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# Rising Data

**DJI F450 Drone Guides**

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## Drone Build

Written by: Marc Hernandez

## Introduction

Use this guide to build the DJI F450 drone with Naza-M Lite flight controller and Devo receiver and transmitter.

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### Tools:

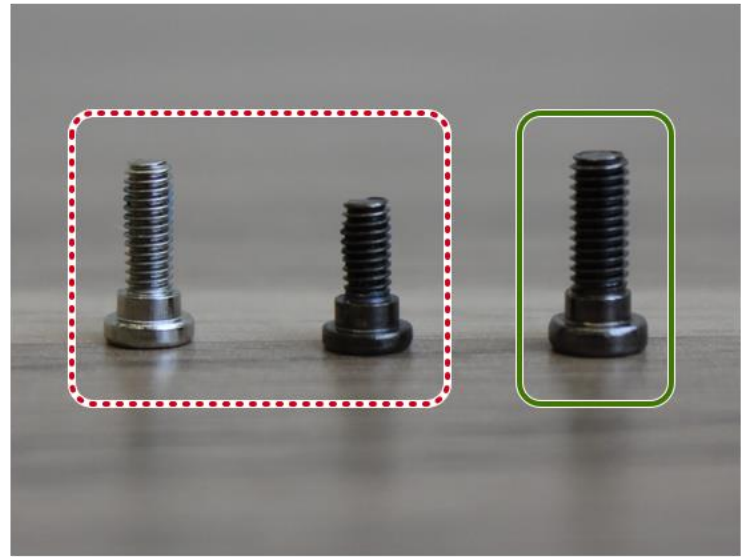
- 2mm Hex Screw Driver
- 2mm Small L-Shaped Hex
- Soldering Station + Solder
- Solder
- Heat Gun
- Helping Hands
- Wire Strippers + Cutter

### Parts:

- DJI Flame Wheel F450
  - Naza-M Lite Flight Controller
  - Flame Wheel Landing Gear
  - Devo-7 Transmitter
  - Devo RX701
  - XT60 Male Battery Connector
  - 6 - Zip Ties
  - 5mm diameter heat shrink tubing
  - Quick Set Epoxy
- 

◆ Denotes a comment regarding the corresponding picture

## Step 1 - Motor Rotation and Screws



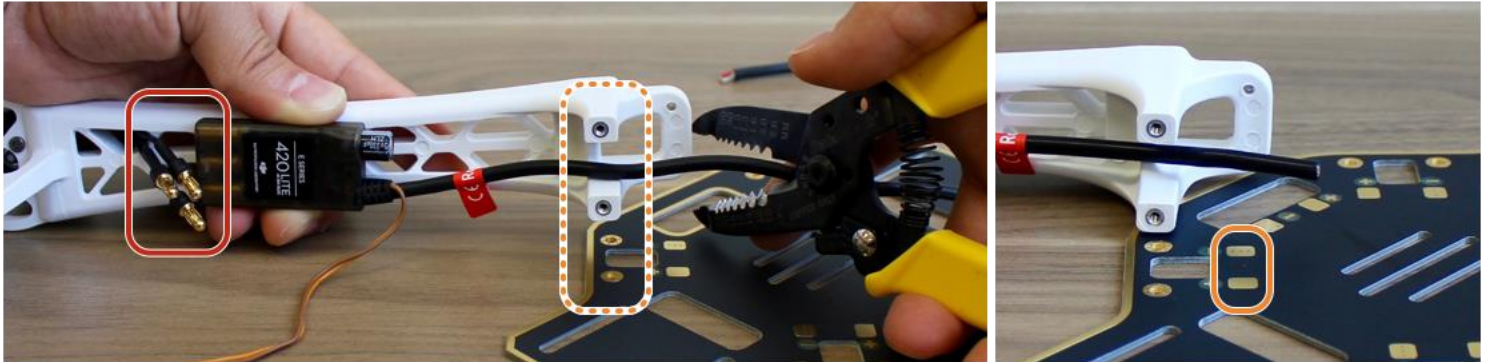
- Note the arrows on the side of each motor to determine its rotation.
- **Clockwise (CW)** motors have dimples on the top of the shaft whereas **Counterclockwise (CCW)** motors have a flat surface.
- Longer M3 screws are used to attach the motors to the arms of the quadcopter.
- M2.5 screws are used to attach the arms to the top and bottom frame boards.
- ◆ M2.5 and M3 are a measure of the screws diameter so, the two screws on the left have a smaller diameter than the one on the right.

## Step 2 - Attach one CW and one CCW Motor to Red Arms



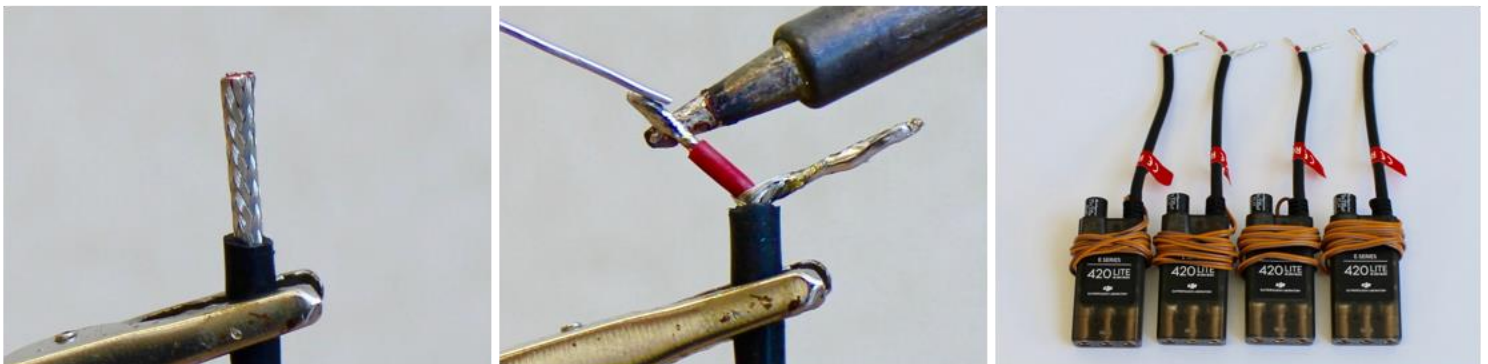
- ◆ Attach one CW and one CCW motor to each color arm. Attach the motors so the wire travels in the direction along the arm and not on the side of the arm.
- ◆ The purpose of the two color arms is because the red arms are used to determine which way the quadcopter is facing. Red arms are placed on the front of the quadcopter.
- ◆ Insert connectors through the arms so that they can be connected to the **Electronic Speed Controller (ESC)** later.

## Step 3 - Measure and cut Electronic Speed Controller Wires



- ◆ With the ESC placed along the bottom side of the arm, prepare to cut the power wire (black) about an inch longer than the location of the contact pads.
- Prior to cutting the wires, ensure that the motor connectors reach the speed controller. Plug them in, if necessary.
- Align the screw holes from the arm to those on the base board.
- Cut the wire. Leave some slack to account for errors, so that they reach the contact pads.

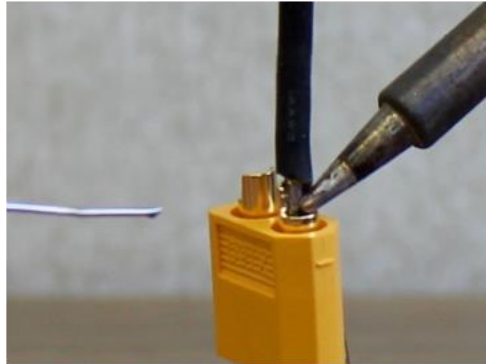
## Step 4 - Strip and Solder Electronic Speed Control Wires



- ◆ When stripping the black insulation be careful not to cut through the shielding wire, which is pictured above .
- ◆ Separate the two wires and strip away half of the red insulation. The remaining insulation insures that the two wires do not touch.
- ◆ Apply solder to the wires by placing the soldering iron below the wire and adding solder from above.
- ◆ Repeat the process for all four of the ESCs. Place them aside for later.

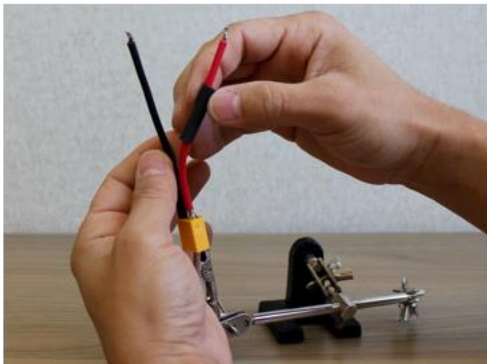


## Step 5 - Solder Male Battery Connector



- Pictured above is the XT60 male connector. Markings on the side of the connector show where to solder the wires. Use the two wires included in the F450 kit and solder the black wire to the negative terminal and red wire to positive.
- ◆ To begin, start by stripping away the insulation so the wire sits completely inside the connector. Next, place the soldering iron to heat up the connector and wire at the same time. When hot enough, fill the area immediately beside the wire with solder.
- ◆ Repeating the process for the red wire should leave you with the result pictured above. Solder should only be in the area immediately around the wire and not in the area between the terminal and plastic connector.

## Step 6 - Cover Exposed Contact with Heat Shrink Tubing



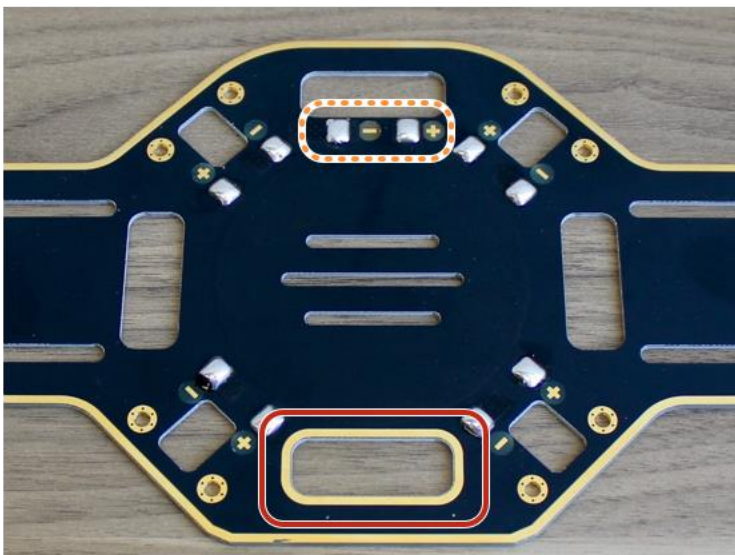
- ◆ Take a piece of 5mm diameter heat-shrink tubing and adjust it so the exposed terminal and soldered wire are completely covered.
- ◆ Using a heat gun, apply some heat to the tubing until it shrinks to a size where it will not slip off.
- Afterwards, use some heat-shrink tubing to bundle the wires of the **power management unit (PMU)** to the wires of the battery connector.

## Step 7 - Prepare the Bottom Board



- ◆ When adding solder to the contact pads, start by adding a small drop of solder on the tip of the soldering iron. This increases the contact area and helps transfer heat from the tip of the iron to the pad faster.
- ◆ After heating the surface, apply solder until it beads up and covers the entire surface of the pad.
- ◆ When done the solder should have a smooth and shiny surface. Repeat the process for the remaining nine contact pads.

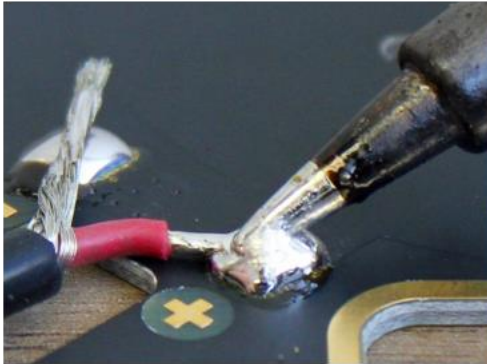
## Step 8 - Notes on Orientation



- ◆ As we begin to work on the bottom board, use identifiers such as the
  - gold-outlined rectangle (front) and
  - battery connector contact pads (back)
- ◆ to determine the front and back of the quadcopter.
- Also note how the polarity on the pads are all the same, with the exception of the battery contact pads. To prevent damaging the quadcopter electronics, it is important to solder all the components with the correct polarity. Red wires should be soldered to positive contacts and black wires to negative.

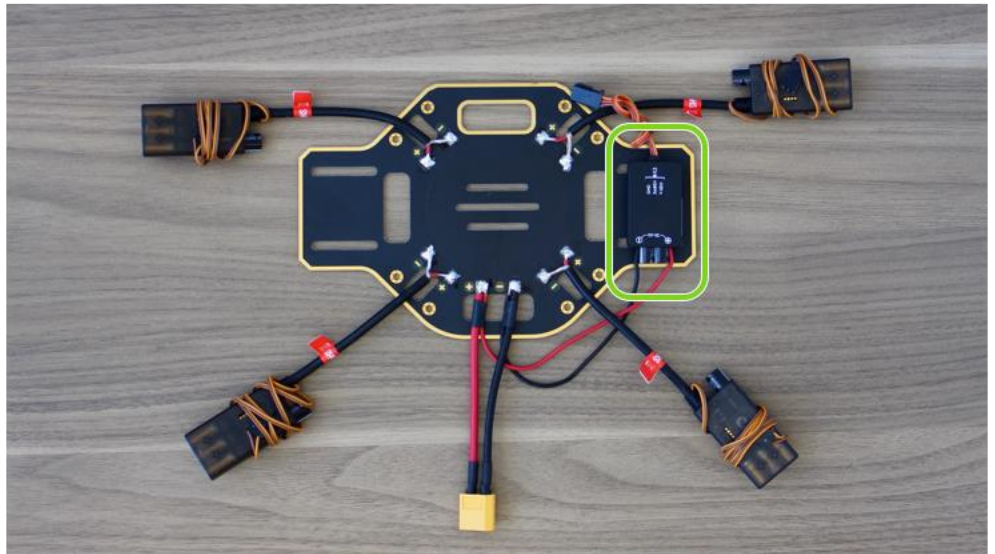


## Step 9 - Solder ESCs and Battery Connector to Bottom Board



- ◆ When soldering wires to the board, begin by sandwiching the wire between the bead of solder and the tip of the soldering iron. Heat from the iron will travel through the wire and melt the pool of solder below. Notice that we are soldering the red wire to the positive contact and black to negative.
- ◆ When the wire sinks into the solder, hold the wire in place with your hand and remove the iron. Give the solder a few seconds to cool before releasing the wire and repeating the process for any remaining wires.
- ◆ Solder the electronic speed controllers and battery connector wire to the bottom board using the method just discussed. When soldering the battery connector wire, make sure both wires bundled together are securely soldered in place. If necessary add more solder.

## Step 10 - Attach Power Management Unit



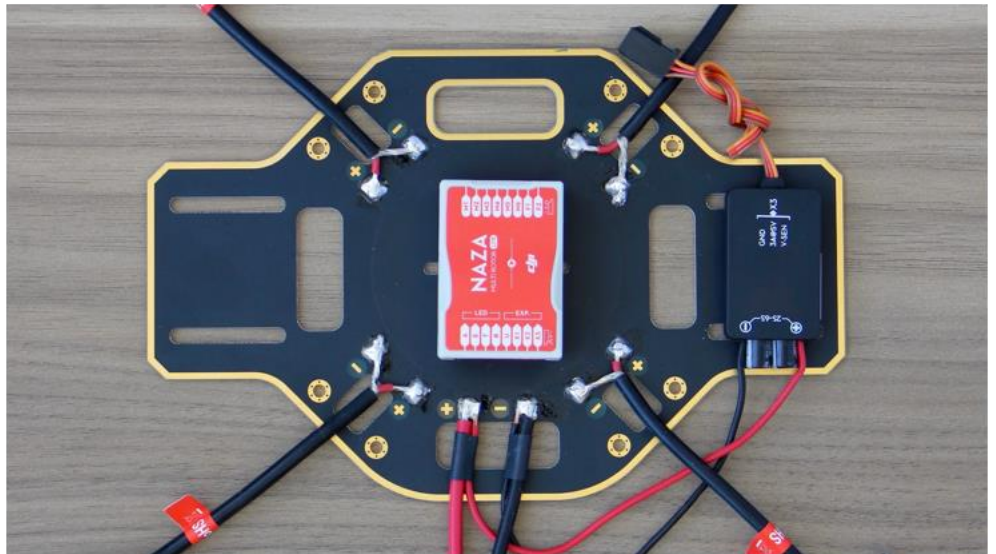
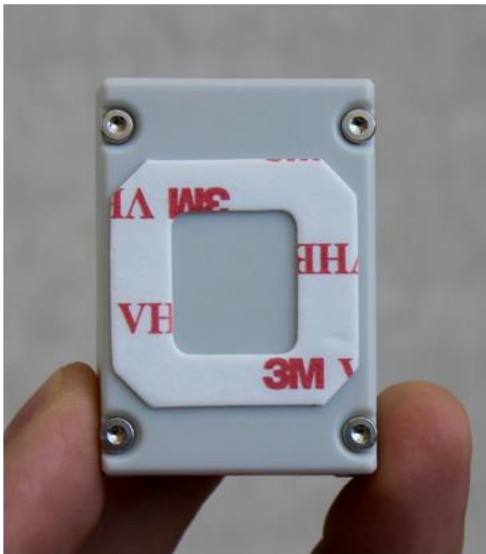
- ◆ Clean the back of the PMU and place a small piece of double sided tape.
- Clean the surface of the board and press the PMU firmly in place, making sure the black and red wires travel beneath the ESC wire.

## Step 11 - Notes on Main Controller



- ◆ The **Main Controller (MC)** is the brain of the quadcopter. It communicates with all ESCs and the RC transmitter to carry out all functionality. The MC has a built-in 3-axis accelerometer, 3-axis gyroscope and a barometer for sensing attitude and altitude.
- When placing the MC, the arrow on top must be pointing in the forward facing direction.

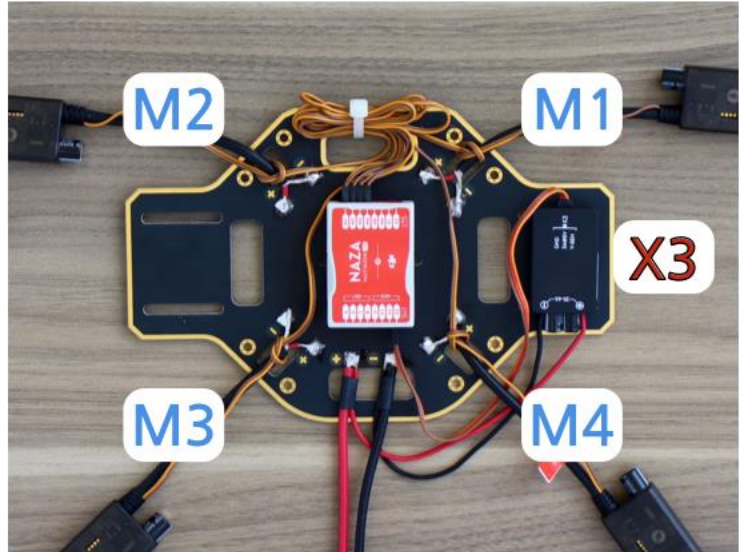
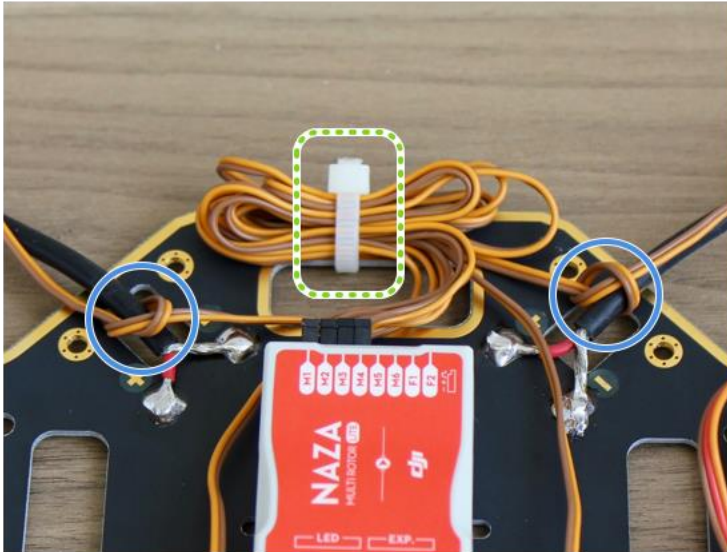
## Step 12 - Attach Main Controller to Bottom Board



- ◆ Clean the back side of the MC before applying a piece of M3 double sided tape.
- ◆ Clean the surface of the board and firmly press the MC in place. With the placement of the MC, we have defined the nose and tail of the quadcopter, where the nose is the side with the gold rectangle and the tail being where the battery connects.

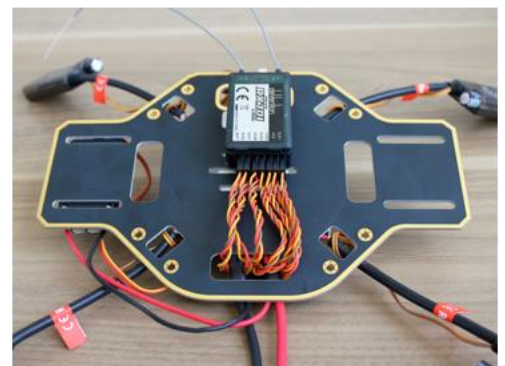
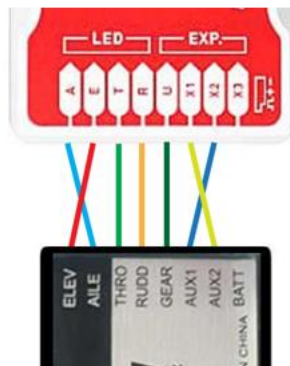
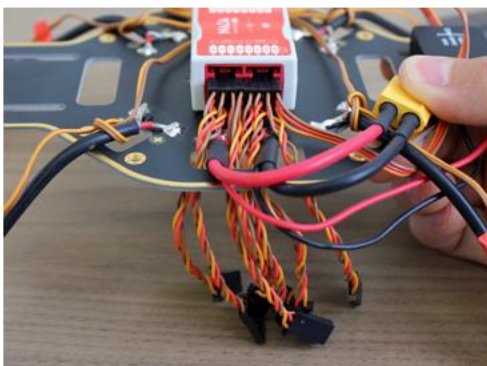


## Step 13 - Connect ESC and PMU to Main Controller



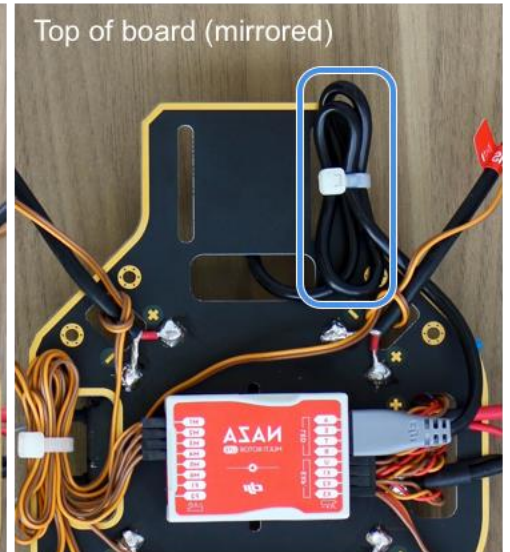
- Use loose knots near the base of the ESC wire to keep the brown and orange communication wires clean and organized.
- Connect all of the communication wires in accordance with the following step before using a zip tie to anchor the excess wire to the board. Make sure wires don't pass over the screw holes.
- Starting with the ESC in the front right (top in the picture above), connect the wire to the corresponding M1 pin on the MC. The top left will go to M2, etc.
- Connect the PMU to the X3 pin on the MC.

## Step 14 - Connect Receiver to Main Controller



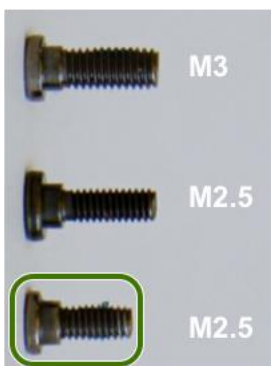
- Connect double sided female connector wires into the remaining seven ports on the tail side of the MC and pass the connectors through the rectangular hole on the board.
- Connect the wires into the appropriate pins according to the image above.
- When connected, add a piece of double sided tape to the back of the receiver and firmly press to the bottom of the board. Place so as to remove as much of the slack as possible.

## Step 15 - Connect Status LED to Main Controller



- ◆ The Status LED is used to communicate with the user when the quadcopter is not connected to a computer.
- ◆ The micro USB port is how the quadcopter is connected to a computer for programming.
- ◆ Using a small piece of double sided tape, attach the Status LED to the underside of the base board and pass the wire through to the top side. Make sure the USB port is facing outwards for easy accessibility.
- ◆ Pass the wire under the ESC wire and plug it into the port labeled LED on the MC.
- Use a zip tie to tie up the excess wire.

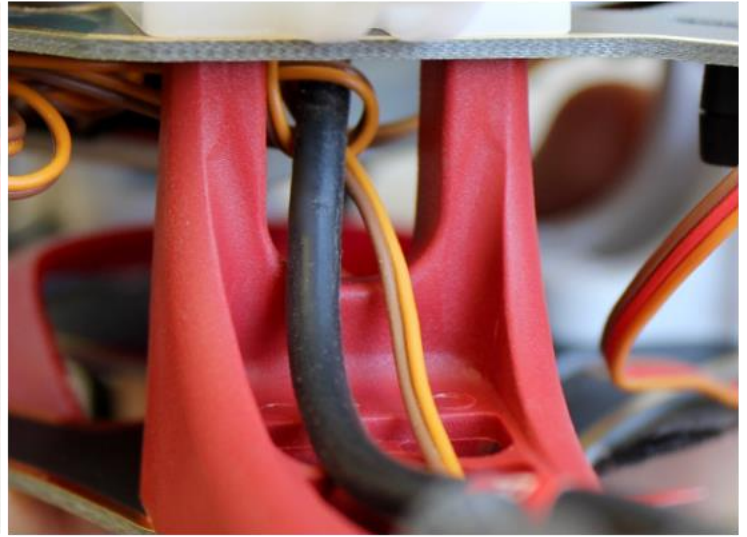
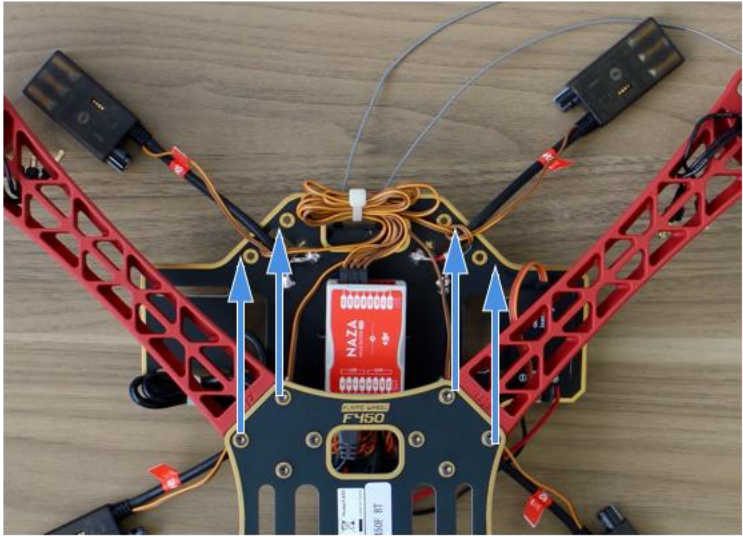
## Step 16 - Attach Arms to Top Board



- Use shorter M2.5 screws to attach arms to top board.
- ◆ The software requires that the motors with the corresponding rotation be attached in a manner where rotation direction alternates.
- The top right and bottom left arms use the ccw motor.
- The top left and bottom right arms use the cw motor.
- ◆ The orientation of the top plate is based on the assumption that the battery will rest horizontally in the picture above.

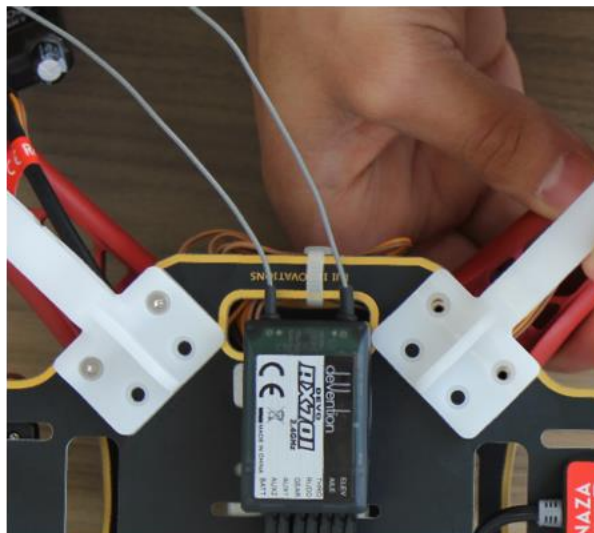
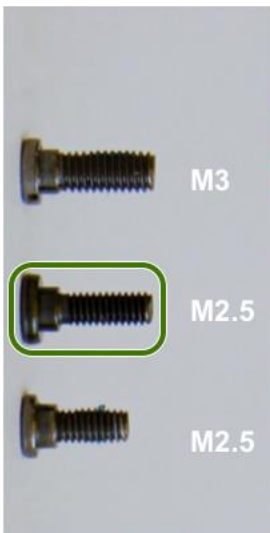


## Step 17 - Attach Top Half of Frame to Bottom Half



- Take the top half of the frame and place it so the red arms attach to the front side of the bottom board. Use nearby objects to support the board if necessary.
- ◆ Before screwing the boards together make sure the wires from the ESCs pass through the hole in the arms.

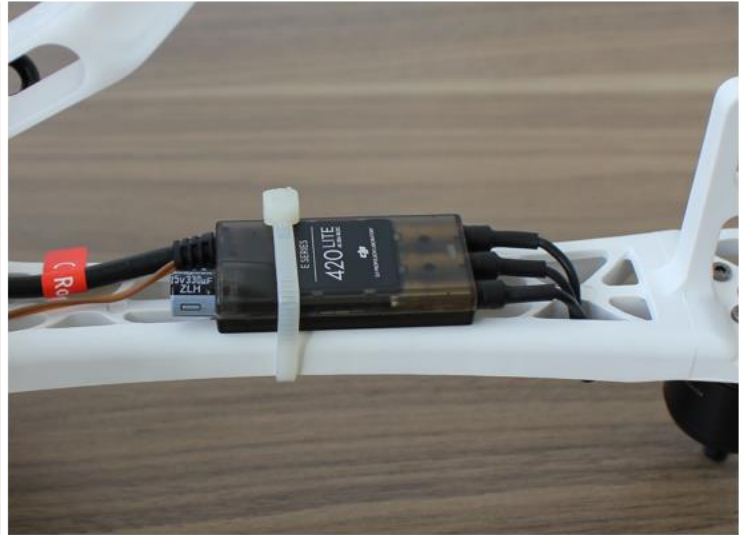
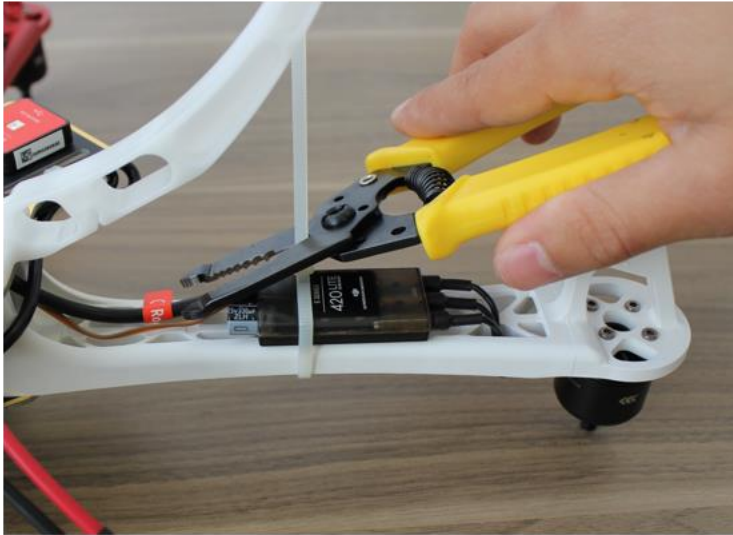
## Step 18 - Attach Legs and Arms



- Use longer M2.5 screws to attach the legs and arms to the quadcopter.
- ◆ Line up the holes as pictured above and use two screws to hold each leg and attach the bottom half of the frame to the top half.
- ◆ Attach all four legs to the bottom of the quadcopter.

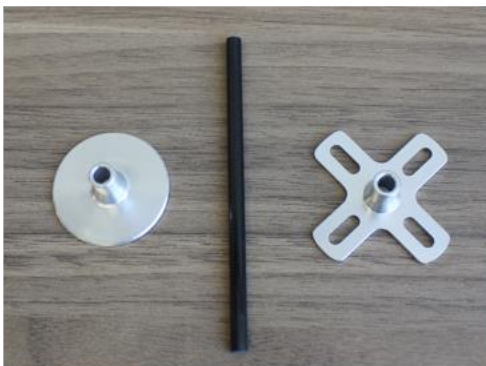


## Step 19 - Connect Motors and Zip Tie ESCs



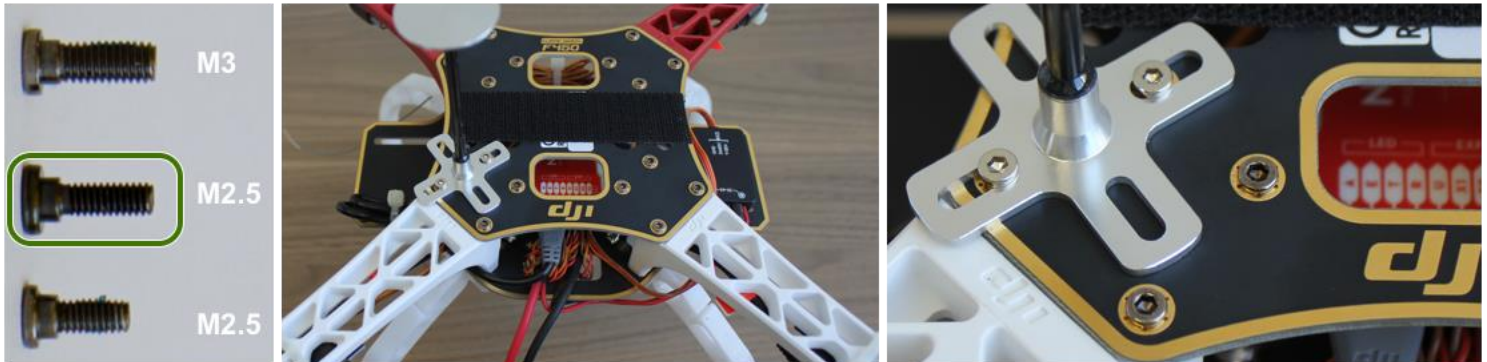
- ◆ Use a zip tie to firmly attach the ESC to the arm of the quadcopter. Cut the slack and repeat to the remaining speed controllers.
- ◆ Connect the pins of the motor to the ESC. As of now the order does not matter and will be corrected later.

## Step 20 - Build GPS Stand



- ◆ Using some quickset epoxy and the pieces pictured above, we can now put the GPS stand together.
- ◆ Take one of the pieces of the stand and place a small drop of quickset epoxy inside. Next, taking the rod place it inside. You will notice that the rod will spring out due to the air trapped inside. To fix this, twist the rod until the air is released.
- ◆ When done, the glue should be neat and clean. Repeat the process to attach the other side of the stand.

## Step 21 - Attach GPS Stand to Quadcopter



- Use longer M2.5 screws to attach the GPS stand.
- ◆ The placement of the GPS stand is arbitrary and its position can be set in the software. For this guide we have placed it on the lefthand side of the tail.
- ◆ Replace the two screws with the longer M2.5 screws, previously used to attach the legs.

## Step 22 - Attach GPS Module



- ◆ Apply some doublesided tape to the GPS stand.
- ◆ When placed, the arrow on top of the GPS module must face forward.
- Wrap the excess wire around the rod of the module and connect it into the port labeled EXP on the back of the MC.

## Step 23 - Complete Software Guide Before Attaching Propellers



- ◆ The propellers will be installed after testing and adjustments have been made in the Naza-M Lite Assistant Software. Follow the software guide to make the appropriate changes to the MC. This concludes the build guide for the DJI F450 quadcopter.

# Continue to Software Guide



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## Software Guide

Written by: Conor Swezey, Khai Chang

### Introduction

Use this guide to program and calibrate the DJI F450 quad copter.

## Step 1 - Download the NAZA-M Lite Software Assistant

### Assistant Software & Driver



Naza-M Lite Assistant Software v1.00

2014-04-22

ZIP

EXE

\* Download the Firmware via Assistant software; the software only supports Windows XP or above (32bit/64bit).

@Naza-M Lite Firmware\* v1.00

2013-05-28



DJI WIN Driver Installer

2013-01-18

ZIP

EXE

supports Windows XP or above (32bit/64bit).



Naza-M Lite Assistant Software v1.00

2014-04-22

DMG

\* Download the Firmware via Assistant software. Mac OS X 10.9 or above.

#### \* Notice:

1. You can upgrade the newest Naza Firmware via above Naza Assistant software we provided.
2. You must re-configure your Naza with Naza Assistant software after firmware upgrade.

Figure 1: NAZA-M LITE Software download page

### Build Directions

1. Download the latest Driver and Software, as seen in Figure 1.
  - a. Go to <http://www.dji.com/product/naza-m-lite/download>
  - b. Download the **NAZA-M LITE Driver Installer** in EXE or DMG format.
  - c. Download the **NAZA-M LITE Software Assistant** in EXE or DMG format.
2. Turn on the transmitter.
3. Turn on the quadcopter.
4. Connect the quadcopter to the computer with Micro-USB cable.
5. Open the **DJI WIN Driver Installation Software** and complete the installation.
6. Open the **NAZA-M LITE Assistant Installation Software** and complete the installation.

**\*Note:** The installer EXE format only supports Windows XP, 7 and 8. For users with Mac OS X 10.9 or higher, use the DMG format.



## Step 2 - Navigating the GUI

### User Information

- This software guide will discuss each section of the **NAZA-M LITE Software Assistant** in greater detail.
- The “**view**” section of the **NAZA-M LITE Software Assistant** gives an overview of the quadcopter settings, as shown in Figure 2.

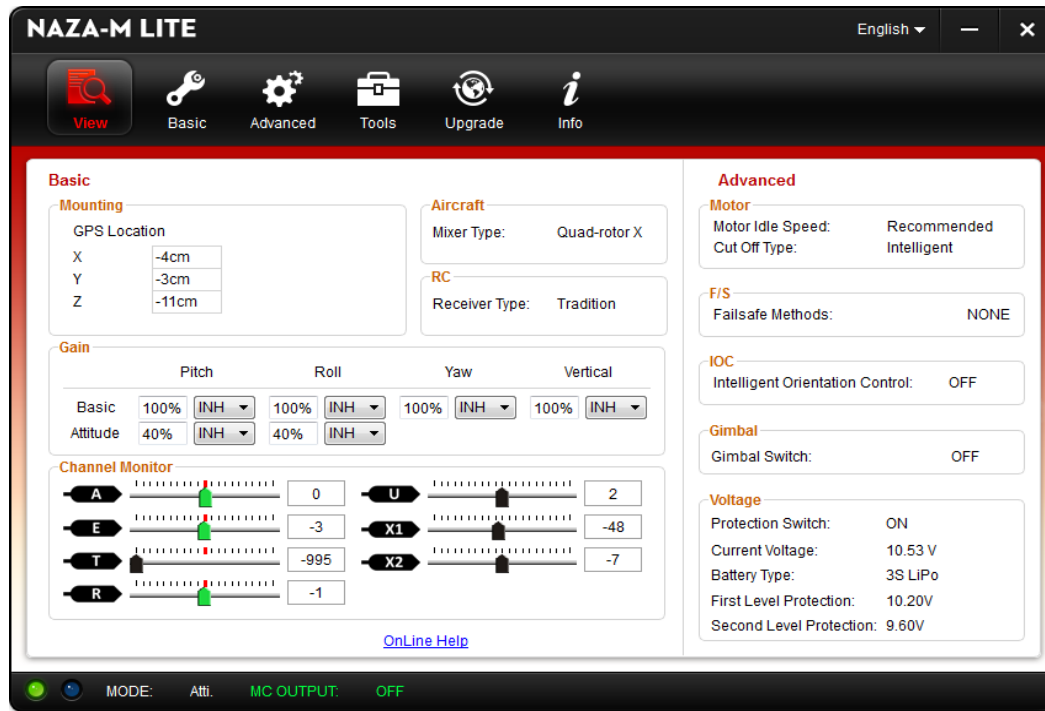


Figure 2: “View” page of the NAZA-M LITE Software Assistant

### Build Directions

1. **View** → Initial status/settings of quadcopter
2. **Basic** → Selecting type of aircraft, RC, Mounting, Gain, and Channel Monitor
3. **Advanced** → Configuring the motor, fail safe, gimbal, and voltage
4. **Tools** → Inertial Measurement Unit calibration
5. **Upgrade** → Upgrading firmware
6. **Info** → Check user information

**\*Note:** Ensure that the micro-USB cable is plugged into a computer with networking before starting the **NAZA-M LITE Software Assistant**. The red and blue lights in the bottom left-hand corner of the **NAZA-M LITE Software Assistant** should flash, indicating that quadcopter is connected and communicating with the software.

**\*\*Note:** The LED mounted on the underside of the quadcopter should be displaying a solid green color, indicating that the flight controller is connected to the **NAZA M-LITE Software Assistant**.

## Step 3 - Basic Settings Page

### User Information

- In the “**Basic**” tab, under the “**Aircraft**” subsection, there are several different **Mixer Type** options. These options describe the arm configuration and motor orientation of different multi-rotor models.
- Figure 3 indicates the highlighted quadcopter option used for the DJI F450 quadcopter.
  - The two red arms indicate the front of the aircraft.
  - **Motor 1** and **Motor 3** spin counter-clockwise, while **Motor 2** and **Motor 4** spin clockwise.
  - The speed of each motor determines how the quadcopter moves and orients itself.

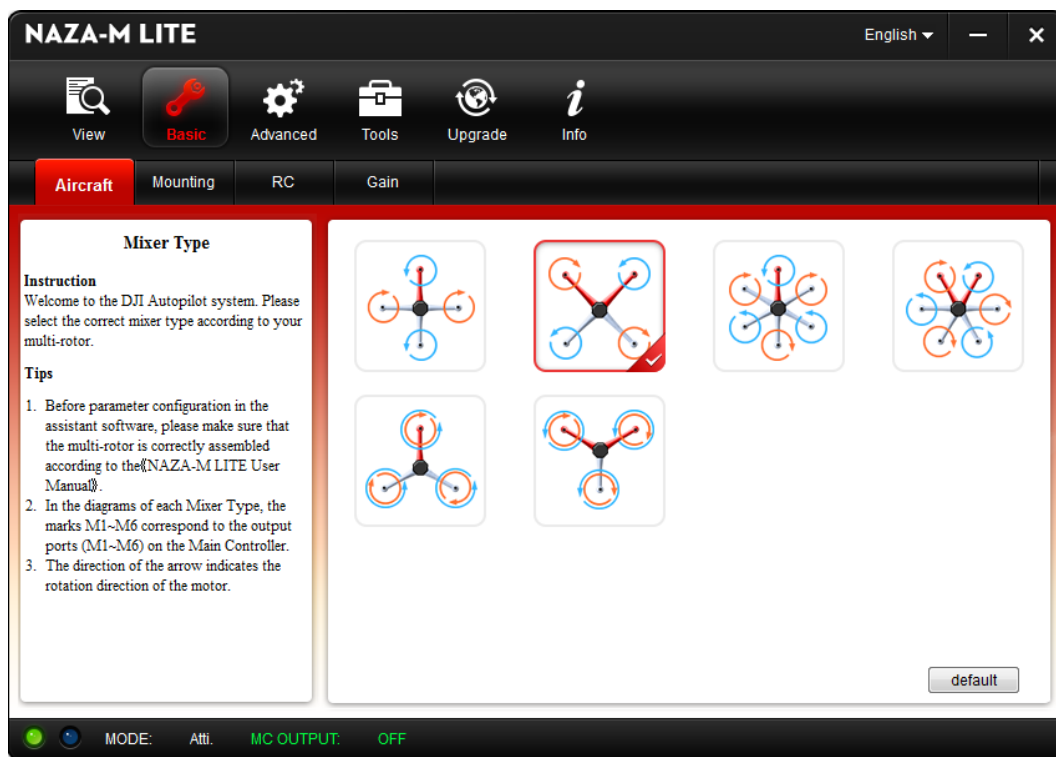


Figure 3: “Aircraft” type page of the NAZA-M LITE Software Assistant.

### Build Directions

1. Click the “**Basic**” icon on top of the **NAZA-M LITE Software Assistant**.
2. On the “**Aircraft**” tab, select the appropriate multi-rotor aircraft. For this build, select the second quadcopter option in the first row.

## Step 3 - Basic Settings Page (continued)

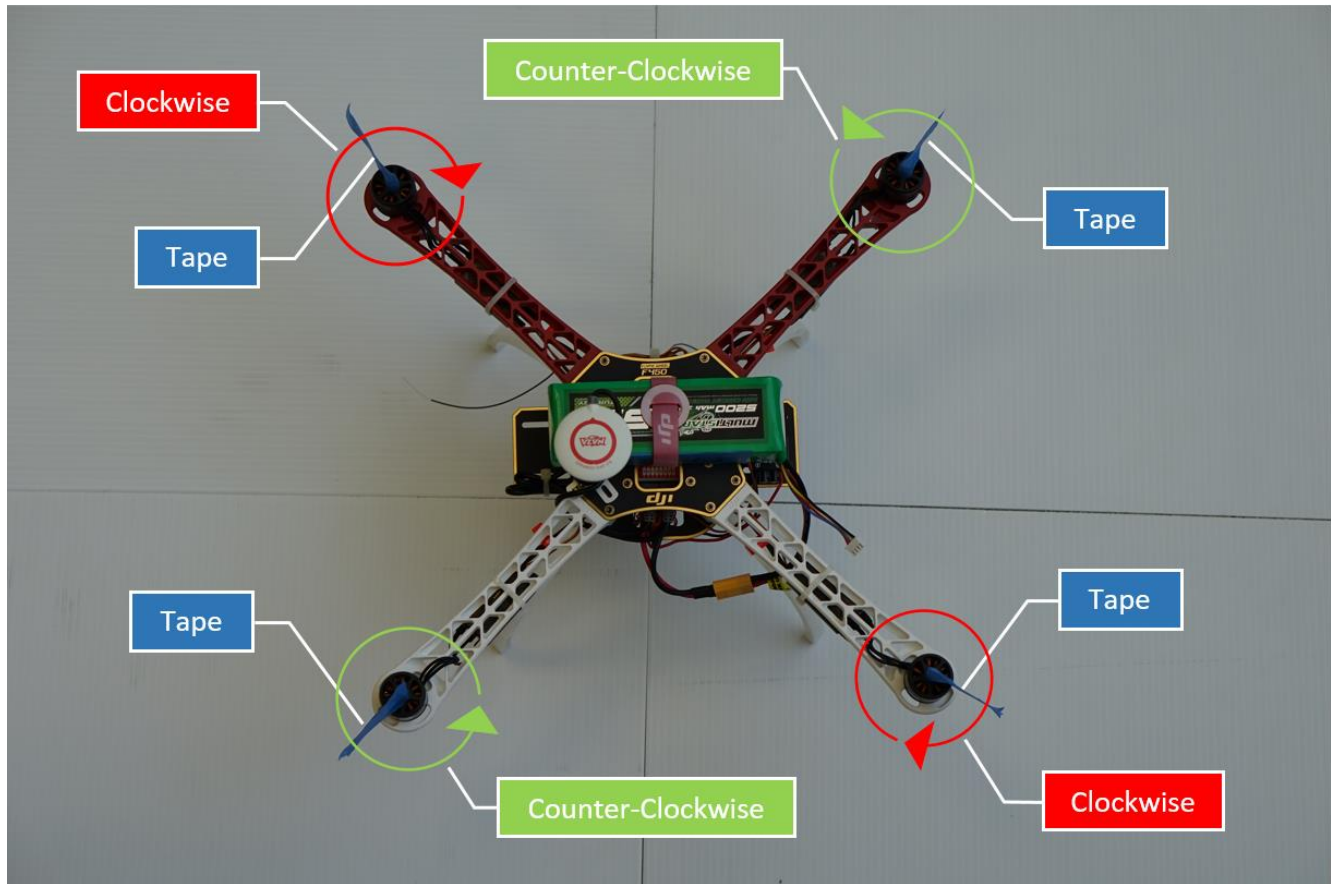


Figure 4: Diagram of motor orientation of the DJI F450 quadcopter.

### Build Directions

#### **WARNING -- Do not attach the propellers for this step!**

1. Check if the directions of the motors are correct:
  - a. Disconnect the Micro-USB cable from the quadcopter.
  - b. Adding tape to the stem of each motor can be used to help determine the direction each motor spins when power is applied (see Figure 4).
  - c. Push the left joystick to the bottom right-hand corner while pushing the right joystick to the bottom left-hand corner to activate the motors.
  - d. The directions of each of the motors should match with those shown in the figure above.
  - e. If any motors are spinning in the opposite direction, swap any of the two connections from the motor to the speed controller.
  - f. Repeat steps "c" through "f" until each motor's spinning direction matches the directions given in Figure 4.
2. Connect the Micro-USB cable to the quadcopter.
3. Relaunch the **NAZA-M LITE Software Assistant** if necessary.

## Step 3 - Basic Settings Page, Aircraft Subsection

### User Information

- The GPS Location settings in the “**Mounting**” section describes the location of the GPS module relative to the Center of Gravity (CG) of the F450 quadcopter (see Figure 5).
- The Center of Gravity of an object is the point at which an object is balanced. For this guide, it is assumed that the center of the DJI F450 frame is its Center of Gravity.
- To center the CG, place the battery, flight controller and GPS module so that the weight is balanced at the center of the quadcopter. Any weight that is not balanced with respect to the center of the quadcopter will make the drone much more difficult to fly.
- Measure the distance between the center of the quadcopter and the GPS module to orient the GPS module to the quadcopter’s Center of Gravity. (**Results will vary depending on how the GPS module is mounted.**)

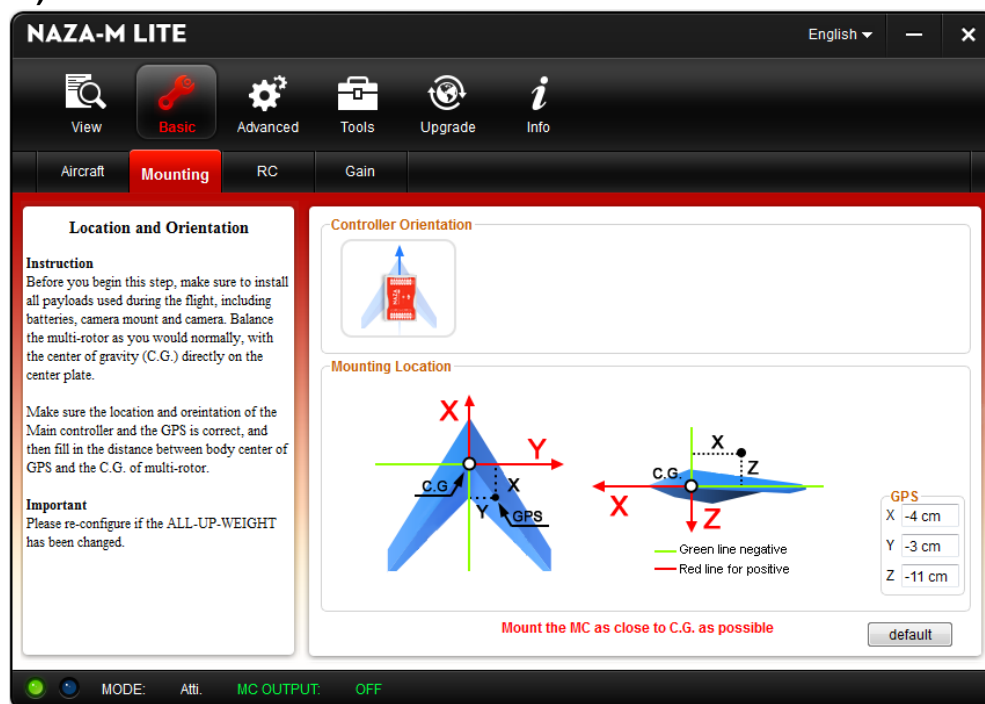


Figure 5: “Mounting” page

### Build Directions

1. Select the “**Mounting**” tab below “**Basic**”.
2. Use a ruler to measure the **X, Y, Z** components of the GPS with respect to the Center of Gravity.
  - a. With the quadcopter facing away from the user, the **Positive X Direction** is the same direction that the drone is pointed (toward the red arms), while the **Negative X Direction** is along the opposite direction that the drone is pointed (toward the white arms).
  - b. With the quadcopter facing away from the user, the **Positive Y Direction** is to the **Right** of the quadcopter’s center, while the **Negative Y Direction** is to the **Left** of the quadcopter’s center.
  - c. The **Positive Z Direction** is **Below** the plane’s center and the **Negative Z Direction** is **Above** the plane’s center.

## Step 3 - Basic Settings Page, Mounting Directions

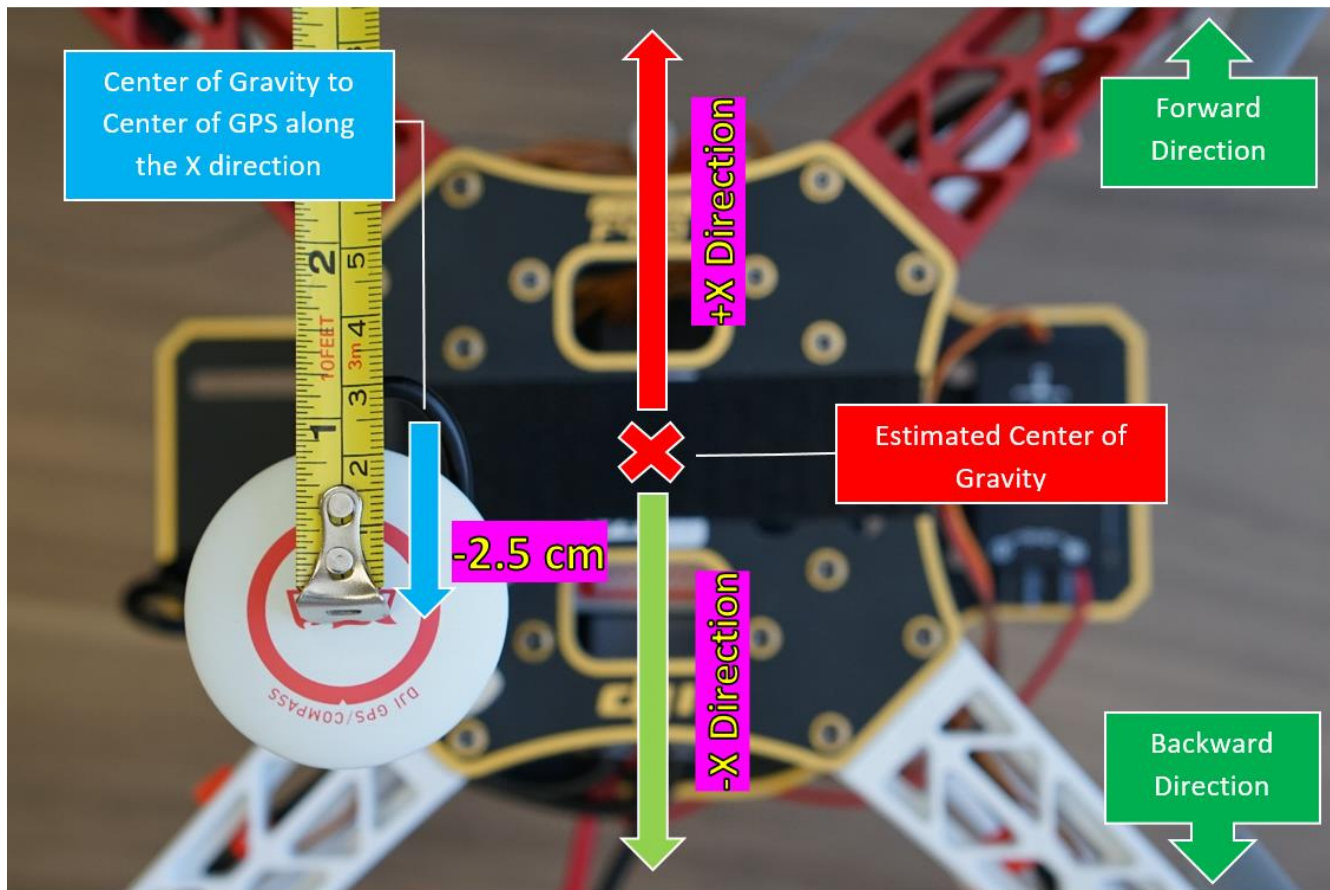


Figure 6: Measuring the X component.

### Build Directions

1. Measuring the **X** axis:
  - a. Figure 6 displays an example of the quadcopter seen from a top-down view.
    - i. The **Positive X Direction** is marked in red and moves toward the **front** of the quadcopter (the two red arms).
    - ii. The **Negative X Direction** is marked in green and moves toward the **back** of the quadcopter (the two white arms).
    - iii. Measure the length between the center of the GPS module and the center of the quadcopter along the **Appropriate X Direction**.
    - iv. Record the value in the **X** section of the **GPS** entry in the lower right-hand corner of the **NAZA-M LITE Software Assistant** page.



## Step 3 - Basic Settings Page, Mounting Directions (continued)

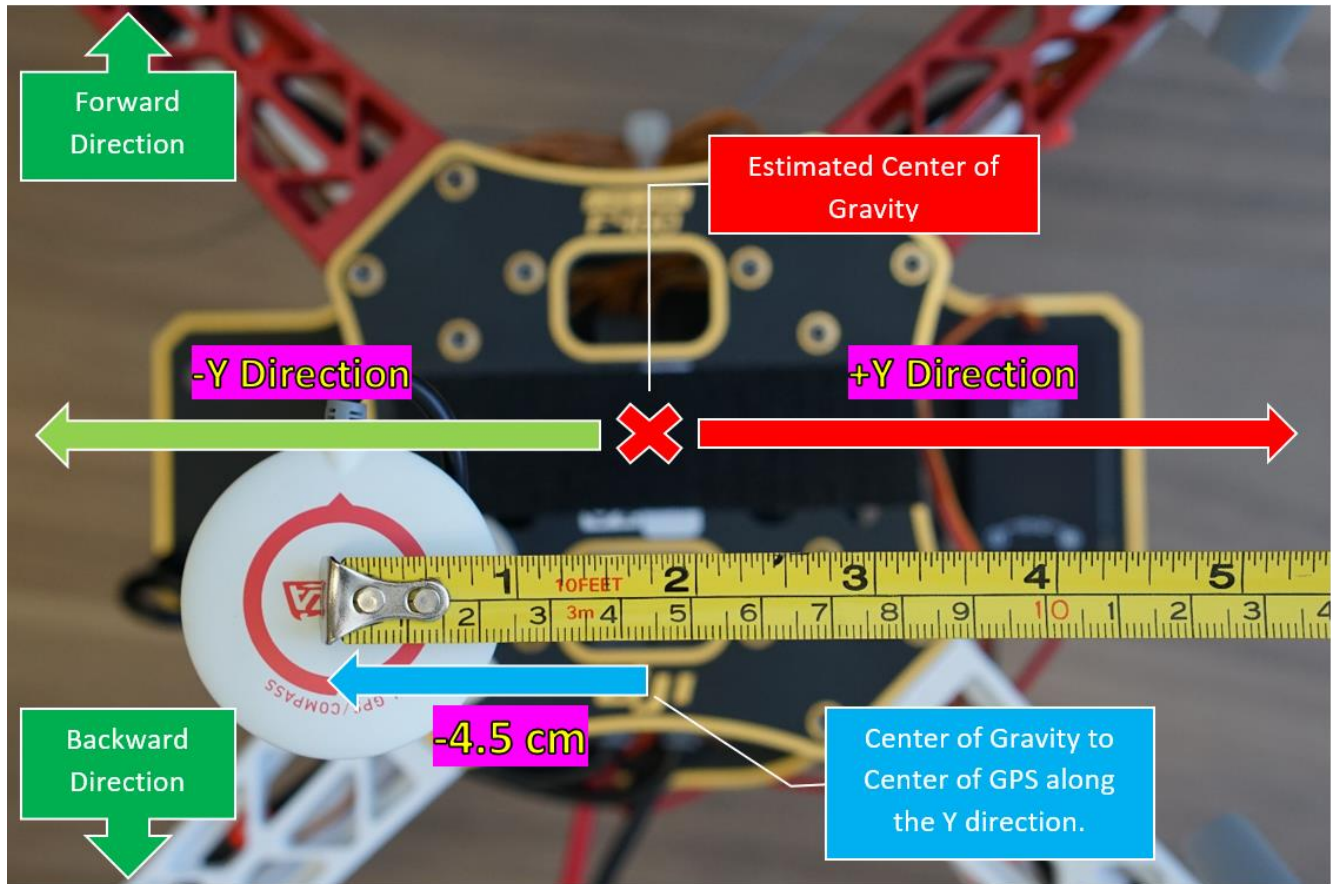


Figure 7: Measuring the Y component.

### Build Directions

1. Measuring the **Y** axis:
  - a. Figure 7 displays an example of the quadcopter seen from a top-down view.
    - i. The **Positive Y Direction** is marked in red and moves toward the right of the quadcopter.
    - ii. The **Negative Y Direction** is marked in green and moves toward the left of the quadcopter.
    - iii. Measure the length between the center of the GPS module and the center of the quadcopter along the **Appropriate Y Direction**.
    - iv. Record the value in the **Y** section of the **GPS** entry in the lower right-hand corner of the **NAZA-M LITE Software Assistant** page.

## Step 3 - Basic Settings Page, Mounting Directions (continued)

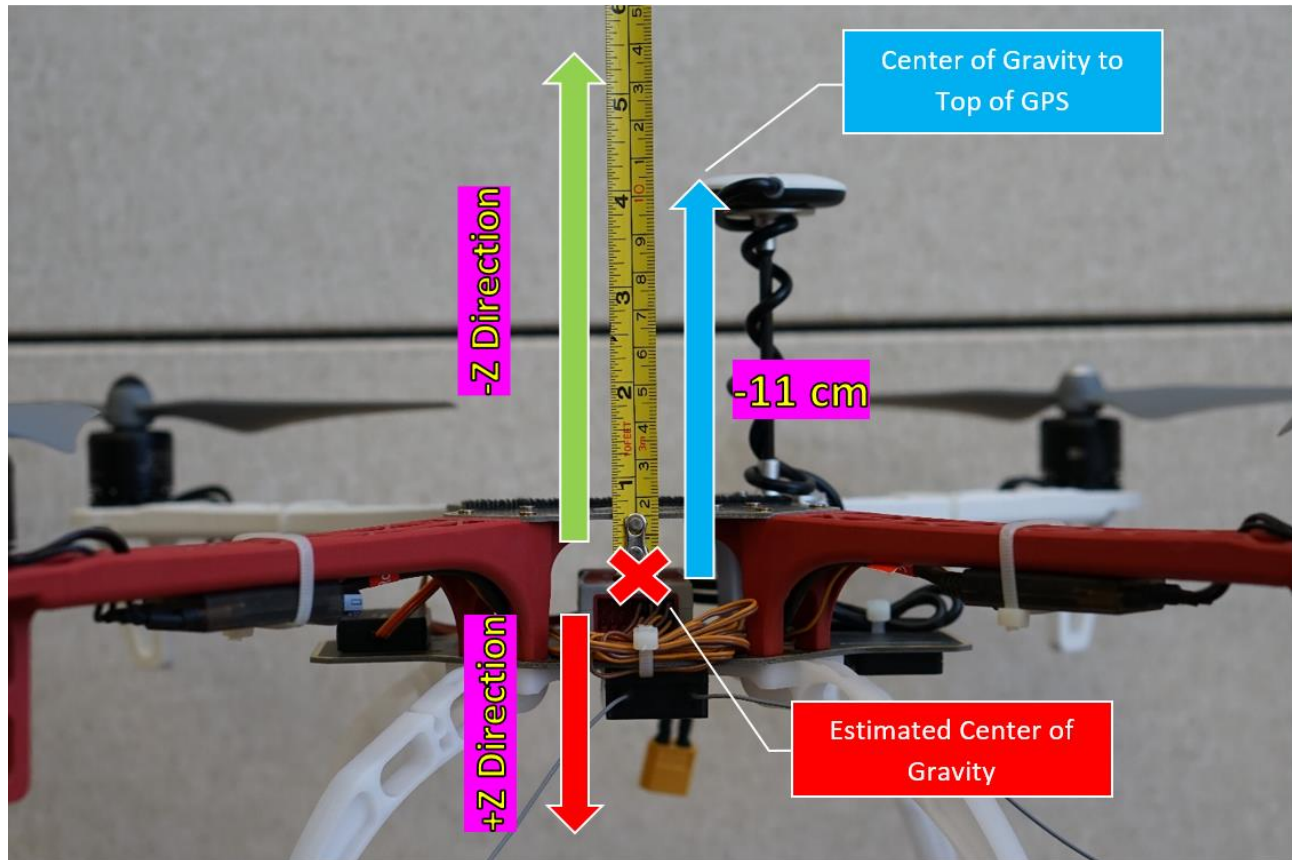


Figure 8: Measuring the Z component.

### Build Directions

1. Measuring the **Z** axis:
  - a. Figure 8 displays an example of the quadcopter seen facing the front of the drone.
    - i. The **Positive Z Direction** is marked in red and moves toward the bottom of the quadcopter.
    - ii. The **Negative Z Direction** is marked in green and moves toward the top of the quadcopter.
    - iii. Measure the length between the center of the GPS module and the center of the quadcopter along the **Appropriate Z Direction**.
    - iv. Record the value in the **Z** section of the **GPS** entry in the lower right-hand corner of the **NAZA-M LITE Assistant Software** page.

**\*Note:** Based on this build, the center of gravity is estimated to be at the center of the quadcopter, and all coordinates are entered as negative since the GPS is located in the negative XYZ plane.

2. After entering the values in the box, press **Enter** on the keyboard to confirm the location of the GPS module and download the values to the flight controller.

## Step 3 - Basic Settings Page, RC Subsection

### User Information

- The “**RC**” settings determine the type of receiver, stick responsiveness, and control mode (see Figure 9).
- The **Command Sticks Calibration** menu allows testing, configuration, calibration of the transmitter’s control sticks and switches.
- **Control Sticks Calibration** options include:
  - **Throttle (T)**: Slide left is craft down; slide right is craft up.
  - **Rudder (R)**: Slide left is nose left; slide right is nose right.
  - **Elevation (E)**: Slide left is craft back; slide right is craft forward.
  - **Aileron (A)**: Slide left is craft left; slide right is craft right.
- The **X1** and **X2** sticks are used for remote gain adjustment, and can be ignored for this tutorial.
- The **Control Mode Switch** changes which flight mode is connected to which switch setting on the transmitter.
- Three modes can be assigned to the switch for each of the configurations: **forward**, **neutral**, and **back**.
- **GPS Mode (GPS)**
  - The copter will maintain its position when input is not received and will correct any deviations in direction or altitude.
- **Attitude Mode (Atti)**
  - The copter will maintain its altitude and orientation, but will move in the original direction of its last horizontal input.
- **Manual Mode (Manual)**
  - The copter will continue moving in the direction of any previous inputs until a new input is received.
  - This mode is very difficult to control for beginning flyers.
- It is suggested to either fly the quadcopter in **Attitude** or **GPS** mode, as **Manual** mode is very difficult to control for beginning flyers.
- For indoor flying, the quadcopter may not be able to connect to the required six satellites to activate **GPS** mode, making **Attitude** mode the ideal flight mode for most situations.

**\*Note:** For this tutorial, it is possible to change the **Control Mode Switch** to either **Attitude**, **GPS**, or **Manual**. However, setting the mode as **Attitude** is recommended.

## Step 3 - Basic Settings Page, RC Subsection (continued)

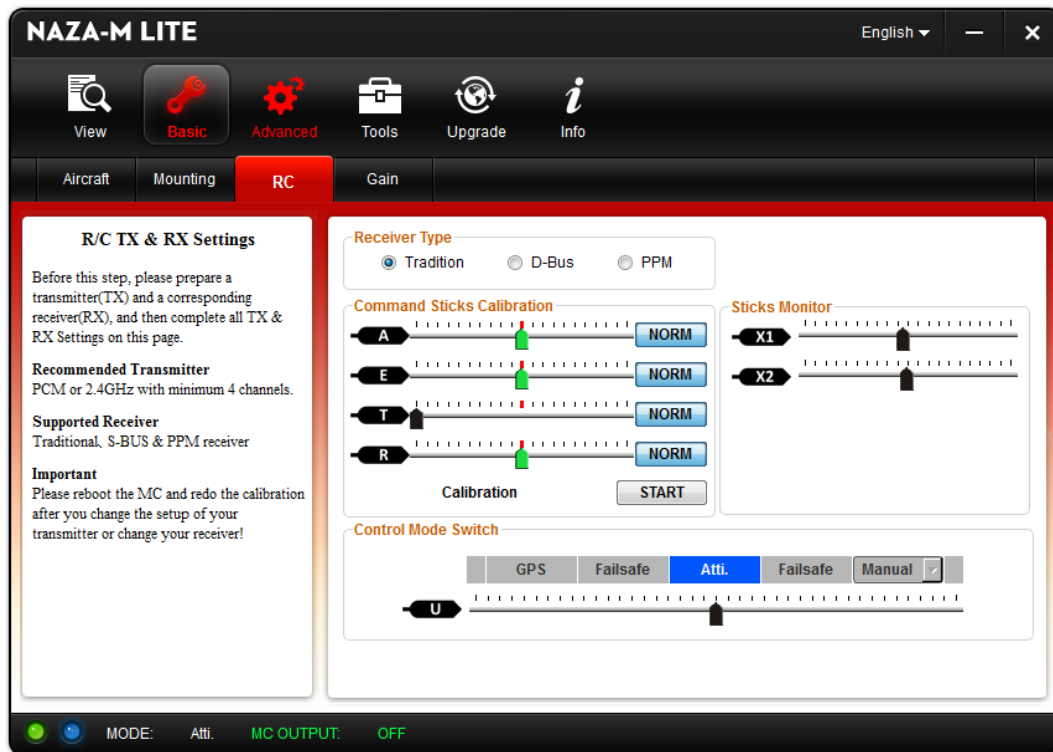


Figure 9: "RC" page.

### Build Directions

1. Select the "RC" tab.
2. In the **Receiver Type** box, select **Tradition**.
3. Next to each command stick slider, ensure that the button to the right reads **NORM**.
4. On **Command Sticks Calibration**, click the **START** button to begin calibrating the joysticks on the transmitter.
5. Move the joysticks around to all corners and sides to allow the software to make any adjustments.
6. Click **Finish** after a few seconds of moving the sticks to end calibration.
7. In the **Control Mode Switch**, click the down arrow of the last box that says **Manual** and select **Atti**.

## Step 3 - Basic Settings Page, Gain Subsection

### User Information

- The **Basic Gain** subsection determines how much the quadcopter will automatically try to correct changes in position and angle (see Figure 10).
  - The information gathered by the IMU is compared to the information gathered by the GPS module.
  - Higher gain values means that the quadcopter will be faster to react to discrepancies, but more likely to over-correct in the opposite direction.
  - Lower gain values mean that the quadcopter will be slower to react to discrepancies, but more difficult to control due to slower response times.
- The **Attitude Gain** subsection determines how sensitive the quadcopter is to respond to changes from the command stick input.
  - Higher gain values mean that the quadcopter will be faster to respond to input changes from the throttle stick.
  - Lower gain values mean that the quadcopter will be slower to respond to input changes from the throttle stick.

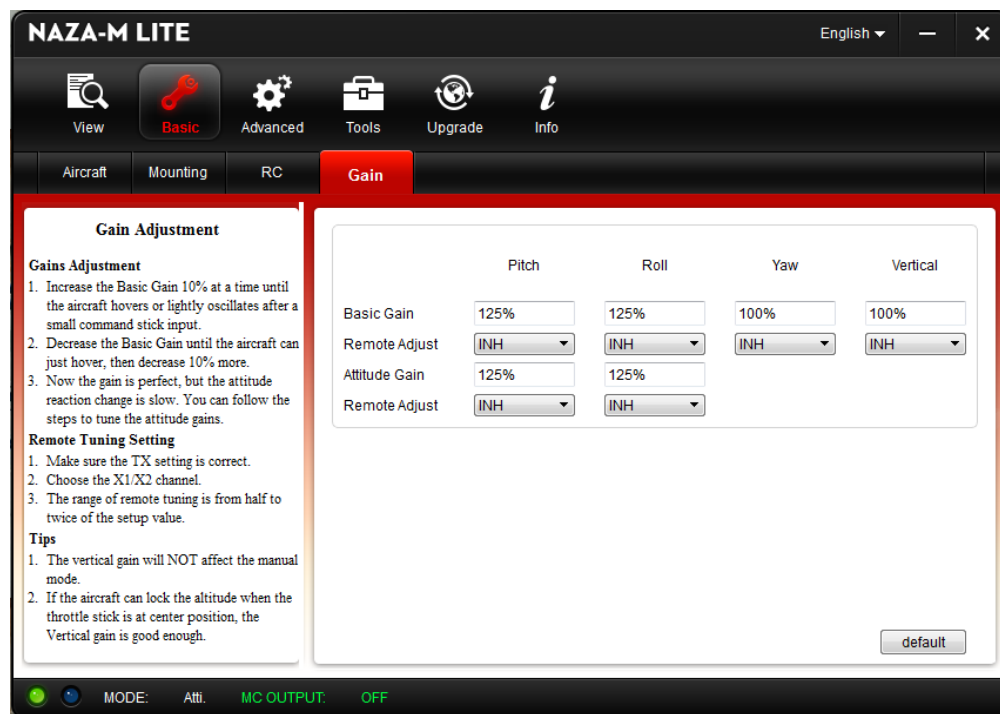


Figure 10: "Gain" page.

### Build Directions

1. No changes needed to be made for "Gain" subsection.



## Step 4 - Advanced Settings Page, Motor Subsection

### User Information

- The **Motor Idle Speed** option allows configuration of the motor's idle speed and cutoff. The recommended speed is preferred for most situations, but the setting can be modified for better flight characteristics (see Figure 11).
- **Immediately**
  - Once started, the motors do not stop if the throttle stick is set over **10%**.
  - If set below **10%** throttle, the motors stop immediately.
  - The user has **5** seconds to push the throttle past **10%** to restart the motors.
- **Intelligent**
  - Once started, the motors will stop under any of the following conditions.
    - If the throttle value is not increased within **3** seconds of the motors starting up.
    - If the motor initiation sequence (CSC) is executed more than once.
    - If the throttle is under **40%** when landed for three seconds.
    - If the slope angle of the quadcopter is over **70 degrees** and the throttle is under **10%**. This occurs in cases of collision, crashes, or motor malfunction.
- **Intelligent** is the preferred motor cutoff mode.

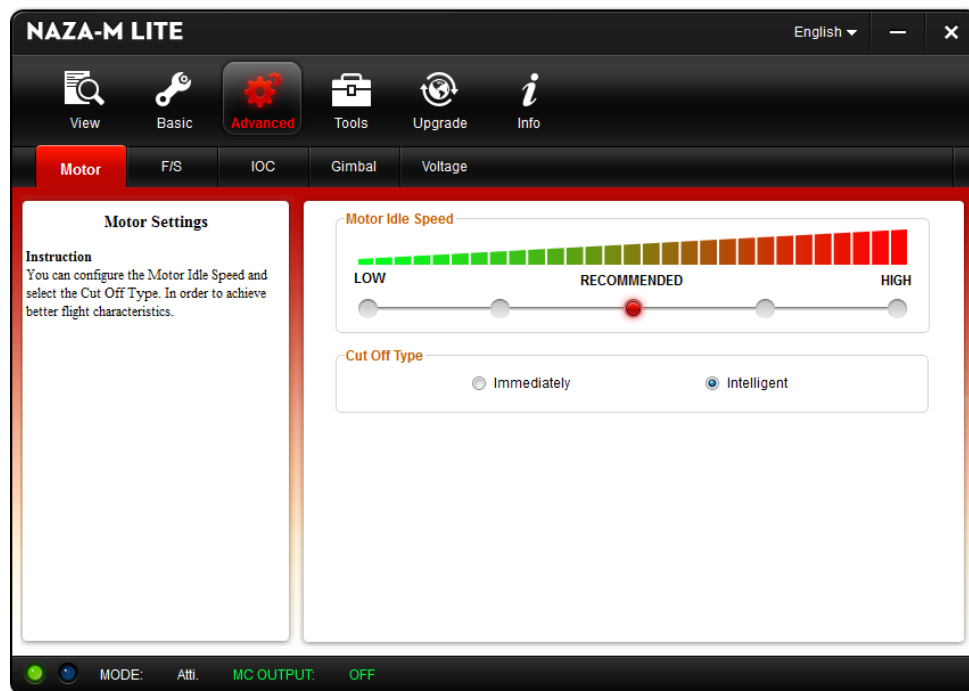


Figure 11: "Motor" page.

### Build Directions

1. Click on the **"Advanced"** icon at the top.
2. Under the **Motor** subsection, select the **RECOMMENDED** motor speed.
3. In the **Cut Off Type** section, select **Intelligent**.

## Step 4 - Advanced Settings Page, F/S Subsection

### User Information

- **Enhanced Failsafe Methods** helps to reduce chances of crashing (see Figure 12).
- This failsafe is triggered by one of the following conditions:
  - If the signal is lost between the transmitter and the receiver for any reason.
  - If any of the channels between the flight controller and the receiver stop receiving a signal.
  - If the motors will not respond to the control sticks, and the flight controller LED begins flashing yellow.
- **Landing**
  - The quadcopter will land after hovering for 6 seconds.
- **Go Home and Landing**
  - If **GPS** mode is enabled, the takeoff position of the quadcopter is saved as a home point by the flight controller. If signal is lost, then the quadcopter will fly to a point 20 meters above the home point, hover for 15 seconds, then land safely.
- In most cases, it is simplest to use **Landing** mode, as **Go Home and Landing** mode requires that a home point be set and **GPS** mode be enabled.

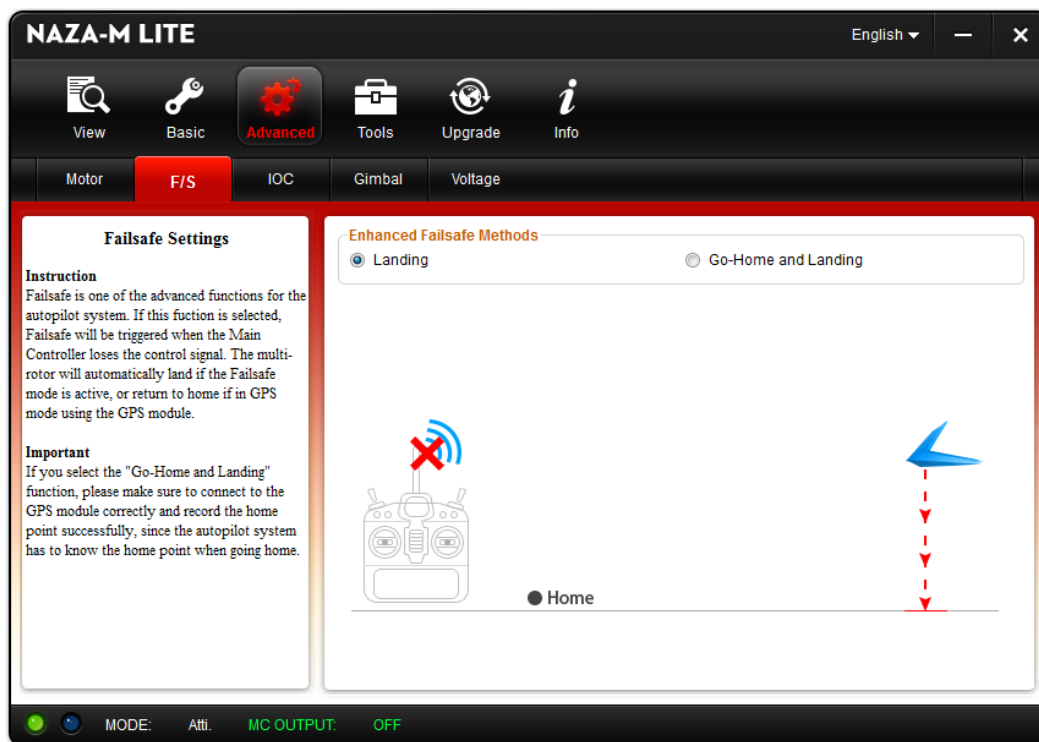


Figure 12: "F/S" page.

### Build Directions

1. Click on the "F/S" (Failsafe) subsection.
2. Select the **Landing** option.

## Step 4 - Advanced Settings Page, IOC Subsection

### User Information

- “**Intelligent Orientation Control**” is a function that allows the user to lock the quadcopter into a particular flight mode (see Figure 13).
- **Home Lock** takes the GPS coordinates of the home point and allows the drone to circle that point.
  - The drone does need to be at least 10 meters away from the **Home Point** in the X direction for **Home Lock** to function properly.
  - Moving the right control stick up and down will move the quadcopter away from and towards the **Home Point**, respectively.
- The **Course Lock** is automatically engaged if the quadcopter moves within 10 meters of the **Home Point**.
  - The **Course Lock** remembers the drone’s forward facing orientation and locks the drone’s movement to be oriented that direction.
  - The right control stick will move the drone forward, back, right, or left while keeping the front of the quadcopter pointed in the remembered direction.

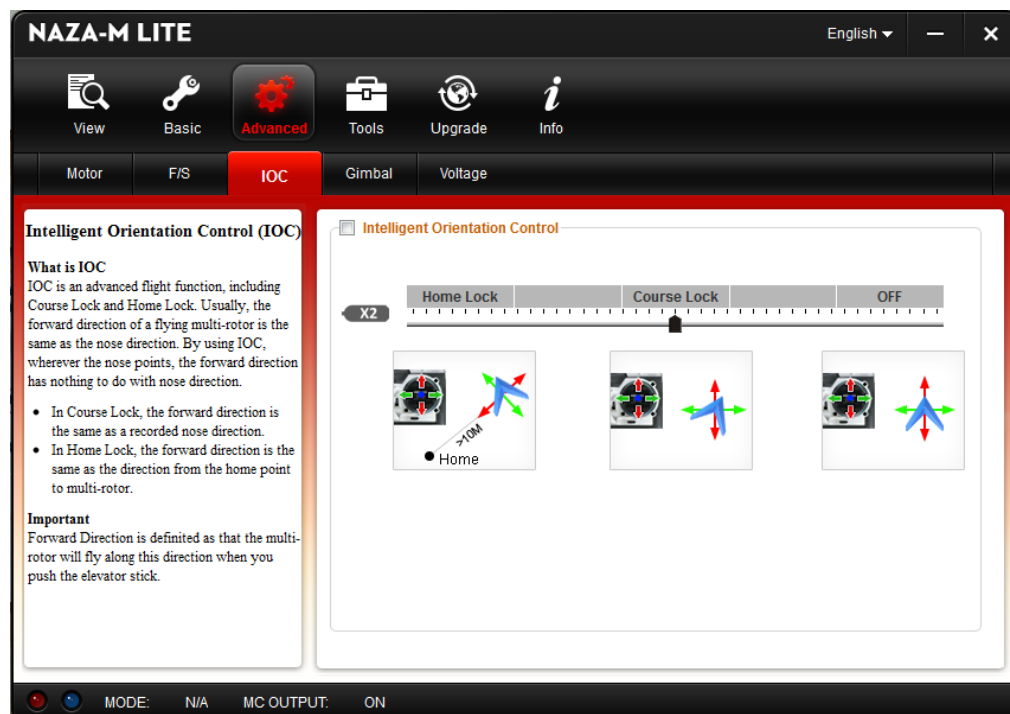


Figure 13: “IOC” page.

### Build Directions

1. No changes needed to be made for “IOC” subsection.

**\*Note:** “**Intelligent Orientation Control**” requires you to be in **GPS mode** in an environment where satellite connections can be easily obtained, so this option will not be used for this tutorial.

## Step 4 - Advanced Settings Page, Voltage Subsection

### User Information

- The “**Low-Voltage Alert**” manually sets two voltage warnings that will activate when the quadcopter’s battery reaches a certain voltage threshold (see Figure 14).
- The **First Level Protection** gives an LED warning, which appears as a rapidly flashing red LED signal that replaces your regular LED signal interval.
  - **3.4 V** per cell, or **10.2 V** total is the point where most **3S 11.3 V** batteries begin running out of power.
- The **Second Level Protection** forces your quadcopter to descend by decreasing the throttle to **10%**.
  - Using an **11.3 V 3S** battery, the absolute lowest safest voltage level is **3.2 V** per cell, or **9.6 V** total.
- These protection settings are meant to prevent sudden quadcopter crashes due to low-voltage batteries.



Figure 14: “Voltage” page.

### Build Directions

1. Click on the “Voltage” tab.
2. Under **Protection Switch**, select the **ON** option.
3. Measure voltage of the battery with a voltmeter.
4. Press the **Calibration** button and record the measured value in the popup menu.
5. Under **Battery**, set the **Current Voltage** to **11.3 V**.
6. Click on drop down menu in **Battery Type** and select **3S LiPo**.
7. In **First Level Protection**, set the **No Load** voltage to **10.20 V** and **Loss** to **0.00 V**.

## Step 5 - Tools Setting Page

8. In **Second Level Protection**, set the **No Load** voltage to **9.60 V** and **Loss** to **0.00 V**.

### User Information

- The “**Tools**” subsection details the information that is being received from the **Inertial Measurement Unit (IMU)** packaged in the NAZA-M LITE kit (see **Figure 15**).
- The **Gyroscope** measures the orientation of the quadcopter as **Roll**, **Pitch**, and **Yaw**.
- **Acceleration** denotes the acceleration of the quadcopter.
- **Compass** shows the direction in which the quadcopter is pointed relative to magnetic north.
- Before operating the quadcopter, the **IMU** will need to be calibrated by clicking the **Basic Cali** button while the flight controller is connected to the computer.



Figure 15: “**Tools**” page.

### Build Directions

1. Select the “**Tools**” section at the top.
2. At the bottom of the page, click on the **Basic Cali** button to calibrate the **IMU**.



Figure 16: NAZA-M LITE LED Signal Chart



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# DEVO 7 Transmitter Setup and Binding Tutorial

Written by: Conor Swezey

## Introduction

Use this guide to configure and bind the DEVO 7 transmitter to the RX701 receiver for the DJI F450 quadcopter.

# Transmitter Layout



Figure 1: The DEVO 7 transmitter with buttons labeled.

## Build Directions

There are six functional keys on the DEVO 7 control panel.

1. **EXT**: The exit key. Press **EXT** to return to the previous menu.
2. **ENT**: The confirmation key. Press **ENT** to access the highlighted option or the system, model, or function menu items.
3. **UP**: Moves the cursor to the previous function item.
4. **DN**: Moves the cursor down to the next function item.
5. **L**: Moves the highlight cursor down or increases the setting value.
6. **R**: Moves the highlighted cursor up or decreases the setting value.

## Step 1 - Model Menu, TYPE Settings

### User Information

- This section discusses which settings to select in the “**MODEL**” menu.
- The “**MODEL**” menu is used to change the transmitter settings to work with different models of unmanned aircraft.

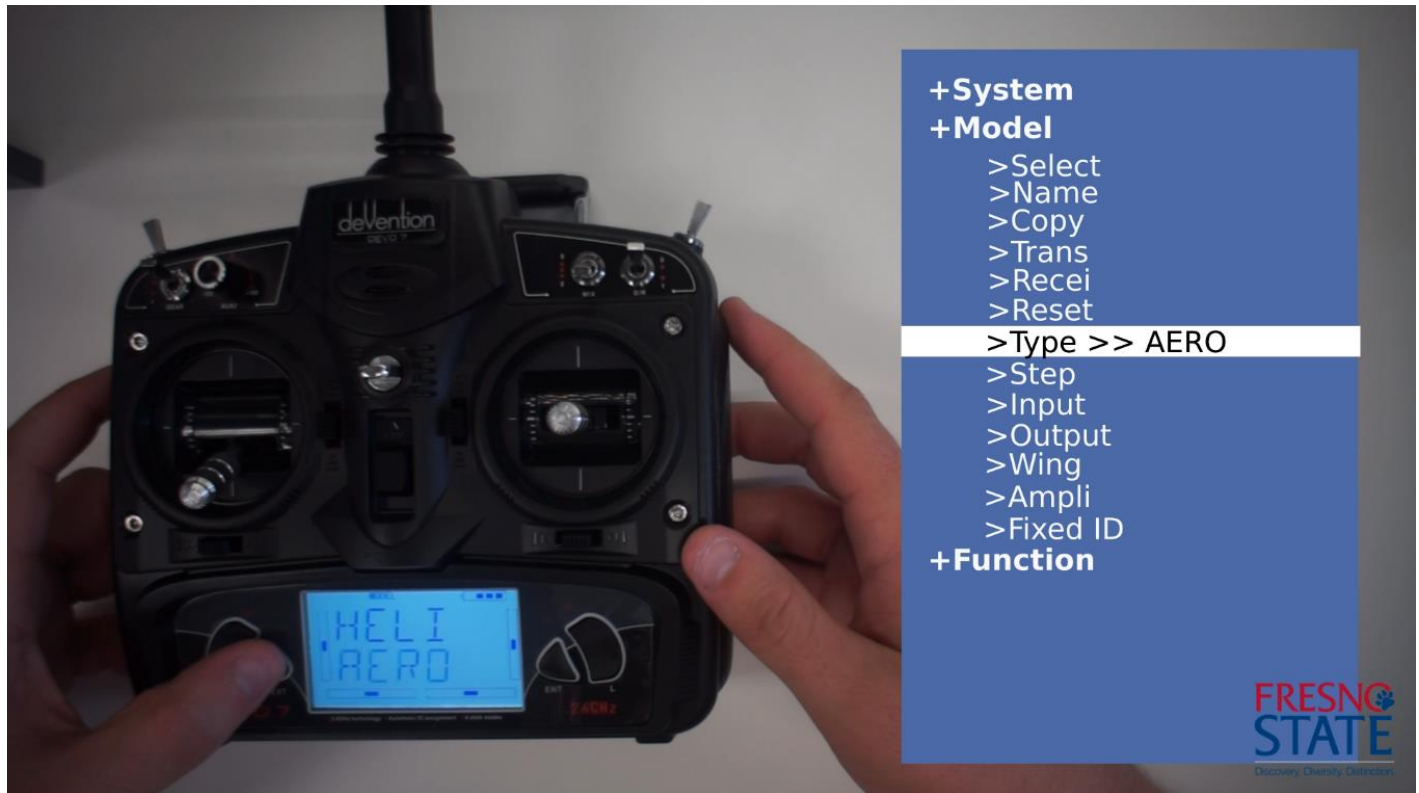


Figure 2: Value of the type setting on the transmitter.

### Build Directions

1. Press **ENT** to bring up the menu options at the top of the DEVO 7's screen.
2. Choose “**MODEL**”, then repeatedly press **L** until you reach the “**TYPE**” option and press **ENT**.
3. Highlight the “**AERO**” option and press **ENT**.
4. Press **EXT** to exit back out into the “**MODEL**” menu.

## Step 2 - Model Menu, INPUT Settings

### User Information

- The “**INPUT**” menu allows for the customization of the various function switches on the DEVO 7 transmitter.
- This menu allows the user to modify the settings for flight mode, throttle hold, and stunt trim mode.



Figure 3: Transmitter settings for “**FM SW**”, “**FMTRM**”, and “**HLDSW**”.

### Build Directions

1. At the “**MODEL**” menu, press **L** until you reach the “**INPUT**” option and press **ENT**.
  - a. Select the “**FM SW**” option and cycle through the options with the **R** and **L** buttons until you see “**FMD**” option.
  - b. Press the **DN** button to reach the “**FMTRM**” option. Cycle through the options until you see “**COMM**”.
  - c. Press the **DN** button to reach the “**HLDSW**” option and cycle through its options until you see “**HOLD**”.
  - d. Press **EXT** to go back to the “**MODEL**” menu.



## Step 3 - Model Menu (continued)

### User Information

- The “**OUTPUT**” menu allows the user to customize the output switches and levers.
- The switches can be activated, modified, or have their functionality changed according to the user’s requirements.



Figure 4: Transmitter settings for the output menu.

**Build Directions**

**WARNING** -- For this section, each setting has **TWO** options. There is no visual indicator for these options. For example, the first **"GEAR"** option will simply appear on the transmitter's screen as **"GEAR"**. Pressing the **DN** key once will bring you to the second **"GEAR"** option, which will display as **"GEAR"** with different settings.

1. At the **"MODEL"** menu, press **L** until you reach the **"OUTPUT"** setting and press **ENT**.
  - a. At the first **"GEAR"** setting, select the **"FMD"** option by pressing **R** or **L**.
  - b. Press **DN** only once to go to the second **"GEAR"** setting. Select **"ACT"** by pressing **R** or **L**.
  - c. Press **DN** until you reach the first **"FLAP"** setting. Press **R** or **L** until the **"MIX"** option is flashing on the bottom part of the screen.
  - d. Press **DN** once to reach the second **"FLAP"** setting. Press **R** or **L** until the **"ACT"** option appears on the screen.
  - e. Press **DN** until you reach the first **"AUX2"** setting. Press **R** or **L** until the **"AUX2"** option appears on the screen.
  - f. Press **DN** once to reach the second **"AUX2"** setting and press **R** or **L** to change the option to **"ACT"**.
  - a. Press **EXT** to go back to the **"MODEL"** menu.

## Step 4 - Model Menu, AMPLI Setting

### User Information

- The “**AMPLI**” setting allows the user to adjust the radio transmission output power of the DEVO 7 transmitter.
- The setting is divided into six levels.
  - o A lower transmitter output power corresponds to a shorter transmitter radio range and a longer battery life.
  - o A higher transmitter output power corresponds to a longer transmitter radio range and a shorter battery life.

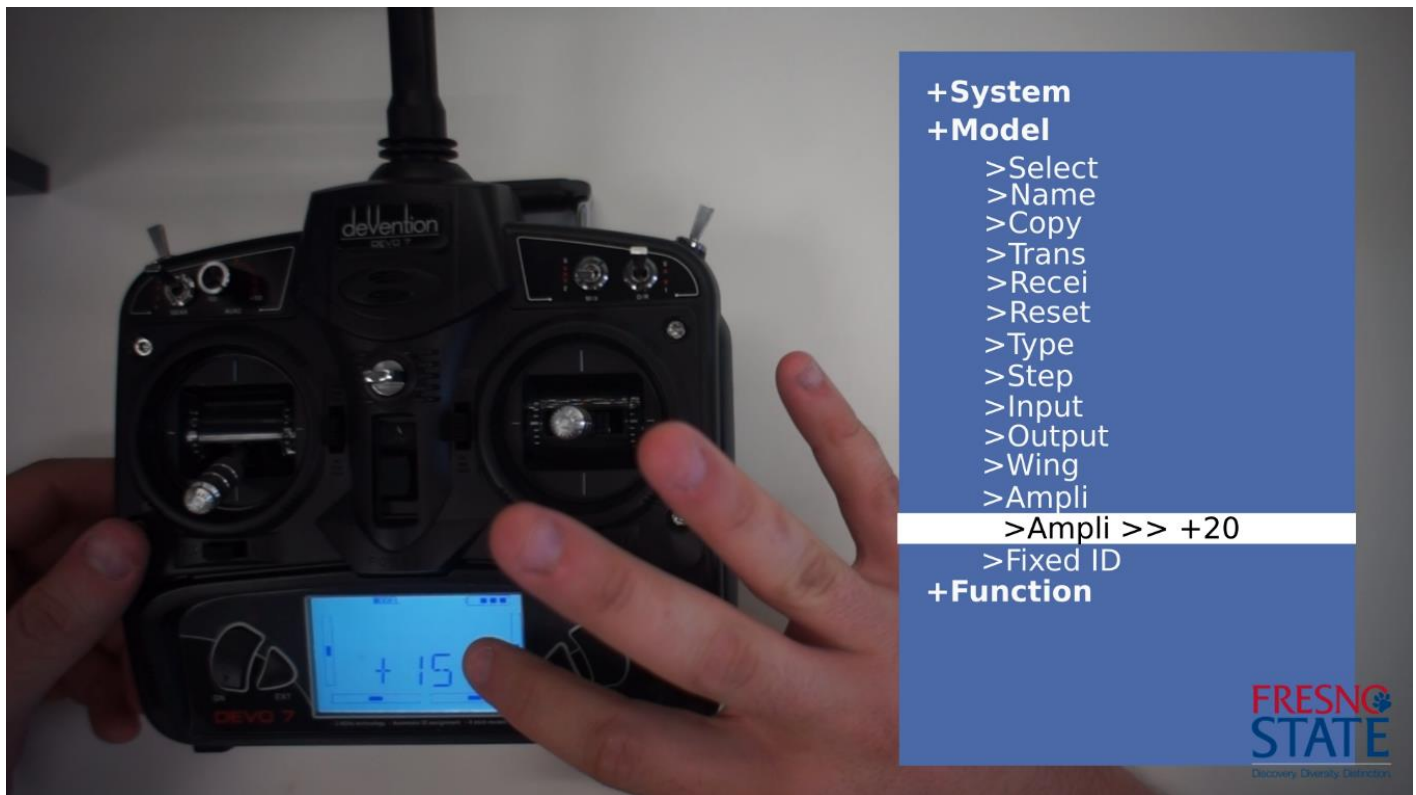


Figure 5: Transmitter settings for the “**AMPLI**” setting

### Build Directions

1. At the “**MODEL**” menu, press **DN** until you see the “**AMPLI**” setting.
  - a. Use the **R** and **L** buttons to scroll through the options and choose the “**+20**” option.
  - b. Press **ENT** to confirm your choice and press **EXT** to return to the “**MODEL**” menu.
  - c. Press **EXT** to go back to the original menu.

## Step 5 - Function Menu, REVSW Setting

### User Information

- The **"FUNCTION"** menu allows the user to customize the flight and control settings for each model profile on the DEVO 7 transmitter.
- The **"REVSW"** setting in particular allows the user to modify the Reverse Switch properties on the transmitter, which corresponds to the appropriate control stick on the transmitter.

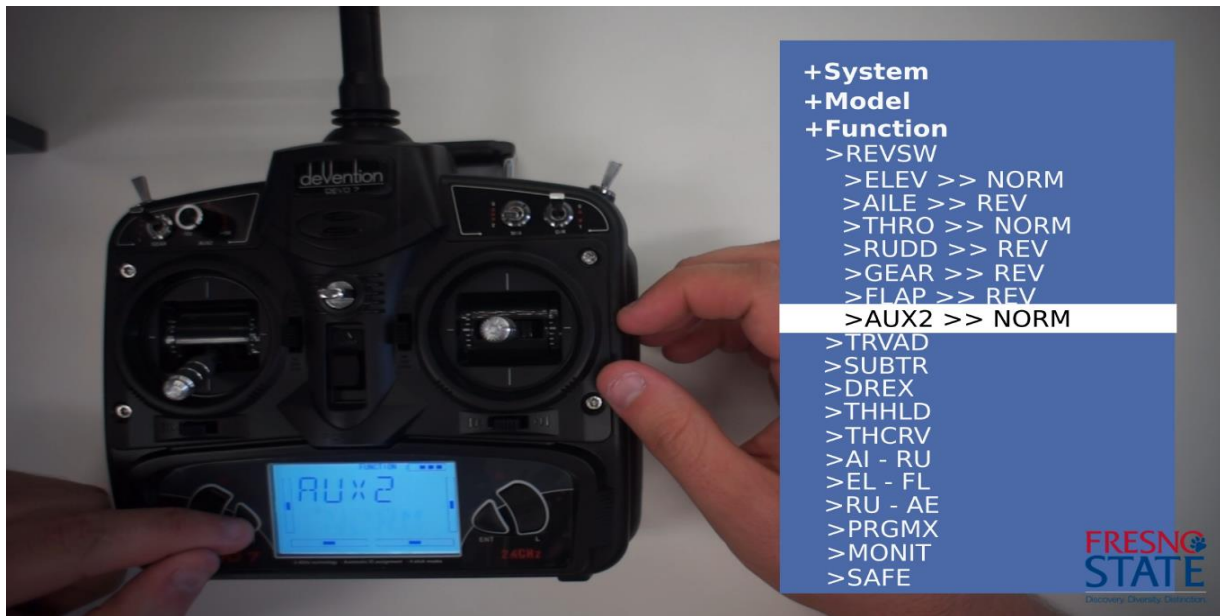


Figure 6: Transmitter settings for the Reverse Switch setting.

### Build Directions

1. Highlight the **"FUNCTION"** menu and scroll down until you reach the **"REVSW"** option, then press **ENT**.
  1. Use the **UP** and **DN** buttons to go to the **"ELEV"** setting. Use the **R** and **L** to choose the **"NORM"** option. Press **DN** to move onto the next setting.
  2. Use the **UP** and **DN** buttons to go to the **"AILE"** setting. Use the **R** and **L** to choose the **"REV"** option. Press **DN** to move onto the next setting.
  3. Use the **UP** and **DN** buttons to go to the **"THRO"** setting. Use the **R** and **L** to choose the **"NORM"** option. Press **DN** to move onto the next setting.
  4. Use the **UP** and **DN** buttons to go to the **"RUDD"** setting. Use the **R** and **L** to choose the **"REV"** option. Press **DN** to move onto the next setting.
  5. Use the **UP** and **DN** buttons to go to the **"GEAR"** setting. Use the **R** and **L** to choose the **"REV"** option. Press **DN** to move onto the next setting.
  6. Use the **UP** and **DN** buttons to go to the **"FLAP"** setting. Use the **R** and **L** to choose the **"REV"** option. Press **DN** to move onto the next setting.
  7. Use the **UP** and **DN** buttons to go to the **"AUX2"** setting. Use the **R** and **L** to choose the **"NORM"** option. Press **EXT** to go back to the **"FUNCTION"** menu.

## Step 6 - Function Menu, TRVAD Setting

### User Information

- The “**TRVAD**” setting determines the Travel Adjust level for the transmitter.
- This setting sets the maximum and minimum servo travel percentages for all of the control channels.



Figure 7: Transmitter settings for “**TRVAD**”.

### Build Directions

1. In the “**FUNCTION**” menu, scroll through the settings using **UP** and **DN** buttons until you reach the “**TRVAD**” setting. Press **ENT** and select the “**GEAR**” option.
  1. Decrease the positive percentage value to “+0.0%” using your **R** and **L** buttons, then press **DN** to advance to the next setting.
  2. Increase the negative percentage value to “-83.5%” using your **R** and **L** buttons.
  3. Press **DN** to go to the first “**FLAP**” option.
  4. Set the percentage to “**U88%**” for the first “**FLAP**” option, then press **DN** to go to the second **DN** option.
  5. Set the percentage to “**D88%**” for the second “**FLAP**” option, then press **EXT** to return to the “**FUNCTION**” menu.



## Step 7 - Function Menu, SUBTR Setting

### User Information

- The “**SUBTR**” setting allows the user to modify the servo neutral position.
- In order to avoid potentially damaging the servo, it is important to set the servo arm/bell crank to be as close to the neutral point as possible.



Figure 8: Transmitter settings for “**SUBTR**”.

### Build Directions

1. In the “**FUNCTION**” menu, scroll through the settings using the **UP** and **DN** buttons until you reach the “**SUBTR**”. Press the **ENT** button.
  1. Select the “**GEAR**” option, use the **R** and **L** buttons to decrease the percentage value to “-5.5%”.
  2. Use the **DN** button to select the “**FLAP**” option.
  3. From the “**FLAP**” option, increase the percentage value to “**D5.0%**” using the **R** and **L** buttons.
  4. Click the **EXT** button to return to the “**FUNCTION**” menu.

## Step 8 - Function Menu, GEAR Setting

### User Information

- The “**GEAR**” setting allows the user to modify the sensitivity and operating mode of the two control sticks on the DEVO 7 transmitter.

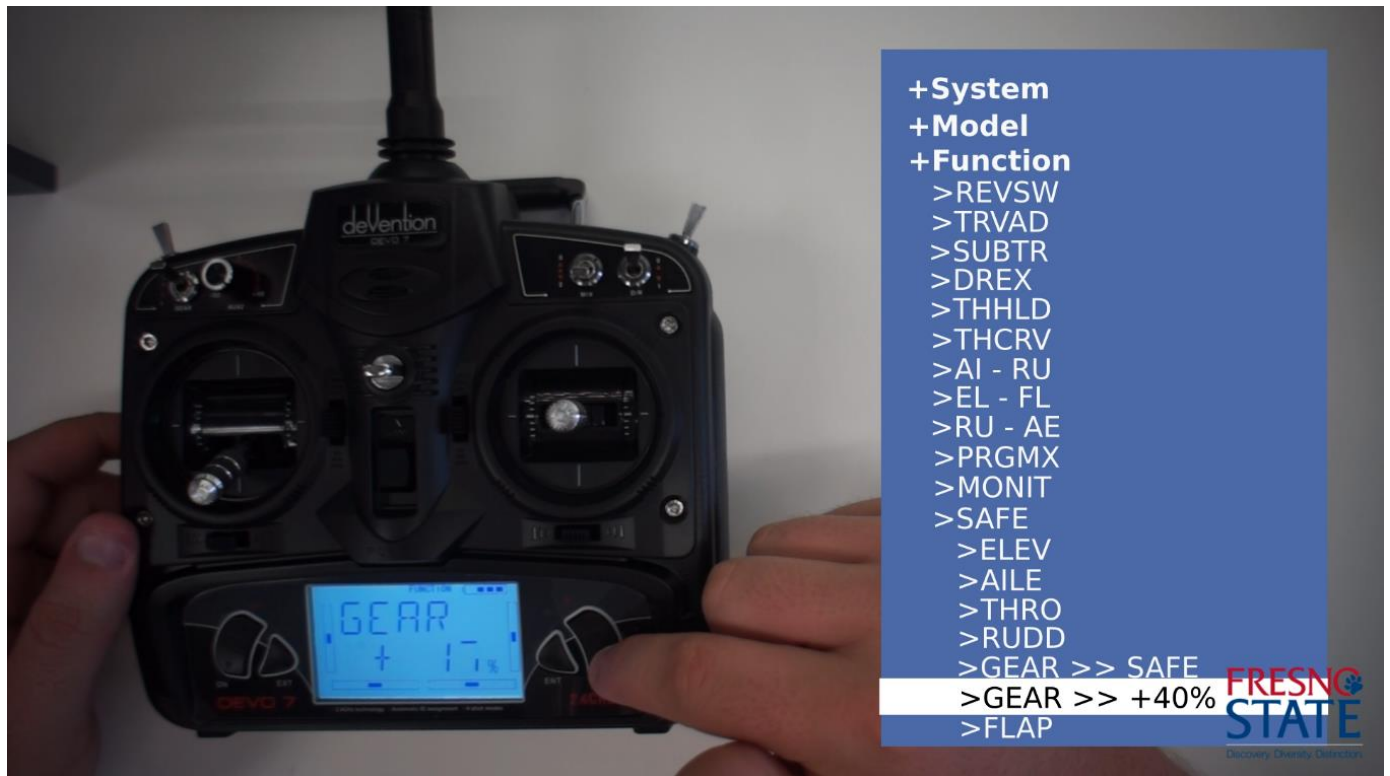


Figure 9: Transmitter settings for GEAR.

### Build Directions

- In the “**FUNCTION**” menu, scroll down using the **UP** and **DN** buttons until you reach the first “**GEAR**” setting.
  - Use the **R** and **L** buttons to choose the “**SAFE**” setting, then press **DN** to move onto the second “**GEAR**” setting.
  - Use the **L** button to increase the value of the second “**GEAR**” setting until it reads “**+40%**”
- Use the **EXT** button to return to the transmitter’s main menu and then follow the instructions for connecting the DEVO 7 transmitter and the RX701 receiver.

## Step 9 - Transmitter/Receiver Binding Guide

### User Information

- This guide will demonstrate how to bind the DEVO 7 transmitter to the RX701 receiver connected to the quadcopter.
- It might be necessary to bind one transmitter to one receiver at a time. This allows the binding process to be completed without radio interference from other transmitters.
- Once this process is completed, follow the included software guide's instructions to configure the quadcopter for flight.

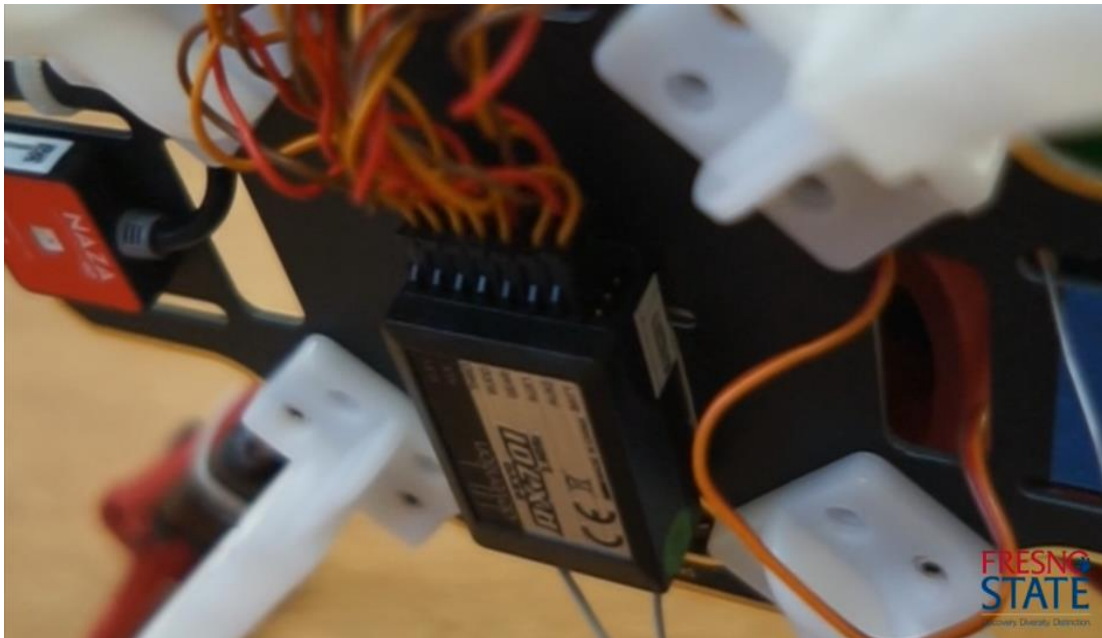


Figure 10: RX701 receiver in its initial state.

### Build Directions

1. Make sure that nothing is plugged into the **"BATT"** port on the DEVO RX701 receiver.
2. On the transmitter, press **ENT** to open the main options menu, then use the **UP** and **DN** buttons to select the **"MODEL"** option.
  - a. In the **"MODEL"** menu, use the **DN** button to scroll down until the **"FIXID"** option is highlighted. Press **ENT**.
  - b. If there is a **"CODE"** option in the menu, press **ENT** twice to move to the **"RUN"** menu.
  - c. At the **"RUN"** option, press the **R** button until the **"NO"** option is highlighted. Press **ENT** to confirm your choice and move to the **"FIXID"** option.
  - d. At the **"FIXID"** option, press **R** until the **"OFF"** option is highlighted, then press **EXT** until you reach the main menu.
  - e. Turn off the transmitter.

## Step 10 - Transmitter/Receiver Binding Guide (Continued)

### User Information

- This section will use the battery bind plug to wipe any previous connections that the receiver has made.
- This is useful if you need to redo the binding process or bind the receiver to another transmitter.
- A receiver cannot be bound to multiple transmitters, but a transmitter may create separate profiles and bind each one to a separate receiver.

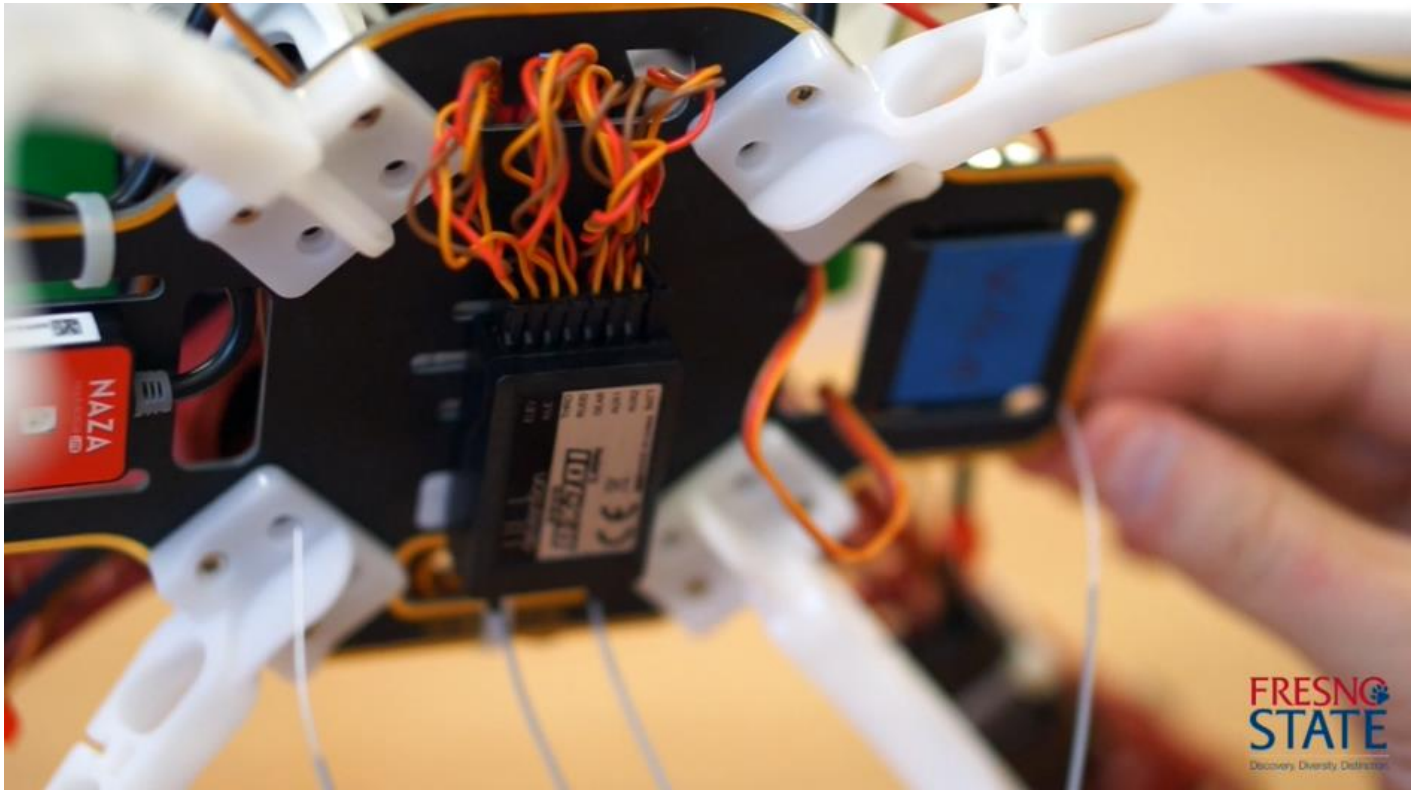


Figure 11: RX701 receiver with the battery bind plug inserted.

### Build Directions

1. Plug the included bind plug into the receiver's "BATT" port.
  1. Connect the battery to the drone.
  2. The red LED indicator on the receiver should be flashing slowly. This indicates that the existing code on the receiver has been erased.
  3. Disconnect the battery and remove the battery bind plug from the "BATT" port.



## Step 11 - Transmitter/Receiver Binding Guide (Continued)

### User Information

- Once the receiver is reset and the transmitter is configured, the binding process can be initiated.
- The transmitter will need to be turned on to initiate a FIXED ID search and then turned off.
- The 11.1V battery will be connected to the quadcopter. The DJI LED indicator and the receiver will begin flashing while the receiver looks for a compatible signal.
- The transmitter will be turned on and will attempt to connect to the closest compatible receiver.
- As stated before, it is important to connect one transmitter to one receiver at a time in order to minimize connection error.

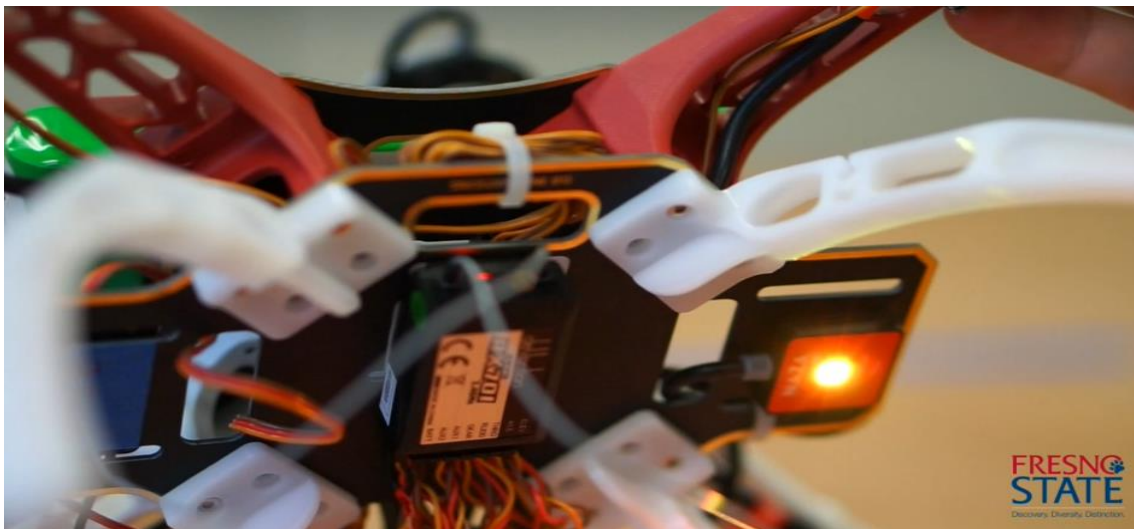


Figure 12: Both the receiver and indicator LEDs are flashing.

### Build Directions

1. Now, you will need to activate the FIXED ID function.
  1. Turn on the transmitter.
  2. Make sure that the transmitter "Throttle Stick" is all the way down and all other switches are pointed away from you.
    - a. Turn off the transmitter.
2. Connect the 11.1V battery to the quadcopter.
  1. The LED indicator should be flashing orange rapidly.
  2. The receiver's LED will be flashing red rapidly.
  3. The drone should be placed on a flat surface.
3. Turn on the transmitter.
  1. There will be black boxes moving on the edges of the transmitter's screen for about seven to ten seconds.
  2. Do not touch the transmitter or change any settings until the transmitter beeps and the boxes stop moving. The receiver will also display a solid red light from its LED. When this occurs, the binding process has been completed.

## Step 11 - Transmitter/Receiver Binding Guide (Continued)

### User Information

- Once the binding process is completed, then the transmitter must be configured to run with the unique "**FIXID**" code given by the receiver.



Figure 13: The transmitter is ready to set a fixed ID for the receiver.

### Build Directions

- On the transmitter, press **ENT** to open the main options menu, then use the **UP** and **DN** buttons to select the "**MODEL**" option.
  - In the "**MODEL**" menu, scroll down using the **R** button until you reach the "**FIXID**" button, then press **ENT**.
  - At the "**FIXID**" option, press the **R** button until the "**ON**" option is highlighted. Press **DN** to move to the "**CODE**" option.
  - At the "**CODE**", press **ENT** twice to confirm the listed code and move onto the "**RUN**" option.
  - At the "**RUN**" option, press **R** until "**YES**" is highlighted and press **ENT**.
  - Press **EXT** to return to the main menu.

Your transmitter should now be bound to the receiver on the drone. You can now configure the DJI NAZA-M LITE flight controller using the NAZA-M LITE Software Assistant detailed in the following guide.



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## Battery Charging

Written by: Marc Hernandez

### Introduction

This guide will discuss how to use the iMax B6AC charger and how to charge the LiPo 3S 11.1V batteries.

## Step 1 – Safety and Connecting the Battery



Figure 1: Charger and Battery.

### Safety

- Discontinue use of a LiPo battery if it begins to smoke or becomes puffy.
- Never leave your LiPo batteries charging unattended.
- Keep the battery charging/discharging and storage area free from any materials which can catch fire.

### Connecting

The following components are what should be used to charge your LiPo batteries.

- Imax B6AC Dual Power charger
- Banana plug to T9 connector
- And a LiPo battery

## Step 2 – Check Connections

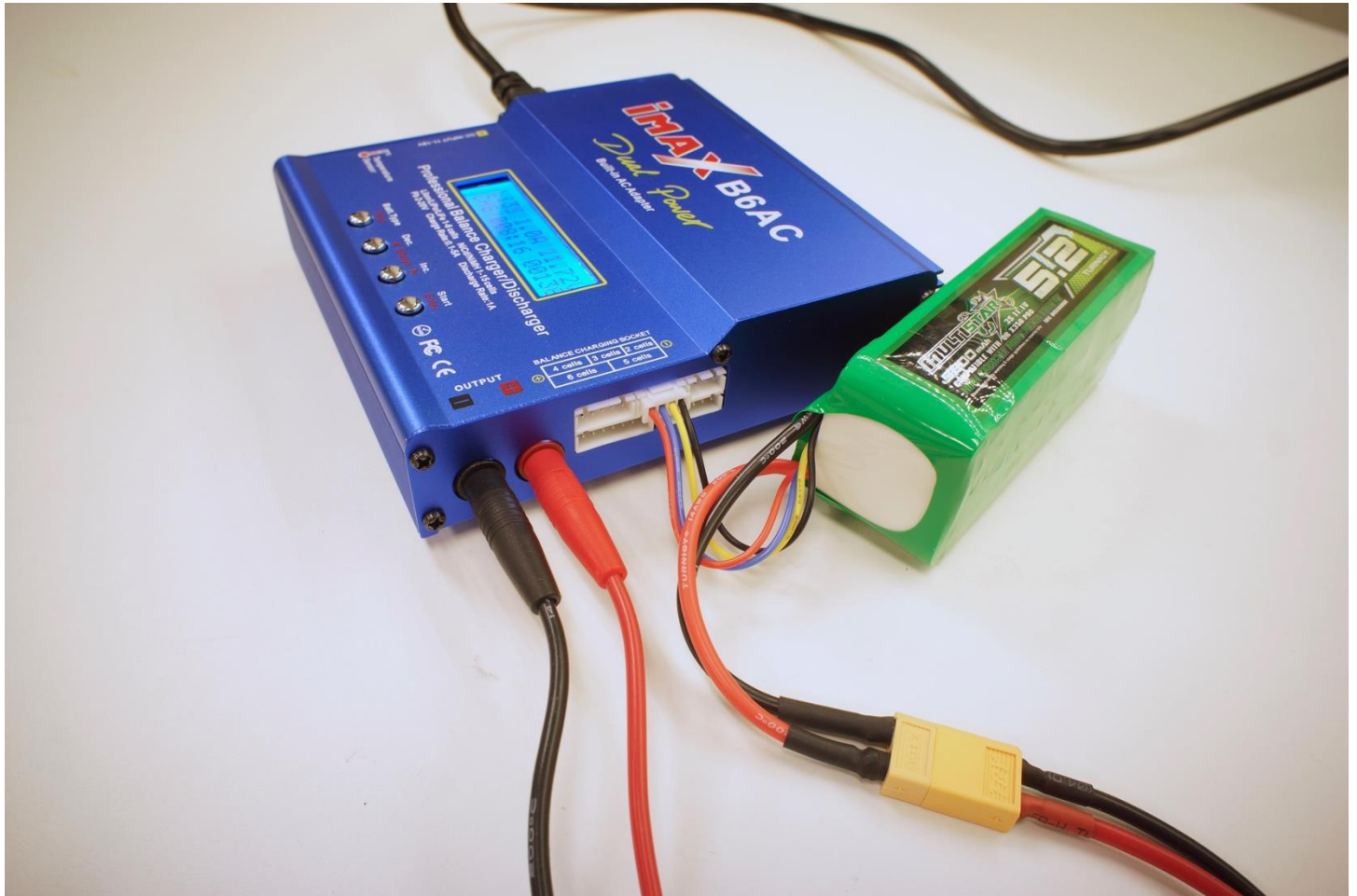


Figure 2: Side view of charger.

### Checking

- Make sure the polarity on the banana plugs are correct and the balance lead (white connector), coming off of the battery pack, is connected to the port on the side of the charger.
- The balance lead is how the charger measures the voltage of the individual battery cells. Measuring the cells voltage assures that they are not overcharged.



## Step 3 – Set Battery Type



Figure 3: Set program select to LiPo Battery.

### Program Select

- Press the Batt. Type/Stop button the select the battery type.
- Use the arrow buttons to till the LiPo BATT option appears.
- Press Start/Enter to select.

## Step 4 – Charging, Discharging and Storage Options



Figure 4: Charging and discharging options.

### Charging, Discharging and Storage

After selecting the battery type, next use the arrows to select the type of charging or discharging to be performed. A brief description of each option is provided below.

**Charge:** Used for charging without the balance lead.

**Balance:** This mode uses the built-in processor to monitor voltage of individual cells and control the current fed into them to equalize the voltage.

**Fast Charge:** Uses a specific CV process to end the charging earlier, but results in a smaller charging capacity than normal.

**Storage:** This mode is used when storing batteries for more than two days. The voltage levels are charged or discharged to a level of 3.85V for LiPo batteries.

**Discharge:** Although offered, it is not recommended to discharge LiPo batteries. Doing so could result in permanent damage of the battery.

The remainder of the guide will use the Balance option, however all other charging and discharging follow the same steps.

## Step 5 – Begin Charging



Figure 5: LiPo Charge menu.

### Settings

- Press the Start/Enter button to change the charge settings. The 1.0A value, pictured above, sets charge current and 11.1V(S3) sets how big the battery is. The Second input should be set according to the values on the battery pack. For the battery used in this guide, this is set to 11.1V(3S). If using any other battery, look for the correct setting on the label of the battery.
- Press and hold Start/Enter to enter the next menu then press Start/Enter again to begin charging.



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# Federal Aviation Administration Registration

## Guide: Hobby

Written by: Khai Chang

### Introduction

Use this guide to register a hobby aircraft with the FAA.

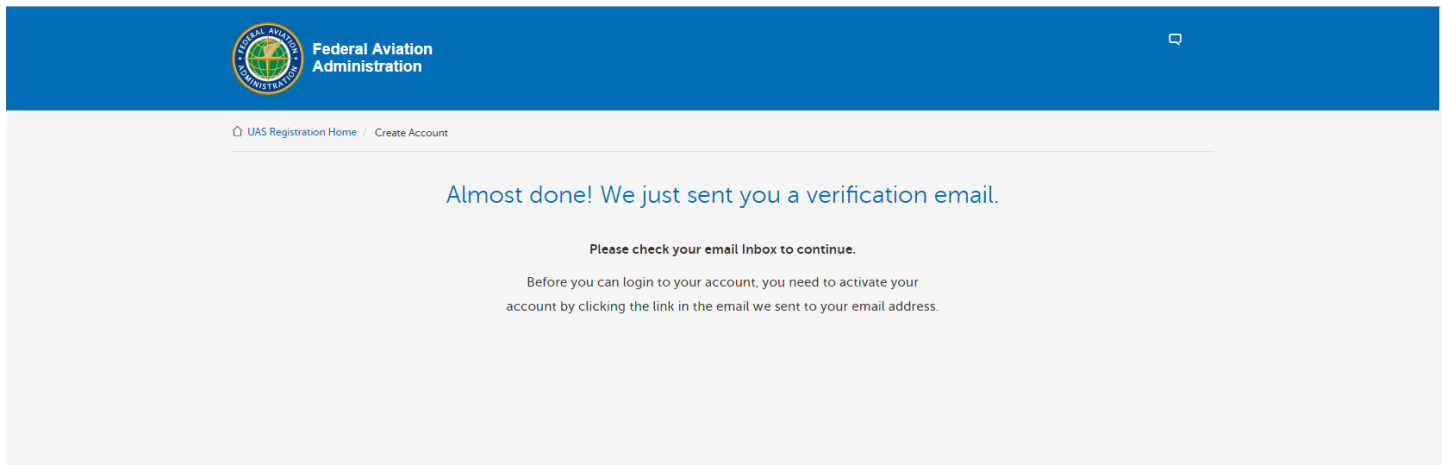
1. Go to <https://registermyuas.faa.gov/> to register Small Unmanned Aircraft System (UAS).
2. On the main page, click "**REGISTER**".



3. Complete the "**EMAIL**" and "**PASSWORD**" sections to create a FAA account.

4. Password must be 8 characters in length and contain one uppercase letter, one lowercase letter, one number, and one special character (!, @, #, \$, %, ^, &, \*).
5. Click "**Create Account**" at the bottom to confirm email and password.
6. Check email address and click on the link to activate account.

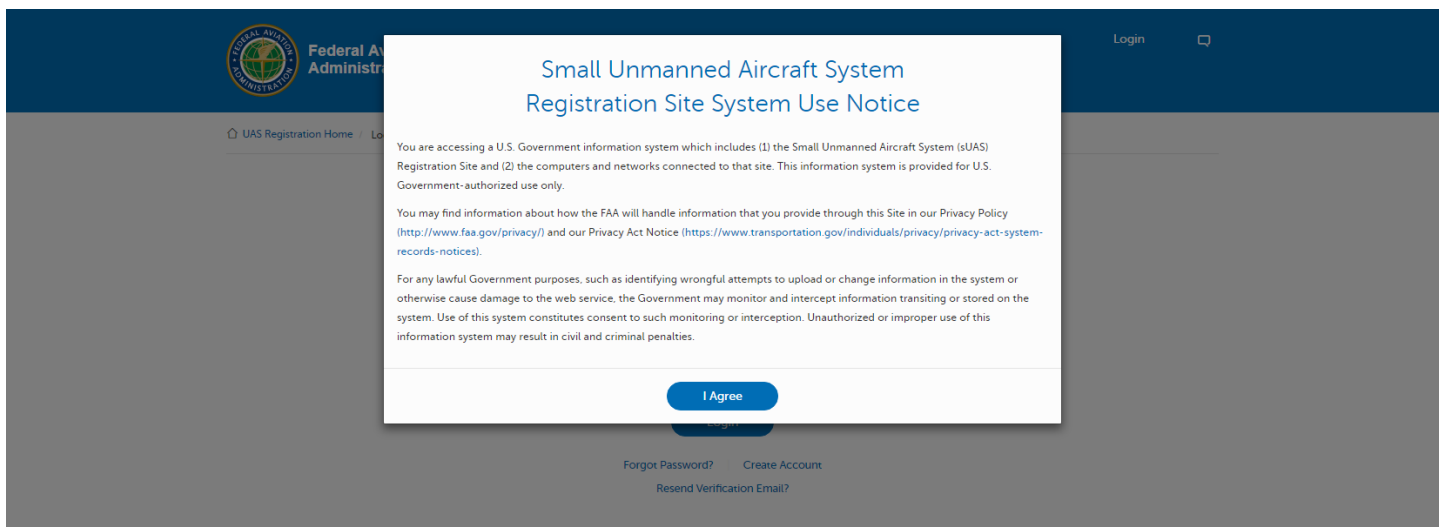




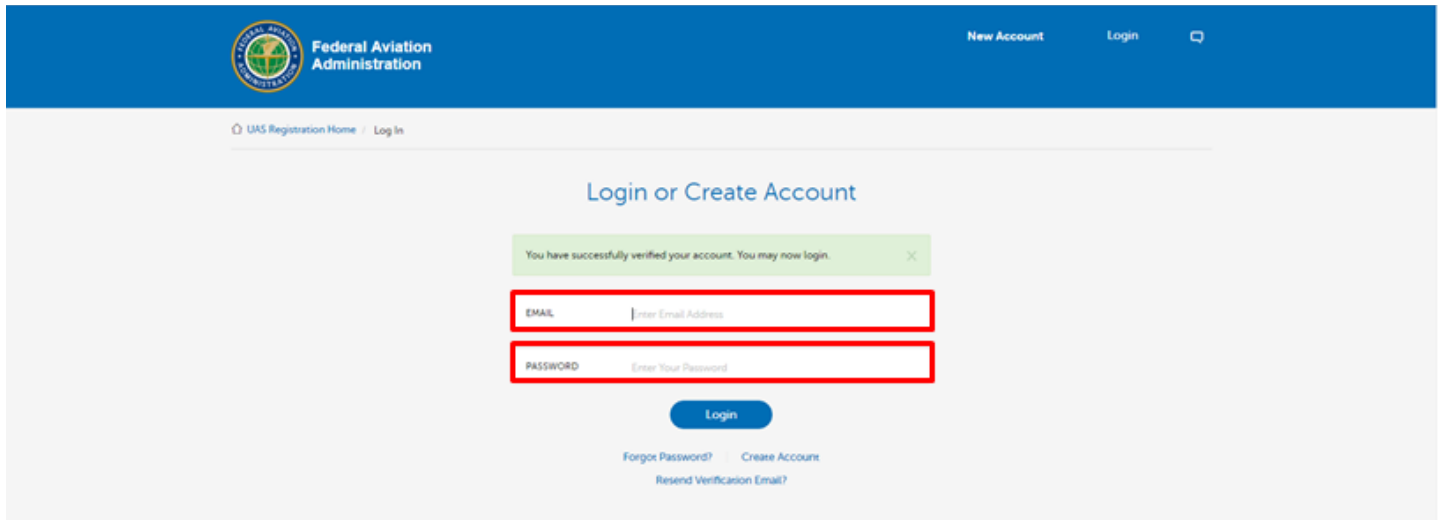
7. After clicking on the link in the email, it will prompt a Registration Site System Use Notice.

This notice explains user access to the U.S. government information system which includes the small UAS registration site, and the computers and networks connected to that site. Use of system constitutes consent to monitoring or interception. Unauthorized use or improper use of system may result in civil or criminal penalties.

8. Click “**I Agree**” to continue with registration.



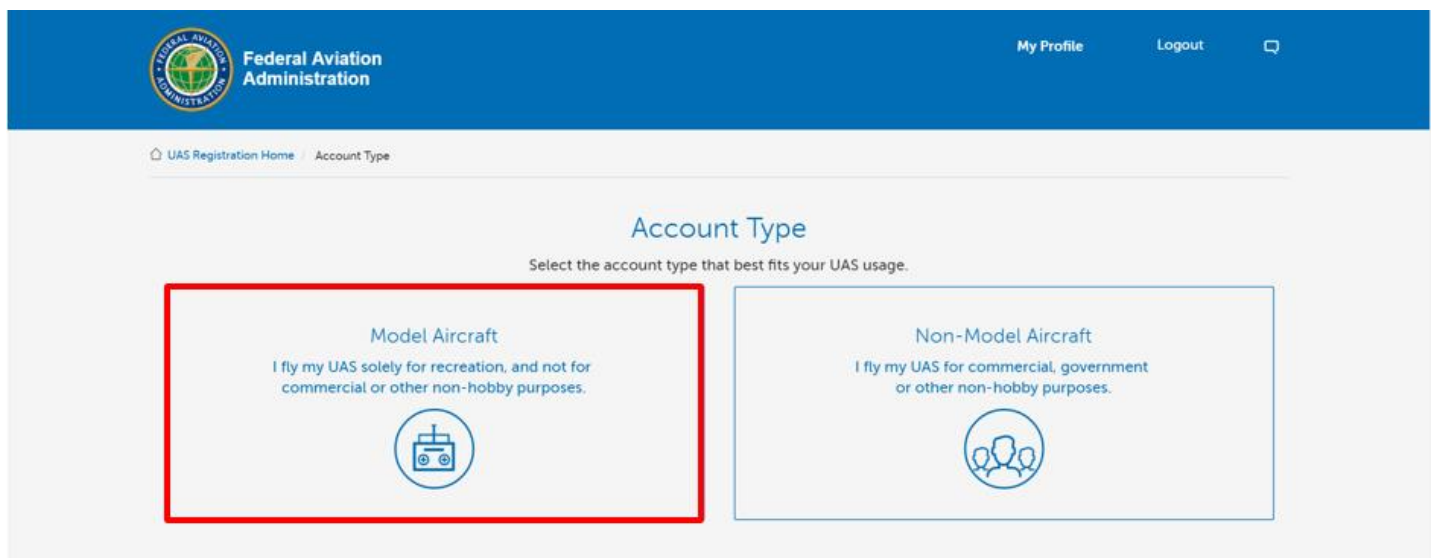
9. Log in using email and password.



10. Select account type based on UAS usage. It is recommended to select Model Aircraft if flying for recreational use only.

**Model Aircraft:** Fly UAS solely for recreation, and not for commercial or other non-hobby purposes.

**Non-Model Aircraft:** Fly UAS for commercial, government or other non-hobby purposes.



11. Complete profile by submitting personal information, physical address, and mailing address.

12. Click **"Proceed to Checkout"** at the bottom to submit information.

13. Check the box at the bottom after reading over the safety guidance of operating UAS.

14. Click **"Next"** to proceed to payment.

15. Complete **Credit Card Info** and **Billing Address** section to complete \$5 payment.

16. Click "**Next**" to review payment before confirming.
17. If order is correct, check the box at the bottom to accept terms.
18. Click "**Pay**" to make \$5 payment.
19. After payment, check email address to receive UAS registration receipt.
20. The assigned UAS Certificate Number should now be available on FAA account.
21. Print the physical copy of the Certificate of Registration and carry it at all times before operating small UAS.
22. Using either a label maker or tape, label registration number on small UAS before flying.
23. Keep in mind that registration number is only valid for 3 years prior to date registered. So please make sure to renew every 3 years.



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# Federal Aviation Administration Registration Guide: Non-Hobby Purpose

Written by: Khai Chang

## Introduction

Use this guide to register a non-recreational model aircraft.

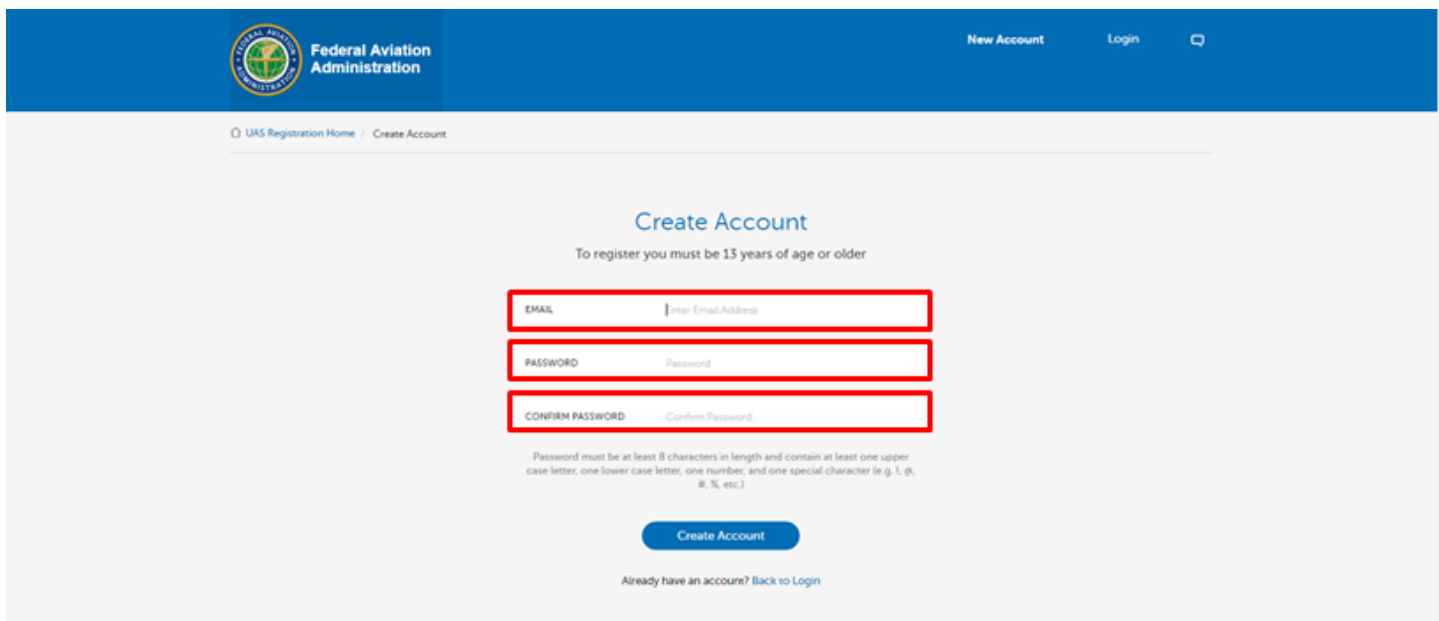


## Federal Aviation Administration (FAA) Registration Guide: Non-Model Aircraft

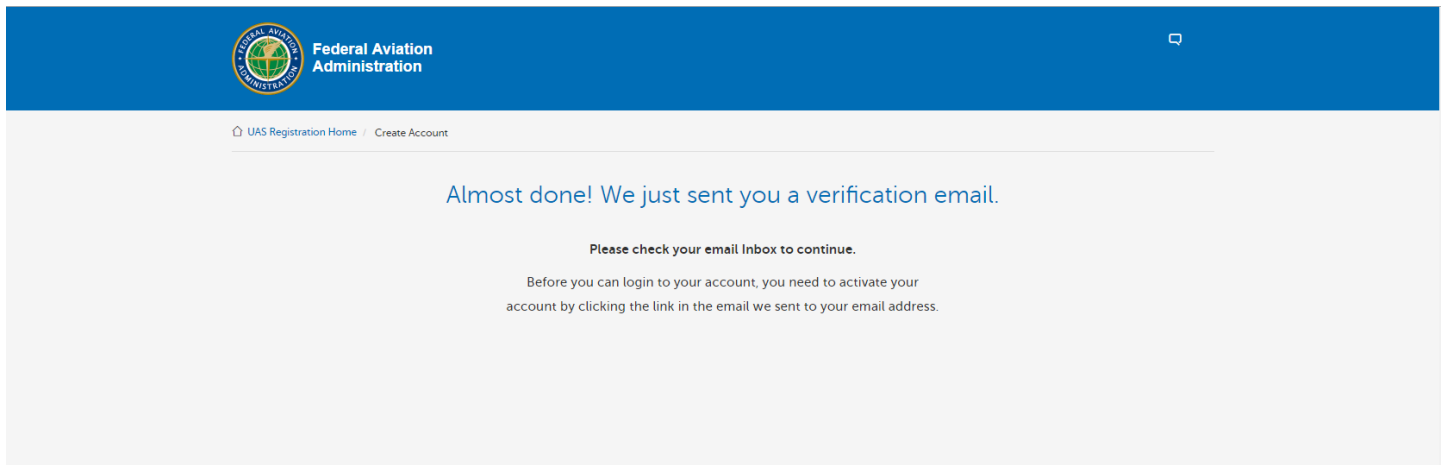
1. Go to <https://registermyuas.faa.gov/> to register Small Unmanned Aircraft System (UAS).
2. On the main page, click "**REGISTER**".



3. Complete the "**EMAIL**" and "**PASSWORD**" sections to create a FAA account.



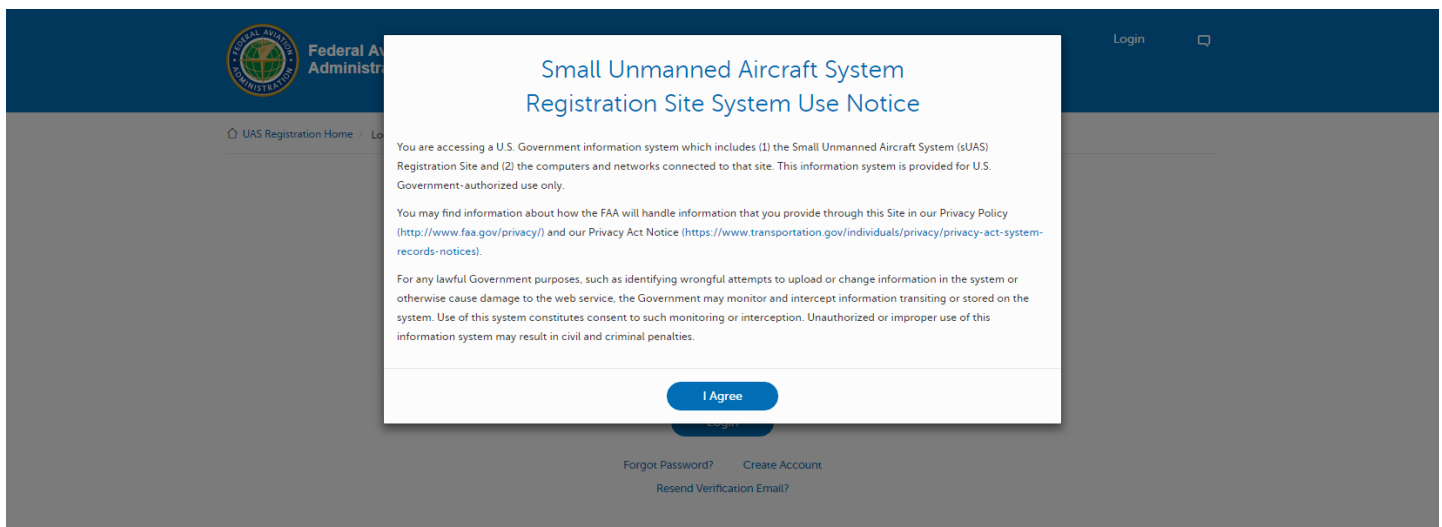
4. Password must be 8 characters in length and contain one uppercase letter, one lowercase letter, one number, and one special character (!, @, #, \$, %, ^, &, \*).
5. Click "**Create Account**" at the bottom to confirm email and password.
6. Check email address and click on the link to activate account.



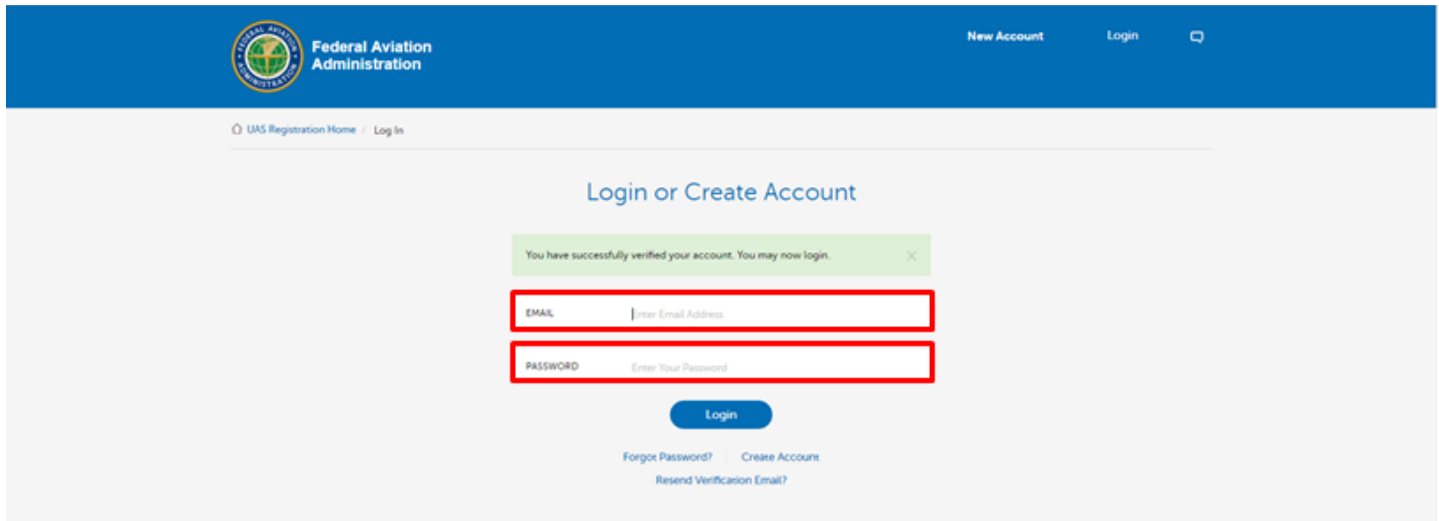
7. After clicking on the link in the email, it will prompt a Registration Site System Use Notice.

This notice explains user access to the U.S. government information system which includes the small UAS registration site, and the computers and networks connected to that site. Use of system constitutes consent to monitoring or interception. Unauthorized use or improper use of system may result in civil or criminal penalties.

8. Click "I Agree" to continue with registration.



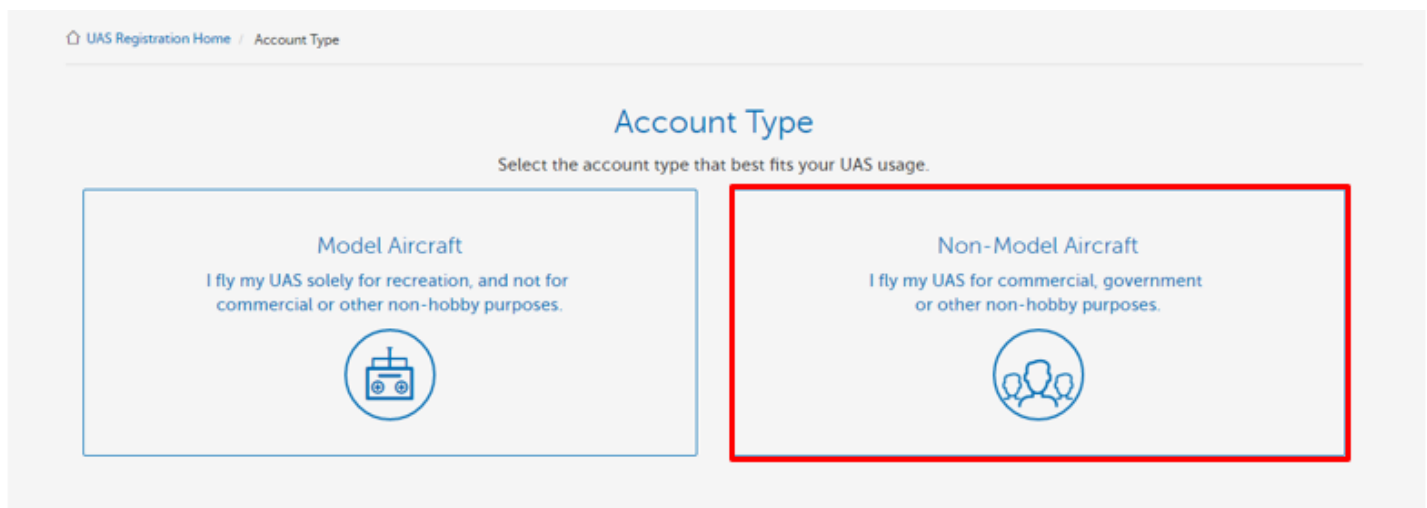
9. Log in using email and password.



10. Select account type based on UAS usage. It is recommended to select Non-Model Aircraft if flying for research, commercial, government, or other non-hobby purposes.

**Model Aircraft:** Fly UAS solely for recreation, and not for commercial or other non-hobby purposes.

**Non-Model Aircraft:** Fly UAS for commercial, government or other non-hobby purposes.



11. Complete profile by submitting personal information, organization information, physical address, and mailing address.

[UAS Registration Home](#) / [Account Type](#) / [Organization Profile](#)\$0.00

PROFILE

INVENTORY

## Organization Profile

To save your profile, click the **Save** button at the bottom of the page.

FIRST NAME	Enter First Name (Required) First name is required.	MIDDLE	Enter Middle Initial
LAST NAME	Enter Last Name (Required) Last name is required.	SUFFIX	Enter Suffix
TITLE	Enter Title	ALT EMAIL	Enter Alternate Email
PHONE	Enter Phone	PHONE EXT	Enter Phone Ext

### Organization Information

ORGANIZATION NAME	Enter Organization Name OR Enter first and last name if organization name does not exist (Required) Organization name is required. Enter first and last name if organization name does not exist.
DBA	Enter Doing Business As

### Physical Address

#### MARK YOUR AIRCRAFT!

- When you register, you will receive a unique registration number valid for 3 years. After 3 years, you must renew your aircraft registration.
- You must mark each aircraft with the assigned unique registration number before it is operated.

12. Click **"Proceed to Checkout"** at the bottom to submit information.

13. In the Inventory section, click **"Add UAS"** to identify UAS being used for the organization.

14. Complete the UAS information in the form and click **"Add"** include UAS to Shopping Cart.

**Note:** There is a \$5 fee for every UAS added to shopping

15. Click “**Checkout**” to proceed.

16. Check the box at the bottom after reading over the safety guidance of operating UAS.

17. Click “**Next**” to proceed to payment.

18. Complete **Credit Card Info** and **Billing Address** section to complete \$5 payment.

19. Click “**Next**” to review payment before confirming.



20. If order is correct, check the box at the bottom to accept terms.
21. Click "**Pay**" to make \$5 payment.
22. After payment, check email address to receive UAS registration receipt.
23. The assigned UAS Certificate Number should now be available on FAA account.
24. Print the physical copy of the Certificate of Registration and carry it at all times before operating small UAS.
25. Using either a label maker or tape, label registration number on small UAS before flying.
26. Keep in mind that registration number is only valid for 3 years prior to date registered. So please make sure to renew every 3 years.



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# Federal Aviation Administration Part 107 Certification

Written by: Khai Chang

## Introduction

Use this guide to learn more about FAA Part 107 rule and flying for commercial or government. If current objective is to fly for recreation or as a hobby, refer to the Registration Guide for Hobby.

## FAA PART 107 REGULATIONS

The FAA stands for the Federal Aviation Administration. They are a federal agency and part of the division of the Department of Transportation. The FAA is responsible for the regulations and oversight of civil aviation. This also includes the any operations and developments of the National Airspace System.

The following list of regulations are the most commonly known for flying, but are not limited to the ones below. More information can be found in the hyperlinks below.

<https://3dr.com/faa/study-guides/uas-regulations/>

[https://www.faa.gov/news/fact\\_sheets/news\\_story.cfm?newsId=20516](https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20516)

In addition, download and install FAA's B4UFLY app to determine where it is okay to fly.

### Regulations:

- FAA Part 107 applies to every civilian unmanned aircraft system that weights under 55 pounds.
- Small UAS must be registered and clearly tagged with their identification number. See the Registration Guide for Non-Hobby Purpose.
- Pilot must be 16 years old or greater to operate small UAS.
- Pilot must be able to read, write, and speak English.
- Pilot must be physically and mentally fit for operation.
- Flight operations must be conducted outside of an airport's 5-mile radius. If flying within 5 miles of an airport, pilot must notify Air Traffic Control tower with prior notice of the operation.
- Maximum altitude cannot exceed 400 feet above ground level.
- Aircraft must always be in visual line-of-sight.
- Aircraft may not operate over any persons.
- Flight operations can only be conducted from sunrise to sunset.
- Manned aircraft always have the right-of-way.
- Dropping objects from unmanned aircraft is permitted as long as object does not pose threat to safety or property on the ground.

## OVERVIEW

FAA Part 107 rules specifies that if pilot is operating small Unmanned Aerial System for commercial or government use, pilot must be licensed under FAA Part 107. Similar to obtaining a driver's license, pilot must take a remote pilot certificate exam at a certified FAA testing location. By taking the 2-hour exam, it will test the pilot's knowledge in five different categories: Regulations, Airspace, Weather Data and Theory, Loading and Performance, and Operations. Categories are not evenly distributed in the test and may ask pilot to refer to different figures in the testing supplement. For example, questions regarding Regulations and Airspace may only cover 30 percent of the test while Operations covers 40 percent. In order to pass the exam, pilot must score 70 percent or higher.

After passing the exam, the test report is handed to pilot with instructions on how to obtain an official certification card from FAA. As part of the requirements, pilots must submit their exam identification number to the specified website on the form to be reviewed before mailing certification card. Process will take up to 5-10 business days before review is approved. During that period, a temporary airman certificate can be printed as proof of certification.

In the event that a pilot does not pass the exam, pilot must wait 14 days before attempting to retake the exam. For situations such as this, the proctor will provide what sections were marked incorrect and that requires more reviewing before the next test.

## HOW TO REGISTER

The first step to becoming a certified pilot is to register for the exam at a testing facility. Of course, it is not required to register immediately, but this guide will cover the steps to registering when pilot is ready.

1. Locate nearest testing facility in the area using the website provided.  
<https://3dr.com/faa/drone-test-centers/>
2. Call to confirm if exam is offered. Request to take Part 107 test.
3. Show up with acceptable form of identification. (Driver's License or State ID)

## WHAT TO EXPECT

Exam is conducted through computer and consist of multiple choice questions. Pilots will be given 2 hours to complete. Throughout the questions, applicants can advance forward and backward to allow users to skip questions or change answers. Applicant can also flag questions to come back it later. Once exam is completed, applicants will be able to know immediately whether they did or did not pass. In addition, the computer will also prompt which questions were missed to allow pilots to know what they lack.

1. Test will be taken on a computer.
2. Pencil and paper are available for scratch work.
3. Personal electronic devices will be locked away for duration of test.
4. Airman Knowledge Testing Supplement book is provided and contains images, figures, and legends relating to the exam.

## LEARN MORE ABOUT PART 107

To learn more about FAA Part 107 regulations and how to prepare for its test, visit the hyperlinks below. However, resources are not limited to the hyperlink and more can be found online.

<b>3DR Website</b>	<a href="https://3dr.com/faa/">https://3dr.com/faa/</a>
<b>Remote Pilot 101 Website</b>	<a href="https://remotepilot101.com/">https://remotepilot101.com/</a>

<b><a href="#">Official FAA Part 107 Study Guide (Copy and Paste to Web Browser)</a></b>	
<a href="https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/remote_pilot_study_guide.pdf">https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/remote_pilot_study_guide.pdf</a>	

<b>Understanding Airspace</b>	<a href="https://www.youtube.com/watch?v=tX2_G9jzeuc&amp;app=desktop">https://www.youtube.com/watch?v=tX2_G9jzeuc&amp;app=desktop</a>
<b>Understanding Chart Symbols</b>	<a href="https://www.youtube.com/watch?v=uc9oG8OApYs&amp;app=desktop">https://www.youtube.com/watch?v=uc9oG8OApYs&amp;app=desktop</a>

<b>Part 107 Knowledge Test</b>	<a href="https://www.youtube.com/watch?v=JxLOWxjX-68&amp;app=desktop">https://www.youtube.com/watch?v=JxLOWxjX-68&amp;app=desktop</a>
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<b>FAA's Guide to Becoming a Pilot</b>	
<a href="https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot/">https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot/</a>	

<b>Integrated Airman Certification and Rating Application (IACRA) Website</b>	
<a href="https://iacra.faa.gov/IACRA/Default.aspx">https://iacra.faa.gov/IACRA/Default.aspx</a>	

<b>sUAS Registration Service</b>	<a href="https://registermyuas.faa.gov/">https://registermyuas.faa.gov/</a>
<b>B4FLY Smartphone App</b>	<a href="https://www.faa.gov/uas/where_to_fly/b4ufly/">https://www.faa.gov/uas/where_to_fly/b4ufly/</a>