RFD900: Still Image System: Setup and Usage

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 vapor 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, OCCAMS, etc. and place them on the ESD rubber mat when not in use.
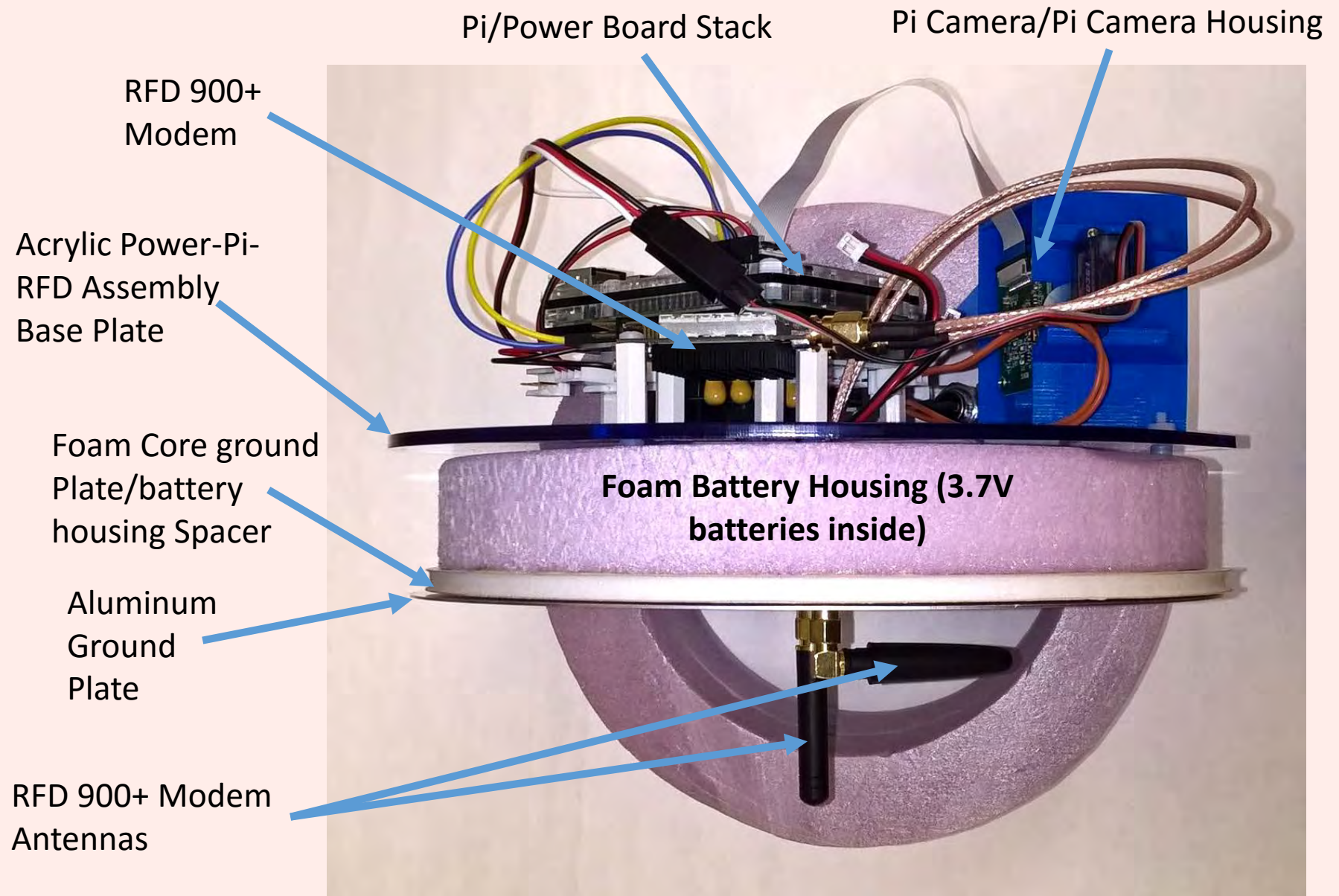
Overview and Introduction

- **The RFD900 Still Image System allows for recording and transmitting of still images**

- **In these slides, you will:**
  - **Connect to laptop and run software**
  - **Use the GUI**
  - **Use various features of the RFD900 system**
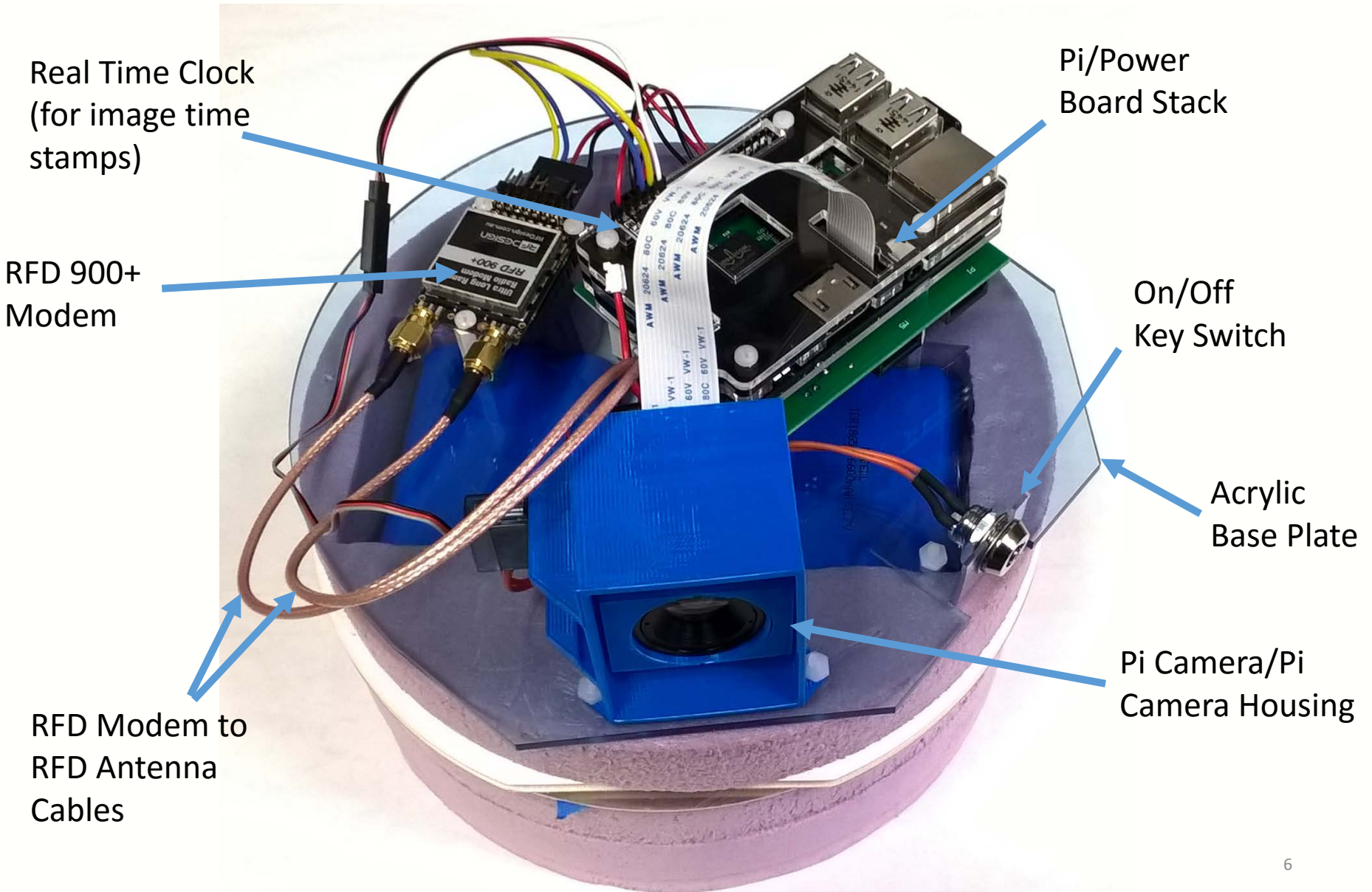
Functional Block Diagram
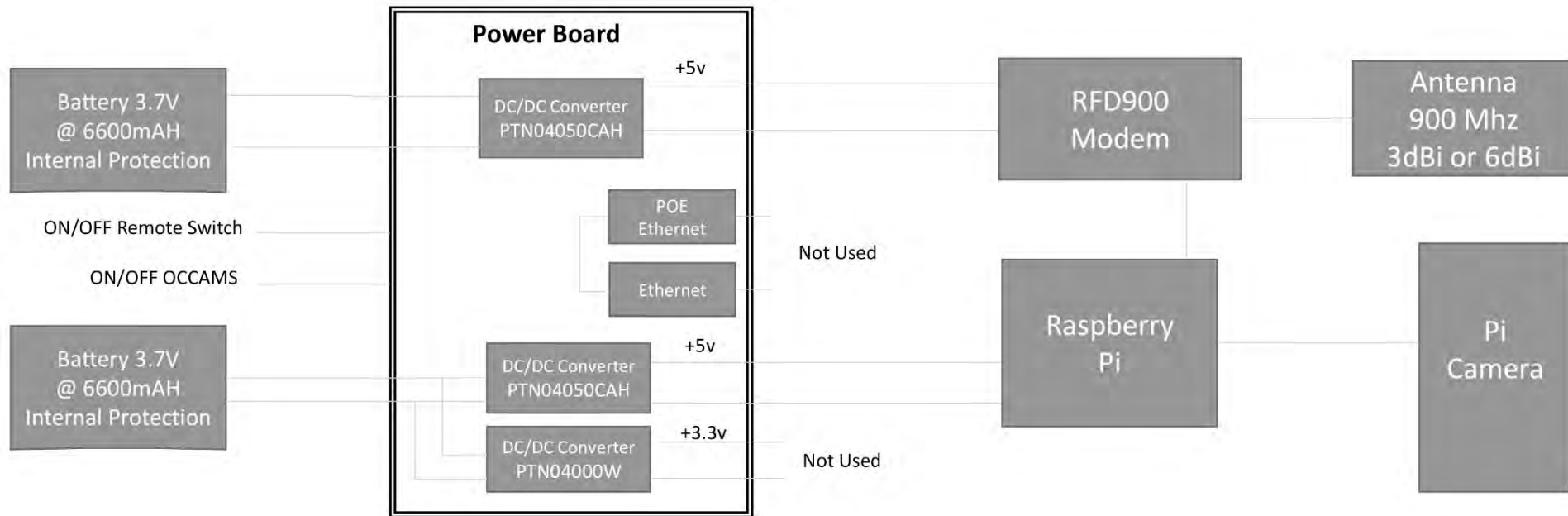
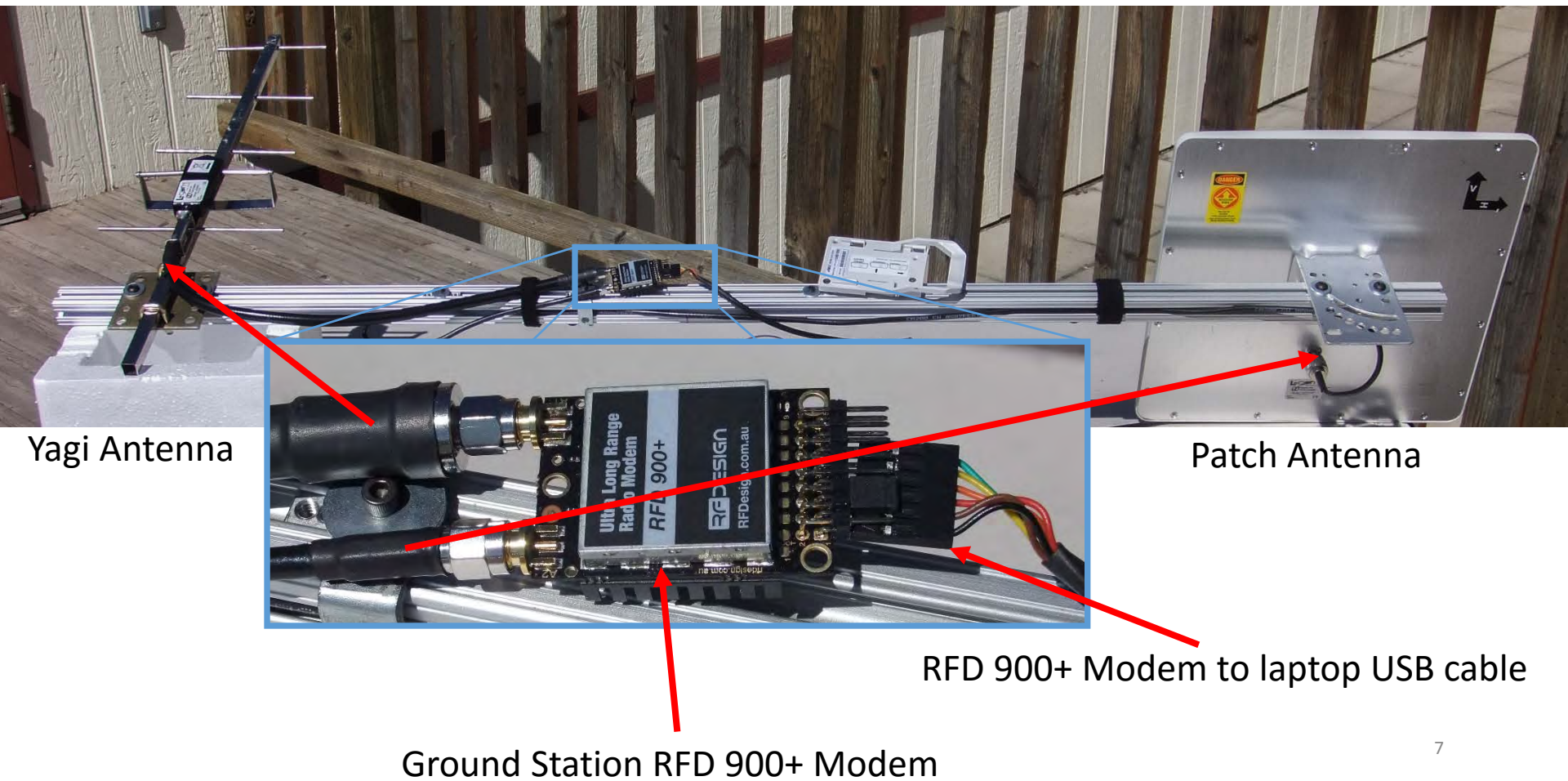Basic Primary Payload Still Image Block Diagram Rev 2 (11-19-15)

Completed System: Side View

Pi/Power Board Stack

Pi Camera/Pi Camera Housing

RFD 900+ Modem

Acrylic Power-Pi-RFD Assembly Base Plate

Foam Battery Housing (3.7V batteries inside)

Foam Core ground Plate/battery housing Spacer

Aluminum Ground Plate

RFD 900+ Modem Antennas

Completed System: Top View

Real Time Clock (for image time stamps)

RFD 900+ Modem

RFD Modem to RFD Antenna Cables

Pi/Power Board Stack

On/Off Key Switch

Acrylic Base Plate

Pi Camera/Pi Camera Housing

Completed System: RFD Ground Station Connections

Yagi Antenna

Patch Antenna

RFD 900+ Modem to laptop USB cable

Ground Station RFD 900+ Modem

Introduction to the Build

- **Each team will build their own RFD900 Still Image System**

- **Each RFD900 System will be tested during the workshop for full functionality**
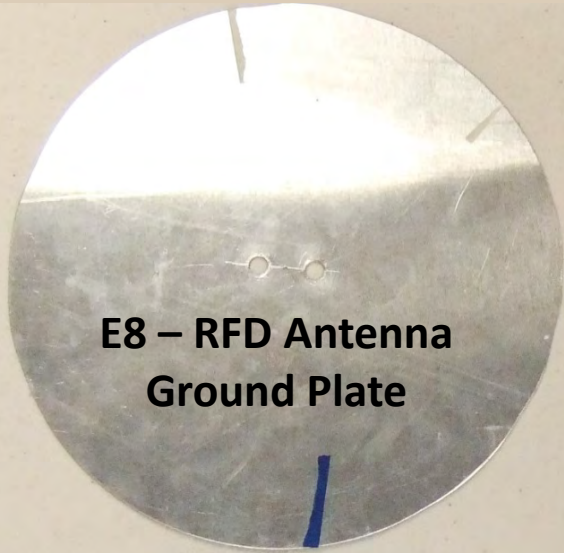
E8 – RFD Antenna Ground Plate
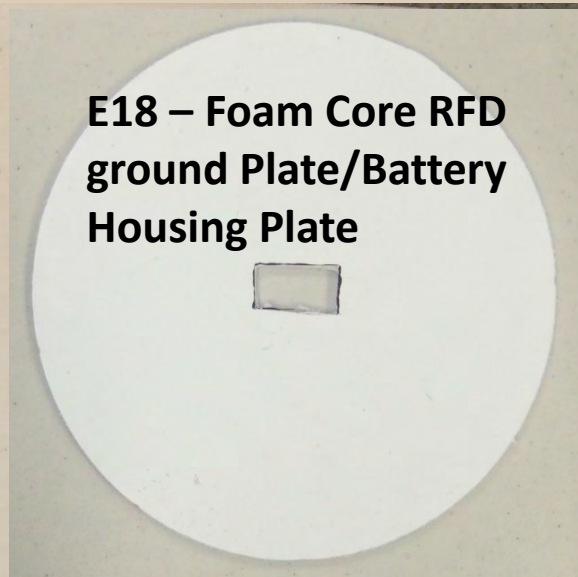
E18 – Foam Core RFD ground Plate/Battery Housing Plate

E20 – Foam Core Flight Housing (x3)
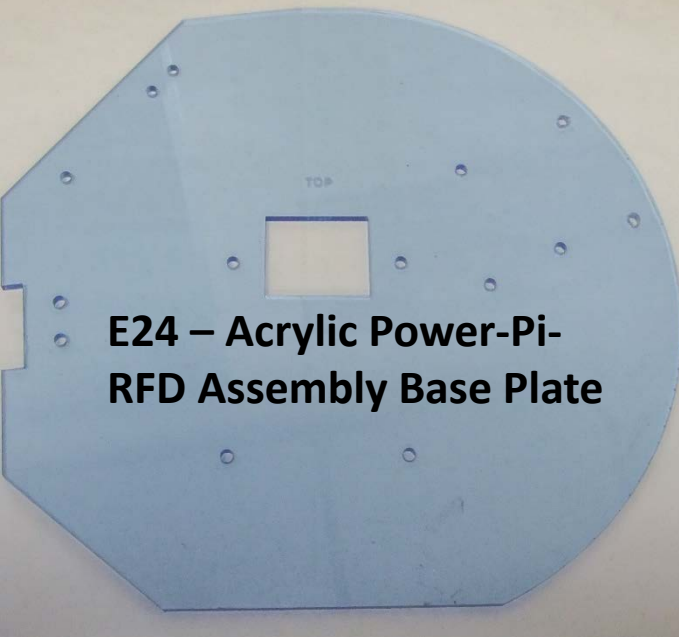
E24 – Acrylic Power-Pi-RFD Assembly Base Plate

TOP
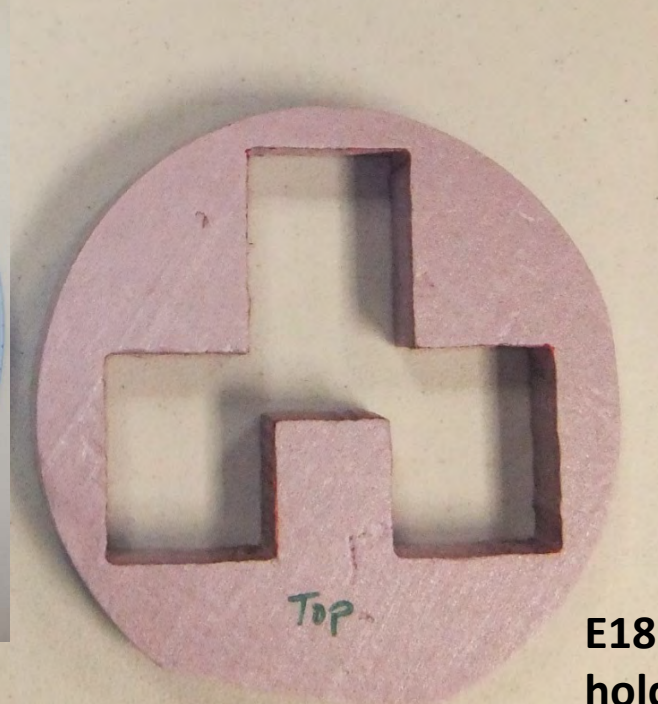
E18 – Foam Battery holder/RFD Antenna Spacer

E9 – Real Time Clock

E6 – Wi-Fi USB Adapter

E1 – Pi Camera

E2 – 3.7V Batteries (x2)

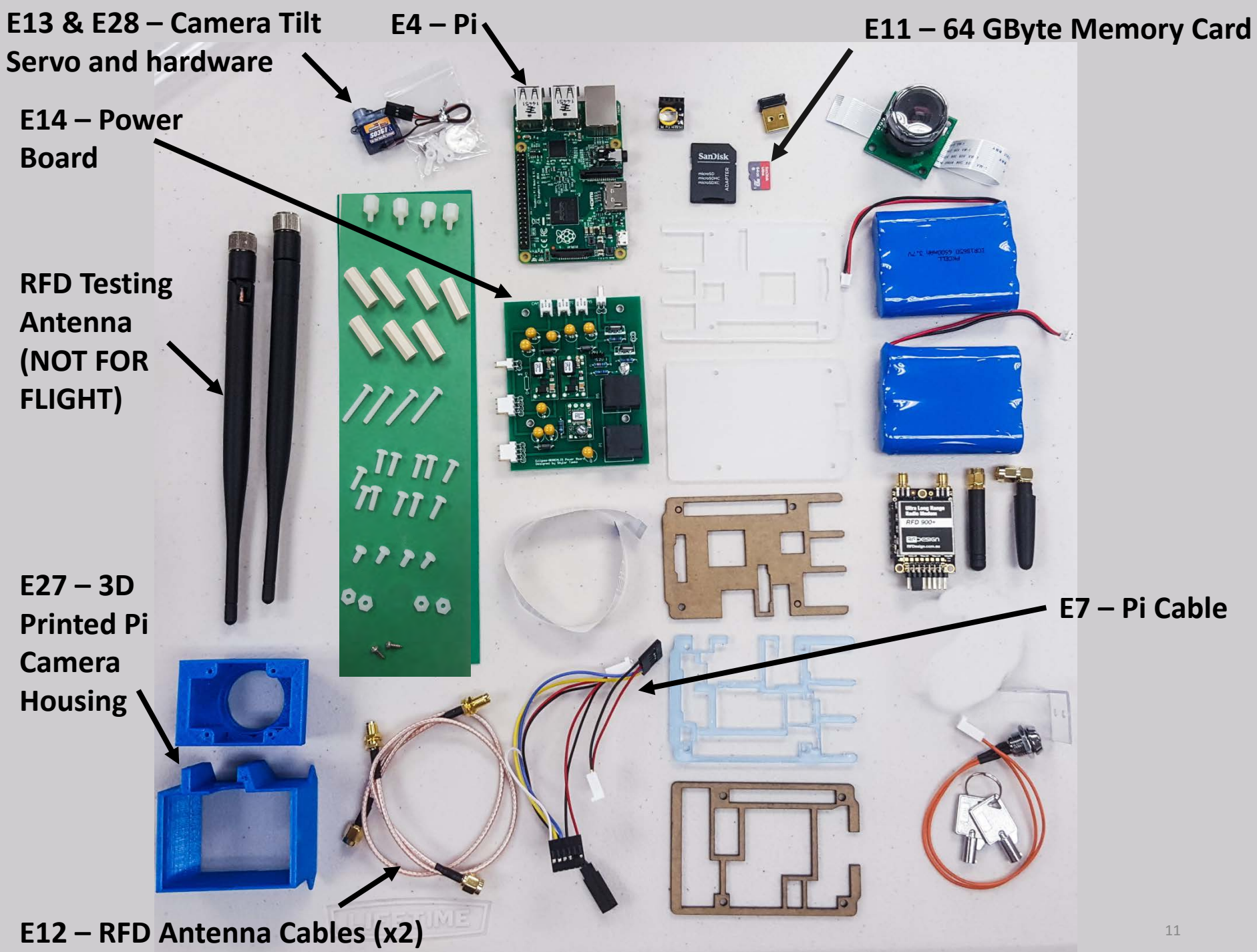E3 – RFD 900+ Modem Air Side

E5 – Pi Case

E3 – RFD payload antenna (x2)

E10 – Pi Camera Flex Cable

E25 – Key Switch Bracket

E30 – System on/off key switch w/ keys
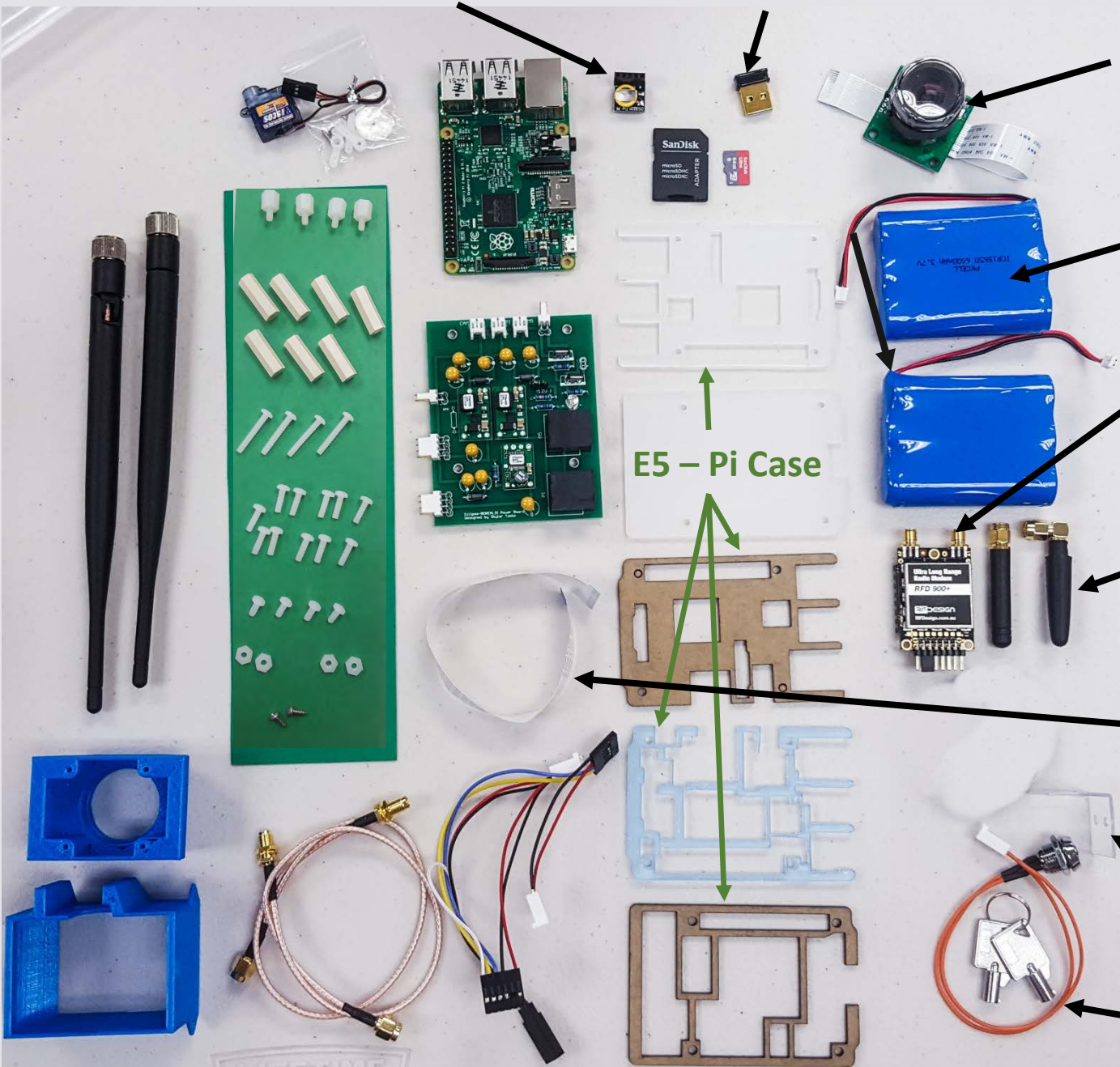
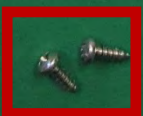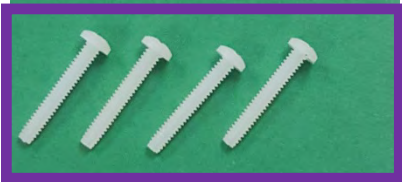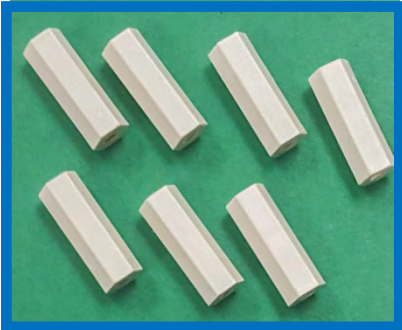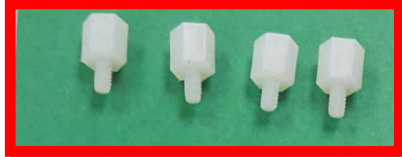E13 & E28 – Camera Tilt Servo and hardware

E4 – Pi

E11 – 64 GByte Memory Card

E14 – Power Board

RFD Testing Antenna (NOT FOR FLIGHT)

E27 – 3D Printed Pi Camera Housing

E7 – Pi Cable

E12 – RFD Antenna Cables (x2)

11

- **E15 – 4-40 Nylon hex standoff 1/4 in. (x4)**
- **E16 – 4-40 Nylon hex standoff 3/4 in. (x7)**
- **E17 – 4-40 Nylon screw 3/4 inch (x4)**
- **E21 – 4-40 Nylon Screw 1/4 inch (x4)**
- **E22 – 4-40 Nylon Screw 3/8 inch (x11)**
- **E26 – 4-40 Nylon Nut (x4)**
- **E28 – 1/4 inch Camera mount screw (x2)**
- **E29 – Internal Star Washer for Key Switch (x2)**
- **E31 – METAL Washer**

Building the Still Image Payload: Power Board and Pi Mounting

The acrylic assembly base plate has a number of pre-drilled holes for mounting the **power board and Pi stack**, **Pi Camera 3D printed housing**, **RFD modem** (still image payload ONLY) and **on/off key switch**.
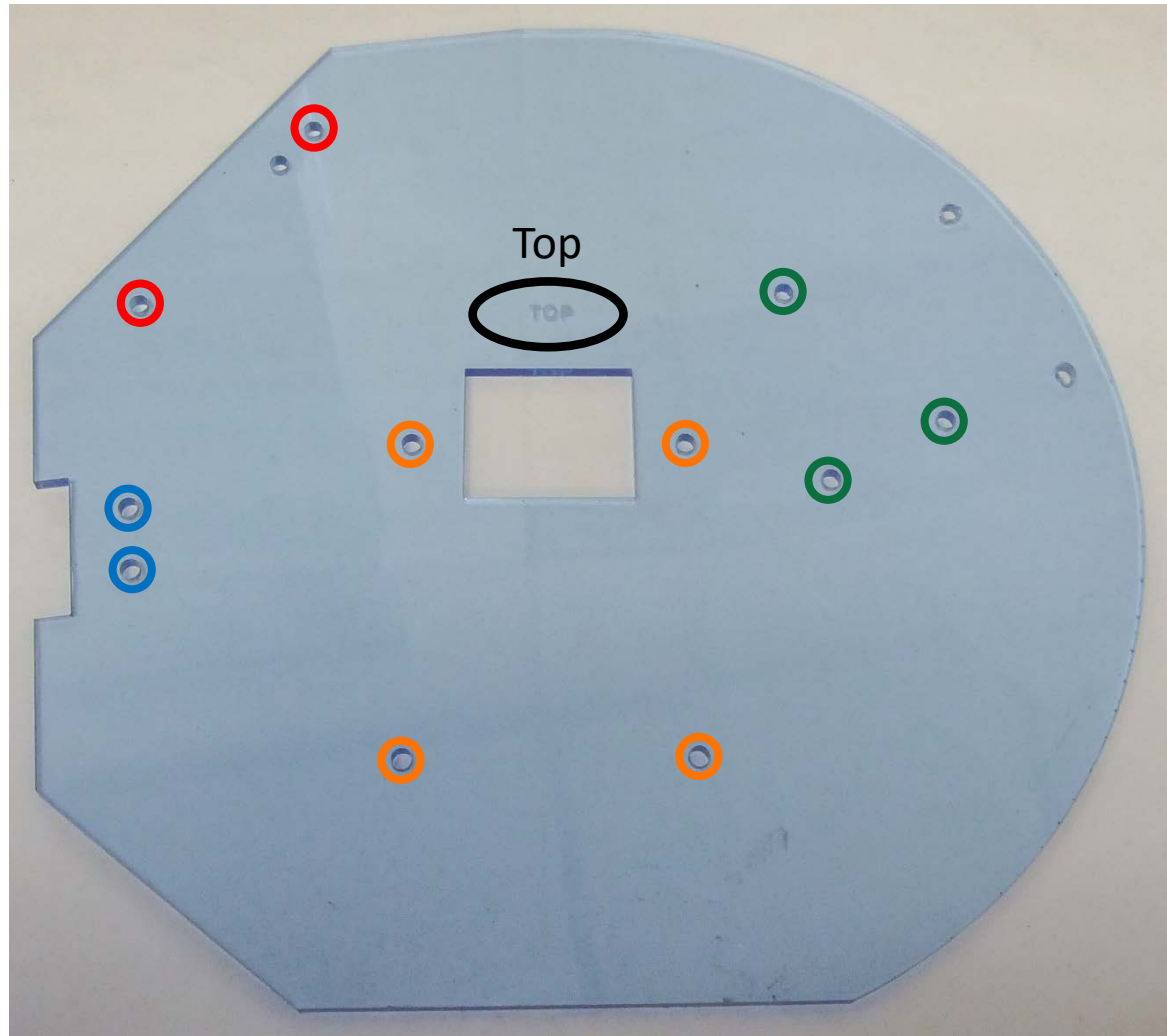
Building the Still Image Payload: Power Board, Pi and RFD Mounting

Insert seven **3/8 inch nylon screws** through the mounting holes from the bottom of the acrylic base plate and screw into the **3/4 inch nylon hex standoff (four for the Pi/Power Board Stack and three for mounting the RFD Modem).** Tighten snug, but don't overtighten!
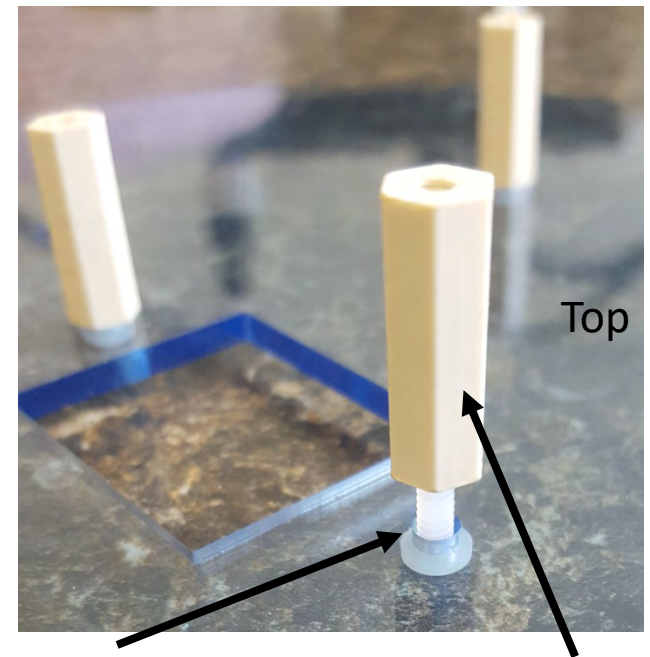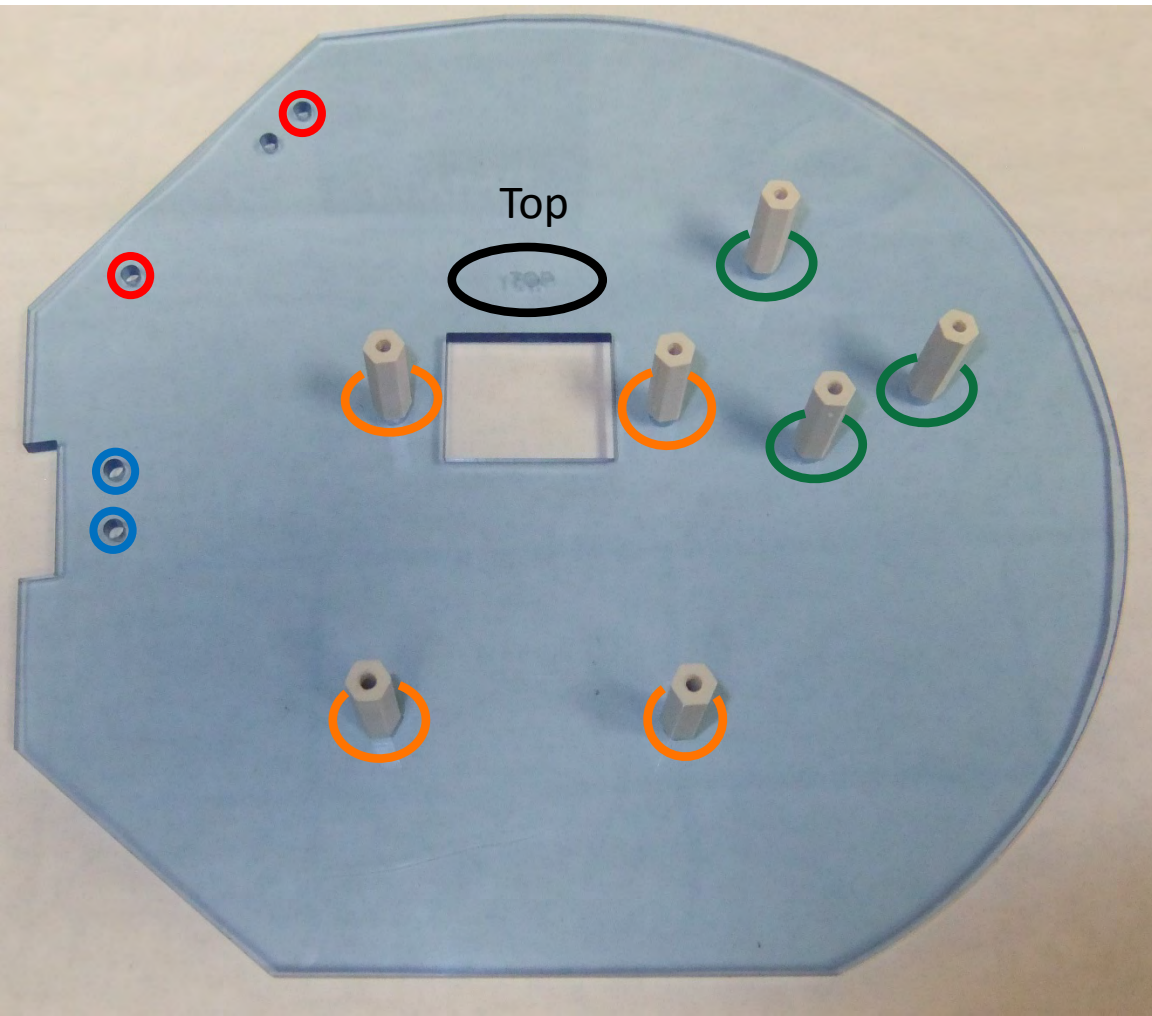
**3/8 inch nylon screws (E22)**

3/4 inch nylon hex standoff (E15)

Building the Still Image Payload: Power Board and Pi Stack
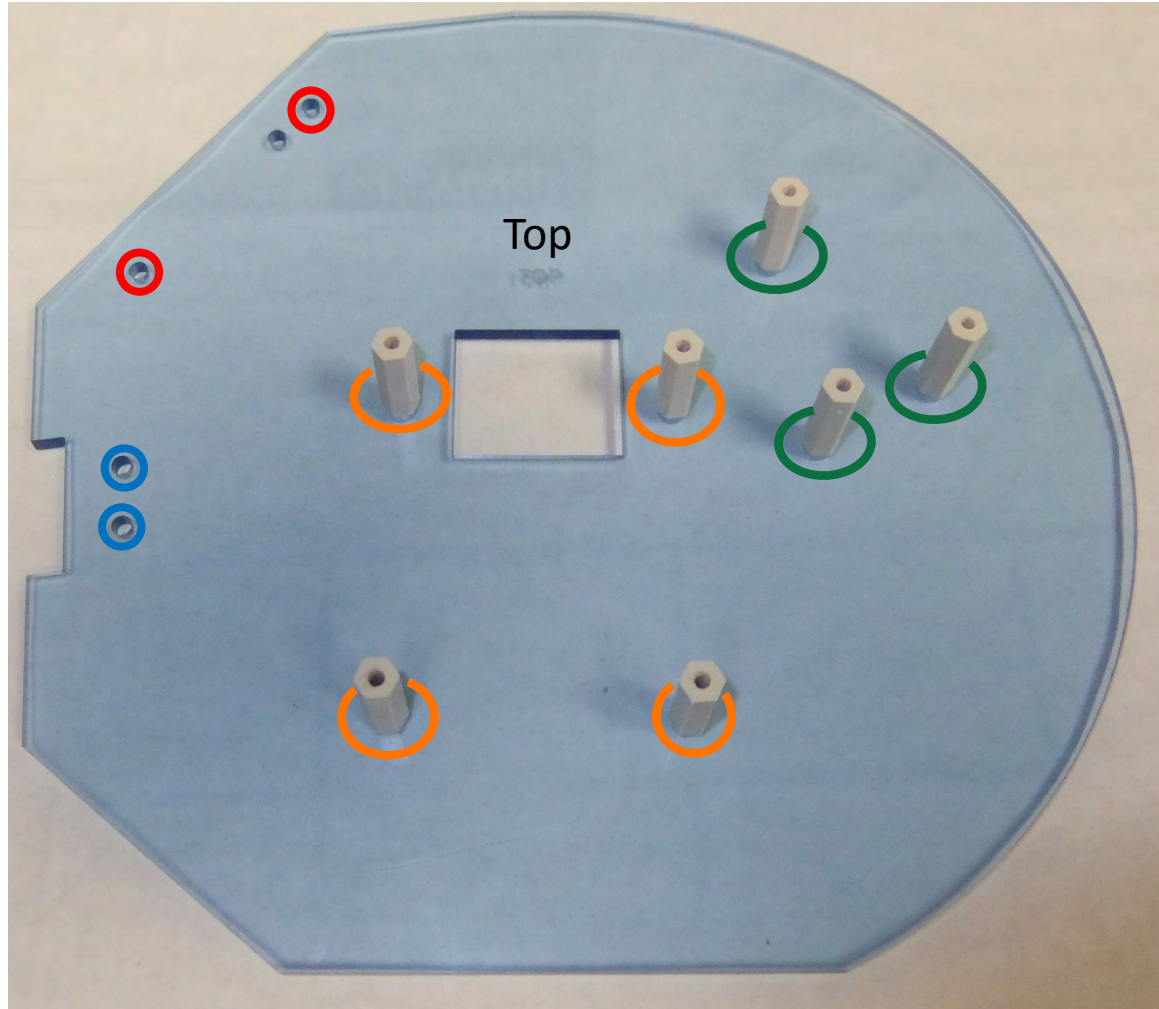
The power board will be mounted upside-down on top of the **four ¾ inch standoffs**

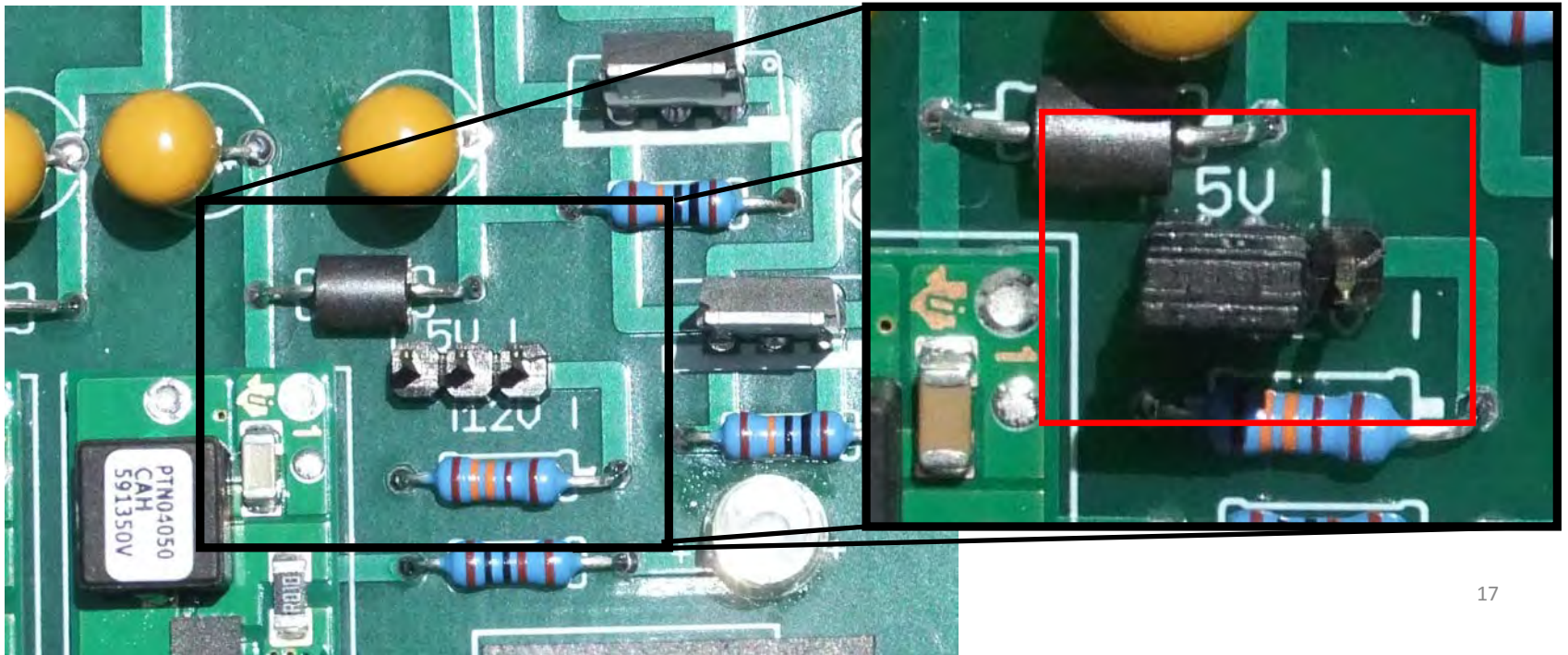# Setting up the Power Board for the **STILL IMAGE PAYLOAD**

- The power board 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 IS IN THE CORRECT POSITION FOR ITS RESPECTIVE PAYLOAD BEFORE USING POWER BOARD!
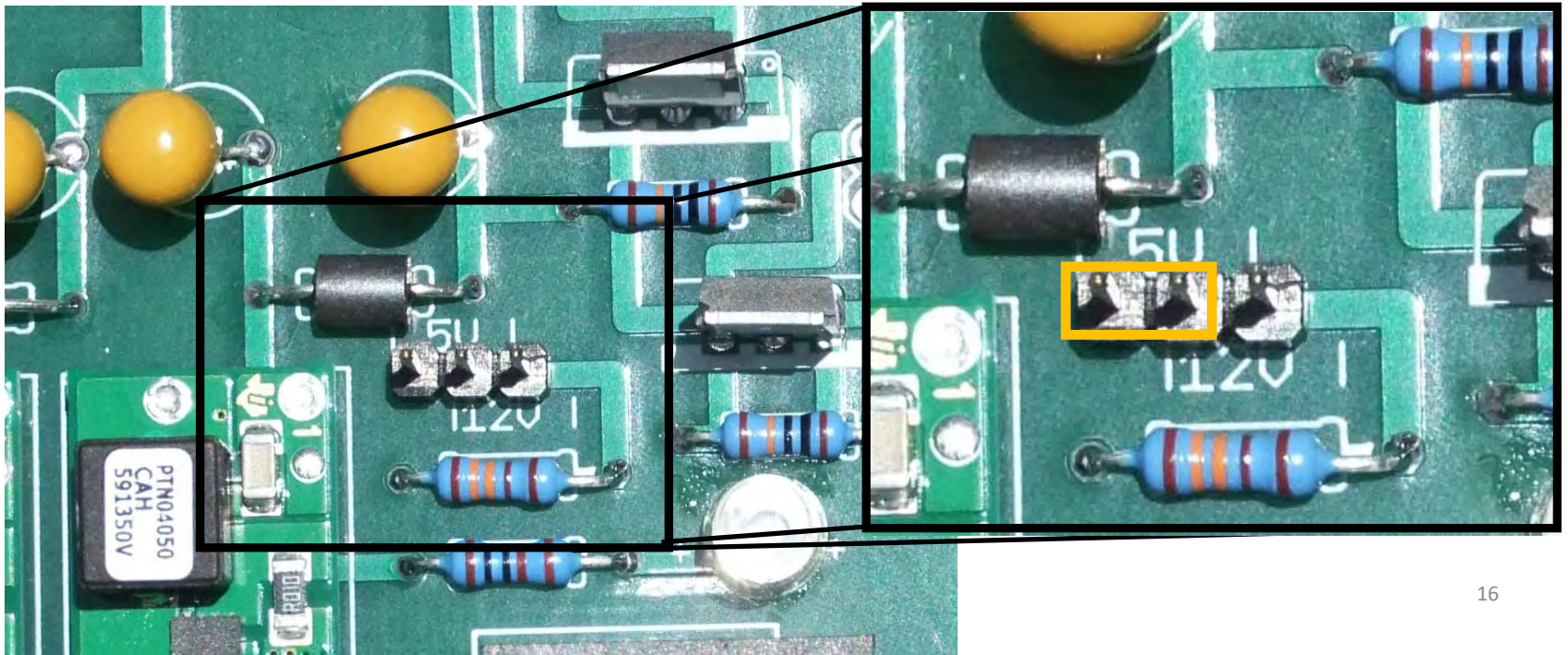
- **For the Still Image Payload the jumper must be set to 5V**.

Setting up the Power Board for the **STILL IMAGE PAYLOAD**

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- MAKE SURE TO CHECK THE JUMPER POSITION BEFORE USING POWER BOARD!

- **For the Still Image Payload the jumper must be set to 5V**.

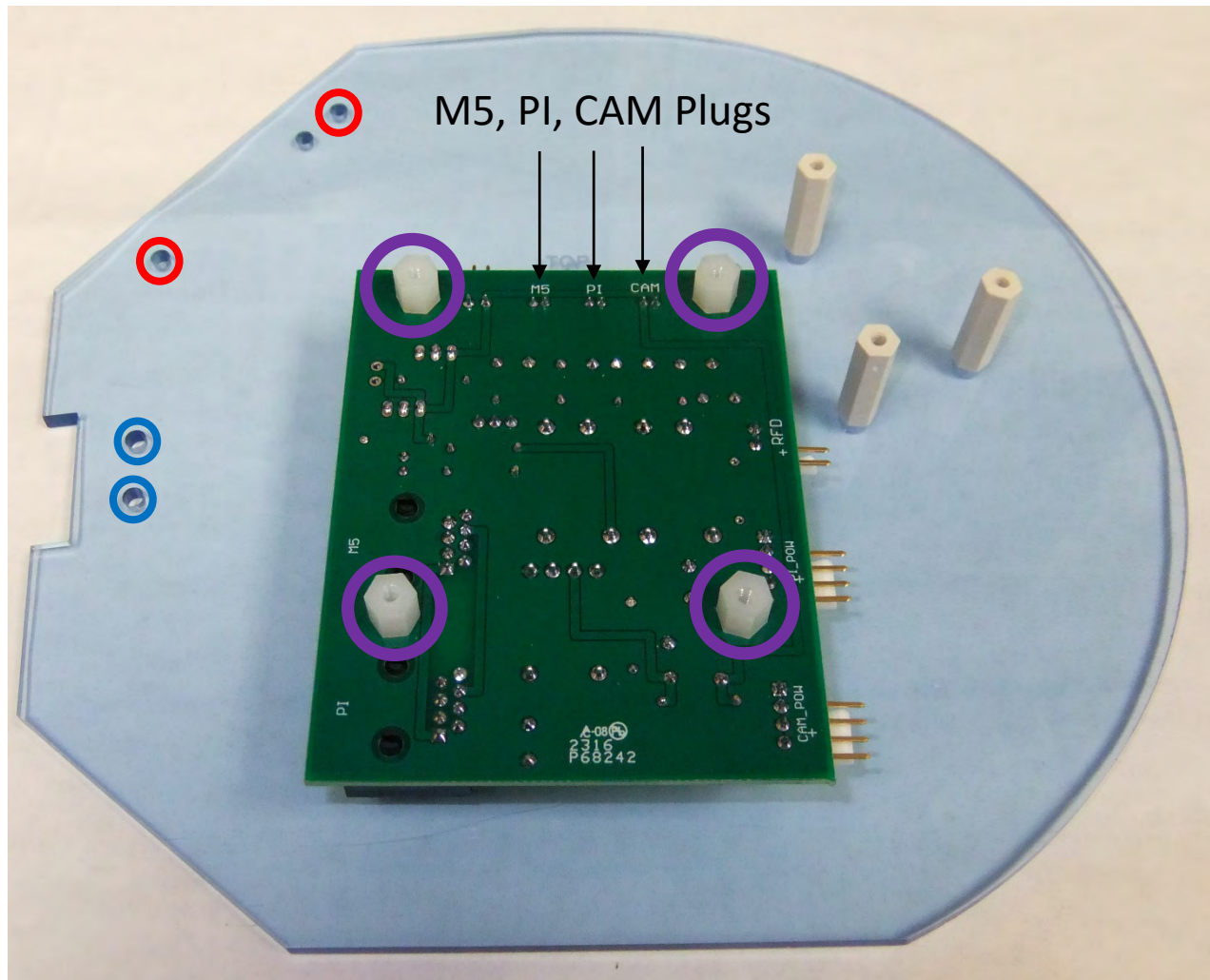# Building the Still Image Payload: Power Board Mounting
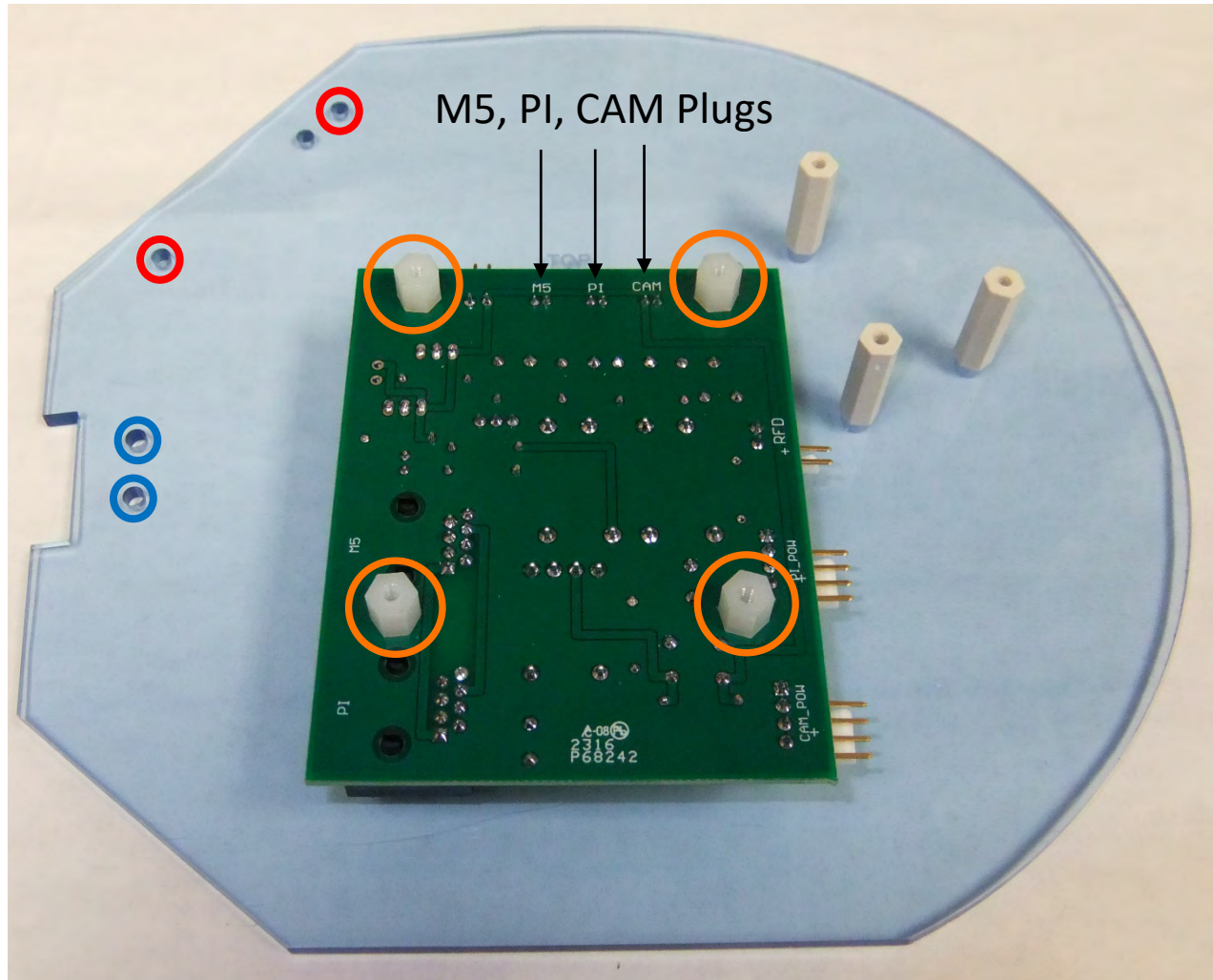
The **power board (E14)** will be held in place by screwing in **four**

**¼ inch standoffs.** Tighten snugly, but do not overtighten.

Building the Still Image Payload: Power Board Mounting

The **Pi (E4)** will be **mounted directly on top** of the power board using the **pi case (E5)**.
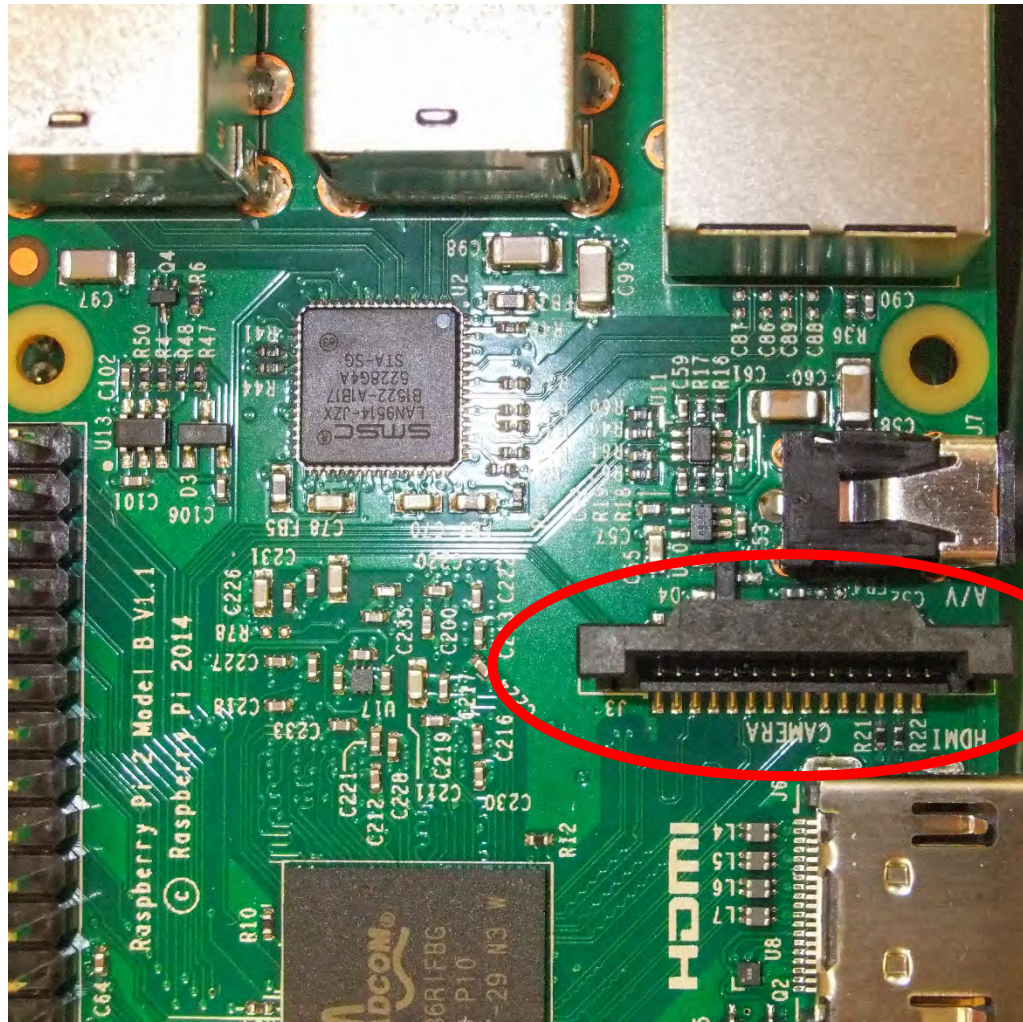
Building the Still Image Payload:
Pi USB Wi-Fi Adapter

Insert the **USB Wi-Fi Adapter (E6)** into one of the **Pi's (E4)** four USB slots. The fit may be tight and you may need to wiggle it into place.
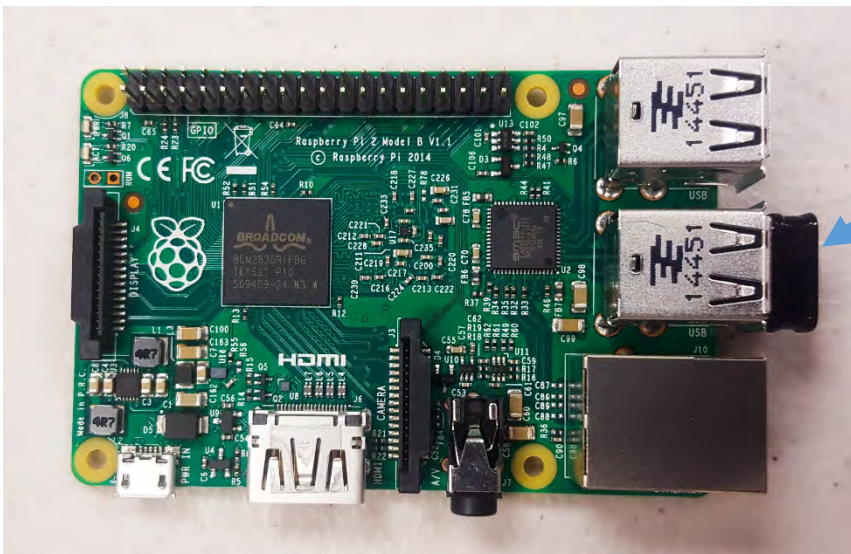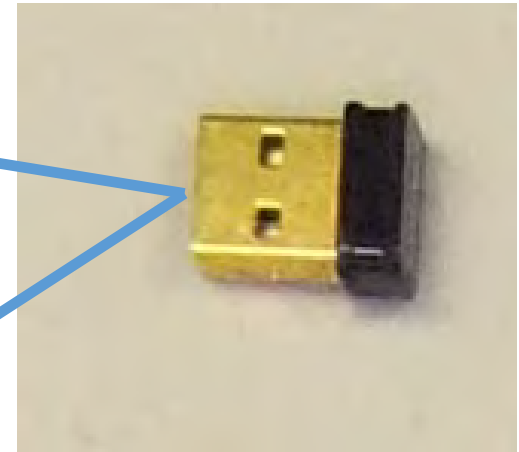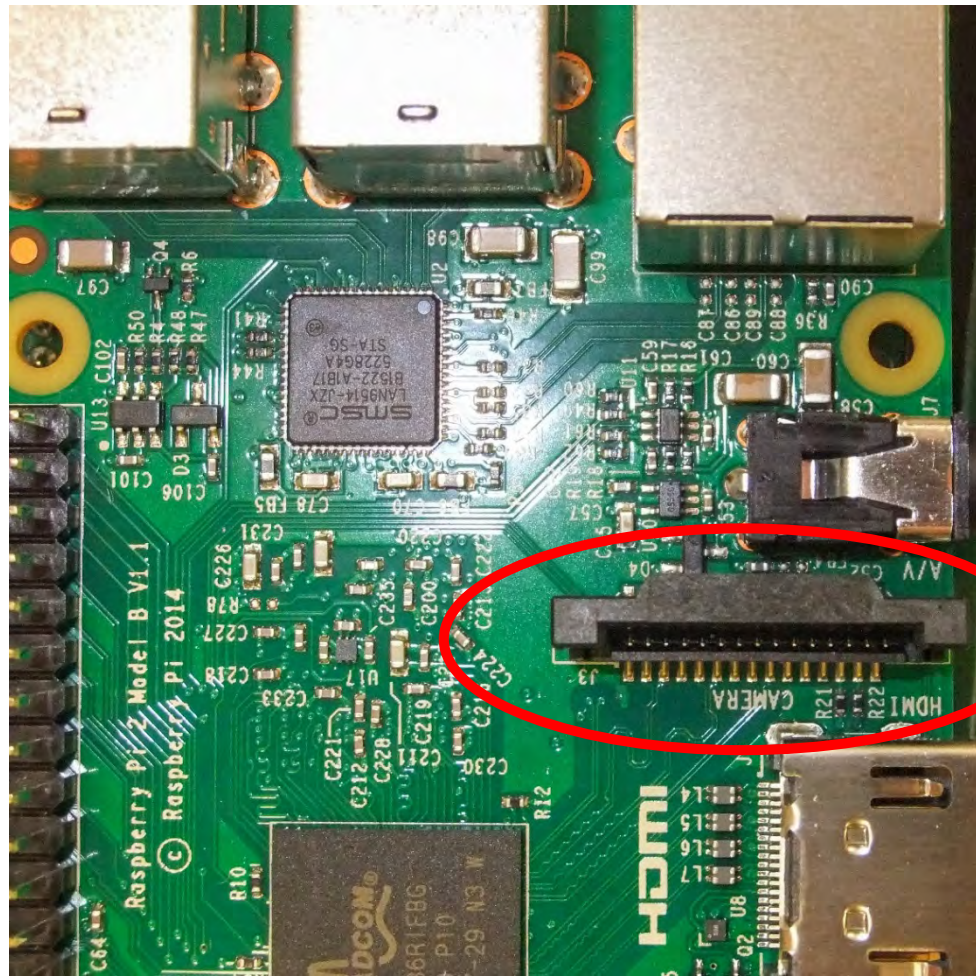
Building the Still Image Payload:
Pi Mounting Prep – Camera Ribbon Cable

The **8 inch camera ribbon cable (E10)** must be inserted before the **Pi (E4)** is put in the case and then mounted above the power board. The ribbon cable will be inserted **here**:
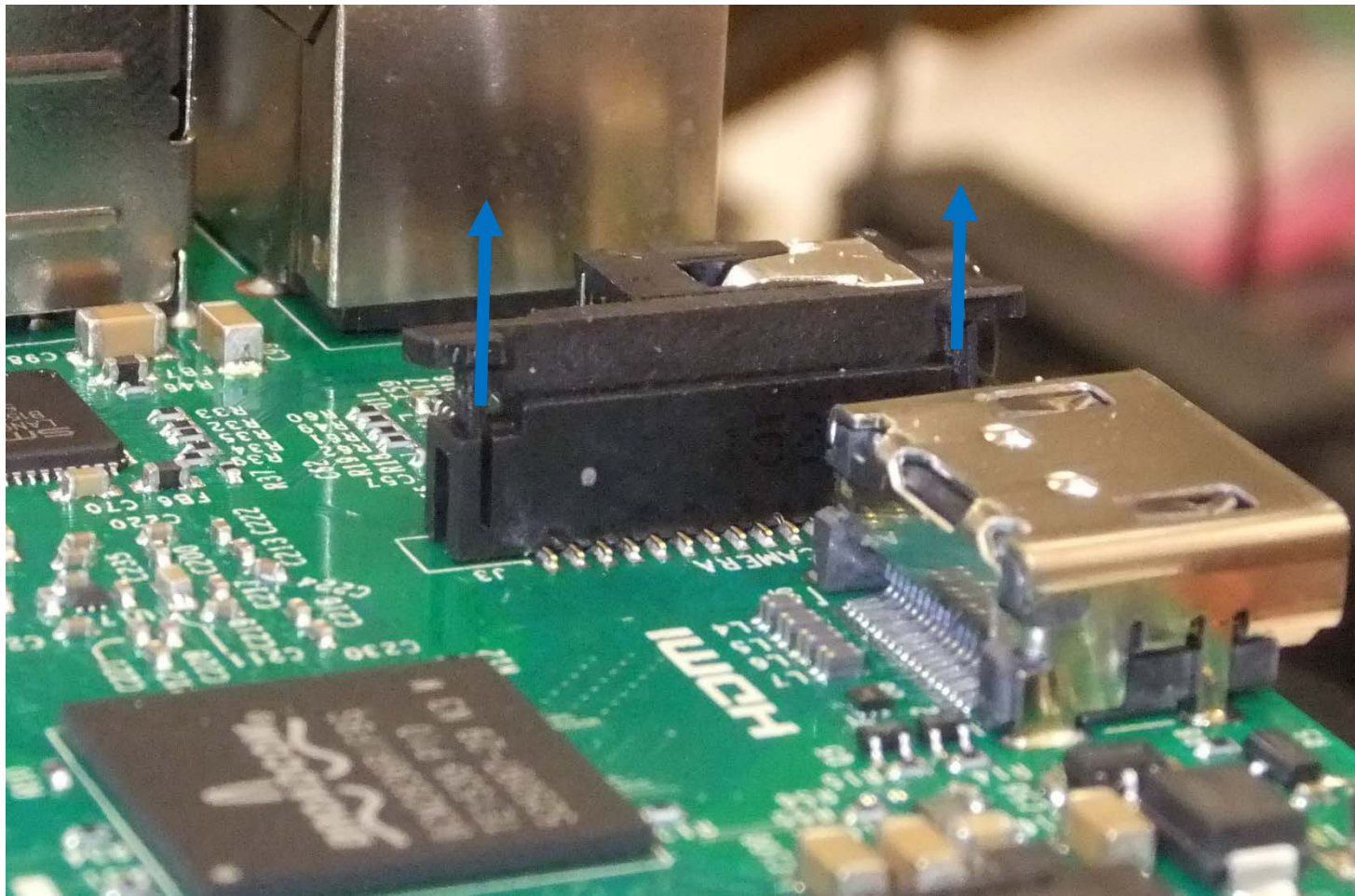
Building the Still Image Payload:
Pi Mounting Prep – Camera Ribbon Cable

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.
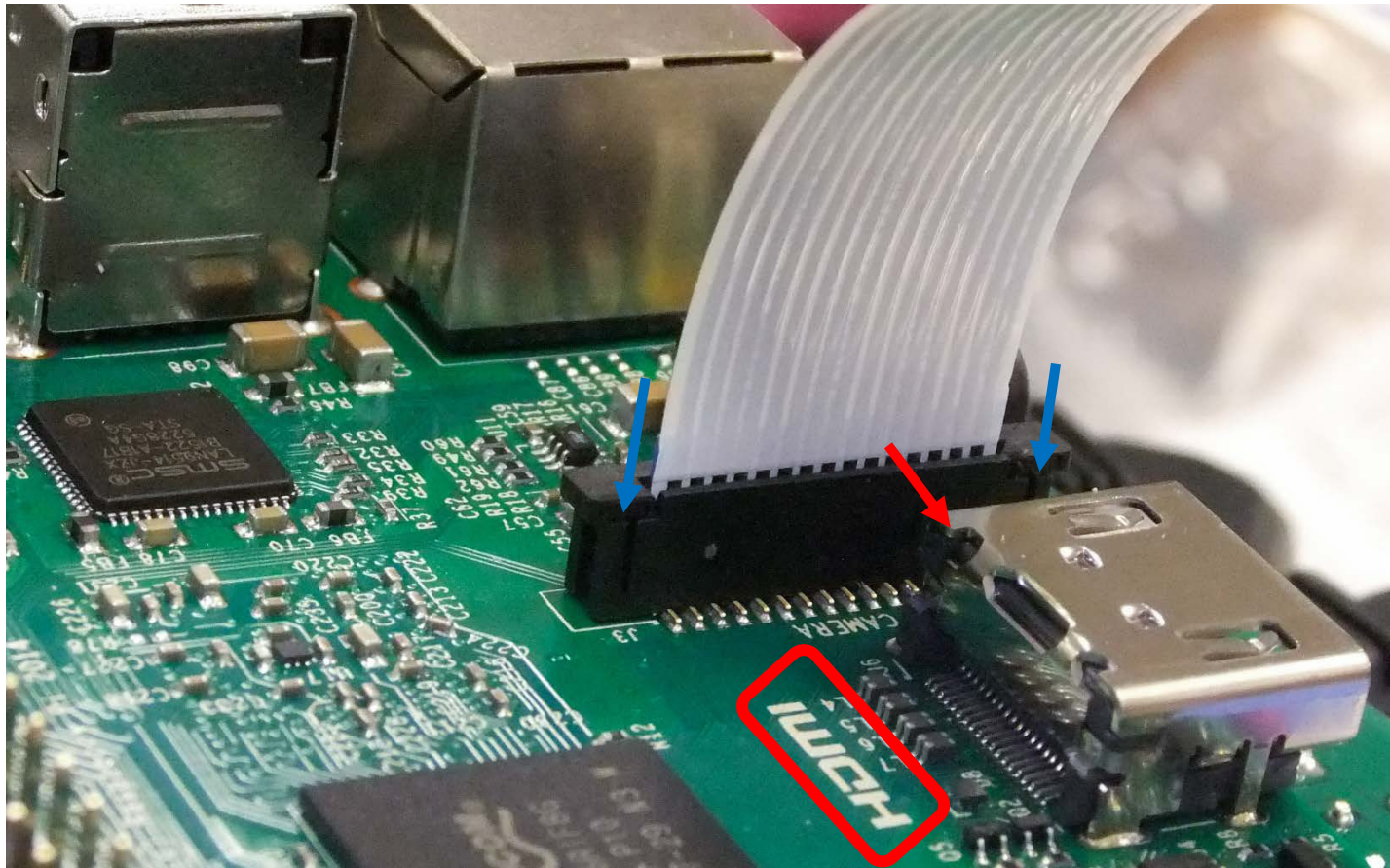
Building the Still Image Payload:
Pi Mounting Prep – Camera Ribbon Cable

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

Building the Still Image Payload:
Pi Mounting Prep – Camera Ribbon Cable

Insert the **8 inch ribbon cable (E10)** 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.
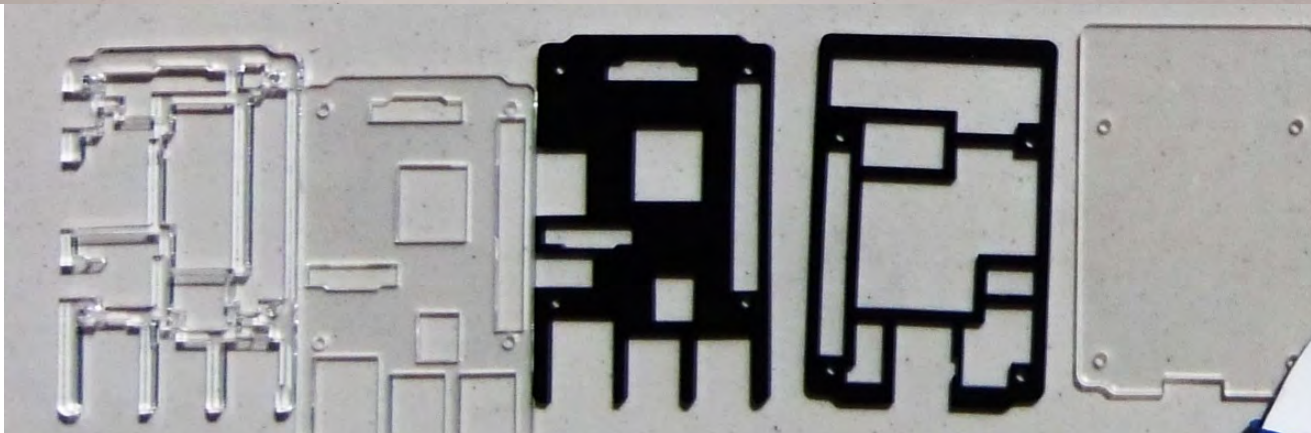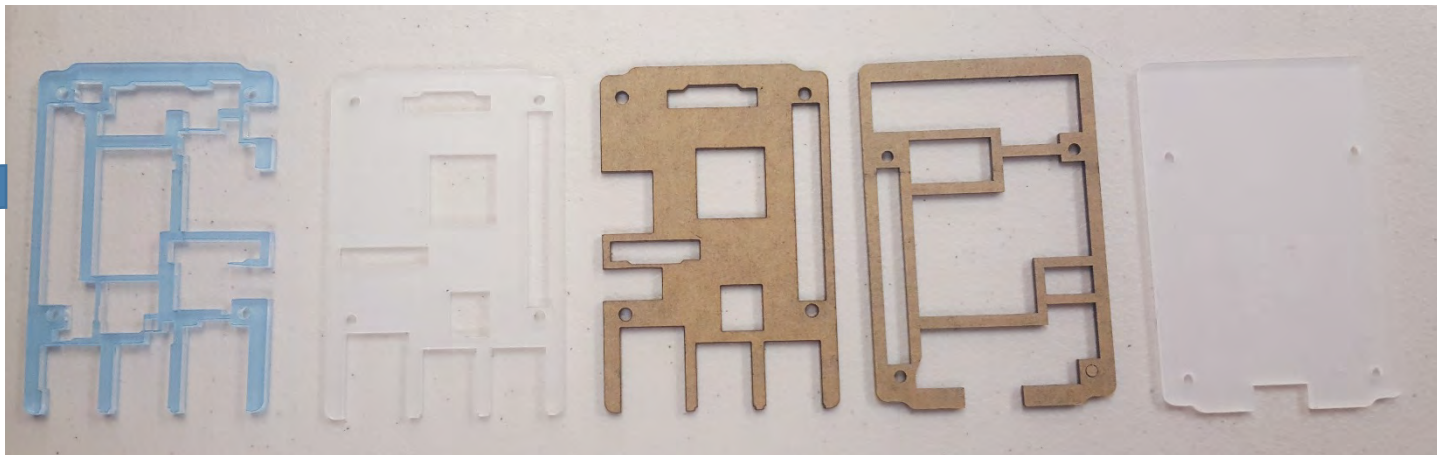
WARNING!

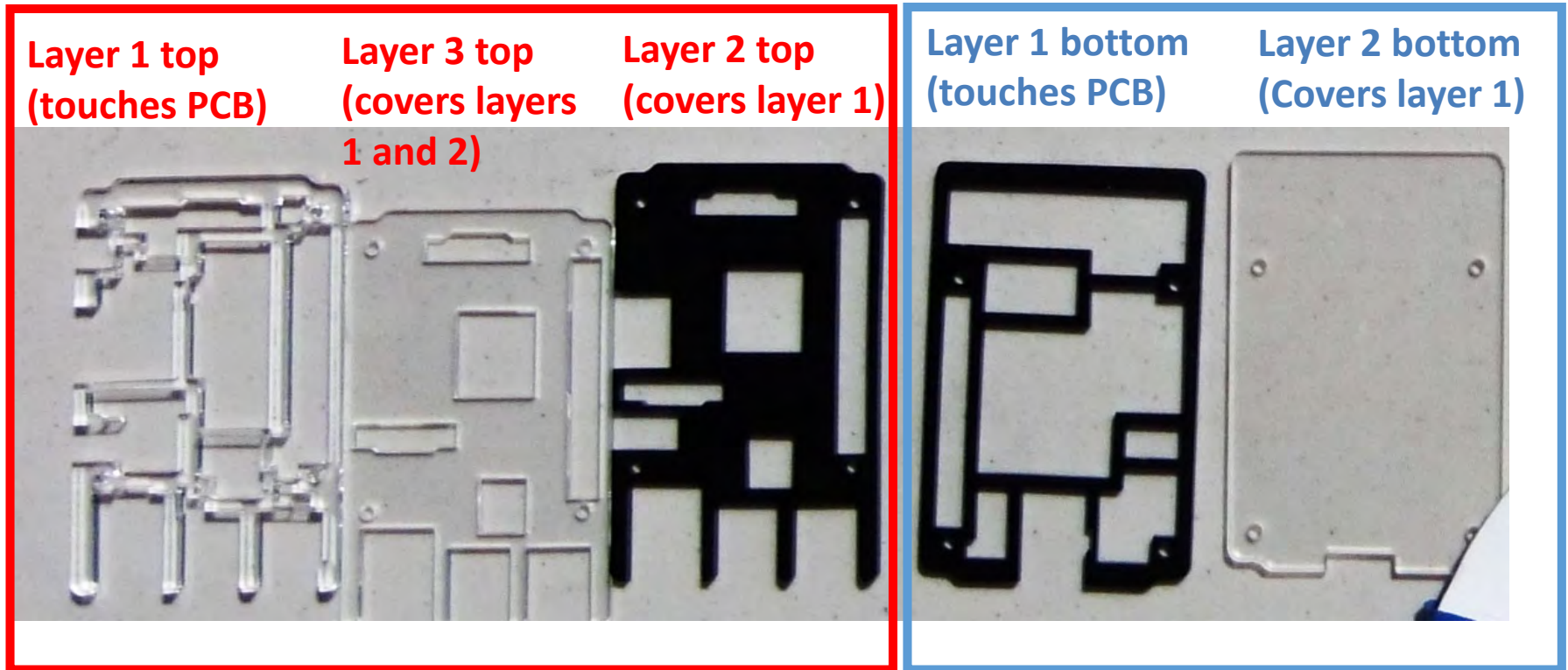You are about to perform the most annoying task in the workshop!

I give up

Building the Still Image Payload: Pi Mounting

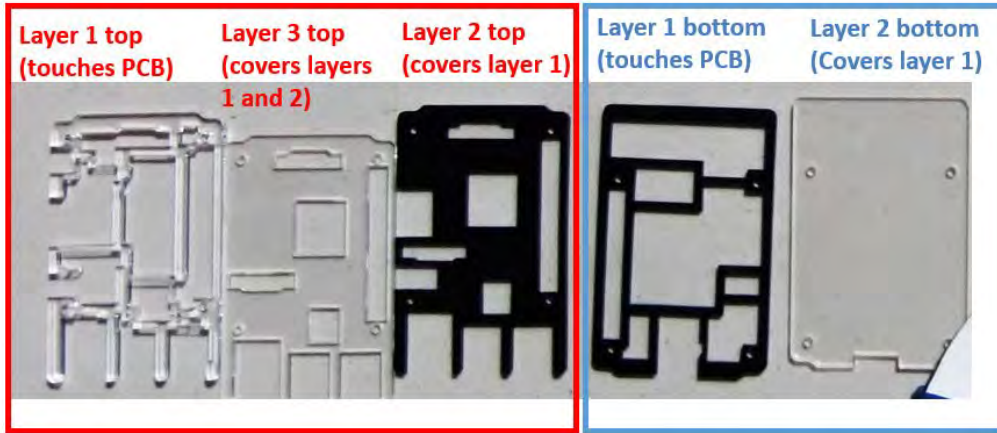**Remove the annoying protective plastic on the top and bottom of the Pi Case (E5) "layers."**

Building the Still Image Payload: Pi Mounting

Layer 1 top (touches PCB) **Layer 3 top (covers layers 1 and 2)** **Layer 2 top (covers layer 1)**

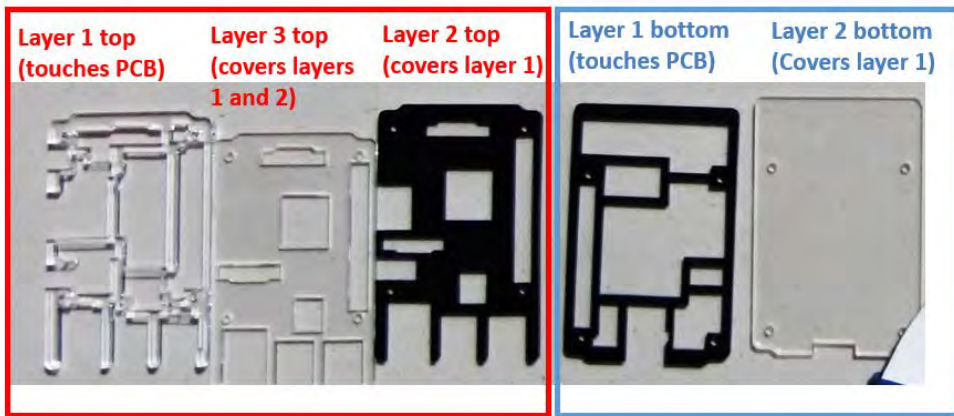**Layer 1 bottom (touches PCB)** **Layer 2 bottom (Covers layer 1)**

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.

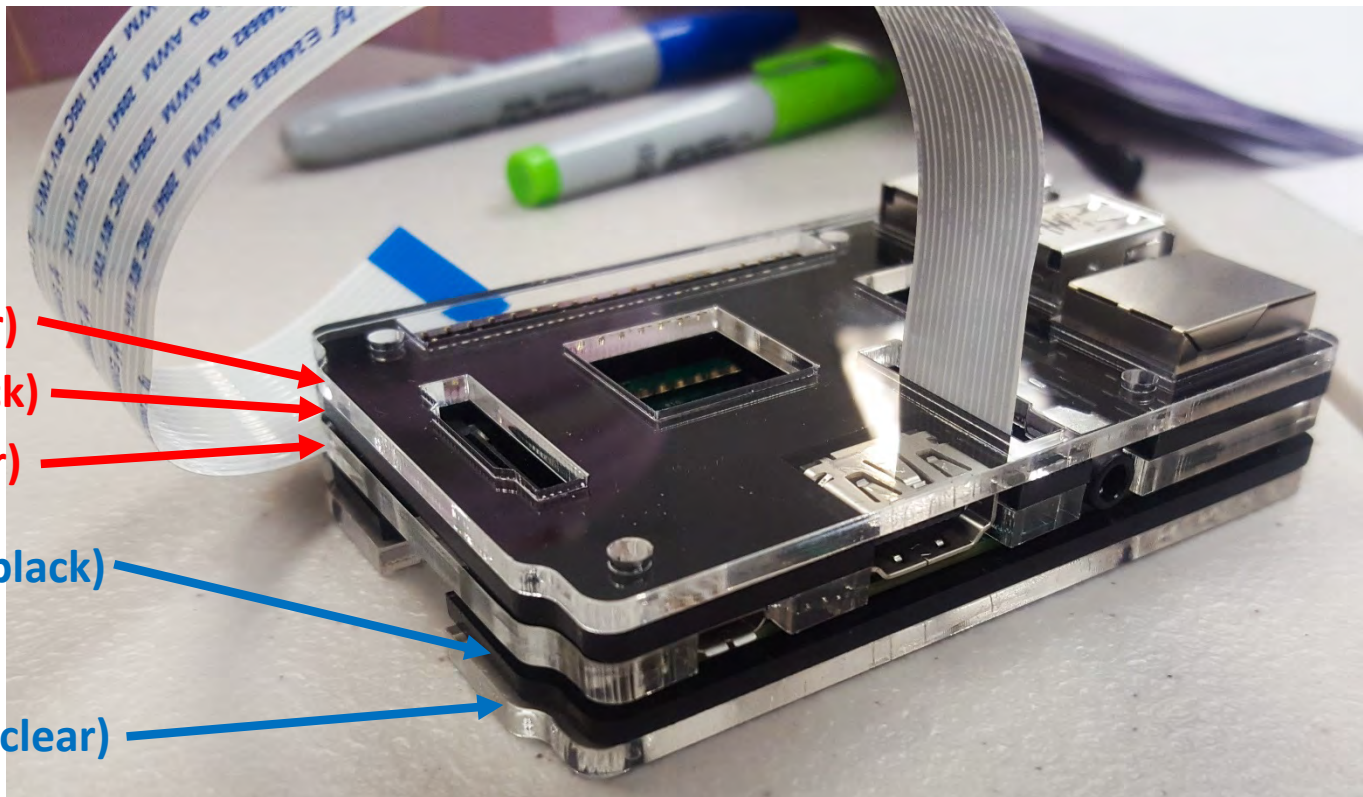# Building the Still Image Payload: Pi Mounting

Layer 1 top (touches PCB) | Layer 3 top (covers layers 1 and 2) | Layer 2 top (covers layer 1) | Layer 1 bottom (touches PCB) | Layer 2 bottom (Covers layer 1)

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

Building the Still Image Payload: Pi Mounting

Layer 1 top (touches PCB)   Layer 3 top (covers layers 1 and 2)   Layer 2 top (covers layer 1)

Layer 1 bottom (touches PCB)   Layer 2 bottom (Covers layer 1)

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

Top layer 3 (clear)
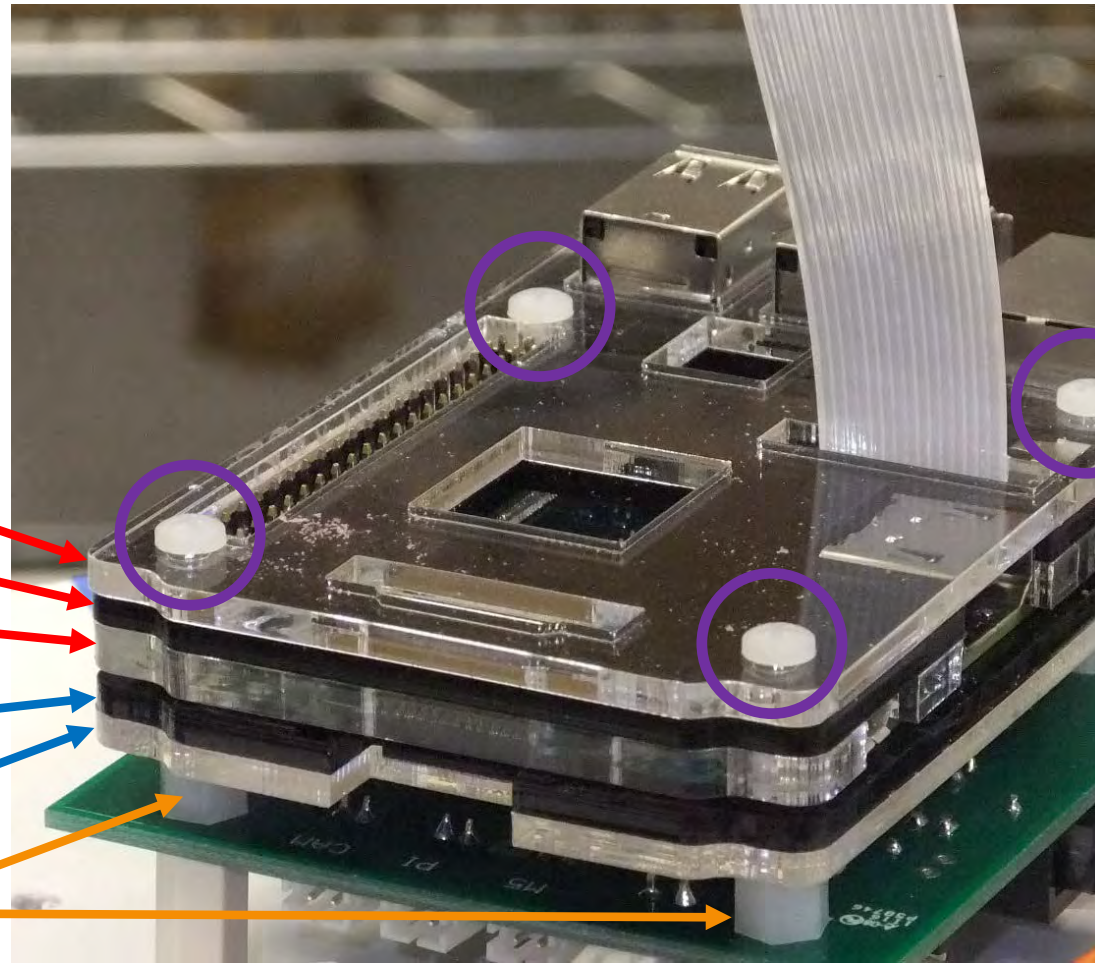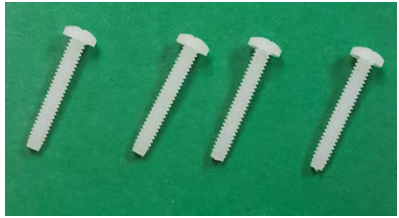**Top layer 2 (black)**
Top layer 1 (clear)

Bottom layer 1 (black)

Bottom layer 2 (clear)

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Building the Still Image 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 (E16)** 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 (E16)

Top layer 3 (clear)
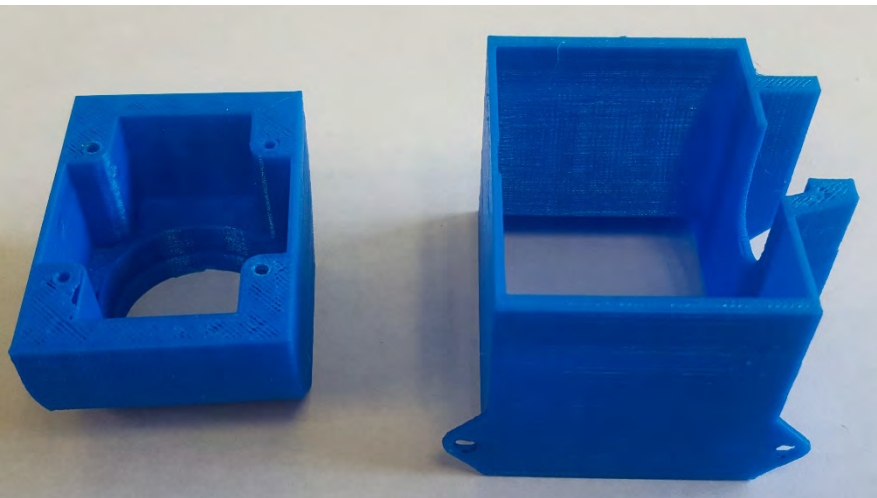**Top layer 2 (black)**
Top layer 1 (clear)

Bottom layer 1 (black)
Bottom layer 2 (clear)

Nylon hex spacers

Building the Still Image Payload: Pi Video Camera Housing Prep

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 (E13)

Glue (Tool Kit)

Building the Still Image Payload: Pi Video Camera Housing Prep

Glue the **servo mounting wheel** to the side of the camera housing **HERE**, making sure to line up the hole in the mounting wheel with the hole in the side of the camera Housing.

Building the Still Image Payload: RFD 900+ Modem Mounting

Place the **RFD Modem (E3)** onto the 3/4 inch standoffs and fasten in place with **three 1/4 inch nylon screws (E21) HERE**.
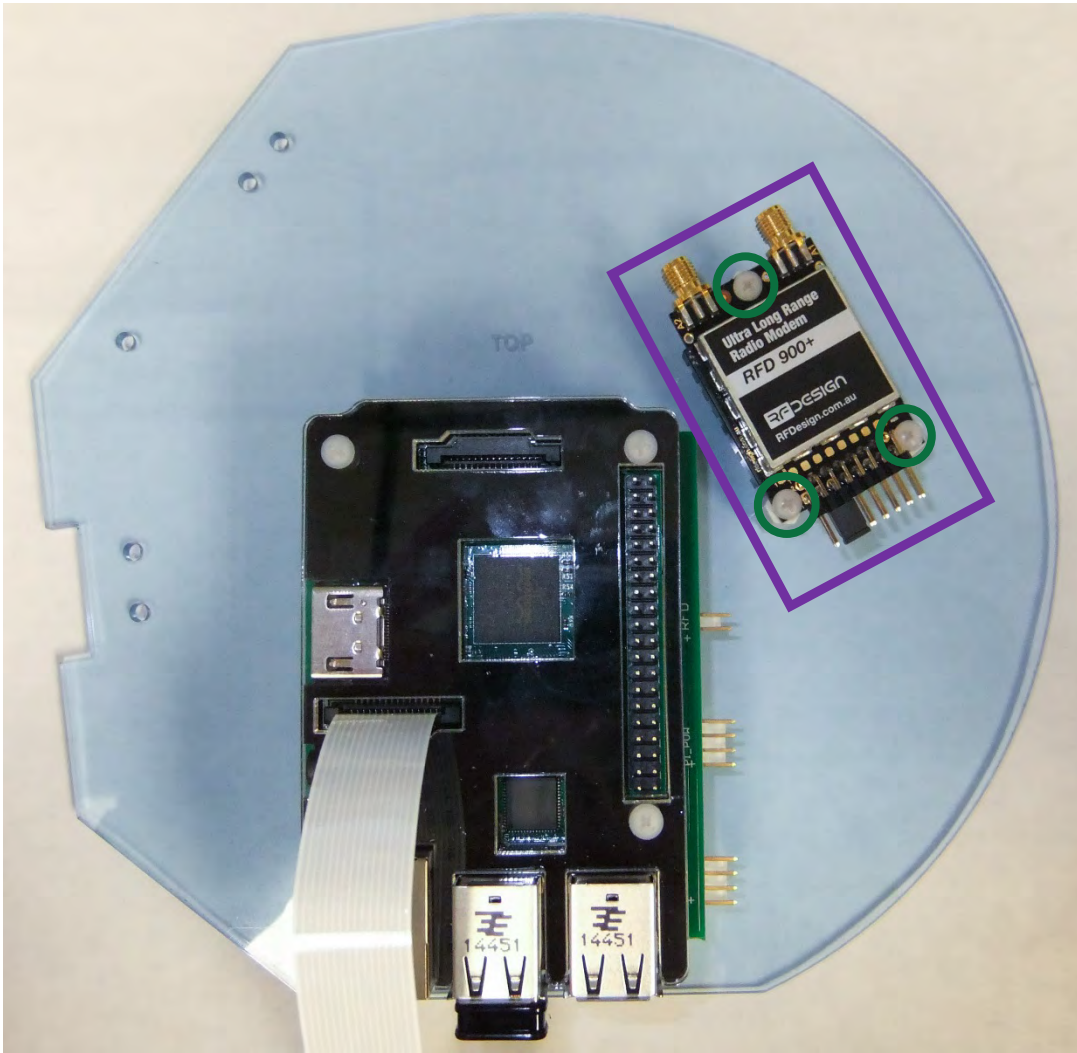
1/4 inch nylon screws (E21)

Building the Still Image Payload: On/Off Key Switch

Two lock washers (E29)

Two 4-40 nylon nuts (E26)

Two 3/8 inch nylon screws (E22)
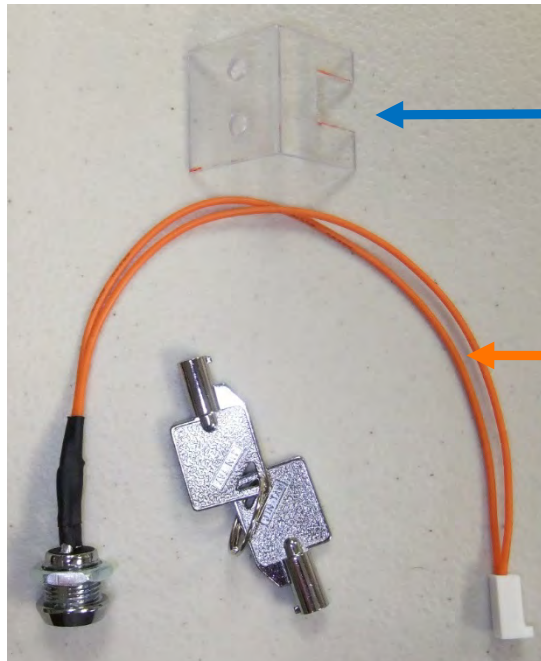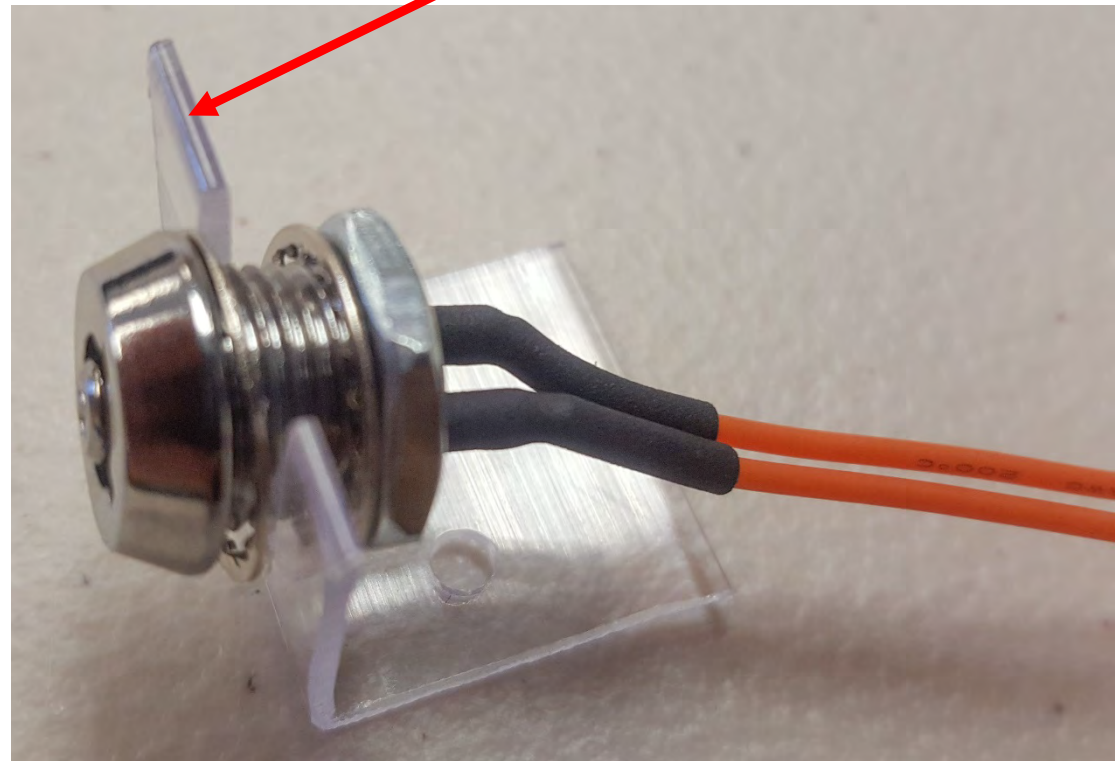
Key Switch Bracket (E25)
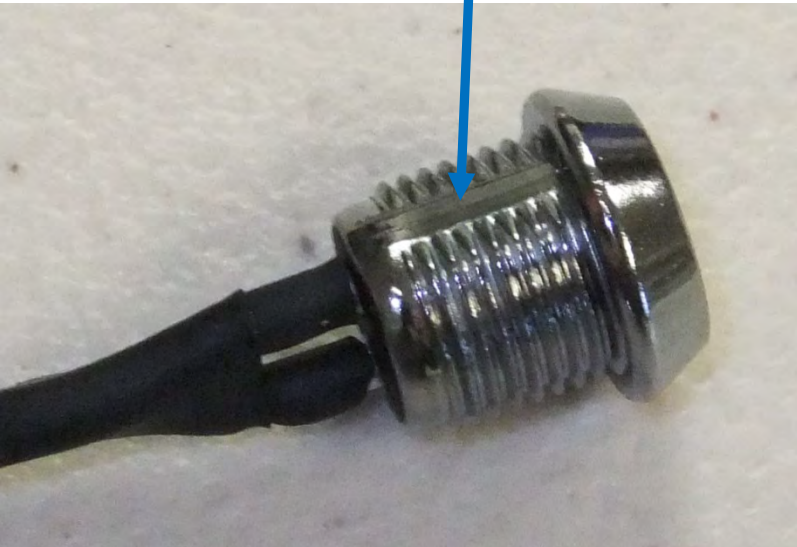
Key Switch and Key (E30)

Building the Still Image Payload: On/Off Key Switch

Remove the **nut on the key** switch (1) and place the two locking star washers on the key switch (2). Replace the nut on the key switch but keep loose (3).

(1)

(2)

(3)
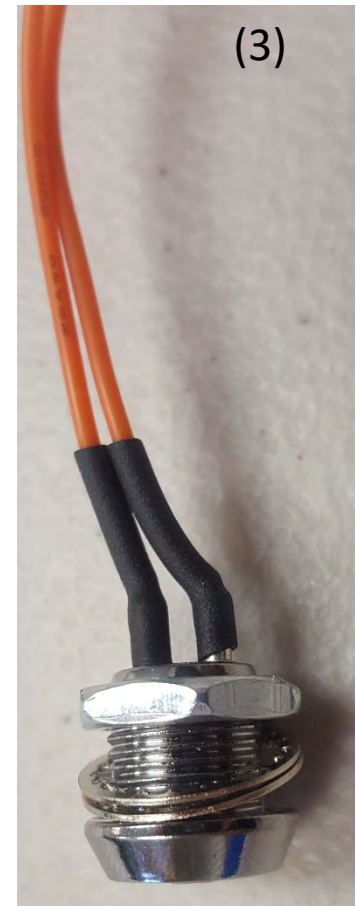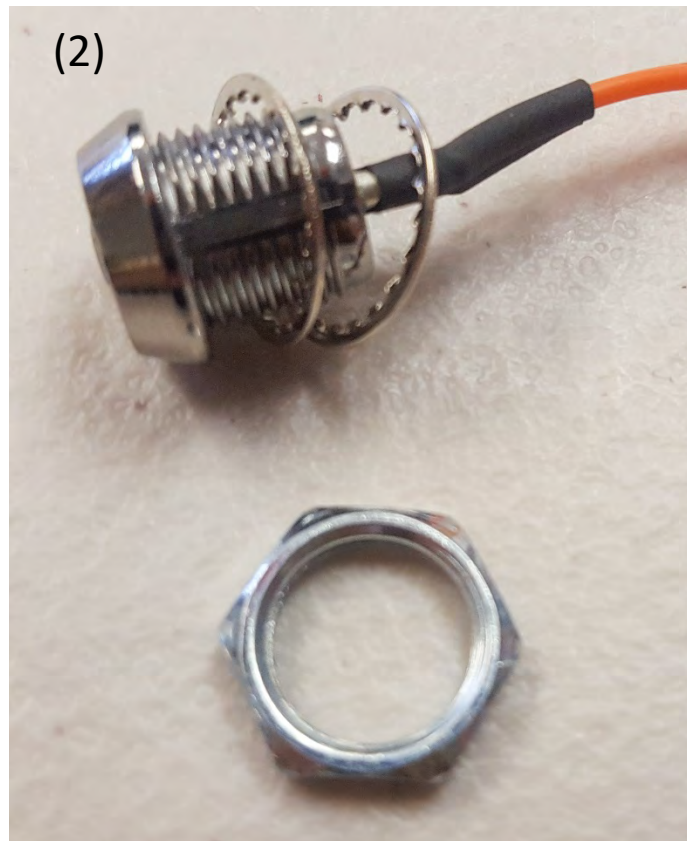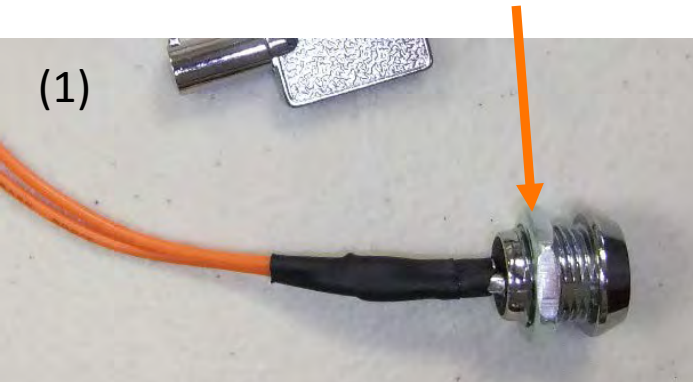
Building the Still Image Payload:
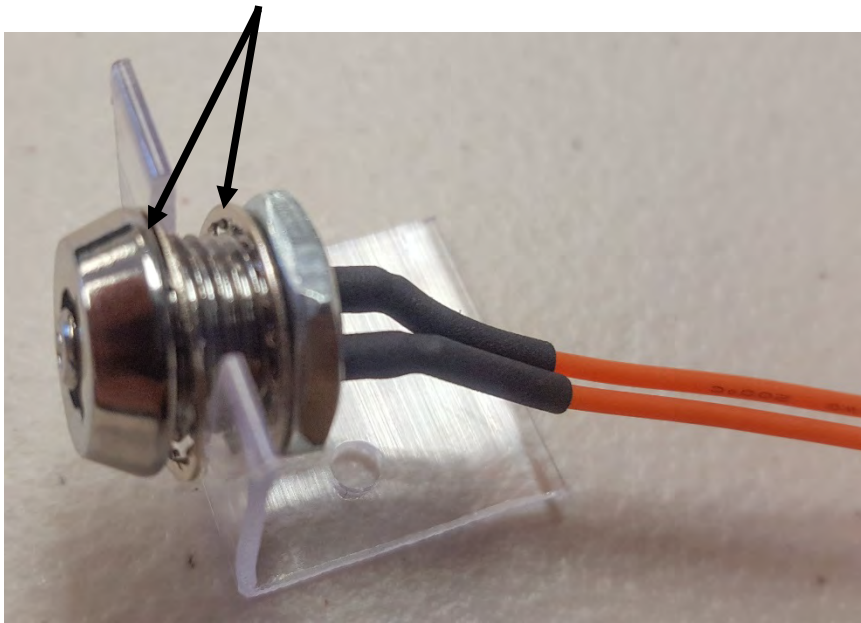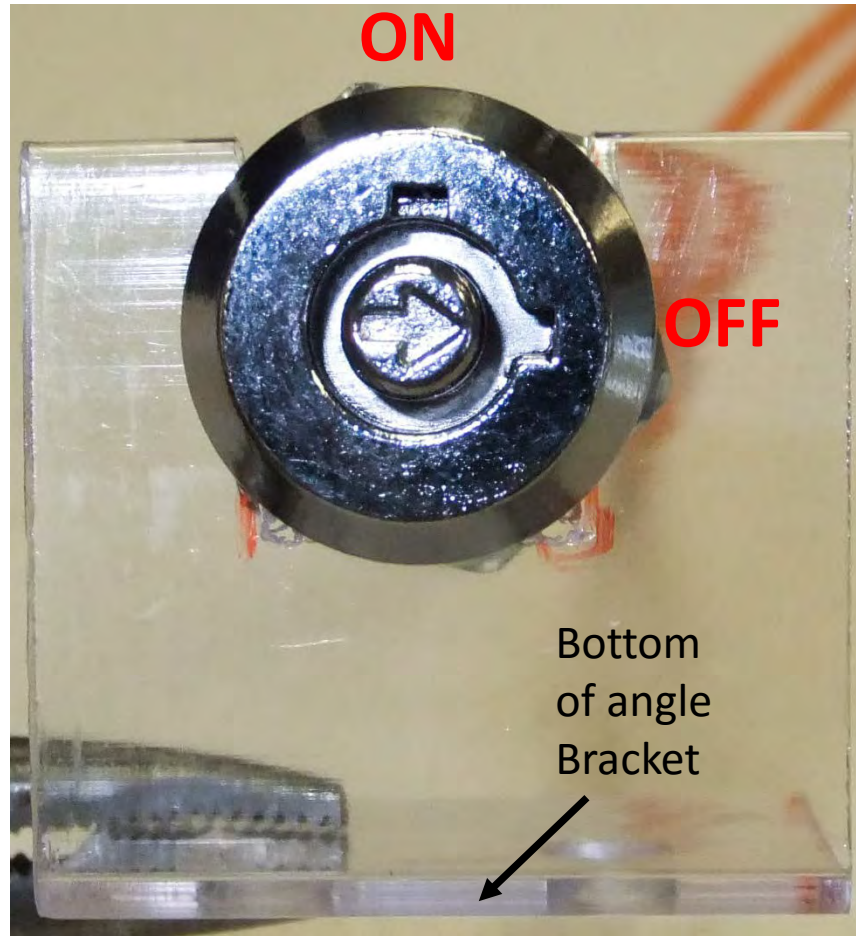# On/Off Key Switch

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

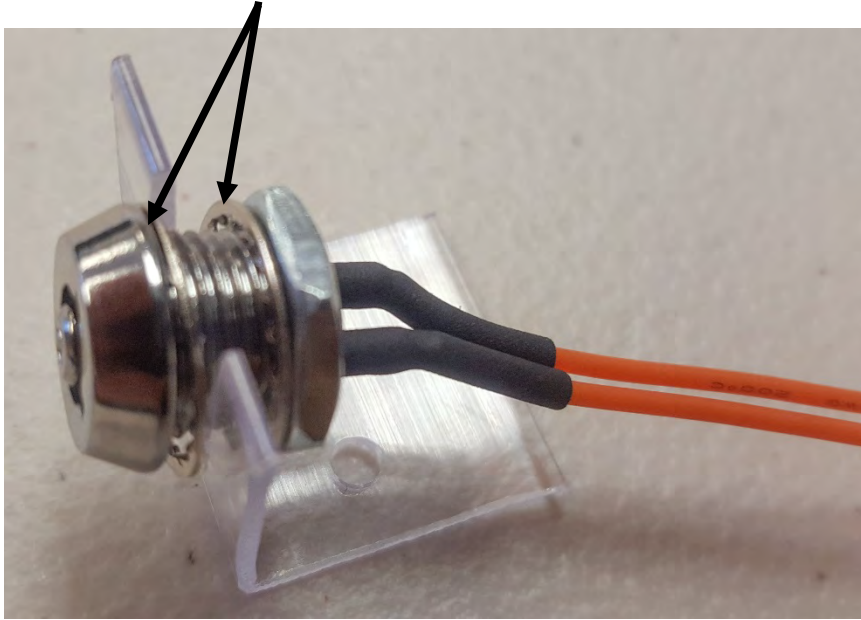# Building the Still Image Payload: On/Off Key Switch NEW BRACKET

Orient the key such that the OFF position is pointed to the 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.
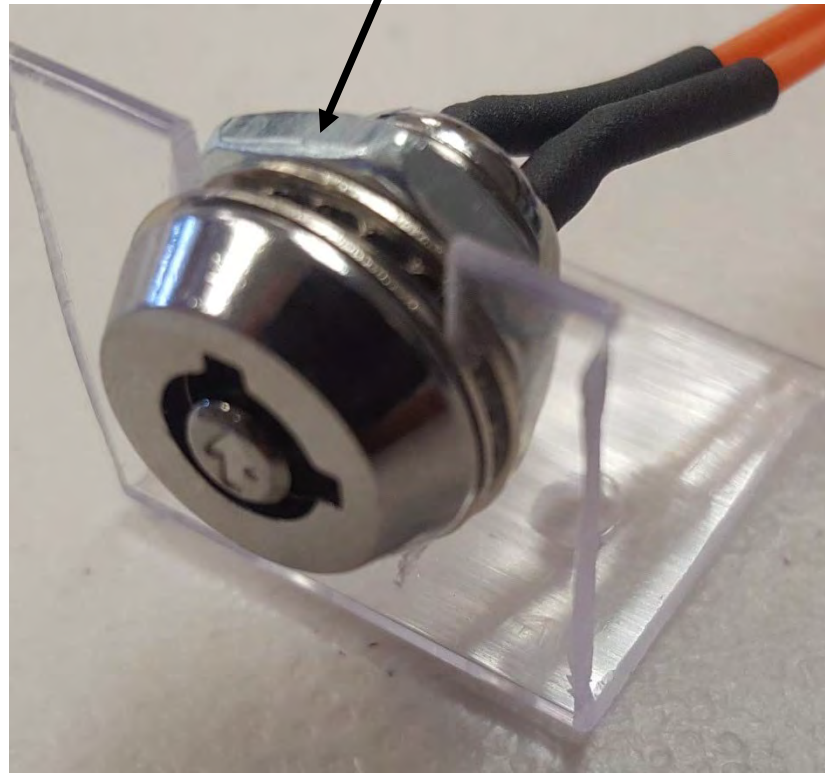
ON

OFF

Bottom of angle Bracket

Building the Still Image 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 Still Image Payload:
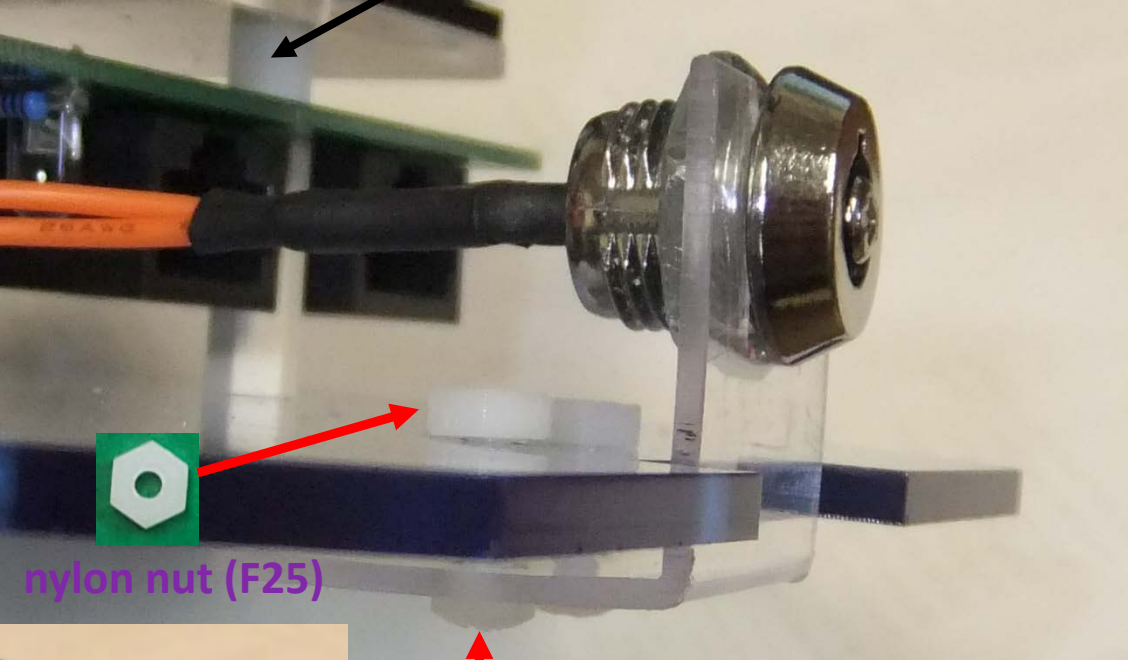## On/Off Key Switch

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 Still Image Payload:
On/Off Key Switch

Pi/Power
Board stack
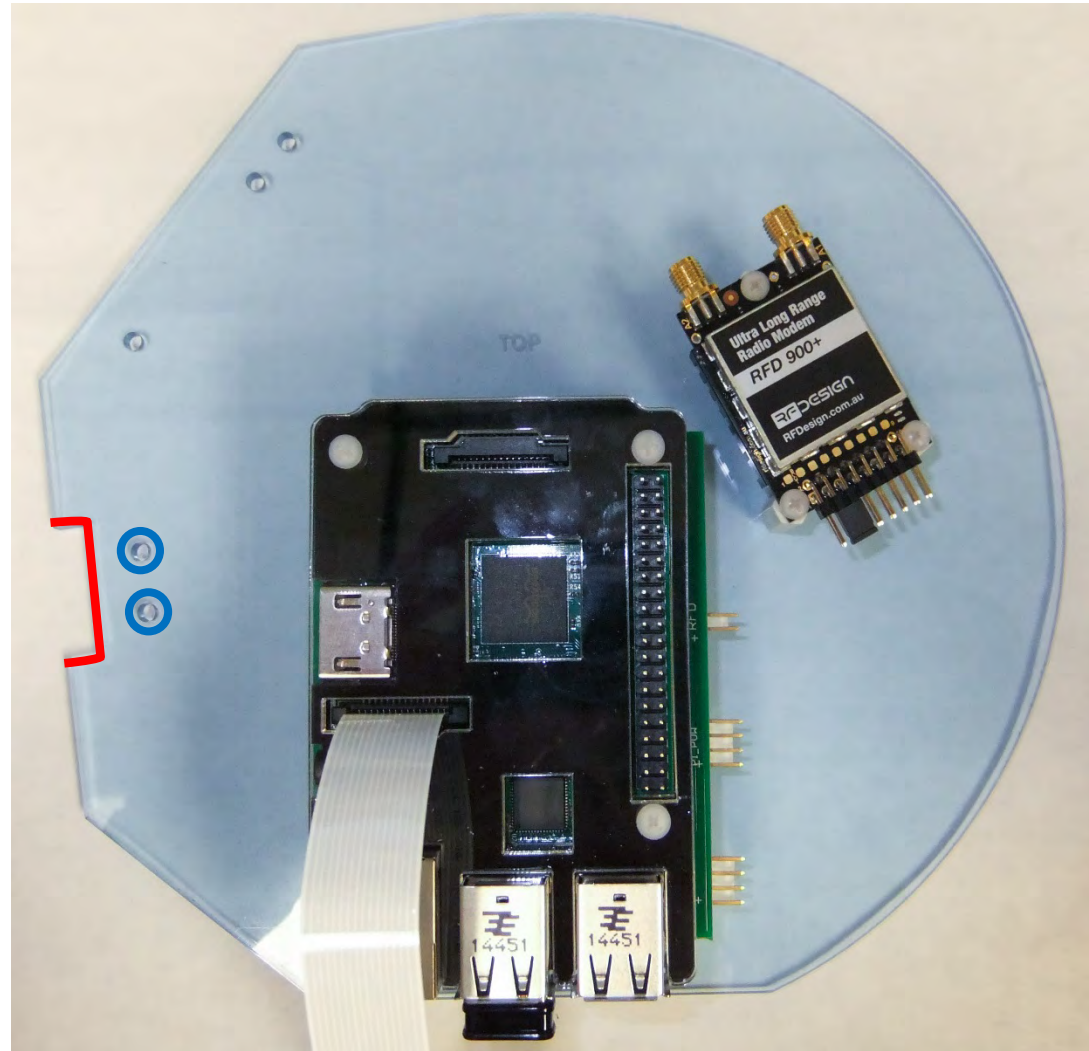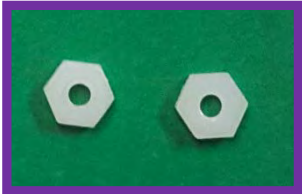
Mount the on/off key switch bracket under the acrylic base plate and fasten with the two nylon screws and nuts. The screw will go in through the bottom of the acrylic base plate with the nut on top.
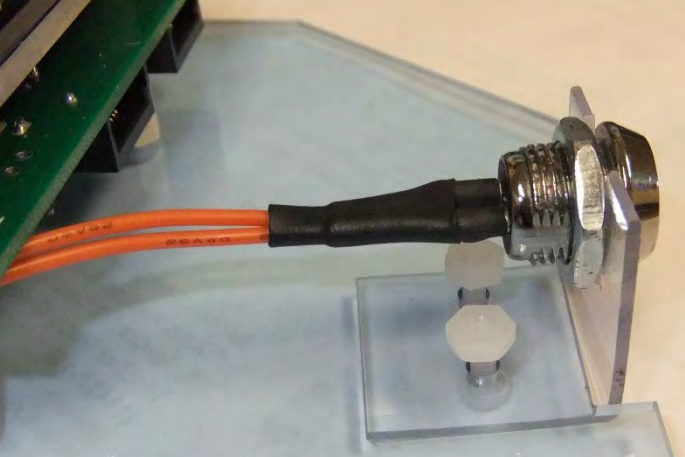
nylon nut (F25)

Tighten snug, but do not overtighten.

3/8 inch nylon screw (F21)
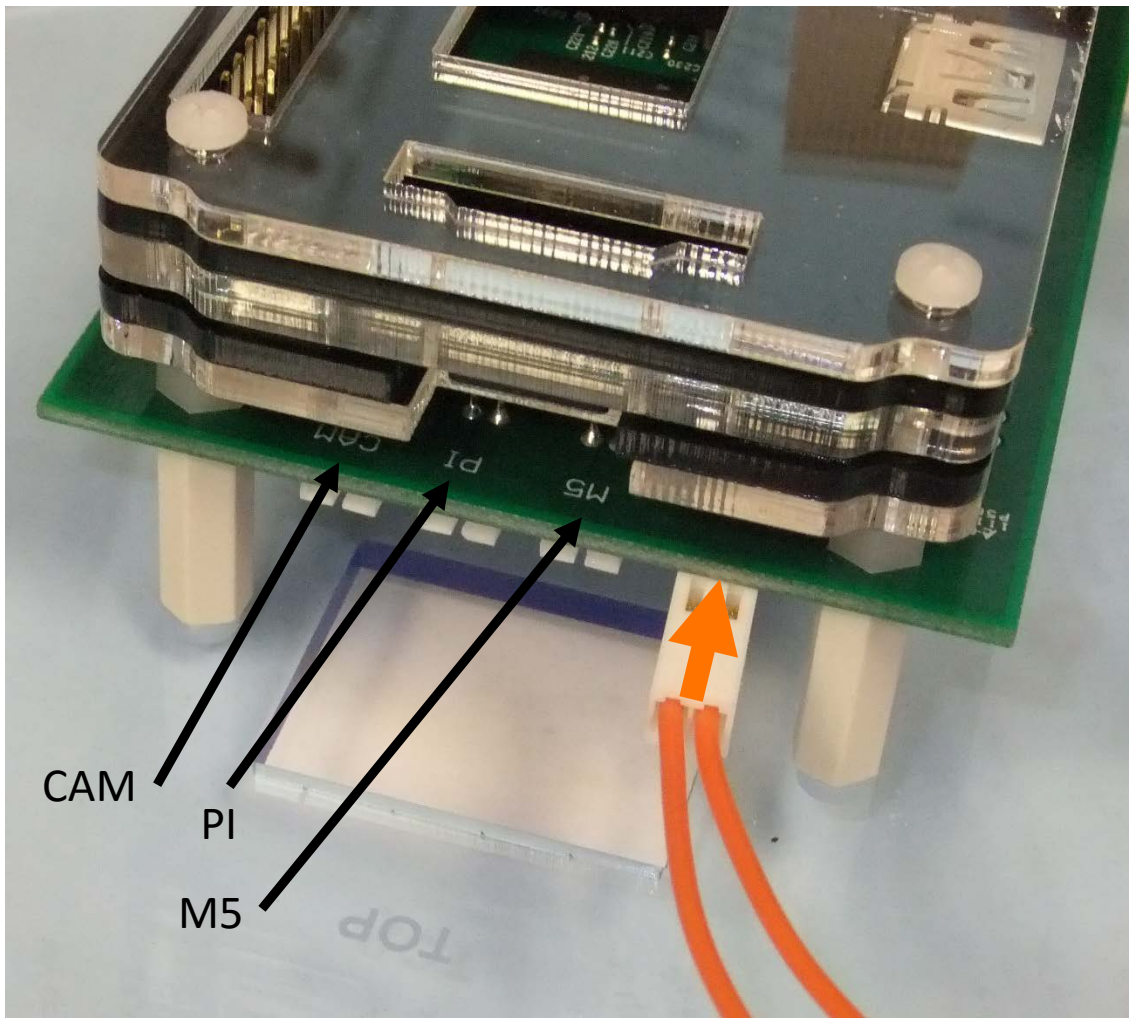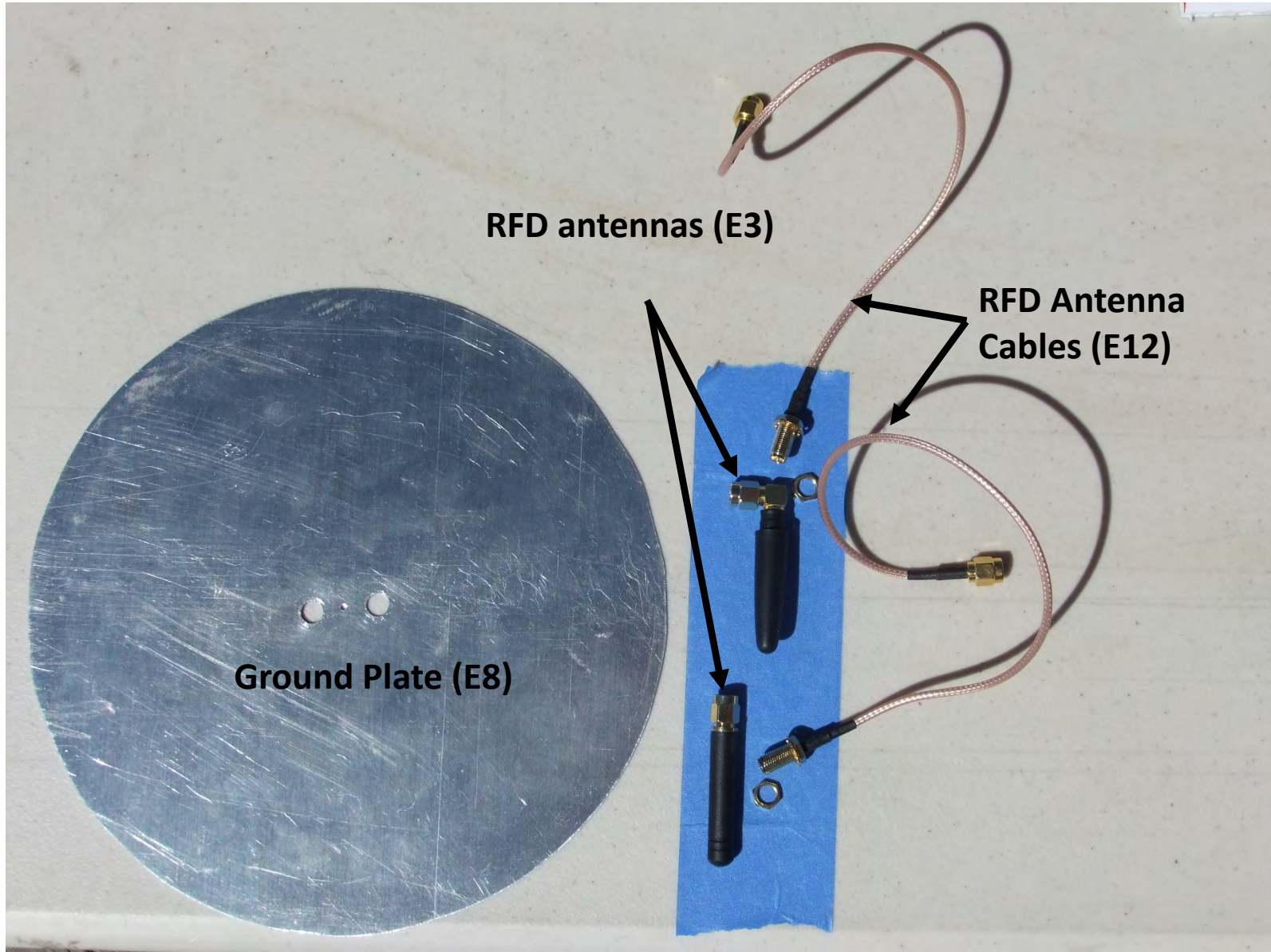
# Building the Still Image Payload: Plugging in the On/Off Key Switch

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!**
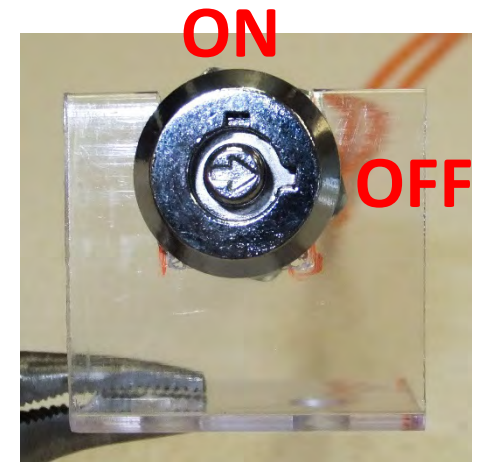
CAM

PI

M5

ON

OFF

Building the Still Image Payload:
RFD 900+ Antenna and Ground Plate

RFD antennas (E3)

RFD Antenna Cables (E12)

Ground Plate (E8)

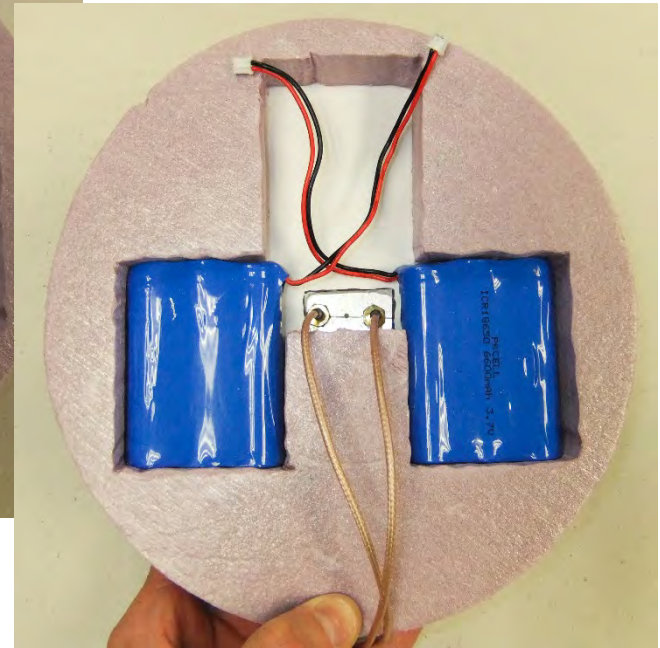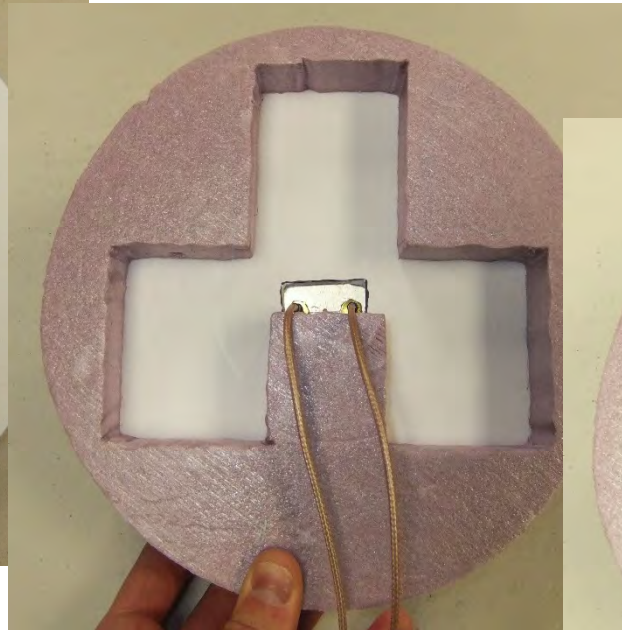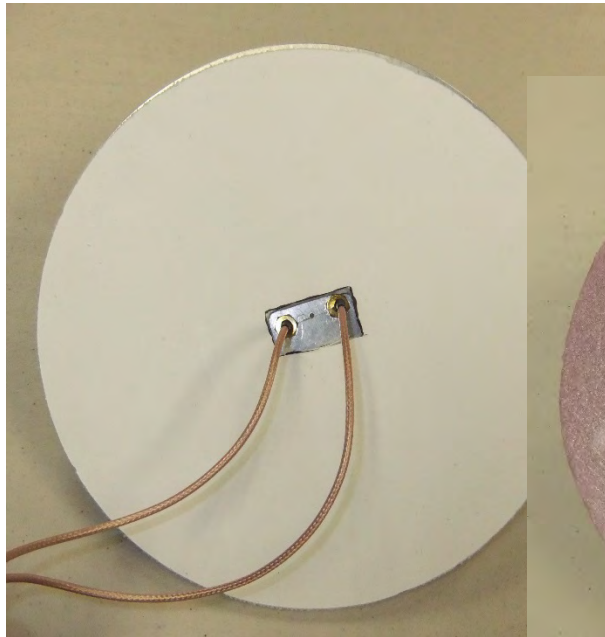# Building the Still Image Payload: RFD 900+ Antenna and Ground Plate
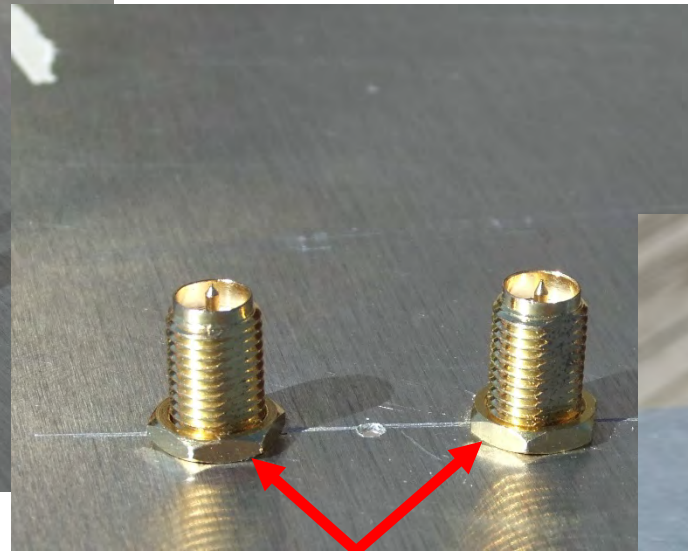
Insert the cables into the ground plate (there is no preferred side). Note placement of **locking washers**. On the other side of the plate lock the cables in place with the **nut** and tighten with needle nose pliers. Finally screw on the two antennas.

Building the Still Image Payload:
Foam Spacer and Battery Holder

Place the foam core battery plate (E18) on top of the back of the RFD antenna ground plate.

Place foam battery housing (E18) onto the white foam core plate.

Place the **two 3.7V batteries (E2)** into the foam spacer such that the cables protrude towards the center.
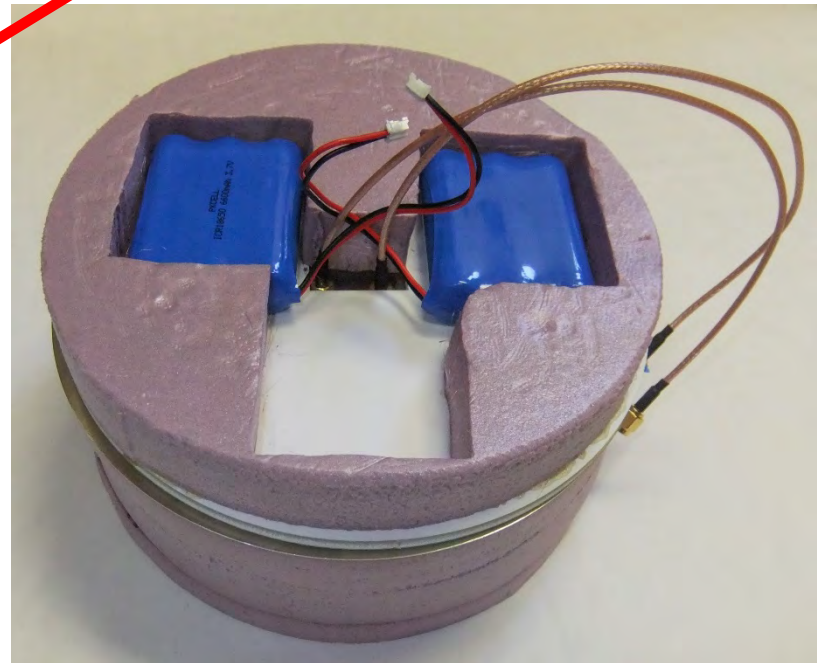

NOTE! The foam core battery plate is already attached to the foam battery housing

Building the Still Image Payload: Foam Spacer and Battery Holder
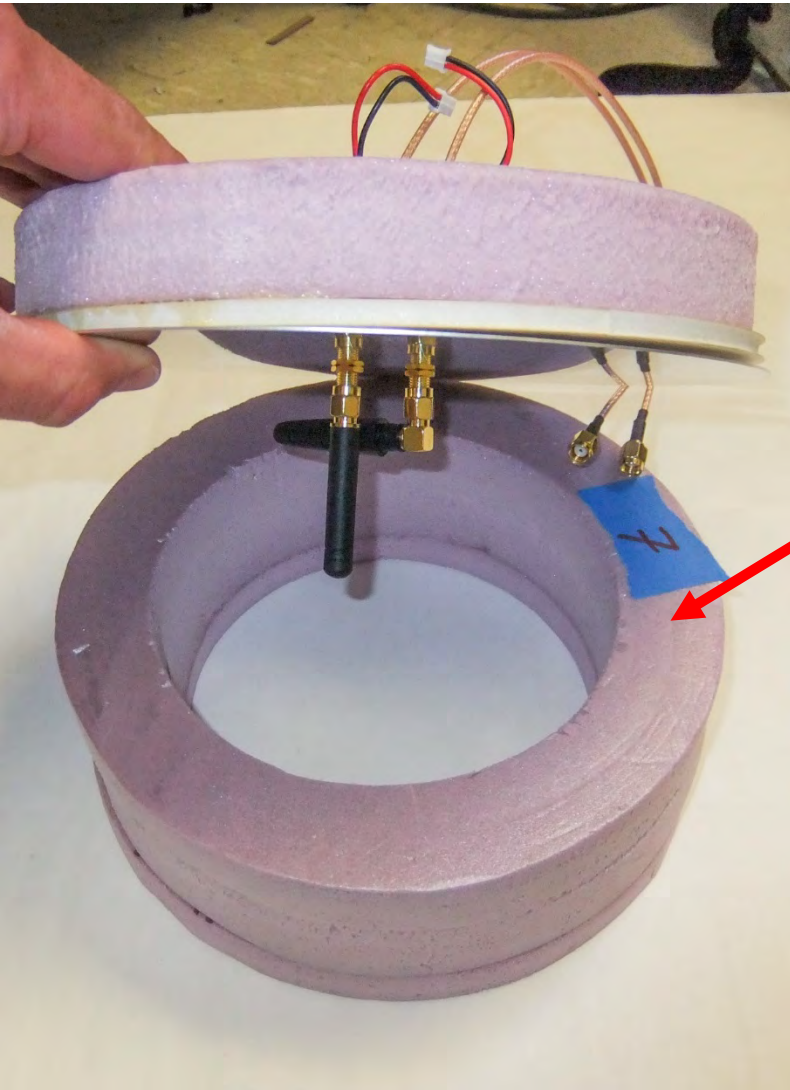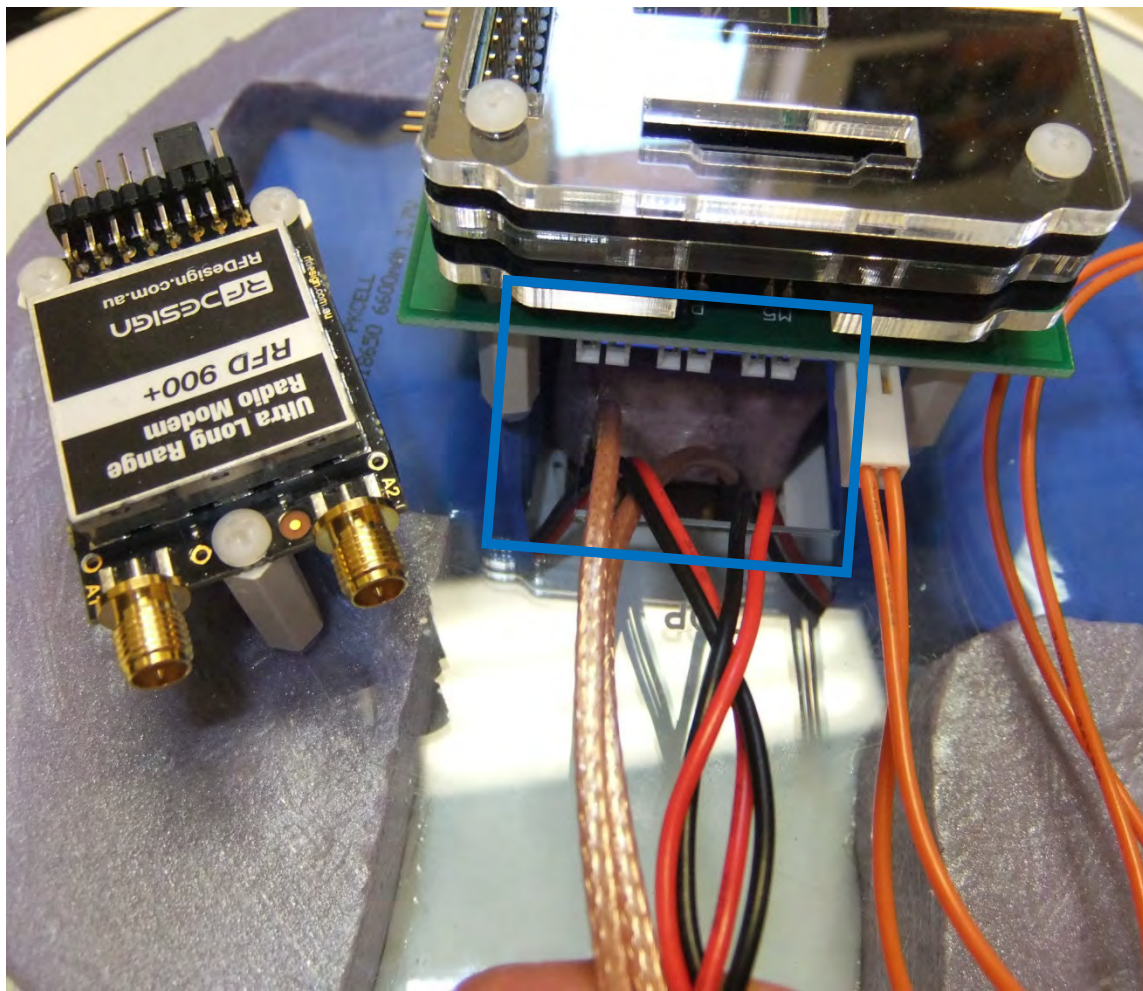

Place the Batteries, Battery Plate and Battery Foam housing onto the **Support Foam (E19)**
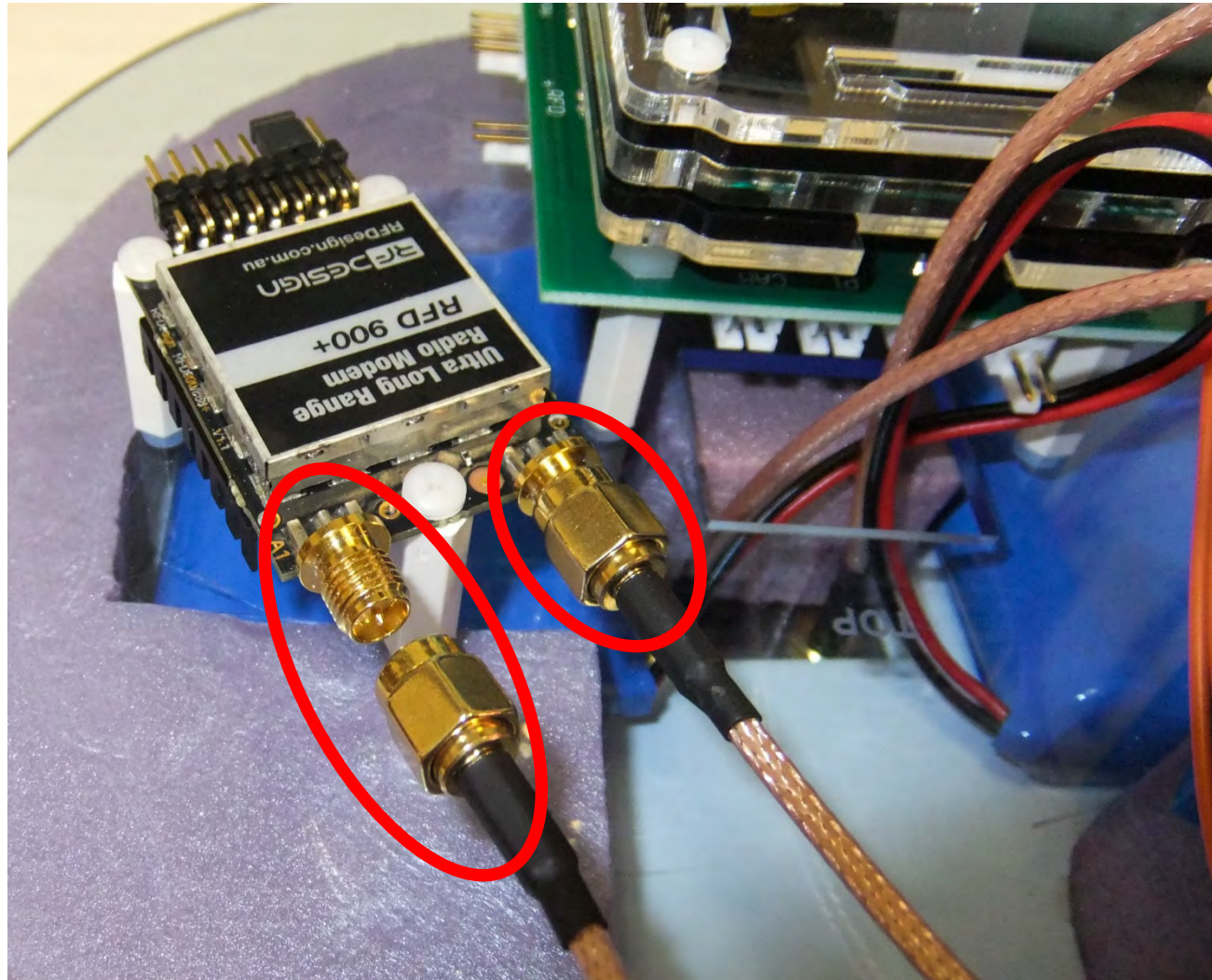
Building the Still Image Payload: Payload Stack

Place the acrylic assembly plate on top of the battery foam housing while threading the two battery cables and two RFD antenna cables **through the center cut out**.

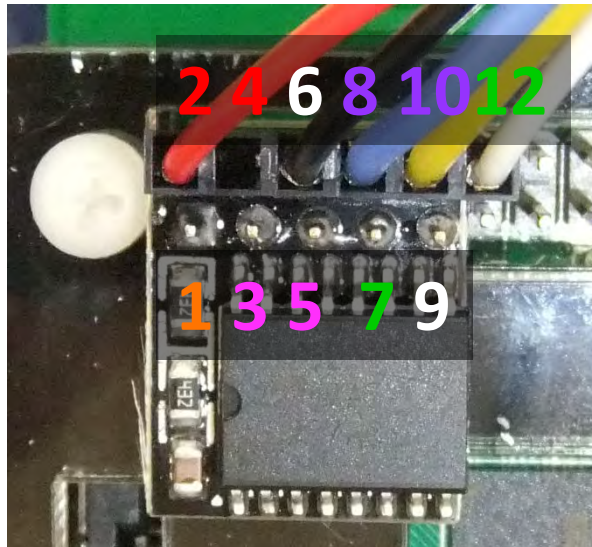# Building the Still Image Payload: Connecting Batteries and RFD antenna

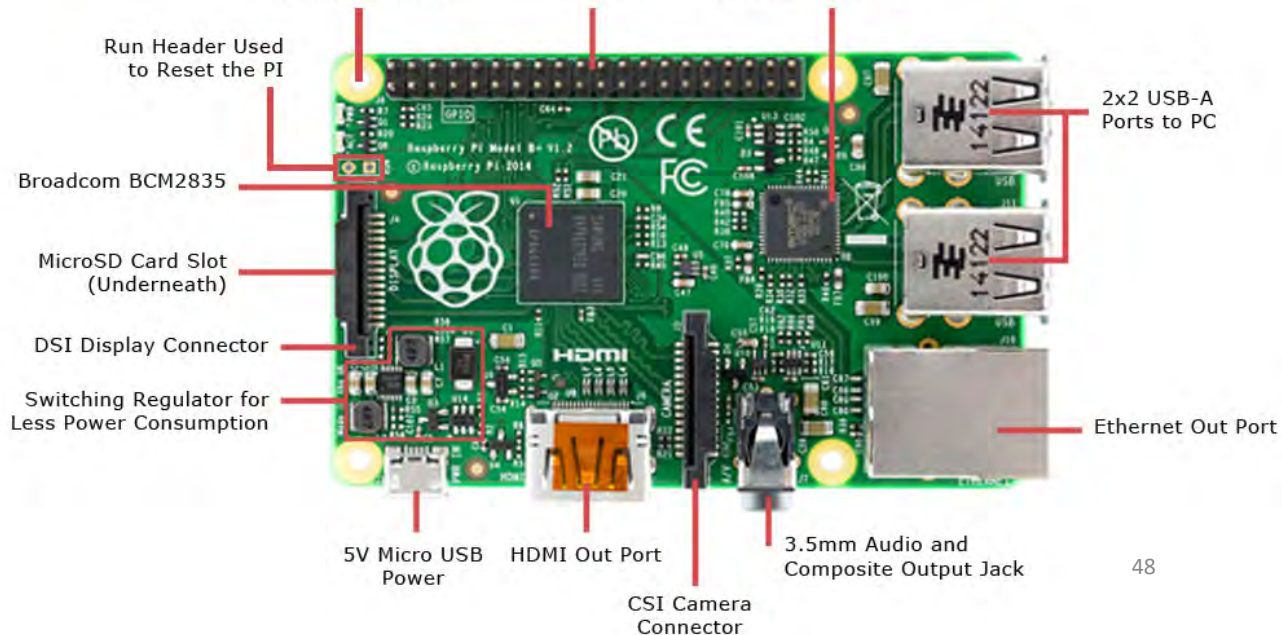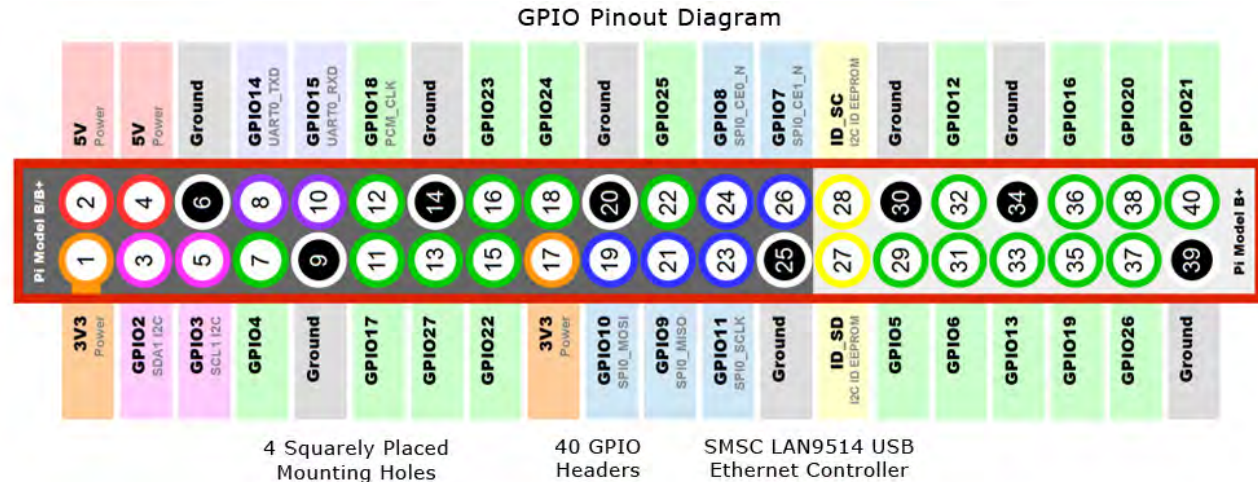**Screw the antenna wires to the RFD 900+ modem.**

Building the Still Image Payload:
Connecting RFD 900+ Modem and Real Time Clock

STEP 27

Orient your Pi as shown in the Pinout Diagram below:

GPIO Pinout Diagram

4 Squarely Placed Mounting Holes

40 GPIO Headers

SMSC LAN9514 USB Ethernet Controller

Run Header Used to Reset the PI

2x2 USB-A Ports to PC

Broadcom BCM2835

MicroSD Card Slot (Underneath)

DSI Display Connector

Switching Regulator for Less Power Consumption

Ethernet Out Port

5V Micro USB Power

HDMI Out Port

3.5mm Audio and Composite Output Jack

CSI Camera Connector

We will plug the Pi Cable into pins 2, 4, 6, 8, 10 and the real time clock into pins 1,3,5,7,9.

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Building the Still Image Payload: Connecting the Real Time Clock

Plug the Real Time Clock (E9) into the Pi as shown below.
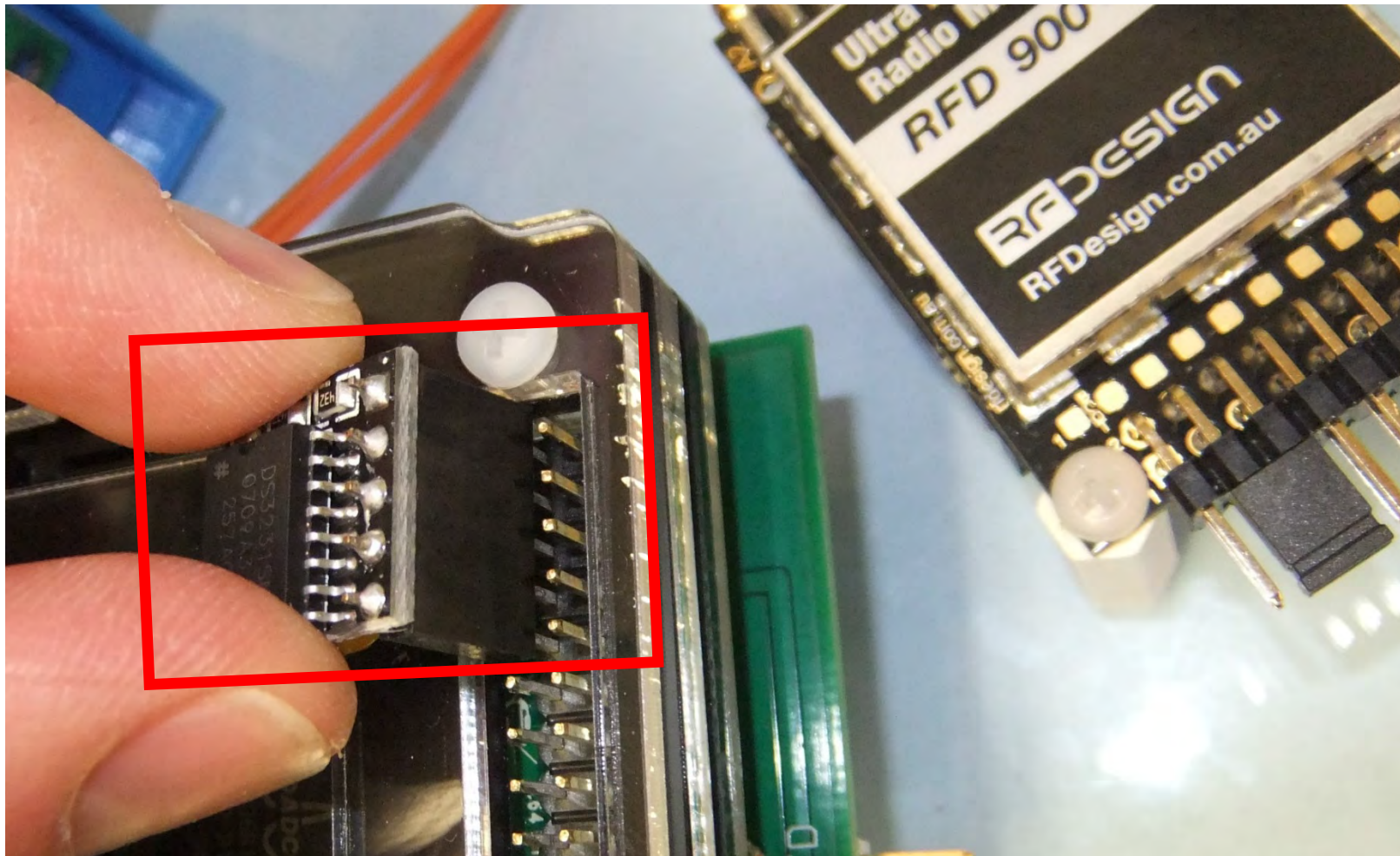
Building the Still Image Payload: Connecting Pi Power

Plug the Pi Cable (E7) into the **Pi** and **PI-POW on the Power board (3 pin)**