# RangePro® RPX8-P

## *User Manual (For Pixhawk/Ardupilot Flight Controlled Systems)*

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**Trademark Statement**

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**Warranty Information**

For warranty information, go to Appendix B, "Warranty" on page 94.

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# About this Guide

This guide describes unpacking and readying for flight the TerraView RangePro® RPX8-P multi-rotor unmanned aircraft system (UAS).

## Audience

This guide is intended for operators and technicians who have experience in operating and/or servicing drone aircraft.

## Structure

This guide contains the following chapters and appendices:

- describes using the Ultimate Duo 400W Charger with a RangePro RPX8-P RP6S24KHDx battery pack

For best results, read the contents of this guide *before* you operate the UAS.

## Precautions

Warnings, cautions, and notes, which have the following meanings, are used throughout this guide to help you become aware of potential problems. *Warnings* relate to personal injury issues, and *Cautions* refer to potential property damage.

**Note**  Highlights a helpful tip to help the user work more efficiently.

**IMPORTANT**  The alert symbol and IMPORTANT heading calls attention to important information.

**CAUTION**  The shock hazard symbol and CAUTION heading indicate a potential electric shock hazard. Strictly follow the instructions to avoid property damage caused by electric shock.

**CAUTION**  The alert symbol and CAUTION heading indicate a potential hazard. Strictly follow the instructions to avoid property damage.

**WARNING**  **The alert symbol and WARNING heading indicate a potential safety hazard. Strictly follow the warning instructions to avoid personal injury.**

## Conventions/Terminology

**CSC**: Control Stick Combination.  There are multiple control stick combinations used to initiate certain aircraft behaviors including calibrate, arm, disarm.

**GCS**: Ground Control Station. The transmitter and the tablet as a combined system.

**GCU** Ground Control Unit. The transmitter.

**HUD**: Heads Up Display.

**Payload**: Any gimbal and/or sensor attachment connected to the RangePro RPX8-P.

**RTH/RTL**: Return to Home/Return to Launch.

**Transmitter**: The controller that the pilot holds while flying the RangePro RPX8-P.

**UAS**: Unmanned Aircraft System. Includes the UAV and all ground units for control and communication.

**UAV**: Unmanned Aerial Vehicle (AKA a drone).

## Reference Documents

Where applicable, this document references other documents that provide detailed notes on how to operate specific pieces of equipment included with the RangePro RPX8-P, safety regulations, and other information that will ensure your flight operations are safe and your RangePro RPX8-P is well maintained.

Prior to flight operations be sure to familiarize yourself with this document and all the information in the reference documents noted below. If you have lost or cannot find a particular document referenced below, an electronic copy may be found on the **www.terraview.com** support page.

- *TerraView Flight Safety Manual*
- *SkyRC LiPoPal Instruction Manual*
- *Using the D400 Charger with RangePro RP6S24KHDx Battery*
- *Lithium Battery Shipping Notice or Appendix O,* "Shipping Lithium Polymer Batteries" on page 130

## Other Documentation

### Hitec

- Hitec SUI Controller Handbook
- Hitec SUI Controller Pairing Supplement

### Airborne Innovations

- Picoradio Manual
- Picoraptor Manual

### Microhard

- Pmddl2450 Manual

### Industry Standards

- Open Standards for Drone Hardware: **https://pixhawk.org**
- Open Source Autopilot System: **https://ardupilot.org**
- QGroundControl: **https://docs.qgroundcontrol.com/master/en/index.html**
- Mission Planner: **https://ardupilot.org/planner/**

# Chapter 1    General Information

## Chapter Contents

## RangePro RPX8 Overview

The RangePro RPX8 (see figure 1) is a small, lightweight, multi-rotor unmanned aircraft system (UAS) proudly engineered, designed, and assembled in the USA. The RangePro RPX8 is unique in its class and is an extremely cost-effective solution.



Figure 1. RangePro RPX8-P UAV

With an ultra-strong carbon fiber body, lightweight design, and efficient motor and propeller pairings, the RangePro RPX8 is capable of flight times in excess of 70 minutes. The quad-arm coaxial motor octocopter design provides redundancy that permits safe flight operations to continue with as many as four damaged or inoperative motors.

The RangePro RPX8 is capable of taking off and landing manually or autonomously while supporting a wide range of payloads. Highly portable and adaptable, a complete system can be transported easily and can be operated by only one person.

The RangePro RPX8 is available with a number of flight control systems, including A3 and Lightbridge 2 electronics, or a Pixhawk Blue Cube solution with a variety of ground control stations.

This document provides details on how to maintain and safely operate a RangePro RPX8-P with Pixhawk flight control systems.

### Understanding Pixhawk and Ardupilot Open Source Autopilot Systems

The Pixhawk and Ardupilot open standards software support a wide range of aircraft configurations and have hundreds of parameters accessible to control flight characteristics, performance, and control of on-board sensors and systems. Experienced RangePro users are able to tweak their aircraft configurations to meet individual operational requirements and preferences.

**WARNING** **Changing parameters can result in erratic and dangerous flight of the RangePro RPX8-P. Many parameters are co-dependent on other parameters, so to avoid the risk of personal injury and/or potential damage to the RangePro RPX8-P, only knowledgeable, experienced users should make adjustments.**

TerraView recommends that before flying, users should connect to their aircraft and download the aircraft-specific parameter file for safekeeping (see section "Downloading Parameter Files" on page 81). This file will have the default parameter settings for the aircraft configuration as well as any aircraft specific parameter modifications such as calibration values for the on-board voltage sensors.

If any parameters have been adjusted from their factory default settings and your RangePro RPX8-P is not performing as expected, TerraView recommends reloading the factory-set parameter file for that specific aircraft and make any new modifications from that baseline (see section "Uploading Parameter Files" on page 81).

**CAUTION** Aircraft configurations are tuned for a specific load. Flying with a lighter load may cause the aircraft to become unstable. Always fly with the minimum load installed.

For example, aircraft tuned to fly with a specific gimbal and payload should not be flown without a gimbal and payload installed, as there is risk that autopilot corrections will be overly aggressive, causing the unit to go into oscillation, resulting in the pilot losing control of the aircraft.

Now that you have an overview of RangePro RPX8-P capabilities, continue to Chapter 2, "What's in the Case?" on page 20.

# Chapter 2 **What's in the Case?**

## *Chapter Contents*

## Introduction

**Note**   To make it easier to move the RangePro RPX8-P case, the extension handle (see figure 2) can be extended by pulling on the handle while sliding the release button. Stop sliding the button after the handle is at the desired length.



Figure 2. Case extension handle and release button

Inspect the case for damage. Open the case and verify that all equipment is secure and nothing was damaged during shipping or transport.

Table 1 on page 22 describes RangePro RPX8-P case contents. Figure 3 on page 22 shows the typical locations of equipment in the case. Your specific case arrangement may vary based on the specific model purchased.

Table 1. RangePro RPX8-P case contents

| Callout | Description | Callout | Description | Callout | Description |
|---------|-------------|---------|-------------|---------|-------------|
| **1** | RangePro RPX8-P Drone | **6** | GCU Antennas | **11** | Breakout Cable Set |
| **2** | GCU Charger | **7** | Ground Control Unit (GCU) | **12** | Temporary Battery Storage Areas (remove the battery before shipping the case) |
| **3** | Battery Charging Cable | **8** | Tablet Storage Area | **13** | Bubble Level |
| **4** | Battery Tester | **9** | Safety Manual | **14** | Spare propellers (1 set of top propellers and 1 set of bottom propellers) and screws |
| **5** | Charger Power Cable | **10** | Drone Antennas | **15** | RangePro RPX8-P Landing Gear |



Figure 3. RangePro RPX8-P equipment locations

## Where is the Battery and Battery Charger?

The RangePro RPX8-P battery and battery charger are typically shipped separately. Be sure to save the shipping material that comes with the battery and charger, because the materials can be reused for future shipments. See Appendix O, "Shipping Lithium Polymer Batteries" on page 130 or the *TerraView Lithium Battery Shipping Notice* for additional details.

⚠️
**IMPORTANT**
Federal regulations prohibit the shipping of large Lithium based batteries with other equipment. Regulations may change so, regardless of whether you are shipping by air or by ground, be sure to check with your carrier before packing and labeling batteries for shipment.

## Spares and Replacements

Your RangePro RPX8-P comes with 1 set of top propellers and 1 set of bottom propellers. In the event of a crash, inspect your RangePro RPX8-P for damage, including small cracks in the propellers and in the arms.

⚠️
**IMPORTANT**
If there is _**any**_ damage to the RangePro RPX8-P, do not fly the drone until it has been repaired.

If a propeller is damaged, it can be replaced with a spare propeller from the RangePro RPX8-P case (see section "Replacing a Pair of Propellers" on page 88).

Now that you have verified that all UAS components and the battery were delivered, continue to Chapter 3, "Register Your Drone" on page 24.

# Chapter 3   Register Your Drone

## Chapter Contents

## Introduction

In the US, current FAA regulations require registration of all drones that weigh in excess of 9 ounces (250 grams). The RangePro RPX8-P with a battery and no payload weighs approximately 10 pounds (4.4 kilograms) and is therefore subject to registration requirements. To register your drone, visit the FAA website at **https://faadronezone.faa.gov**.

> ⚠️ **IMPORTANT**
>
> If you are a commercial operator of the RangePro RPX8-P in the US, review the FAA Part 107 requirements and comply with all local and federal regulations.
>
> If you are an operator outside of the US, contact your local authorities to ensure compliance with local laws and regulations.

## Label Your Drone According to FAA Regulations

Comply with the current regulation for labeling your drone. In the US, refer to **https://faadronezone.faa.gov**.

Now that you have registered and labeled the UAV, continue to Chapter 4, "Cautions and Warnings" on page 26.

# Chapter 4  Cautions and Warnings

## Chapter Contents

## Introduction

The RangePro RPX8-P is a sophisticated UAV. Flying it can be dangerous. Review and heed all warnings.

For best results, review section "Reference Documents" on page 16 of this manual *__before__* using the UAV.

| | |
|---|---|
| ⚠️ **WARNING** | **To avoid the risk personal injury, DO NOT fly the RangePro RPX8-P above or near large crowds.** |

In addition, heed the following cautions and warnings when operating or servicing the drone.

## Motors and Propellers

The motors and rotating propellers of the aircraft can cause serious injury to yourself and others. Obey the following cautions and warnings for your safety and the safety of others:

| | |
|---|---|
| ⚠️ **WARNING** | **To avoid the risk personal injury, be aware of the sharp edges of the propellers during pre-flight setup or when replacing the propellers. Wear gloves or take other protective measures when touching the propellers.**<br><br>**Stay away from rotating propellers and motors.**<br><br>**Keep foreign objects away from rotating motors and propellers.**<br><br>**Power off the aircraft before touching the propellers.**<br><br>**Burn risk: Motors may be hot after a flight. Do not touch or handle the motors until they have cooled down after a flight.** |

| | |
|---|---|
| ⚠️ **CAUTION** | To avoid damaging the RangePro RPX8-P:<br><br>• **DO NOT** attempt to modify the structure of the motors.<br>• **DO NOT** stop the motors in mid-flight.<br>• **DO NOT** use aged, chipped or broken propellers.<br>• **DO NOT** turn the motors on when propellers are mounted and there are other people or animals in the immediate vicinity.<br>• **Verify** that the motors are securely mounted and rotating smoothly.<br>• **Verify** that the propellers and frame arms are properly positioned for flight.<br>• **Verify** that the propellers are in good condition and securely tightened and mounted to prevent them from falling off the motors.<br>• **Verify** there is nothing obstructing the motors before activating them. |

## The Aircraft

**CAUTION**

To avoid damaging the RangePro RPX8-P:

- **DO NOT** fly the RangePro RPX8-P if any battery cell is below 3.2V. Full charge on the battery should be 4.3V per cell, or 25.8V total.

- **DO NOT** use RangePro RPX8-P parts (i.e. batteries, flight controller, etc.) for anything other than their intended purpose.

- **Verify** that any attached gimbal mount or payload is properly locked into position and secured before flight.

- **Verify** that there are no foreign objects (such as water, oil, soil, sand, etc.) inside of the aircraft fuselage or its components.

- **Verify** that there is sufficient room around the UAV (TerraView recommends a 30-foot or 9-meter radius around the aircraft) for takeoff and landing.

- **Only** use RangePro RPX8-P replacement parts when servicing the UAV.

- **Perform** regular maintenance on your aircraft and its components (see Chapter 11, "Maintenance" on page 87) to ensure that everything is working properly.

## During a Flight

**WARNING**

**To avoid the risk of personal injury and/or property damage, land immediately if severe drifting occurs (i.e. if the aircraft does NOT fly in straight lines) or if the aircraft does not properly respond to flight commands.**

**CAUTION**

To avoid damaging the RangePro RPX8-P, before using the UAV, consult a weather service for local weather conditions. Avoid flying the drone if:

- Wind speeds may exceed 25 mph (40 kph)

- Precipitation is present.

- Temperatures are below 14 °F or above 104 °F (below -10 °C or above 40 °C).

Comply with local regulations for piloting a small UAV.

## Shipping Lithium Polymer Batteries

**IMPORTANT**

Federal regulations prohibit the shipping of large Lithium based batteries with other equipment. Regulations may change, so regardless of whether you are shipping by air or by ground, be sure to check with your carrier before packing and labeling batteries for shipment.

See Appendix O, "Shipping Lithium Polymer Batteries" on page 130 or the *TerraView Lithium Battery Shipping Notice* for additional details

Now that you have read and understood the cautions and warnings, continue to Chapter 5, "Assemble Range-Pro RPX8-P for Flight" on page 29.

# Chapter 5 Assemble RangePro RPX8-P for Flight

## Chapter Contents

## Introduction

Refer to the following sections to assemble the UAV for flight:

- Parts of the Aircraft

- Aircraft Assembly (see page page 33)

- Battery Installation (see page 43)

- Payload Installation (see page 48)

## Parts of the Aircraft

The top view of the aircraft is shown in figure 4 on page 31. The following are called out in the figure:

- Front LED (White)

- Rear LED (Green)

- Accessory Platform

- Propeller Mount Screws

- Propeller Blade Screws

- GPS Antenna (Raised)

The bottom view of the aircraft is shown in figure 5 on page 32. The following are called out in the figure:

- Radio Antenna SMA Connectors

- Payload GPS Antenna SMA Connector (one SMA only—not to be confused with the two radio antenna SMA connectors)

- Payload Mounting Points

- Gimbal Plate

- Gimbal Plate Mounting Standoffs

- HDMI Video Connection (if so equipped)

- Breakout Board Ports:

  - Power Out

  - Serial Out

  - Ethernet Out

  - I2C Out

  - SBus Out, not to be confused with SBus In.

  - PWM Out ports 1–6

The rear view of the aircraft is shown in figure 6 on page 33. The following are called out in the figure:

- GPS Antenna (Raised)
- USB Access Port
- Radio Antennas



Figure 4. Top view

Gimbal Plate Mounting
Standoffs (Qty: 4)

Payload GPS Antenna
SMA Connector

Breakout Board (Located
Under Gimbal Plate)

PWM Out Ports 1–6

SBus Out

I2C Out

Ethernet Out

Serial Out

Power Out

HDMI Video
Connection

Radio Antenna
SMA Connector

Gimbal Plate

Payload Mounting
Points (Qty: 4)

Radio Antenna
SMA Connector

Radio Antenna
SMA Connector
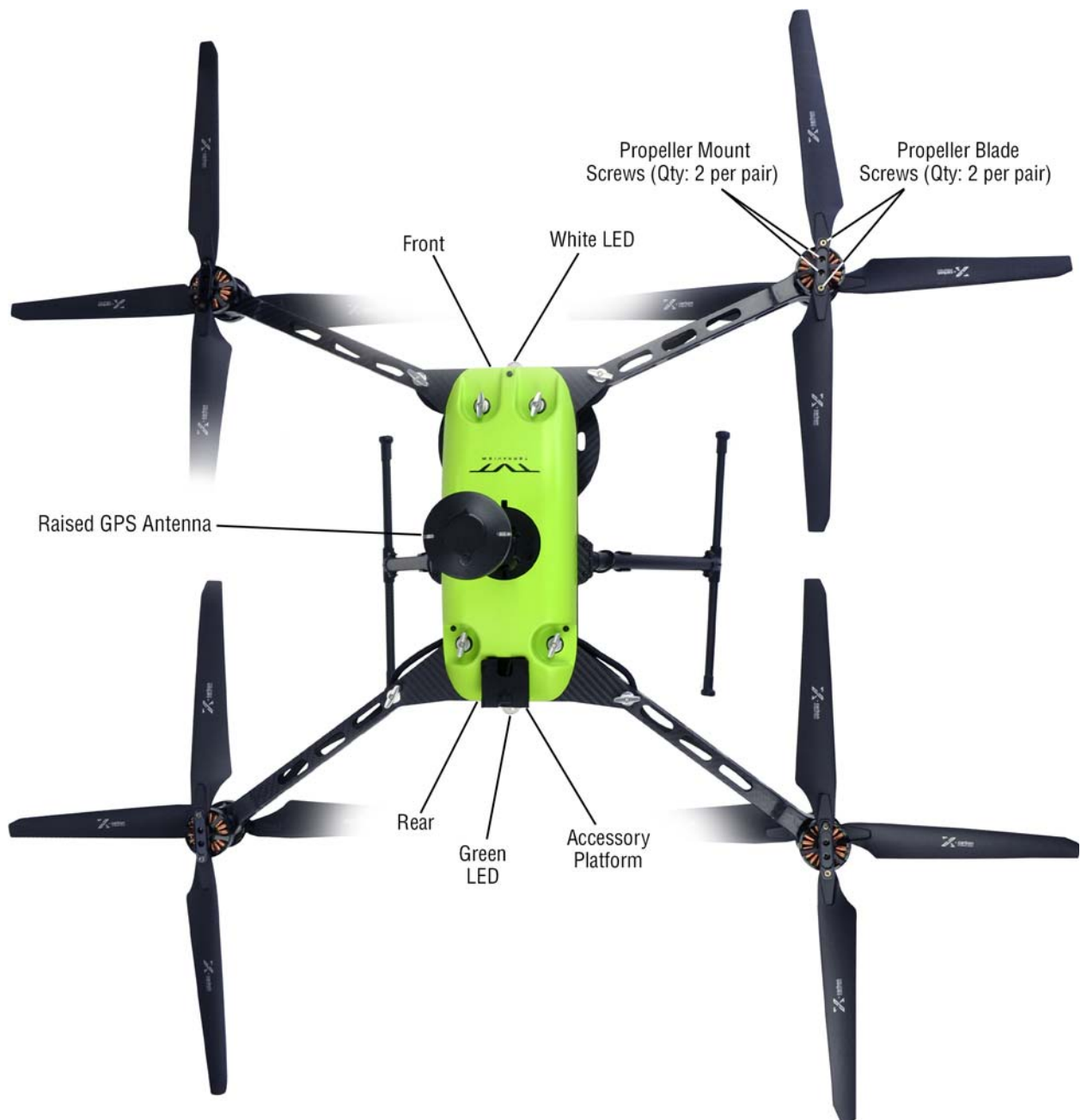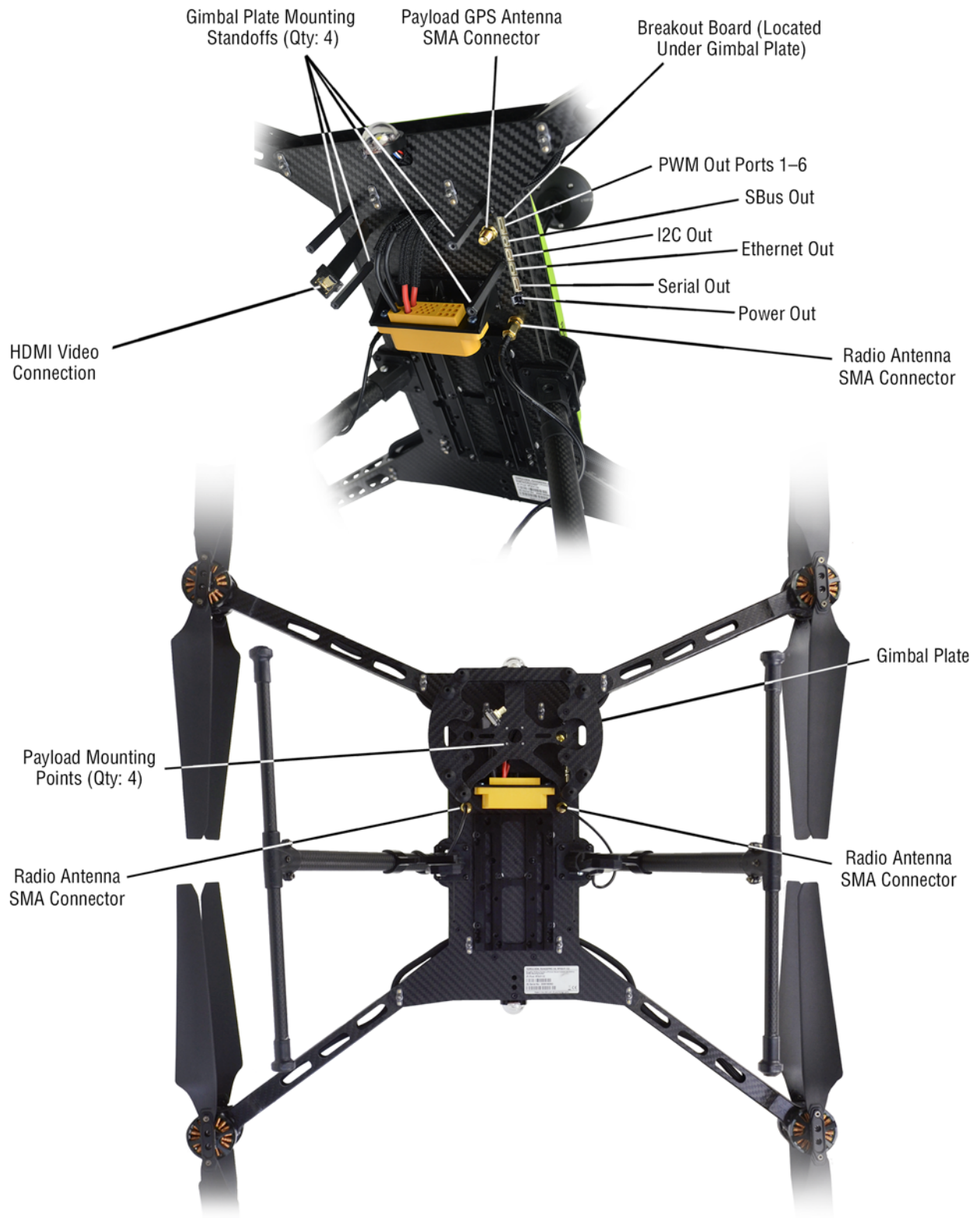
Figure 5. Bottom view

Figure 6. Rear view

## Aircraft Assembly

Do the following to assemble the UAV:

1. Remove landing legs from the case (see ) and set them aside.

Figure 7. Removing landing leg from case

> ⚠ **CAUTION**
>
> Until the landing legs have been installed, if you must place the UAV on a flat sturdy surface, do so carefully to avoid damaging the propellers.

Figure 8. Removing RangePro RPX8-P drone from case

2.  While gripping the RangePro RPX8-P firmly as shown in figure 8, carefully lift it from the case.

3.  Install a landing leg by first positioning it as shown in figure 9 on page 36.

Figure 9. Installing a landing leg

4.  Insert the landing leg into a socket on the airframe (see figure 10) by pressing the pin so the leg can enter the socket. Then fully insert the landing leg into the socket until the pin engages the hole (you may need to turn the leg in the socket until the pin aligns with the hole).
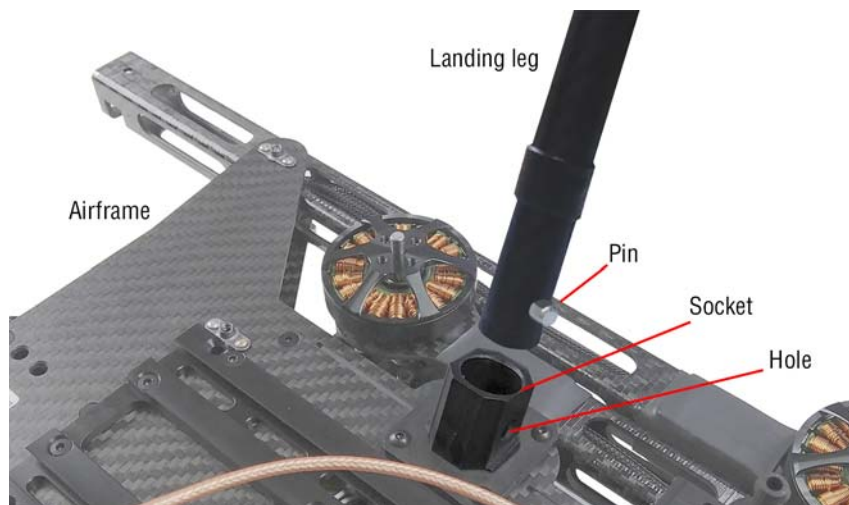


Figure 10. Installing a landing leg (close-up)

5.  Repeat steps 3 and 4 to install the remaining landing leg into the other socket.

6.  On the underside of the aircraft, connect a radio antenna cable connector to one of the two radio antenna SMA connectors located near the battery power connector as shown in figure 11 on page 37).

> ⚠️ **IMPORTANT**   Install both antennas. Installing only one will lead to reduced performance and may even cause the radio system to fail permanently.

**Note**   If alternate antennas are used they **must** use 50-ohm cable terminated with standard SMA connectors (**not** RP-SMA).
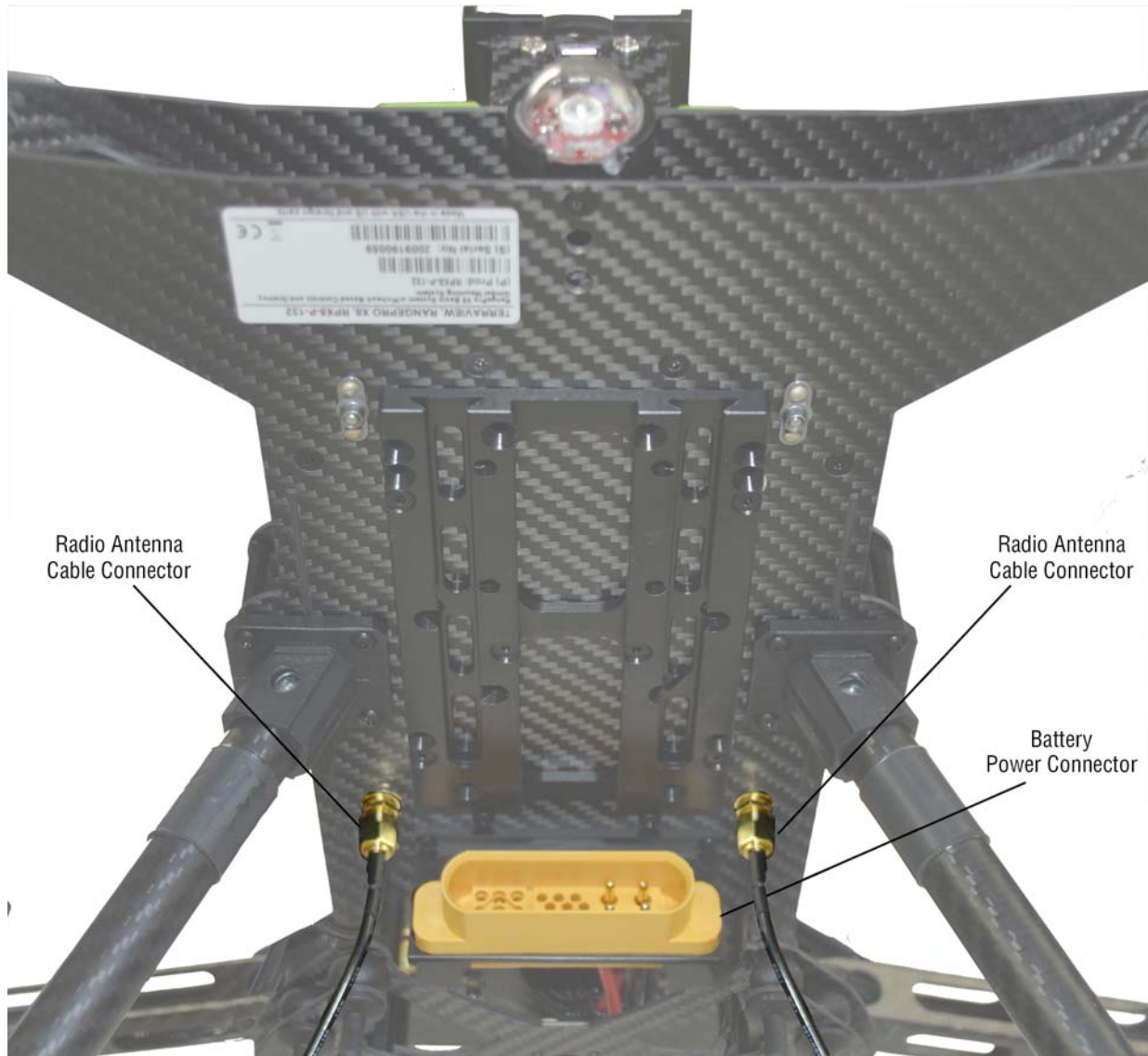


Figure 11. Installing the antenna cables

7.   Attach the antenna clip onto a landing leg as shown in figure 12 on page 38.

Figure 12. Attaching antenna clips onto landing legs

8.   Install the second antenna cable onto the remaining radio antenna SMA connector (shown in figure 11 on page 37).

9.   Attach the remaining antenna clip onto the other landing leg (see figure 12).

10. Stand the drone on its legs on a sturdy flat surface as shown in figure 13.



Figure 13. RangePro RPX8-P standing on landing legs

11. Rotate the GPS antenna mast to the upright position, then tighten the locking nut at the base of the antenna mast (see figure 14 on page 40).

Figure 14. Raising the GPS antenna

12. Now you are ready to unfold the arms. Turn the props out of the way, then loosen the 4 wing fasteners about 1/4 turn as shown in figure 15 on page 41.

Figure 15. Loosening wing fasteners

13. Unfold the rear arms, being careful not to damage the propellers (see figure 16).

Figure 16. Rear arms unfolded

14. Lift arm pins (see figure 17) and continue to rotate arms into position (see figure 18). Make sure the arm pin clears the arm flange and inserts into the arm. Wiggle arm slightly when the pin is seated into the threads, making sure the arms are locked in position.



Figure 17. Lifting arm pins

Figure 18. All arms unfolded

15. Once an arm is in position, lower the arm pin into place and lightly tighten. Repeat this process for the remaining arms.

16. Once aircraft arms are correctly positioned, tighten the arm and pivot pins securely by hand.

The drone is assembled. Continue to section "Battery Installation".

## Battery Installation

Installing the battery consists of the following:

• Testing the battery charge and cell health

• Installing the battery into the airframe (see page 46)

### *Testing the Battery*
Check the battery charge and cell health of battery sides B1 and B2 as follows:

1. Remove the battery tester (see figure 19) from the case.
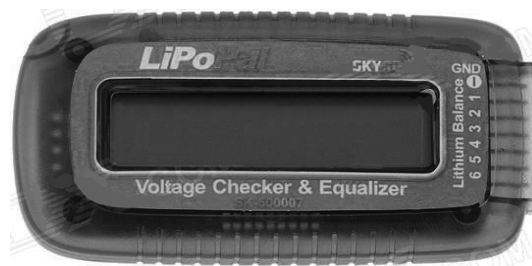
Figure 19. Battery tester

2.  Remove the battery tester cable (see figure 20) from the case.



Figure 20. Battery tester cable

3.  Connect the battery tester cable to the battery.

4.  Plug connector B1 into the battery tester as shown in figure 21 on page 45 (position the connector so the black wire goes in the topmost pin of the battery tester connector as shown in figure 22 on page 45).

5.  Verify that all battery cells are at least 4.2 V.

6.  Disconnect B1 from the battery tester when finished.
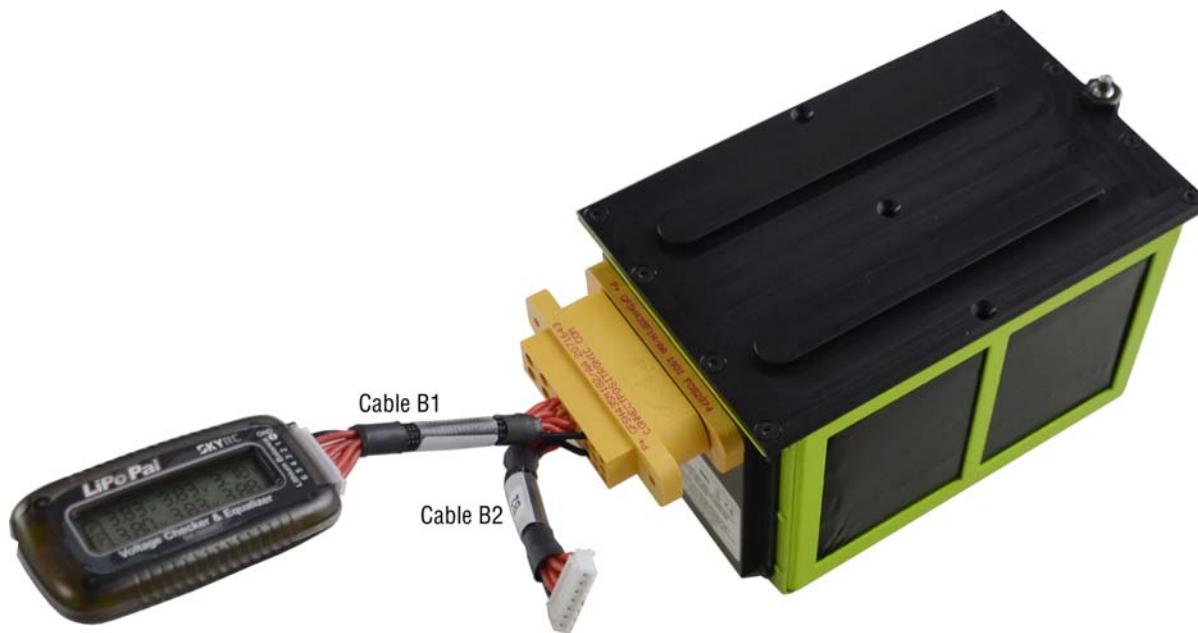
Figure 21. Battery tester connected to battery



Figure 22. Cable B1 connector black wire

> **DO NOT** fly the RangePro RPX8-P if the variation between cells exceeds 0.1 volts. Balance charging the battery typically results in all cells being within 0.03 volts of each other. If the variation between cells exceeds 0.1 volts this may be an indicator of a failing battery.
>
> **DO NOT** attempt to fly the RangePro RPX8-P if the total battery voltage is below 19.2 volts (3.2 volts per cell).
>
> If the battery voltage is too low, or is reporting variation between cells in excess of 0.1 volts, refer to section "Charging the Battery" on page 84 to charge the battery.

7.  Repeat steps 3 through 6 to plug connector B2 into the battery tester, and verify that all battery cells are at least 4.2 V.

> ⚠️ **IMPORTANT**
>
> **DO NOT** disconnect the battery tester cable from the battery by pulling on the cable wires. Instead, grasp the connector as shown in figure 23.

8.   Disconnect the battery tester cable from the battery.
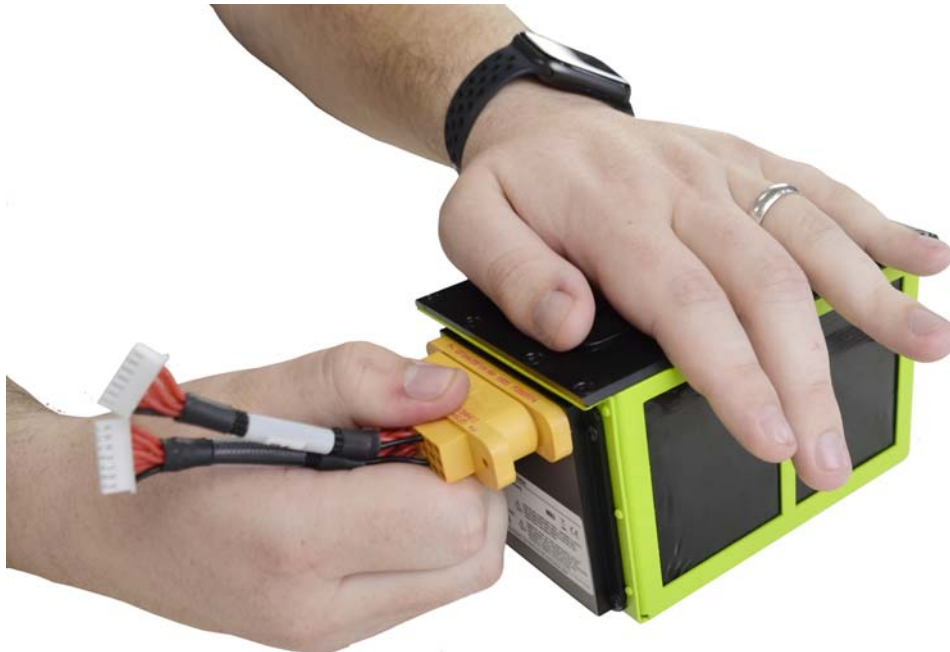


Figure 23. Disconnecting battery tester cable

### *Installing the Battery*

Install the battery as follows:

1.   While pulling down the battery locking pin (see figure 24 on page 47), slide the battery into the rails located under the fuselage. When the locking pin is just past the airframe edge, release the locking pin.

Figure 24. Installing the battery into the airframe rails

2.  Continue inserting the battery into the rails until the spring-loaded pin engages the battery transport mode hole (see figure 25).
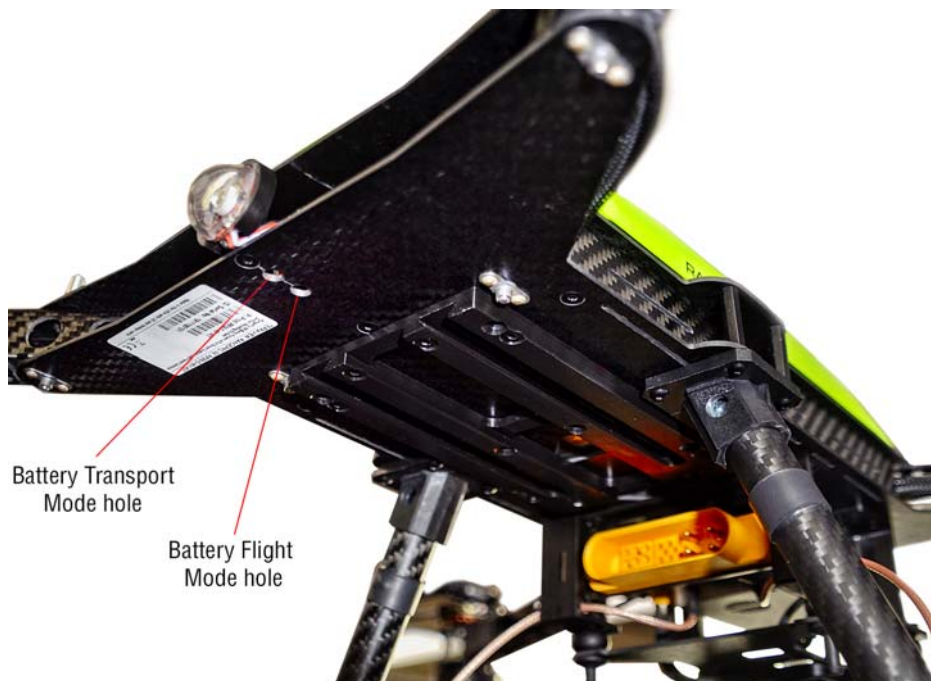


Figure 25. Battery transport mode hole and battery flight mode hole

Battery installation is complete. Continue to section "Payload Installation" on page 48.

## Payload Installation

> **Note**    There are a wide range of payloads available from third party suppliers. For
> additional support details, contact **https://terraview.com/contact/**.

If you are installing a payload other than a Pixy U or Pixy F, install it using payload specific instructions. Otherwise, do the following to install a Pixy gimbal:

1.  Detach the gimbal plate (see figure 26) from the aircraft by removing M2 hex head screws from the 4
    mounting points (see figure 26).



Figure 26. Removing the gimbal plate from the aircraft

2.  Using the 4 mounting screws provided with your gimbal, attach the gimbal ring to the gimbal plate as shown in figure 27.
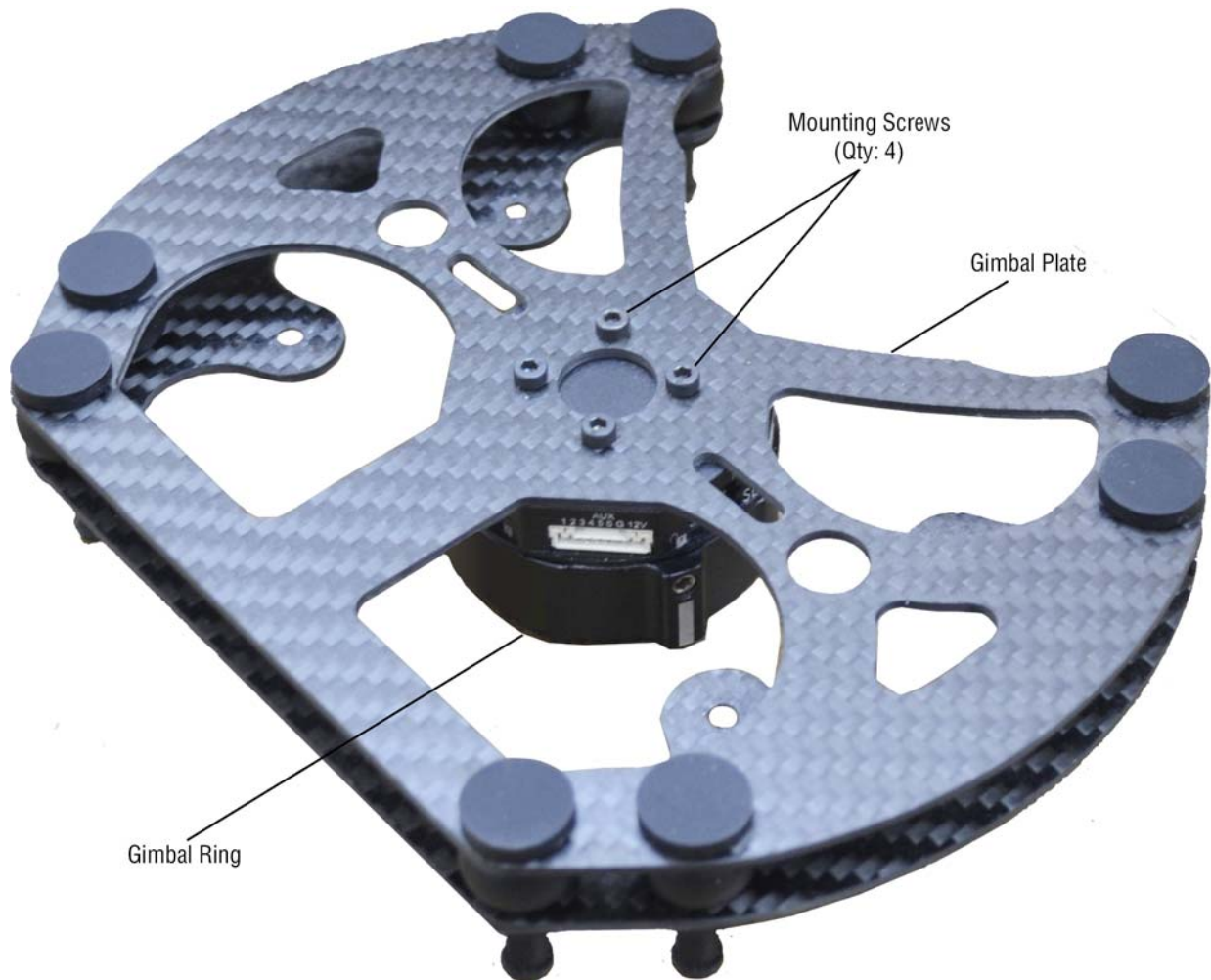


Figure 27. Installing gimbal ring onto gimbal plate

3.  Attach the gimbal plate onto the aircraft by positioning the 4 mounting holes in the plate over the gimbal plate mounting standoffs (see figure 5 on page 32). Then install the screws that were removed in step 1.

Figure 28. Installing gimbal on gimbal ring

4.  Align the white dot on the gimbal with the alignment mark on the gimbal ring (see figure 28), then insert the gimbal into the ring.
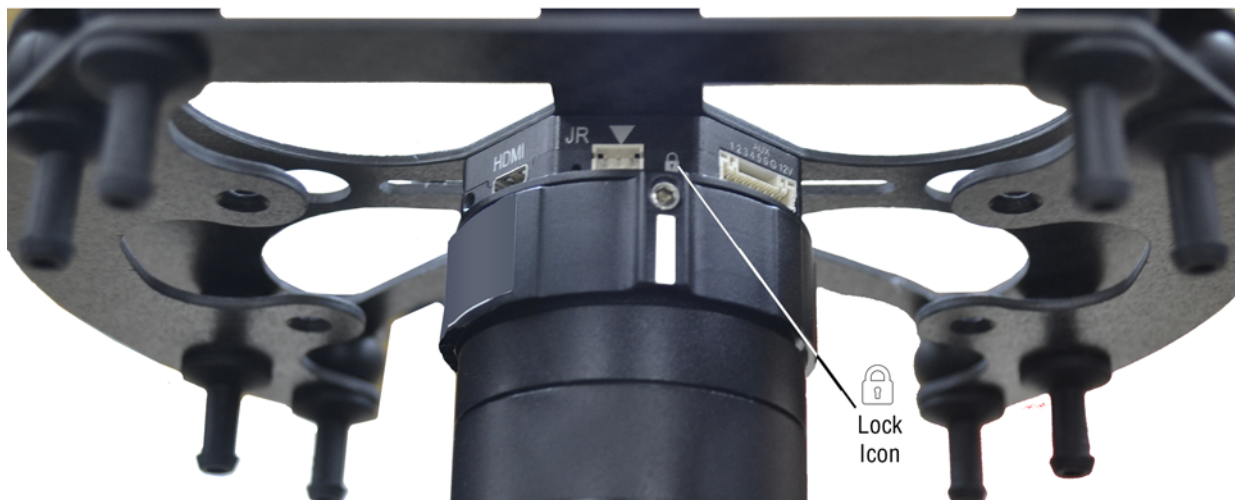


Figure 29. Rotate ring clockwise to locked icon

5.  Rotate the ring clockwise (from right to left) until the alignment mark on the ring is aligned with the locked icon

6.  If the payload, such as the FLIR Duo Pro R, requires input from a passive GPS antenna, connect from the GPS feed-through payload GPS antenna SMA connector (see figure 5 on page 32) to the payload using the provided SMA to right-angle SMA micro cable. It is recommended that the right-angle connector be attached to the camera.

> ⚠️ **CAUTION**  **Do not** over-tighten the GPS SMA connector to the FLIR camera. When over-tightened the SMA connector on the camera may come loose when attempting to remove the extension cable, spin in place, and eventually break the antenna connection internal to the FLIR camera.

The payload is installed. Continue to Chapter 6, "Ground Control Station Setup" on page 52.

# Chapter 6  Ground Control Station Setup

## Chapter Contents

## Introduction

Refer to the following sections to set up a ground control station (GCS) using QGroundControl:

- Herelink Radio System setup

- Standard Ground Control Station (GCS) setup

- Setting Up the GCS (see page 54)

- Mounting the Tablet onto the Tablet Holder (see page 57)

- Connecting the Client Device to WiFi (see page 60)

- Running the QGroundControl Application (see page 61)

- Setting up Video Connections (see page 61)

## Herelink Radio System Setup

The Herelink Radio System Ground Control Station (GCS) includes a tablet integrated into the GCS with QGroundControl preloaded. Typically, there is very little setup required for Herelink units and no requirement for credentials or knowledge of IP addresses. Gain control and frequency are automatic with the Herelink system. For more details on factory defaults and reference materials see Appendix I, "Herelink Controller Settings" on page 114.

Install the ground control station antennas on the GCS.

> **Note**　　The straight antenna goes on the left of the GCS near the scroll wheel and the disc antenna goes on the right nearer the camera trigger button.

⚠ **CAUTION**　　**Never** operate any GCS without antennas installed. Doing so will result in damage to the radio.

Herelink radios are charged using a micro USB power connector. The connector is hidden behind the rubber weather cover at the front of the unit. Carefully pull back the cover from the right hand side. It is attached nearer to the middle of the unit. There is no LED power indicator. Power is indicated on the tablet when it is turned on.

Turn the unit on or off by holding down the power button.

## Standard Ground Control Station Setup

RangePro's Standard Ground Control Station (GCS) consists of the ground control unit (GCU) transmitter and a client device (a tablet or laptop computer, for example). The GCS uses Microhard pmDDL radios for command and control, telemetry and video distribution. The ground radio is embedded in the standard GCS, and the air radio is embedded in an Airborne Innovations Picoradio. Video conversion is accomplished using an Airborne Innovations Picoraptor. IP address configuration and credential management are paramount in ensuring the system works as expected. Documentation for these units can be found on the TerraView support site or from the manufacturer.The combined GCU and client device make up the ground station controller (GCS)

## Setting Up the Ground Control Unit (GCU)

⚠️ **IMPORTANT**  An AC power outlet must be available to charge the ground control unit (GCU).

Verify that the GCU is fully charged as follows:

1.  Remove the GCU (see figure 30) from the case (callout 7 in figure 3 on page 22).



Figure 30. GCU

Figure 31. Installing antennas on the GCU

2.  Install the ground control unit antennas (see callout 6 in figure 3 on page 22 for antennas location) on the GCU as shown in figure 31.

⚠️ **CAUTION**  **Never** operate any GCU without antennas installed. Doing so will result in damage to the radio.

3.  Slide the GCU power button to the ON position (see figure 32). All 4 LEDs of the battery level indicator should be lit, showing that the battery is fully charged (see figure 33).
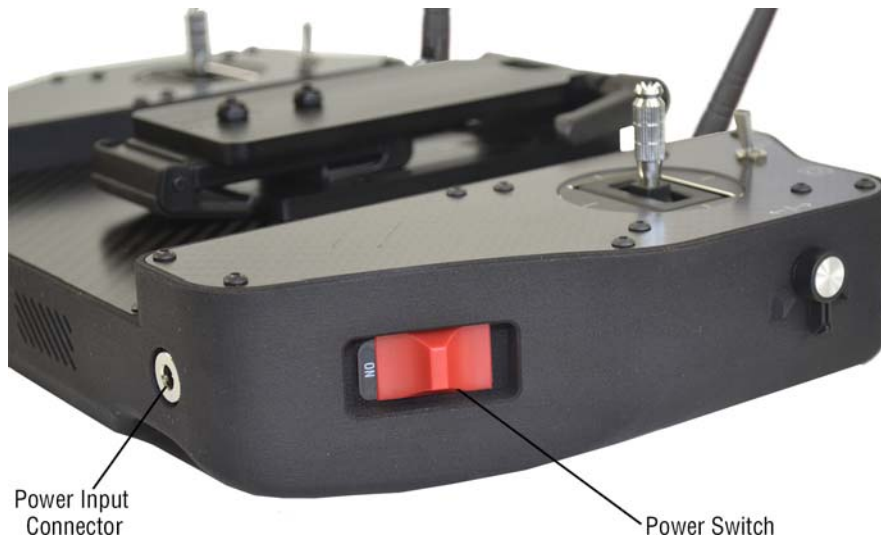


Figure 32. GCU power switch
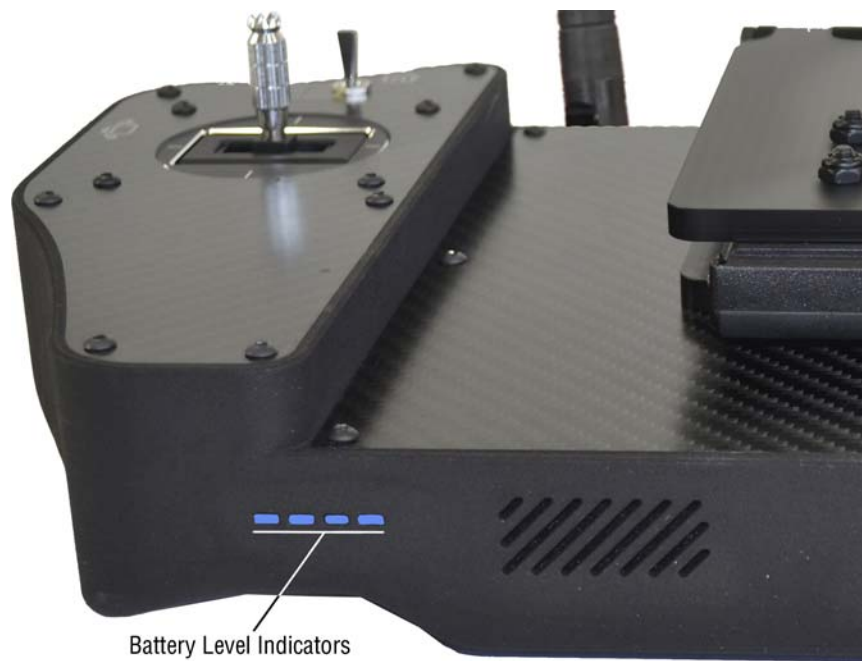


Figure 33. GCU battery level indicators

4.  If the battery is charged, go to step 10 to continue setting up the GCU. Otherwise, go to step 5 to charge the GCU.

Figure 34. GCU charger

5.   Remove the GCU charger (see figure 34) from the case.

6.   Plug the GCU charger cable barrel plug into the GCU power input connector (see figure 32 on page 56).

7.   Connect the GCU charger to an AC power outlet.

8.   When all 4 battery level indicators are lit (see figure 33), disconnect the charger from the GCU.

9.   Store the charger in the case.

10.  Power down the GCU by sliding the switch to the OFF position.

## Mounting the Tablet onto the Tablet Holder

1.   Release the locking lever that secures the tablet holder (see figure 35).



Figure 35. Tablet holder locking lever

2.   Unfold the tablet holder (see figure 36)



Figure 36. Unfolded tablet holder

3.   Grasp and lift the tablet holder clamp, as shown in figure 37 on page 59, until there is space enough to place the tablet inside the table holder.

Figure 37. Lifting the tablet holder clamp

4.  Place the tablet inside the clamp and adjust it to secure the tablet, then release the clamp (see figure 38 on page 60).

Figure 38. Mounting the tablet on the tablet holder

5. Position the tablet for convenient viewing, then tighten the locking lever to secure the tablet holder.

6. Adjust the antennas to the desired positions.

The combined GCU and client device now make up the ground control station (GCS).

## Connecting the Client Device to WiFi

The GCS provides a WiFi connection for a client device. This device can be any WiFi enabled device with a flight control software package such as QGroundControl. Currently only one client can connect at a time. To establish a connection to the GCS, do the following:

1. Power on the GCU.

2. Power on the client device.

3. Open the network settings on the client device and connect to the GCU WiFi:

   - The default network name is "SUI_xxx", where "xxx" is a GCU-specific ID

   - The default network password is "hcs_controller"

4. Set tablet IP on the network as follows:

   – Static IP Address: 192.168.42.246

– Gateway: 192.168.42.1

– Prefix Length: 24 (255.255.255.0)

## Running the QGroundControl Application

Do the following to run the QGroundControl app:

1.  Load the QGroundControl app onto the client device. Versions of the app are available for iOS and Android devices as well as Windows.



Figure 39. QGroundControl app is available at the Apple App Store and Android stores

2.  Start the QGroundControl app.

3.  Continue to section "Setting up Video Connections".

## Setting up Video Connections

1.  Select the  icon in the top left-hand corner of the QGroundControl App.

2.  Select the "General" tab.

3.  Scroll down to the section titled "Video",

4.  Set Video Source to "RTSP Video Stream".

5.  Set Video Source as follows:

    – On Herelink Radio Systems: rtsp://192.168.43.1:8554/fpv_stream

    – On US Radio Systems with a Picoraptor Video Encoder: rtsp://192.168.168.168:8557/PSIA/Streaming/channels/2?videoCodecType=H.264

6.  Set Aspect Ratio to "1.777777".

7.  Scroll down to the section titled "Video Sharing".

8.  If Video streaming is enabled, ensure the URL is set to the same RTSP URL noted above.

Ground control has been set up. Continue to Chapter 7 to learn about emergency procedures you should know before your first flight.

# Chapter 7    Emergency Procedures

## Chapter Contents

## Introduction

Refer to the appropriate sections for instructions on what to do in case of an emergency:

- Propeller loss

- Loss of power

- Loss of GPS (see page 64)

- Loss of command and control link (see page 64)

- Loss of telemetry data link (see page 64)

- Loss of video link (see page 64)

- Fly away (see page 65)

## Propeller Loss

Do the following:

1. If you suspect that you have lost a propeller, slowly and carefully fly the aircraft to a reasonable landing area and land immediately.

2. You may also use the automated RTL function, but keep an eye on the aircraft and make sure it is heading in the correct direction to come back home. If the aircraft starts to deviate from the RTL flight path, initiate the automated RTL sequence again. Repeat this step until the aircraft comes home and lands.

3. If the unit is not able to return to home, manually land in the nearest unpopulated area.

4. If the aircraft loses a propeller and is flying out of control toward a populated area, initiating a full motor stop would be the safer recourse. This feature is not programmed into the ground station by default. If this is an important feature for your flight operations, reference the on-line Ardupilot documentation for details on how to program an RC input channel to initiate an emergency motor stop (RCx_OPTION value =31).

## Loss of Power

Do the following:

1. If power loss occurs, the aircraft will drop from the sky and fall to the ground.

2. Verbally warn others in the operation area immediately.

3. After the aircraft has hit the ground, approach the crash site cautiously.

4. Look for debris as there may be sharp jagged pieces lying about. Also be cautious in case a damaged battery erupts into a fire.

## Loss of GPS

Do the following:

1.  If the GPS signal degrades until it is not working properly, or fails completely, you can still fly the aircraft in Altitude Hold or Stabilize flight modes. The difference between these two modes is that in Altitude Hold mode the aircraft altitude is automatically held using on board sensors Roll, Pitch, and Yaw are all under manual control. It is recommended that new pilots intentionally switch into these modes in a safe environment in order to gain practice and be prepared in case of an emergency.

2.  Bring the aircraft back to the landing area if you are able and land immediately.

3.  If you cannot return to your landing area, then land immediately in the area of GPS loss if the area is suitable and safe for landing.

## Loss of Command and Control Link

Do the following:

1.  If you lose your data link/command and control functionality of the aircraft, then after 3 seconds the aircraft will switch to fail-safe RTL. This will bring the aircraft back to the takeoff location and automatically land.

2.  Ensure the landing area is clear and continue to monitor the aircraft and the surroundings for any dangerous situations that may arise.

## Loss of Telemetry Data Link

Do the following:

1.  If you lose your video and telemetry data link, yet still have control of the aircraft through the GCU, it is possible to continue to fly the aircraft.

2.  In some cases a loss of this link will cause the QGroundControl application to lock up. If this happens it is possible to close the application and reopen it to reestablish the link. However, exercise caution when doing so and ensure that the pilot remains in full control of the aircraft at all times.

3.  If the telemetry link cannot be reestablished immediately return the aircraft to a safe location and land it. Without a telemetry link an operator is not able to monitor power status or receive critical in-flight warnings being issued by the aircraft.

## Loss of Video Link

Do the following:

1.  With a loss of video link you will still have command and control of the aircraft.

2.  You may have flown too far away or have run into signal interference.

3.  Try flying back toward your location to pick up signal again.

4.  You may also try adjusting the antennas so that they are facing the aircraft. If this doesn't work, bring the aircraft back and land immediately using your instruments or by initiating the RTH/RTL function.

## Fly Away

Do the following:

1.  If the aircraft doesn't respond to any pilot inputs and is flying without pilot commands, you may have a fly away situation.

2.  If this occurs note the battery voltage, speed and direction of flight. Based on these factors determine where the aircraft will most likely end up.

3.  Notify local authorities of the incident.

Now that you know what to do in the event of an emergency, continue to continue to Chapter 8, "Flight Ops" on page 66.

# Chapter 8   Flight Ops

## Chapter Contents

## Introduction

Refer to the following sections for information about the phases of flight operations:

- Pre-Flight

- Ground Station Connection (see page 71)

- Takeoff (see page 74)

- In-Flight (see page 75)

- Landing (see page 76)

- Post-Flight (see page 77)

> **IMPORTANT** Emergencies such as the loss of a propeller; loss of power, GPS, video or data links; or a fly away condition can happen while operating the RangePro RPX8-P. Refer to Chapter 7, "Emergency Procedures" on page 62 to learn how to deal with these situations should they occur.

## Pre-Flight

Do the following:

1. Place the RangePro RPX8-P in a clear area absent of debris with direct access to satellites to obtain GPS lock.

2. Unfold propellers so they are fully extended and perpendicular with props below and repeat for each arm (see figure 40).

Figure 40. Positioning propellers for flight

3.  Raise and secure the GPS antenna mast.

4.  Ensure the radio antennas connections are tight and the antennas secured to the legs.

5.  Ensure the payload is properly installed and clear of obstructions.

Figure 41. Proper distance between propeller tips

6.  Verify that the UAV arms are positioned properly by performing a quick check of the propeller tips. Make sure there is about 1.5 inches (3.8 cm) between front and rear arms' propeller tips, and 3.5 inches (8.9 cm) between left and right arms' tips as shown in figure 41.

7.  Check all propellers to verify the mounting flanges are secure to the motors and that the tension on the individual props is fairly tight.

8.  Check the arm pivot pin and arm mount thumb screws for tightness.

> **CAUTION**
> To avoid damaging the RangePro RPX8-P, **verify** that there is sufficient clear space (no loose debris on the ground) around the UAV (TerraView recommends a 30-foot or 9-meter radius around the aircraft, as shown in figure 42 on page 70) for takeoff and landing.
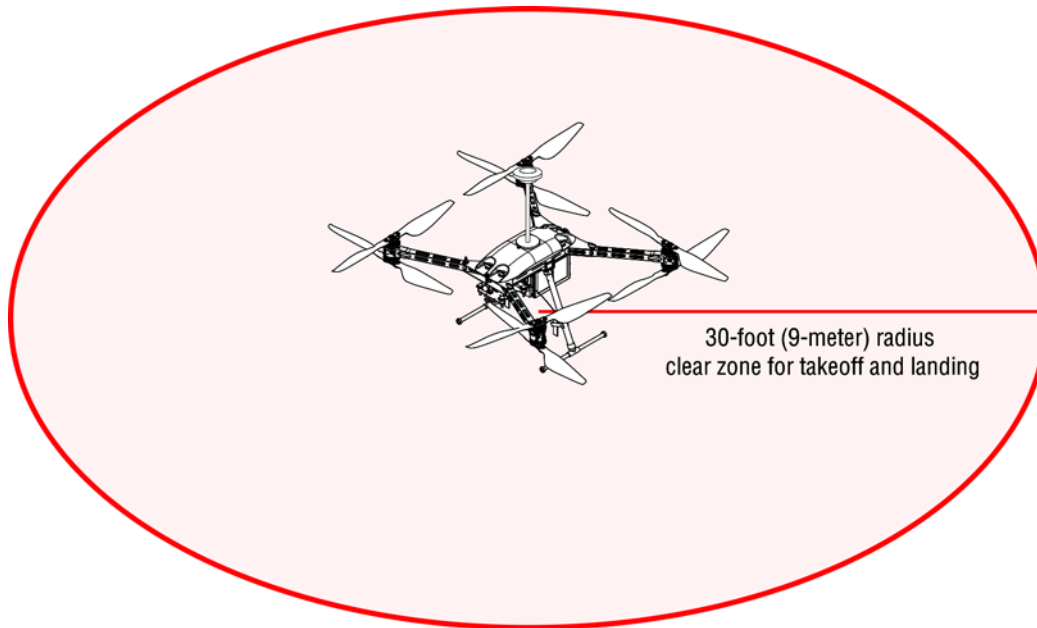
Figure 42. Clear zone around UAV

9. Power on the Ground Control Station, verifying that it is fully charged.

10. Turn on the tablet.

11. Open the QGroundControl app.

12. With the transmitter on, it's now time to turn on the RangePro RPX8-P. While pulling down the battery locking pin, press the battery into the rails far enough that the battery pin clears the battery transport mode hole (see figure 25 on page 47). When that happens, release the pin. Continue pressing the battery until the locking pin engages the battery flight mode hole, at which point the RangePro X8 will activate and power up. The RangePro UAV will emit a series of beeps as part of the startup process:

   – First sequence: Three rising beeps indicating power has been applied.

   – Second sequence: Series of "diddley" beeps indicating unit has booted.

   – Third sequence: Two falling beeps indicating no radio connection.

   – Fourth sequence: Two rising beeps indicating radio connection.

13. After initial power up do not move the unit while the gyroscope is being calibrated. The side LEDs on the GPS unit flash red and blue during the gyroscope calibration process. When the side LEDs start flashing yellow it is okay to touch or move the unit.

Figure 43. UAV green and white position strobe lights

14. Verify that the white position strobe light on the UAV front (see figure 43), and the green position strobe light on the rear are flashing.

> **Note** During the boot process, prior to the radio connection being complete, the strobes may not function as expected.

Pre-Flight ops are complete. Continue to section "Ground Station Connection" on page 71.

## Ground Station Connection

Do the following:

1. Ensure the client device is connected to the ground station network.

⚠️ **IMPORTANT**
> Note that two errors are typically encountered at this stage:
>
> One, when the GCU is turned off it is possible that the client device will connect to another known network. Then when the GCU turns back on, the client device does not switch back to the GCU making it appear as if there is no connection with the aircraft.
>
> Two, if multiple devices that have been connected to the GCU are WiFi enabled they may both fight over a connection to the GCU, causing the connection to fail or to be inter-mittent. Always ensure the client device is connected to the correct network and there are not multiple devices trying to connect.

2. Open the QGroundControl app to verify that the aircraft has connected to the ground station/radio and monitor telemetry.

3. Verify that camera link is operational.

4. If applicable, insert the SD card into the slot in the payload.

### *Calibration*
Newer versions of Ardupilot include a declination map and do not require recalibration of the compass at every new location. However, if compass calibration is required, remove the payload prior to calibrating the compass

and follow the instructions provided at **https://docs.qgroundcontrol.com/master/en/SetupView/sensors_ardupilot.html**

To start the compass calibration sequence from QGroundControl, select Settings > Sensor > Compass > OK and follow the instructions provided on the screen.

To start or cancel the compass calibration sequence manually using GCS gimbal controls use the control stick combinations noted below.
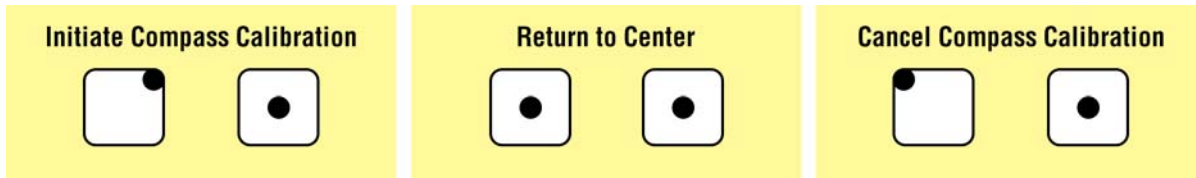


Figure 44. Manual Compass Calibration Initiation Sequence

Otherwise, go to section "Battery Health Monitor".

### Battery Health Monitor

Go into the battery status display by tapping on the battery icon at the top of the QGroundControl application. Verify that the battery voltage is about 20 volts—the minimum takeoff voltage. Preferably it should be a fully charged battery reading ~25 volts.

> **Note**   The percent (%) reported next to the Battery status icon in the top ribbon of QGroundControl assumes a full battery at power on. Powering on the unit with a partially charged battery will also show a value of 100%. Always be sure to monitor the actual voltage and do not rely on the percentage indicator shown in the ribbon.
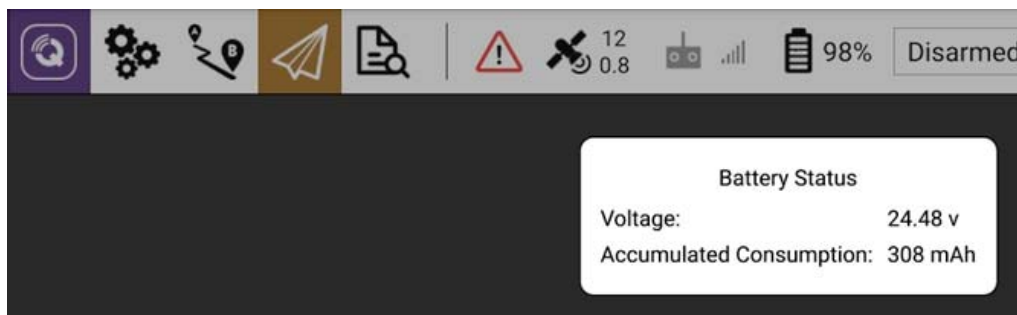


Figure 45. Battery Status Display

### Flight Safety Settings

Select the Gear icon at the top of the QGroundControl application. Select the Safety tab. Confirm the settings shown in figure 46 on page 73.
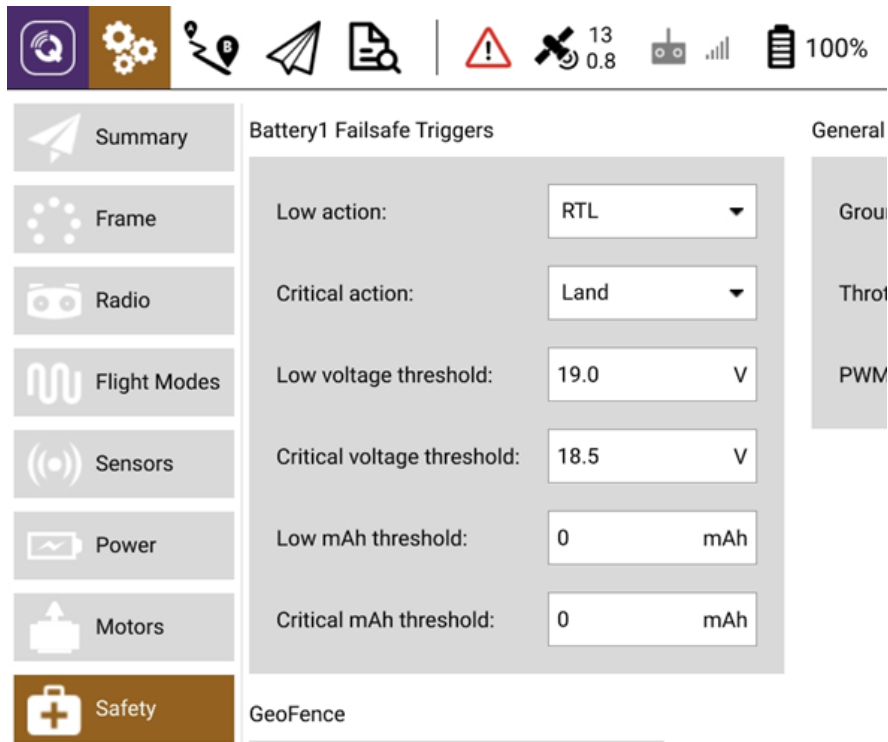
Figure 46. Flight Safety Settings

### *GPS Satellite Connectivity*

Verify that there is sufficient GPS signal strength (10 or higher with an HDOP of 1.0 or lower to support flight operations on the QGroundControl app as shown in figure 47).
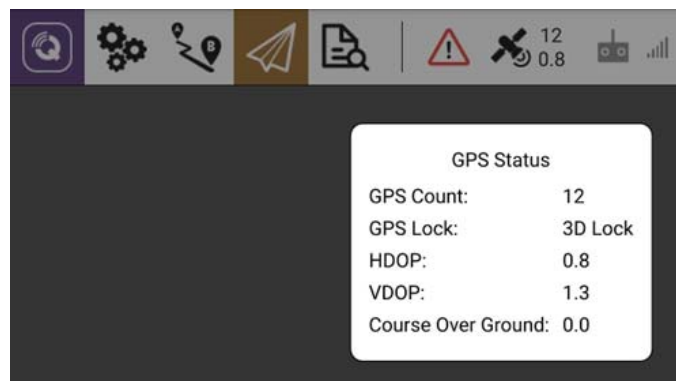


Figure 47. GPS Status Display

If all indications are correct, continue to section "Takeoff".

## Takeoff

Do the following:

1. Make sure the RangePro RPX8-P is in a good takeoff location (free of debris and a safe distance from objects and structures like buildings and trees. TerraView recommends a 30-foot or 9-meter radius around the aircraft) for takeoff and landing (see figure 42 on page 70). Remember that this area will probably be the return-to-land (RTL) location.

2. We also recommend using a flat and level surface for takeoffs and landings. Use of a takeoff mat may be needed for dusty sites.

3. Be aware of possible strong magnetic interference when choosing your takeoff location. Vehicles, buildings, dumpsters, street lights and even the rebar in the concrete you are standing on may cause issues. (Remember, this area will be the RTL location as well.)

4. Clear the area of personnel and notify participants of your intention to take off.

5. Double check the Heads-Up Display (HUD) on the tablet to make sure all systems are in the green and ready to go.

6. Ensure the aircraft is in the correct mode for your preferred flight operations. TerraView recommends using Position Hold or Loiter modes for most non-automated flight operations.

7. Approach the aircraft carefully and press and hold the button on the GPS unit at the top of the mast. The LED circle around the button should change from flashing red to solid red. The two side LEDS should change from flashing yellow to flashing green. Release the button. And move outside the takeoff safety area.



Figure 48. Arming the aircraft

8. Arm the aircraft, which means to start the motors spinning at a speed that will not cause the aircraft to takeoff. This can be done from within QGroundControl by pressing the Armed/Disarmed drop down menu and selecting Arm (see figure 48), or by manual stick input as follows (see figure 49 on page 75):

   – Set the left stick to Full Throttle Down, Full Yaw Right and hold until the aircraft beeps.

   – Remove any Yaw input but keep the stick Full Throttle Down.

   – Slowly let the stick return to the center middle position.
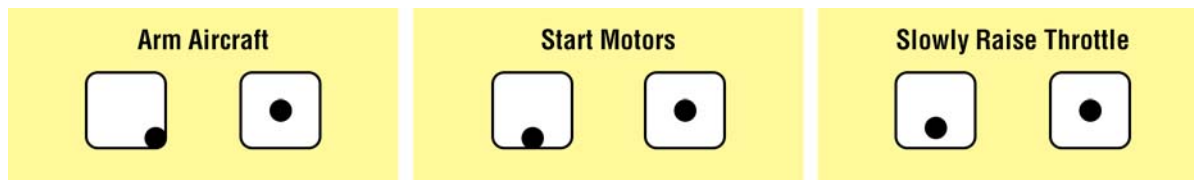
Figure 49. Manual Arming Sequence

9.  Command the aircraft to take off, manually or automated. (See Ardupilot and QGroundControl on-line documentation for details on how to take-off and control the aircraft.)

> ⚠️ **CAUTION**  In automated takeoff at approximately 5–10 meters in altitude the unit will recalibrate its internal compass. This may cause the unit to pitch and roll of its own accord for several seconds. Do not be alarmed. However, if it persists, switch into RTL mode or a manual control mode and land the aircraft safely. See chapter 7, "Emergency Procedures" on page 62 for additional details.

> ⚠️ **CAUTION**  In automated flight the unit climbs and descends in route. That means that as soon as the aircraft reaches its takeoff altitude it will start moving laterally towards its next way-point as it climbs. Be sure the flight path is clear of obstruction and people. It is highly recommended that takeoffs be done manually if possible and the unit placed in a hover at a safe location and altitude prior to starting the automated mission. If this is not possible, pay careful attention to the takeoff altitude to ensure the aircraft can obtain a safe altitude before moving laterally.

To take off manually, Throttle up until the unit is at least three meters off the ground. This ensures that as the unit acquires better GPS location information or encounters pressure variations it does not unintentionally strike the ground while making automatic in-flight adjustments.

The RangePro RPX8-P is in flight. Continue to section "In-Flight" on page 75.

## In-Flight

Do the following:

1.  Once the RangePro RPX8-P has taken flight, put it in a hover approximately 10 feet (3 meters) above the ground.

2.  With the right stick, make small left and right (roll) commands, then up and down (pitch) commands, and verify the aircraft responds as expected.

3.  With the left stick, make small left and right (yaw) commands, then up and down (thrust/altitude) commands, and verify that the aircraft responds as expected.

4.  Start a timer, if needed.

5.  Double check the HUD for vitals and make sure all is correct. Note the battery voltage and fly the drone to the area of operation.

6.  Monitor the HUD for RangePro RPX8-P system health and continually scan the area of operation for maximum situational awareness. Look for good GPS signal strength, a good data link signal, battery voltage, and other alert notifications that may be displayed on the HUD screen. Be aware of other aircraft in the vicinity or for personnel that might enter the flight area.

When it is time to return to the take-off point, continue to section "Landing".

## Landing

Do the following:

1.  You may command the aircraft to return to land (RTL) manually or automated. (See QGroundControl and Ardupilot on-line documentation for landing instructions.)

2.  Verify that the landing area is clear of personnel and loose objects.

3.  Announce your landing intentions to others in the area.

4.  If the automated RTL command was given, allow the aircraft to land itself. Keep in mind that the aircraft might veer off from the exact landing location. Monitor the automated descent and make necessary lateral adjustments (right control stick) to ensure the aircraft lands in the desired area. With the factory default parameter settings, the aircraft will:

    – Ascend as necessary to a minimum RTL flight altitude (RTL_ALT = 5000 cm)

    – Orient appropriately to the landing site (WP_YAW_BEHAVIOR = 0)

    – Descend rapidly (LAND_SPEED_HIGH = 200 cm/s)

    – Until obtaining landing altitude (LAND_ALT_LOW = 1000 cm)

    – Then descend slowly (LAND_SPEED = 50 cm/s)

    – Until landing is complete

    – At which point the aircraft will disarm

5.  If the UAV is being manually flown, bring the aircraft down slow and steady. There are no ground sensors (such as a rangefinder) to assist with descent, so you are own your own. Be careful.

6.  When the aircraft has landed, set the left stick to Full Throttle Down, Full Yaw Left and hold until the aircraft beeps and QGroundControl announces the aircraft has disarmed (see figure 50).
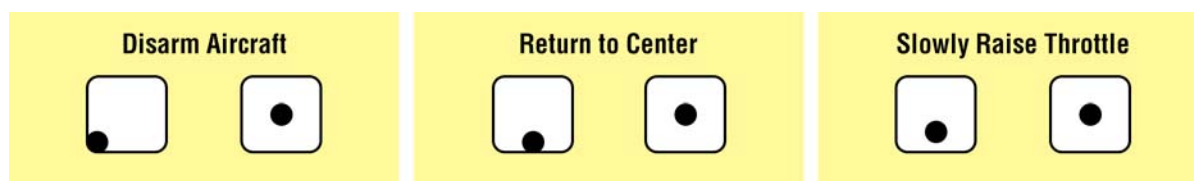


Figure 50. Manual Disarming Sequence

7.  After confirming the aircraft has disarmed, carefully return the left stick to the center and then to center middle position. This extra step prevents uncontrolled accidental restart of the motors by releasing the stick too soon.

> ⚠️ **WARNING**
>
> **To avoid the risk of personal injury, do not let go early, ensure the unit is disarmed. After hearing the audible confirmations, slowly return the left stick to the center position and ensure the motors do not start spinning again—many pilots have flipped aircraft or sustained injury by not ensuring the unit is disarmed prior to releasing the sticks and approaching the aircraft.**

The UAV has safely landed. Continue to section "Post-Flight".

## Post-Flight

Post-Flight consists of the following:

*   Disassembling the RangePro RPX8-P (see page 77)
*   Disassembling the Ground Control Station (see page 78)
*   Packing up (see page 78)

### Disassemble the RangePro RPX8-P

Essentially the disassembly of the aircraft is much like the assembly of the aircraft only in reverse order:

> ⚠️ **IMPORTANT**
>
> You can temporarily leave the battery inside the drone until it is time to ship the drone off-site.
>
> Federal regulations prohibit the shipping of large Lithium based batteries with other equipment. Regulations may change, so regardless of whether you are shipping by air or by ground, be sure to check with your carrier before packing and labeling batteries for shipment.
>
> See Appendix O, "Shipping Lithium Polymer Batteries" on page 130 or the *TerraView Lithium Battery Shipping Notice* for additional details

1.  Remove the battery by pulling down on the battery pin with one hand while using the other hand to pull the battery forward on its rails. Be careful not to pull the battery so far that you drop it. Alternatively, if you choose not to remove it completely, you can slide the battery just enough for the locking pin to engage in the battery transport mode hole.

2.  Remove the payload. The method of doing this will depend on the payload you are using.

3.  Fold the propellers and point them to the rear of the aircraft.

4.  Fold the arms as follows: Loosen the pivot pin screw, and loosen and lift the arm pins before attempting to fold the arms. Front arms fold back first with props pointing to the rear. Back arms fold back second with props pointing to the rear.

5.  Secure the arms using the pivot pin screws.

6. Unscrew the GPS antenna locking nut, then rotate the GPS antenna mast so it is resting on the front of the RangePro RPX8-P.

> ⚠ **CAUTION**   To avoid damage to the antenna mast when closing the case lid, **do not** position the antenna mast so it is resting on the accessory platform.

7. Detach the antenna clips from the landing gear struts.

8. Disconnect the antenna cable connectors from the bottom of the aircraft

9. Remove a landing leg from the frame by pushing the pin in and pulling the strut until it disconnects from the frame.

10. Repeat step 9 to remove the other landing leg.

> ⚠ **CAUTION**   To avoid damaging parts of the aircraft or the gimbal mount, avoid setting the aircraft on the ground if the landing legs are not installed.

11. Gently lower the aircraft into the case.

> ⚠ **CAUTION**   To avoid damaging parts of the aircraft, ensure the propellers do not rotate out of their designated spaces and get caught on the foam.

### *Disassemble the Ground Control Station*
Do the following:

1. Power down the tablet (the procedure for powering down the tablet will be tablet specific).

2. Power down the ground controller setting the power switch to OFF.

3. Remove the tablet from the client device holder.

4. Loosen the locking lever, then fold down the holder.

5. Tighten the locking lever.

6. Fold in the antennas.

7. Remove the GCU antennas and store them in the case.

### *Packing up*
Place all components into their original locations in the case as shown in table 1 and figure 3 on page 22.

> ⚠️ **IMPORTANT**
>
> Verify that the battery or batteries have been removed from the temporary storage area in the case and/or the drone *before* shipping the case.
>
> See Appendix O, "Shipping Lithium Polymer Batteries" on page 130 or the *TerraView Lithium Battery Shipping Notice* for additional details

Continue to Chapter 9, "Data Management" on page 80.

# Chapter 9    Data Management

## Chapter Contents

## Introduction

Use the QGroundControl app or Mission Planner running on a PC to collect data and manage parameter settings.

## Downloading Parameter Files

It is highly recommended that the factory parameter load be downloaded and saved prior to any flight operations or user parameter changes. This ensures a solid baseline to which the user can return if something gets out of sorts. Then each time a change is made, save the new parameter set under a different file name in order to better track changes to your configuration over time.

### QGroundControl

Select the Gear Icon > Parameters > Tools > Refresh (this step reloads all parameters from the aircraft into QGroundControl)

Select the Gear Icon > Parameters > Tools > Save to File (this step saves the parameters in QGroundControl to a user defined file).

### Mission Planner

Select Config > Full Parameter List > Refresh Params (this step reloads all parameters from the aircraft into Mission Planner software)

Select Config > Full Parameter List > Save to File (this step saves the parameters in Mission Planner to a user defined file).

## Uploading Parameter Files

On occasion, the best way to configure an aircraft is to load a parameter file. The parameter file can include a line for every parameter used by the flight controller, or it can contain just a select few parameters that are used to easily switch between flight configurations. Caution should be taken to ensure only the desired changes are being made. It is possible to load a file that will cause the aircraft to operate in an unstable manner. Be sure to have a known good configuration as a backup before proceeding with uploading a parameter file.

> ⚠️ **IMPORTANT**  Only expert users should modify the parameter file after TerraView Flight Support provides instructions for uploading a new parameter file (see Chapter 12, "Contacting Terra-View for Support" on page 90).

### QGroundControl

Select the Gear Icon > Parameters > Tools > Load from File (this step loads parameters from a file into QGroundControl software and the aircraft).

### Mission Planner

Select Config > Full Parameter List > Load from File (this step loads parameters from a file into Mission Planner)

Select Config > Full Parameter List > Write Params (this step loads the parameters in Mission Planner to the aircraft).

## Collecting On-Board Flight Telemetry

Sometimes it is important to download telemetry flight data to assist in analysis of sensor data, or to analyze performance of the aircraft during flight operations.

### *QGroundControl*

Select the Analyze Icon > Refresh > Log Download > [select files] > Download

QGroundControl lets the user select the storage location

### *Mission Planner*

Select Data > Data Flash Logs > Download DataFlash Log via Mavlink > [select file(s)] > Download Selected Logs

Mission Planner places the files in the default location C:\Users\...\Documents\Mission Planner\logs\OCTO-ROTOR\1

Despite this inconvenience, Mission Planner has the added benefit of providing a MatLab conversion tool for viewing data in MatLab. Select Data > Create MatLab File > [select file(s)] > Open

## Collecting Payload Data

See your payload documentation for details on extracting data or storage devices from the payload.

Now that you know about data management, continue to Chapter 10, "Drone Battery Management" on page 83.

# Chapter 10  Drone Battery Management

## Chapter Contents

## Introduction

Refer to the following sections for information on drone battery management:

• Charging the Battery

• Inspecting the Battery (see page 86)

• Storing the Battery (see page 86)

• End of Life Battery Processing Steps (see page 86)

## Charging the Battery

Do the following:

1.  Remove the battery charger AC power cord (see figure 51) from its box.



Figure 51. Battery charger AC power cord

2.  Remove the battery charger (see figure 52) from the case.



Figure 52. Battery charger

3. Remove the battery charging cable (see figure 53) from the case.



Figure 53. Battery charging cable

**⚠ CAUTION**  **DO NOT** connect the battery charging cable to the battery at this time.

4. Connect the battery charging cable to the battery charger as shown in figure 54.



Figure 54. Connecting the battery charging cable to the battery charger

5. Connect one end of the AC power cord to the *AC INPUT* port on the back panel of the battery charger. Connect the other end to an AC wall outlet.

6. Connect the battery to the battery charging cable connector

7. Refer to Appendix P on page 133 for instructions on using the Ultimate Duo 400W Charger with a RangePro RPX8-P RP6S24KHDx battery pack or refer to the *Ultimate Duo 400W Charger with a Range Pro X8 RP6S24KHDx Battery Pack* guide for the remainder of the battery charging procedure.

## Inspecting the Battery

Before and after every flight:

1. Check each cell and the battery frame for dents, punctures, or cell puffing.

2. Check connector pins to ensure pins are secure and there are no burn marks.

> ⚠️ **CAUTION**
> **DO NOT** use a battery that shows signs of damage. This includes damage to the cells, wires, and connectors associated with the battery.

See the document *Ultimate Duo 400W Charger with a Range Pro X8 RP6S24KHDx Battery Pack.*

## Storing the Battery

Charge batteries to their storage level. (See *Ultimate Duo 400W Charger with a Range Pro X8 RP6S24KHDx Battery Pack* for a how-to guide).

Always store your batteries in a dry and temperate storage area.

If you will be shipping a battery or storing it for more than one week, check the battery voltage, and either charge or discharge the voltage so that all cells are balanced to 3.7 volts ±0.2 volts

## End of Life Battery Processing Steps

Please check your local regulations for proper discharge and disposal of lithium polymer batteries upon end of life.

Now that you know about drone battery management, continue to Chapter 11, "Maintenance" on page 87.

# Chapter 11  Maintenance

## *Chapter Contents*

## Introduction

Maintenance consists of user maintenance activities, and replacing a pair of propellers.

All other activities require factory maintenance from TerraView or an Authorized TerraView Service Center. These include activities such as arm replacement, correcting unexpected flight characteristics, motor or bearing replacement, power issues, and connectivity issues.

> **Note**    Additional spare components can be purchased by contacting us at **https://terraview.com/contact/**.

## User Maintenance Activities

The following should be performed by the user before and after every flight:

- Keep it clean: The proper way to clean your RangePro RPX8-P is to use a damp cloth to wipe down the cover and remove any debris from the visible carbon fiber components. Do NOT remove any components for cleaning. Store in a temperate and dry place.

  You can also use a can of compressed air to ensure there is no debris in the motors.

- Inspect for damage to propellers, loose screws, and other unusual indications.

- Replace damaged propellers.

- Replace broken landing gear.

- Tighten loose propeller mounts.

- Tighten loose propeller screws (use LOCTITE® 243 blue threadlocker or equivalent).

- Before every flight, rotate the motors while listening for noticeable noise. If you hear noise, the motors may need servicing. Do not fly if there is noticeable noise in a motor.

  Replace motors every 800 to 1000 hours or as needed. If a motor is making noise, contact us at **https://terraview.com/contact/**.

## Replacing a Pair of Propellers

> ⚠️ **IMPORTANT**    Each pair of propellers is balanced, so if one is damaged, both propellers in the pair must be replaced.

Your RangePro RPX8-P comes with 1 set of replacement top propellers and 1 set of bottom propellers. You can replace a damaged propeller as follows:

1.  Using a 2.5 mm Allen key wrench (or equivalent hex key), remove the 2 propeller mount screws (see figure 4 on page 31) securing the mounting bracket to the motor, then detach the propellers.

> **Note**    Propellers should be installed with the words on the propeller facing up.

2. Position the appropriate replacement propellers at the location on the motor where they will be installed, then lightly secure them in place with a replacement screw from the plastic bag located in the case. Leave the screw loose enough so that the propellers can easily be adjusted to accommodate the other screw.

3. Install the second screw.

4. Using the Allen key wrench, tighten both mount screws securely.

The replacement propellers are now installed.

If you need to contact TerraView for support, continue to Chapter 12, "Contacting TerraView for Support" on page 90.

# Chapter 12  Contacting TerraView for Support

## Chapter Contents

## Support Options

In addition to standard warranty support, TerraView offers training, integration, and customization services, maintenance, repair, and extended warranty options. Contact your distributor or sales representative for more information.

For technical support, contact the TerraView Flight Support line at **1-800-628-3119** or e-mail **support@terraview.com**.

# Appendix A **Certifications/Compliance**

## *Chapter Contents*

## Compliance

The RangePro RPX8-P is compliant with the following standards for North America and the European Union. Subsystem specific certification and compliance statements can be found in their respective user manuals and documentation.

## North America (United States and Canada)

### FCC Part 15 Class B

This device generates and uses radio frequency energy, and if not installed and used properly - that is, in strict accordance with the manufacturer's instructions - may cause interference to radio and television reception. The device has been tested and found to comply with the limits for a Class B computing device in accordance with specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection from such interference in a commercial installation. However, there is no guarantee that interference will not occur in a particular installation. If the device does cause interference to radio or television reception, which can be determined by disconnecting the battery in the unit, the user is encouraged to try to correct the interference by one or more of the following measures: moving the equipment away from the receiver or re-orienting the receiving antenna.

### NRTL (Nationally Recognized Test Lab) Mark

This device is in compliance with UL 62368-1:2014 Ed.2, the standard for Audio/Video, Information And Communication Technology Equipment. The requirements of this standard do not consider Federal Regulations associated with the operation of commercial UAVs. The operation of commercial UAVs is intended to be in accordance with all Federal Regulations when the UAV is used.

### Standards

UL 62368-1:2014 Ed.2 Standards

## European Union

### CE Mark

This device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EC relating to radio equipment, Directive 2014/35/EC relating to electrical equipment designed for use within certain voltage limits and Directives 2011/65/EU and 2015/863/EU relating to RoHS (Restrictions on Hazardous Substances) and REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) compliance.

The safety advice in the documentation accompanying this device shall be obeyed. The conformity to the above directive is indicated by CE mark on the device.

### Standards

EN 301 489-1 V2.2.0 (2017-03)

EN 301 489-17 V3.1.1 (2017-02)

EN 62368-1 (2018)

EN 50581 (2012)

# Appendix B **Warranty**

## *Chapter Contents*

## What Is Covered

TerraView 360, Inc ("TerraView") warrants to the original retail purchaser that the TerraView product and associated accessories (not including batteries) covered by this limited warranty statement, if purchased new from TerraView or an authorized reseller and used in the United States or Canada under normal conditions in accordance with the handling instructions and general information and warnings appearing in the operating manual, conform to the manufacturer's specifications and will be free from defects in materials and workmanship for a period of one (1) year from the date of original purchase. Batteries are warranted to be free from defects in materials and workmanship for a period of three (3) months from the date of original purchase, such defects generally being defined as zero or extremely low voltage, battery swelling or outgassing, or failed connectors. Motors are warranted for 100 hours of flight. For warranty service, you must provide proof of the date of original purchase.

## What TerraView Will Do To Correct Problems

Should your TerraView product prove defective during the warranty period, please call the TerraView Flight Support line at **1-800-628-3119** or e-mail **support@terraview.com** for warranty repair instructions and/or return authorization. A TerraView service technician will provide telephone or e-mail diagnostic service to determine whether the product requires service. If service is needed, TerraView will, at its option, replace or repair the product without charge for parts or labor.

If your product is being replaced or repaired, TerraView will direct you to send your product to TerraView or its authorized service center. You are responsible for securely packing the product and for shipping costs to the TerraView service center. TerraView will ship the repaired or replacement item(s) to you, freight prepaid, so long as you use an address in Canada or the U.S. (excluding Puerto Rico and U.S. Possessions). Shipments to other locations will be made freight collect.

When warranty service involves the exchange of the product or a part, item replaced becomes TerraView property. The replacement product or part may be new or refurbished to the TerraView standard of quality, and, at TerraView's discretion may be another model of like kind and quality. TerraView's liability for replacement of the covered product will not exceed the original retail selling price of the covered product. Exchange products and parts assume the remaining warranty period of the original product covered by this limited warranty plus an additional 30 days.

## What This Warranty Does Not Cover

This warranty does not apply to refurbished or reconditioned products. This warranty covers only normal use in the United States and Canada under normal conditions in accordance with the handling instructions and general information and warnings appearing in the operating manual. This warranty is not transferable.

Battery warranty does not cover typical reduced capacity that occurs as battery is used and recharged in standard operations or degradation caused by human error, overcharging, or improper battery storage or maintenance.

This warranty does not cover accessories, third party parts, components, or peripheral devices added to the TerraView product after its shipment from TerraView, e.g., dealer or user-added sensors, data recorders, etc.

TerraView is not responsible for warranty service should the TerraView label or logo or the rating label or serial number(s) be removed or should the product fail to be properly maintained or fail to function properly as a result of misuse, abuse, improper installation, improper or abnormal use, accident neglect, improper shipping, damage caused by disasters such as fire, flood, and lightning, improper electrical current, or service other than

by a TerraView authorized servicer. If a claimed defect cannot be identified or reproduced, you will be held responsible for the costs incurred.

THE WARRANTY AND REMEDY PROVIDED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT OR FITNESS FOR A PARTICULAR PURPOSE. SOME LAWS DO NOT ALLOW THE EXCLUSION OF IMPLIED WAR-RANTIES. IF THESE LAWS APPLY, THEN ALL EXPRESS AND IMPLIED WARRANTIES ARE LIM-ITED TO THE WARRANTY PERIOD IDENTIFIED ABOVE. UNLESS STATED HEREIN, ANY STATEMENT OR REPRESENTATIONS MADE BY ANY OTHER PERSON OR FIRM ARE VOID. EXCEPT AS PROVIDED IN THIS WRITTEN WARRANTY, NEITHER TerraView NOR ITS AFFILI-ATES SHALL BE LIABLE FOR ANY LOSS, INCONVENIENCE, OR DAMAGE, INCLUDING DIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, RESULTING FROM THE USE OR INABILITY TO USE THE TerraView PRODUCT, WHETHER RESULTING FROM BREACH OF WARRANTY OR ANY OTHER LEGAL THEORY.

Some jurisdictions do not allow limitations on how long an implied warranty lasts, and some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusions may not apply to you. This warranty gives you specific legal rights, and you may have other rights which vary from jurisdiction to jurisdiction.

TerraView recommends all original packing materials be retained in the event the product needs to be shipped again.

# Appendix C **RangePro RPX8-P Manual Flight Checklist**

## *Chapter Contents*

## Preflight Checklist

1. Check batteries to make sure they are properly charged.

2. Turn on Ground Control Station (GCS)—control unit and client device.

3. Verify GCS battery status.

4. Verify volume on the client device and ensure GCS warnings are audible.

5. Mount payload onto RPX8.

6. Install battery into flight position on aircraft.

7. Listen for initial 3 tones from ESCs followed by musical tones from the Cube.

8. Observe GPS lights flashing blue and red on initial startup to indicate IMU is initializing.

> ⚠️ **IMPORTANT**  Do not touch the unit while the IMU is initializing.

9. Observe GPS lights flash yellow when IMU is initialized.

10. Wait for radio connection to complete—could take up to one minute. The GPS status light will turn blue or green once the radio connection is completed. The connection can be tested by flipping the Strobe control switch on the GCS and observing a proper response from the aircraft.

11. Verify data download to GCS.

12. Verify camera image/connection on GCS.

13. Verify the Flight mode switch on the GCS is set to Loiter and that the RTL switch on the GCS is switched down.

14. Using the software on the GCS client, verify the flight mode is set to Position Hold.

15. Using the software on the GCS client, verify the HDOP is less than 1.0 (signifies strong sensor operation).

16. Verify Cube temperature is greater than 43°C or 110°F.

17. Verify Battery voltage is sufficient for the mission, preferably starting with 24V or more.

> **Note**    Record the battery voltage in the log book.

18. Verify safety settings found at the bottom of the Summary page are correctly set.

19. Press hardware safety switch on the GPS for approximately three seconds to activate ESCs.

20. Listen for tones signifying the unit is ready to fly.

21. Verify the lights on the GPS have moved from flashing yellow to flashing green.

22. Initial Pre-Flight is now complete, RangePro is now ready to arm.

## Arm for Flight, Takeoff, and Control Validation

1. Verify the area is clear and that it is safe to arm.

2. Arm aircraft from GCS by moving left gimbal inwards (to the right) and down.

3. When aircraft gives tone signifying arm state:

   – move left gimbal to middle bottom (neutralizing rudder / yaw control) then

   – slowly increase throttle to neutral (middle) permitting props to spin slowly

4. When ready to take off, move throttle (left gimbal) upwards with authority giving maximum throttle until safely away from ground (3–5 meters/10–15 feet).

5. Ensure unit is stable in a hover then cycle through small adjustments in all control dimensions (Roll, Pitch, Yaw, and Throttle) to ensure proper control of basic flight functionality.

6. Fly safely, following all rules and good practices.

## Landing

1. To land, fly above a safe landing location and decrease altitude by lowering throttle.

2. Taper descent speed until craft is safely on the ground.

3. When aircraft is landed, hold left gimbal all the way down THEN to the left and hold in that position until aircraft signals disarmed status (approximately 7 seconds).

4. Slowly return gimbal to neutral position and ensure propellers do not restart.

5. Unit is safely landed and disarmed.

# Appendix D **RangePro RPX8-P Automated Flight Checklist**

## *Chapter Contents*

## Preflight Checklist

1. Ensure GCS client has been preloaded with up to date maps of the flight area.

2. Ensure GCS client has a complete and validated flight plan defined and ready for upload.

3. Follow all steps in the Preflight Checklist section of the RangePro RPX8-P Manual Flight Checklist.

4. If required, ensure payload GPS cable is installed and has freedom of movement.

5. Select desired flight plan and upload, checking for "Syncing Mission" and "Done" prompt.

6. Double check all altitudes and command prompts, if changes are made you must upload again.

7. Toggle between plan view and camera view, make sure plan is visible and camera is operational.

## Perform the Mission

1. Slide bar to "Start Mission"

2. Be aware of automatic aircraft calibration at 5–10 meters/15–30 feet AGL.

   – Unit will pitch, roll, and wobble for a few seconds.

   – Take emergency action if it does not stop on its own.

3. Verify via the video downlink that camera orientation commands are being obeyed.

4. Verify that aircraft climbs to desired altitude at each way point.

5. Verify that aircraft is flying the flight plan as intended, maintaining altitude, course, and heading.

6. Continue to monitor the aircraft telemetry throughout the mission.

## Completing the Mission

1. Aircraft completes mission and, if programmed to RTH/RTL, returns to launch area.

2. Verify landing area is clear of people and debris, aircraft will land and disarm.

3. If required, make slight lateral adjustments during descent to ensure the aircraft lands in a preferred location.

4. Mission complete.

5. Remember to "clear vehicle mission" before performing another flight, manual or automated.

# Appendix E  RangePro RPX8-P Post Flight Checklist

## Power Down Sequence

1. Ensure aircraft is on ground, props have stopped rotating, and system has disarmed.

2. Note battery voltage and flight time on GCS Client Display and record in logbook.

3. Stop recording video if needed.

4. Remove battery from aircraft and check for abnormal temperature.

5. Check aircraft motors for excessive heat.

6. Turn off GCS.

## Safety Inspection

1. Inspect landing gear and landing gear brackets for cracks or structural defects.

2. Inspect aircraft for debris or loose fasteners.

3. Inspect propellers and propeller mounts for proper tightness.

4. Remove debris from all surfaces.

## Payload Management

1. Inspect payload sensor lens and clean if necessary.

2. Install payload sensor lens covers, if applicable.

3. Remove GPS antenna connection from payload, if applicable.

4. Remove gimbal and payload from aircraft.

5. Collect data from payload storage devices, if applicable,

## Stowing the Aircraft

1. Disassemble aircraft and return to the transport case.

2. Ensure notebook is updated with:

    – flight duration

    – battery usage

    – any anomalies encountered during flight

# Appendix F  LED Meanings

## *Chapter Contents*

# Introduction

The following information is available from the cubepilot.org website and is provided here for easy reference:

**https://docs.cubepilot.org/user-guides/here+/here+v2-user-manual**

| Indicator | Status |
|---|---|
| Flashing red and blue | Initializing sensors; place the vehicle still and level while it initializes the sensors. |
| Flashing blue | Disarmed, no GPS lock; auto-mission, loiter and return-to-launch flight modes require GPS lock |
| Solid blue | Armed with no GPS lock |
| Flashing green | Disarmed (ready to arm), GPS lock acquired. Quick double tone when disarming from the armed state. |
| Fast flashing green | Same as above but GPS is using SBAS (so should have better position estimate) |
| Solid green | With single long tone at time of arming: Armed, GPS lock acquired. Ready to fly! |
| Double flashing yellow | Failing pre-arm checks (system refuses to arm) |
| Single flashing yellow | Radio failsafe activated |
| Flashing yellow with quick beeping tone | Battery failsafe activated |
| Flashing yellow and blue with high-high-high-low tone sequence (dah-dah-dah-doh) | GPS glitch or GPS failsafe activated |
| Flashing red and yellow | EKF or Inertial Nav failure |
| Flashing purple and yellow | Barometer glitch |
| Solid red | Error, usually due to the SD card (re-plug or place the SD card to solve), MTD or IMU, you may check the SD card and have a look at BOOT.txt for boot message analysis |
| Solid red with SOS tone sequence | SD card missing or SD card bad format |
| No light when power on | No firmware, firmware lost, SD card missing or bad format (ac3.4 or higher version) |

# Appendix G **Passwords and IP Addresses**

## *Chapter Contents*

## Introduction

Different RangePro configurations utilize a variety of radio and video processing systems to communicate and transmit telemetry and sensor data. For these systems to work well together it is important to ensure each device is programmed to the correct IP address and the comms links are compatible. The following sections provide details on login credentials, preferred and/or required settings, and details on how different systems work together.

## Herelink Systems

Herelink systems consist of two parts. These include a ground unit with integrated tablet and an air unit. These units are paired together at the factory and programmed to support certain default behaviors.

Typically, there is very little setup required for Herelink units and no requirement for credentials or knowledge of IP addresses. Gain control and frequency are automatic with the Herelink system.

There are multiple tutorials on-line that explain how to calibrate and operate the Herelink. An on-line copy of the Herelink manual can be found here:

**http://www.hex.aero/wp-content/uploads/2018/11/HereLink-Manual-EN.pdf**

One critical piece of information to retain is the Product Key that is provided with the unit. That product key is required when performing firmware upgrades to the radio system.

### Important Settings Within QGroundControl

For video display:

- Video Source: RTSP Video Stream

- RTSP URL: rtsp://192.168.43.1:8554/fpv_stream

For Video Sharing

- rtsp://192.168.43.1:8554/fpv_stream

- Network Name: Typically RPX8#### (where #### are the last four digits of the aircraft serial number)

- Security: WPA2 PSK

- Password: copter123

Network name and password are required when the unit is setup as a hot-spot for other clients to connect to for streaming video and telemetry.

## Standard Ground Control Station

RangePro's Standard Ground Control Station utilizes Microhard pmDDL radios for command and control, telemetry and video distribution. The ground radio is embedded in the Ground Control Unit (GCU) and the air radio is embedded in an Airborne Innovations Picoradio. Video conversion is accomplished using an Airborne Innovations Picoraptor. IP address configuration and credential management are paramount in ensuring the system works as expected. Documentation for these units can be found on the TerraView support site or from the manufacturer.

## GCS Client Configuration

The Ground Control Unit provides a WiFi connection for a client device. This device can be any WiFi enabled device with a flight control software package such as QGroundControl. The GCU and the client device make up the Ground Control Station (GCS). Currently only one client can connect at a time. To establish a connection to the GCU:

1. Ensure both external antennas are installed on the GCU.

2. Power on the GCU.

3. Power on the client device.

4. Open the network settings on the client device and connect to the GCU WiFi:

   – The default network name is "SUI_xxx", where "xxx" is a GCU specific ID

   – The default network password is "hcs_controller"

5. Set tablet IP on the network as follows:

   – Static IP Address: 192.168.42.246

   – Gateway: 192.168.42.1

   – Prefix Length: 24 (255.255.255.0)

   **Note**    At this time, it is not possible to change the network name or password from the web interface.

## Connecting to the Radios

The Microhard radios do not currently support automatic gain control or frequency selection. To minimize interference from other sources, the units are typically set at the factory to operate at the extreme end of the commercial/residential WiFi band on either channel 75 or 76 and power is set to the full 30 dBm.

In standard operations there is no need for a user to connect directly to either the ground station or air unit radios. However, in certain cases there may be a need to change the network settings or radio selections in order to improve security or performance in a particular environment. Changing the wrong parameter can result in an irreparable link. Before logging into a radio be sure to read Microhard documentation about how to work through the system menus to accomplish any changes. To connect to and utilize the menus available for the subsystems, open a network browser and enter in the details noted in the table below.

|  | Ground Unit Radio | Air Unit Radio | Video Encoder (if installed) |
|---|---|---|---|
| **Device IP address** | 192.168.168.101 | 192.168.168.201 | 192.168.168.168 |
| **Browser URL** | 192.168.168.101 | 192.168.168.201 | 192.168.168.168/config.html |
| **Username** | admin | admin | admin |
| **Password** | sui4TheWin | sui4TheWin | 9999 |

When making changes to the airborne unit through the wireless comms link, be sure to make changes to the air unit first. Making changes to the ground unit first may make it impossible to reconnect to the air unit. If the air-ground link is broken it is possible to reconnect to the air side radio and video encoder through the hard-wired Ethernet port found on the aircraft I/O breakout panel.

### *Video Encoder*

Not all units have a video encoder. It is recommended that the video compression rate be set to as low as possible to support a clear video display on the client screen. Setting this number too high may result in drop outs and significantly worse video, possibly even causing the application to freeze as it attempts to stitch together a broken video stream.

The RTSP video link is:

> rtsp://192.168.168.168:8557/PSIA/Streaming/channels/2?videoCodecType=H.264

# Appendix H  Standard Controller Channel Numbers

## Chapter Contents

# Standard Controller Layout



Figure 55. Standard Controller Layout

| Channel | Description |
|---------|-------------|
| **CH1** | Yaw Control |
| **CH2** | Pitch Control |
| **CH3** | Throttle Control |
| **CH4** | Roll Control |
| **CH5** | 3-position switch, usually used for flight modes. |
| **CH6** | 3-position momentary switch, springs to center from both directions. Usually used for zoom. |
| **CH7** | Momentary button, usually used for camera trigger. |
| **CH8** | 2-position switch, usually used for dedicated RTL. |
| **CH9** | 90-degree Rotary dial. Range of motion with center detent. Usually used for gimbal tilt. |
| **CH10** | 90-degree Rotary dial. Range of motion with center detent. Usually used for gimbal pan. |
| **CH11** | 2-position switch, assigned to Strobes |
| **CH12** | 6-position rotary dial with detents at each position. |

## Standard Controller Related Parameter Settings

| Channel | Purpose or Example | Ardupilot Settings |
|---|---|---|
| 1 | Yaw Control Gimbal | **RCMAP_YAW = 1**, *do not change* |
| 2 | Pitch Control Gimbal | **RCMAP_PITCH = 2**, *do not change* |
| 3 | Throttle Control Gimbal | **RCMAP_THROTTLE = 3***, do not change* |
| 4 | Roll Control Gimbal | **RCMAP_ROLL = 4**, *do not change* |
| 5 | Flight Mode 3-Pos Switch | **FLTMODE_CH = 5**, *do not change*<br>**FLTMODE1 = 2** (Alt Hold), *do not change*<br>**FLTMODE4 = 5** (Loiter), *do not change*<br>**FLTMODE6 = 3** (Auto), *do not change* |
| 6 | Zoom 3-Pos Momentary Switch or other… | To use for camera zoom:<br>**Camera dependent**<br><br>To use for directly driving a servo:<br>**SERVOxx_FUNCTION=56 (RCIN6)** |
| 7 | Camera Trigger Momentary | **CAM_SERVO_ON = 2000**; *do not change*<br>**CAM_SERVO_OFF = 1000**; *do not change*<br>**CH7_OPT = 9**; forces the Camera Trigger Function to be activated based on RC7, *do not change*<br>**CAM_DUR = 8**; sets duration that flight controller effectively holds the shutter/camera trigger button<br>Specific Settings for FLIR camera<br>**Note**: Servo12 = Aux4, wired to PWM #3 in the FLIR setup<br>**SERVO12_FUNCTION=10** (Respond to Camera_Trigger)<br>**SERVO12_REVERSED=0**<br>**SERVO12_MAX = 2000**<br>**SERVO12_MIN=1000**<br>**SERVO12_TRIM=1500** |
| 8 | RTL 2-Pos Switch | **CH8_OPT = 4** (RTL), *do not change*<br>**RC8_REVERSED = 0**, *do not change* |
| 9 | Gimbal Tilt Rotary Dial | **MNT_RC_IN_TILT = 9** (RC9), *do not change* |

| Channel | Purpose or Example | Ardupilot Settings |
|---|---|---|
| **10** | Gimbal Pan Rotary Dial or other… | To use for gimbal pan:<br>**MNT_RC_IN_PAN = 10** (RC10)<br>**SERVO11_FUNCTION=0** (disabled)<br><br>To use for digital zoom on FLIR<br>**Note**: **Servo11 = Aux3**, wired to PWM #2 in the FLIR setup<br>**MNT_RC_IN_PAN = 0** (disabled)<br>**SERVO11_FUNCTION = 60** (RCIN10)<br>**SERVO11_MAX = 1900**<br>**SERVO11_MIN=1100**<br>**SERVO11_REVERSED=0**<br>**SERVO11_TRIM=1500** |
| **11** | Strobe 2-Pos Switch | **Note**: **Servo9 = Aux1**, typically wired to the strobe lights<br>**SERVO9_FUNCTION = 61** (RCIN11)<br>**SERVO9_MAX = 1900**<br>**SERVO9_MIN = 1100**<br>**SERVO9_REVERSED = 1** (force strobes on at start)<br>**SERVO9_TRIM = 1500** |
| **12** | FLIR Payload View 6-Pos Switch | **Note**: **Servo10 = Aux2**, wired to PWM #1 in the FLIR setup<br>**SERVO10_FUNCTION = 62** (RCIN12)<br>**SERVO10_REVERSED=0**<br>**SERVO10_MAX = 1900**<br>**SERVO10_MIN=1100**<br>**SERVO10_TRIM=1500** |

# Appendix I   Herelink Controller Settings

## Chapter Contents

# Herelink Controller Settings

## Radio Tab

| Item | Value | Notes |
|------|-------|-------|
| Country | United States | |
| Video Sharing | Enabled | Turn off to prevent other clients from connecting |

## Joystick Tab

| Item | Value | Notes |
|------|-------|-------|
| Wchannel | 9 | This is the scroll wheel |
| Wbus | 1 | |
| Throttle Center Zero | Unchecked | |
| Mode | 2 | |

## Button Tab

| Button | Mode | Default Value | Active Value | Channel | Bus |
|--------|------|---------------|--------------|---------|-----|
| A Short Press | Toggle | 1700 | 1900 | 5 | 1 |
| A Long Press | Toggle | 1100 | 1900 | 8 | 1 |
| B Short Press | Toggle | 1100 | 1900 | 12 | 1 |
| C Short Press | Toggle | 1100 | 1900 | 10 | 1 |
| D Short Press | Toggle | 1100 | 1900 | 11 | 1 |
| CAM Short Press | Momentary | 1100 | 1900 | 7 | 1 |

## Channel Purpose and Effect

| Channel | Purpose | Associated Commands |
|---------|---------|---------------------|
| 5 | Switch Between FLTMODE5 and FLITMODE6 | FLTMODE_CH = 5<br>FLTMODE5 = x<br>FLTMODE6 = y |
| 7 | Switches RC7 between high and low, causing Camera_Trigger to be asserted.<br>Servo12 / Aux4 monitors Camera_Trigger and drives PWM#3 on FLIR setup | CH7_OPT = 9<br><br>SERVO12_FUNCTION = 10<br>User selectable function on FLIR |
| 8 | Switches RC8 between high and low, forcing RTL | CH8_OPT = 4 |
| 9 | Changes payload gimbal tilt deflection angle | MNT_RC_IN_TILT = 9 |
| 10 | Switch Servo11 / Aux3 between high and low, drives PWM#2 on FLIR setup | SERVO11_FUNCTION = 60<br>User selectable function on FLIR |

| Channel | Purpose | Associated Commands |
|---------|---------|---------------------|
| **11** | Switch Servo9 / Aux1 between high and low, direct wired to Strobe Lights | SERVO9_FUNCTION = 61 |
| **12** | Switch Servo10 / Aux2 between high and low, drives PWM#1 on FLIR setup | SERVO10_FUNCTION = 62 User selectable function on FLIR |

## *Hotspot*

| Item | Value | Notes |
|------|-------|-------|
| **Hotspot Name** | RPX8-xxxx | Last four digits of aircraft serial number |
| **Password** | copter123 | |

# Appendix J  **Helpful Parameter Hints**

## *Chapter Contents*

# General Ardupilot Settings

### *Aircraft Orientation During Autonomous Flight*

Is your aircraft pointing the right direction during autonomous flight? Solar panel inspection may require keeping the aircraft always oriented in the same direction regardless of the direction of flight, while a tower inspection may require the aircraft to change orientation. Use the parameter **WP_YAW_BEHAVIOR** to determine whether the aircraft maintains a constant orientation or always points in the direction it is heading.

### *Behavior During Return to Land*

In RTL mode the unit does not make a beeline for the landing point. Instead, it manages altitude and orientation to reduce the risk of hitting an obstacle along the way or hitting the ground too hard. Expect the following steps:

1.  The aircraft ascends to a minimum altitude (**RTL_ALT**),

2.  orients itself for return to the next waypoint (**WP_YAW_BEHAVIOR**),

3.  descends rapidly (**LAND_SPEED_HIGH**),

4.  until obtaining landing altitude (**LAND_ALT_LOW**),

5.  then descends slowly (**LAND_SPEED**),

6.  until landing is complete and the aircraft disarms.

# Herelink Specific

### *Trick for Tilting the Camera*

In normal flight operations many pilots prefer for the camera to be tilted down a little to get more ground and less sky. However, since the scroll wheel on the Herelink is spring loaded and setup for momentary operations there is no easy way to pick and hold an angle during manual flight operations.

However, there is way to adjust the maximum and minimum tilt angles to set a specific default tilt angle.

**MNT_ANGMAX_TIL** sets the maximum tilt angle. **MNT_ANGMIN_TIL** sets the minimum tilt angle. The center tilt value is halfway in between these two angles. Both are measured in centidegrees. Below are some examples showing what settings to use to establish a different default tilt angle:

|  | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|
| **MNT_ANGMAX_TIL** | 9000 (+90 deg) | 7000 (+70 deg) | 9000 (+90 deg) |
| **MNT_ANGMIN_TIL** | -9000 (-90 deg) | -9000 (-90 deg) | -7000 (-70 deg) |
| **Math** | (90 - 90) / 2 | (70 - 90) / 2 | (90 - 70) / 2 |
| **Halfway Point** | 0 deg | -10 deg | +10 deg |

# Appendix K  Configuration Specific Parameters

## *Chapter Contents*

# Load Specific Parameters

| Parameter | Herelink Standard | Herelink Airbot | US GCS Airbot | Notes |
|---|---|---|---|---|
| **BATT_AMP_PERVLT** | ~32 | ~32 | ~32 | Device Specific |
| **BATT_VOLT_MULT** | ~10 | ~10 | ~10 | Device Specific |
| **MNT_ANGMAX_TIL** | 7000 | 7000 | 9000 | 7000 used to force -10 deg gimbal tilt |
| **RCMAP_PITCH** | 2 | 2 | 2 | |
| **RCMAP_ROLL** | 1 | 1 | 4 | Swap Roll and Yaw |
| **RCMAP_THROTTLE** | 3 | 3 | 3 | |
| **RCMAP_YAW** | 4 | 4 | 1 | Swap Roll and Yaw |
| **RC1_REVERSED** | 0 | 0 | 0 | |
| **RC2_REVERSED** | 0 | 0 | 0 | |
| **RC3_REVERSED** | 1 | 1 | 0 | Reversed for Herelink |
| **RC4_REVERSED** | 0 | 0 | 0 | |
| **SERIAL0_PROTOCOL** | 1 | 1 | 1 | USB Port, Linked to SR0 |
| **SERIAL1_PROTOCOL** | 1 | 1 | 2 | Telem1 Port, Linked to SR1 |
| **SERIAL2_PROTOCOL** | 1 | 1 | 2 | Telem2 Port, Linked to SR2 |
| **SERIAL3_PROTOCOL** | 5 | 5 | 5 | GPS1 Port used for external GPS |
| **SERIAL4_PROTOCOL** | -1 | -1 | -1 | GPS2 Port A, Disabled |
| **SERIAL5_PROTOCOL** | -1 | -1 | -1 | GPS2 Port A, Disabled |
| **SERVO1_FUNCTION** | 33 | 35 | 35 | 33 = Motor1 = Top Front Right |
| **SERVO2_FUNCTION** | 34 | 33 | 33 | 34 = Motor2 = Top Front Left |
| **SERVO3_FUNCTION** | 35 | 36 | 36 | 35 = Motor3 = Top Rear Left |
| **SERVO4_FUNCTION** | 36 | 34 | 34 | 36 = Motor4 = Top Rear Right |
| **SERVO5_FUNCTION** | 37 | 39 | 39 | 37 = Motor5 = Bottom Front Left |
| **SERVO6_FUNCTION** | 38 | 40 | 40 | 38 = Motor6 = Bottom Front Right |
| **SERVO7_FUNCTION** | 39 | 37 | 37 | 39 = Motor7 = Bottom Rear Right |
| **SERVO8_FUNCTION** | 40 | 38 | 38 | 40 = Motor8 = Bottom Rear Left |
| **SERVO9_FUNCTION** | 61 | 61 | 61 | Links Aux1 Port to RC11, Strobes |
| **SERVO10_FUNCTION** | 62 | 62 | 62 | Links Aux2 Port to RC12, FLIR PWM#1 |
| **SERVO11_FUNCTION** | 60 | 60 | 60 | Links Aux3 Port to RC10, FLIR PWM#2 |
| **SERVO12_FUNCTION** | 10 | 10 | 10 | Links Aux4 Port to Camera Trigger, FLIR PWM#3 |
| **SERVO13_FUNCTION** | 0 | 0 | 0 | Not Used |
| **SERVO14_FUNCTION** | 0 | 0 | 0 | Not Used |
| **MNT_RC_IN_TILT** | 9 | 9 | 9 | Links Gimbal Tilt to RC9 |
| **CH7_OPT** | 9 | 9 | 9 | RC7 High forces Camera Trigger event |
| **CH8_OPT** | 4 | 4 | 4 | RC8 High forces RTL Flight Mode |

# Appendix L  Making Sense of Motor Tests

## Chapter Contents

## Making Sense of Motor Tests

When running a motor test within Mission Planner the motors are identified alphabetically, not numerically. The table below shows the link between the Motor Location ID, the Motor Test ID, and the expected rotational direction of the motor.

| Motor Test ID | Motor Map ID | Rotation | Motor Map |
|:---:|:---:|:---:|:---:|
| A | 1 | CCW | |
| B | 6 | CW | |
| C | 4 | CW | |
| D | 7 | CCW | |
| E | 3 | CCW | |
| F | 8 | CW | |
| G | 2 | CW | |
| H | 5 | CCW | |

# Appendix M **Serial Port Assignment**

## *Chapter Contents*

## Serial Port Assignment

| Carrier Port | External Access Point | Serial Channel | Protocol | SRx Assignment |
|---|---|---|---|---|
| USB | Rear of Aircraft | Serial0 | 1: MAVlink1 | SR0 |
| Telem1 | N/A | Serial1 | 2: MAVlink2 | SR1 |
| Telem2 | Bottom of Aircraft | Serial2 | 2: MAVlink2 | SR2 |
| GPS1 | N/A | Serial3 | 5: GPS | N/A |
| GPS2 | N/A | Serial4 | -1: None | N/A |

# Appendix N Breakout Board Connections and Pinouts

## Chapter Contents

## Introduction

The RangePro RPX8-P includes a breakout board underneath the airframe, just above the payload area. Connections include 12V power, serial, Ethernet, I2C, SBus, and PWM signals (see figure 56). Depending on your configuration, some mating cables may be provided as part of the drone kit.
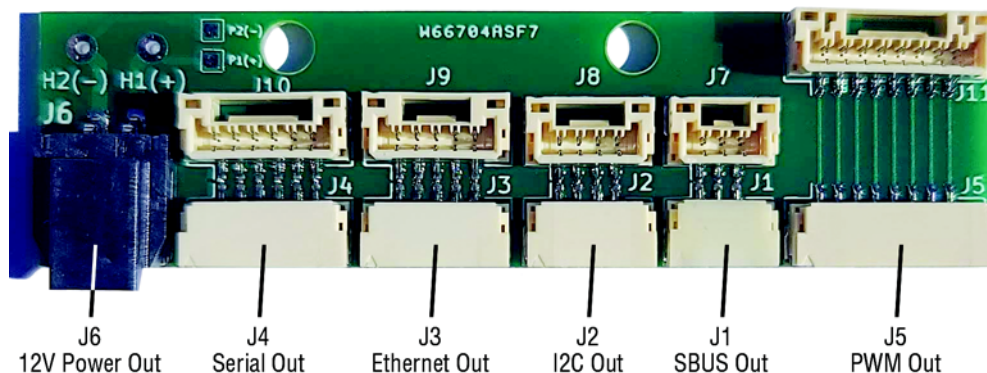


Figure 56. Breakout Board Connectors

## Power Out

Power for external devices provided from 12V BEC internal to the chassis. Maximum draw of 5 Amps.

- Connector ID: **J6**

- Breakout board connector: **Molex 1054301102**

- Mating connector: **Molex 1053071202**

- Mating connector crimp pins: **1053001100**

- Pinout shown in table 2.

Table 2. Power Out Pinout

| Pin | Description |
| --- | --- |
| 1 | Ground |
| 2 | 12VDC |

## Serial Out

Extension of the Telem2 serial port on the carrier board. In Ardupilot this port is typically referenced as Serial2 and, as long as Serial0 and Serial1 are set to use the Mavlink protocol, the parameter rates are typically set with the SR2 commands. This is a one-to-one connection that mimics the port on the carrier board.

- Connector ID: **J4**

- Breakout board connector: **JST SM06B-GHS-TB(LF)(SN)**

- Mating connector: **JST GHR-06V-S**

- Mating connector crimp pins: **JST SSHL-002T-P0.2**

- Pinout shown in table 3.

Table 3. Serial Out Pinout

| Pin | Description |
|-----|-------------|
| 1 | VCC/VCC |
| 2 | TX/TX |
| 3 | RX/RX |
| 4 | CTS/CTS |
| 5 | RX/RX |
| 6 | GND |

## Ethernet Out

Extension of the Ethernet port from the radio system, typically the J4 WAN Ethernet port of the Picoradio. While the Picoradio uses a 9-pin connector, it only uses the first five pins for standard Ethernet connectivity. This connector follows the same pinouts.

- Connector ID: **J3**

- Breakout board connector: **JST SM05B-GHS-TB(LF)(SN)**

- Mating connector: **JST GHR-05V-S**

- Mating connector crimp pins: **JST SSHL-002T-P0.2**

- Pinout shown in table 4.

Table 4. Ethernet Out Pinout

| Pin | Description |
|-----|-------------|
| 1 | ETH_1_T+ |
| 2 | ETH_2_T- |
| 3 | ETH_3_R+ |
| 4 | N/C |
| 5 | ETH_6_R- |

## I2C Out

Extension of the I2C port on the carrier board. This is a one-to-one connection that mimics the port on the carrier board.

- Connector ID: **J2**

- Breakout board connector: **JST SM04B-GHS-TB(LF)(SN)**

- Mating connector: **JST GHR-04V-S**

- Mating connector crimp pins: **JST SSHL-002T-P0.2**

- Pinout shown in table 5.

Table 5. I2C Out Pinout

| Pin | Description |
|-----|-------------|
| 1 | VCC |
| 2 | SCL |
| 3 | SDA |
| 4 | GND |

## SBus Out

Extension of the SBus pins on the carrier board.

- Connector ID: **J1**

- Breakout board connector: **JST SM03B-GHS-TB(LF)(SN)**

- Mating connector: **JST GHR-03V-S**

- Mating connector crimp pins: **JST SSHL-002T-P0.2**

- Pinout shown in table 6.

Table 6. SBus Out Pinout

| Pin | Description |
|-----|-------------|
| 1 | GND |
| 2 | VCC |
| 3 | S.OUT |

## PWM Out

Extension of the PWM pins on the carrier board.

- Connector ID: **J5**

- Breakout board connector: **JST SM08B-GHS-TB(LF)(SN)**

- Mating connector: **JST GHR-08V-S**

- Mating connector crimp pins: **JST SSHL-002T-P0.2**

- Pinout shown in table 7.

Table 7. PWM Out Pinout

| Pin | Description |
|-----|-------------|
| 1 | N/C |
| 2 | AUX 2 |
| 3 | AUX 3 |
| 4 | AUX 4 |
| 5 | AUX 5 |

Table 7. PWM Out Pinout (Continued)

| Pin | Description |
|-----|-------------|
| 6 | AUX 6 |
| 7 | GND |
| 8 | N/C |

## Related TerraView Breakout Cables

| Cable Number | Description | Note |
|--------------|-------------|------|
| 10000061 | Serial to Pixy QuickConnect | Six-pin JST to six-pin JST; serial crossover cable can be installed in either direction |
| 10000063 | I2C Pigtail | Four-pin JST with four wire leads |
| 10000065 | SBus Pigtail | Three-pin JST with three wire leads |
| 10000067 | Aux to Pixy QuickConnect | Eight-pin JST to eight-pin JST; connector with pins 2, 3, 4 & 7 populated plugs into aircraft; connector with pins 4, 5, 6 & 7 populated plugs into QuickConnect |
| 10000074 | FLIR GPS Mini Cable | SMA to right-angle SMA connector used to connect passive GPS antenna port to payload |
| 10000079 | Power to Pixy QuickConnect | Black two-pin connector plugs into aircraft; white two-pin connector plugs into QuickConnect |
| 10000089 | Ethernet Pigtail | Five-pin JST with four wire leads |
| 10000090 | Ethernet to RJ45 | Five-pin JST terminating in an RJ45 |

# Appendix O **Shipping Lithium Polymer Batteries**

## *Chapter Contents*

## Introduction

The TerraView RangePro RPX8-P series of batteries, RP6S24KHDx are considered Class 9 Hazardous Material and must be shipped accordingly per UN3480. These are very strict regulations regarding shipment of batteries containing lithium.

| ⚠ **IMPORTANT** | Keep the shipping material that shipped with the batteries! |

## Basic Shipping Requirements

| ⚠ **WARNING** | **If you are not properly trained and certified as a hazardous material shipper, consult a local shipping agency such as FedEx or UPS.** |

When shipping these batteries for return to TerraView or a third party, the following basic requirements must be met:

1.  The shipping box must meet the U3480 regulation. The packaging in which the batteries shipped is appropriate and approved.

2.  For Class 9 Hazardous Materials under UN3480, the label shown in figure 57 must be present on the shipping container.



Figure 57. Shipping container label

3. The capacity of these batteries does not allow for shipping on passenger aircraft. The label shown in figure 58 must also be present on the shipping container when shipping via air. When shipping via ground, this label is not required.



Figure 58. Cargo aircraft only label

4. Finally, UN3480 covers shipping lithium batteries shipped by themselves. To indicate this on the packaging, the label shown in figure 59 is also required. The shipper's phone number should be included on the label.



Figure 59. UN3480 label

# Appendix P  Using the D400 Charger with a RangePro RPX8-P Battery

## Chapter Contents

## Introduction

The Range Pro X8 RP6S24KHDx is a dual 6S2P, 24,000 mAh, high density, battery pack consisting of two independent 6S2P Lithium Ion Polymer battery packs installed in a single battery cage. The battery packs are impedance matched at the factory, placed in a common cage, and wired independently to a single connector.

On the aircraft the unit provides a blind mating power solution with easy insertion and extraction from the system using a dovetail rail system and latching mechanism. The power pins from both battery packs, though housed in the same connector, are independently routed to the aircraft power sensor module.

For charging, power and balance port connectors are separately wired for each battery pack and broken out for connection to a charger using a custom cable. To connect the RP6S24KHDx to the SKYRC Ultimate Duo 400W (D400) Balance Charger, use the RPBCCA400-12 twelve-inch cable that includes a battery mating connector on one end and two sets of power and balance ports on the other. Custom cable lengths are available upon request.

This appendix provides instructions on how to customize the D400 charger for use with the RP6S24KHDx battery as well as some common troubleshooting steps for addressing issues that may arise when the unit is not set up correctly. For additional details on how to use the D400, refer to the Ultimate Duo Instruction Manual provided with the charger.

## Modify and Verify System Settings

Verify the correct system settings for BOTH charging channels using the following steps:

1. Power-on the Ultimate Duo 400W Charger (D400).

2. Press the *STATUS* "+" or "-" buttons for the channel until the display screen reads:

   **BATT/PROGRAM**
   **SYSTEM SETTING->**

3. Press *ENTER* " ▶ " to review the system settings.

4. To scroll from one parameter to another, use the *STATUS* "+" or "-" buttons.

5. To change the value of a parameter enter into editing mode by pressing *ENTER* " ▶ ".

6. In editing mode, the value of the selected parameter will blink slowly. Press the *STATUS* "+" or "-" button to adjust the parameter value. When the value is set correctly exit the editing mode by pressing the *ENTER* " ▶ " button. Some screens contain two parameters. In this case, pressing the *ENTER* " ▶ " button will close editing for the first parameter and open editing for the second parameter. *ENTER* " ▶ " a second time will close editing on the second parameter.

| Parameter | Channel 1 Value(s) | | Channel 2 Value(s) | |
|---|---|---|---|---|
| **Max Power Set** | 200W | | 200W | |
| **Synchronization**[a] | OFF | | N/A | |
| **Safety Timer** | ON | 150Min | ON | 150Min |
| **Capacity Cut-Off** | ON | 12600mAh | ON | 12600mAh |
| **Temp Cut-Off** | ON | 50C 122F | ON | 50C 122F |
| **Temperature Unit** | Celsius | | Celsius | |
| **Rest Time CHG\DCHG** | 10Min | | 10Min | |
| **NiMH Sensitivity** | N/A | | N/A | |
| **NiCd Sensitivity** | N/A | | N/A | |
| **Key Beep** | ON | | ON | |
| **Buzzer** | ON | | ON | |
| **DC Input Low Cut-Off** | 11.0 V | | 11.0 V | |
| **Balance Port** | Enable | | Enable | |
| **Load Factory Set** | (See Manual) | | (See Manual) | |

a. In most cases Synchronization can be set to *ON* but it is important to note that in rare cases Synchronization may prevent one side or another from charging properly if there is a significant mismatch between battery states. Also note that while Synchronization will ensure the same program is being used by both sides of the charger, in the case of custom Battery Memory programs it does not ensure that the programs for each channel are identical. Battery Memory programs must be independently set on each side of the charger.

7. When all system settings for the channel have been properly set and verified, press the *BATT/PROG* "∎" button to return to the main menu.

8. If not already completed, repeat steps 2 through 7 for the other charging channel.

## Program Battery Memory Charge Settings

Verify the correct Battery Memory settings for BOTH charging channels using the following steps:

1. Power-on the Ultimate Duo 400W Charger (D400).

2. Press the *STATUS* "+" or "-" buttons for the channel until the display screen reads:

   **[BATT MEMORY 1]**
   
         **ENTER SET->**

3. Press *ENTER* "▶" to gain access to the ten (10) battery memory locations.

4. Use the *STATUS* "+" or "-" buttons to scroll through the locations until the screen reads:

   **BATT/PROGRAM**
   
         **BATT MEMORY**

5. Press *ENTER* "▶" to verify the correct setting for Battery Memory 1.

6. To scroll from one parameter to another, use the *STATUS* "+" or "-" buttons.

7. To change the value of a parameter enter into editing mode by pressing *ENTER* "▶".

8. In editing mode, the value of the selected parameter will blink slowly. Press the *STATUS* "+" or "-" button to adjust the parameter value. When the value is set correctly exit the editing mode by pressing the *ENTER* "▶" button.

| Parameter | Channel 1 Value(s) | Channel 2 Value(s) |
|---|---|---|
| **BATT TYPE** | LiHV | LiHV |
| **BATT VOLTAGE** | 22.8V(6S)OFF | 22.8V(6S)OFF |
| **CHARGE CURRENT** | 6.0A | 6.0A |
| **DSCHG CURRENT** | 3.0A | 3.0A |
| **DSCHG VOLTAGE** | 3.2V/CELL | 3.2V/CELL |
| **TVC=YOUR RISK!** | 4.30V | 4.30V |
| **SAVE PROGRAM** | (see below) | (see below) |

9. When all system settings for the channel have been properly set and verified it is necessary to save the programmed values. The last option in the parameter list is "*SAVE PROGRAM*". To save the program press the *ENTER* "▶" button. On the screen the word "*ENTER*" will disappear and be replaced with the word "*SAVE…."* When these memory settings have been saved the display screen will return to the Battery Memory screen and alternate between the following.

**[BATT MEMORY 1]**          **[BATT MEMORY 1]**

**LiHV 22.8V(6S)**           **C:6.0A   D:3.0A**

10. Press the *BATT/PROG* "■" button to return to the main menu.

11. If not already completed, repeat steps 2 through 10 for the other charging channel.

> ⚠️ **IMPORTANT**  Anytime the BATT TYPE is changed and the program saved, the TVC (Terminal Voltage Charge) is reset to the default voltage for that battery type and will remain at the default value until manually changed by the user. **Prior to saving the program always confirm the TVC is set to the correct value!**

## Balance Charge the Battery Using Battery Memory #1

1. Start up the Ultimate Duo 400W Charger (D400)

2. Press the *STATUS* "+" or "-" buttons for the channel until the display screen reads:

**BATT/PROGRAM**
        **BATT MEMORY**

3. Press *ENTER* "▶" to gain access to the ten (10) battery memory locations.

4. Use the *STATUS* "+" or "-" buttons to scroll through the locations until the top line of the display screen reads:

   **[BATT MEMORY 1]**

5. Press and hold *ENTER* " ▶ " until the unit beeps and the top line of the display screen reads:

   **LiHV BALANCE**

6. To select a different mode, Press the *STATUS* "+" or "-" buttons to cycle through the available modes. Available modes include:

   – LiHV BALANCE

   – LiHV CHARGE

   – LiHV FAST CHG

   – LiHV STORAGE

   – LiHV DISCHARGE

7. When the correct mode is selected, Press and hold *ENTER* " ▶ " until the unit beeps. The unit will perform a battery check to ensure the correct type of battery is properly installed. Assuming there are no errors, the display screen will alternate between the following:

   **R: 6SER    S:6SER              R: 6SER    S:6SER**

   **CONFIRM(ENTER)              CANCEL(STOP)**

8. Press *ENTER* " ▶ " to proceed to the next step or press *BATT/PROG* "■" to cancel. If continuing with charging the display screen will read:.

   **WARNING For LiHV**

   **Battery only [OK]**

9. Press *ENTER* " ▶ " to proceed to the next step or press *BATT/PROG* "■" to cancel.

10. If not already completed, repeat steps 2 through 9 for the other charging channel.

11. If after the program has started it is necessary to stop the program, press the *BATT/PROG* "■" button to stop the current program and return to the main menu.

## Troubleshooting Common Charging Errors

### *The Channel Times Out Before Charging is Complete*

1. Error Message: *OVER TIME LIMIT*.

2. In the system settings:

   a. Set the Safety Timer to *OFF* to prevent this from ever happening, OR

   b. Set the Safety Timer to *ON* and 150 minutes

**Note**  Each Range Pro X8 RP6S24KHDx battery pack requires approximately 12,000 mAH for a full charge. At 6 Amps this equates to two hours or 120 minutes.

Another 30 minutes is added to support the extra time required to complete final balancing at lower currents.

### The Channel Stops Charging Due to an Over Charge Capacity Limit

1.  Error Message: *OVER CHARGE CAPACITY LIMIT.*

2.  In the system settings:

    a.  Set the Capacity Cut-Off to *OFF* to prevent this from ever happening, OR

    b.  Set the Capacity Cut-Off to ON and 12,600 mAH

        **Note**  Each Range Pro X8 RP6S24KHDx battery pack requires approximately 12,000 mAH for a full charge.

        Another 5%, or 600mAh, is added to permit support for some more extreme battery drainage situations.

### The Channel Charges Batteries to 4.35V per Cell

1.  Error Message: None - determined when checking battery cell voltages after charging is completed.

2.  Within memory setup, anytime the BATT TYPE field is opened for editing, the TVC (Terminal Voltage Charge) is reset to the default voltage for that battery type. The user is not informed of this background change. If the program is then saved without ensuring the TVC is set correctly, the memory setup will overwrite the previous setting and use the default.

    a.  The custom memory program for the Range Pro X8 RP6S24KHDx battery pack uses the LiHV setting, which has a default TVC value of 4.35 VDC.

    b.  For the Range Pro X8 RP6S24KHDx battery pack the correct TVC value is 4.30 VDC.

    c.  After changing the battery type and prior to charging, always confirm the TVC is set to the correct value.

3.  Why does this resetting of the TVC sometimes happen unexpectedly?

    a.  To start a charging sequence using Battery Memory 1, the user needs to press and hold the *ENTER* "▶" key.

    b.  To start editing setup for Battery Memory 1, the user needs to press the *ENTER* "▶" key.

    c.  If a user is not careful and, starting at the [BATT MEMORY 1] screen, presses the *ENTER* "▶" key twice in a row, the system enters edit mode for the Battery Type. Even if no change is made in this field, the TVC is updated to match the default TVC for the battery type selected. To prevent the default value from being saved either press *BATT/PROG* "■" to cancel without saving or prior to saving, adjust the TVC to the correct value.

### *The Charger Will Only Charge the Battery at 0.1A and it Takes a Long Time*

1.  This can happen when a battery is significantly drained beyond normal operating voltages and the cell voltages have fallen below a certain charging threshold.

2.  When using the LiHV model as a basis for a customized program, if the total battery voltage is below 20.4 volts (3.4 volts per cell), the charger will only trickle charge at 0.1A until the battery reaches the minimum voltage threshold. After all cells exceed the minimum voltage threshold the unit will switch to charging at full current until the process nears completion. Near the end of the charging process the current will slowly decrease as the individual cells are finely balanced.

3.  One way to accelerate the charging process when slow charging occurs is to start charging in the LiPO mode, being sure to set the channel to 6Amps and a 6S configuration, which has a lower charging threshold of 19.8 (3.3 volts per cell). After the battery voltage exceeds 20.4 volts per cell switch to the customized LiHV model to obtain a full charge of 4.30 volts per cell.