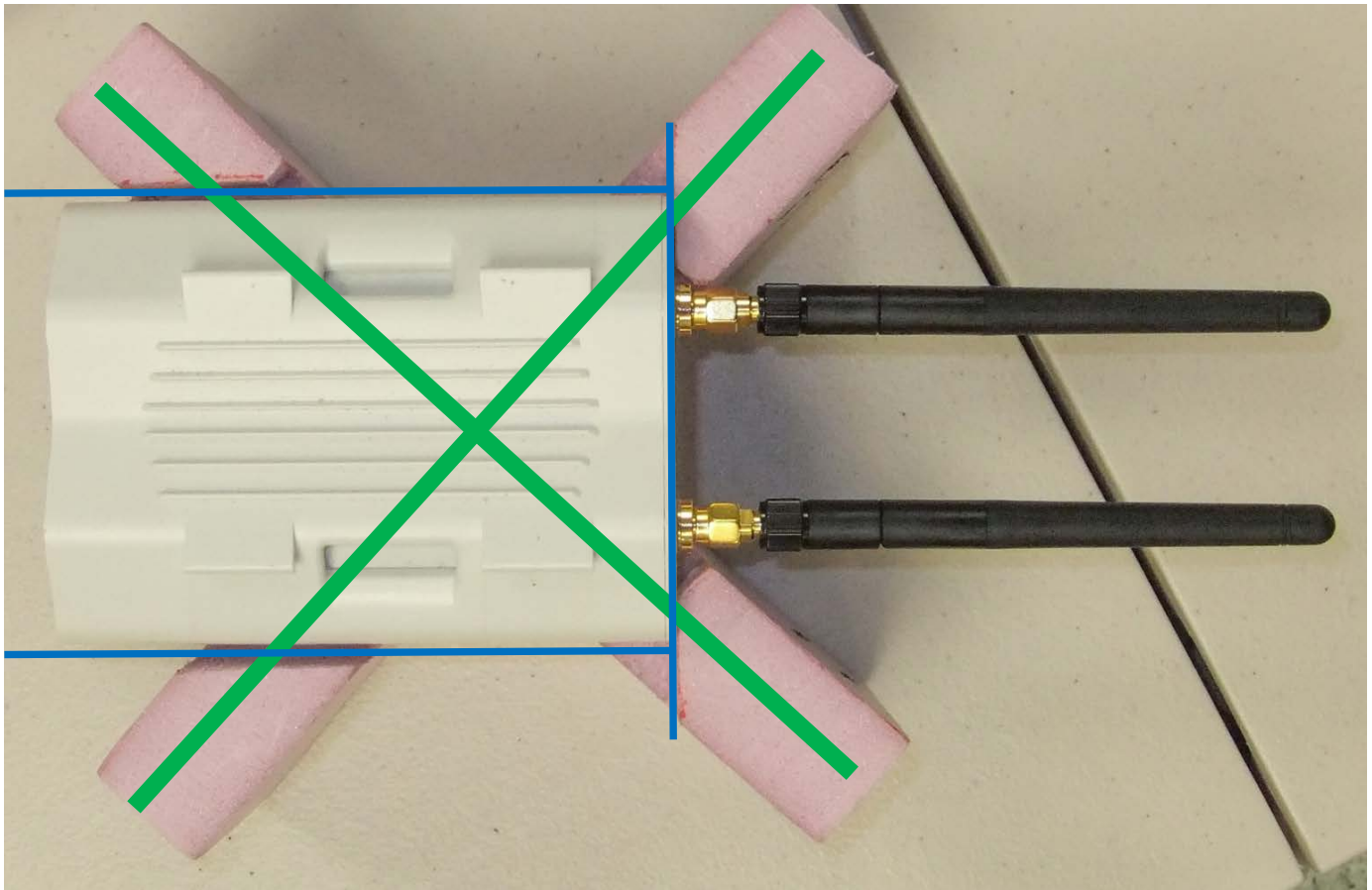
The Video Payload Base: UBIQUITI M5 Modem

Using the two UBIQUITI Foam Base pieces (F19) lace them together so they form an "**X**" such that you have **three straight "lines"** which the UBIQUITI M5 modem can be placed "face down" within the cutout.



The Video Payload Base: UBIQUITI M5 Modem

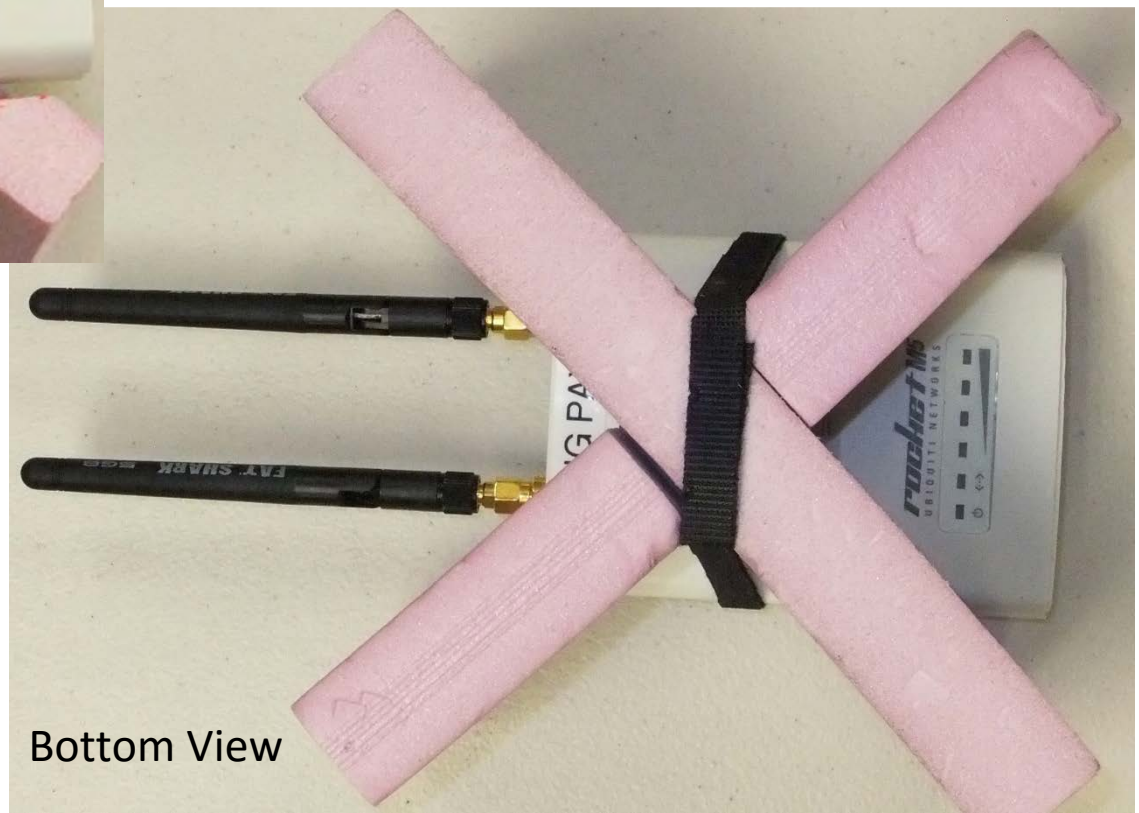
Place the UBIQUITI modem (F9) into the foam base (F19) as shown below.



The Video Payload Base: Securing the UBIQUITI M5 Modem to the Foam Base

Top View

To secure the M5 modem, lace a ~3/8 inch wide strip of Velcro (you will need to cut the length/width correctly) located in your tool kit which will need to be cut to width and length) through the back of the UBIQUITI M5 modem and then secure it on the bottom of the foam base as shown.

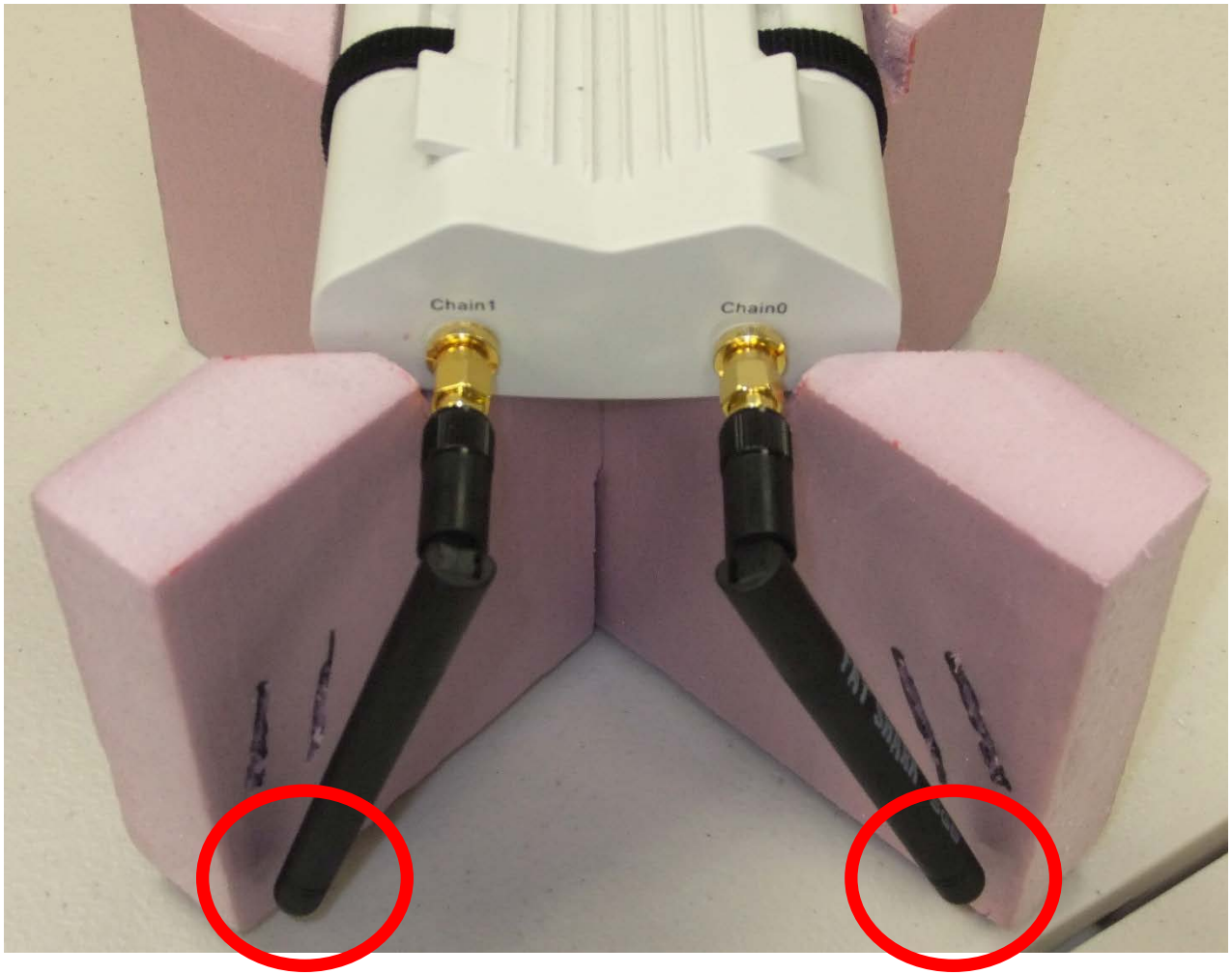


Bottom View

USE YOUR DOUBLE SIDED VELCRO SPARINGLY! YOU WILL NEED IT THROUGHOUT THE WORKSHOP!

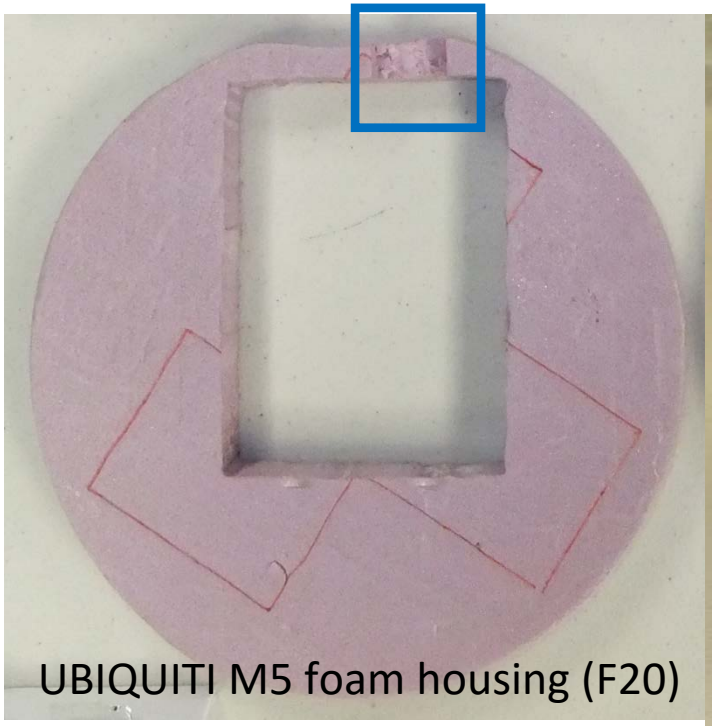
The Video Payload Base: Fat Shark Antennas

Bend/rotate the Fat Shark Antennas so they face downward and gently rest against the foam base **here**.

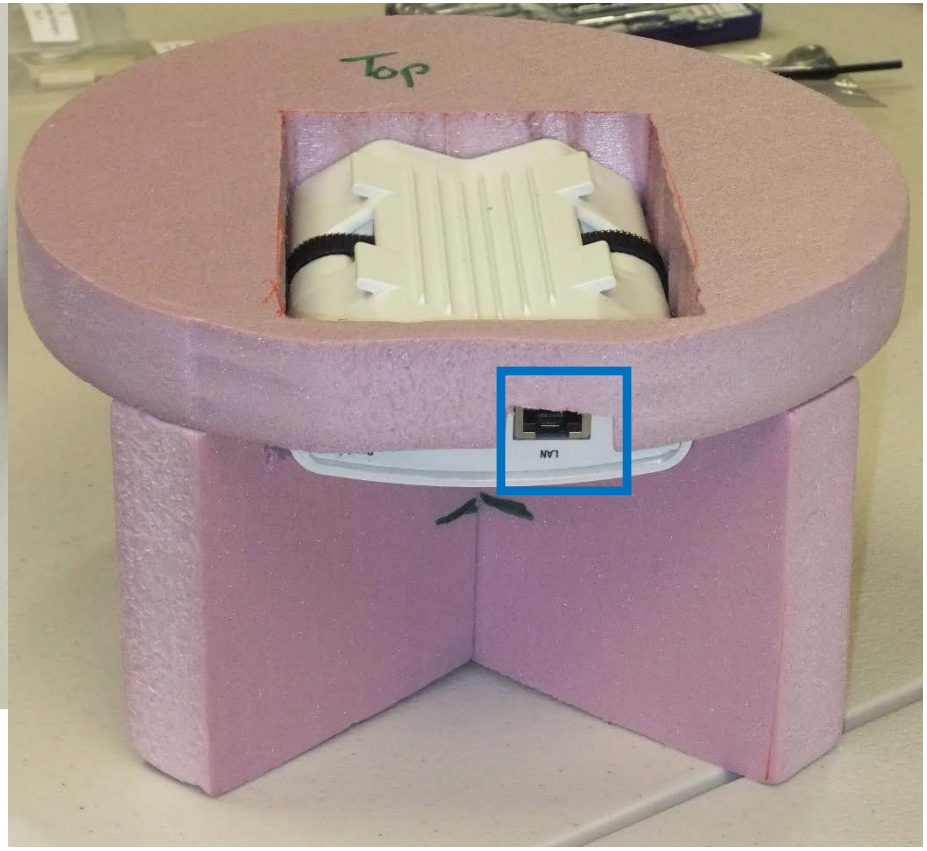


The Video Payload Base: UBIQUITI M5 Modem Foam Housing

Take the UBIQUITI M5 foam housing (F20) and place it on top of the M5 modem and the M5 modem base. Orient it so that the **notch in the foam housing** allows easy access to the Ethernet port on the M5 Modem.



UBIQUITI M5 foam housing (F20)



The Video Payload Base: Securing M5 modem Housing and the Fat Shark Antennas to the Foam Base

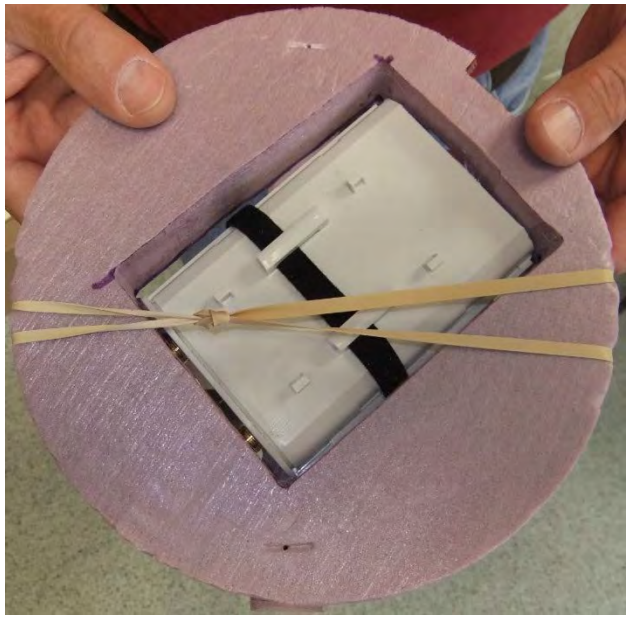
We will share two ways to secure the Fat Shark Antennas and foam base. One will be a easy for us to accomplish during this workshop, the other is one that you can do when you get home should you wish to do so.

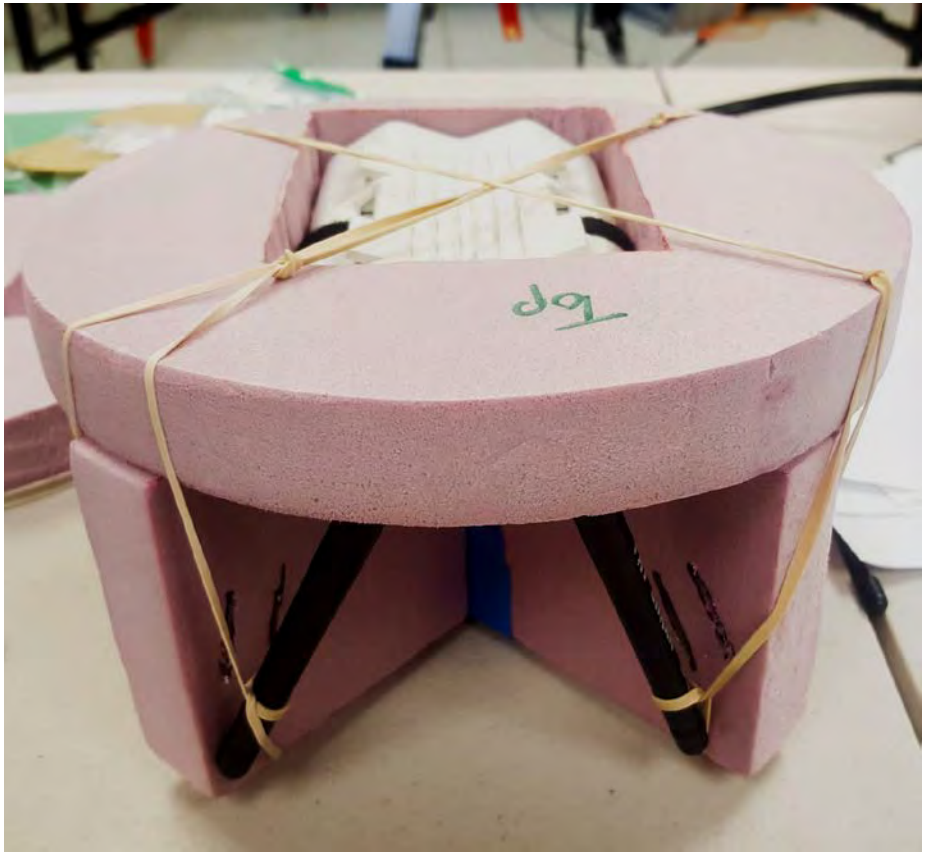
The Video Payload Base: Securing M5 modem Housing and the Fat Shark Antennas to the Foam Base

Workshop Way:
1) Take two (or three) rubber bands and loop them together to make one long rubber band:

2) Run this loop over the top of the foam M5 modem housing and latch onto two opposing legs of the foam base.

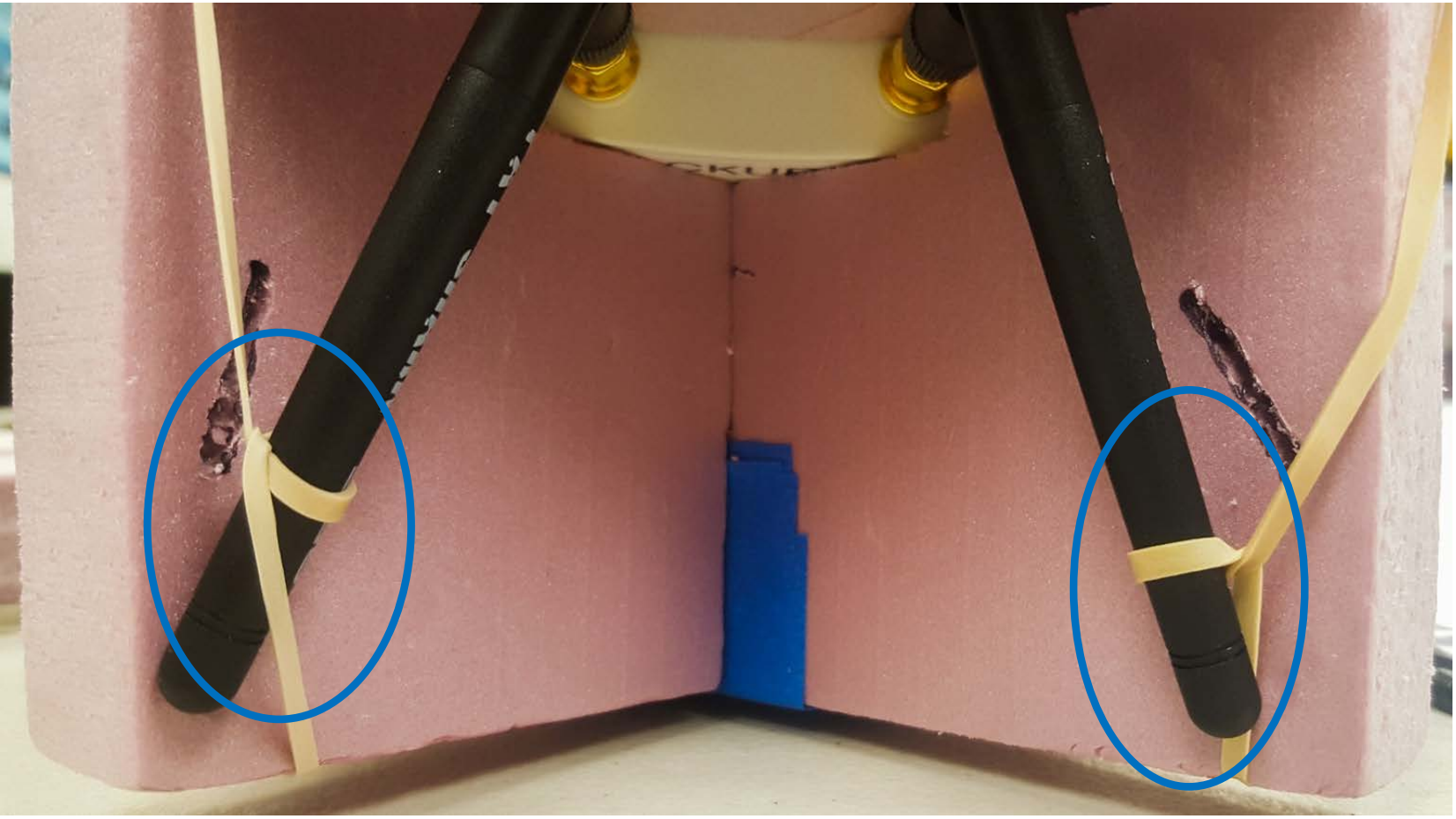
The Video Payload Base: Securing M5 modem Housing and the Fat Shark Antennas to the Foam Base





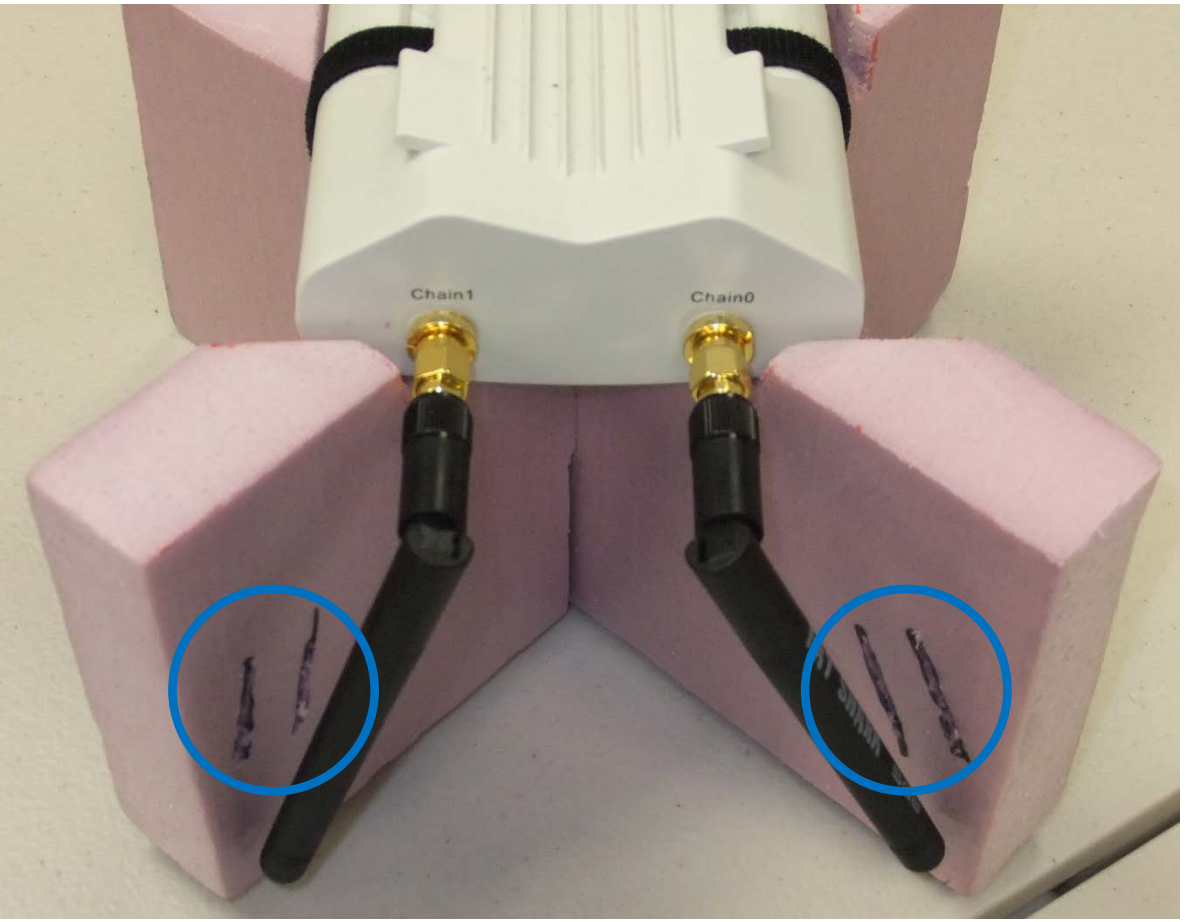
3) Run one more loop over the top of the foam M5 modem housing and latch onto two other opposing legs of the foam base.

The Video Payload Base: Securing M5 modem Housing and the Fat Shark Antennas to the Foam Base



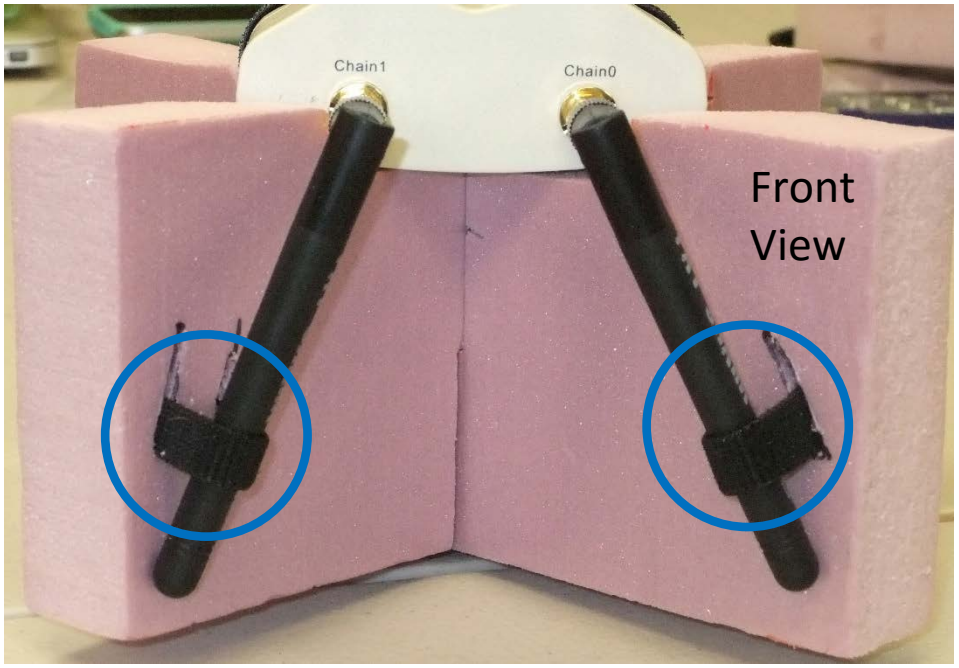
To secure the Fat Shark Antennas, **loop the rubber band around the end of the antenna**.

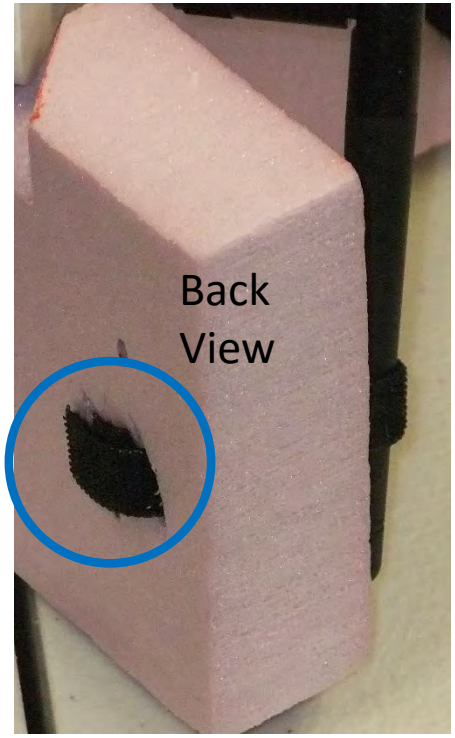
The Video Payload Base: Securing M5 modem Housing and the Fat Shark Antennas to the Foam Base



The Home Way: Should you be interested in another way to secure the Fat Shark Antennas, cut two slots behind the end of the antennas just wide enough for a strip of Velcro to fit through.

The Video Payload Base: Securing M5 modem Housing and the Fat Shark Antennas to the Foam Base

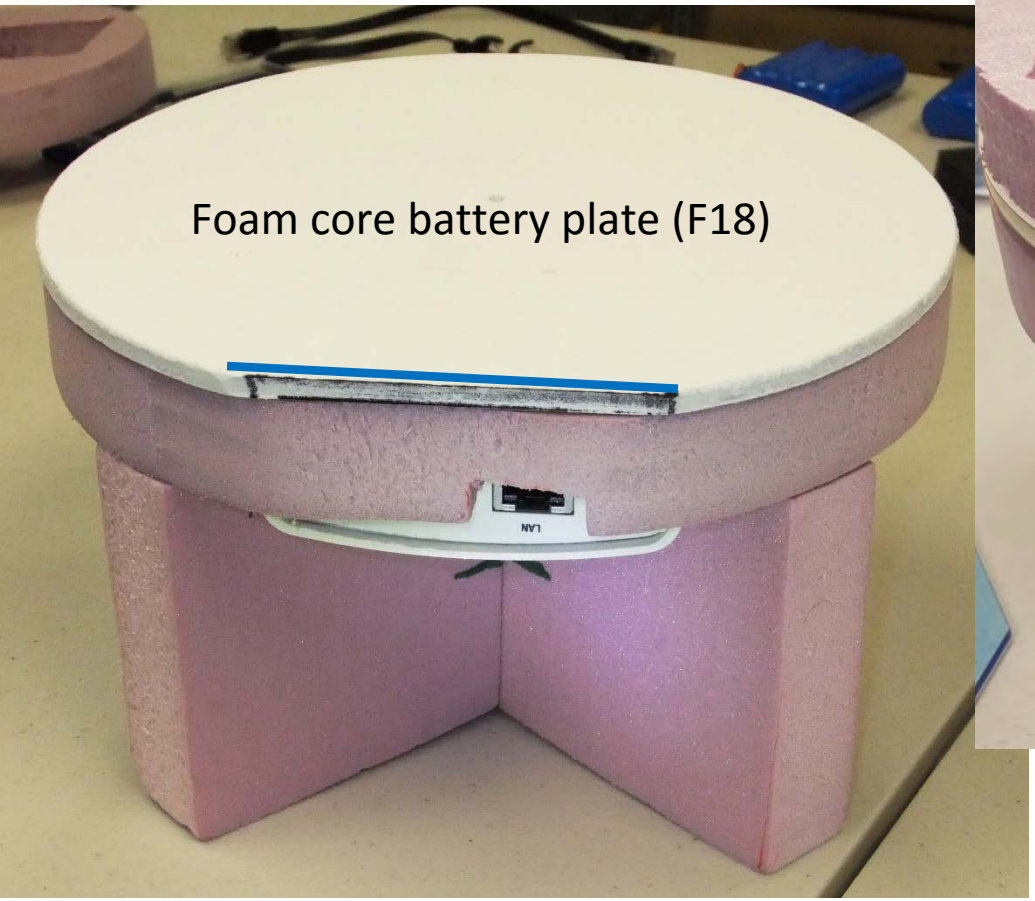


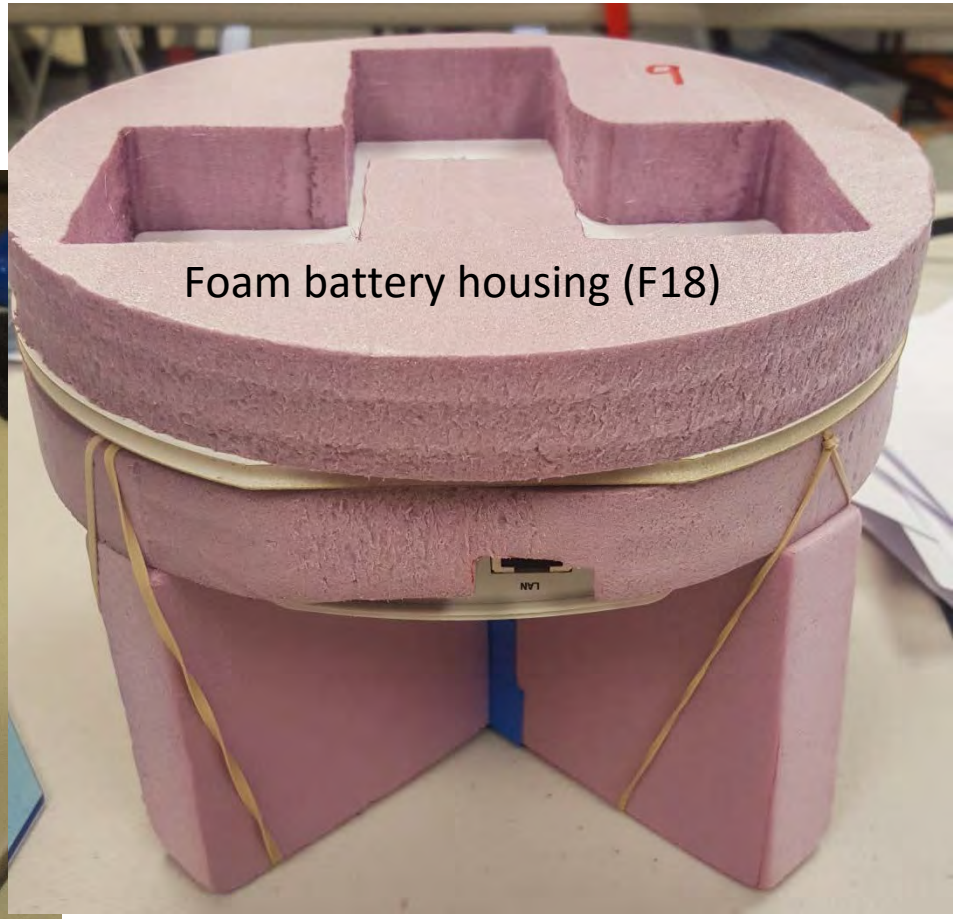


The Home Way: **Secure the antennas using a ~3 inch long ~2/8 inch wide strip of Velcro**.

Video Payload Battery housing

Place the foam core battery plate (F18) on top of the UBIQUITI M5 foam housing. Note alignment by the **cut edge**



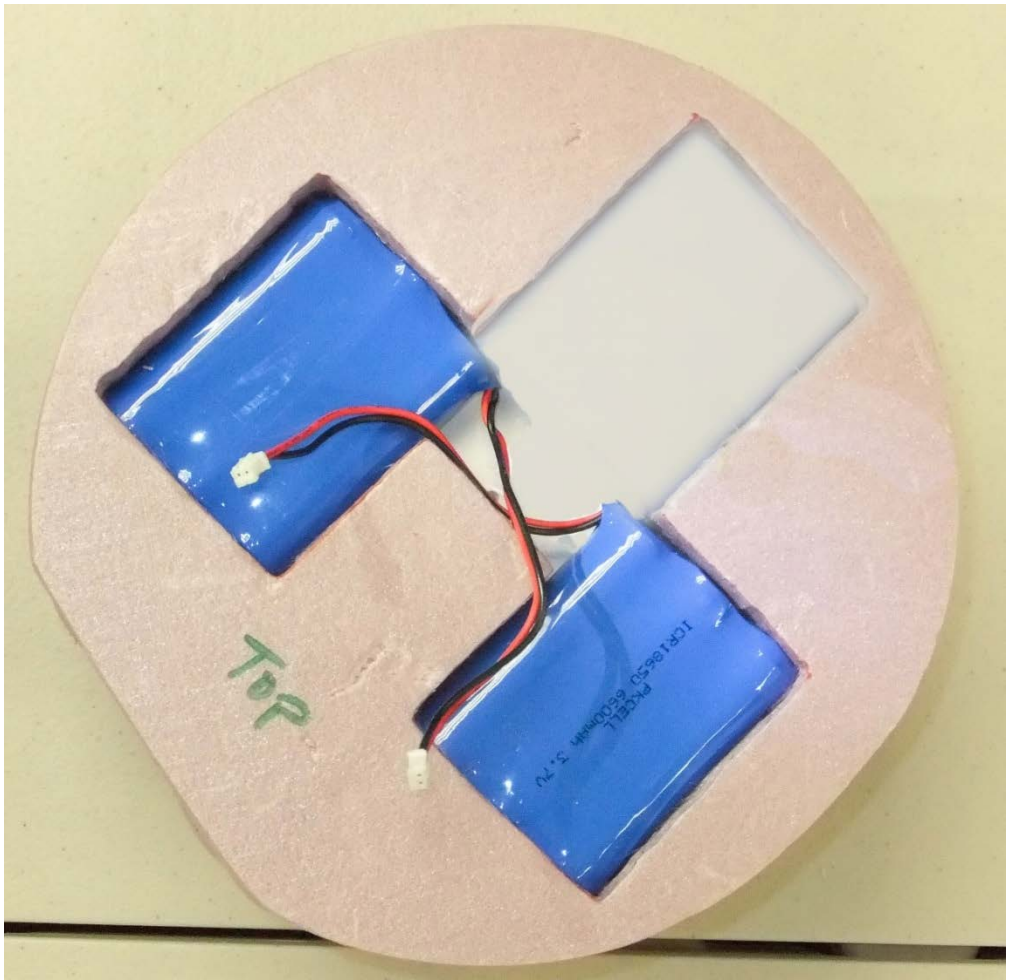


Place the foam battery housing on top of the foam core spacer.

NOTE! Your foam core battery plate is already attached to the foam battery housing.

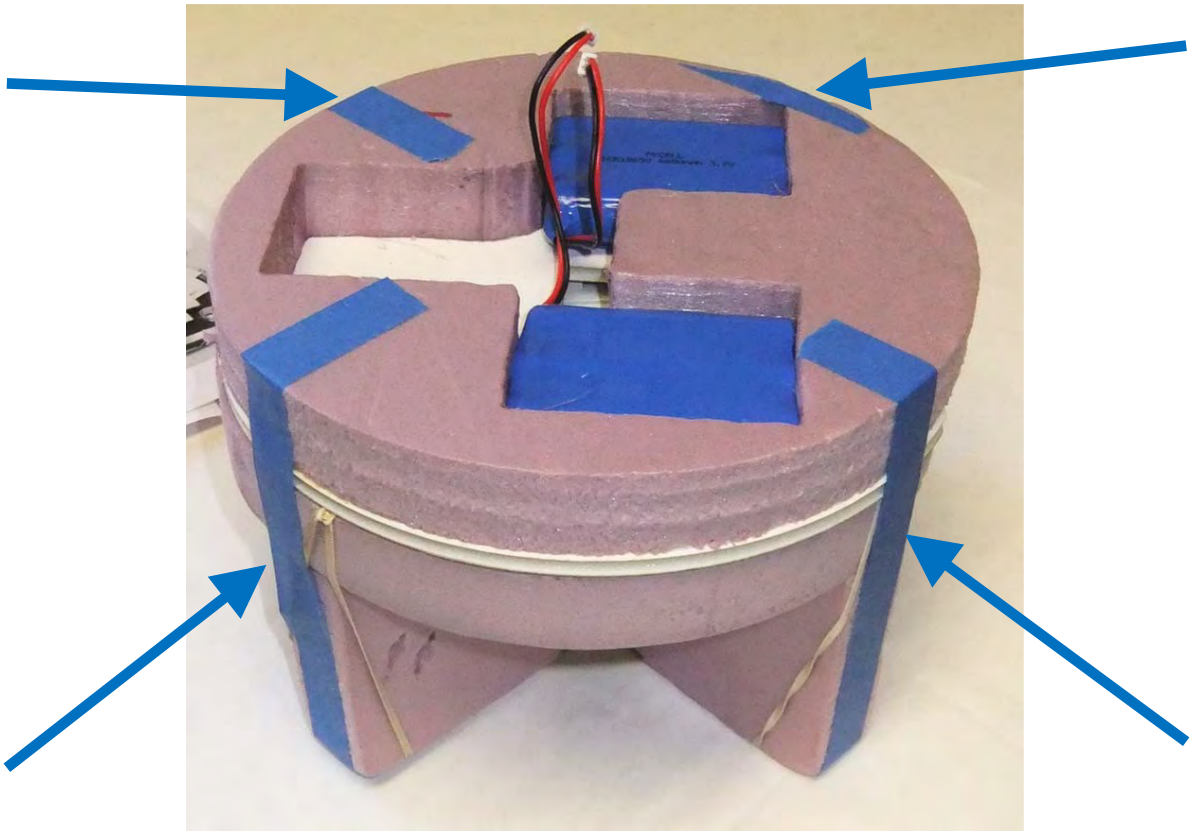
Video Payload Battery Placement

Place two 3.7V lithium batteries (F1) as shown with the cable connections facing the center of the payload. An additional battery can be added later for further functionality at a later time.



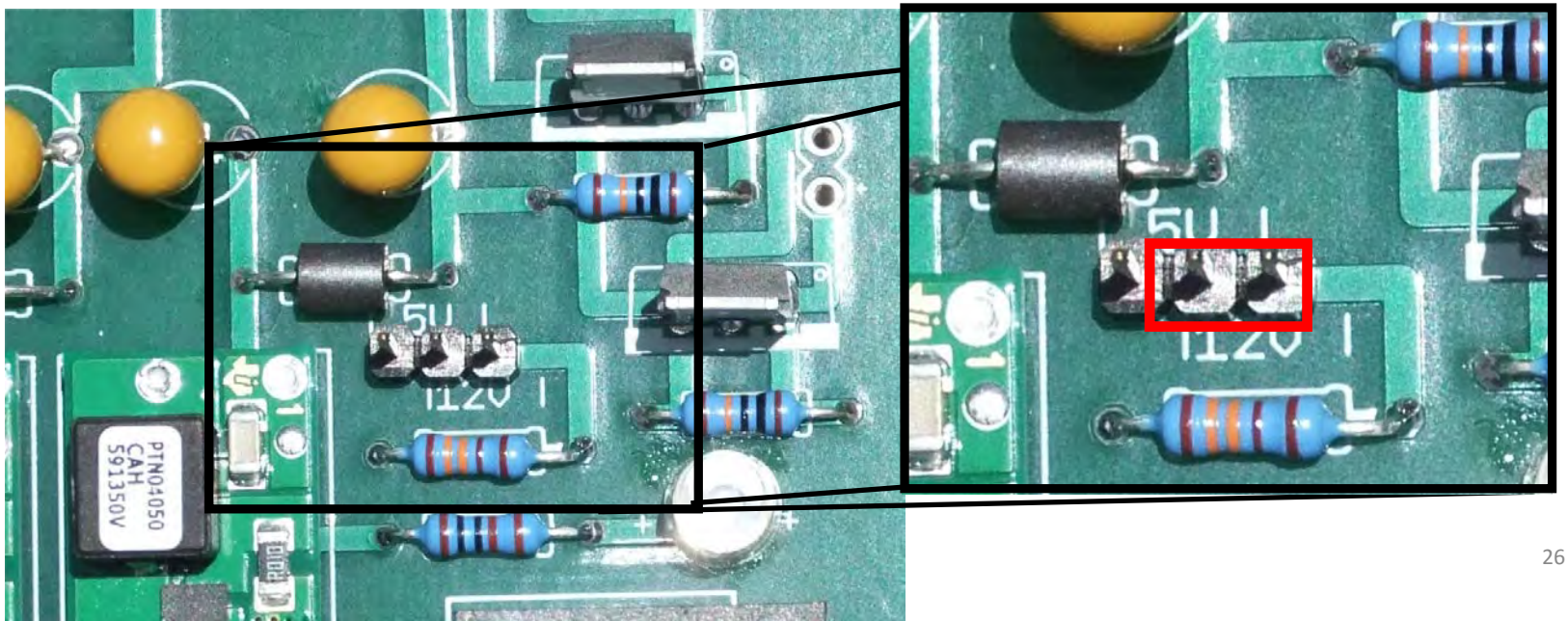
The Video Payload: Base Assembly Plate

- The base with the batteries can be set aside for the time being. Feel free to tape the battery housing foam to the foam base using the **blue masking tape** (tool kit) to keep it from sliding off.



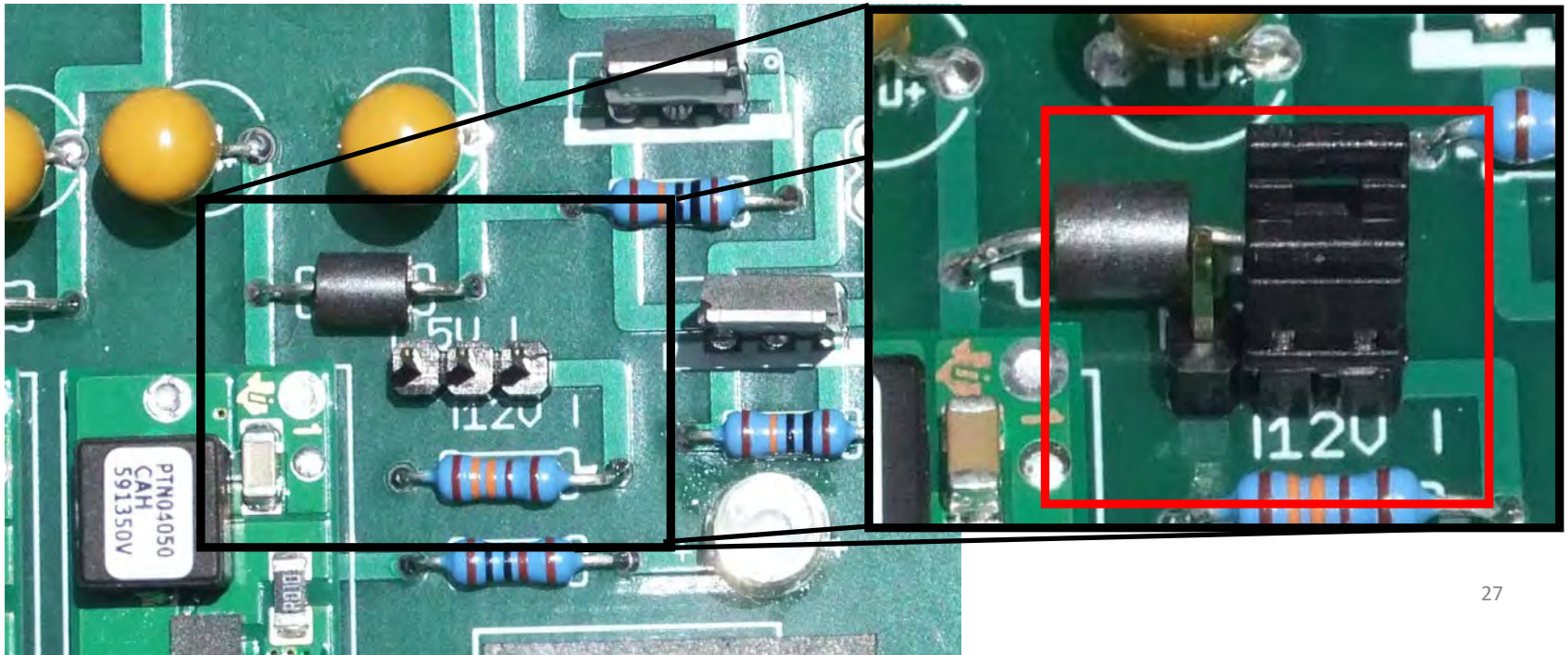
Setting up the Power Board for the **Video PAYLOAD**

- The power board (F14) can be used with both the still image payload and video payload by simply adjusting a jumper to change Vout to 5V or 12V respectively.
- MAKE SURE TO CHECK THE JUMPER POSITION IS IN THE CORRECT POSITION FOR ITS RESPECTIVE PAYLOAD BEFORE USING POWER BOARD!
- **For the Video payload the jumper must be at the 12V position**.



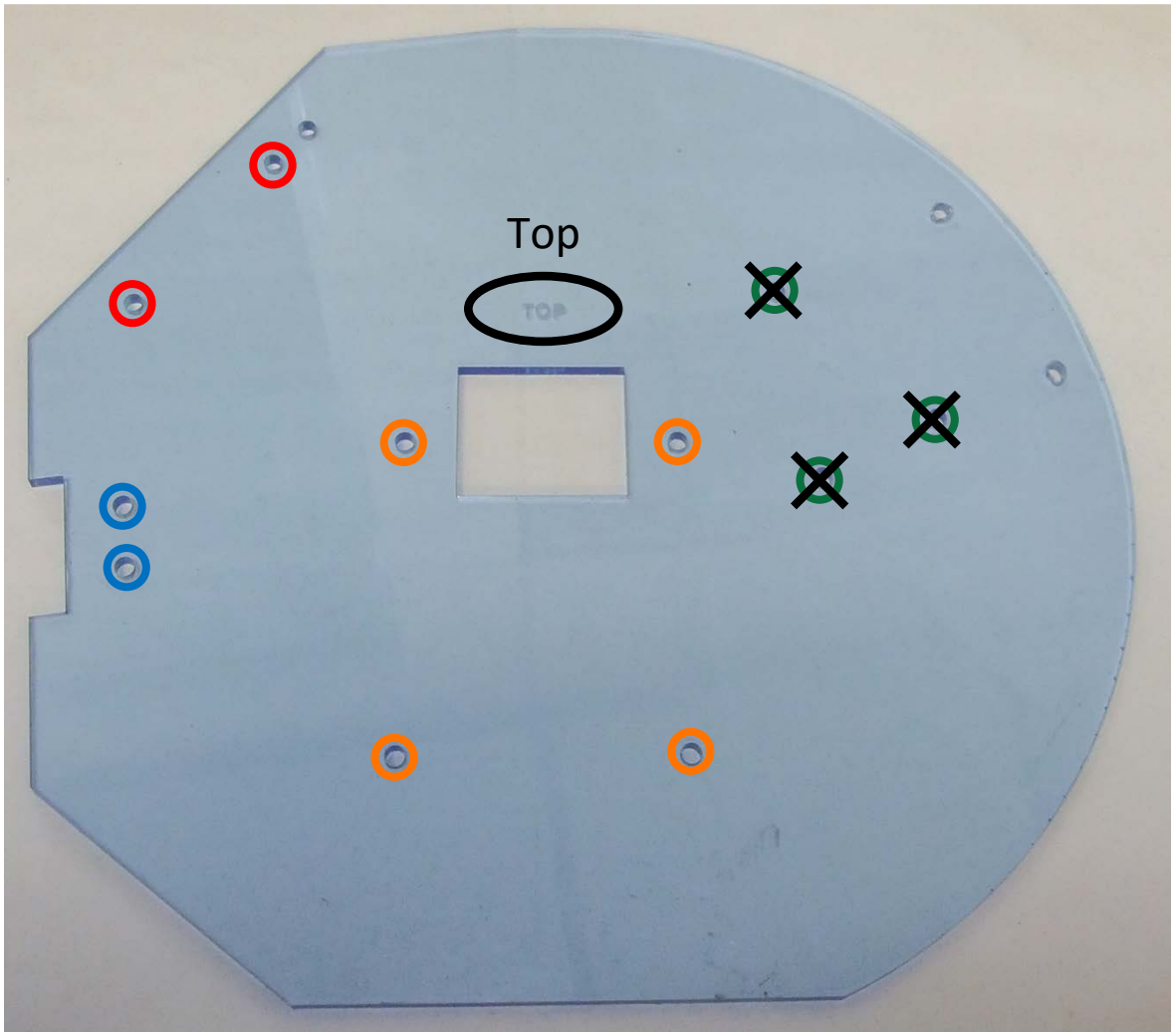
Setting up the Power Board for the **VIDEO PAYLAOD**

- The power board (F14) can be used with both the still image payload or the video payload by simply adjusting a jumper to change Vout to 5V or 12V respectively.
- MAKE SURE TO CHECK THE JUMPER POSITION BEFORE USING POWER BOARD!
- **For the Video payload the jumper must be set to 12V.**



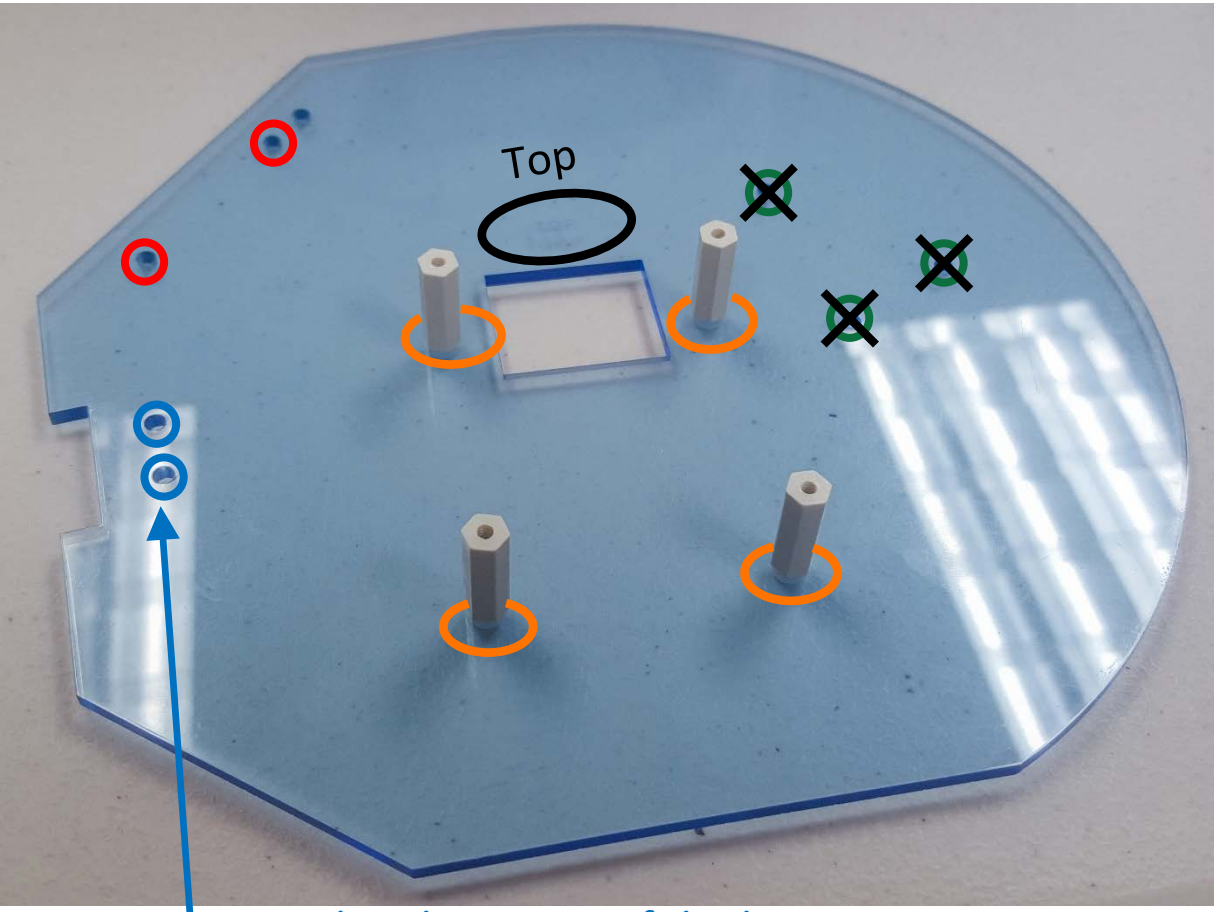
Building the Video Payload: Power Board and Pi Mounting

The acrylic assembly base plate (F23) has a number of pre-drilled holes for mounting the **power board**, **Pi**, **RFD modem** (still image payload ONLY, not used for video build.), **3D printed camera housing** and **on/off key switch**.



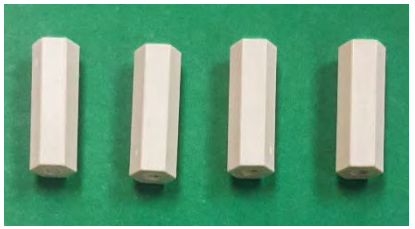
Building the Video Payload: Power Board and Pi Mounting

Insert **the 3/8 inch nylon screws (F21)** through the mounting holes from the bottom of the acrylic base plate. Screw them into the **3/4 inch nylon hex standoff (F16)** on the top. Tighten so the screws/standoff are snug, but don't overtighten!



Note the placement of the key switch holes for orientation

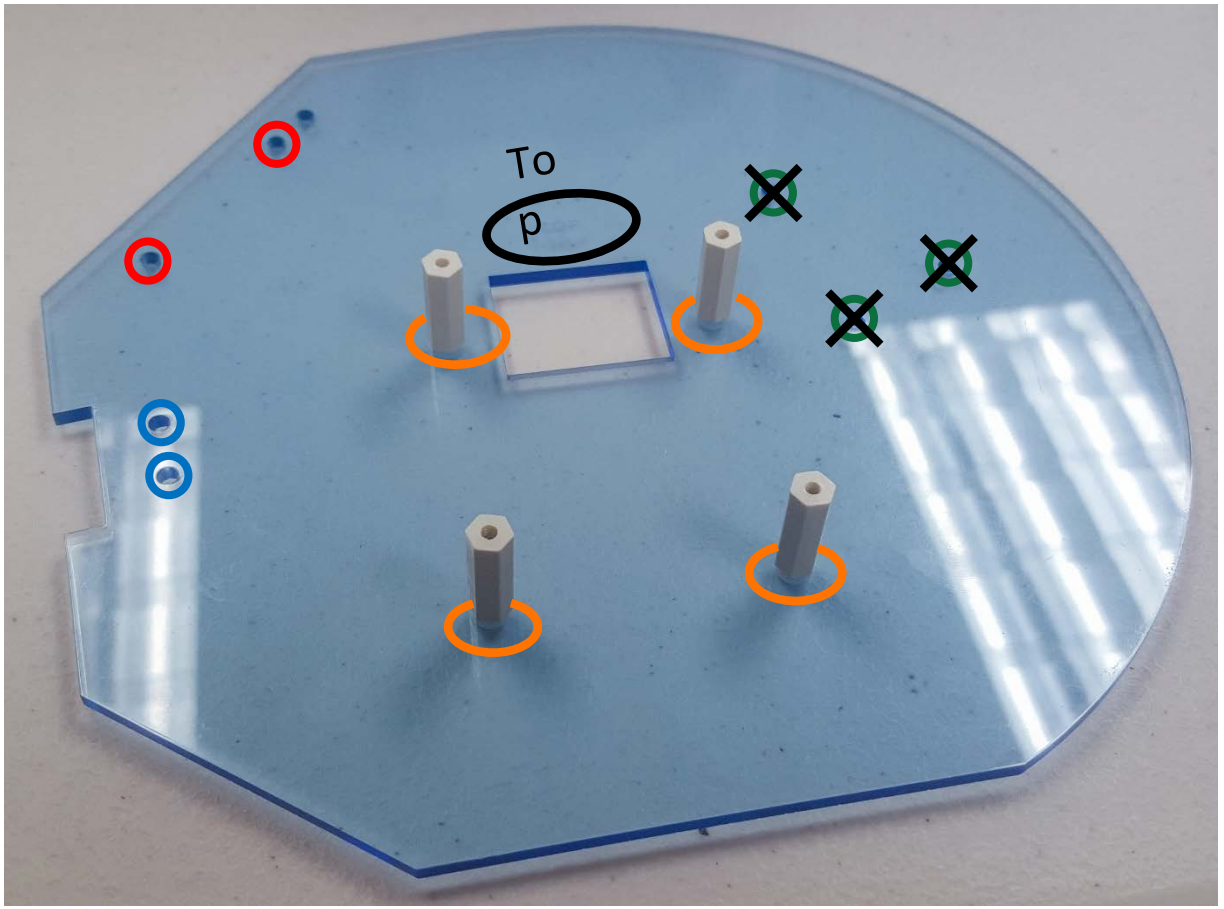
¾ inch nylon hex standoff (F16) x4 for video payload



The 3/8 inch nylon screws (F21) x4 for video payload

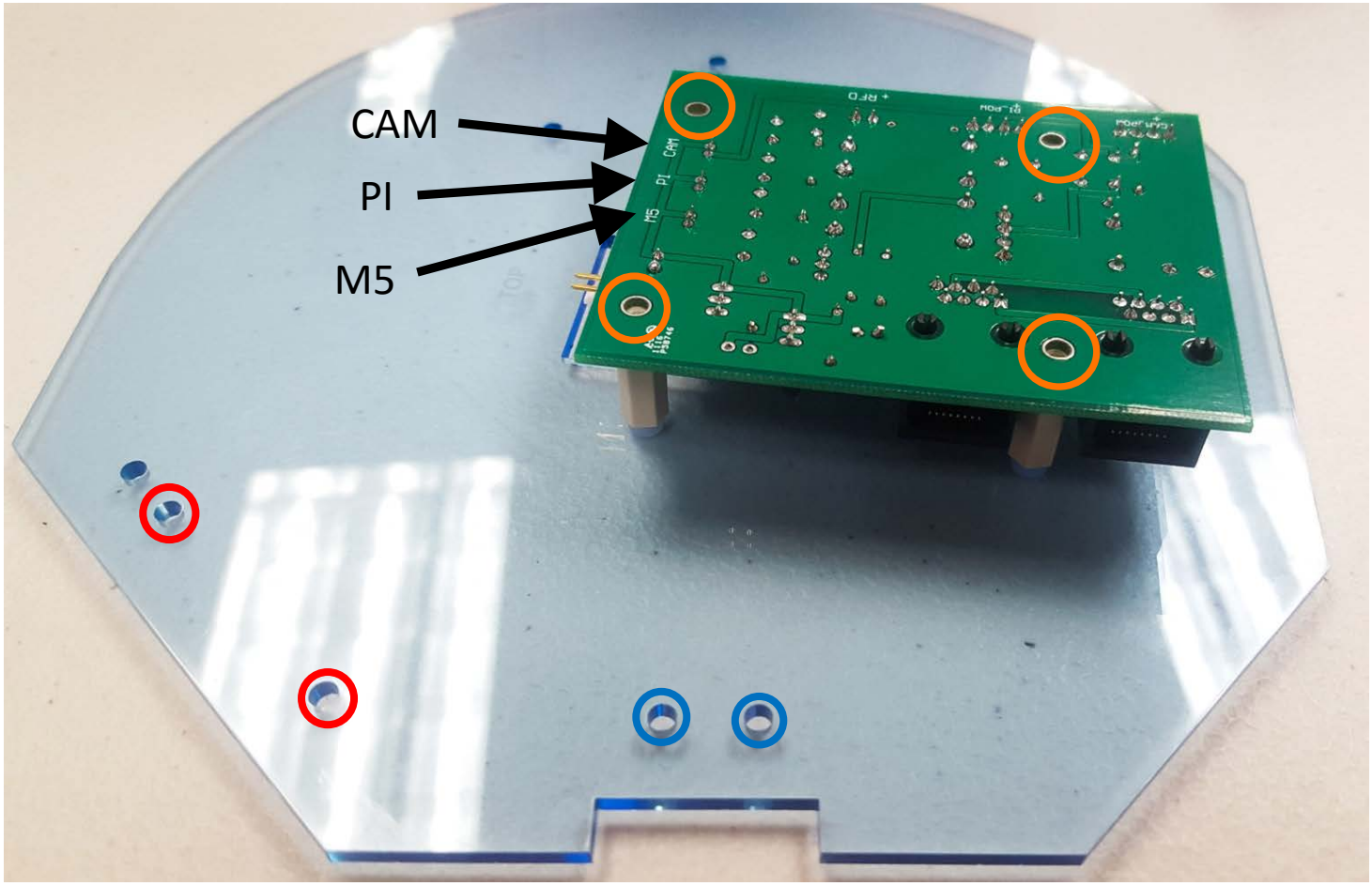
Building the Video Payload: Power Board and Pi Stack

STEP 12:



The power board will be mounted upside-down on top of the **four ¾ inch standoffs**

Building the Video Payload: Power Board Mounting

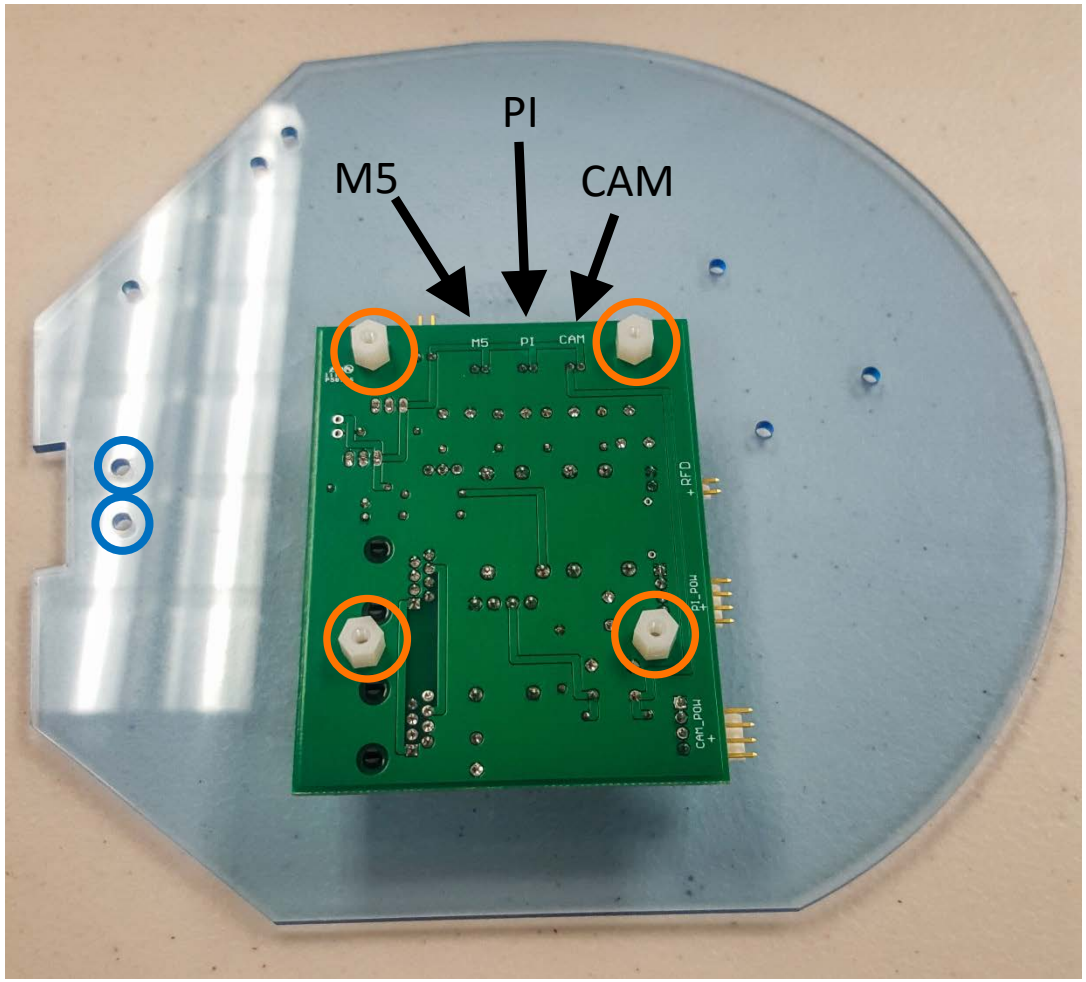


The power board will be held in place by screwing in **four ¼ inch standoffs (F15).** Note the placement of the **key switch holes**.

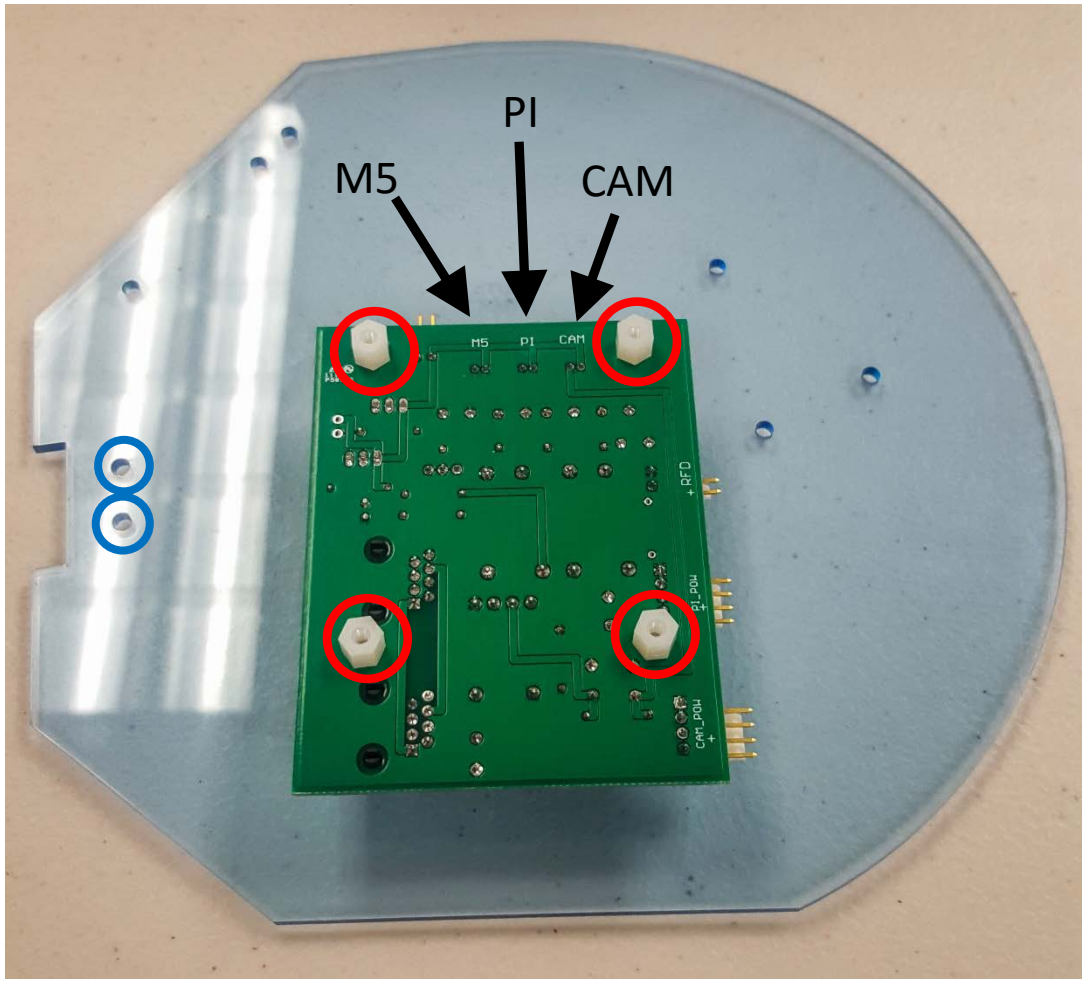
Building the Video Payload Step ##: Power Board Mounting

The power board will be held in place by screwing in **four ¼ inch standoffs (F15).** Note the placement of the **key hole switch holes**. Tighten snugly, but do not overtighten.

1/4 inch nylon hex standoffs (F15) x4 for video payload



Building the Video Payload: Pi Mounting

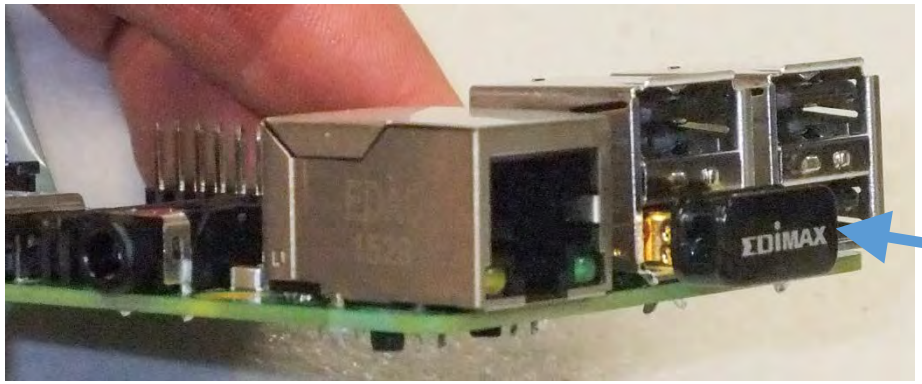


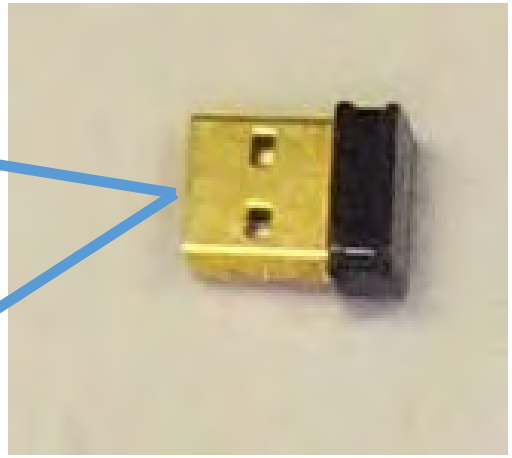
The Pi will be **mounted directly on top** of the power board using the **pi case**.

Building the Video Payload: Pi USB Wi-Fi Adapter

STEP 14:

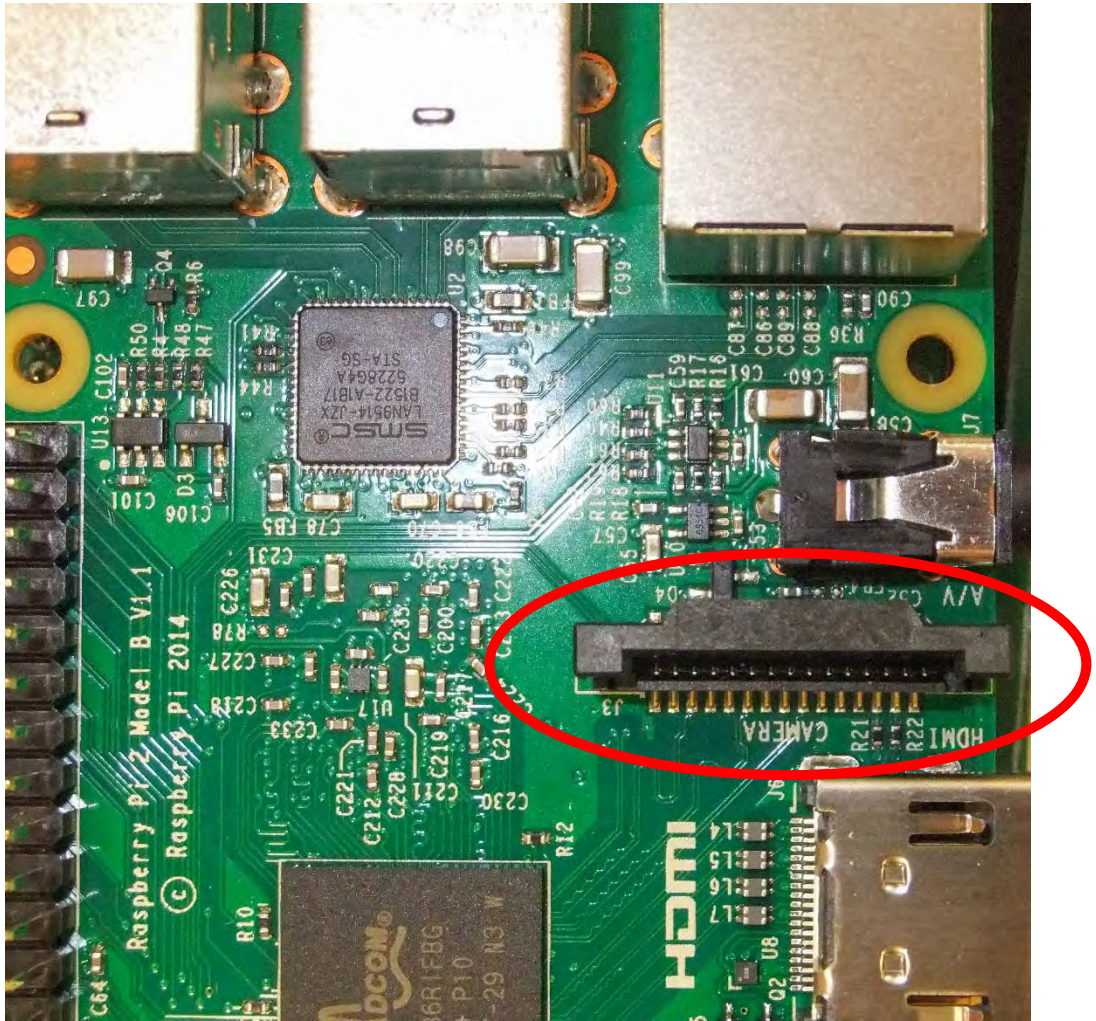
Insert the USB Wi-Fi Adapter (F5) into one of the Pi's (F4) four USB slots. The fit may be tight and you may need to wiggle it into place.





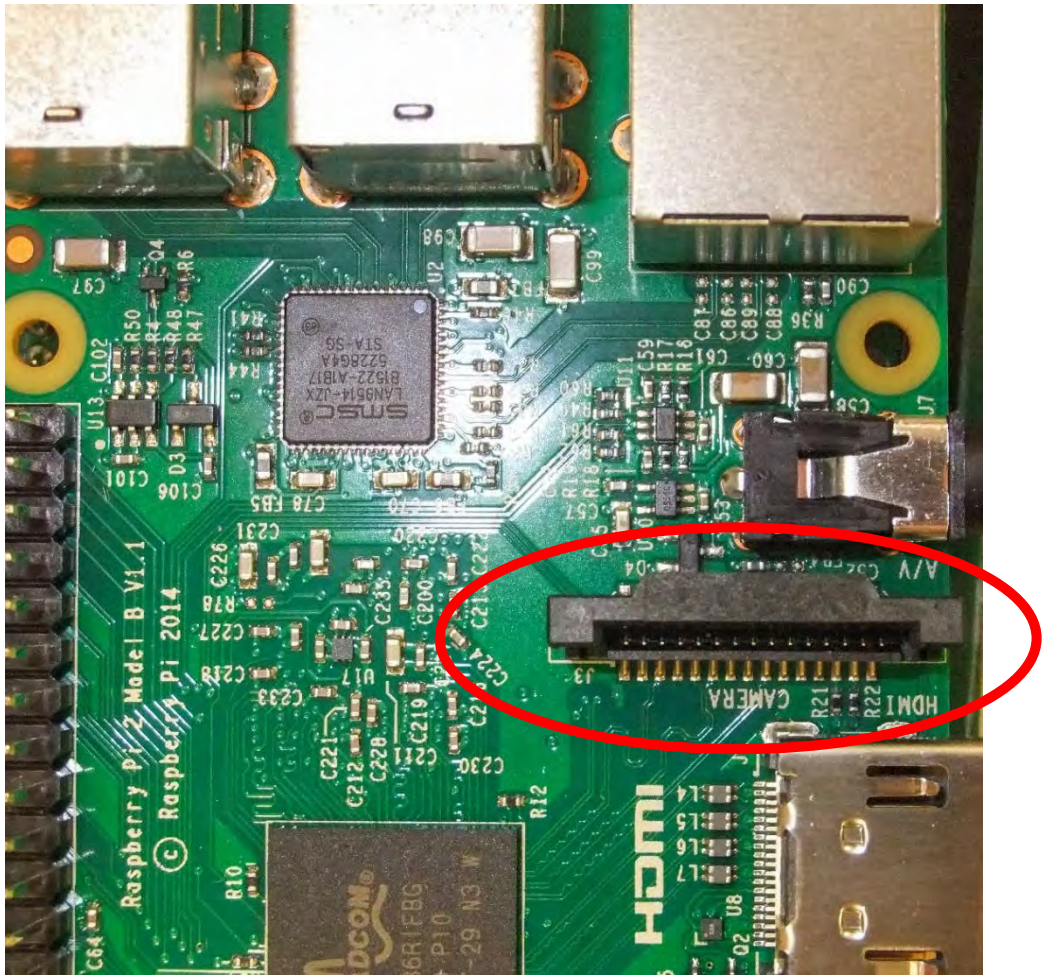
Building the Video Payload: Pi Mounting Prep – Camera Ribbon Cable

The 8 inch camera ribbon cable (F2) must be inserted before the Pi (F4) is put in the case and then mounted above the power board. The ribbon cable will be inserted **here**:



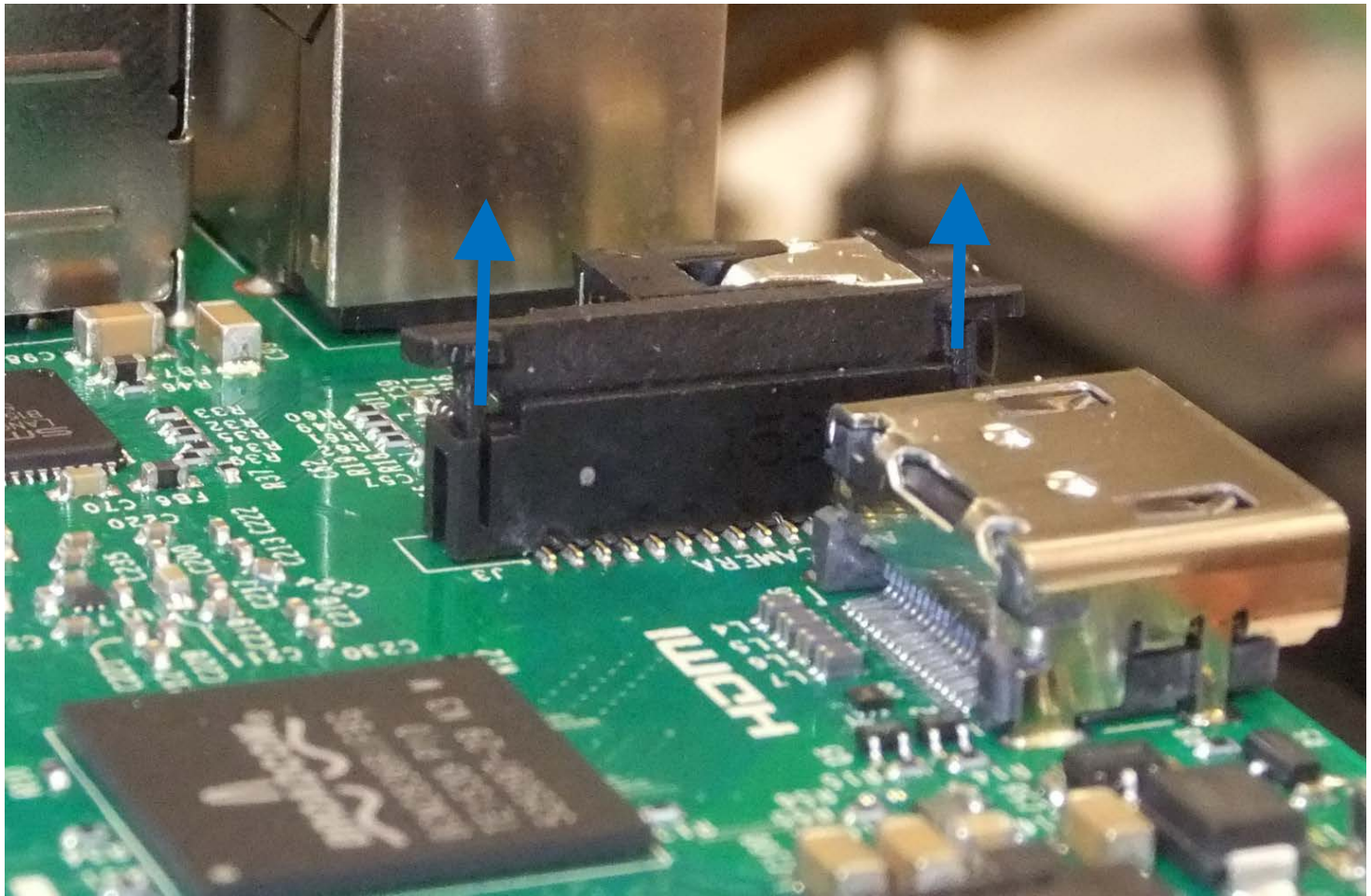
Building the Video Payload: Pi Mounting Prep – Camera Ribbon Cable

WARNING!!!!! The **connector for the ribbon cable** is easily broken if not handled gently and correctly. Be very careful when inserting/removing the pi camera ribbon cable from the Pi and follow the following instructions.



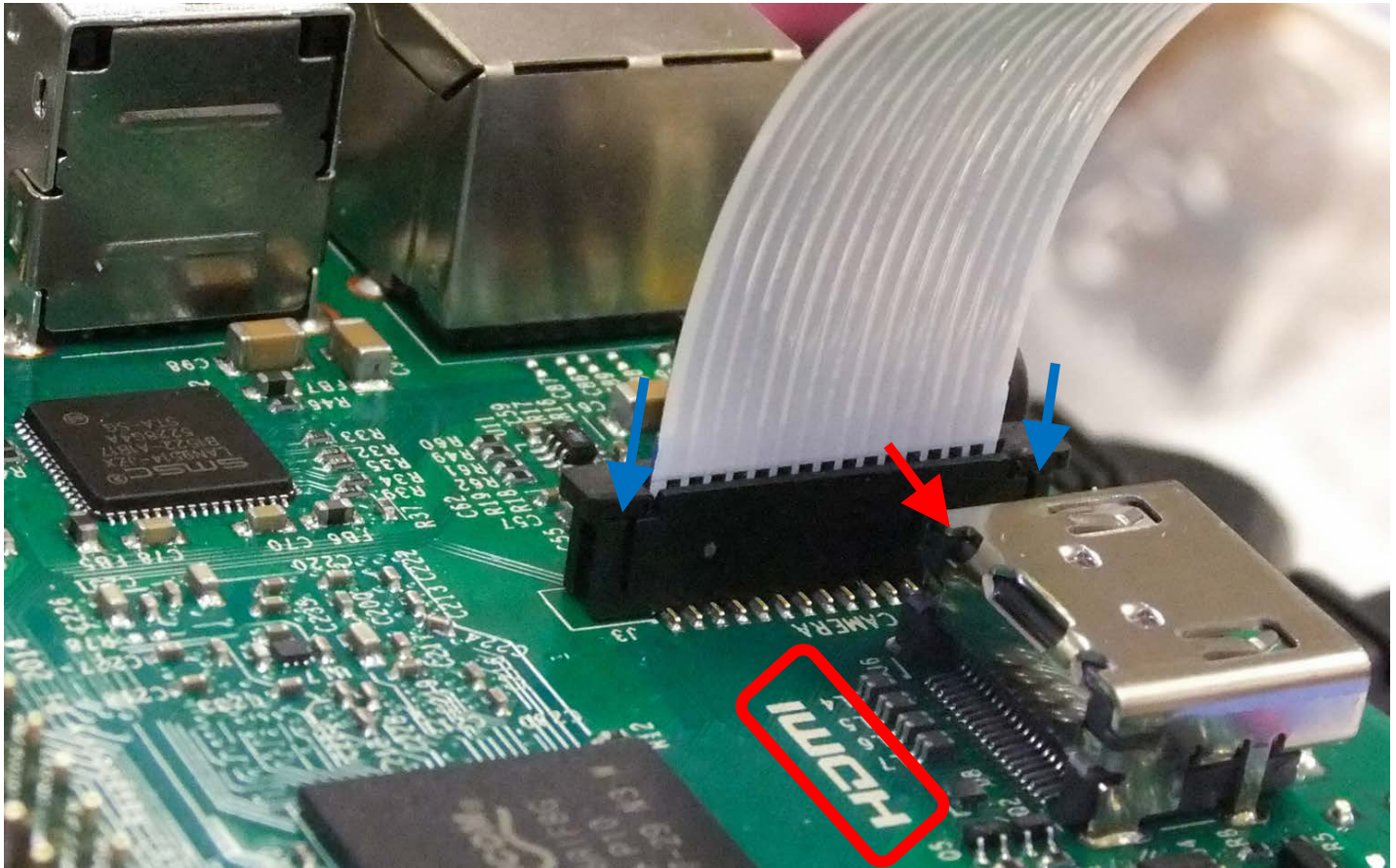
Building the Video Payload:
Pi Mounting Prep – Camera Ribbon Cable

GENTLY pull directly up on each tab on the sides of the **ribbon cable lock** until it pops up.



Building the Video Payload:
Pi Mounting Prep – Camera Ribbon Cable

Insert the **8 inch ribbon cable (F2)** with the **silver connections facing towards the HDMI connector**. Once inserted, make sure the **ribbon cable lock** is perpendicular to the PCB plane (not at an angle) and GENTLY push the lock directly toward the Pi board.

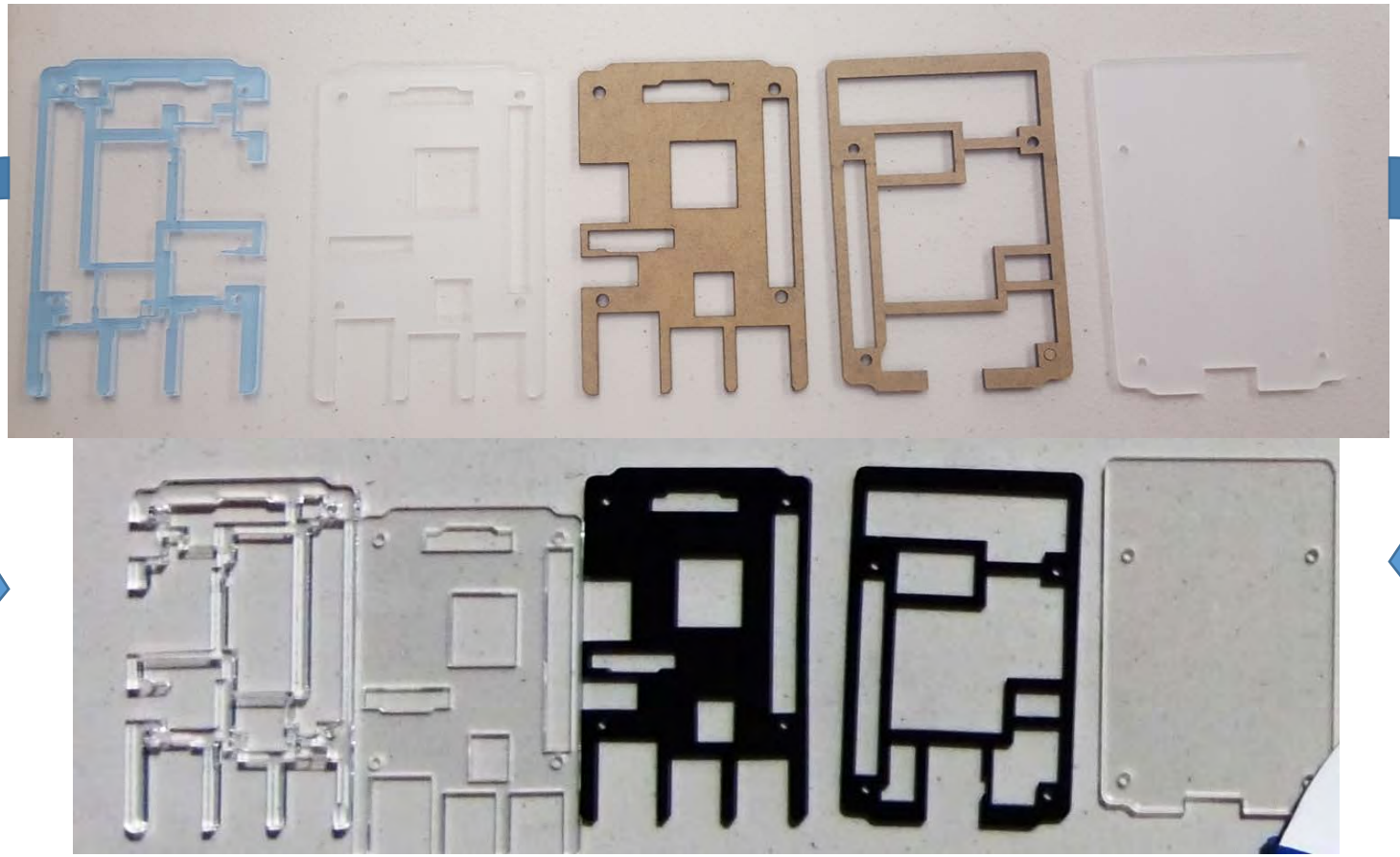


WARNING!

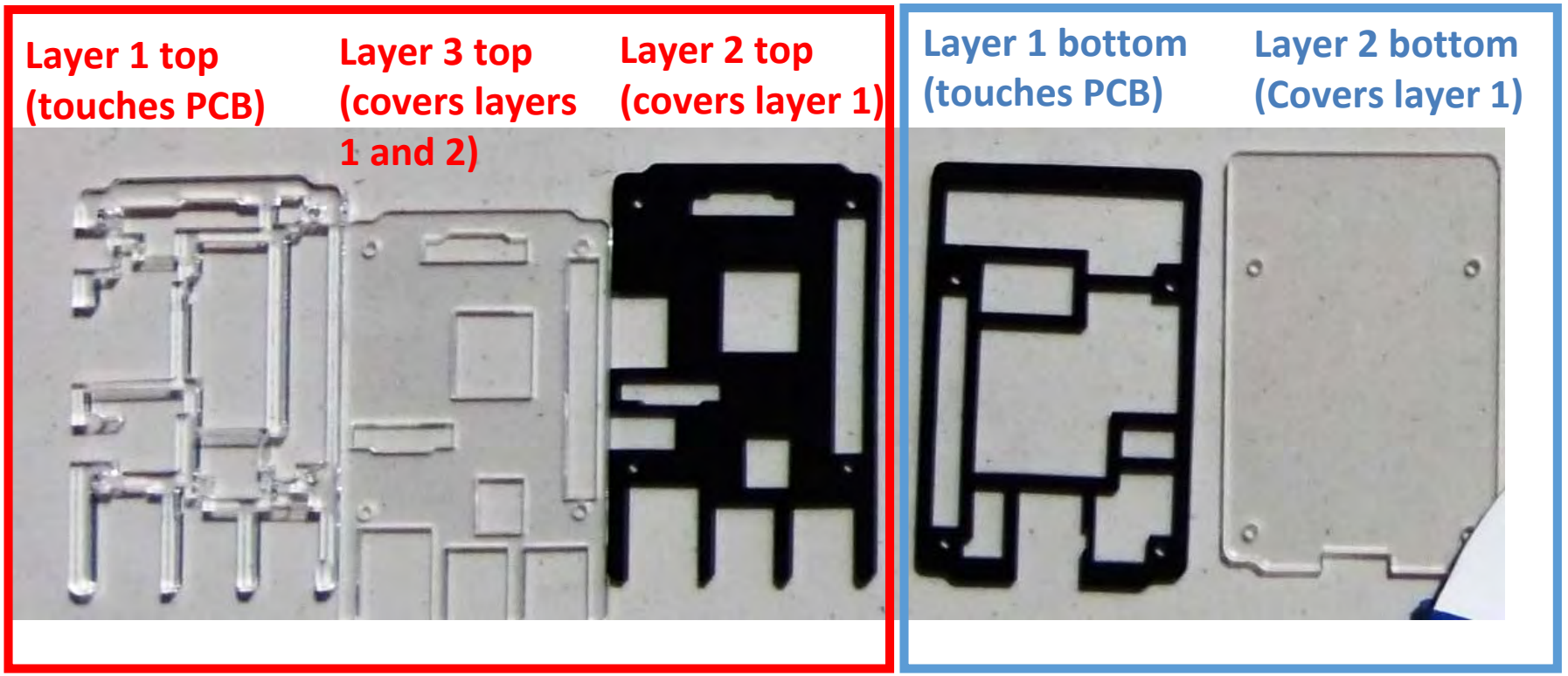
You are about to perform the most annoying task in the workshop!

Building the Video Payload: Pi Mounting

Remove the annoying protective plastic on the top and bottom of the Pi Case (F6) “layers.”

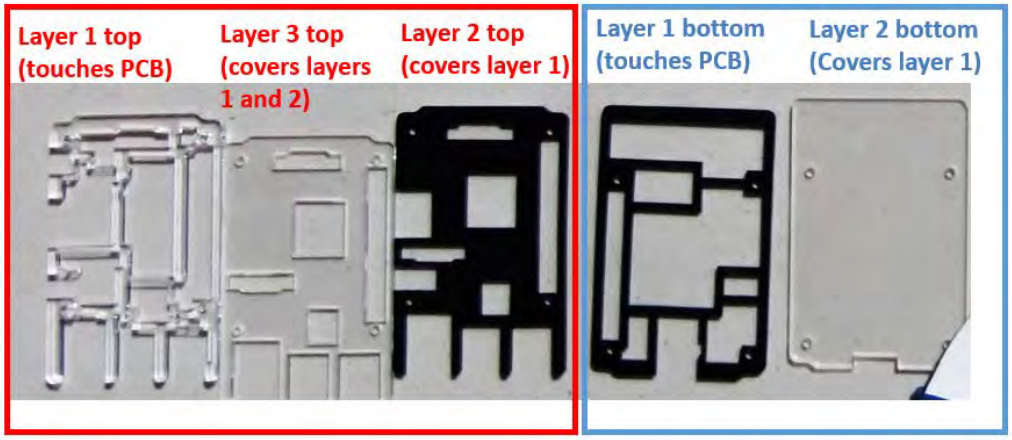


Building the Video Payload: Pi Mounting



The bottom protective layer spacers each neatly fit in-between Pi board components. Each additional layer fits on top of the other providing additional protection and spacing.

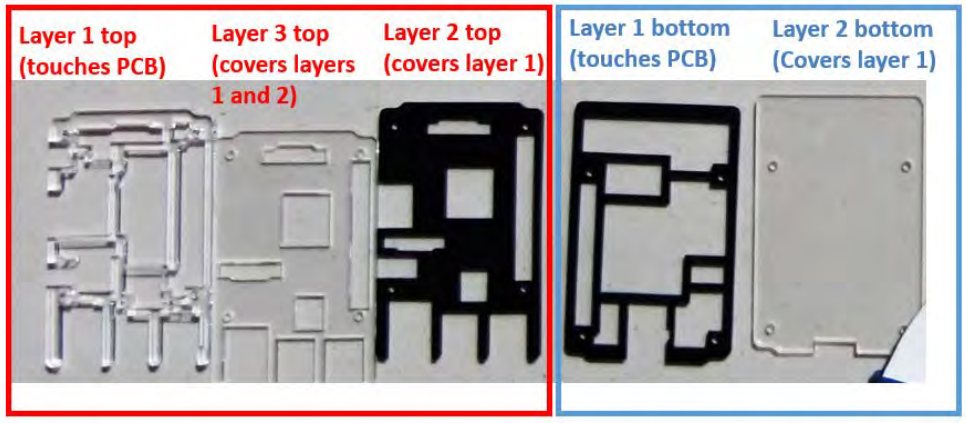
Building the Video Payload: Pi Mounting



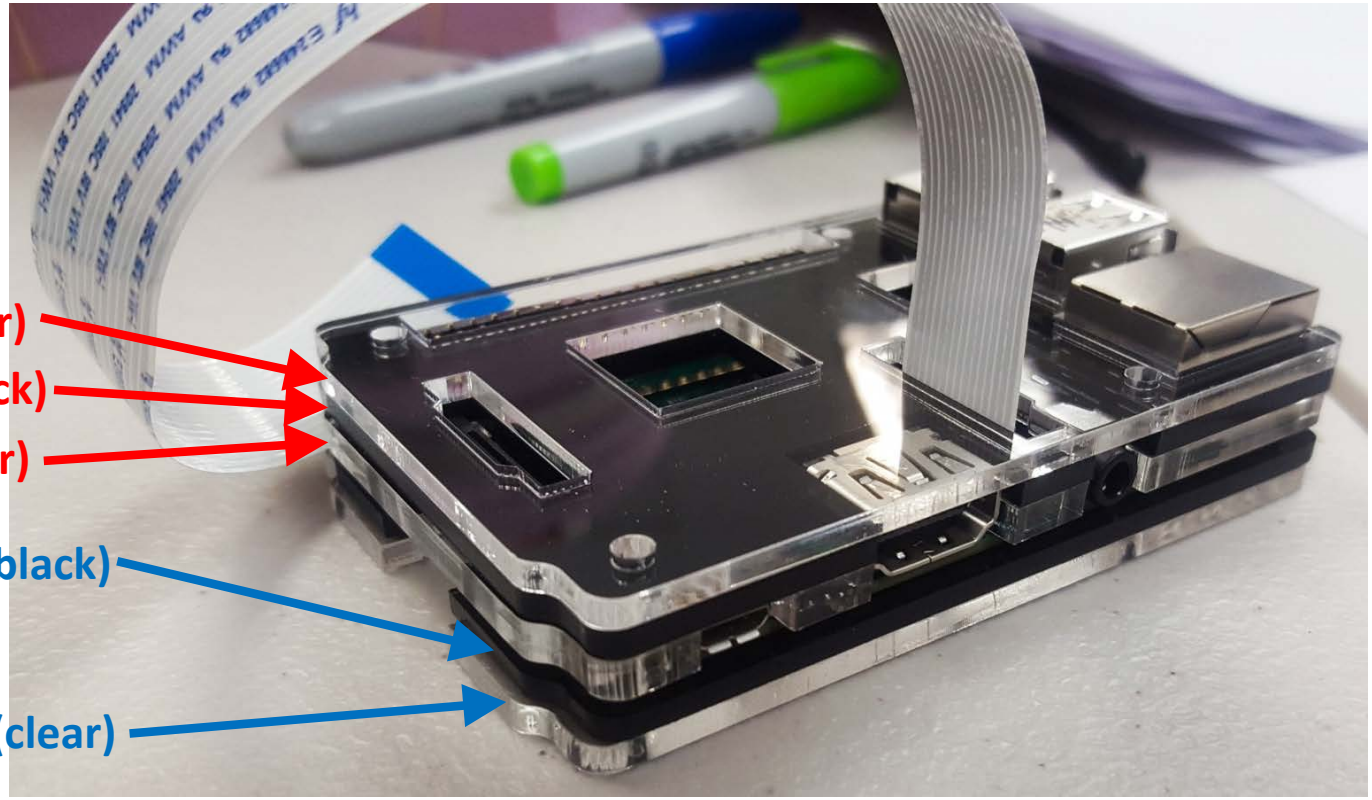
STEP 19:

The two bottom Pi Case Layers 1 (black) and 2 (clear, top layer as imaged on right)

Building the Video Payload: Pi Mounting



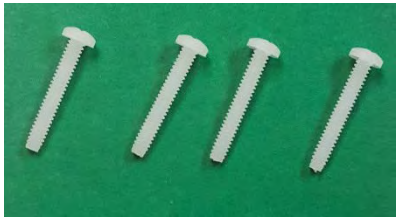
Next place the **top Pi Case** on the top of the Pi while threading the ribbon cable through the cutout in the spacer.

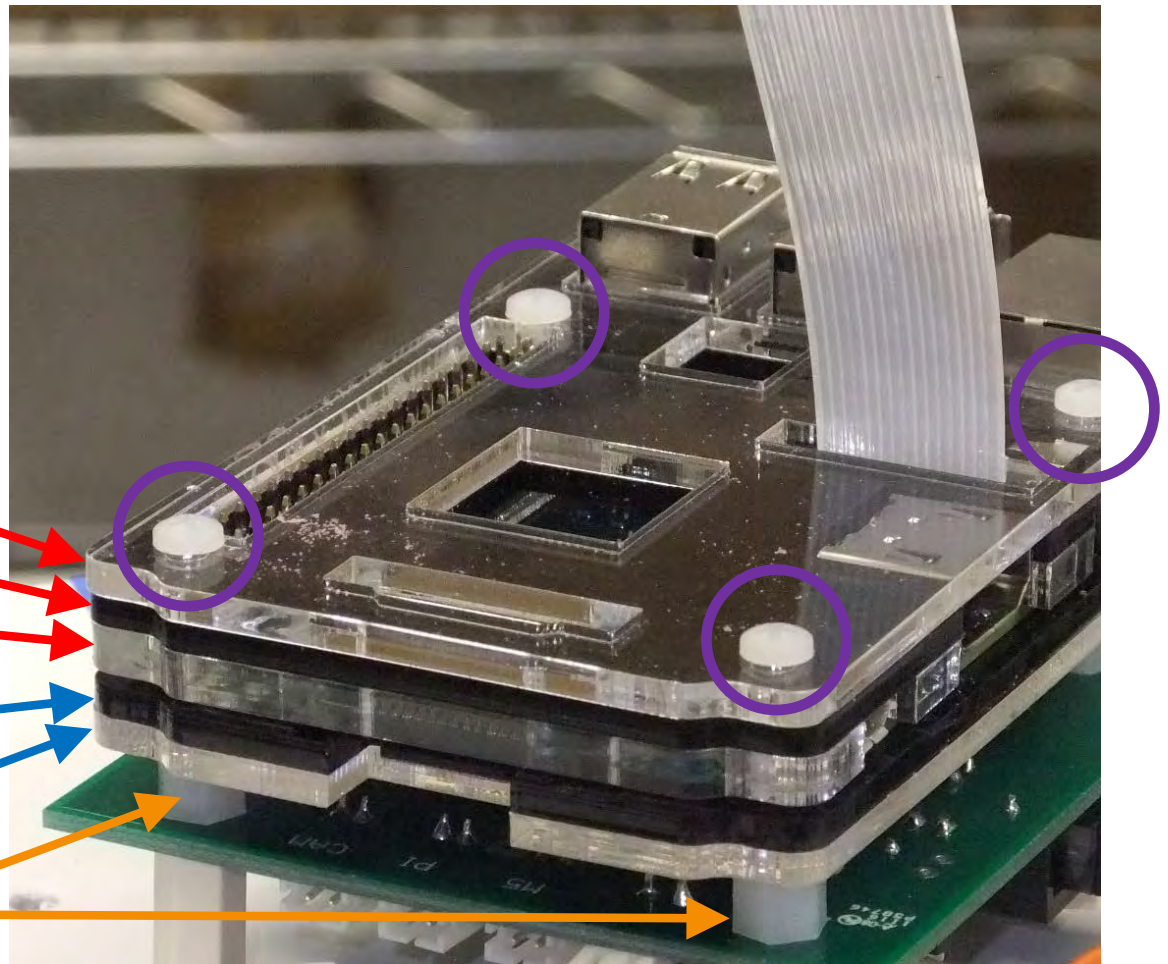


Building the Video Payload: Pi Mounting

Place the Pi with the **bottom Pi case layers** on top of the **nylon hex spacers** above the power board. Gently thread **the 3/4 inch nylon screws (F17)** through the **top Pi case layers**, the Pi, and the **bottom Pi case layers** and into the nylon hex spacers. Tighten snug.

3/4 inch nylon screws (F17)

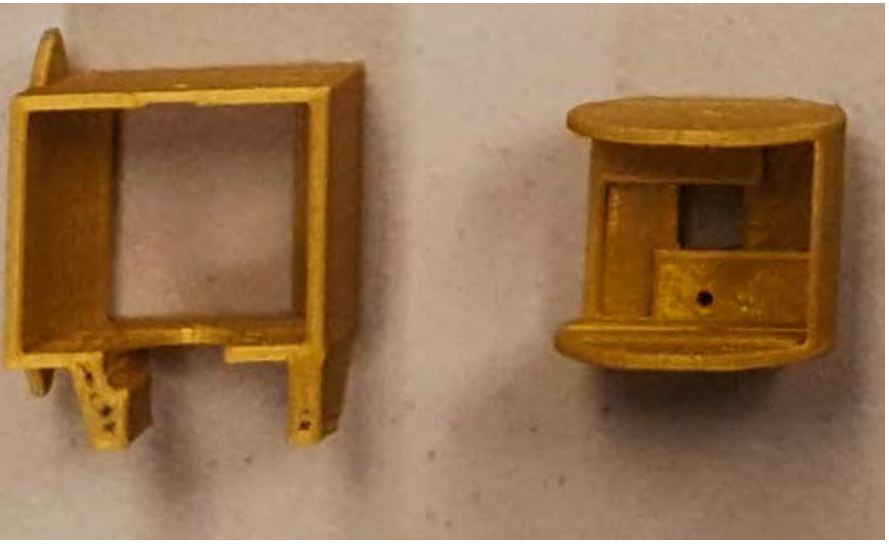




Building the Video Payload: Pi Video Camera Housing

We are going to make a quick detour to prepare for a later step in the build. Please get the following parts/tools:

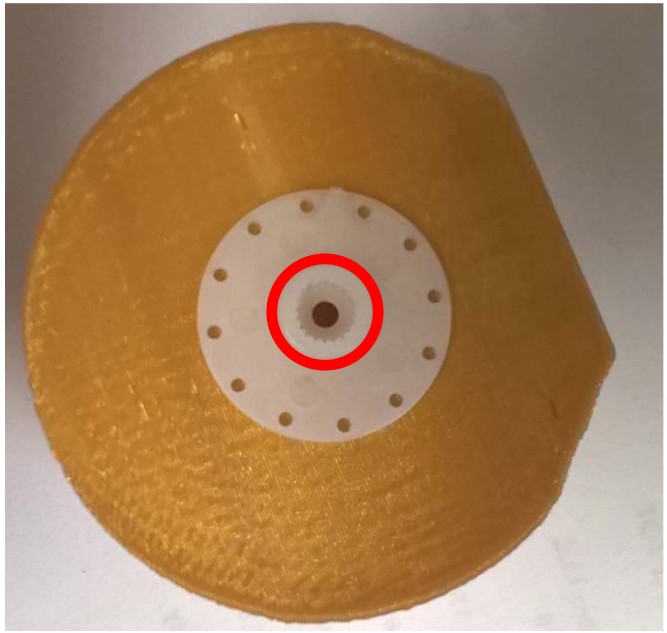
Pi Camera 3D Printed Housing – F26



Pi Camera Servo (F13)

Glue (Tool Kit)

Building the Video Payload: Pi Video Camera Housing



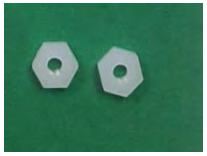
Glue the motor mount disk onto the side of the side of the 3D camera mount. **MAKE SURE YOU GLUE IT TO THE CORRECT SIDE! CHECK ORIENTATION WITH IMAGES ABOVE!**

CENTER THE HOLE OF THE MOTOR MOUNT DISK WITH THE HOLE IN THE 3D PRINTED CAMERA MOUNT.

Let the glue set for ~5 minutes

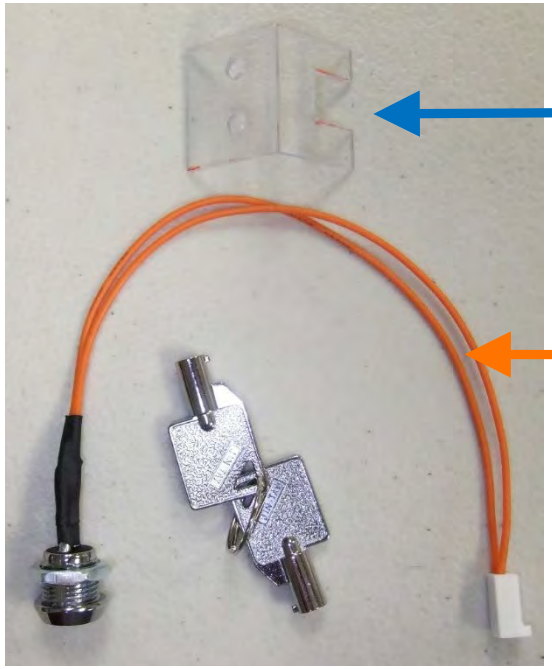
Building the Video Payload: On/Off Key Switch

Two lock washers (E29)



Two 4-40 nylon nuts (E26)

Two 3/8 inch nylon screws (E22)

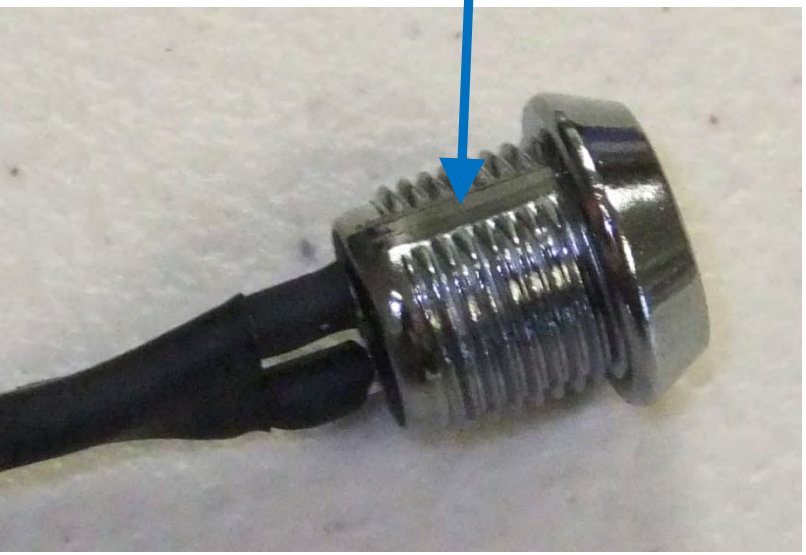


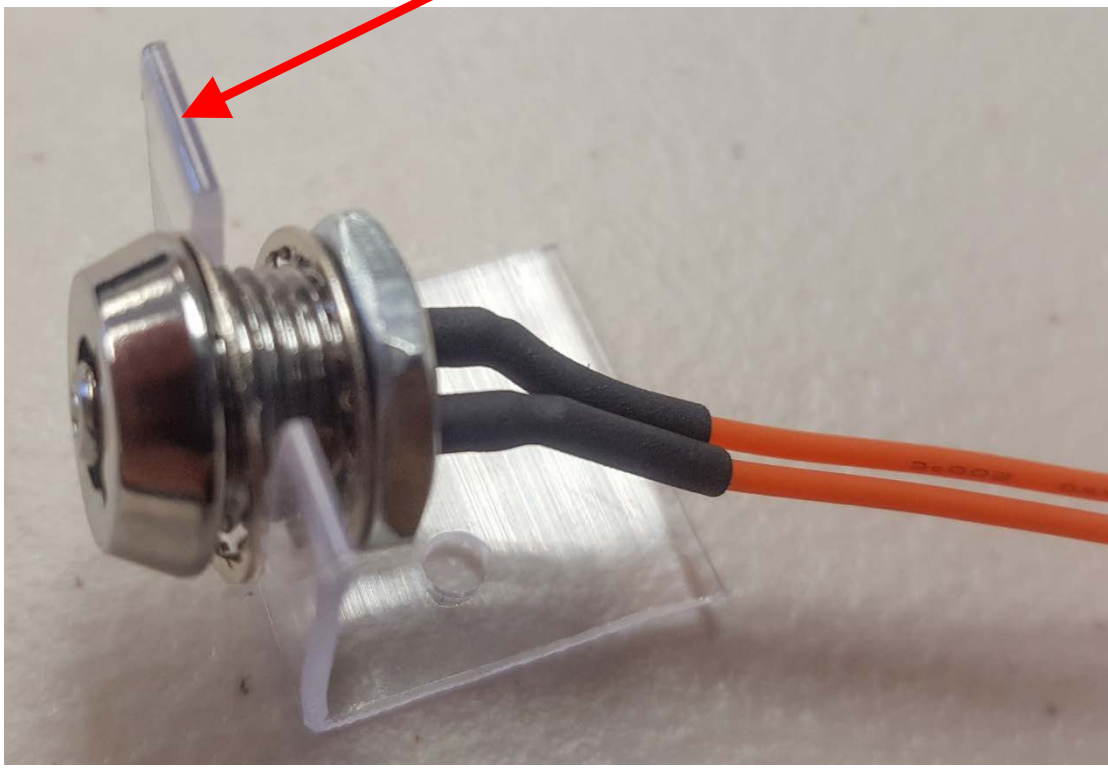
Key Switch Bracket (E25)

Key Switch and Key (E30)

Building the Video Payload: On/Off Key Switch

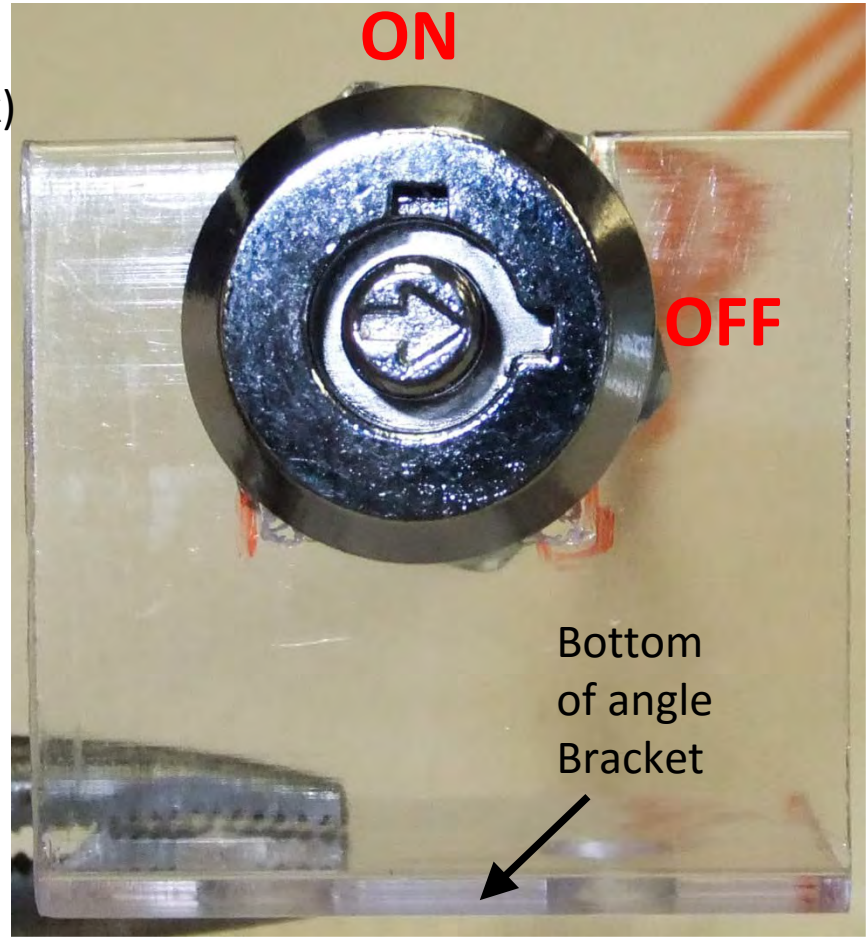
The **flat portions of the threads** will orient the key switch in the **bracket**.



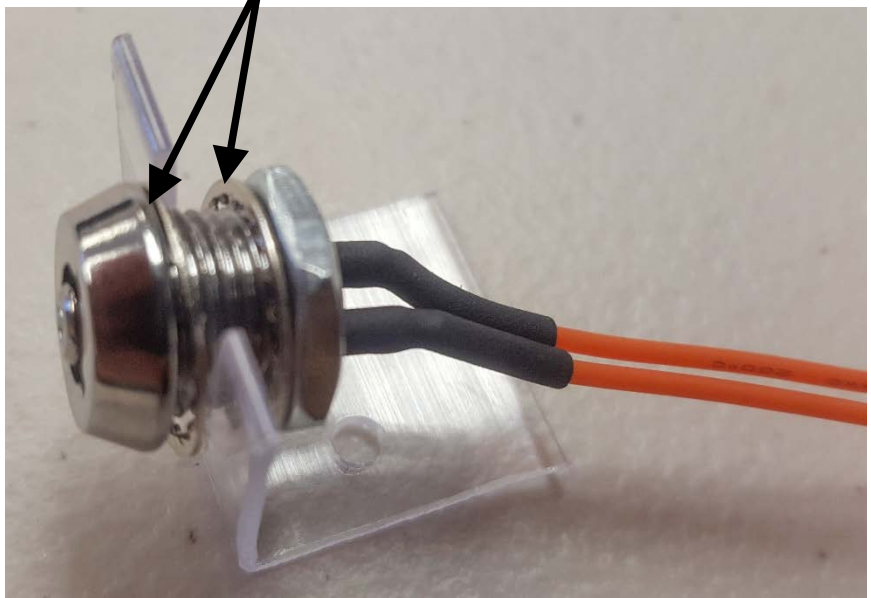


Building the Video Payload: On/Off Key Switch NEW BRACKET

Orient the key such that the OFF position is pointed right (3 o'clock) and on is pointed up (12 o'clock position)

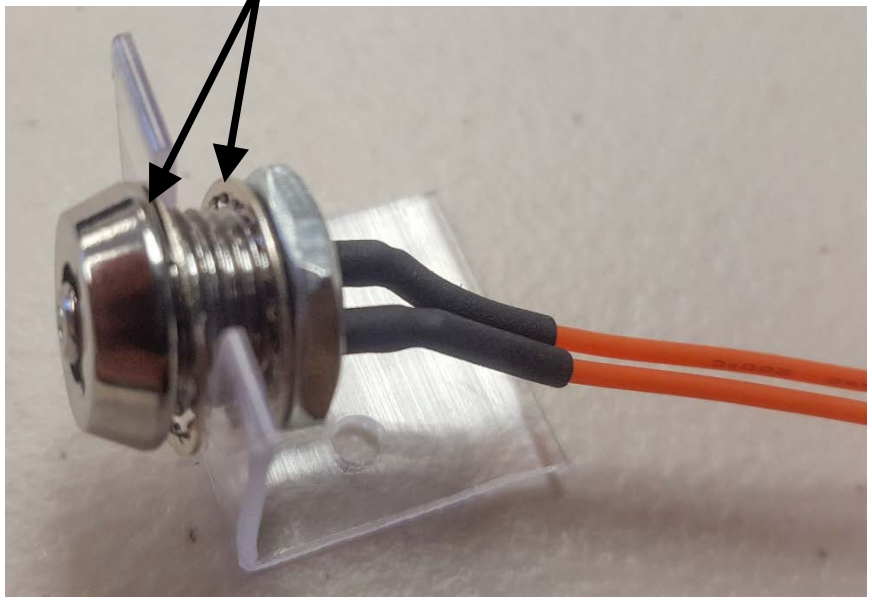


Make sure there is a star locking washer on each side of the bracket.

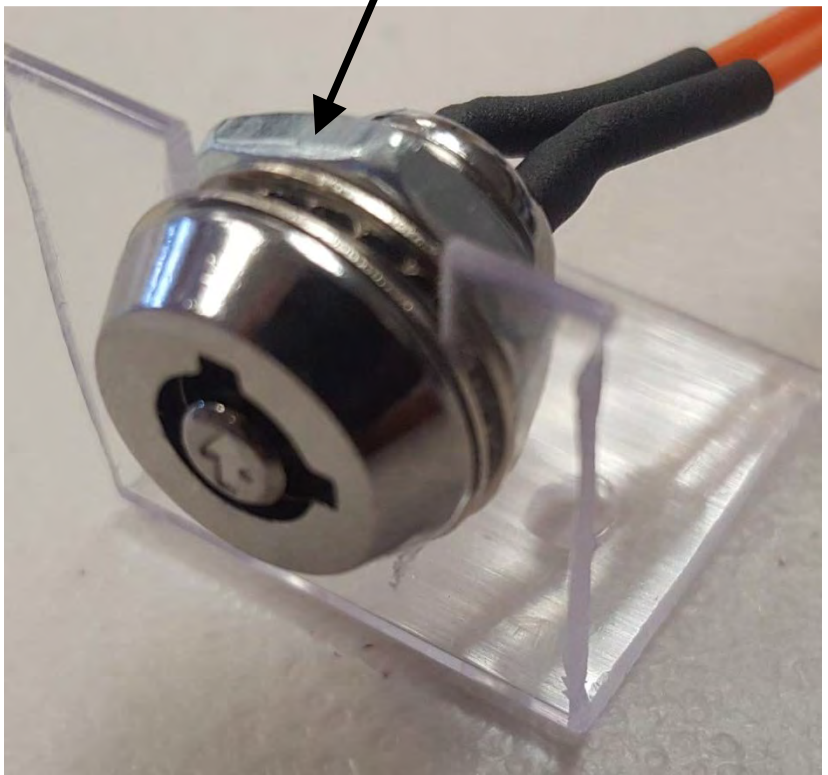


Building the Video Payload: On/Off Key Switch

Make sure there is a star locking washer on each side of the bracket.

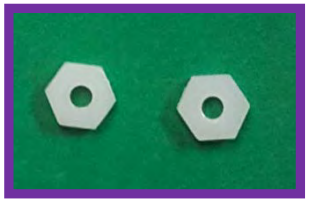


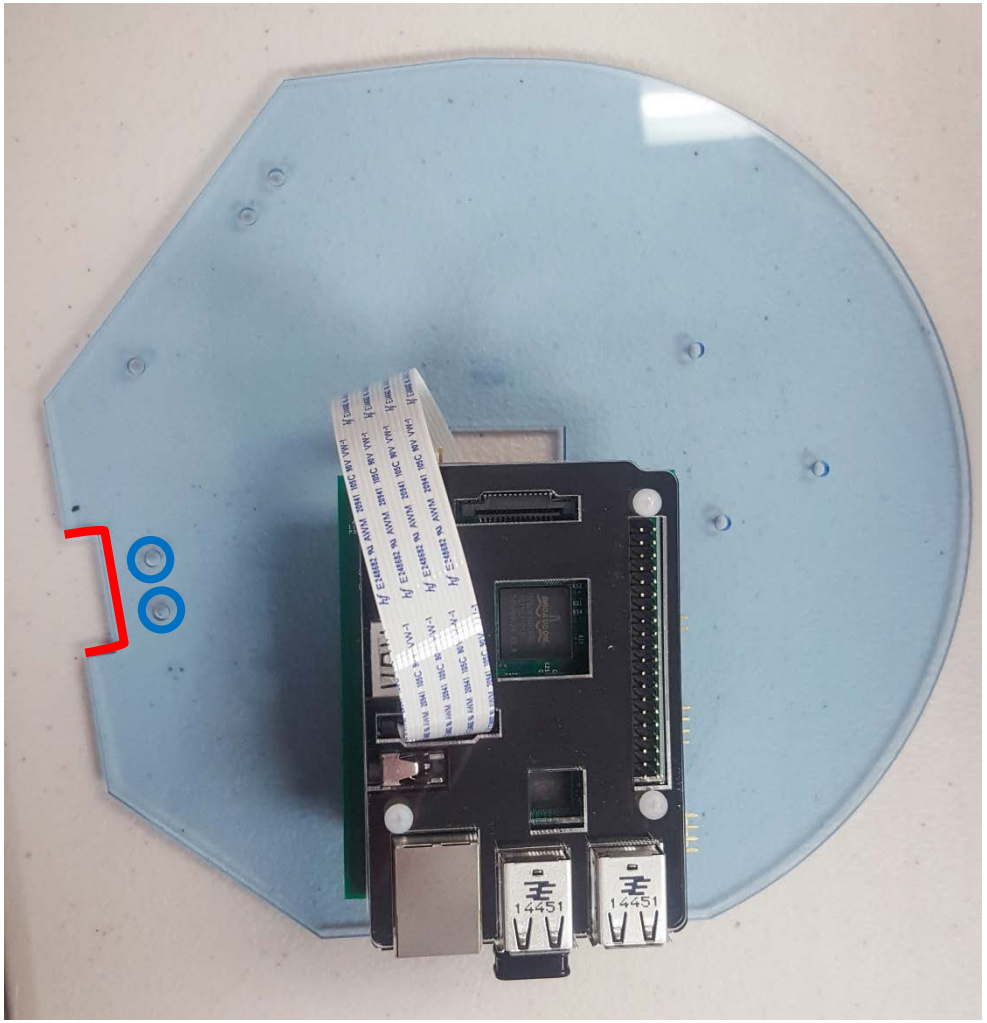
Tighten the nut locking the key switch in the bracket.



Building the Video Payload STEP ##: On/Off Key Switch

The **on/off key switch w/ bracket** will be mounted with the two **pre-drilled holes** where the **cutout** is in the acrylic base plate. The key switch bracket will be held in place with **two 3/8 inch nylon screws** and **two nylon nuts**.

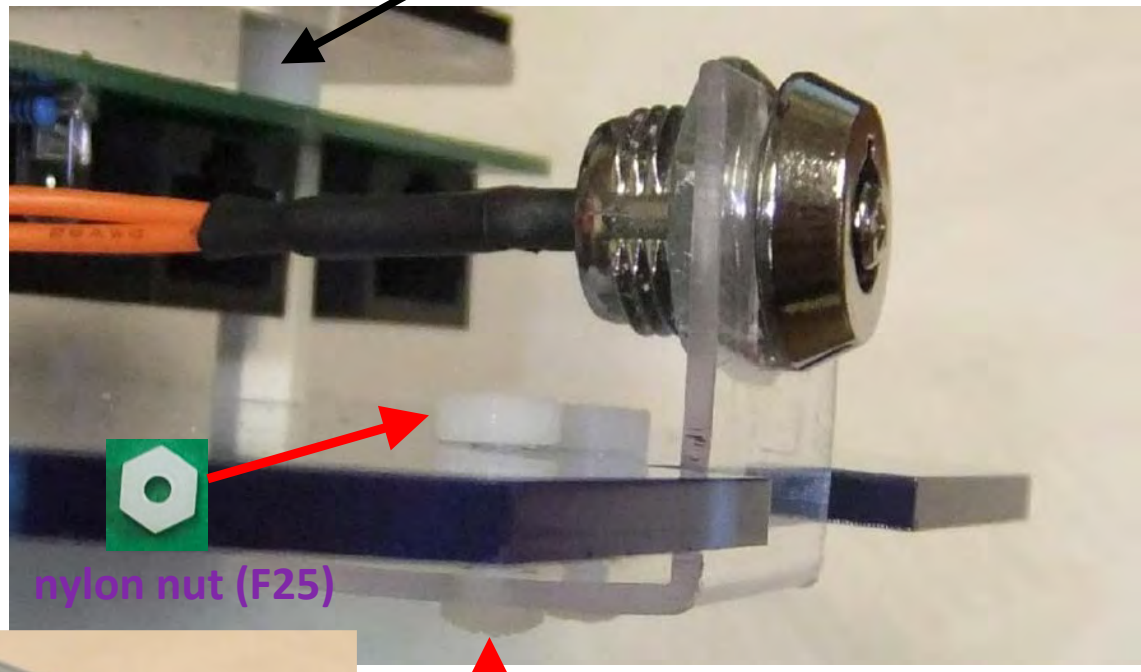


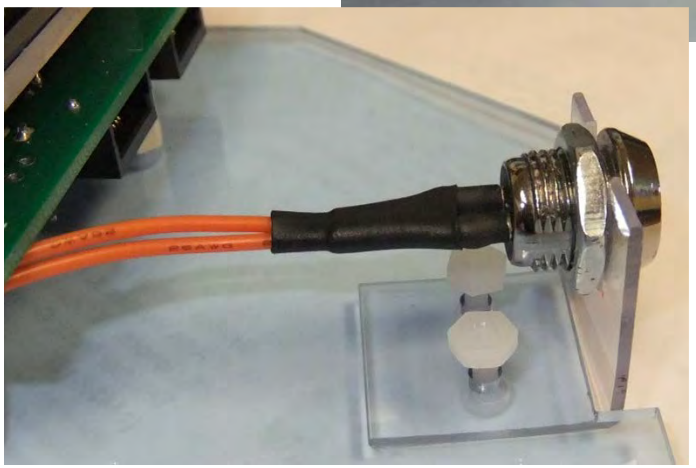


Building the Video Payload: On/Off Key Switch

Pi/Power Board stack

Mount the on/off key switch bracket under the acrylic base plate and fasten with the two nylon screws and nuts. The screw will go in through the bottom of the acrylic base plate with the nut on top.



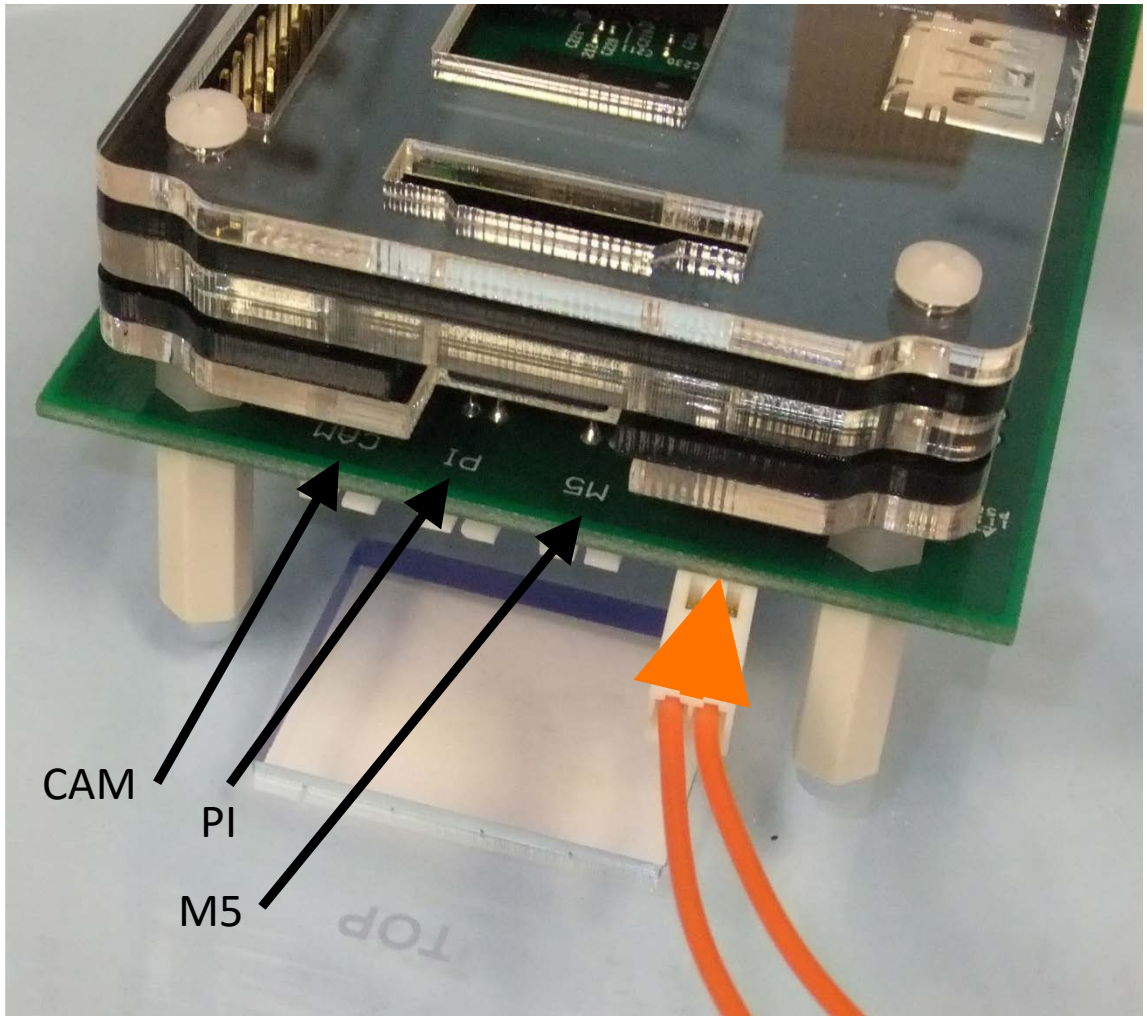


Tighten snug, but do not overtighten.

3/8 inch nylon screw (F21)

Building the Video Payload STEP 33: Plugging in the On/Off Key Switch

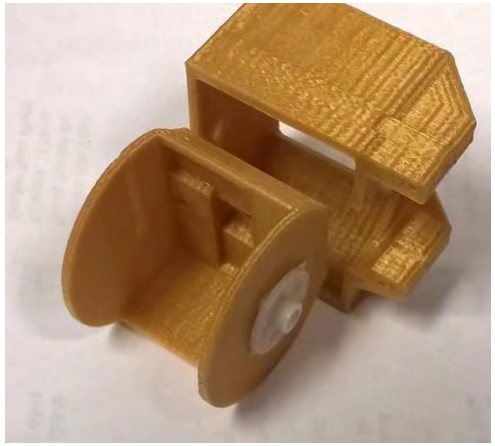
Plug the key switch into the power board using the 3 pin male plug located just to the right of the male M5 plug. **MAKE SURE THE KEY SWITCH IS IN THE OFF POSITION!**



Building the Video Payload: Pi Video Camera Housing

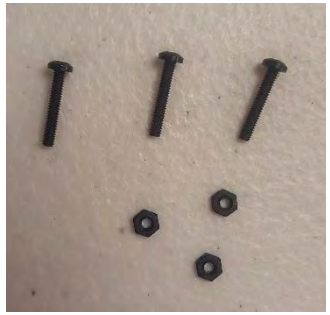
The camera mount and camera mount housing are two 3D printed components to house the Pi video camera and attach to the acrylic base plate. Please gather the following components for steps XX through YY:

Pi Video Camera (F7)



Pi Camera 3D Printed Housing (F26)

Pi Camera Servo (F13)



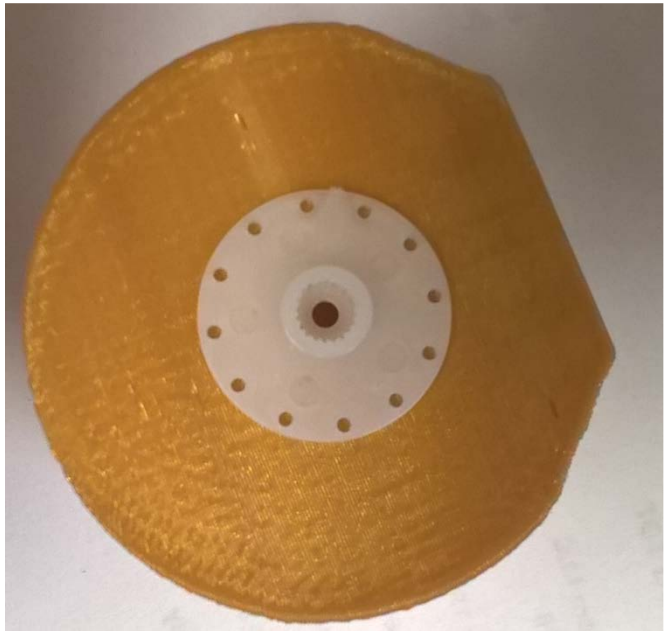
Camera Mount pan head screw and nut (F27 & F28)

3/8 inch nylon screw (F21)

Nylon nut (F25)

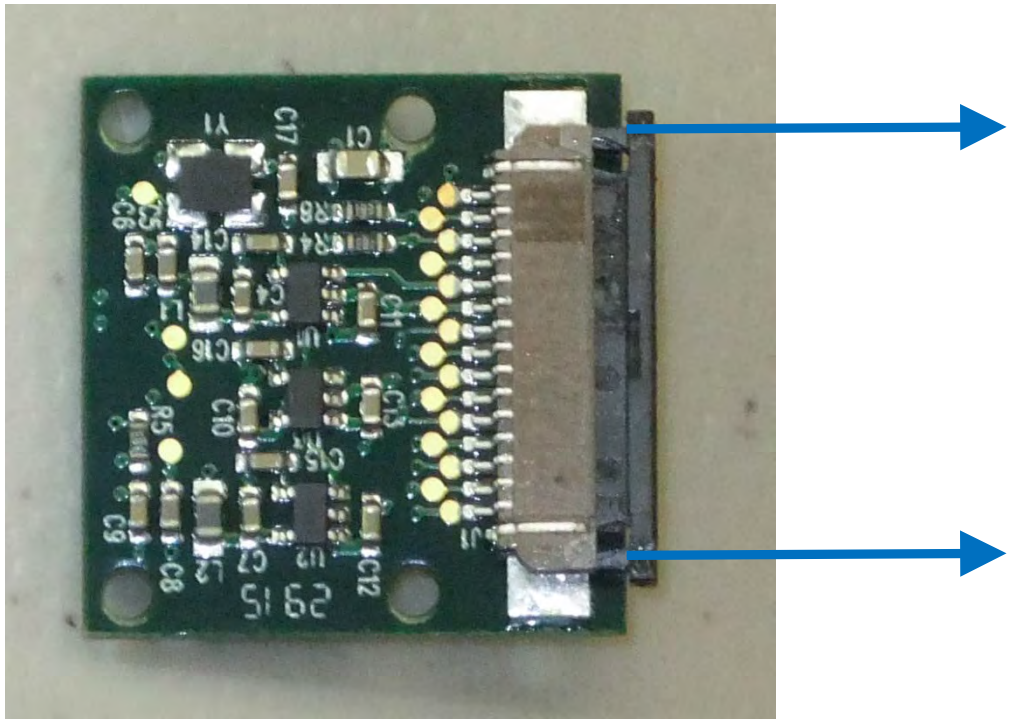
Camera Mount Washer (METAL!)

Building the Video Payload: Pi Video Camera Housing



If you have not already done so during slide 46, glue the motor mount disk onto the side of the side of the 3D camera mount. **MAKE SURE YOU GLUE IT TO THE CORRECT SIDE!**
CHECK ORIENTATION WITH IMAGES ABOVE!
Let the glue set for 5-10 minutes

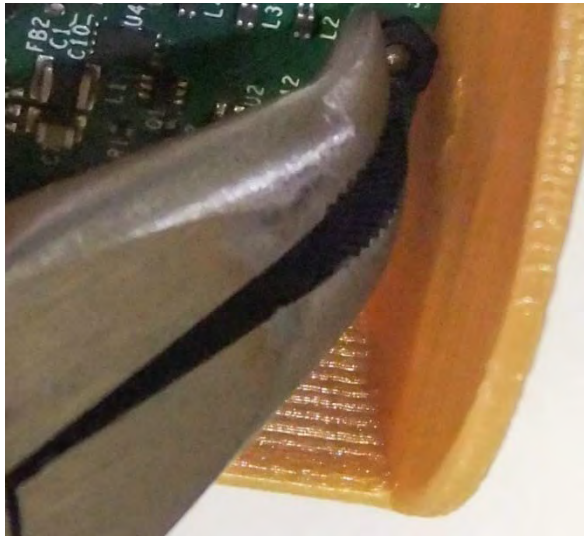
Building the Video Payload: Pi Video Camera Housing

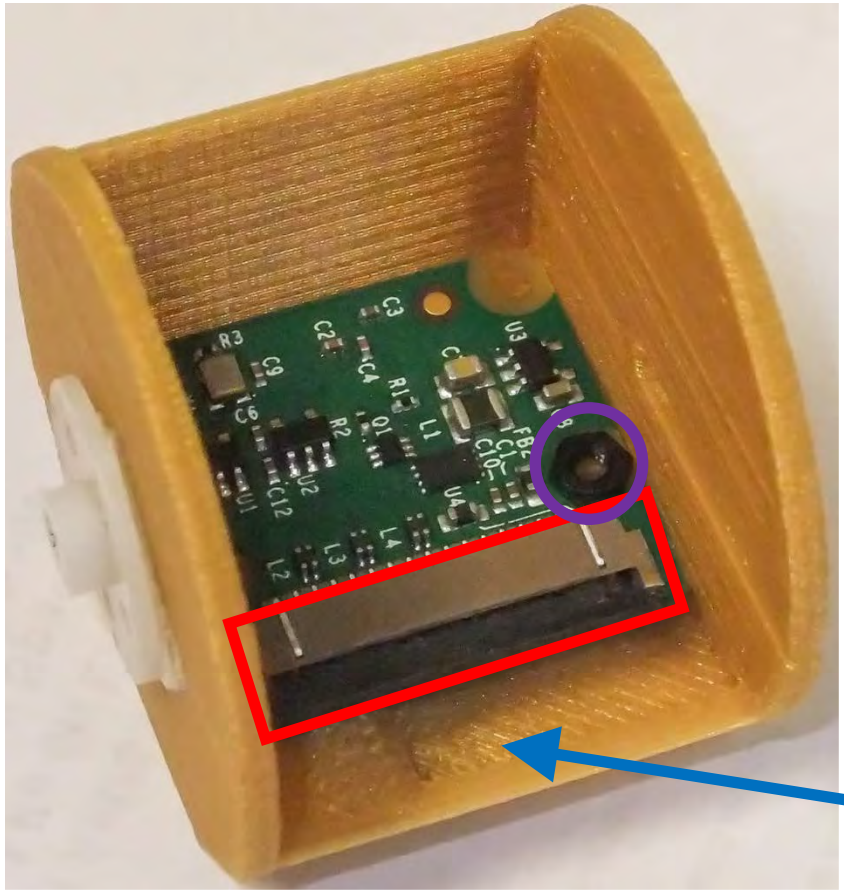


Take you Pi Camera (F7) and remove the ribbon cable that came pre-installed. Save this ribbon cable as a backup or for future use. **Remember to pull the two edge tabs GENTLY directly out to remove the lock. Be gentle as these locks can break easily if mishandled!** Leave the lock open and “loose” for now.

Building the Video Payload: Pi Video Camera Housing

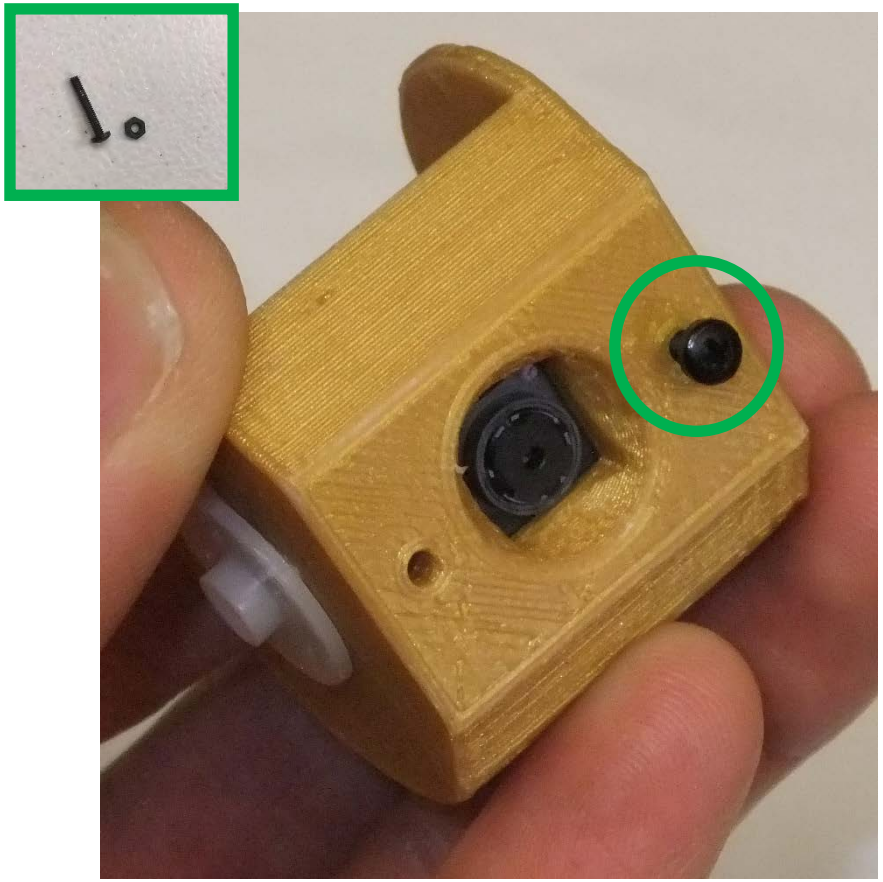
Place the camera into the camera mount. Place such that the **connector for the flex cable** is pointed toward the "**open end**" of the enclosure. Line up the PCB holes with the holes in the camera mount as best you can. Take a black **2 mm nut (F28)** and **place over the hole on the PCB** as shown.

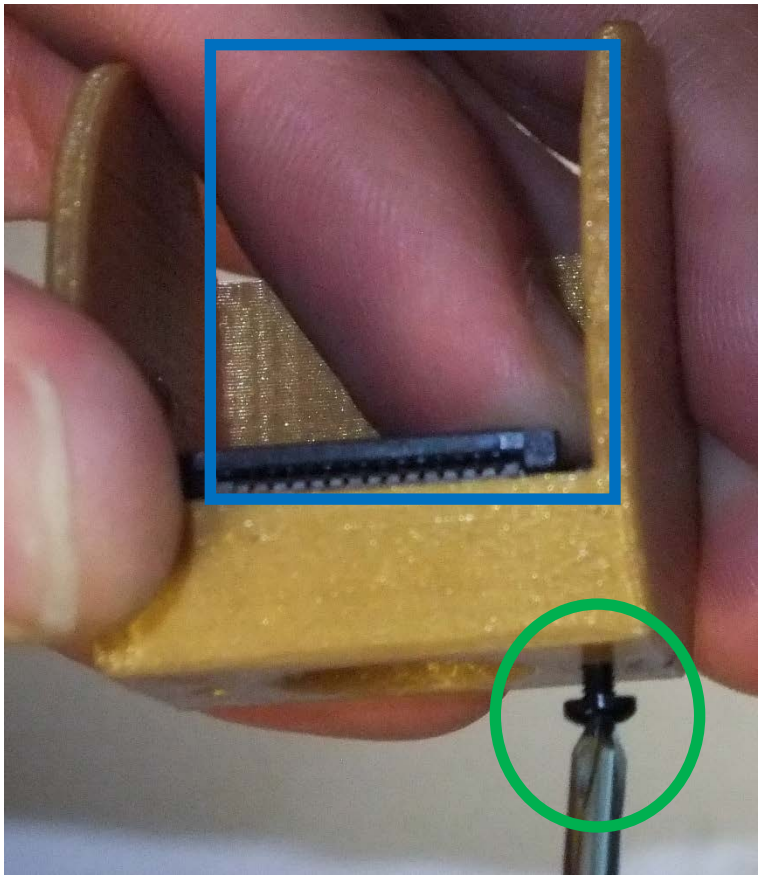




Building the Video Payload: Pi Video Camera Housing

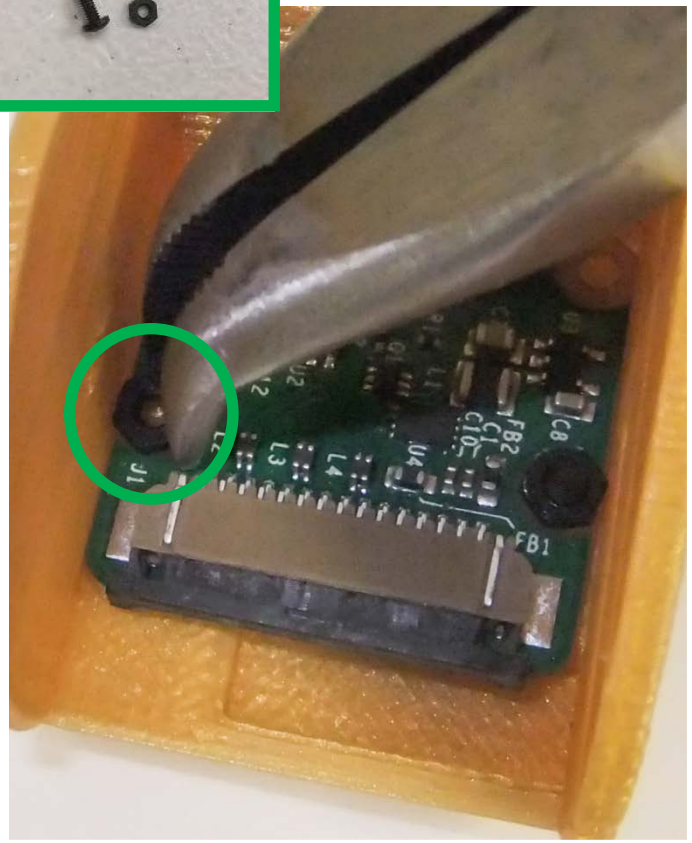
While holding the nut in place with your finger, thread a **2 mm screw (F27) through front of the camera mount**. GENTLY move your finger with the nut around (being careful not scrape the nut against any components) until the screw catches the threads of the nut. DO NOT OVER TIGHTEN. TIGHTEN UNTIL GENTLY SNUG.

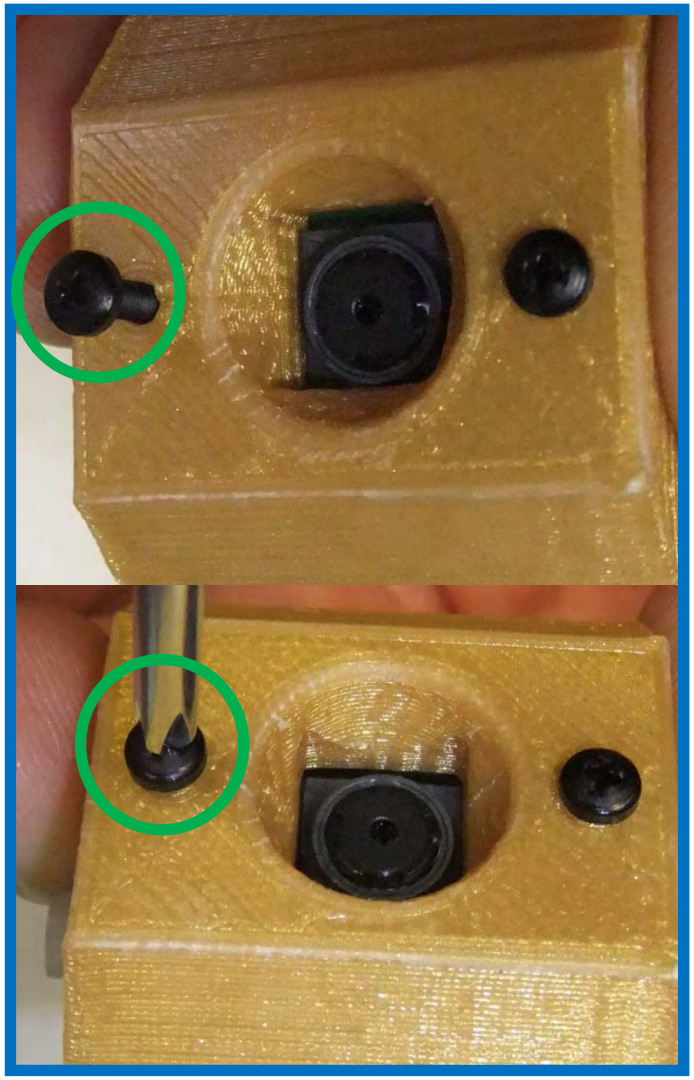




Building the Video Payload: Pi Video Camera Housing

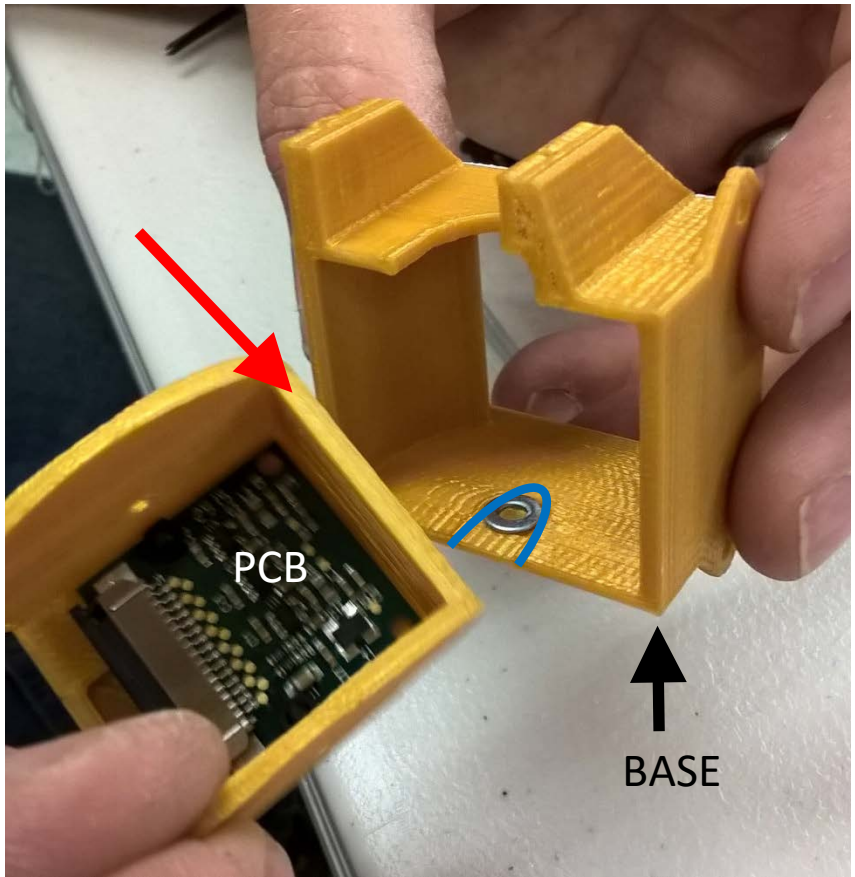
Perform the same task with another 2 mm screw and nut. Place the nut on the camera PCB and hold in place with your finger while you insert and screw in the screw.

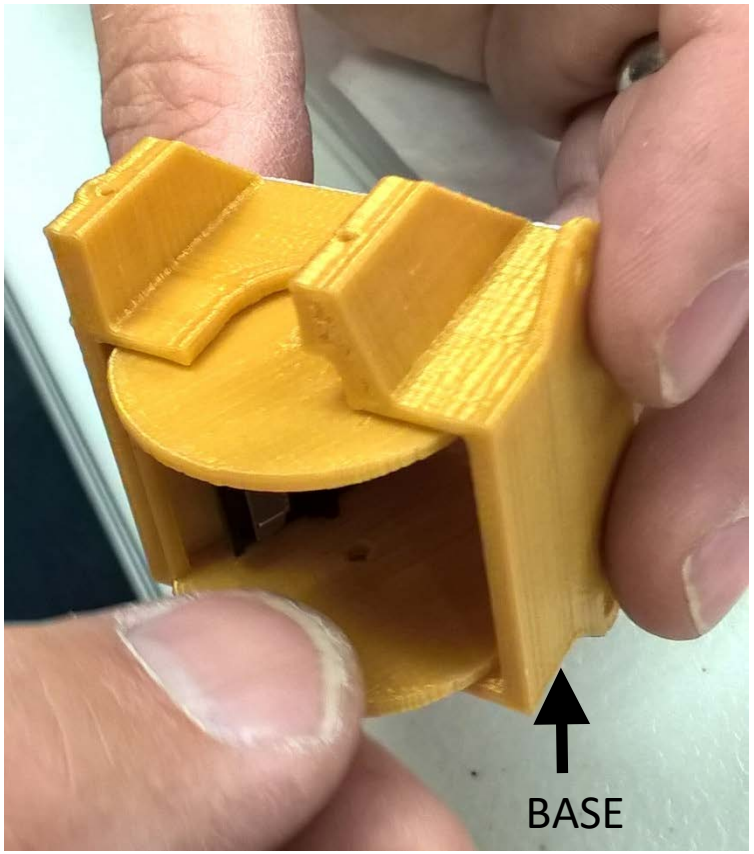




Building the Video Payload: Pi Video Camera Housing

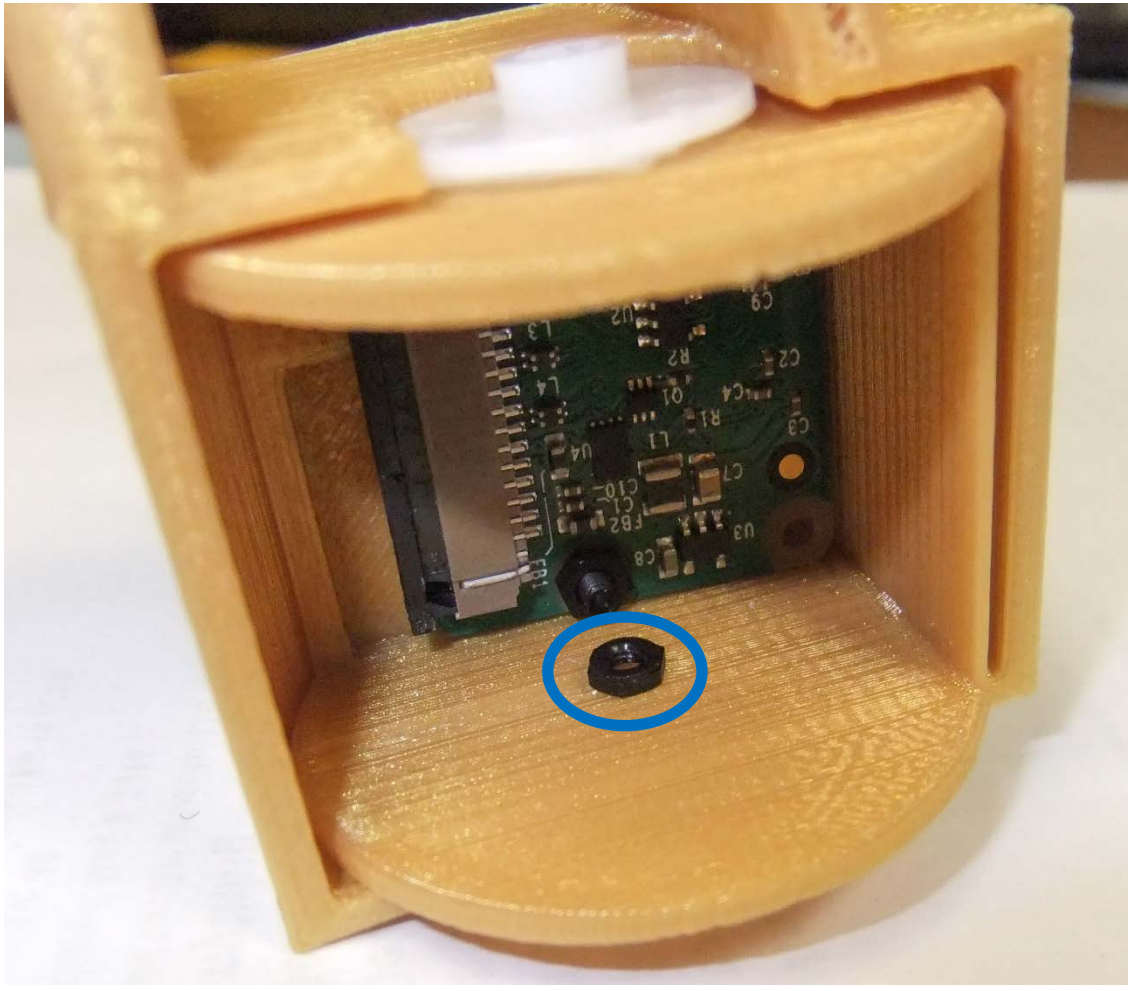
Place the **small metal washer** in the **indentation in the camera mount housing** (note placement and orientation of the base of the camera mount housing). Then carefully slide the camera mount into the camera mount housing inserting the **enclosed end in first** with PCB facing outward. Once inserted the ribbon cable connector should be on the opposite side of the base of the camera mount housing.





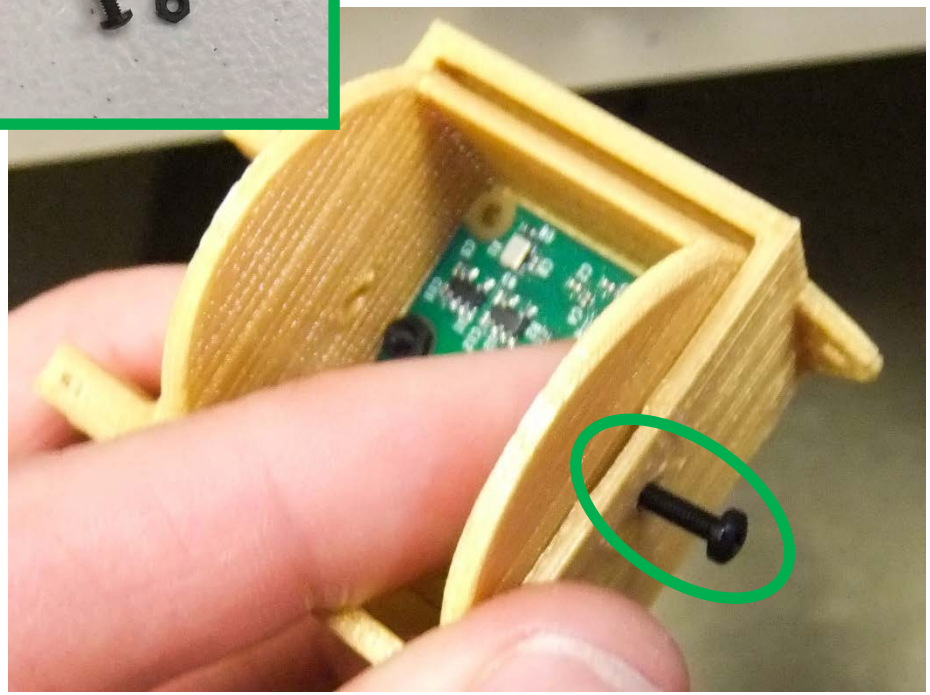
Building the Video Payload: Pi Video Camera Housing

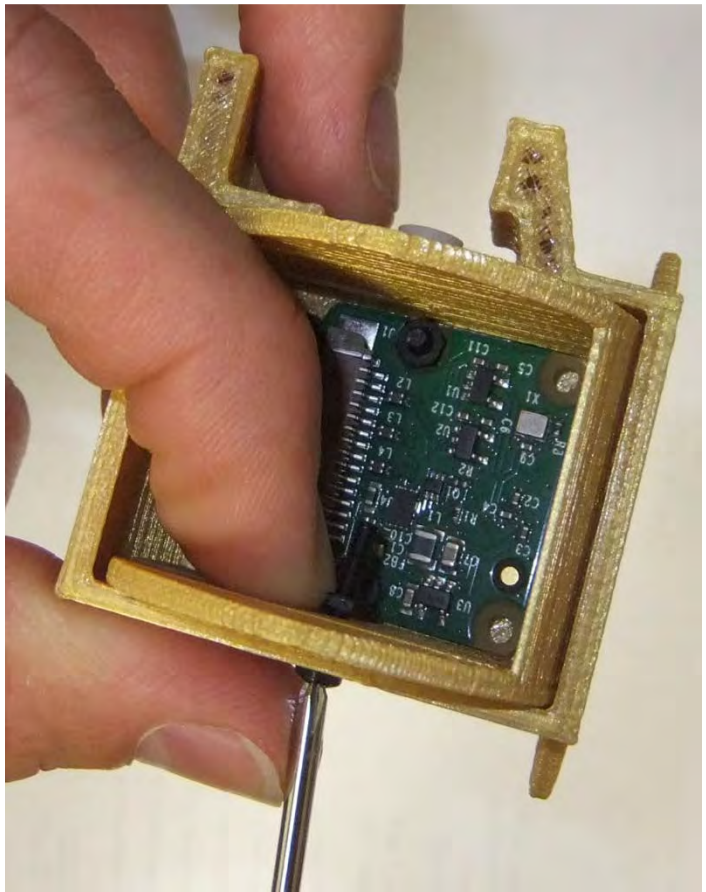
Take the last **2 mm screw and nut (F27 and F28)** and **place the nut on the hole in the camera mount opposite of the motor mount disk**.



Building the Video Payload: Pi Video Camera Housing

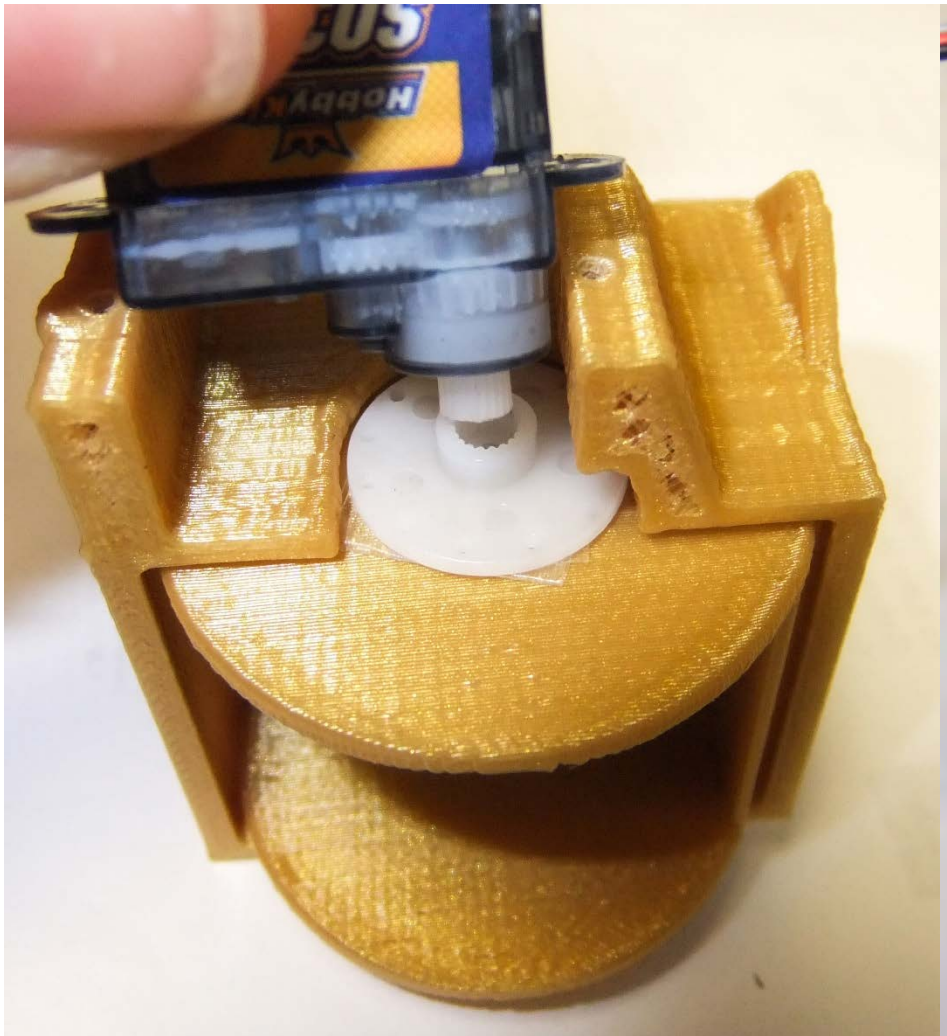
While holding the 2mm nut in place with your finger, thread the 2mm screw through the camera mount housing, washer, and camera mount. Move the nut around with your finger until the screw catches the threads and tighten snug. You want the camera mount to move un-impeded within the housing.





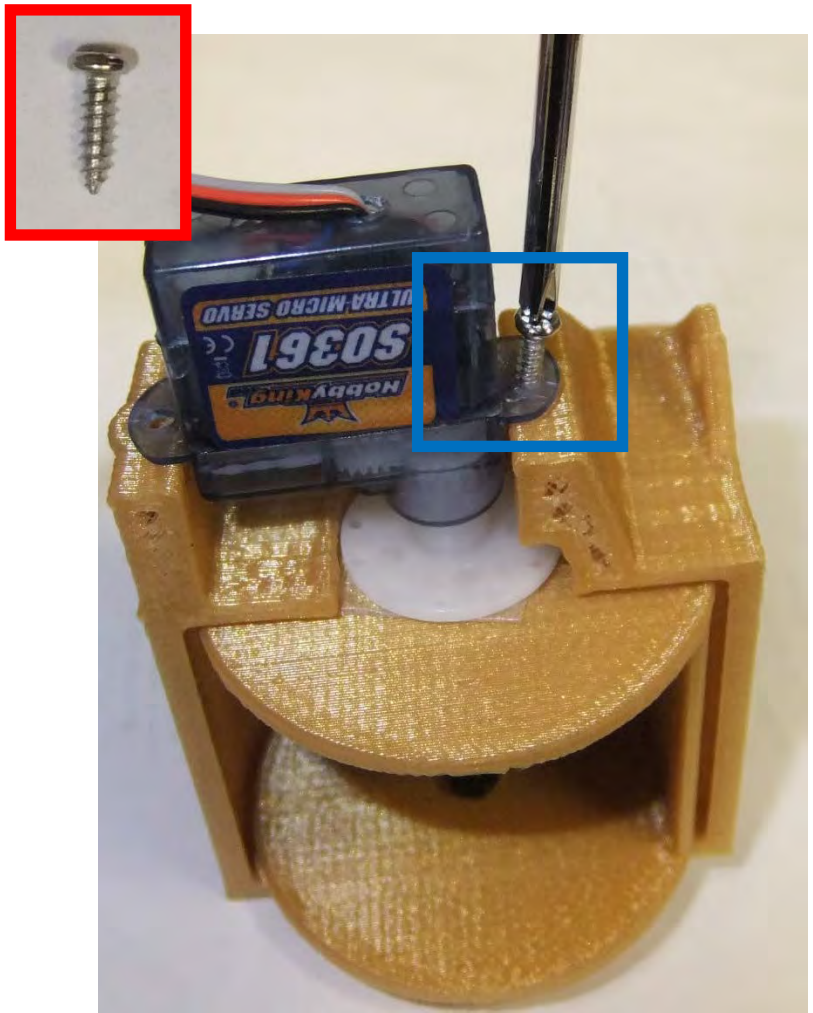
Building the Video Payload: Pi Video Camera Housing

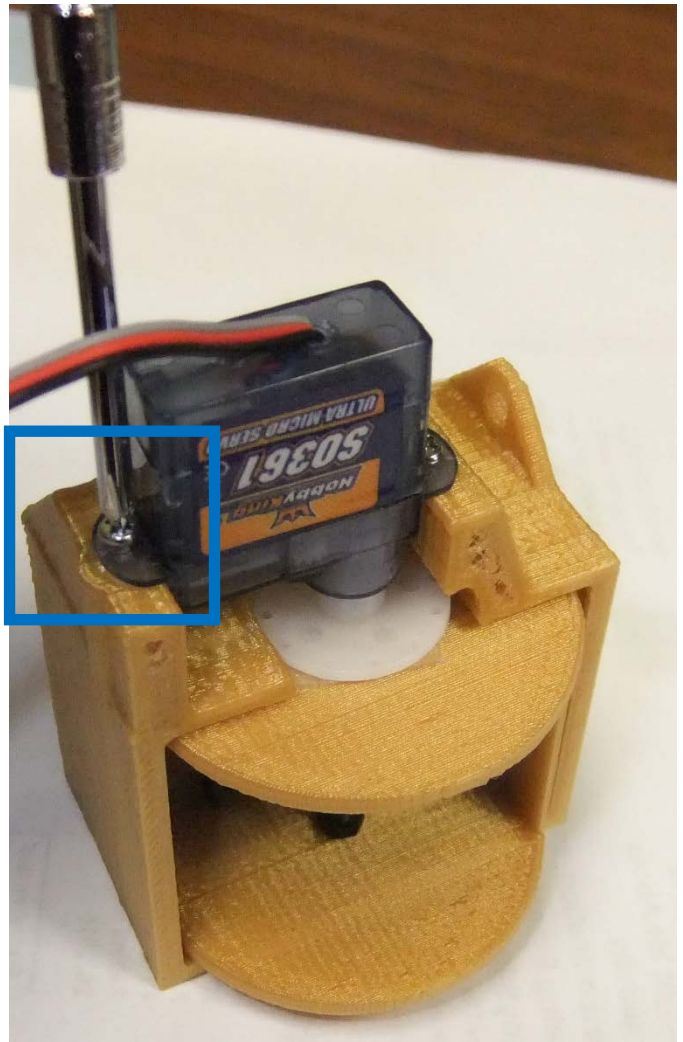
Insert the motor (F13) into the motor mount disk in the orientation shown below.



Building the Video Payload: Pi Video Camera Housing

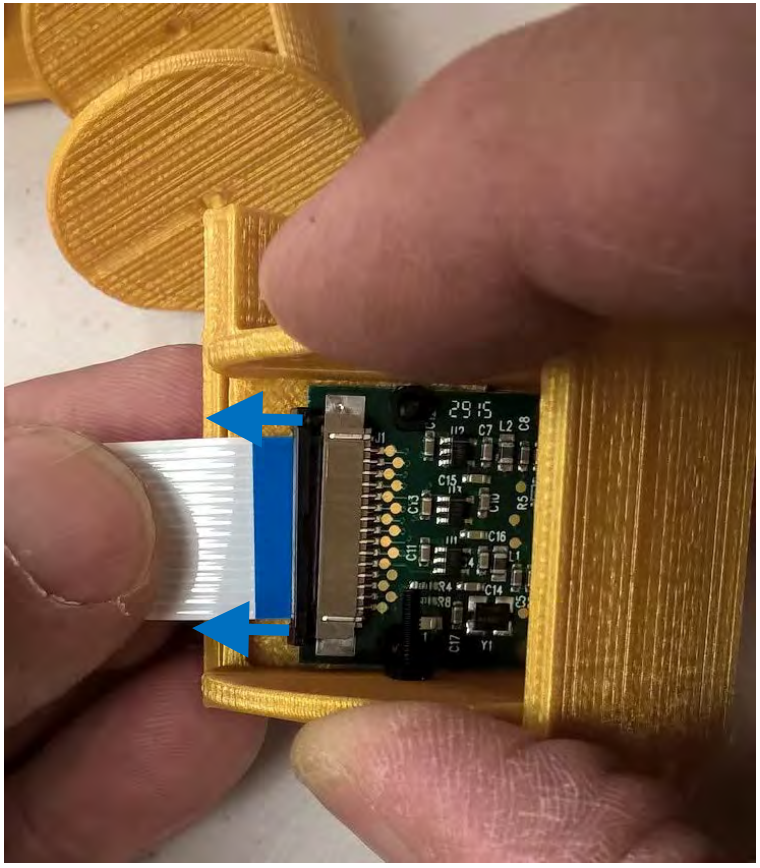
Secure the motor to the camera mounting housing by taking the **two self tapping screws (F29)** and screwing the motor into the housing as shown:

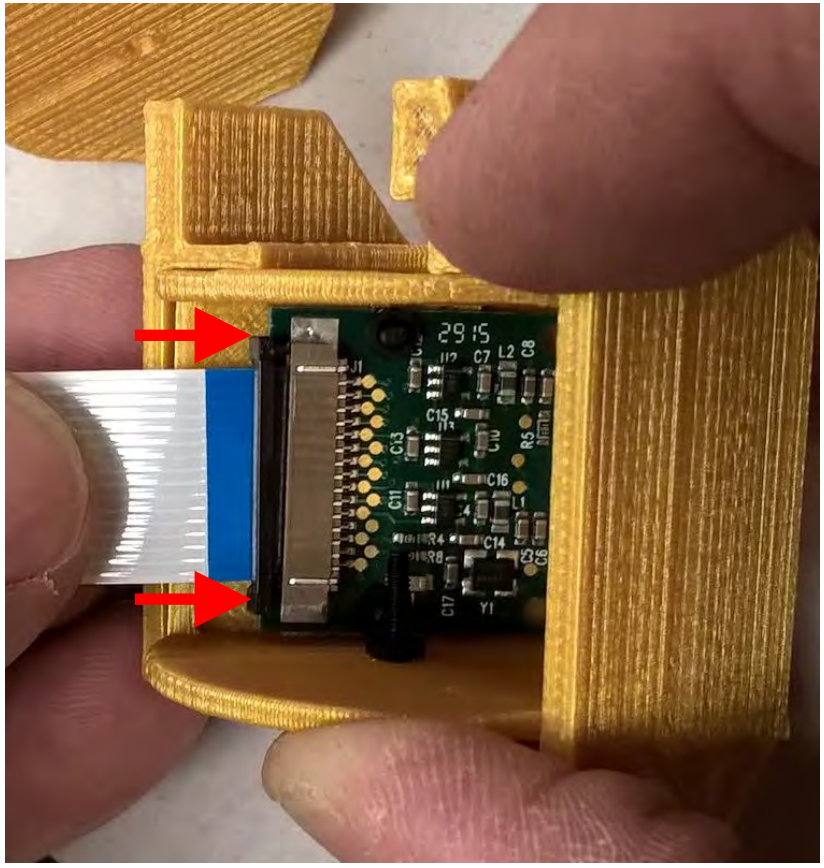




Building the Video Payload: Pi Video Camera Housing

Make sure the ribbon cable connector on the back of the Pi Camera is unlocked. If not, unlock by **GENTLY** **pulling the black lock out** straight out. Insert the ribbon cable such that the exposed pins face the PCB as shown below. **Gently** **push the black lock in** to the lock the ribbon cable into place.

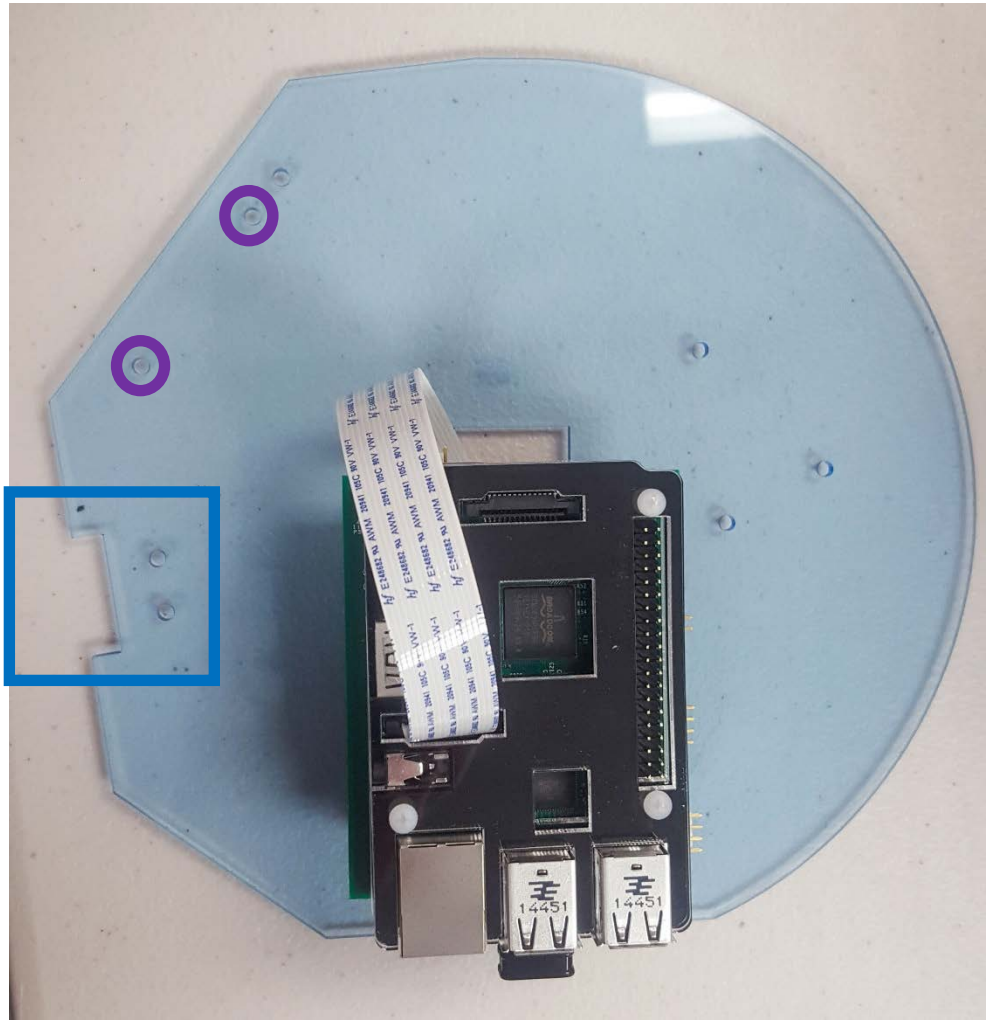


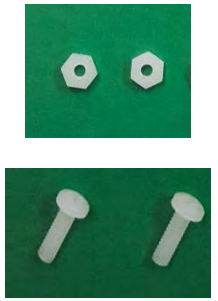


Building the Video Payload: Pi Video Camera Housing Mounting

The camera mount housing enclosure will be mounted on the acrylic base plate using **two mounting holes** with two 3/8 inch nylon screws (F21) and two nylon nuts (F25).

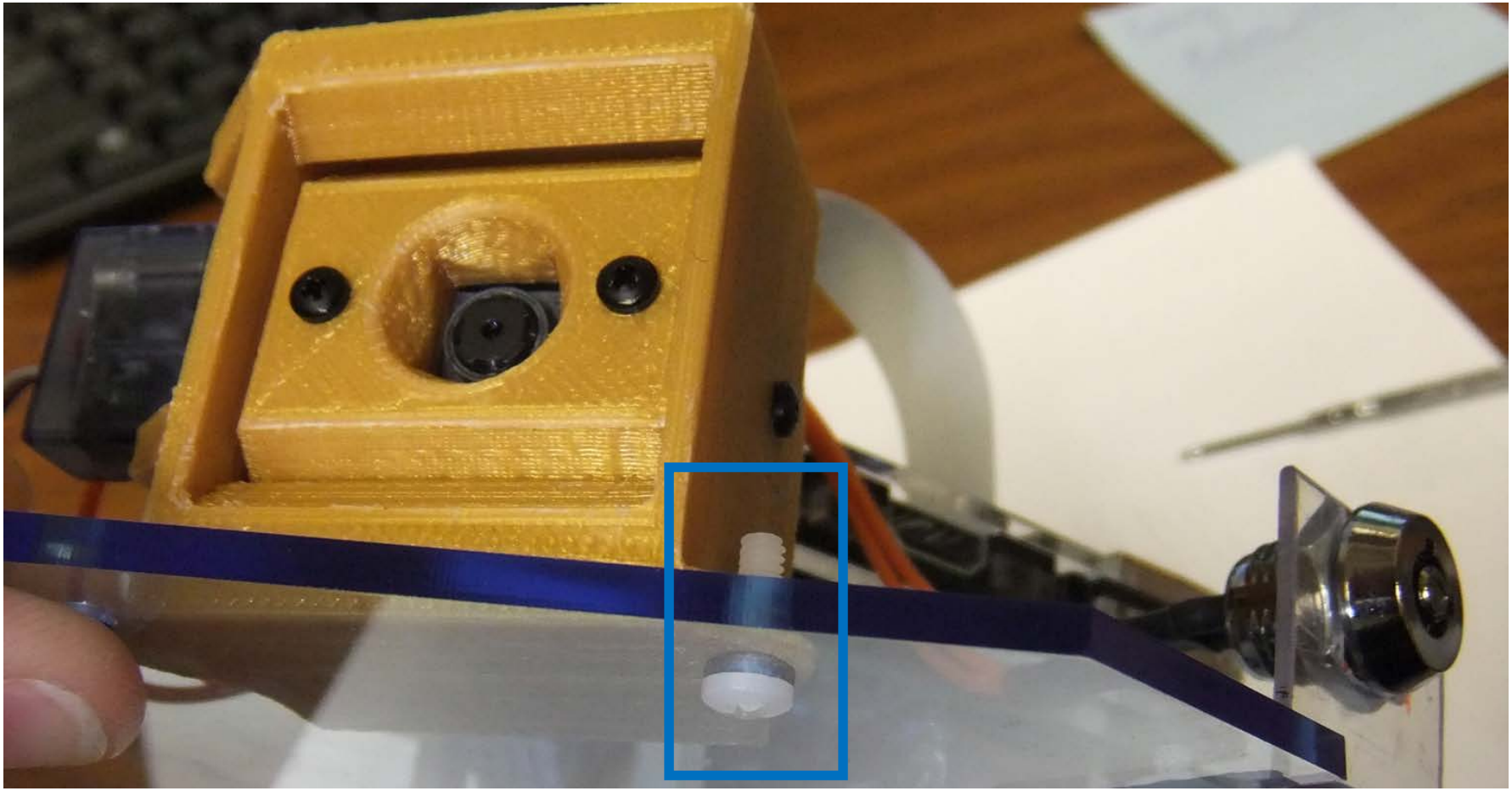
On/Off key switch is mounted here





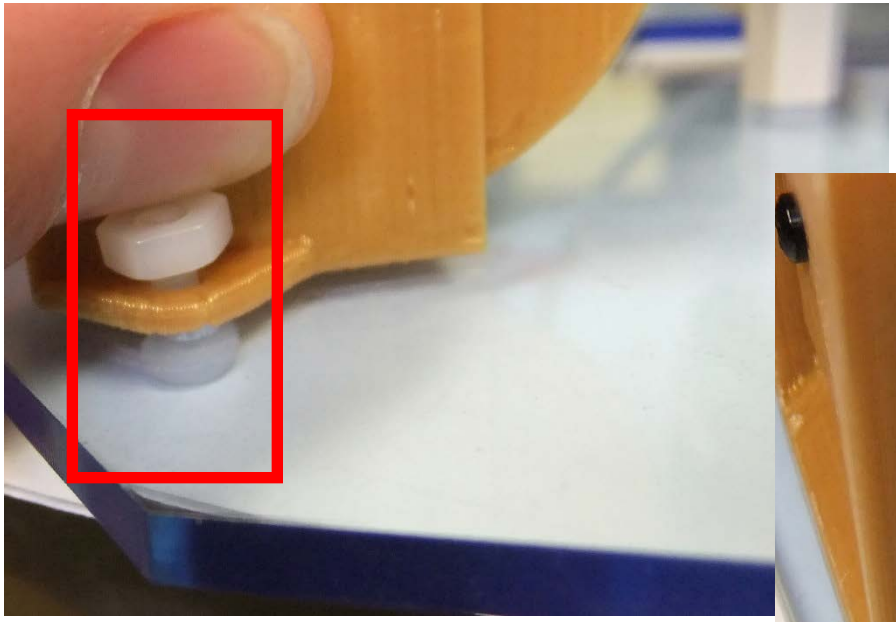
Building the Video Payload: Pi Video Camera Housing Mounting

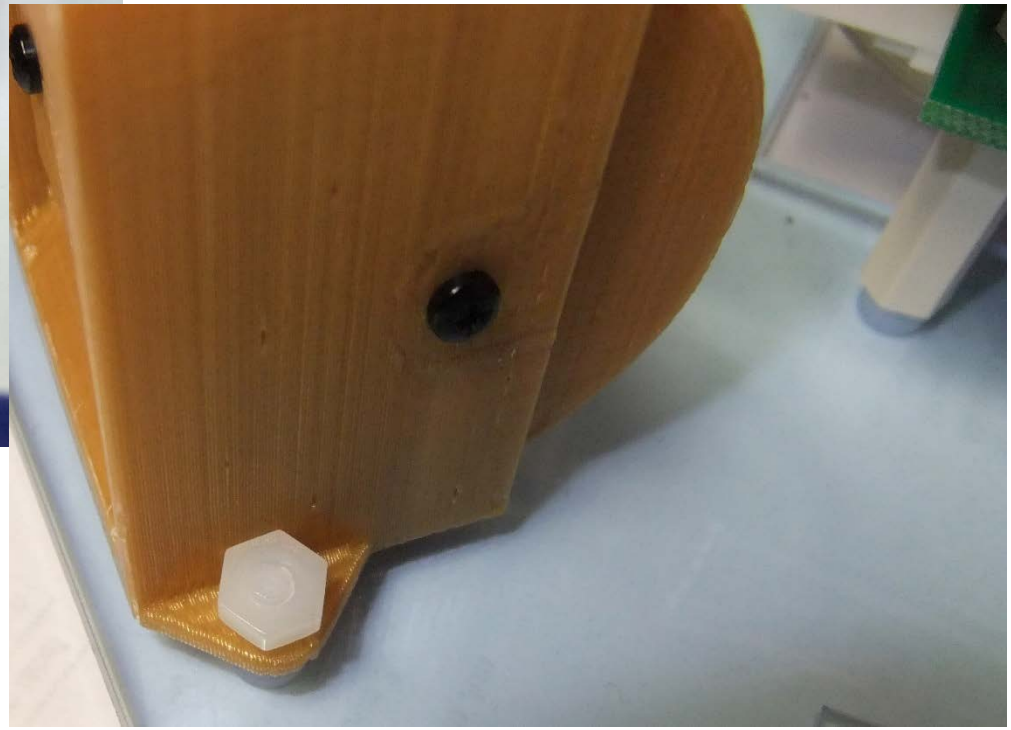
From the bottom of the acrylic base plate **insert a 3/8 inch screw** through the base plate and the mount of the camera housing.



Building the Video Payload: Pi Video Camera Housing Mounting

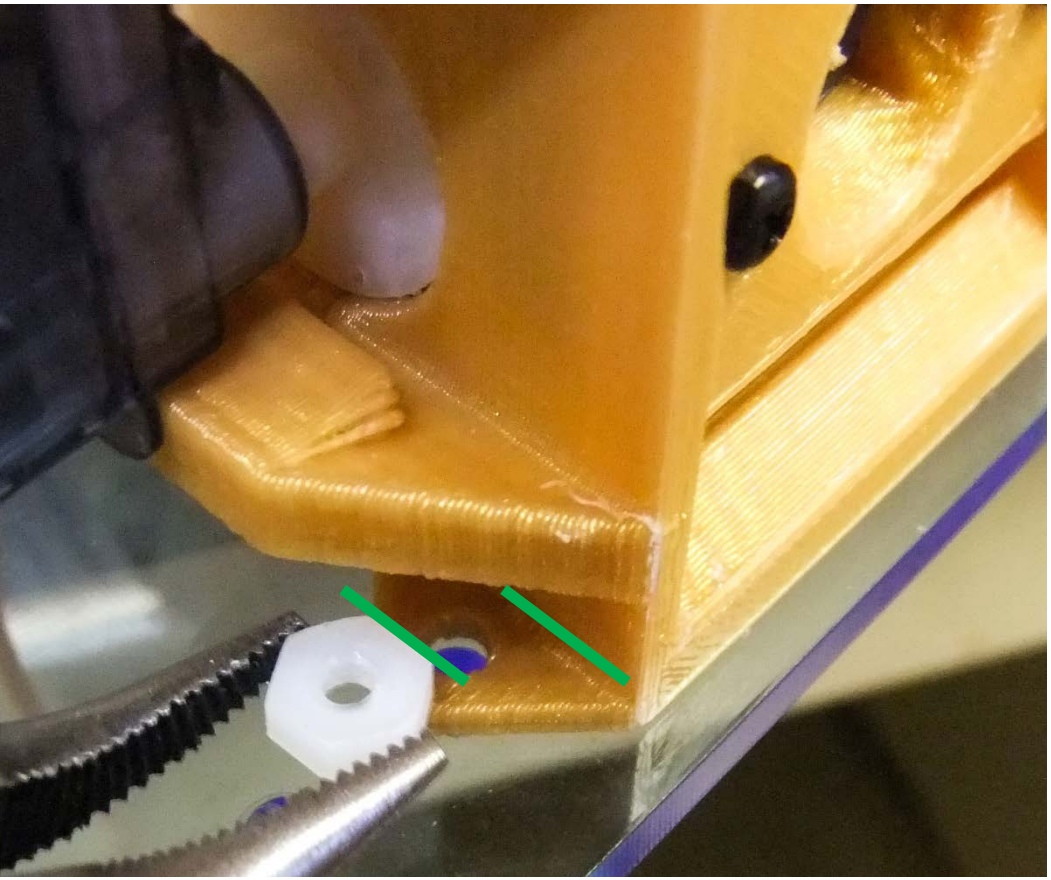
Place a **nut on the top of the 3/8 inch screw** and hold in place with a finger while using a screw driver to thread the screw into the nut from the bottom of the acrylic plate base plate. Tighten snug.

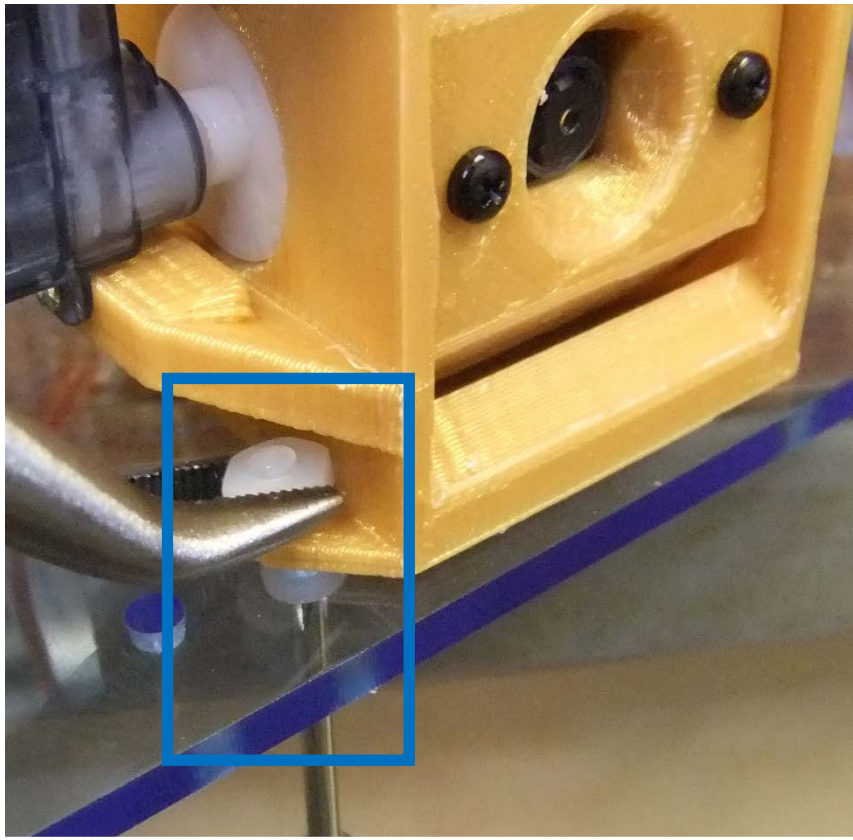




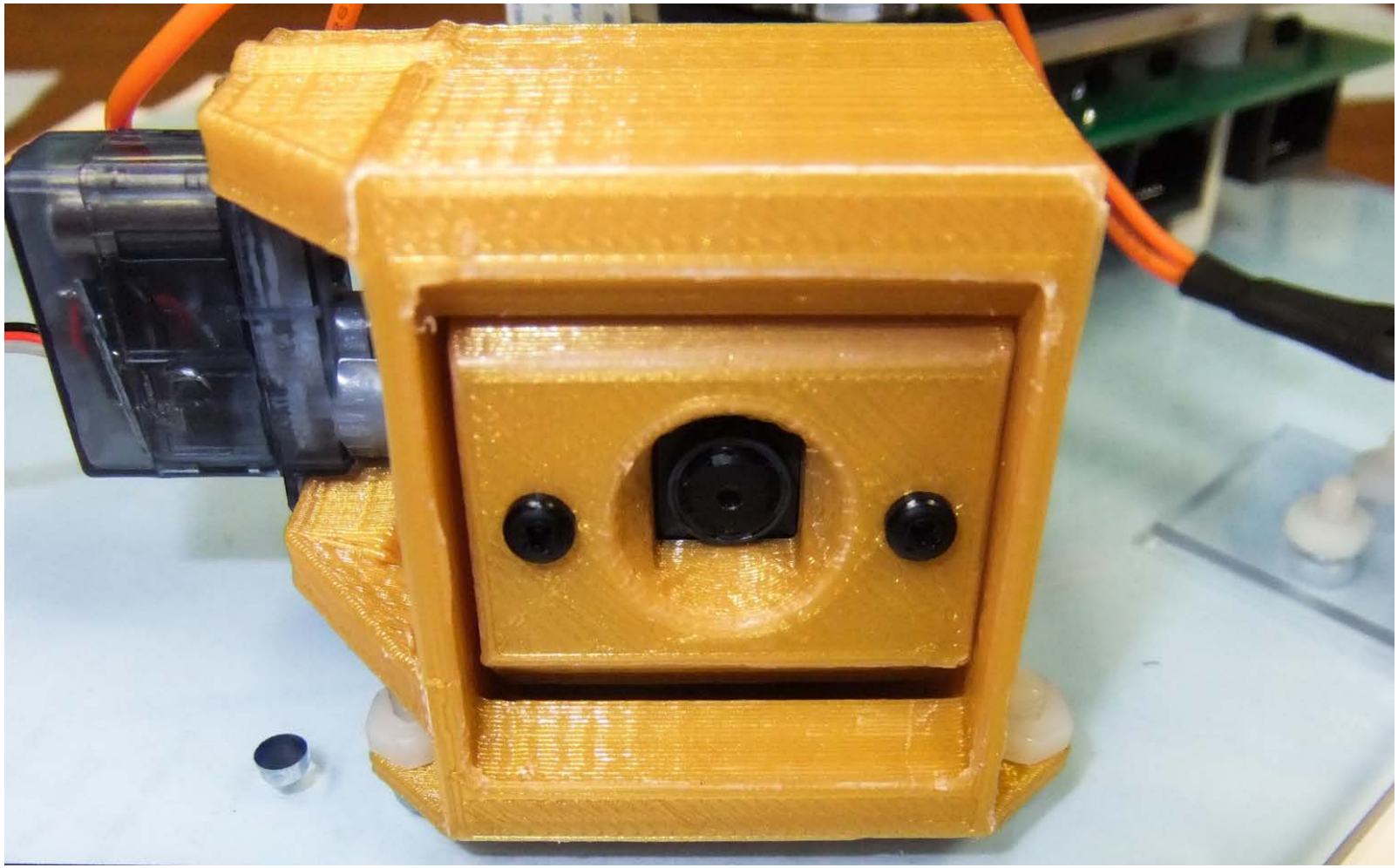
Building the Video Payload: Pi Video Camera Housing Mounting

Grab the last nut with pliers as shown such that the **nut will lie flush with the camera mount housing**. **Hold the nut in place as shown with the pliers while inserting a 3/8 inch screw through the base plate and camera mount housing** and tighten snug.



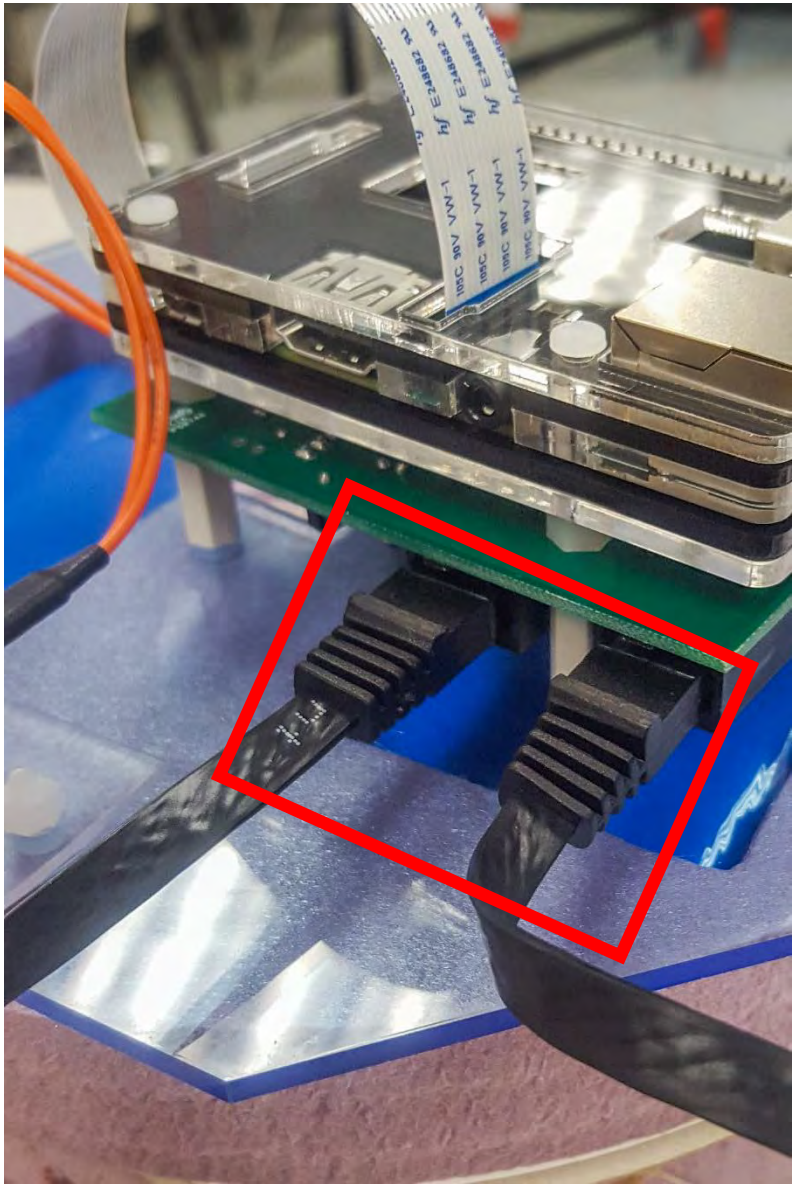


Building the Video Payload: Pi Video Camera Housing Mounting



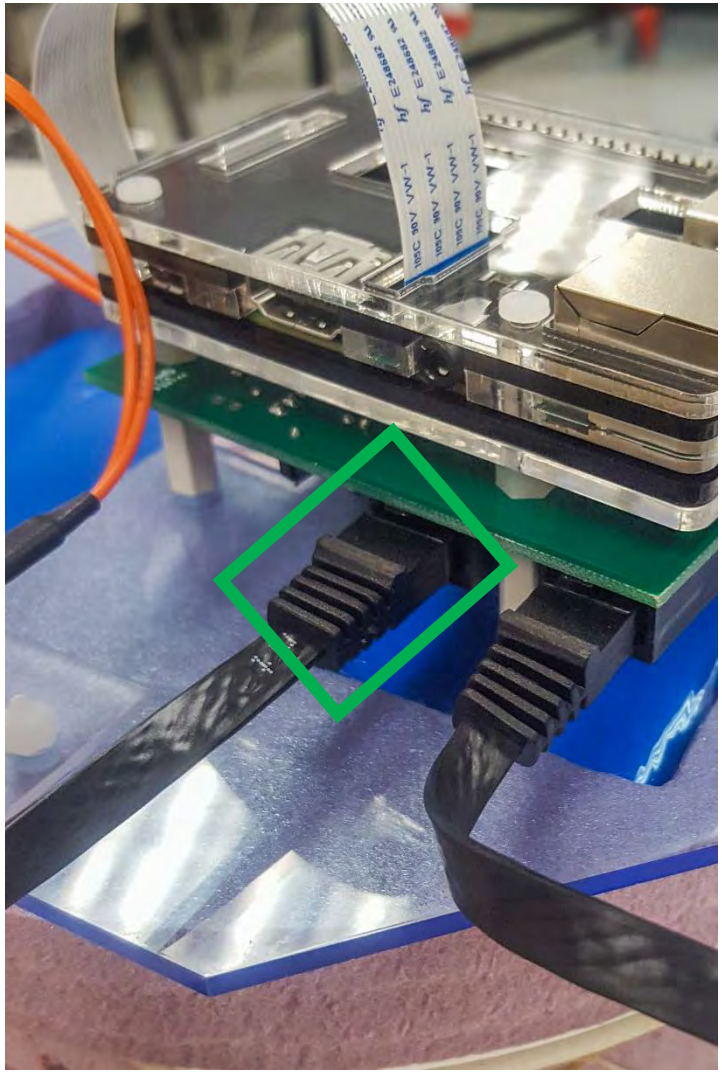
Building the Video Payload: Final Connections

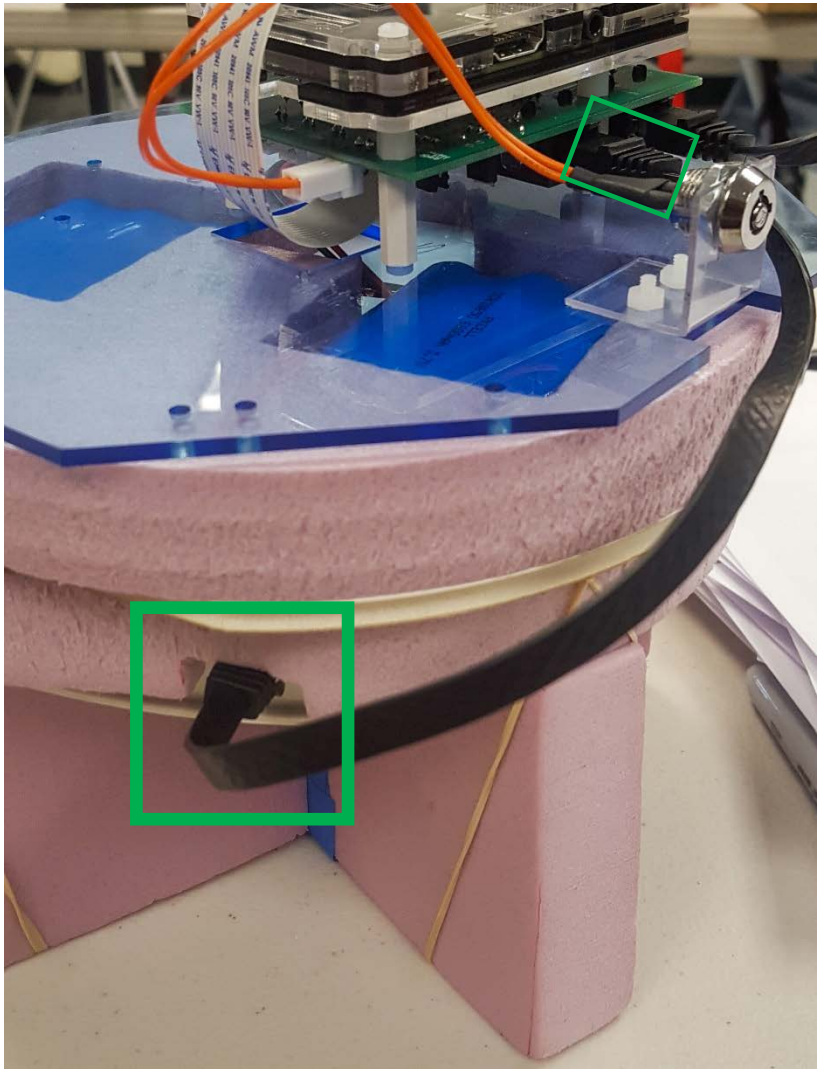
Plug the two flat Ethernet cables (F3) into the power board Ethernet jacks.



Building the Video Payload: Final Connections

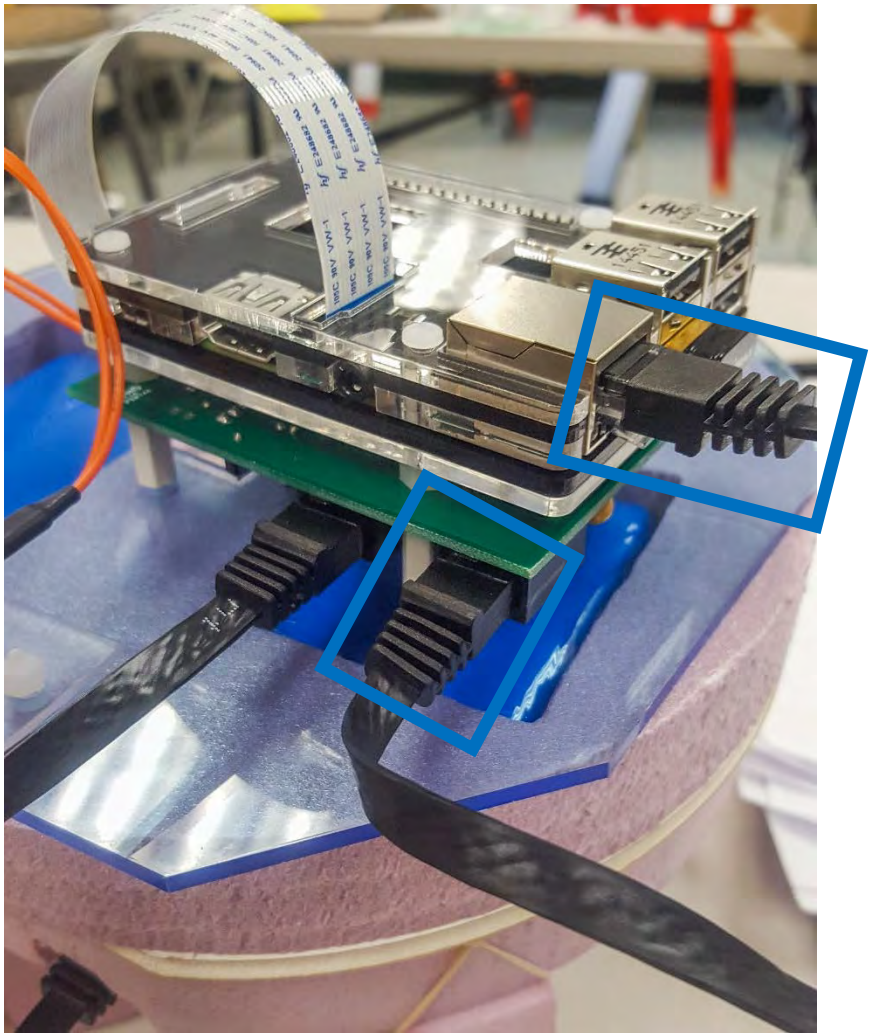
Plug the cable on the Left (M5) into the UBIQUITI M5 Modem Ethernet (Lan) port.





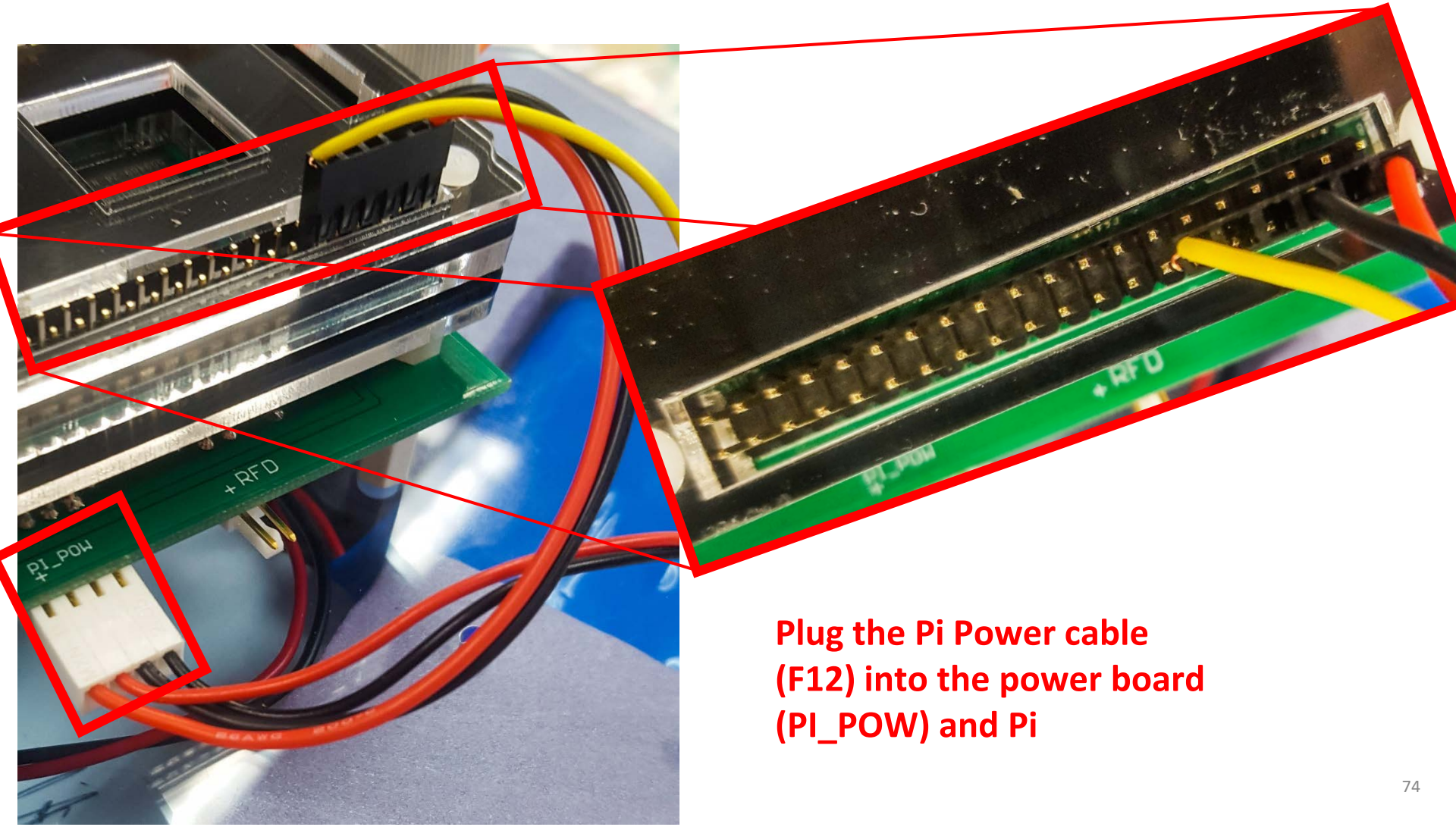
Building the Video Payload: Final Connections

Plug the cable on the right side of the power board (Pi) into the Pi board Ethernet port.



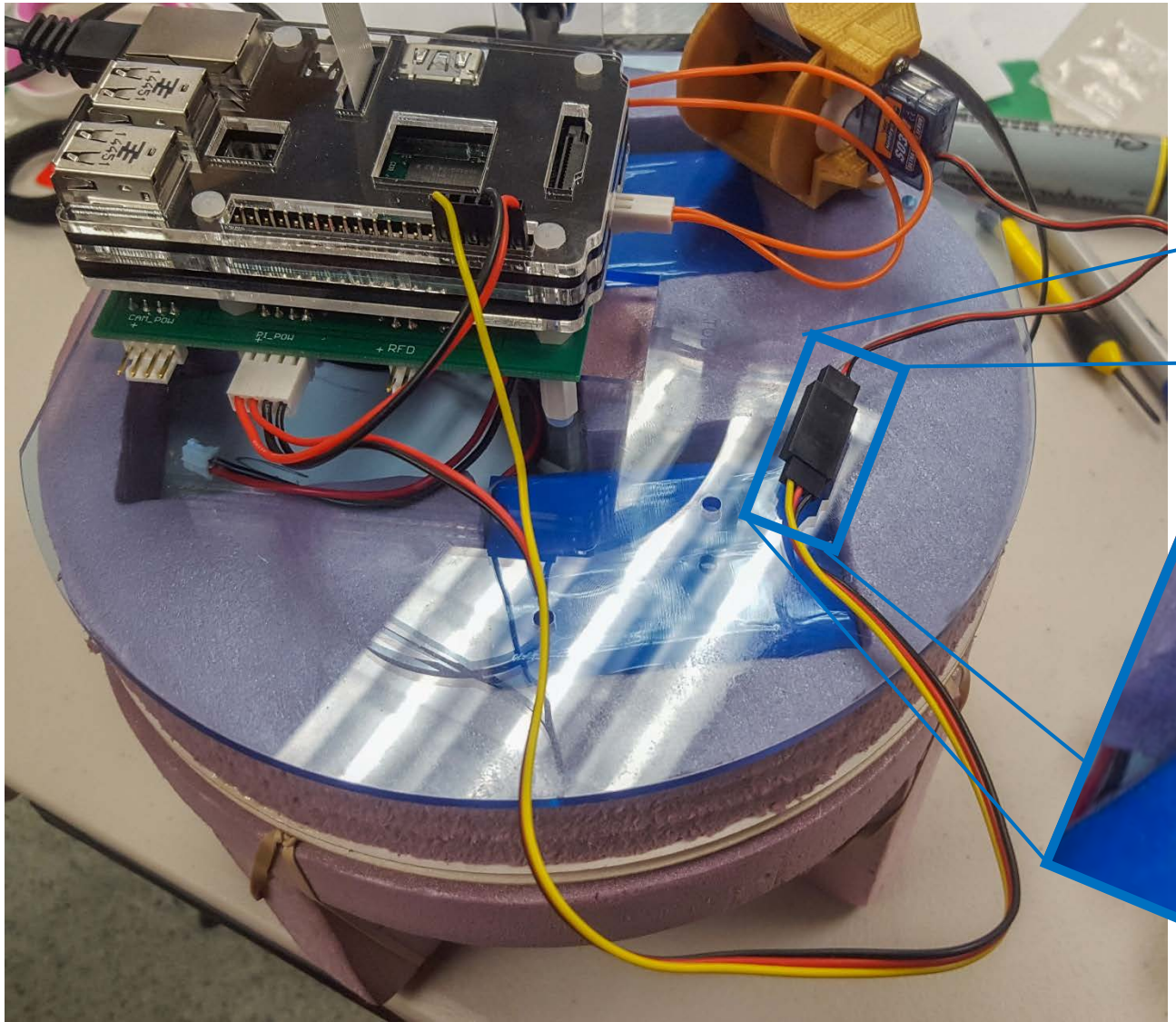
Building the Video Payload: Pi Power

(Top View)

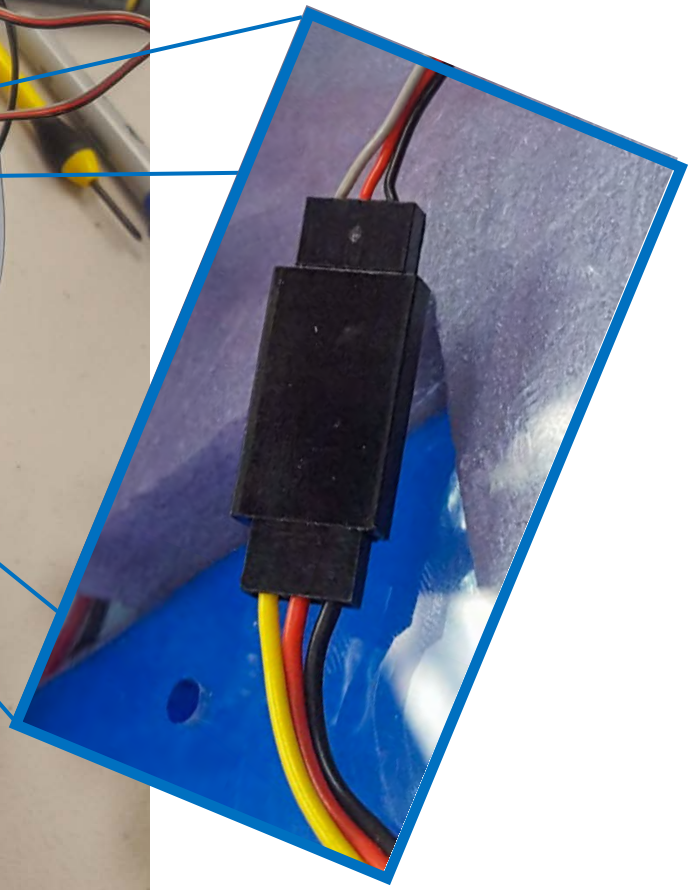


Plug the Pi Power cable (F12) into the power board (PI_POW) and Pi

Building the Video Payload: Pi and Motor Power



Plug the camera tilt motor into the Pi Power Harness as shown.



Your 3.7V 6600mAh Lithium Ion Battery Pack

Taking care of, using, and safety of your 3.7V Lithium battery packs.

Safety Notes

- Each cell can provide **0.5C** of current (1.1 A per) so all together the peak current you can draw is over 3.3 Amps. Note that these batteries are not designed to sustain such high loads, we suggest keeping any constant current draw under 0.2C or 1.3A.
- The packs come with color coded wires, and now they come with a JST 2-pin cable attached for use with our chargers! Because they have a genuine JST connector, not a knock-off, the cable won't snag or get stuck in a matching JST jack, they click in and out smoothly. The cables are rated for 2A so if you use them keep that in mind.
- The included protection circuitry keeps the battery voltage from going too high (over-charging) or low (over-use) which means that the battery will cut-out when completely dead at about 3.0V. However, even with this protection **it is very important that you only use a Li-Ion/Li-Poly constant-voltage/constant-current charger to recharge them and at a rate of 0.25C (1.5A) or less.**
- Like most lithium-ion packs, the batteries we sell do not have thermistors built in. This is why we suggest charging at 0.2C or even less - 1A max in this case. Of course, you can charge at a lower rate - it'll just take a little longer to fill up.
- Do not use a Ni-MH/Ni-Cad/lead-acid charger! Also, do not abuse these batteries, do not short, bend, crush or puncture. **Never charge or use unattended. Always inspect batteries and surrounding circuitry constantly for any damage, loose wiring, or possibility of short circuits.** As with all Lithium ion polymer batteries and with any power source - they should be used by experts who are comfortable working with power supplies

To prevent potential leaking, overheating or explosion of batteries please be advised to take the following precautions:

WARNINGS!

- Do not immerse the battery in water or seawater, and keep the battery in a cool dry environment during stand-by periods.
- Do not use or leave the battery near a heat source such as fire or heater.
- When recharging, use the battery charger specifically for that purpose.
- Do not reverse the positive (+) and negative (-) terminals.
- Do not connect the battery to an electrical outlet.
- Do not dispose of the battery in fire or heat.
- Do not short-circuit the battery by directly connecting the positive (+) and negative (-) terminal with metal objects such as wire.
- Do not transport or store the battery together with metal objects such as necklaces, hairpins etc.
- Do not strike or throw the battery against any hard surface.
- Do not directly solder to the battery and pierce the battery with a nail or other sharp object.
- The outer metal conductor should never contact the aluminum laminate film, especially with electrification, since this can result in “black spots ”and/or gas release (swelling).
- Do not use sharp things to hit the battery.

To prevent potential leaking, overheating or explosion of batteries please be advised to take the following precautions:

CAUTIONS!

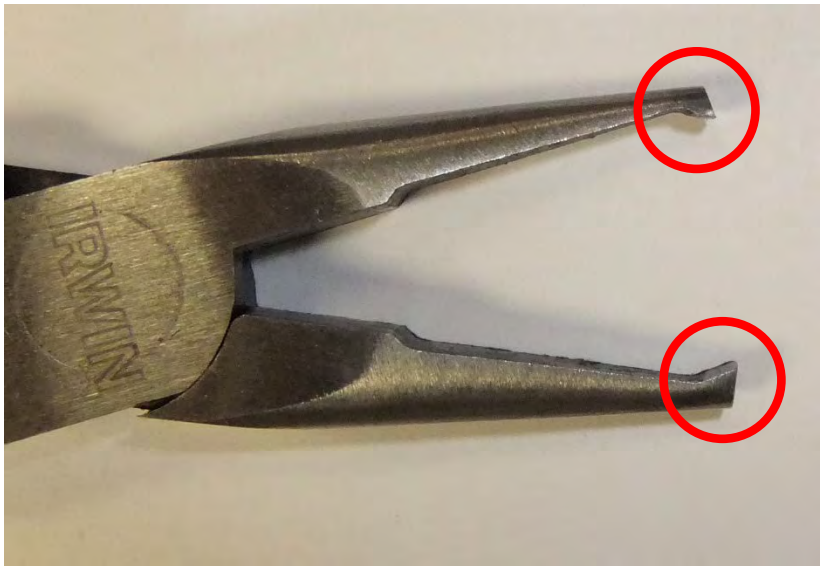
- Do not use or leave the battery at very high temperature (for example, in strong/direct sunlight or in a vehicle in extremely hot weather). Otherwise, it can overheat or catch fire or its performance will be degenerate and its service life will be shortened.
- Do not use it in locations prone to static electric discharges, otherwise, the safety devices may be damaged, causing a harmful situation.
- In case the electrolyte gets into the eyes due to the leakage of battery, do not rub the eyes!
- Rinse the eyes with clean running water, and seek medical attention immediately. Otherwise, it may injure eyes or cause a loss of sight.
- If the battery gives off an odor, generates heat, becomes discolored or deformed, or in any way appears abnormal during use, recharging or storage, immediately remove it from the device or battery charger and place it in a contained vessel such as a metal box.
- In case the battery terminals are contaminated, clean the terminals with a dry cloth before use.
- Otherwise power failure or charge failure may occur due to the poor connection between the battery and the electronic circuitry of the instrument.
- Be aware that discarded batteries may cause fire - tape the battery terminals to insulate them before disposal.

Taking Care of your Batteries

- Be careful plugging the batteries into the power board and un-plugging from the power board.
- Repeatedly pulling/pushing on the wires can cause them to be pulled from the connector (rendering the battery useless) and/or cause a dangerous short.
  - This can also wear out the male power connector on the power board
- We have a few tools and techniques to help keep your batteries in good shape…

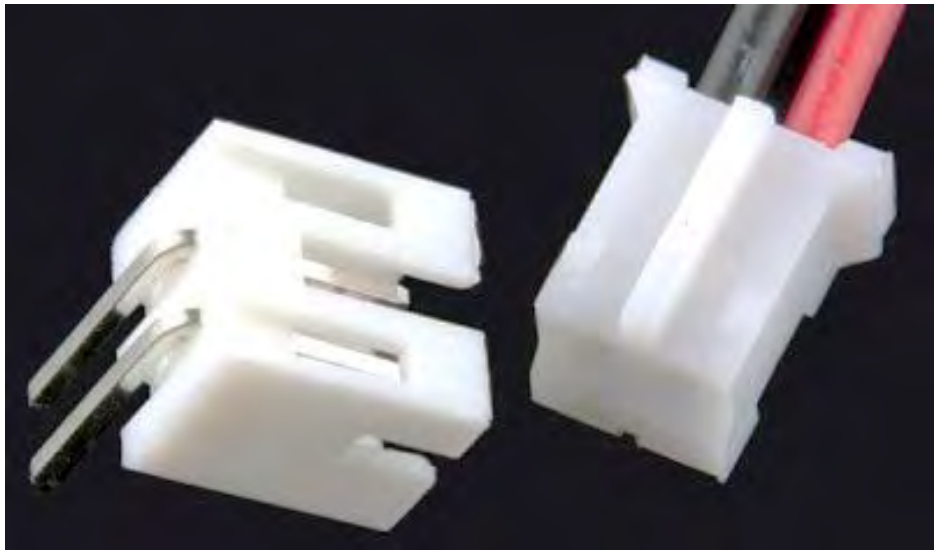
Transverse End Cutter Pliers = Great “Connector Pullers”

- The tool we will use as a “connector puller” is a transverse end cutter pliers, should you need to get a replacement
  - These work well because you are able to grab the connector firmly and pull the connector out, lessening the risk of slipping off the connector and damaging the wires.
  - These are not cheap! Try and take care of the one in your kit.
  - Should you buy a new connector puller, take a metal file and file down the sharp “**teeth**” of the pliers so they don’t cut into the connector.



Connector “Gender”

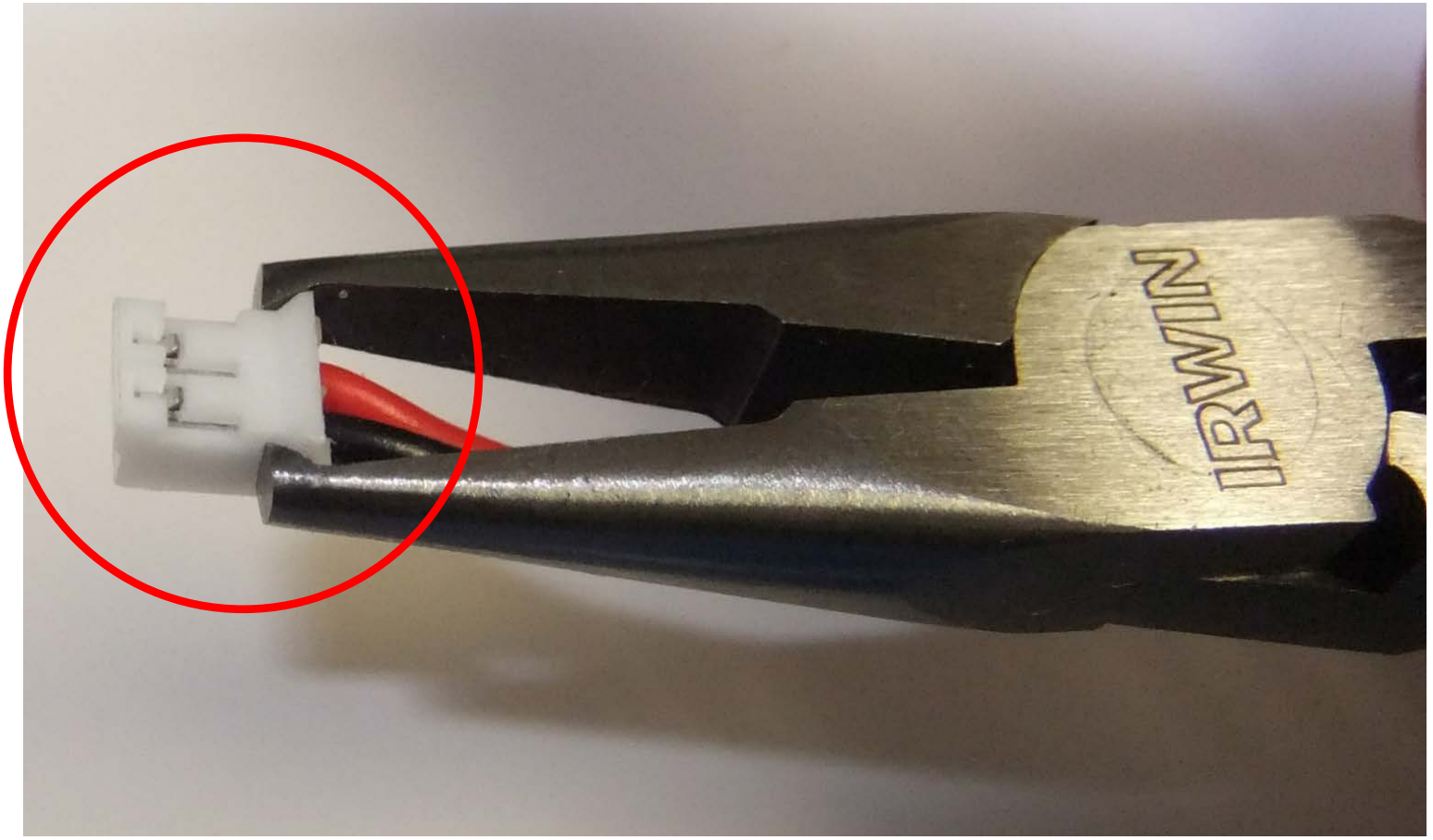
Gender - The gender of a connector refers to whether it plugs in or is plugged into and is typically male or female, respectively (kids, ask your parents for a more thorough explanation). Unfortunately, there are cases where a connector may be referred to as “male” when it would appear to be female



Male (left) and female 2.0mm PH series JST connectors. In this case, gender is determined by the individual conductor.

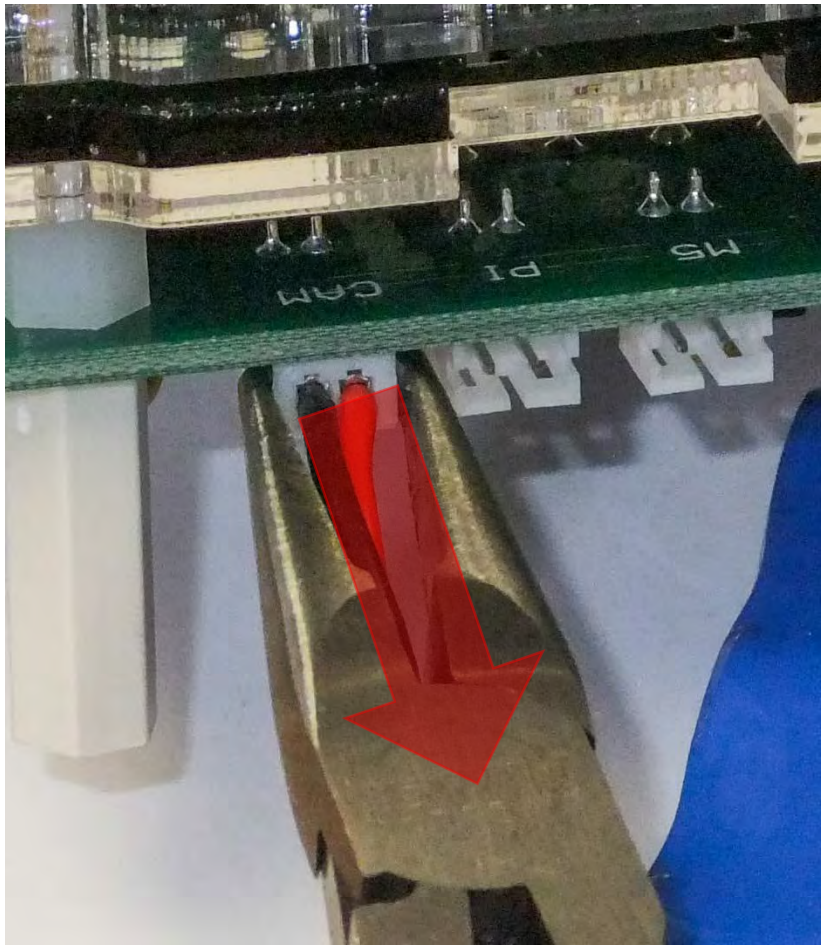
Using the Connector Pullers

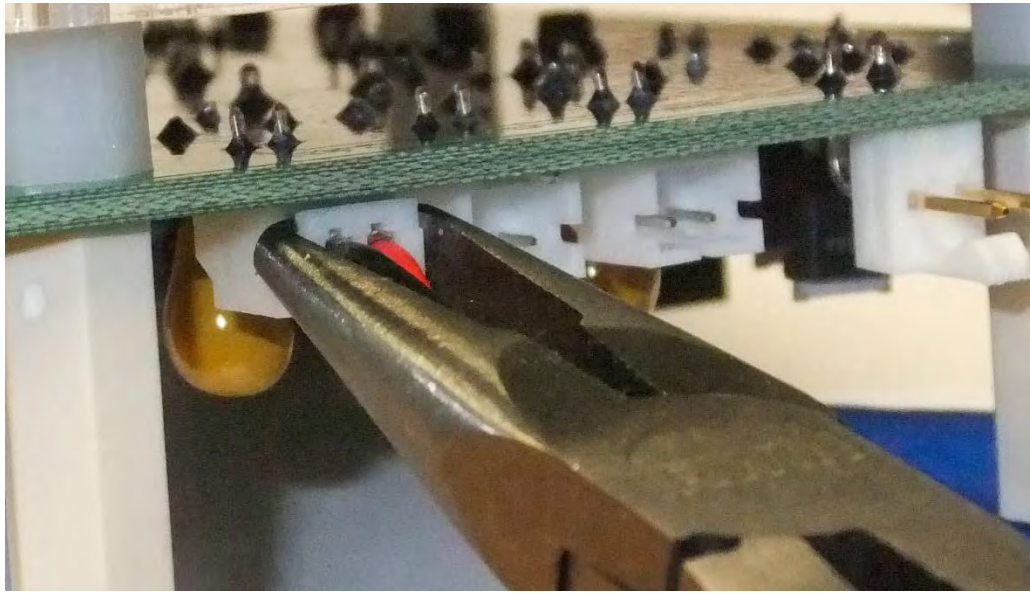
You can use these to both insert the battery connectors or to remove the battery connectors from the power boards. Grab the connector right behind the connector where it flares out. Don’t squeeze the connector too tight lest you cut into the connector.



Using the Connector Pullers

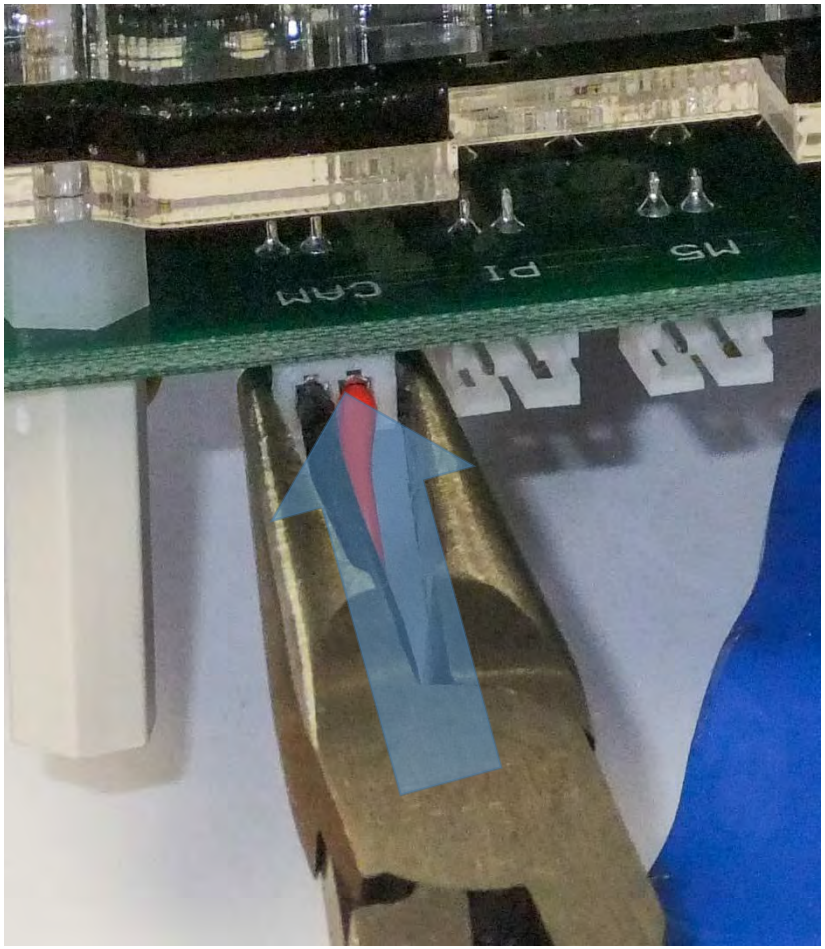
To remove the battery connector, grab the connector right behind where the end “flares” out and gently pull straight out. Make sure you grip just the female connector which is connected to the battery wires and not the male end connected to the power board.





Using the Connector Pullers

To insert the battery connector, grab the connector right behind where the end “flares” out and gently push it in. Don’t push too hard as you can damage the male connector on the power board.



WARNING!!!!

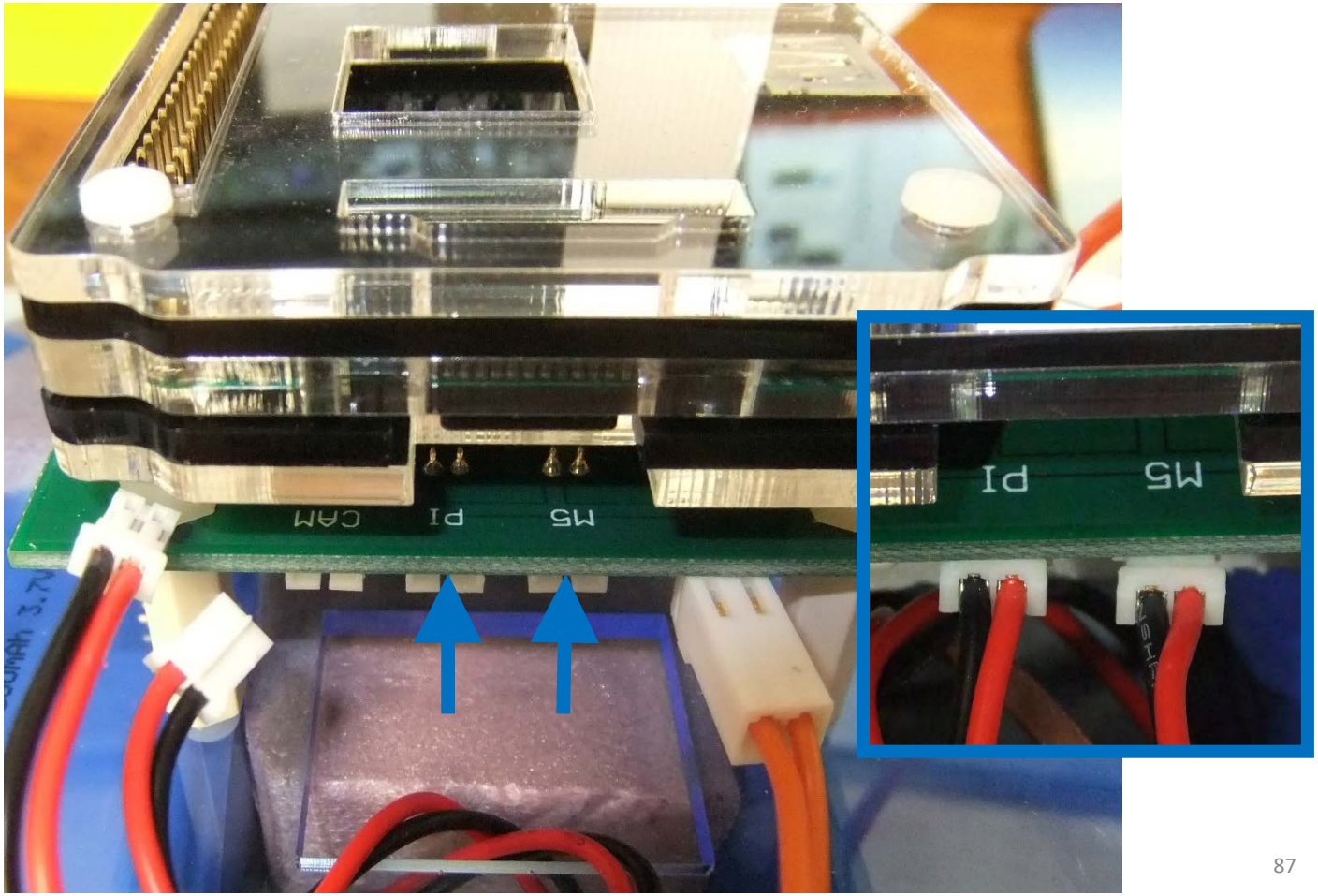
NEVER CONNECT A MODEM TO POWER UNLESS IT HAS THE ANTENNA(S) CONNECTED TO IT!

CONNECTING A MODEM TO POWER WITHOUT AN ANTENNA CONNECTED WILL DESTROY THE MODEM RENDERING IT USELESS!

NONE OF THESE MODEMS ARE CHEAP AND SOME ARE VERY EXPENSIVE (~$700)!

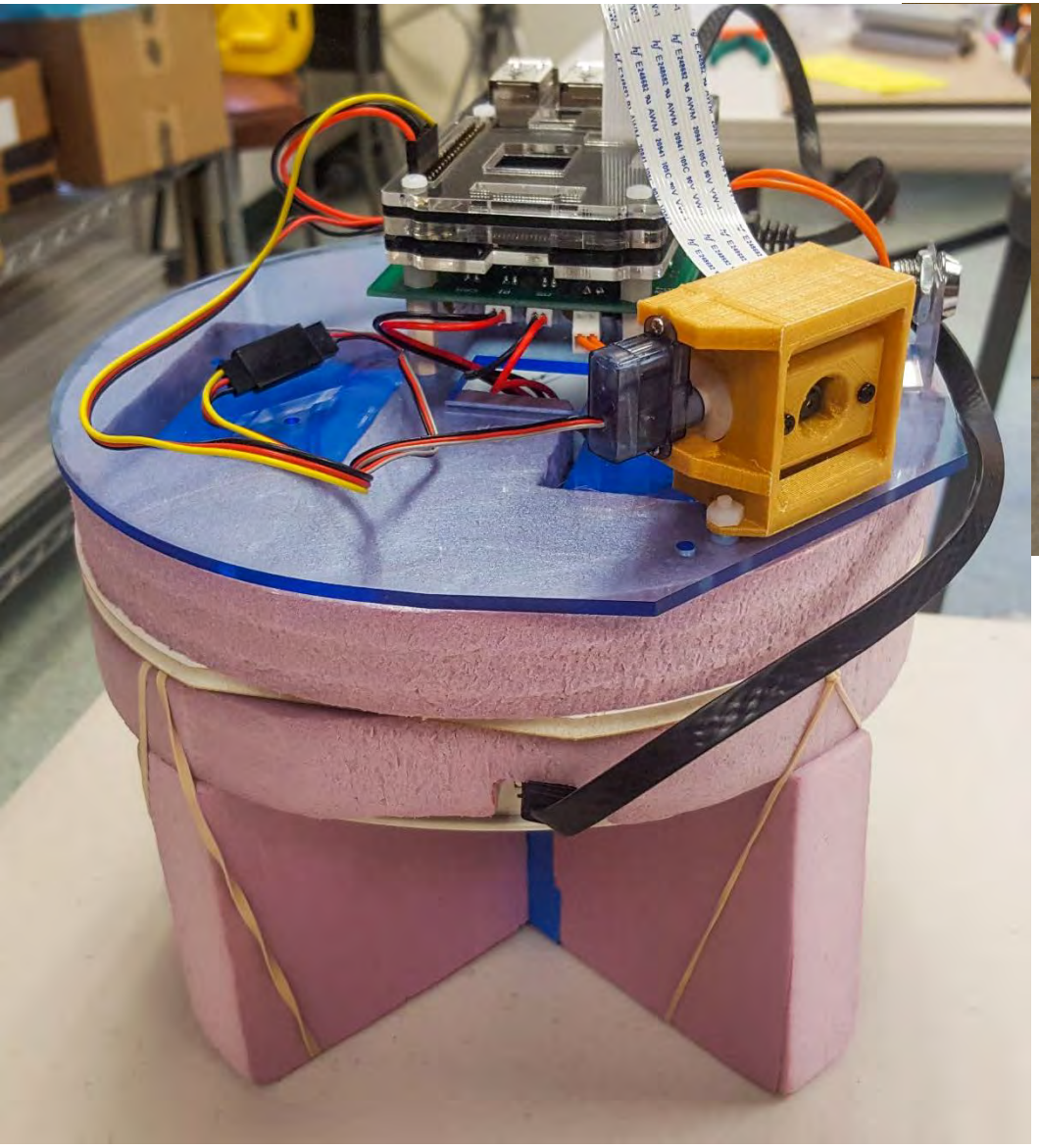
Building the Video Payload: Connecting Batteries

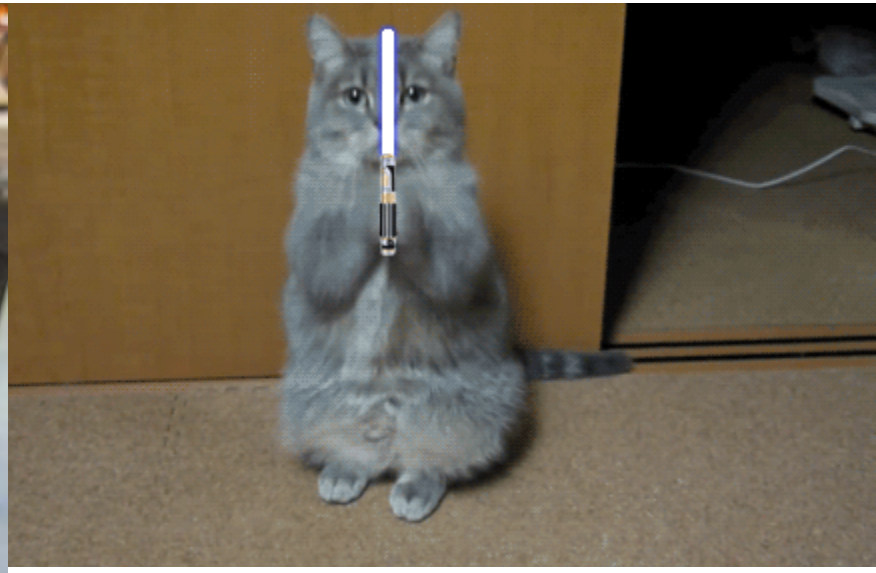
Plug the batteries into the two pin connectors labeled Pi and M5 on the bottom of the power board. The extra male connector labeled CAM is for an extra battery pack to supply extra power for an additional source.



BEFORE PLUGGING IN BATTERIES MAKE SURE THE KEY SWITCH IS IN THE OFF POSITION AND PLUGGED INTO THE POWER BOARD!

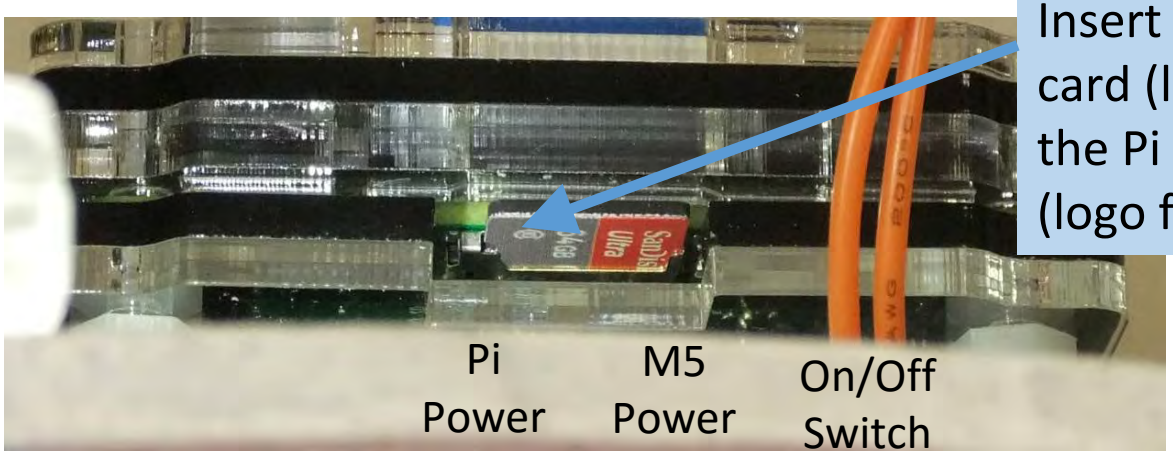
Building the Video Payload: Payload Construction Complete!





(Jedi cat approves)

Video Payload Pi System Prep



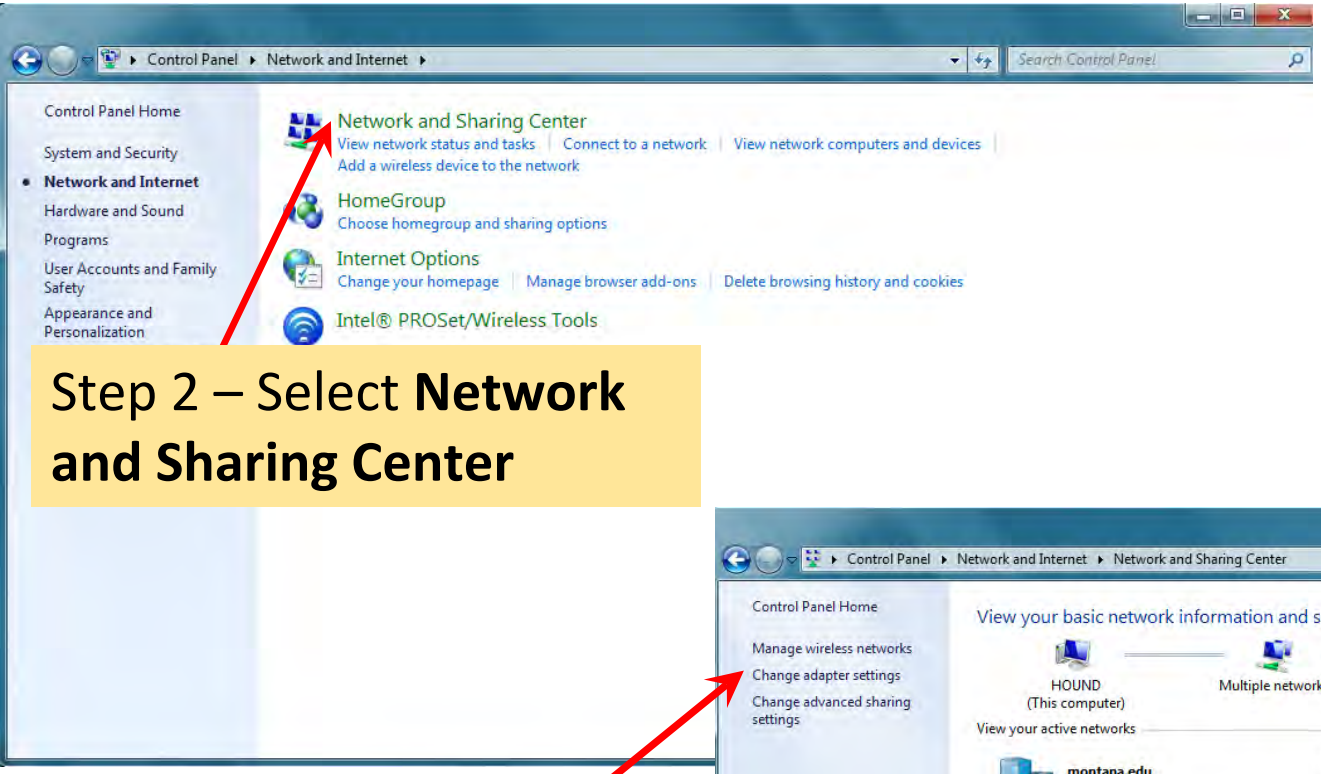
Insert the **<u>UBIQUITI Micro SD</u>** card (labeled with a “U”) into the Pi here with pins face up (logo face down)

Setting up Static IP – Step 1

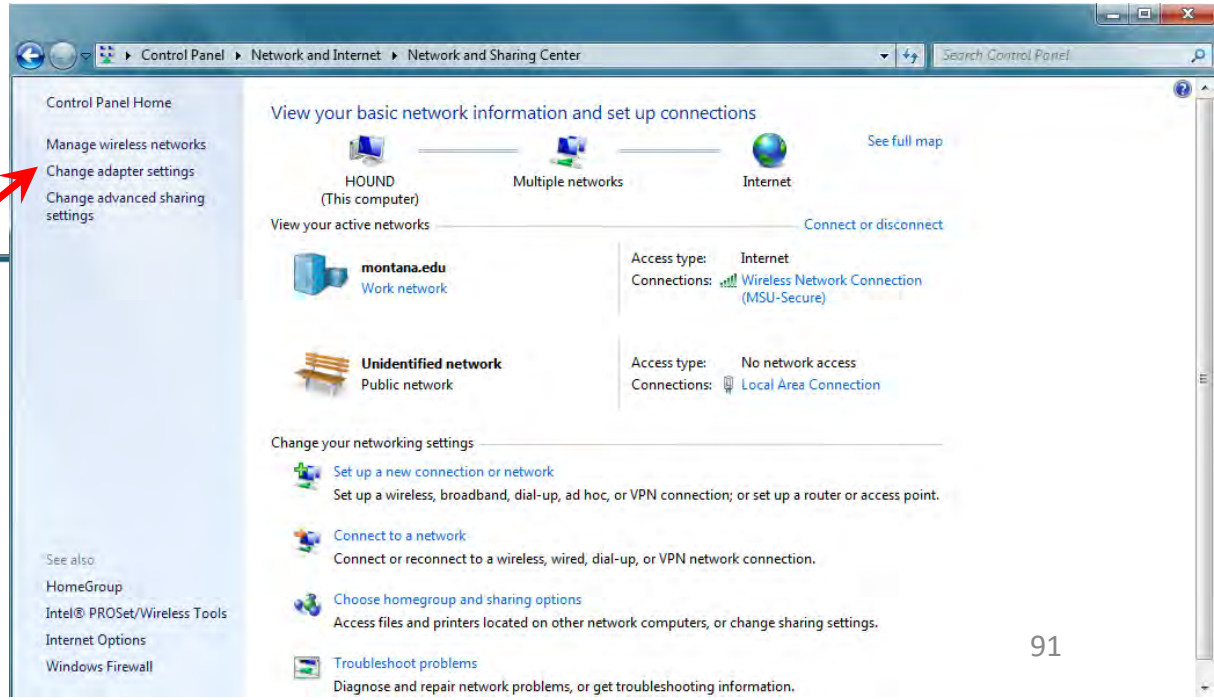
Step 1 – Open control panel and then select **Network and Internet**

(Type “Control Panel” into windows search for quick access)

Setting up Static IP – Steps 2, 3

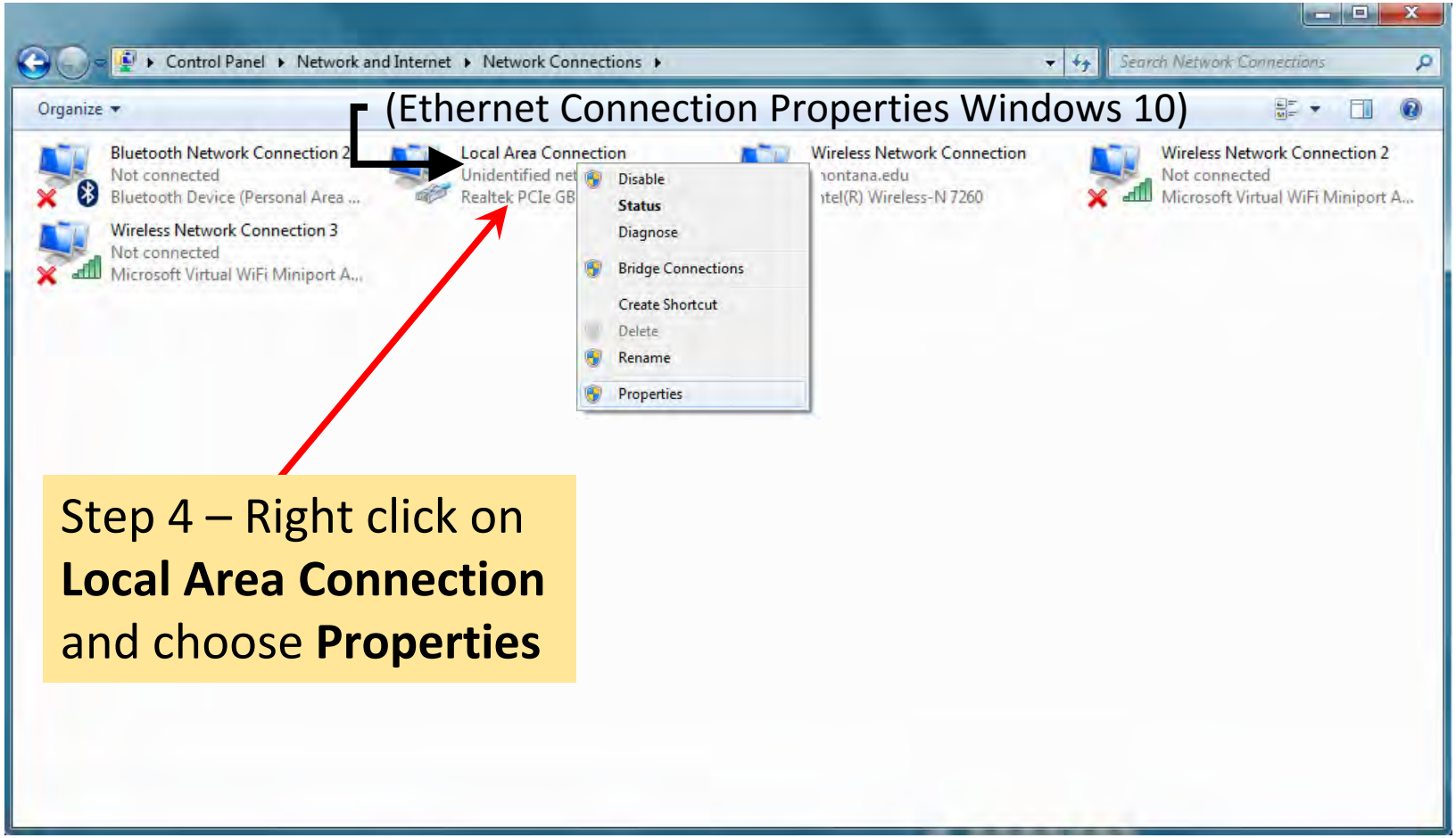


Step 2 – Select **Network and Sharing Center**



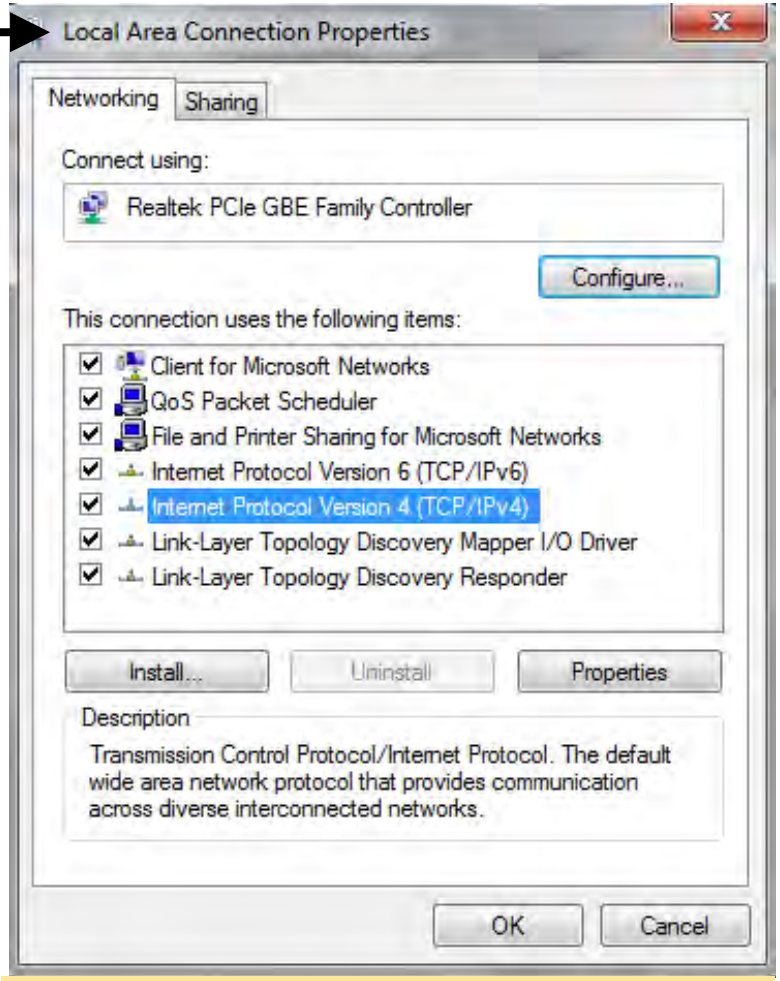
Step 3 – Select **Change adapter settings**

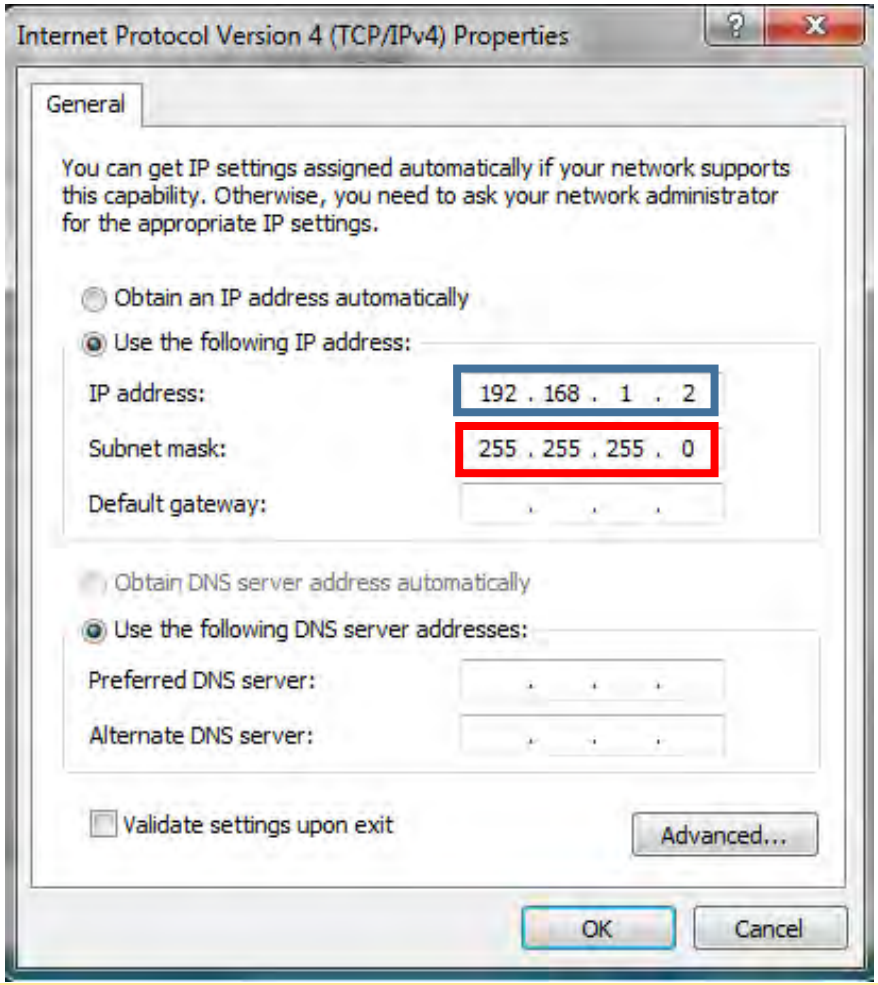
Setting up Static IP – Step 4



Setting up Static IP – Steps 5-6

(Ethernet Connection Properties Windows 10)

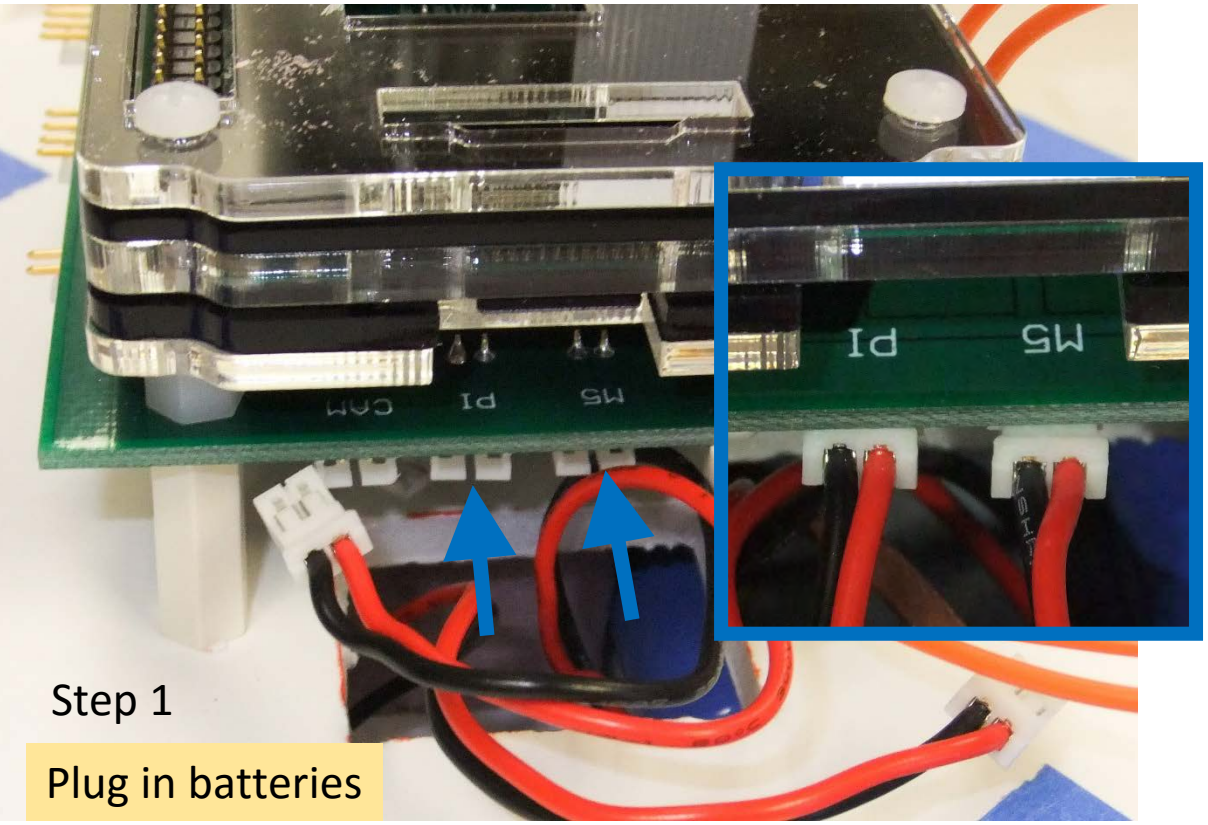




Step 5 – Left click on **Internet Protocol 4 (TCP/IPv4)** and then click on **Properties**

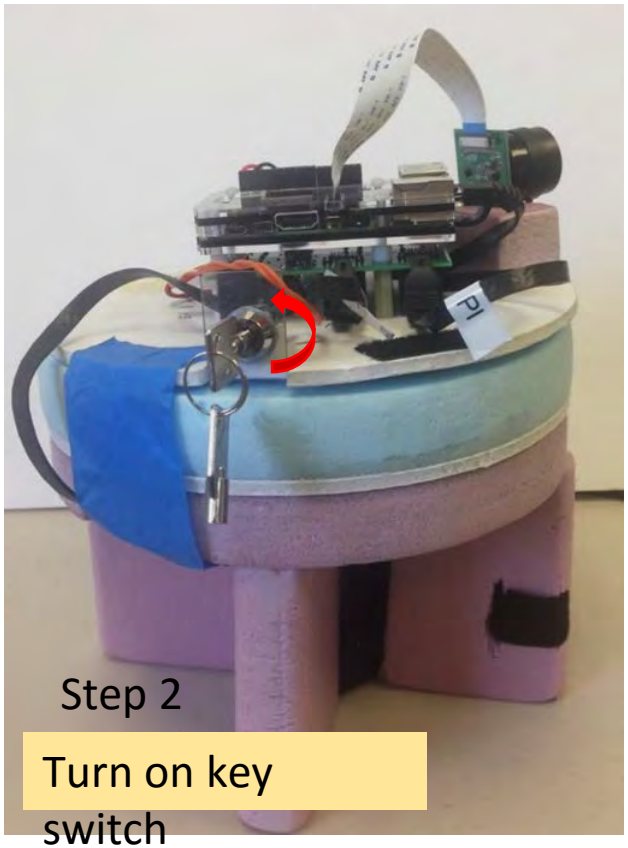
Step 6 – Enter the IP address: **192.168.1.2** and Subnet mask: **255.255.255.0** as shown. Then click **OK** to finish. Static IP is now set.

Powering on the Video Payload



Step 1

Plug in batteries



Step 2

Turn on key switch

Checking Ground Station Radio and Computer Connections

Verification of Cable Connection:

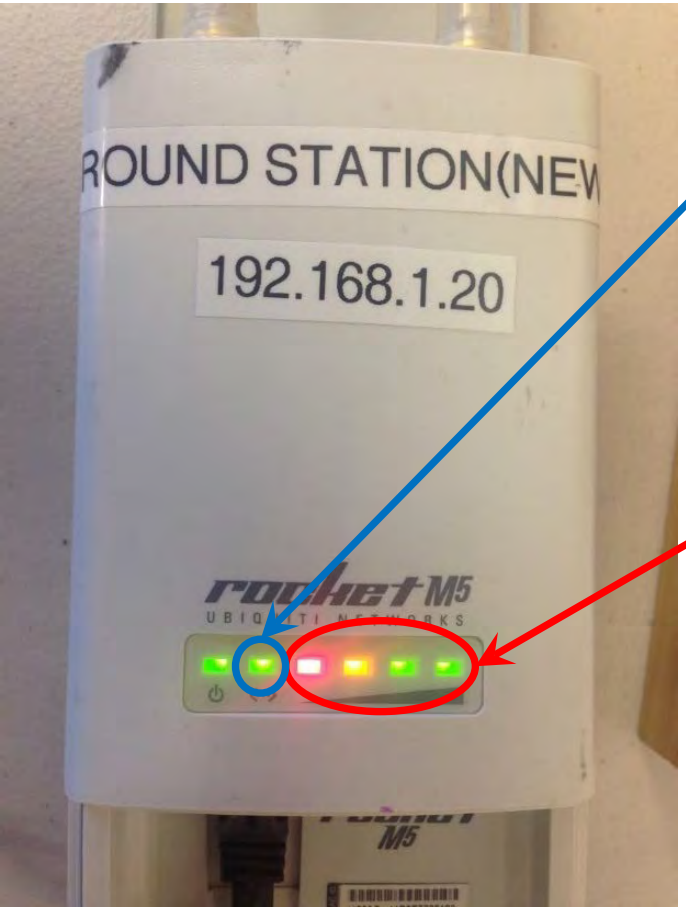
Verify the connection of your power over Ethernet (POE) converter and install cables.

- Ethernet cable from POE to ground M5 modem
- Ethernet cable connects from LAN to Laptop

Plug in POE converter when cables are connected

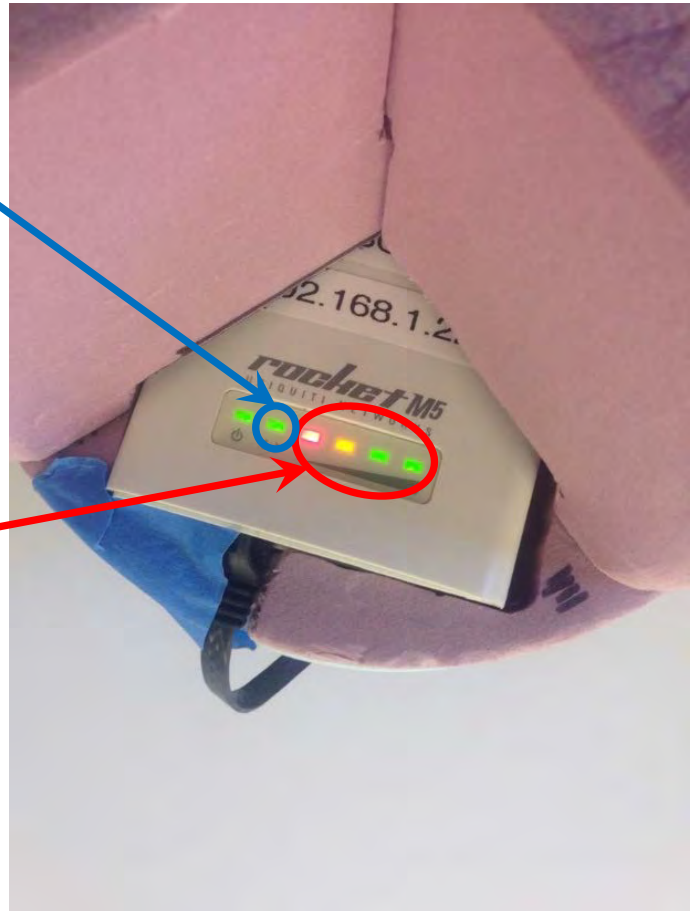
Warning – NEVER CONNECT POE cable TO Computer!!!!!

Checking connections



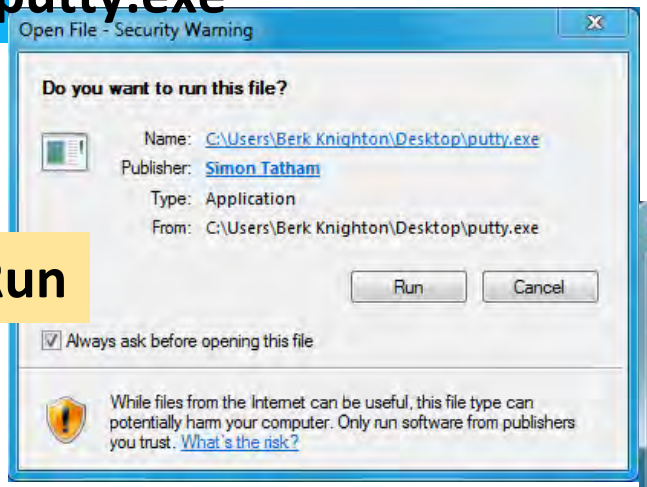
Connection of M5 modems

Connection Strength

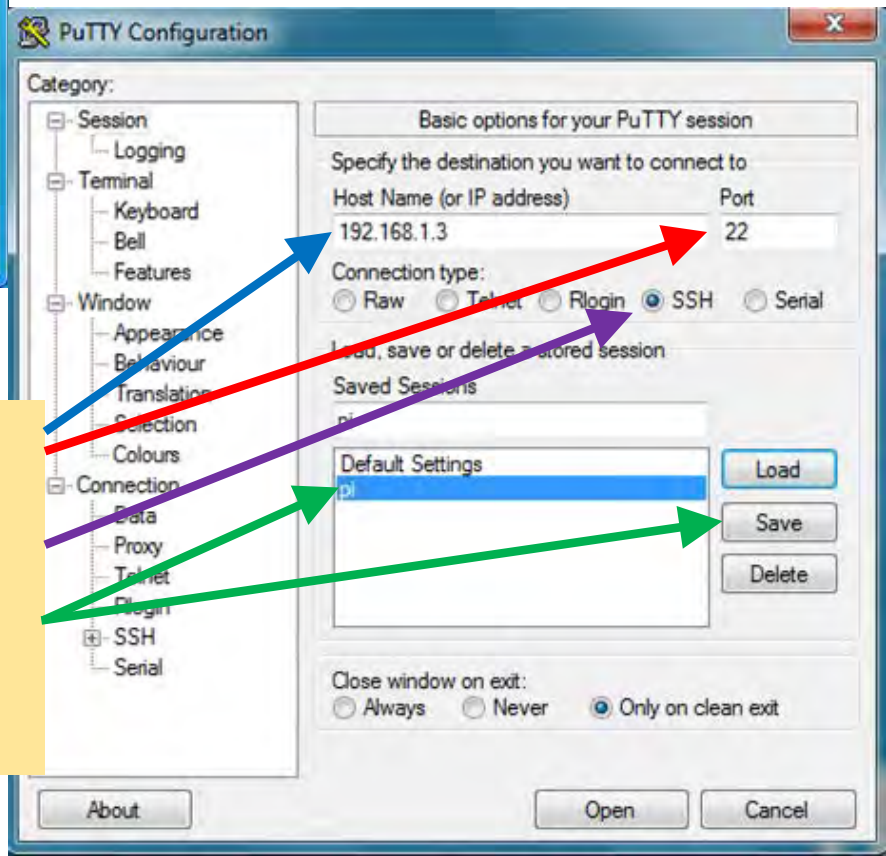


Establishing communication between computer and Raspberry pi

Step 1 – Open **putty.exe**

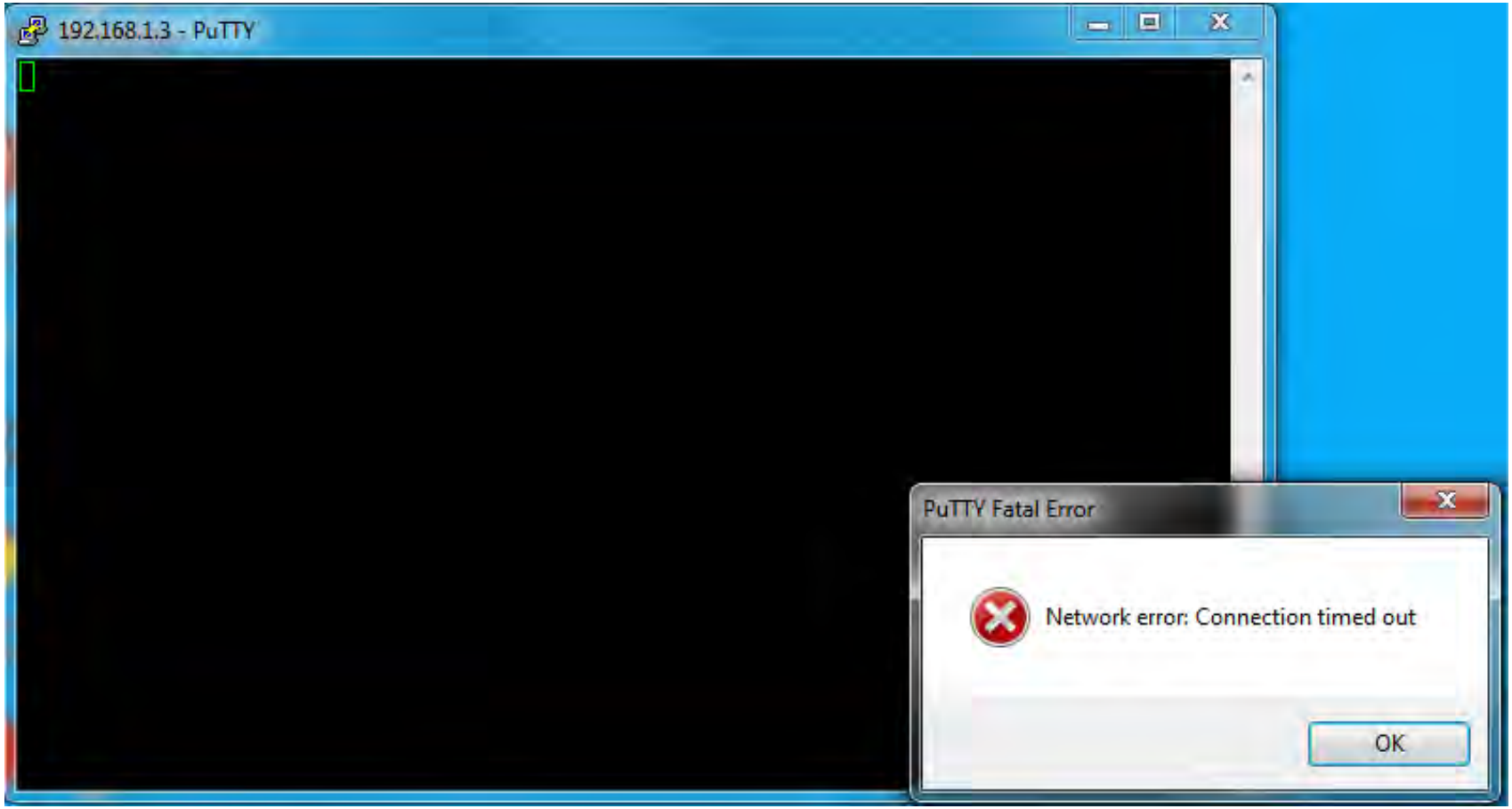


Step 2 – Click **Run**



Step 3 – enter IP address **192.168.1.3** and check to make sure **Port is 22** and **Connection type is SSH**. Save session as **pi** so you can load it later. When done, click on **Open**.

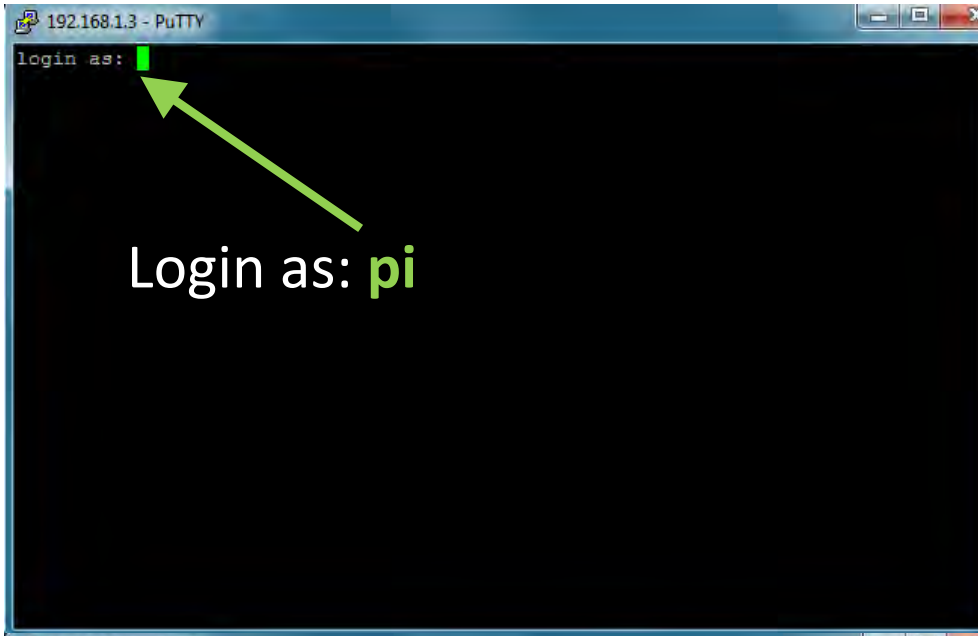
Connecting to the Raspberry pi

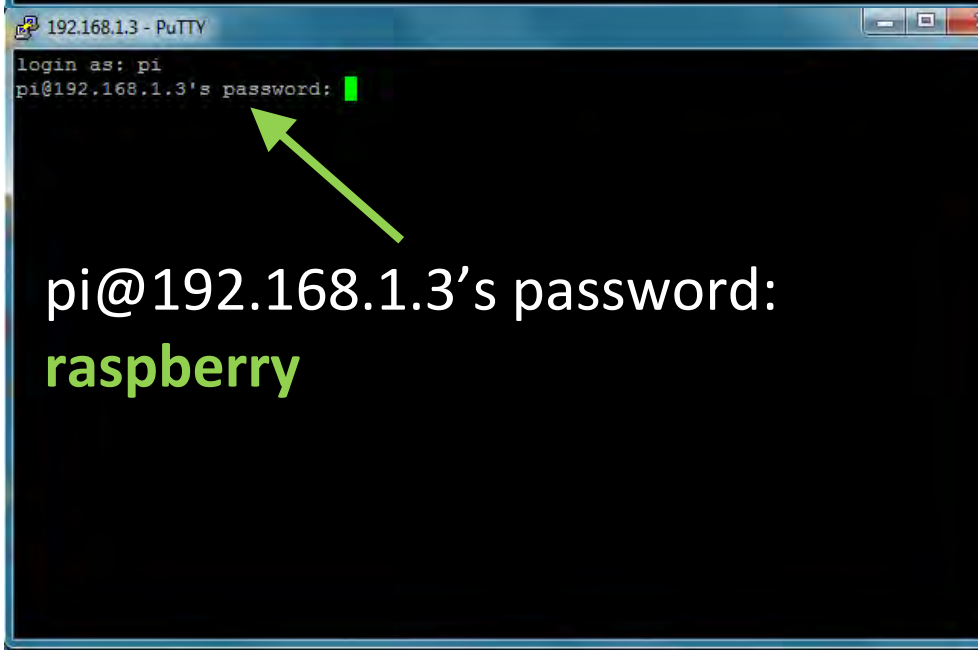


Should you get the following error: **PuTTy Fatal Error "Network error: Connection timed out"** something went wrong. Click **OK** and close the window and reopen PuTTY.

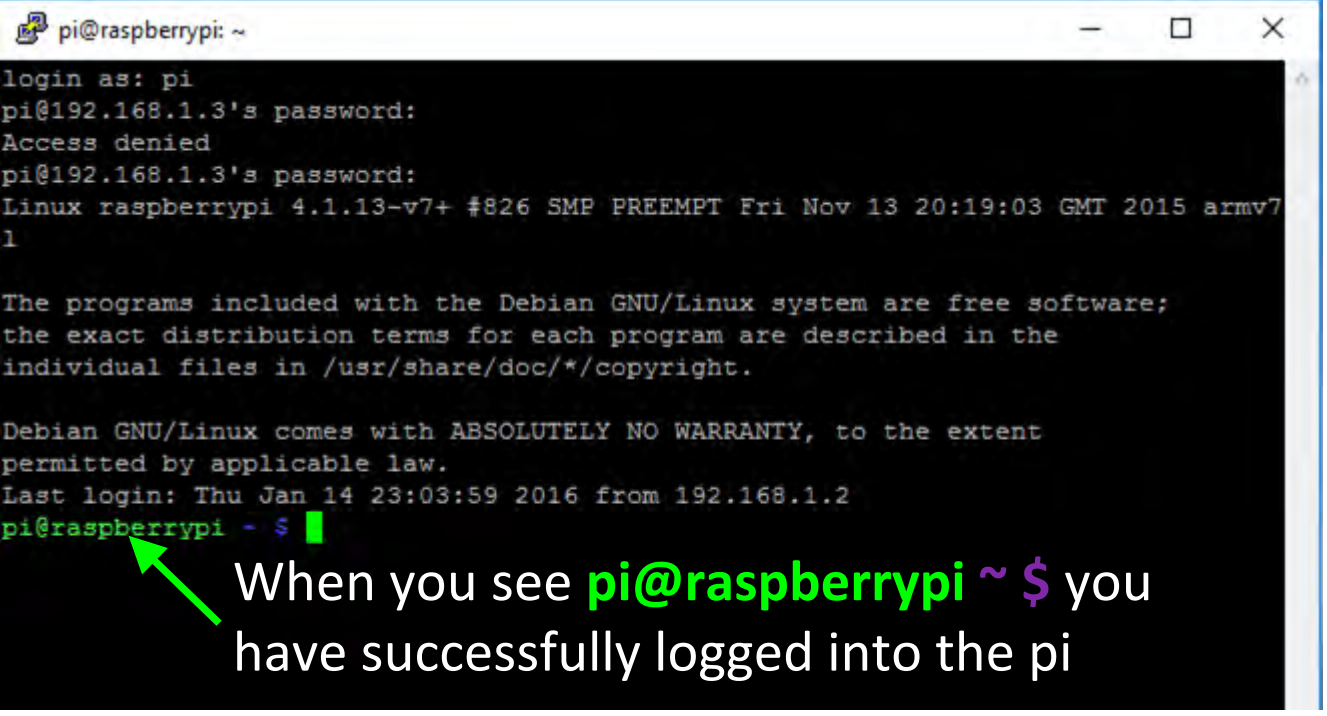
Connecting to the Raspberry pi

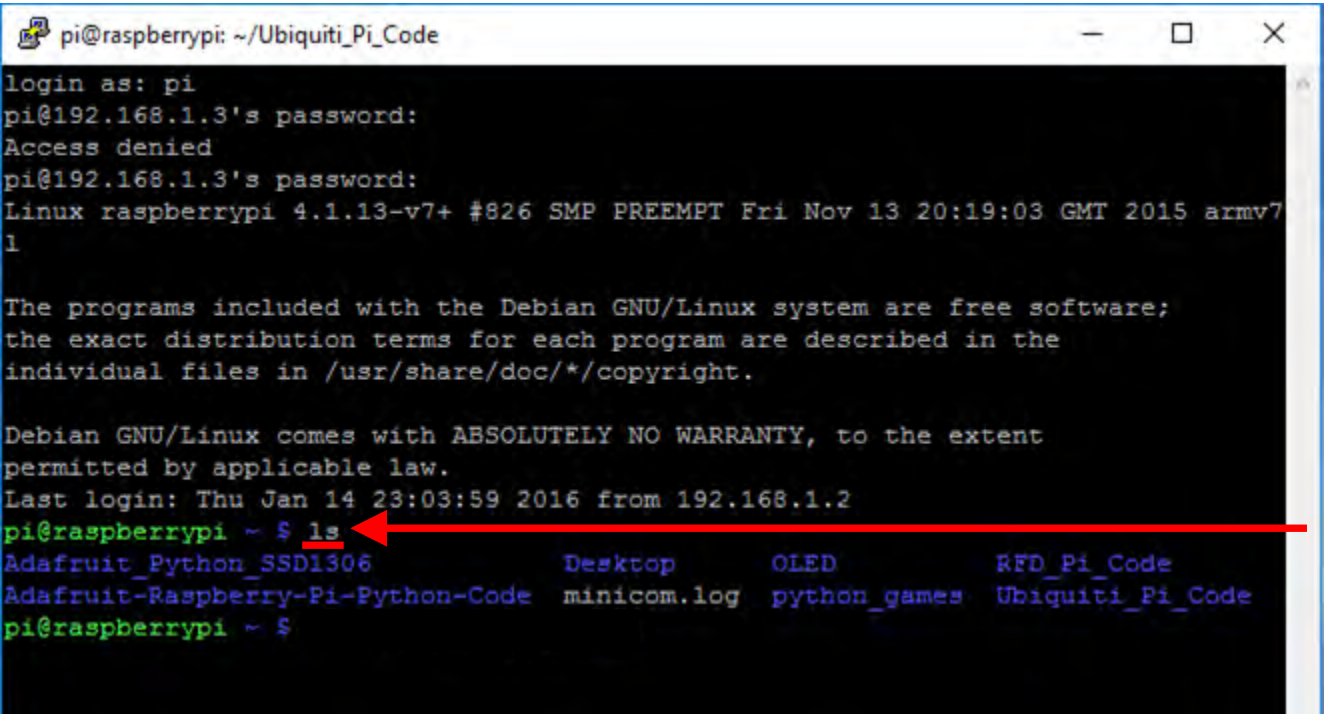
In order to connect to the Raspberry Pi, you must first login. The login is **pi** and the password is **raspberry**. Note that nothing will appear as you enter the password.



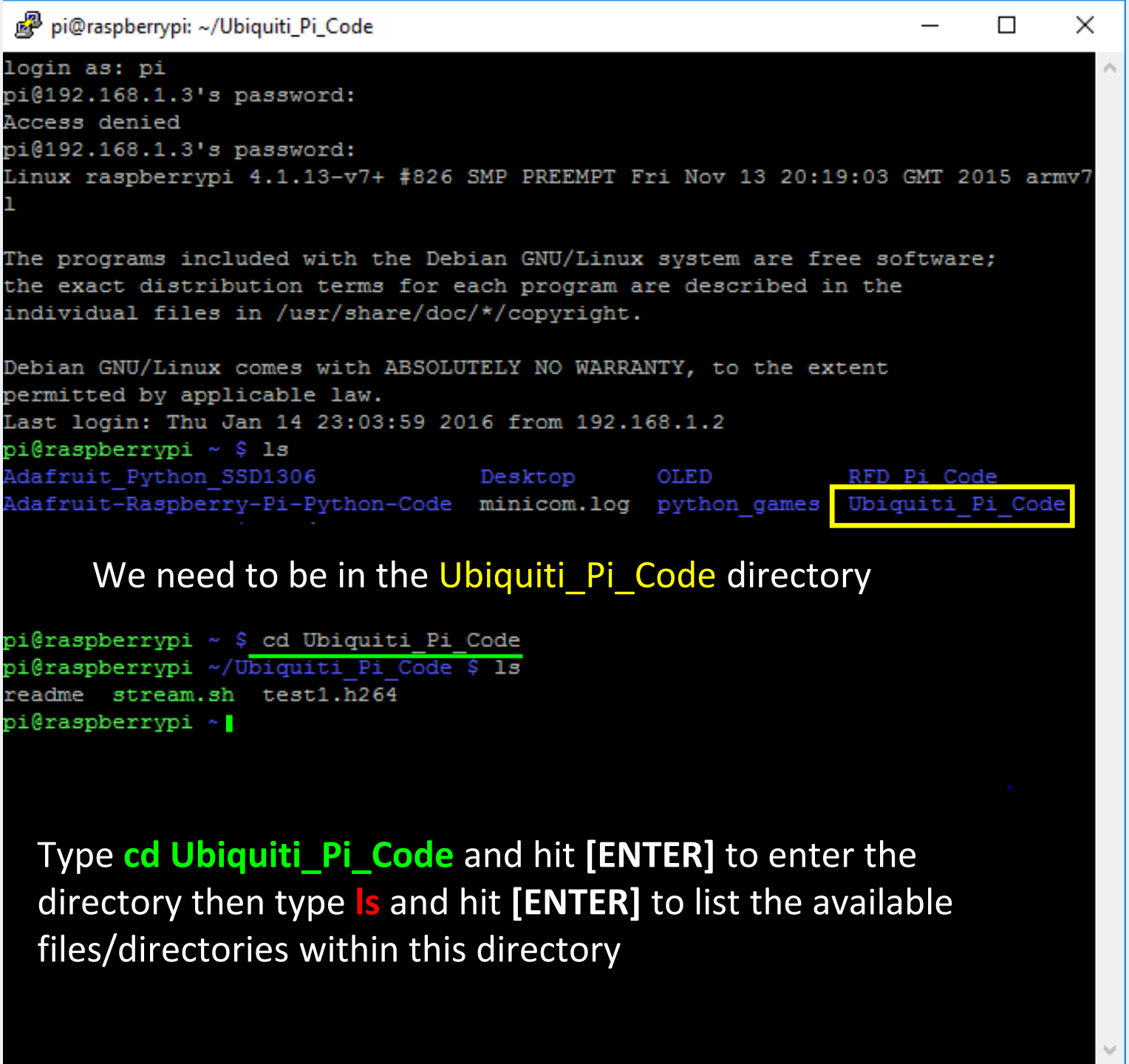


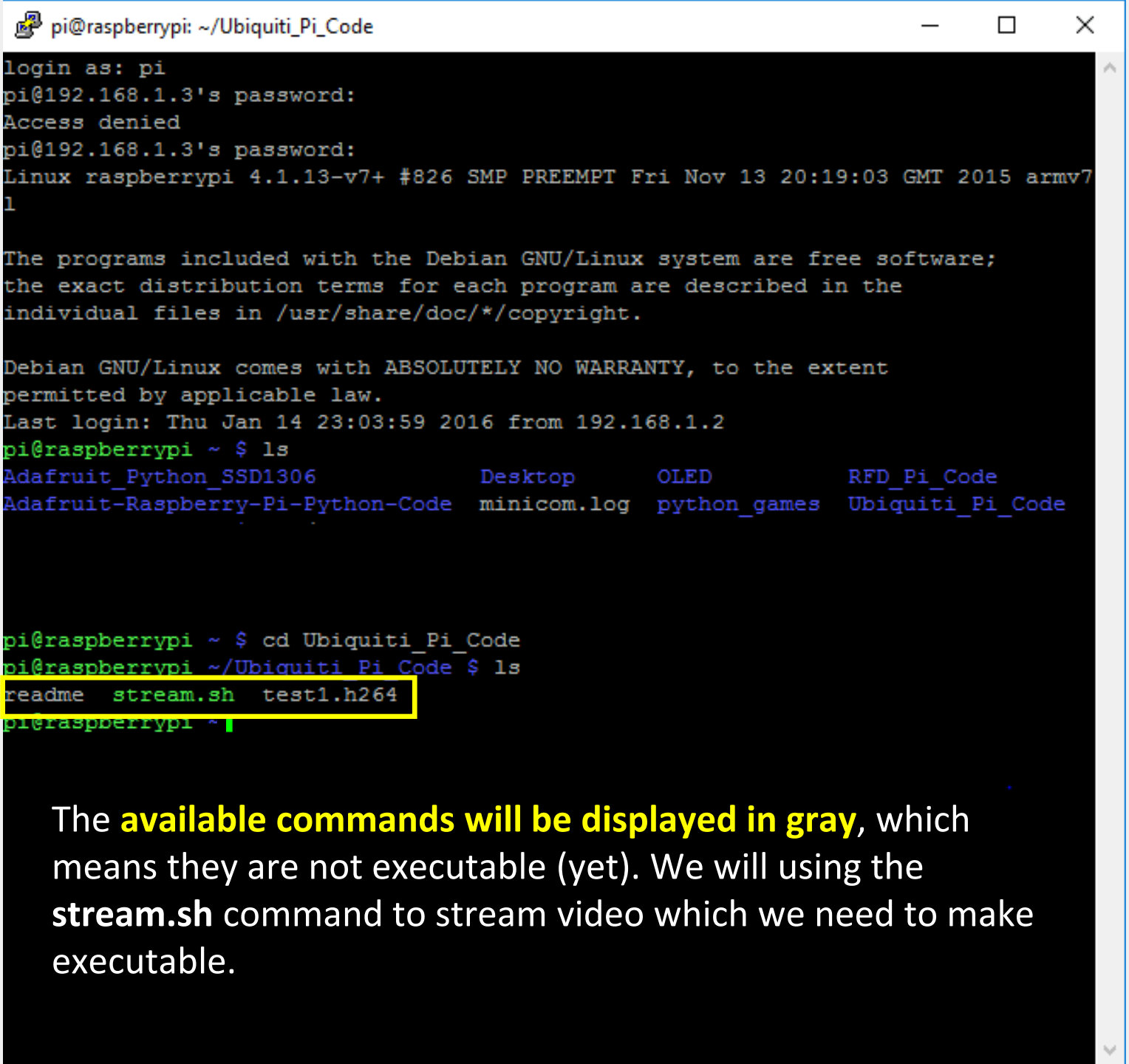
Raspberry pi: Commands



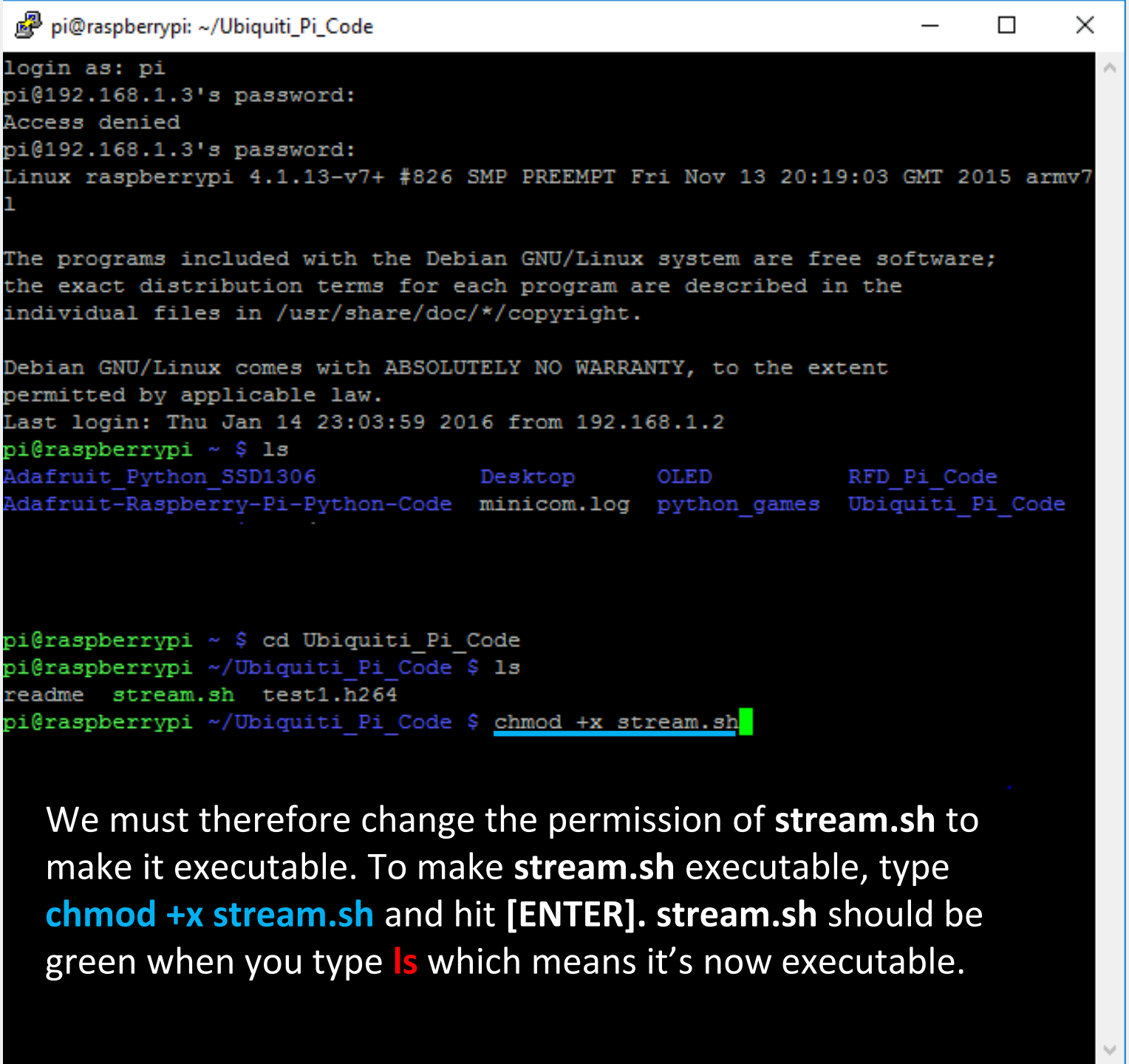


Type **ls** (small "L", small "S", short for "list") in the command line followed by **[ENTER]**. This will list the files/directories stored on your pi


pi@raspberrypi: ~/Ubiquiti_Pi_Code
login as: pi
pi@192.168.1.3's password:
Access denied
pi@192.168.1.3's password:
Linux raspberrypi 4.1.13-v7+ #826 SMP PREEMPT Fri Nov 13 20:19:03 GMT 2015 armv7
l
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Thu Jan 14 23:03:59 2016 from 192.168.1.2
pi@raspberrypi ~ $ ls
Adafruit_Python_SSD1306 Desktop OLED RFD_Pi_Code
Adafruit-Raspberry-Pi-Python-Code minicom.log python_games Ubiquiti_Pi_Code
We need to be in the Ubiquiti_Pi_Code directory
pi@raspberrypi ~ $ cd Ubiquiti_Pi_Code
pi@raspberrypi ~/Ubiquiti_Pi_Code $ ls
readme stream.sh test1.h264
pi@raspberrypi ~
Type cd Ubiquiti_Pi_Code and hit [ENTER] to enter the
directory then type ls and hit [ENTER] to list the available
files/directories within this directory



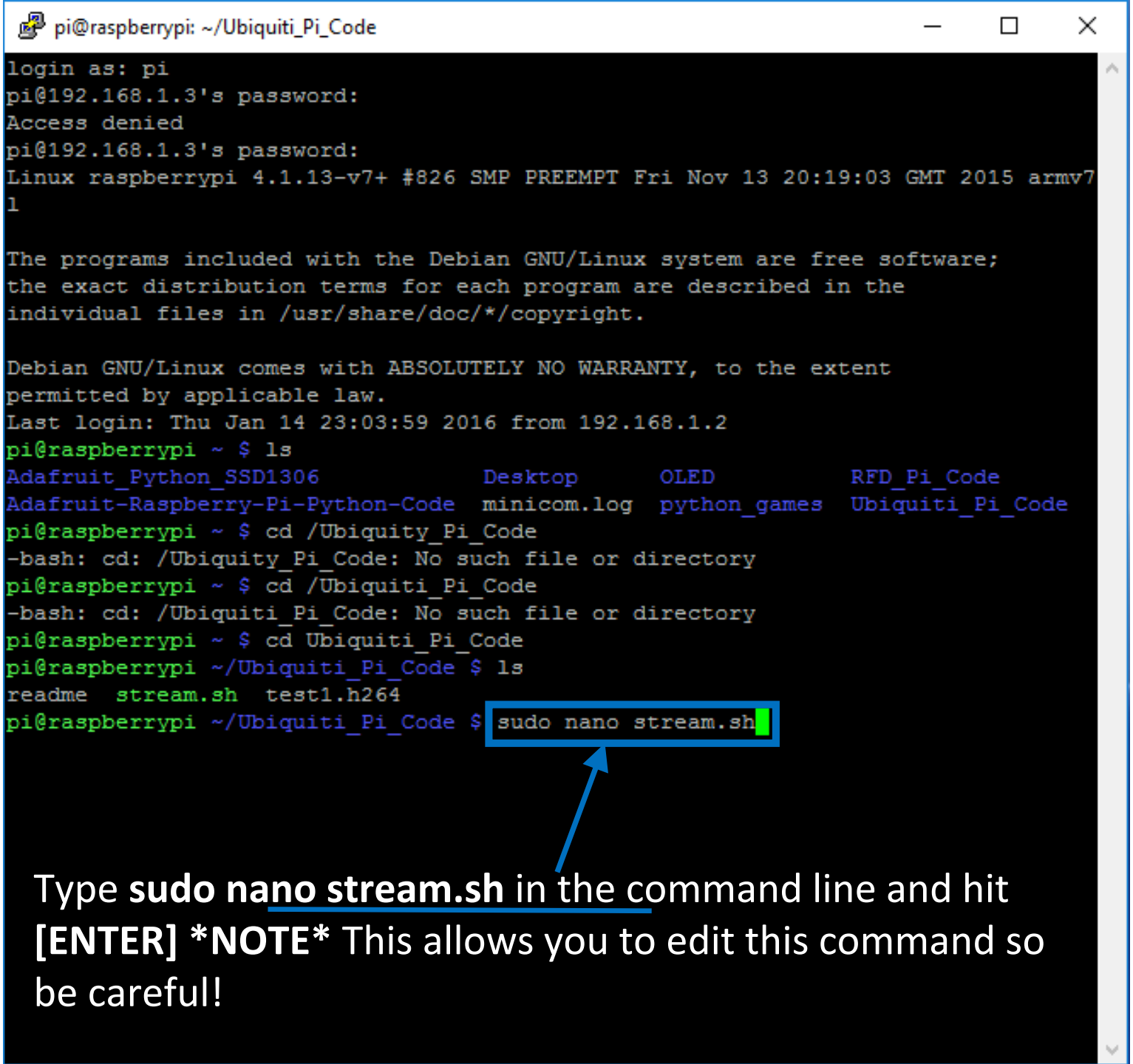
The **available commands will be displayed in gray**, which means they are not executable (yet). We will using the **stream.sh** command to stream video which we need to make executable.



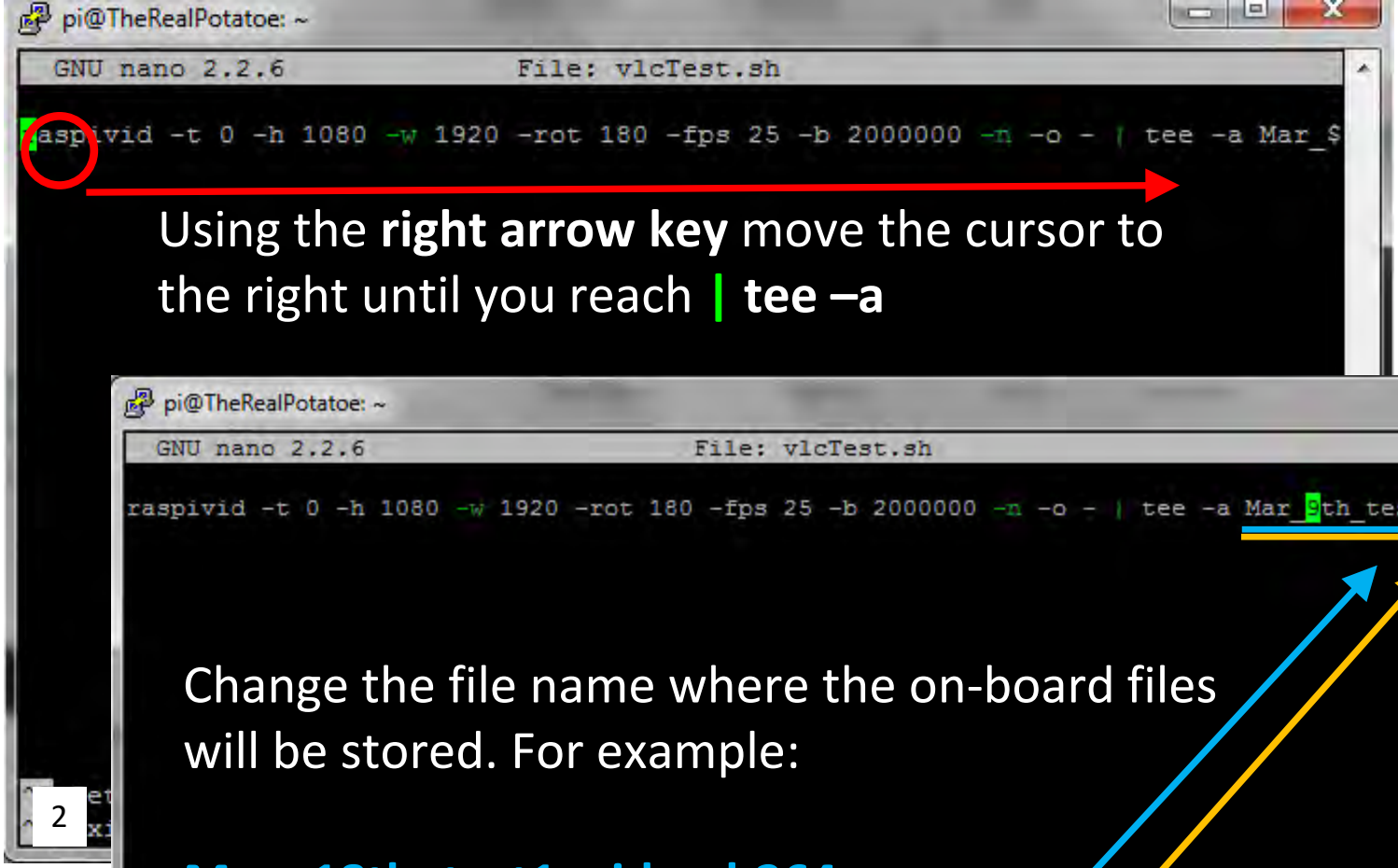
We must therefore change the permission of **stream.sh** to make it executable. To make **stream.sh** executable, type **chmod +x stream.sh** and hit **[ENTER]. stream.sh** should be green when you type **ls** which means it's now executable.

Pre-Flight Preparations for Video Streaming and Storing

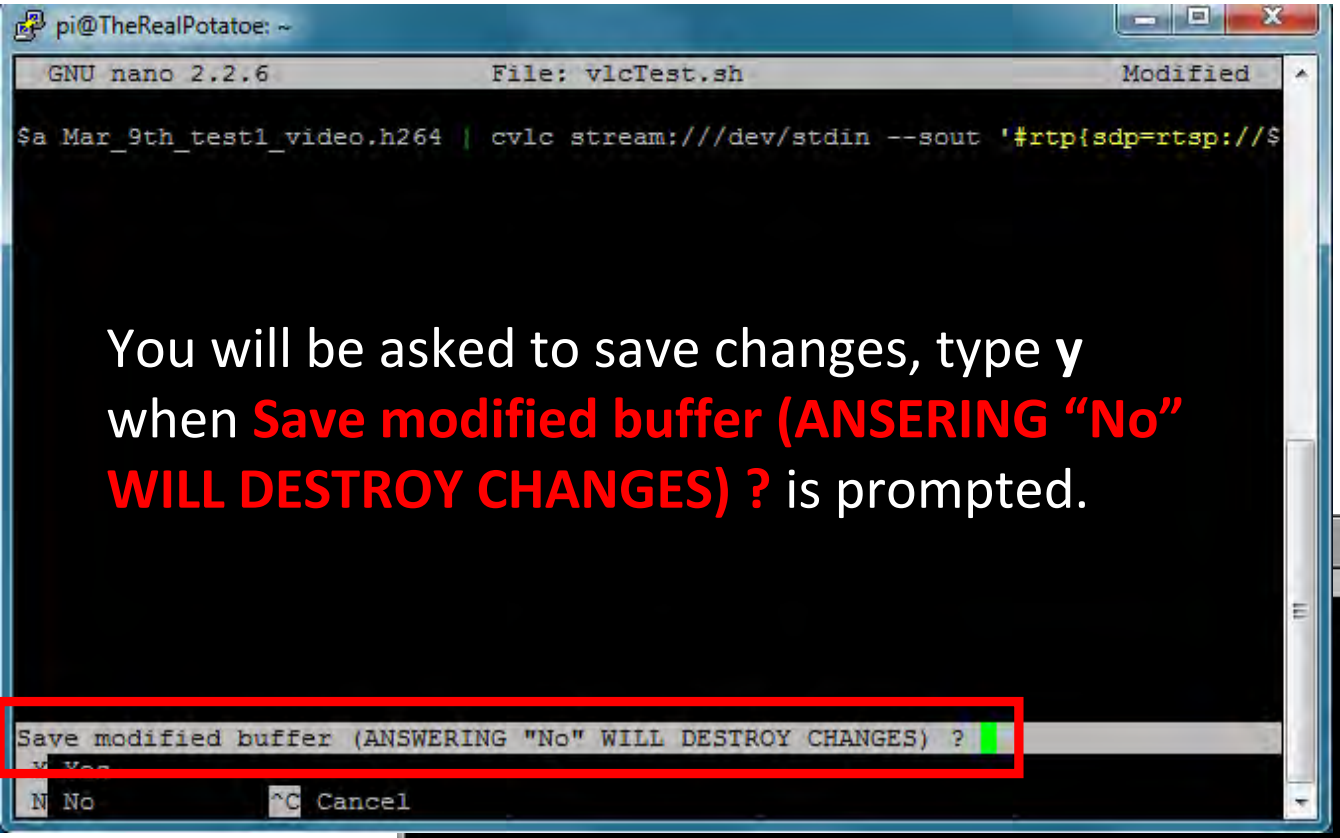
- The Video Payload will both feed a live stream down to the ground station and store the video on the on-board SD card.
- Before each flight, you must make a new name to store the video stream to the Pi SD card.
- To do this, you will be modifying a command. By modifying this command, you can also change video settings (vertical/horizontal flip of image, brightness, contrast, etc.). We will have more on this at the end of the slide deck. For now, we will just be modifying the file storage name.



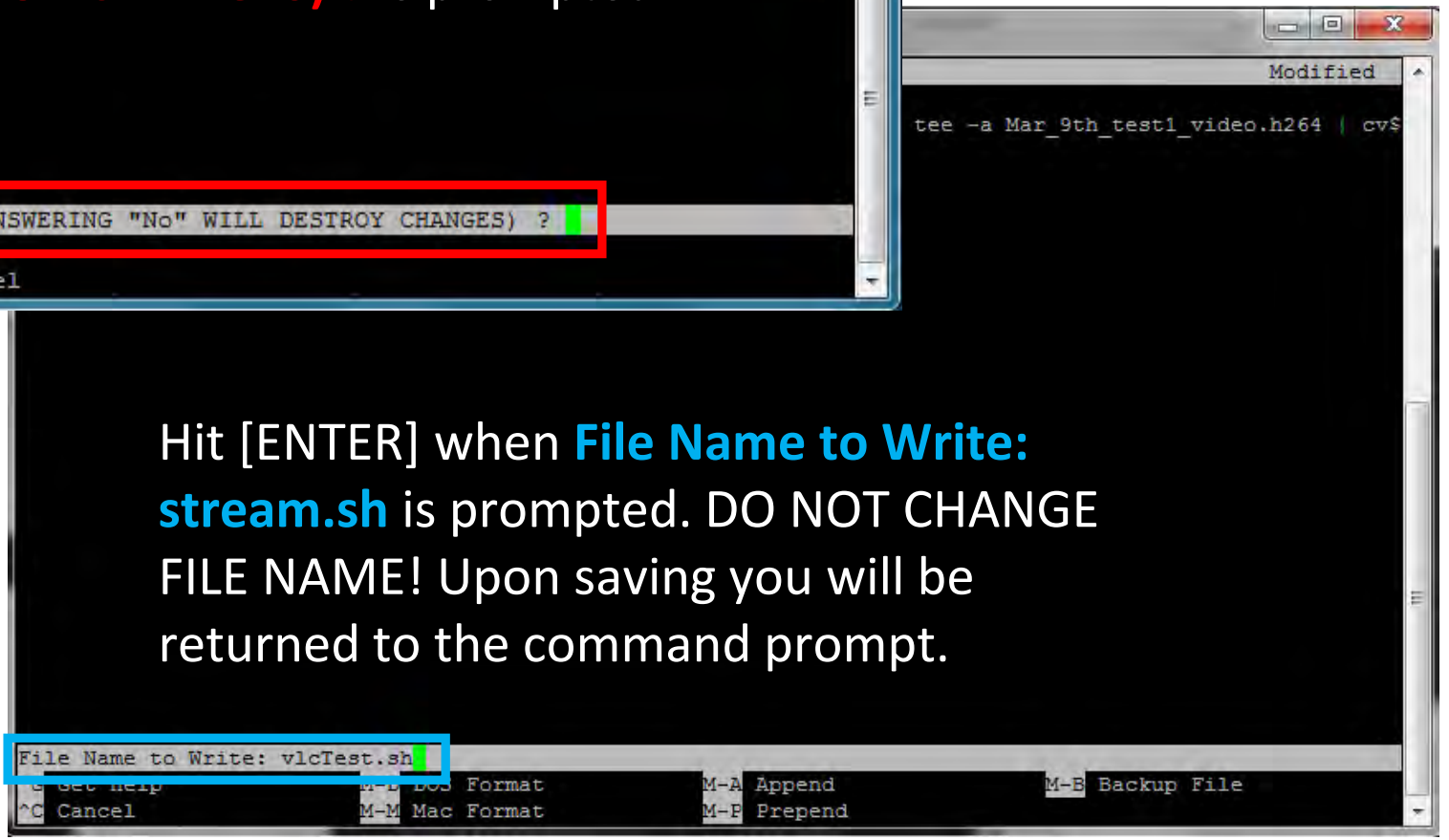
Type **sudo nano stream.sh** in the command line and hit **[ENTER] *NOTE*** This allows you to edit this command so be careful!


pi@TheRealPotatoe: ~
GNU nano 2.2.6 File: vlcTest.sh
raspivid -t 0 -h 1080 -w 1920 -rot 180 -fps 25 -b 2000000 -n -o - | tee -a Mar_$
Using the right arrow key move the cursor to the right until you reach | tee –a

pi@TheRealPotatoe: ~
GNU nano 2.2.6 File: vlcTest.sh Modified
raspivid -t 0 -h 1080 -w 1920 -rot 180 -fps 25 -b 2000000 -n -o - | tee -a Mar_9th_test1_video.h264 | cv$
Change the file name where the on-board files will be stored. For example:
May_18th_test1_video.h264
-or-
Aug_21st_flight4_video.h264
Once renamed hit [CTRL] + [x] to save and exit.
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell

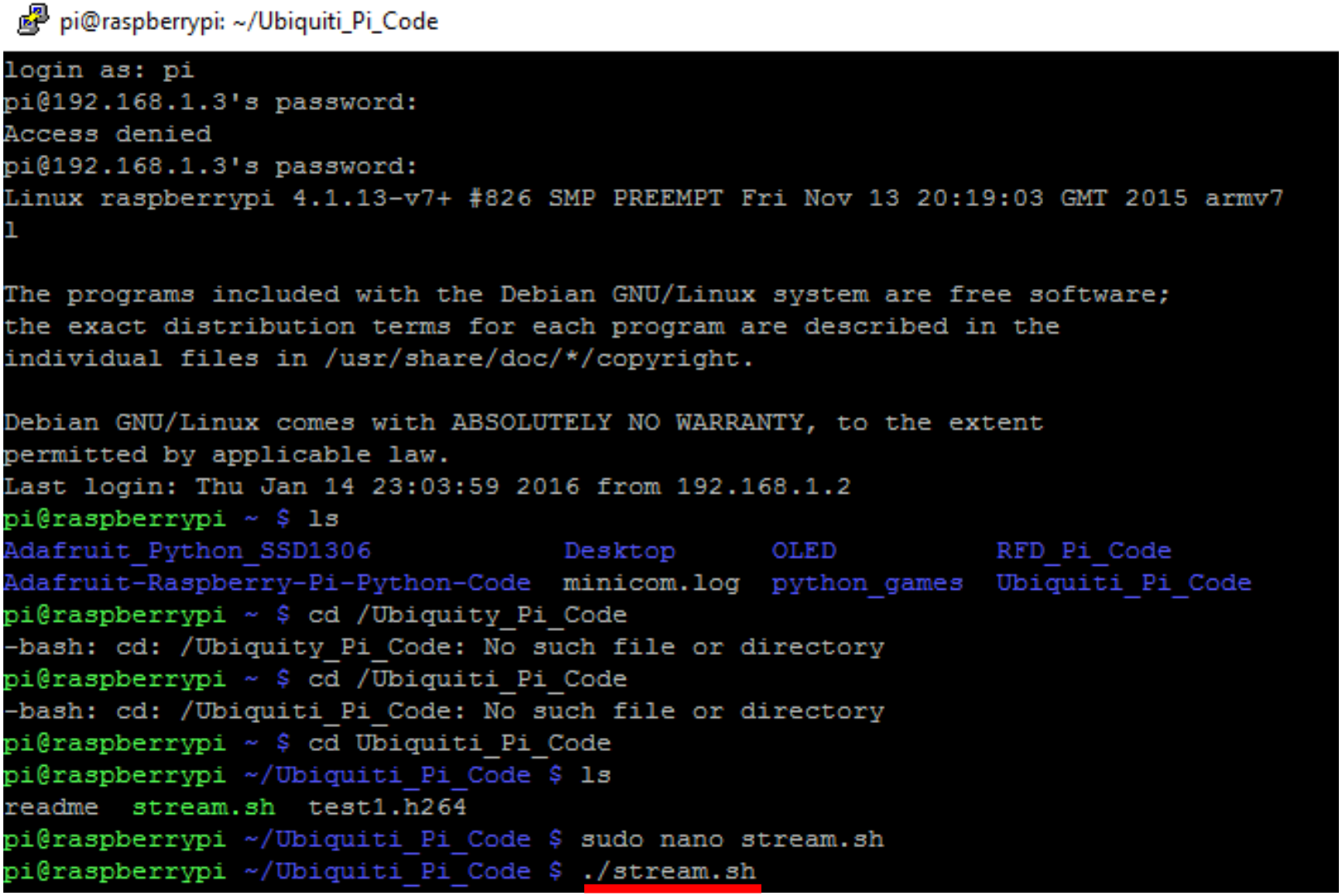


You will be asked to save changes, type **y** when **Save modified buffer (ANSERING "No" WILL DESTROY CHANGES) ?** is prompted.



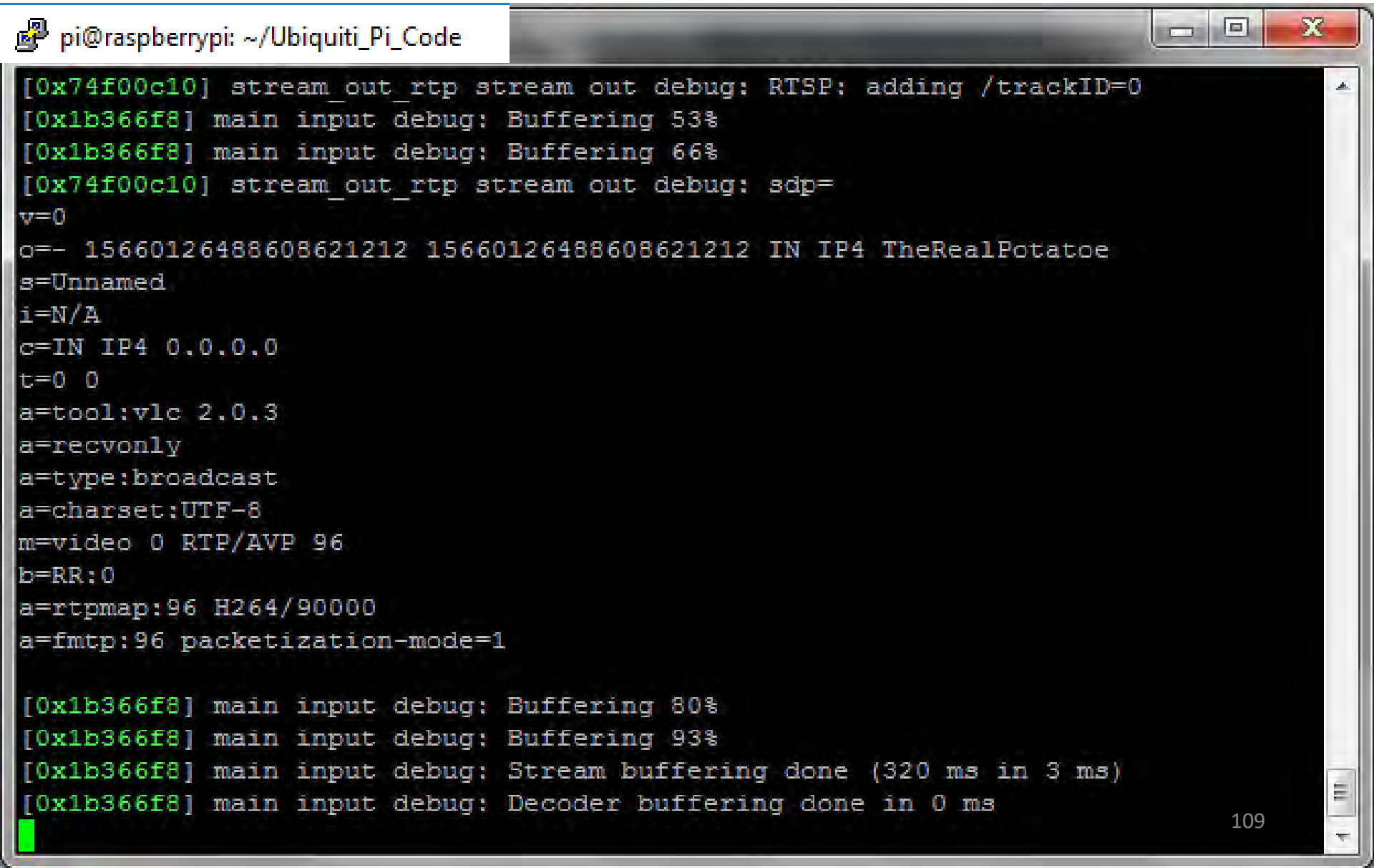
Hit [ENTER] when **File Name to Write: stream.sh** is prompted. DO NOT CHANGE FILE NAME! Upon saving you will be returned to the command prompt.

Let the video streaming… BEGIN!

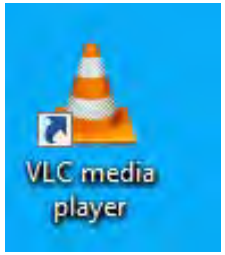


To begin the video streaming process, type **./stream.sh** in the command line and hit **[ENTER]**

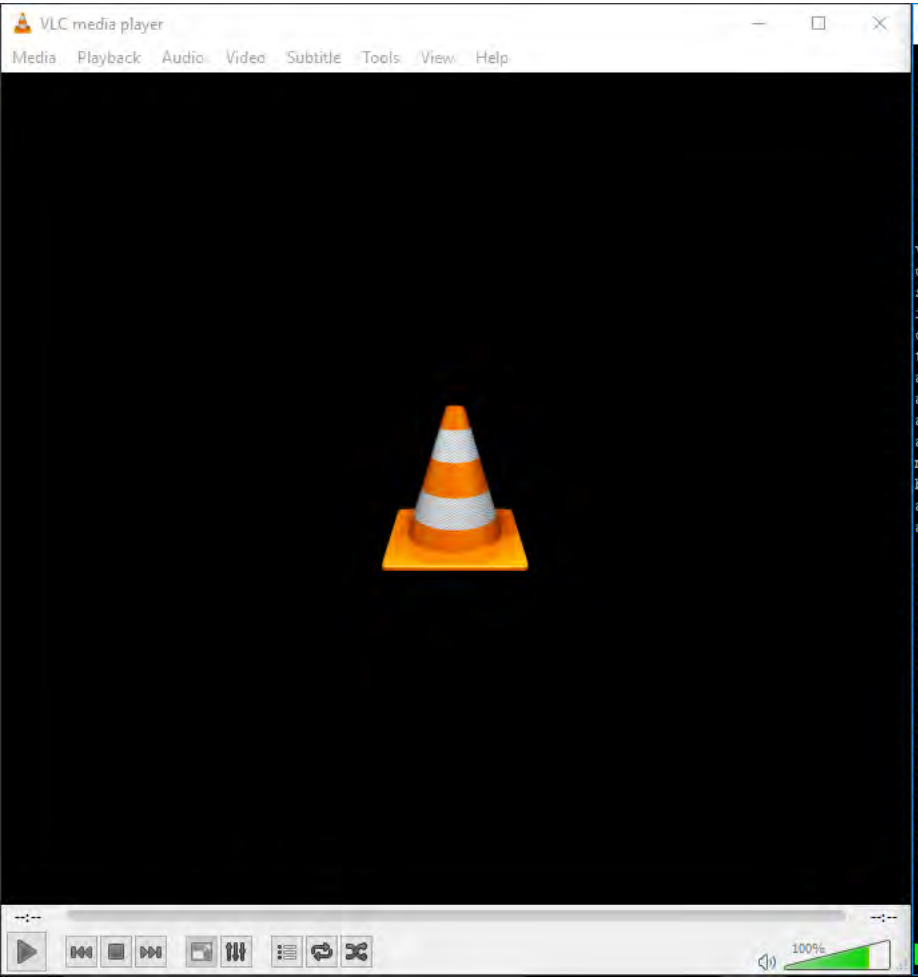
The following will appear, indicating the pi is streaming and recording video:

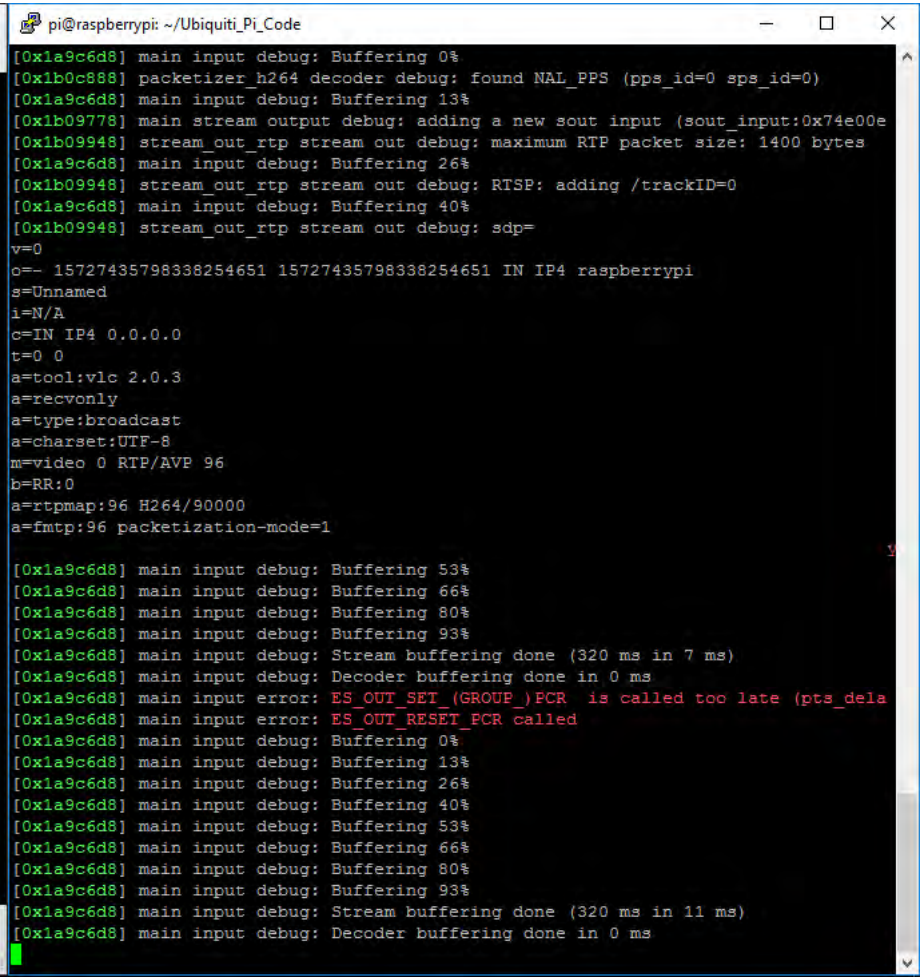


Viewing your video



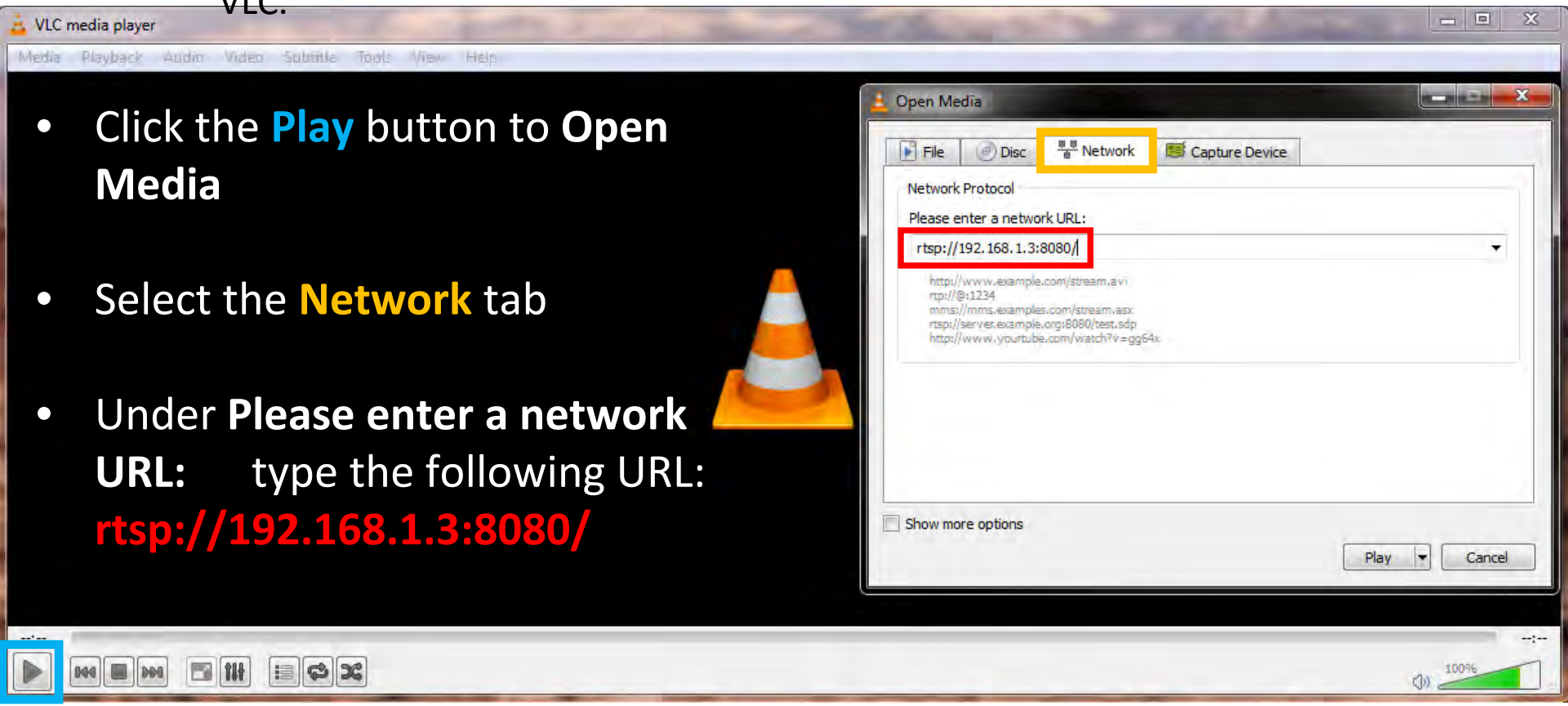
We will be using VLC media player to view the live feed. Open VLC player while keeping the PuTTy command window accessible (minimized or in a small window).





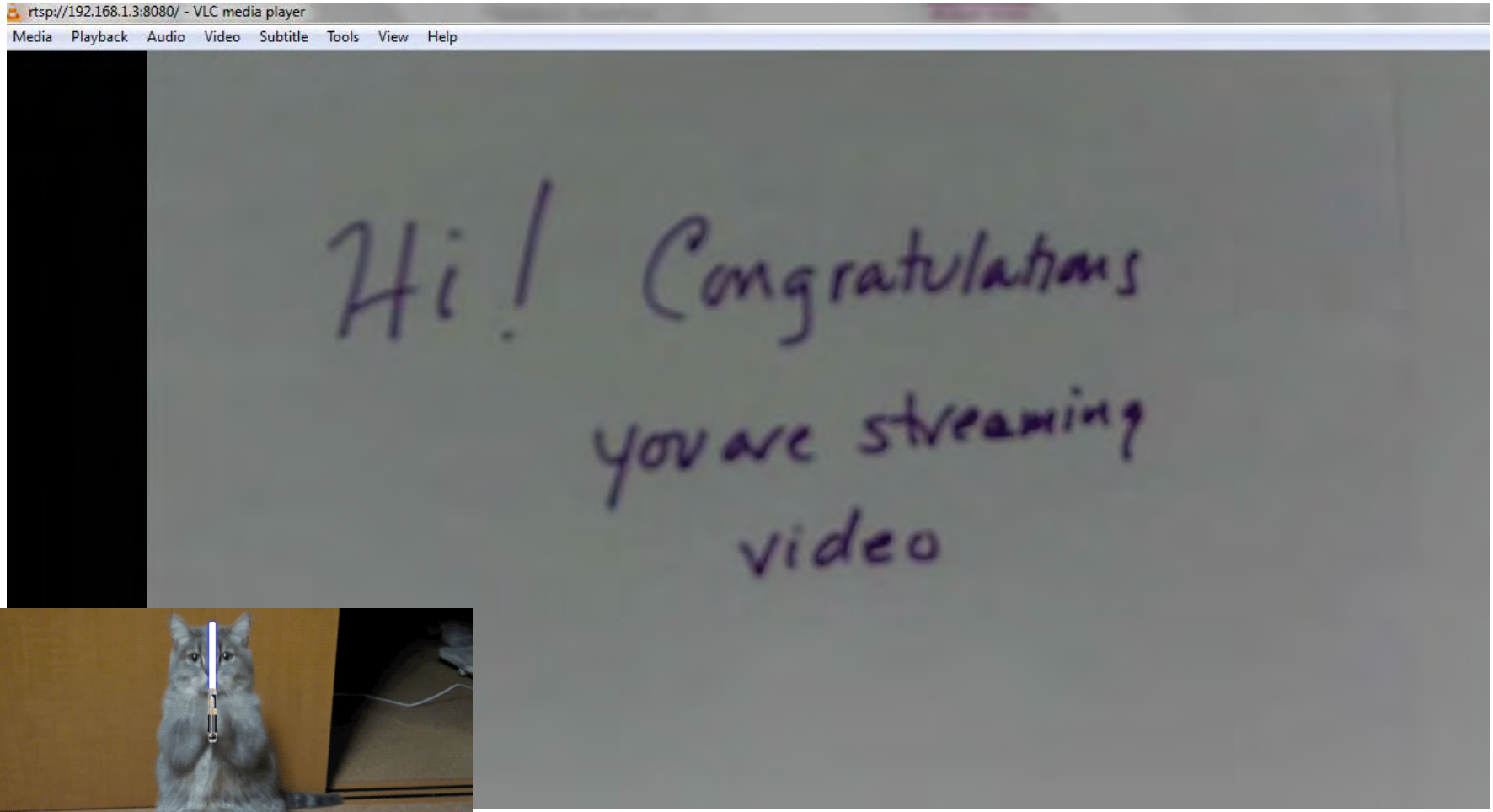
Viewing your video

In VLC, follow the steps below to view your live stream within VLC.



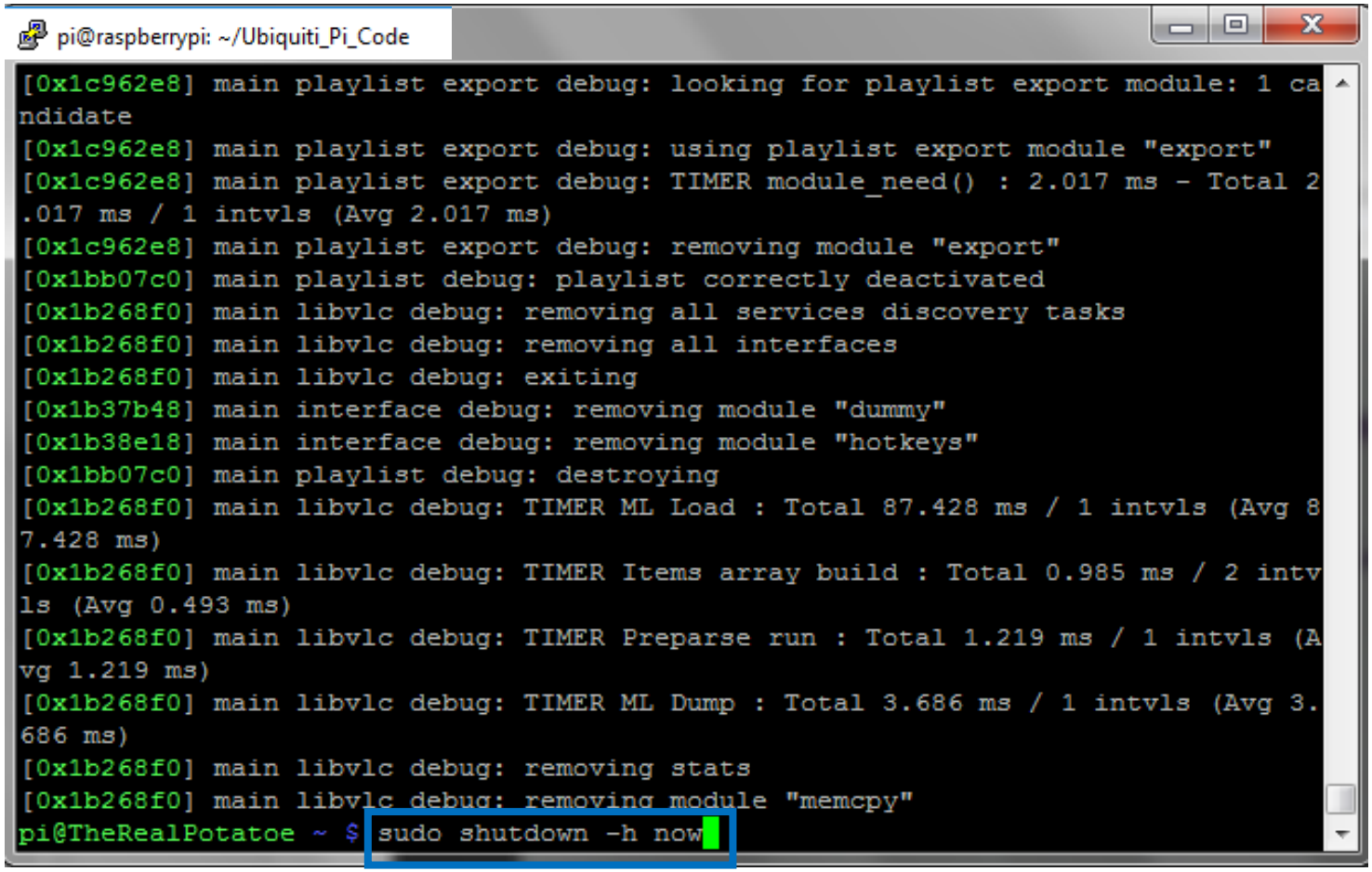
- Click the **Play** button to **Open Media**
- Select the **Network** tab
- Under **Please enter a network URL:** type the following URL: **rtsp://192.168.1.3:8080/**

Congratulations!
You should see your video stream

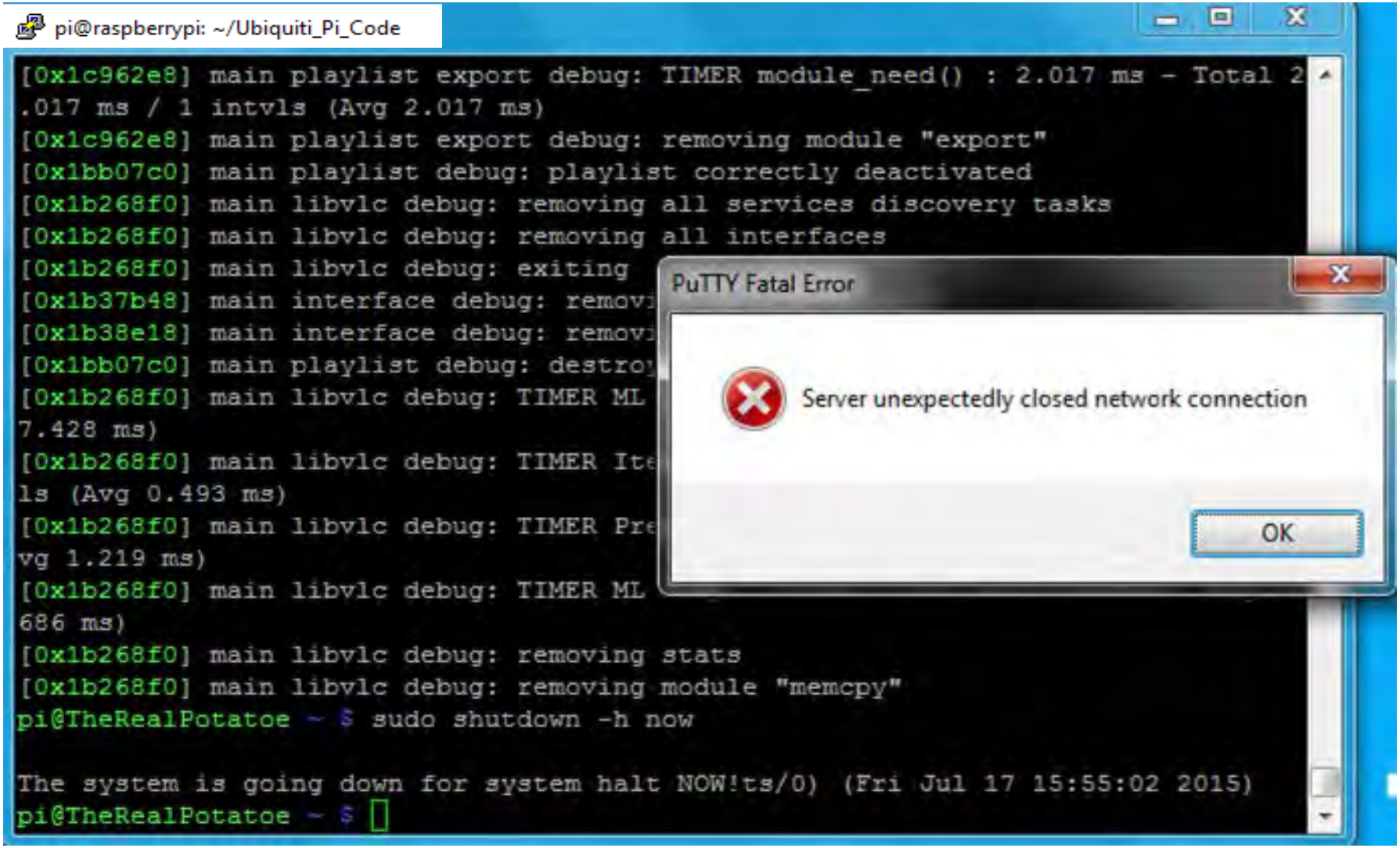


Shutting down your pi safely

1. Close VLC media player
2. Return to the PuTTY window
3. To exit video streaming mode hit **[CTRL]** + **[c]**
4. Type in the command prompt: **sudo shutdown –h now** and hit **[ENTER]**



Shutting down your pi safely



It is now safe to turn off the Pi

GUI and Payload Shutdown

- To shutdown the payload Pi, use a laptop to connect wirelessly to the Pi (using PuTTY). Login to the Pi (Username: pi Password: raspberry) and in the command prompt type **sudo shutdown –h now** and wait ~10 seconds. Insert the key into the key switch and turn it to the 3-o'clock position to turn power off to the payload.
- You can just turn the key switch to off without shutting down the pi, but there is the risk of corrupting the SD card. Images, etc. can still be recovered (using a Linux based computer). It is recommended, even on recovery, that you have a laptop available to wirelessly turn off the RFD Pi.

- To close the GUI, simply click the **x** in the upper right corner and then close the Anaconda Prompt window.