Precision RDASS

Aircraft Flight Manual

Contents

1. INTRODUCTION

Congratulations on your purchase of the Precision RDASS. The RDASS offers a superior aerial data collection platform. Leptron provides this manual to support safe, effective, and legal operations of our small Unmanned Aircraft System (sUAS). You can ensure that you are getting the maximum benefit from your sUAS by strictly observing all operating procedures and practices outlined in this manual. You should regularly check leptron.com for updates to this manual, as this manual is subject to change without notice. For service and support call (800) 722-2800.

1.1 Documentation Conventions

NOTE	An operating procedure, condition, etc., which is essential to highlight.
CAUTION	An operating procedure, practice, etc. which, if not strictly observed, could result in damage to or destruction of equipment.
WARNING	An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.
SHALL:	used to indicate a mandatory requirement
WILL:	used to express a declaration of purpose
SHOULD:	used to indicate a nonmandatory but preferred method of accomplishment
MAY:	used to indicate an acceptable method

1.2 Notes, Cautions, and Warnings

NOTE	Read the entire manual before operating the RDASS
NOTE	This manual shall be immediately available to the operator at all times during operation of the RDASS. Check leptron.com regularly to ensure the most up-to-date version of this manual is used
NOTE	Always use the Flight Checklist provided herein during flight. A supplemental laminated Flight Checklist (P/N: 27670008) may be substituted to meet this requirement
NOTE	Maintain a Pilot Log and an Inspection & Maintenance Log for all flights (FAA 14 CFR 61.51 (b). Additional log sheets are available on leptron.com
NOTE	Comply with all FAA (or similar aviation authority) and local regulations
NOTE	Before flying, check for Temporary Flight Restrictions (TFRs), Military Training Routes (MTRs), and Notice to Airmen (NOTAMs) that may affect your planned flight
NOTE	If you experience any issue not covered in this manual, please contact a Leptron Authorized Dealer. A list of dealers can be found at leptron.com Or call (800) 722-2800 for assistance.
NOTE	Do not leave ToughPad in direct sunlight. The ToughPad can overheat and will not be usable until the temperature of the ToughPad drops sufficiently
CAUTION	Keep the aircraft in Visual Line of Sight (VLOS) at all times. Visual Line of Sight SHALL be maintained at all times by either the PIC or VO
CAUTION	Do not fly within 500 feet below or within 2000 feet horizontally of any cloud

CAUTION	ONLY use Leptron provided rotors. See Chapter 8 for rotor replacement procedure.
CAUTION	Keep the compass module away from magnets including car speakers. Magnets can damage the compass and can cause the aircraft to lose control.
CAUTION	Do not leave LiPo batteries in direct sunlight. This can reduce the life of the batteries
CAUTION	Do Not Expose LiPo batteries to temperatures below 20°F. The internal battery cells can freeze and rupture
CAUTION	Verify the Wi-Fi function is disabled on GoPro to avoid interference with the Radio Controller, which may adversely affect RDASS controllability.
CAUTION	Do not leave LiPo batteries unattended while charging. An undetected fault in the charger could cause a fire
CAUTION	Failure to install antennas can cause permantant damage to equipment . Always install antennas prior to powering any equipment that uses an antenna.
CAUTION	Do not Fly at night
WARNING	Flight within 5 nautical miles of any airport requires special permissions, a VHF 2-Way radio, and coordination with Air Traffic Control (ATC) a minimum of 24 hours in advance.
WARNING	Always give right of way to manned aircraft.

WARNING	Before flying you should seek out flight training from a qualified instructor. Leptron recommends receiving flight training from a Leptron factory trained instructor.
WARNING	Maintain 500 foot clearance from all persons and property when conducting a post-maintenance functional test flight
WARNING	Beware of spinning motors and propellers
WARNING	Motors can be very hot after flight!
WARNING	Do not alter auto-pilot firmware or settings. Flight stability can be negatively affected

2. RDASS SYSTEM DESCRIPTION

2.1 List of Components

Table 1: RDASS Basic Components

Item	Qty	Description	Part Number
A	1	Pelican Case with foam	57605018
B	1	Battery Charger	17605036

Item	Qty	Description		Part Number
C	1	HMMWV Adapter Cable		17606741
D	2	Flight Battery		57605014
E.0	1	GB200 Gyro Gimbal		17606742
E.1	1	RDASS Antenna		17606701
E.2		Camera		17606099
F	2	Anti-Crush Tubes with Vinyl Caps		27606044 17606586
G	1	DX9 Radio Transmitter with Charger		57605024

Table 2: RDASS Ground Station Components (Part # 87606009)

Item	Qty	Description		Part Number
H.0	1	Toughpad		17600004

Item	Qty	Description		Part Number
H.1	1	Microhard Radio		17600009
H.2	2	Ground Station Battery Pack (one pre-installed)		17606704
H.3	1	Microhard Radio Case		57606003
H.4	1	Ground Station Antenna		17606736
H.5	1	Toughpad Case		17606755
-	1	24 Volt Power Supply		17605035
-	1	Laminated Checklist		27670008

Table 3: RDASS Maintenance Kit (Part # 57605030)

Item	Qty	Description		Part Number
-	1	Wattmeter		17606022
-	1	Dynamite Driver toolkit		17606091

Item	Qty	Description		Part Number
-	1	10mm open/closed end wrench		17606176
-	1	Spare Battery, DX9 Radio		27606155
-	2	Spare e-Props (Right)		17606024
-	2	Spare e-Props (Left)		17606025
	1	HDMI Cable		17606431

Table 4: Optional Equipment

Item	Qty	Description		Part Number
P	1	SanDisk 64 GB Card		17606527
-	1	Gyro Stabilized Dual Camera Gimble		17606769
-	1	FLIR Camera		17606639

2.2 Flight Tablet

Stylus with right-click Button

Power Button

Screen Orientation

Start Menu

Volume Increase

Volume Decrease

Digital Keyboard

Dashboard for PC
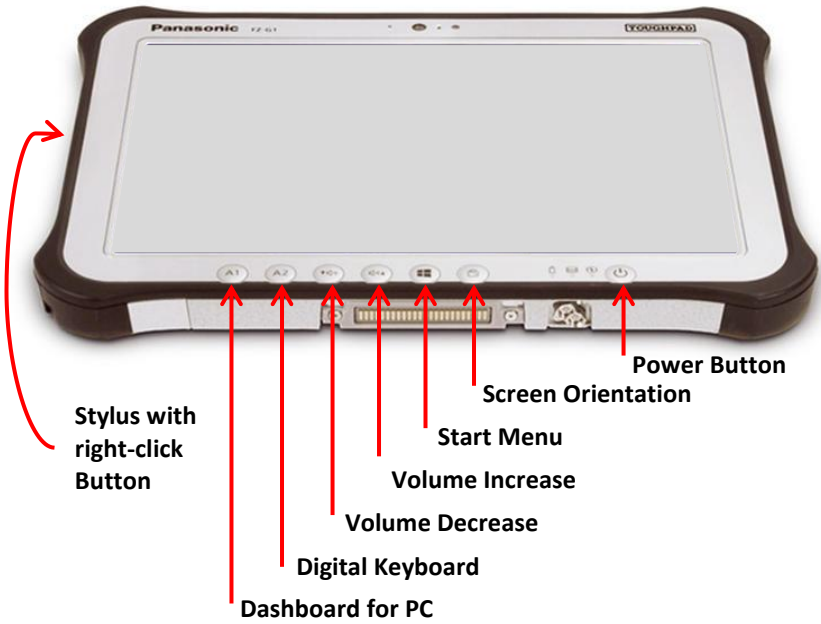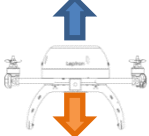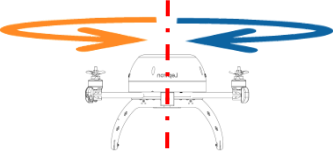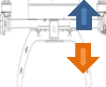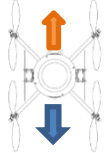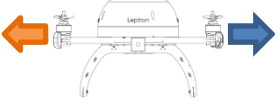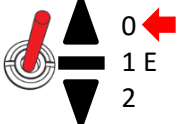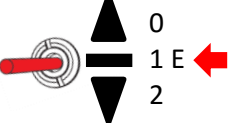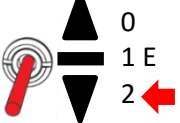
CAUTION	The Pilot-on-the-Controls must exercise caution when directing attention to the live video. Always use a Visual Observer to assist in maintaining situational awareness of aircraft positioning and to aid in obstacle avoidance

2.3 DX9 Radio Controller Switchology

LED indicator – Orange = Power ON
– Blue = Charging Battery

Count-Down Timer Switch

Power Switch

Flight Mode Switch

Throttle Trim

Yaw Trim

Pitch (Fore)/Aft Trim

Lateral Trim

Count-Down Timer

Throttle	Climb Descend	
Yaw Control	Yaw Left Yaw Right	
Pitch Control	Fly Forward Fly Rearward	
Roll Control	Fly Right Fly Left	
0 1 E 2	Auto-Pilot Mode	The aircraft receives flight commands from the tablet
0 1 E 2 0 1 E 2	Steering Mode	Position 1 and Position 2 on the Flight Mode Switch have identical functions. The aircraft receives flight commands from the DX9 Remote Control

2.4 Ground Station Components

Ground Station Antenna

Power Switch

Battery Access Door

Voltage
LED Status

Ethernet Port

Connection Signal
LED Status
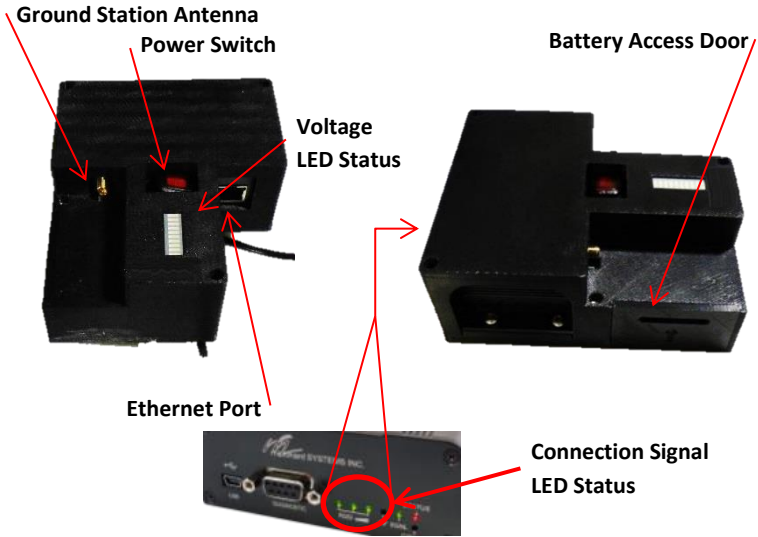
2.5 Hyperion Charger Components

Banana Clip to Anderson Powerpole

Power Source

Battery Charger

Balance Board

3. BATTERY PROCEDURES

3.1 Battery Safety

CAUTION	The operator should not begin a flight with less than 25.0 Volts on the Flight Battery.
	DO NOT discharge the flight battery beyond 80% of its capacity (7,200 mAh), or leave the battery plugged into the RDASS when unused. If the LiPo flight battery is over discharged the battery may be irreparably damaged.
	Never allow batteries or battery packs to come into contact with moisture at any time. Store the battery in a cool and dry environment.
	Do not use or store the battery near fire.
	Only use provided charger to charge batteries.
	Dropping the battery can cause it to rupture; Avoid Puncturing the battery; Do not disassemble or alter the battery in any way.
	Do not use or store the battery in extreme heat environments, such as direct sunlight or in a car. Overheating the battery may affect the performance of the battery and shorten the service life of the battery.
	Use a clean dry lint-free cloth to clean battery contacts.
	Battery electrolyte gel can be harmful or fatal if swallowed. Battery electrolyte gel is an eye irritant. If battery ruptures, avoid getting any gel in your eyes. If battery electrolyte gets in eyes, flush eyes with water then seek medical assistance immediately.
	If the battery gives off a foul odor, the battery swells, or any other abnormal phenomena occur, discontinue use of the battery and discard the battery in accordance with local laws and regulations.
	Do not charge batteries unattended. Undetected faults in the charger could cause a fire

3.2 Charging the DX9 Radio Controller

The DX9 has an internal charger designed to charge the included 2-cell Li-Ion battery at a charge rate of 200mAh. The charge port on the right side of the transmitter is not polarity-dependent. Always charge the transmitter on a heat resistant surface.

1. Power off your transmitter.
2. Connect the power supply connector to the transmitter charge port.
3. Connect the power supply to a power outlet using the appropriate adapter.
4. The blue LED on the front of the transmitter turns on during charging and turns off when the battery is fully charged.
5. Disconnect the transmitter from the power supply once charging is complete and disconnect the power supply from the power outlet.

	Never connect an external battery charger to your DX9 transmitter. If you wish to charge the Li-Ion battery using a Lipo/ Li-Ion charger, you must remove the battery from the transmitter before charging.
CAUTION	

3.3 Charging the GoPro

Charge the battery by connecting the camera to a computer or other USB charging adapter using the included USB cable. The camera status light turns on during charging and turns off when charging is complete. Use on 5V 1A charger.

3.4 Testing LiPo Battery Voltage

To determine the voltage of either the Flight Battery or the Ground Station Battery connect the battery to the appropriately configured side of the Wattmeter.
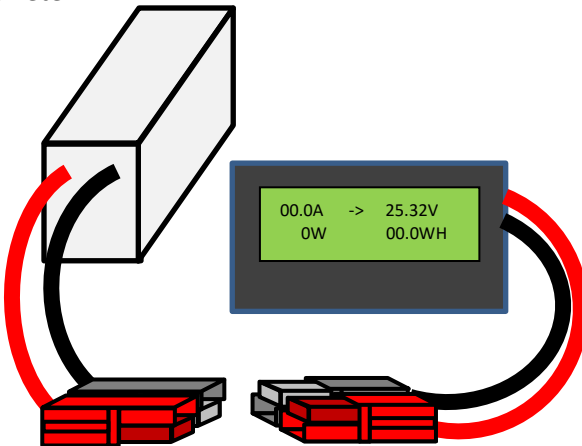
3.5 Ground Station In-line Connector

The Ground Station voltage input is limited to 12.6 volts. The Battery leads on the Ground Station and Ground Station Battery have been configured in such a way as to discourage connecting a 25 Volt flight battery. A short in-line connector is provided with the battery charger In order to charge the Ground Station Battery.

3.6 Hyperion Charger Setup

1. Connect the balancer connector to the front of the charger.
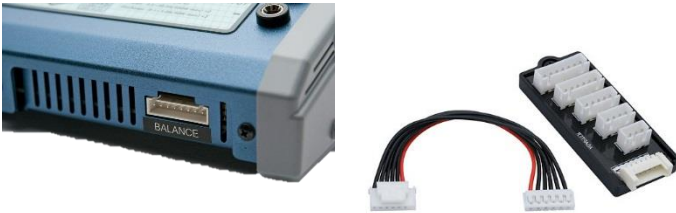
2. Plug in the banana-clip-to-Anderson-Powerpole cable to the Hyperion Charger.
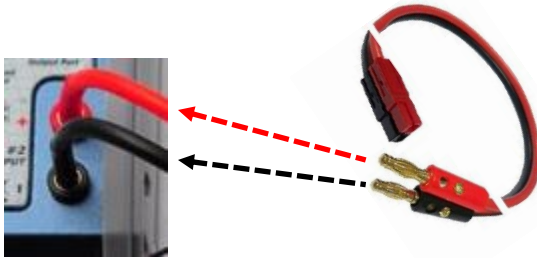
3. Connect the Hyperion charger to a 24V Power Supply

-OR-

Connect the battery to both the Anderson Powerpole connector and the balance board.
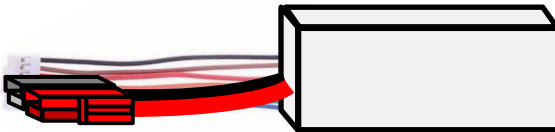
⚠️ **WARNING**	Do not remove the banana-clip-to-Anderson-Powerpole cable from the charger while connected to the battery. The terminal ends can contact and create a dangerous short condition.

3.7 Charging and Balancing LiPo Batteries
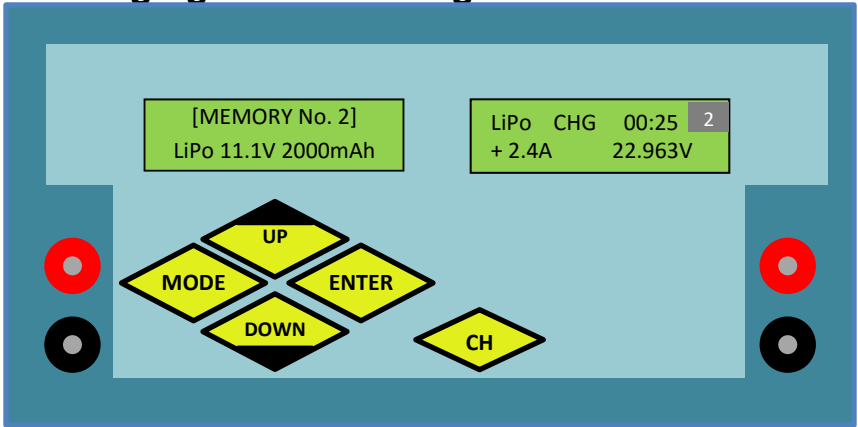

```
[MEMORY No. 2]            LiPo  CHG   00:25   2
LiPo 11.1V 2000mAh        + 2.4A       22.963V
```

1. Press **CH** to select channel (left/right side of charger).

2. Press **ENTER** to highlight MEMORY.

3. Press **UP** or **DOWN**. Use [Memory No.1] for Flight

   Batteries and [Memory No. 2] for Ground Station Batteries.

4. Press and hold **ENTER** for 2 seconds to confirm selection.

5. Press and hold **ENTER** for 2 seconds to check battery .

```
-- --   BATTERY   -- --       **   BATTERY   **        CONNECTED CELLS
-- --    CHECK    -- --       **    CHECK    **        [6 CELLS]    23.786V
```

6. Press **ENTER** to start charging.

7. Press **MODE** then **UP** or **DOWN** during charging
   to view additional information.
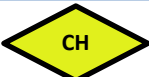
```
LiPo  CHG   00:25        C 0027mAh  25 Vi        [    BALANCER    ]
+ 2.4A       23.786V     + 2.4A      23.786V      1CL  3.963V  59%
```

8. Press and hold **ENTER** for 2 seconds to abort charging.

3.8 Storing LiPo Batteries
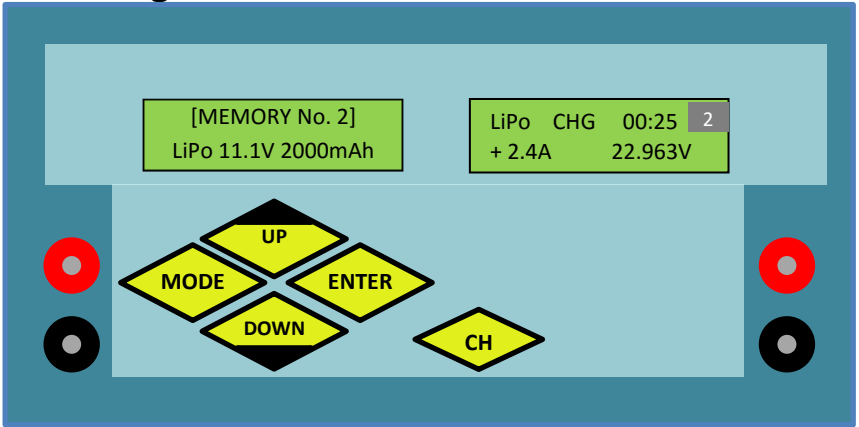
| [MEMORY No. 2] | LiPo   CHG   00:25   2 |
| LiPo 11.1V 2000mAh | + 2.4A   22.963V |

1. Press **CH** to select channel (left/right side of charger).

2. Press **ENTER** to highlight MEMORY.

3. Press **UP** or **DOWN**. Use [Memory No.1] for Flight

    Batteries and [Memory No. 2] for Ground Station Batteries.

4. Press **DOWN** to select STORE MODE

    STORE START
    SOLO MODE

5. Press and hold **ENTER** for 2 seconds to confirm selection.

6. Press and hold **ENTER** for 2 seconds to check battery .

| -- --   BATTERY   -- -- | ** BATTERY ** | CONNECTED CELLS |
| -- --   CHECK   -- -- | ** CHECK ** | [6 CELLS]   22.96V |

7. Press **ENTER** to start de-energizing battery.

8. Press **MODE** to view additional information.

| LiPo CHG 00:25 | LiPo CHG 00:25 | LiPo CHG 00:25 |
| + 2.4A   22.963V | + 2.4A   22.963V | + 2.4A   22.963V |

9. Press and hold **ENTER** for 2 seconds to abort.

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Battery	Type	Charge Setting	Charge Rate (A)	Maximum Voltage (V)	Charge Time
Flight	Lipo	22.2 (6S)	6-8	25.65	~40 min.
Ground Station	Lipo	11.1 (3S)	2	12.25	~20 min.
Camera	Li-ion	USB (5 volt)	1	🔋	~120 min

The Battery Cliff

Volts

25
24
23
22
21
20
19

Time
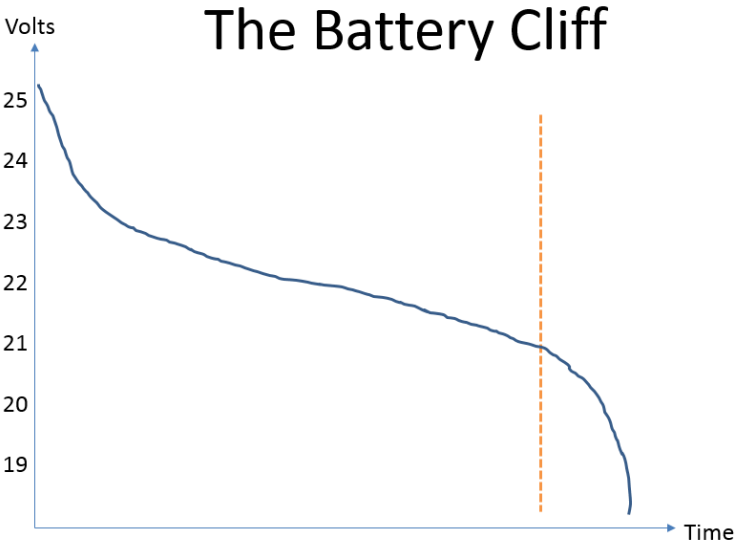
✋ CAUTION	Do not discharge LiPo Batteries more than 80% of their capacity. The flight batteries shall be limited to 7,200 mAh discharge
⚠ WARNING	If a LiPo Battery puffs discontinue use of battery.

4. CAMERAS
4.1 GOPRO BASICS
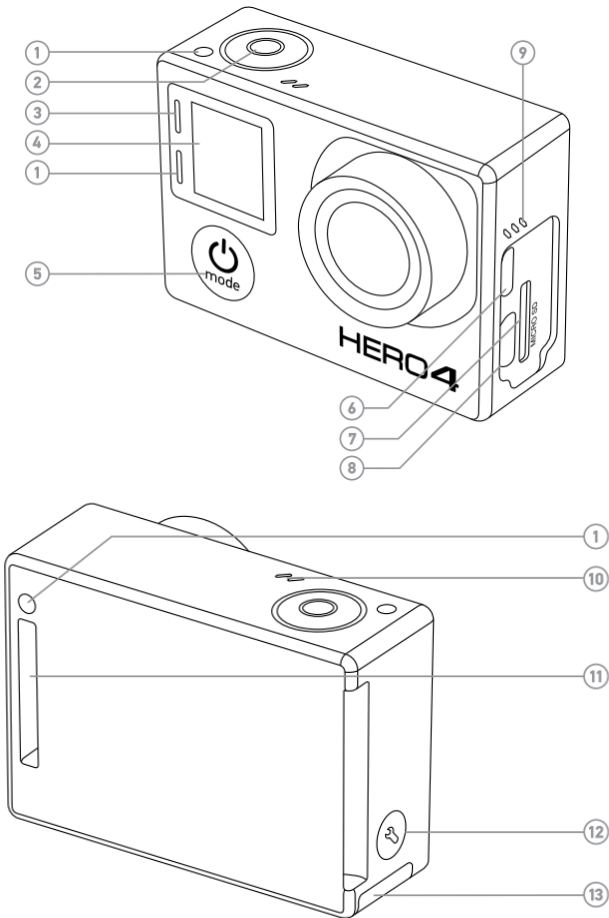
1. Camera Status Light (red)	6. Micro HDMI Port (cable not included)
2. Shutter/Select Button [ ]	7. microSD Card Slot (microSD card not included)
3. Wireless Status Light (blue)	8. Mini-USB Port (supports composite A/V cable/3.5mm stereo mic adapter, not included)
4. Camera Status Screen	9. Audio Alert
5. Power/Mode Button [ ]	10. Microphone
11. HERO Port	12. Settings/Tag Button [ ]
13. Battery Door	

4.1 COMMON CAMERA OPERATIONS

Take Time Lapse Photos

🖼️	🔧	🔴	TIME LAPSE	mode	➰	mode x2	EXIT

Take Time Lapse Video

🎥	🔧	🔴	TIME LAPSE	mode	➰	mode x5	EXIT

Capture Time Interval Stills while recording video

🎥	🔧	🔴	VID + PHOTO	mode	➰	🔴	

Adjust Video Resolution

🎥	🔧	mode	⟷	mode x6	EXIT
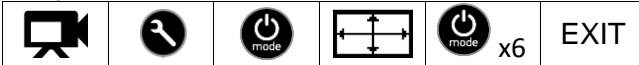
Adjust Photo Resolution

📷	🔧	mode	MP

⏱️📷	🖥️📷

4.2 GOPRO HERO4 MENUS AND S
4.3 TATUS

CAMERA MODES

VIDEO MODES		
🎥 Video	Video + Photo	Looping

VIDEO SETTINGS	
Interval	Video Resolution
FPS Frames Per Second	FOV Field of View
Auto Low Light	Spot Meter
Protune	

PHOTO MODES		
Single Photo	Continuous Photos	Night Photo

PHOTO SETTINGS	
S Shutter	Interval
MP Megapixels	Spot Meter
Protune	

PROTUNE SUB-MENU	
White Balance	Color
ISO Limit	Sharpness
Exposure Value Compensation	

22

SETUP MODE	
📶 Wireless	▤ Touch Display
↑↓ Orientation	⏻ DEFAULT Default Mode
🐇 QuikCapture	☀ LEDs
♪ Beeps	📺 Video Format
OSD On-Screen Display	⏻FF Auto Off
▦ Date/Time	🗑 Delete
💬 Language	

Camera Modes / Field of View

Camera Settings

Resolution

1080S-30

Frames/sec.

Protune™

PT

# of Files Captured

01

Battery Life

Time/Storage/Files

2H:05 ▮▮▮ 📶

Wi-Fi

23

5. PccLite

Video Stream

Cautions and Warnings

Pull to Expand Video

This is where cautions and

ABORT

Land aircraft immediately at current location

Landing Waypoint

Tilt Camera Toward Ground

Aircraft Symbol

Hover Aircraft

Center Map on Aircraft

Select Map Overlays

Configure Speed

CAMS   SPEED   MAP   CENTER   HO

Choose Active Camera

Yaw Aircraft Nose Right

Tilt Camera Toward Horizon

Yaw Aircraft Nose Left

Settings Menu

Count Down Timer

Pre-flight Checklist

warnings appear

PREFLIGHT   0:15:00

Maximum Altitude Set during Pre-Flight — 60

Fly-To Altitude — 41

Minimum Altitude Set during Pre-Flight

Current Altitude — 10 / 6

METERS

+/- 5

Slide Aircraft Forward

Hover Waypoint

Build/Recall Flightplan

Start/Kill Engines

HOVER   PLAN   ENGINE   LAND

Land at

Slide Aircraft Left

Slide Aircraft Aft

Slide Aircraft Right

5.1   Introduction

This chapter covers the capabilities of Piccolo Command Center Lite (PccLite), a Windows PC software application meant mainly for Touchscreen devices, though also usable for Desktop or Laptop. PccLite provides a command and control interface for the Precision RDASS operators. Only the most important features are accessible from this interface, which simplifies the operator experience.

PccLite is designed with ease of use and simplicity in mind. Being primarily designed for touch screen applications, the interface is configured for ease of access and rapid response. Most of the icons in PccLite offer user interaction with the exception of the warnings bar, status tray, and the north arrow indicator.

Piccolo Command Center (PCC) will be used for user-level maintenance such as compass calibrations.

5.2   General layout

From the main page users can see the map window, the abort slider (upper middle), flight controls, command tray (bottom buttons), Preflight button, the settings button, and the video sub-window.

5.3   Video/Map Picture-in-Picture

The upper-left corner of the main page displays the Picture-in-Picture Subwindow (PnP). This drag-able PnP window can be changed to 3 states: Minimized, PnP, and Swapped. In the Minimized state the window will be barely visible in the upper-left corner. In the PnP state the Video (or Map if swapped) will take up a portion of the upper-left screen, allowing the user to view both Map and Video. In the Swapped state, if the user "flicks" (drag the window down and to the right) the window to be larger than the PnP size, the Subwindow will switch positions with the Main window (swapping between Map and

Video). This Swapped state is useful if users prefer flying from a "First Person" viewpoint.

5.4   System Status
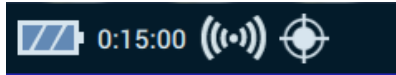
The system status displays the current condition of the autopilot, and has no controls associated with it. The quantities displayed from left to right are Battery charge, flight time remaining (flight timer), communications, and GPS.

5.4.1   Battery Charge

This icon displays the condition of the battery. The battery icon will display different charge levels and colors depending on the defined settings in the Battery section of Mission Limits in the Preflight Checklist. A full battery will be displayed as three blue wedges. When a battery is low, one red wedge will be displayed. When the battery is critical, one thin red bar will be displayed.

5.4.2   Flight Time Remaining

The Flight Time Remaining is controlled by the flight timer, as defined in the mission limits section of the prelaunch checklist. On launch, the Piccolo starts the flight timer and downlinks updated times. Once the time has expired, a warning will appear in the warning tab, and the Flight Time Remaining will change to red.

5.4.3   Communications

This icon indicates the health of the radio command and control communications with the aircraft. When communications are good this icon will remain white. Limits for communications thresholds must be configured during the initial flight testing of the aircraft through PCC.

5.4.4   GPS Health

This icon indicates the health of the GPS solution. When the GPS is within defined limits this icon will remain white. Limits for GPS thresholds must be configured during the initial flight testing of the aircraft through PCC.

5.5   Icons

5.5.1   Aircraft

Depicts the state and position of the aircraft being controlled by PccLite. It is comprised of a dark and light arrow depicting the direction or heading of flight, and is surrounded by a dashed ark that will revolve when the aircraft's engines are active. The aircraft icon also has a transparent arrow beginning at the nose of the icon depicting an estimate of the field of view of the aircraft. Since the Map in PccLite is always "North Up" an aircraft with arrows pointing to the top of the screen is pointing True North.

5.5.2   Waypoints

Waypoints are depicted as dark blue circles atop an arrow pointing to a GPS coordinate. In the center of the icon is a white number annotating the waypoint number. Waypoints outline the flightpath the aircraft will take if commanded. In PccLite, only one flight plan can exist at a time. Once a flight plan is created, users can drag a waypoint to change its position.

5.5.3   Scan Points

These Waypoint-like icons are of the same shape but are a lighter color. Like flight plans, there can only be one existing scan plan, an old scan plan must be deleted before making a new one. Scan points will be covered more in the Map Commands section of this document.

5.5.4   Hover Point

The hover point is depicted as a light blue dot surrounded by a dashed circle. This point can be found by selecting and dragging the aircraft. If the aircraft is commanded to a waypoint the hover point will be left behind at the last location the aircraft was hovering. The user can drag the hover point to a desired location and the aircraft will immediately begin to track the hover point.

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5.5.5   Land Point

The land point is depicted as a white dot surrounded by two light blue circles. This point is used once the user commands land. The land point can be moved by the user via dragging, but the move must be confirmed by the user. If the move is not confirmed in approximately five seconds the land point returns to its original position.

5.6   Abort
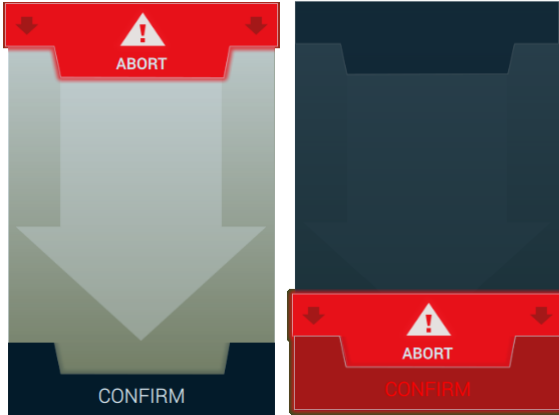
The abort slider can be found in the top middle of the screen. This command is easily accessible and requires no confirmation to activate. Once the abort slider is dragged to the bottom of its range of motion the abort will be commanded. If the engine is off the abort slider will remain gray and indicate an engine off status. Below is a list of the actions taken when abort is commanded. The aircraft's state can be viewed in the launch tab of the preflight checklist.

5.7   Emergency Descent

This is the most common action taken by the autopilot when abort is commanded. In this flight mode the aircraft will begin hovering, and begin to descend. The land point is automatically moved to be underneath the aircraft's current position, and the aircraft will land.

5.8   Preflight

PREFLIGHT

Preflight Checklist

1. Pre-Flight Checks

2. Settings

3. Unlock Configuration

4. Compass

5. Battery

6. Mission Limits

7. GPS

8. Speed

9. Flight Plan

10. Camera

11. Flight Preparation

12. Enable Engine
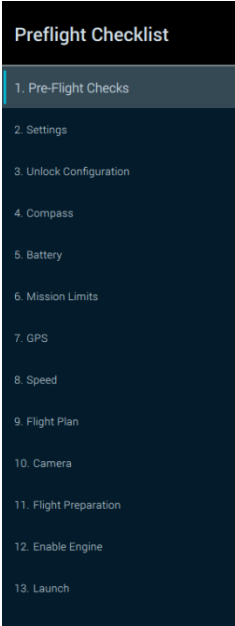
13. Launch

The Preflight Checklist allows the user to configure the aircraft for launch. The checklist offers a level of interaction that improves safety and streamlines the preflight procedures. This checklist can also be accessed during flight operations.

Click the PREFLIGHT button at the top of the PccLite screen to open the preflight checklist. Follow the on-screen instructions and press CONFIRM in the low-right corner of the preflight checklist window once each section is compete. After pressing confirm the checklist will automaticly proceed to the next step. Completed steps are highlighted green and incompleted steps remain white.

5.8.1   Pre-Flight Checks

Before proceding, the user should prepare the aircraft for flight by preforming the pre-flight checks outlined in Chapeter 6.

5.8.2   Settings ⚙

The Settings tab houses commands that may not need to be changed during the course of a flight. This tab is depicted as a light blue gear on the upper-right corner of PccLite. The Settings window houses the following pages.

Communications

This window is used to select the method of communicating with the autopilot. Apply on startup will automatically try to connect when PccLite launches.

Network Server

Server: 192.168.1.200:20001

☐ Listen Only
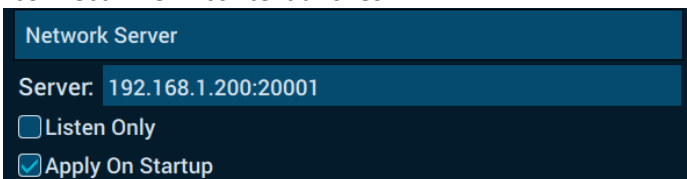
☑ Apply On Startup

- Aircraft: 192.168.1.200:20001
- Simulator: localhost:2005 OR 2000 if using Ground station
- Listen Only can be used for monitoring and/or handoff
- Apply on startup will automatically try to connect when PccLite launches.
- Make sure PC is also on 192.168.1.xx

Video

This window controls the method for video acquisition. Low Latency reduces buffer size at the cost of video reliability.
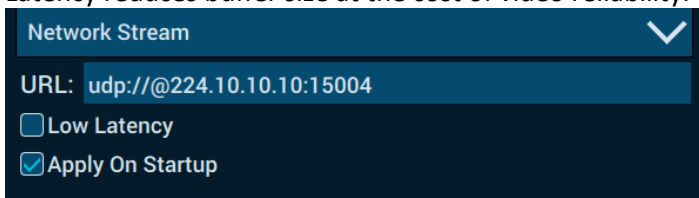
Enter network address for the video stream
- GoPro with MicroRaptorHD:
   rtsp://192.168.1.250:8557/PSIA/Streaming/channels/2?videoCodecType=H.264
- GoPro with Sighline SLE-1500:
   udp://@224.10.10.10:15004
- Found by connecting to the device with SLAPanel and navigating to the "Ethernet Video" tab.

Network

This window is used to enter network proxy settings. Select Use Proxy and enter the corresponding information if a proxy is used by the host network.

Joystick

The joystick window controls the sensitivity of the primary flight controls or "thumb sticks". The deadband controls the amount of motion that will be ignored by the system and is applied to both joysticks.

About

The about window displays information on the version of PccLite software, its build date, and information regarding the programs used in its development.

5.8.3   Unlock Configuration

Unlocking the configuration allows all configuration settings (e.g. Altitude, Compass, Battery, Mission Limits, etc.) to be changed. If a user desires to change a configuration setting during flight, the user must first *Unlock Configuration* in the Preflight Menu

5.8.4   Compass Direction

The aircraft icon should be oriented in the same direction as the aircraft (top of map on Flight Tablet represents North).

5.8.5   Battery Settings

Flight Battery Voltage is given on this page. The user may return to this preflight step at anytime during flight to check the status of the battery voltage.

5.8.6   Mission Limits

Altitude Limits are given as meters above mean sea level. Select a minimum altitude that ensures obstacle clearance.

Battery Limits

- Set Low Battery to 21.8 Volts. If "Land on Low Batt" is checked,the aircraft's flight battery reaches the Low Battery Setting the aircraft will fly to the *Land Point* and land.
- Set Critical Battery to 21.0 Volts. If "Abort on Critical Batt" is checked, the aircraft's flight battery reaches the Critical Battery Setting the aircraft will begin a vertical descent in order to land wherever the Critical Battery is triggered.

Timeouts

- Flight Timer: count-down timer. If "Land if Timeout AND Lost Comms" is checked the aircraft will return to the land point when the flight timer expires.

- GPS: if GPS signal is lost for longer than the limit set the aircraft will return to the land point.
- Comm: If the signal between the aircraft and the Flight Tablet is lost for longer than the limit set the aircraft with return to the land point.
- Pilot: If the signal between the aircraft and the remote control is lost the aircraft with return to the land point.

5.8.7   GPS Settings

The number of visible and usable satelites, the PDOP (Position Dilution of Precision), and the ground speed are displayed on this page.

5.8.8   Speed Settings

The aircraft has 3 preset speeds that can be used during flight. The defaults for these speeds are:
Slow: 1 [m/s] ; Cruise: 3 [m/s] ; Dash: 6 [m/s]

5.8.9   Flight Plan

Refer to 5.14.6

5.8.10   Camera

Refer to Sections 4.1 and 5.14.1

5.9   Map Commands

Many commands can be sent simply through the Map alone. Since PccLite was designed for a touchscreen device, these commands are accessible with standard touchscreen gestures including touch, drag, and pinch.

5.9.1   Dragging

The most common map command is the dragging of points. Hover, landing, scan, and waypoints can all be dragged to change their position. The hover waypoint is the only one not requiring confirmation before moving, since it is meant to be a quickly commanded point.

5.9.2   Selection

Waypoints and scan points can be selected by touching or clicking on their icon. Once selected, a waypoint or scan point window will appear. This window displays the altitude of the selected waypoint, waypoint settings, the option to save the waypoint to file, and the command to track the waypoint. To exit out of the waypoint/scan point window, simply select the point again. Waypoints and scan points are saved as a time-stamped ".fp" file to the path Users\[User Name]\Cloud Cap\PccLite x.x.x\Flight Plans\. The exact file name is momentarily displayed across the warnings bar (top center) in yellow.

5.9.3   Zooming

Zooming of the map is accomplished by the standard touchscreen pinch gesture. Using two fingers the map can be zoomed in or out. In a non-touch screen environment the mouse wheel may be used similarly to PCC.

5.10 Primary Flight Controls

In addition to using waypoint control, the aircraft can be commanded via the Primary Flight Controls. These controls are not direct manual controls, but instead send commands to the autopilot to perform at pre-defined rates. These rates are primarily pre-defined in the configuration stage of aircraft integration through PCC, but some joystick gains are available in the settings page under "Joystick".
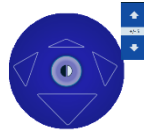
5.11 Aircraft Steering Control

This primary flight command can be found on the bottom-right corner of PccLite. The user should think of this command as a joystick and not a collection of buttons. To command the aircraft's horizontal velocity the user should touch and hold the center joystick and drag it in the desired direction of flight. The aircraft can be commanded forward, backward, laterally, or any combination of those. As the arrows on the icon indicate, the nose of the aircraft is always pointing toward the top of the screen. If the user holds the joystick upward, the aircraft will maintain forward flight, even if it is commanded to yaw. Once

the joystick is released, it will center itself, and the aircraft will maintain a hover at its current position.
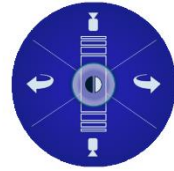
5.12 Yaw and Camera Control

The aircraft yaw and camera control can be found on the bottom-left portion of the screen. The functionality is much the same as the aircraft steering control joystick. Left and right on the joystick controls left and right yaw, and up and down will control elevation and depression of an onboard camera. As with the aircraft steering control, the front of the aircraft will remain up (toward the top of the screen) in reference to the joystick (i.e. if the user continuously holds left on the yaw control, the aircraft will continuously rotate counter-clockwise).

5.13 Altitude Controls

On the left side of PccLite the user will find the altitude control. This control is comprised of a slider bar and an incremental altitude adjustment. The slider bar displays both the present altitude of the aircraft and the commanded altitude. The two are distinguished as the present altitude is displayed in black font, and the commanded altitude is displayed with white font surrounded with a large bracket. The Up/Down buttons can be used to command discrete altitude changes. Select the +/- box to change the step size of the discrete commands buttons. Select the "Meters" or "Feet" to toggle between metric and English units respectively.
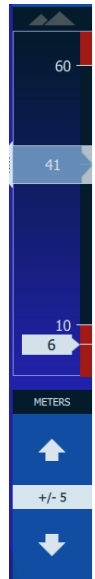
5.14 Command Tray Buttons

The Command Tray Buttons can be found in the bottom-center of the screen. These controls house the commands essential for flight such that they are easily selectable. The commands that have subsequent options are denoted with an arrow in the upper-right corner of the button.

5.14.1 Cameras
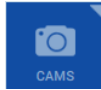
The Camera tray allows the user to select which camera is displayed in the video sub-window. The High Definition daytime video is Camera 0 and the FLIR is activated by selecting Camera 1

5.14.2 Speed

The Speed tray allows the user to select from three pre-defined speeds for the aircraft. The pre-defined speeds (Slow, Cruise, and Dash) are configurable in the Set Speed step (10) of the Preflight Checklist. The default speeds are 1m/s, 3m/s and 6m/s. To close the speed tray simply select the speed button again.

5.14.3 Map

The Map tray allows the user to select which imagery is displayed on the map. The current imagery options are NAIP, Open Street Maps, and Bing maps. This tray also allows the user to set a Bing token if one has been purchased. To close the map tray simply select the map icon again.
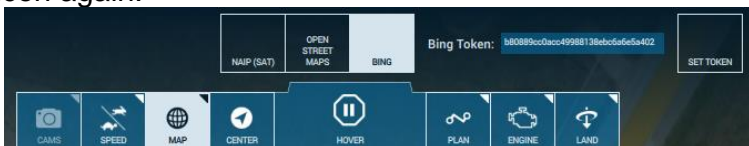
5.14.4 Center

The Center button will re-orient the map to a pre-defined view of the location around the autopilot. The user should select this button if the map view is either over-zoomed, or the active autopilot is not in view.

5.14.5 Hover

The Hover button will immediately halt all forward flight and command a hover. There is no confirmation needed for the hover button.

5.14.6   Plan

The Plan tray is used for the creation and modification of flight plans. There are several options from which to choose, however the user should keep in mind that only one flight plan and one scan plan may exist at a time.

5.14.7   Plan Menu >> Clear Plans

This button will clear both the flight plan and the scan plan. There is no confirmation required to delete flight plans, but the plans cannot be deleted if the aircraft is tracking them.

5.14.8   Plan Menu >> Add Scan Plan

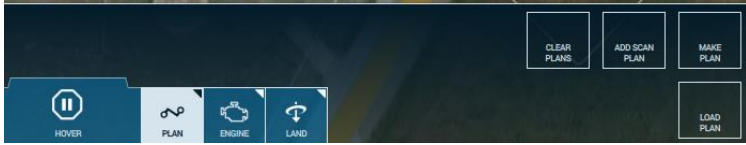To add a scan plan there must be no current scan plans. The scan plan is comprised of two major parts:

- The area to be scanned. This area is depicted with dark blue dots and dashed lines. These dots are not waypoints of any kind and cannot be selected. They are merely a reminder of the area selected while creating the scan plan.
- The flight path of the scan plan. This flight path is depicted as small white dotted lines capped by light blue numbered markers. These markers are not explicitly created by the user, but are generated by the parameters selected while making the scan plan.

The method for creating a scan plan is as follows
1) Select the boundary of the area to be scanned
2) Ensure the desired scan parameters match the needs of the flight plan
3) Tap DONE
4) Choose the starting point for the scan. In most instances the starting point should be as close as possible to the first boundary point created. The starting point should also be within the defined boundary. If the user selects a position close to the first boundary point created, the maximum

amount of scan flight paths will be created. If the user selects a starting pint close to the opposite side of the boundary from the initial point, a minimum of scan paths will be created. In the following figure the beginning boundary point is the bottom-left point.

5.14.9 Plan Menu >> Make Plan

The user makes flight plans in much the same way scan boundaries are created. Flight plans must be closed, i.e. the last point must connect to another waypoint. Tap on the map to create waypoints numbered in the order in which they were made. To close the flight plan, simply tap on one of the waypoints. On closing the plan, the flight plan is then sent to the Piccolo and the icons color changes from grey to blue to indicate the flight plan is now aboard the aircraft.

5.14.10 Plan Menu >> Load Plan

This option allows the user to load a flight plan from a previously saved file. Once selected a file dialog window will open allowing the user to choose the ".fp" flightplan file to be used for loading.

5.14.11 Engine
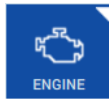
The Engine tray houses the engine start or kill command. Select Start to start the engine. Once the engine kill command is selected, all engines will be disabled. There is no confirmation required for the selection of engine kill, and engines will be killed regardless of the aircrafts flight mode.

5.14.12 Land

The Land tray houses the Land Now button. This button will command the aircraft to land at the land point. The Land Now button does have a confirmation window, where users must confirm they want to land now. Once commanded to land, the aircraft may still be re-tasked via the hover point or waypoints.

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6. FLIGHT CHECKLIST

	PRE-FLIGHT CHECKS
1	**Conduct Crew Brief**
2	**Tough Pad (Refer to Section 2.2)**
	Tablet Power – ON (Check tablet battery greater than 50%)
3	**Ground Station (Refer to Section 2.4)**
	Ground Station Battery – Check first flight of day (11.0 Volts min.)
	Ground Station Antenna – Install
	Ground Station Power – ON
	Battery Charge Indicator – Check minimum 6 of 10 bars illminated
	Ethernet Cable – Connect to tablet
4	**Mechanical Checks – Bottom**
	Landing Gear – Check
	SD Cards – Install (§ 4.1)
	Camera Bracket - Check
	Gimbal Rubber Mounts - Check (4 zip ties)
	Video Ribbon Cable - Check
	Underside - Check for Worn/Loose Items
5	**Flight Battery Installation (Refer to Section 3.4)**
	Flight Battery - Check and Record Voltage (25.0 Volts minimum)
	Flight Battery – Install with Velcro Strap **Do Not Trap Ribbon Cable**
6	**Mechanical Checks – Top**
	Aircraft Antenna – Attach and verify pointing down (away from rotor)
	Main Rotor Nuts - Check Tightness (Hold motor housing)
	Motor Mounts and Arms - Check Security and Verify Level/Plumb
	Rotor Blades – Check Condition
	Aircraft - Place on level non-metallic surface
	Flight Battery – Connect
7	**PCC Connection (Refer to Section 2.42.2)**
	Verify Communication LEDs on GS Transceiver are illuminated solid
	Ground Station Application – Launch (PccLite)
	Verify aircraft icon populates on the map
8	**Radio Controller Checks (Refer to Section 2.3)**
	Radio Controller Switches - Down and Away
	Radio Controller Power Switch – ON
	Throttle Full Down to acknowledge warning
	Radio Controller Voltage – Check 7.5 Volts minimum
	Radio Controller Trim Settings - Zero (4 Trims)

PccLite Preflight Checks (Refer to Section 5.8)	
2	**Settings (Refer to Sections 5.8.2)**
	>> Communications >> Server: 192.168.1.200:20001 (§ 5.8.2**Error! Reference source not found.**)
	>> Video >> URL: udp://@224.10.10.10:15004 (§ 5.8.2)
	>> Image Processor >> Send Address: 224.10.10.10 Send Port 15004 (§ 5.8.2)
3	**Unlock Piccolo Configuration (Refer to Section 5.8.3)**
4	**Compass Direction (Refer to Section 5.8.4)**
	Compare indicated heading to actual heading
5	**Battery Settings (Refer to Section 5.8.5)**
	Battery Voltage – Check greater than 24.50 Volts
6	**Mission Limits Settings (Refer to Section 5.8.6)**
	Altitude: Set Min and Max to a value higher than Current Altitude
	Battery: Low Batt: 21.8 [V] Critical Batt: 21.0 [V]
	Land on Low Batt – Check the Box
	Abort on Critical Batt – Check the Box
	Timeouts: Flight Timer: 15min ; GPS: 10s ; Comm: 20s ; Pilot:1s
	Land if Timeout AND Lost Comms – Check the Box
	Send All to Piccolo – Press (only if values are changed)
7	**GPS Settings (Refer to Section 5.8.7)**
	Satellites – Check (more than 6 used)
	PDOP – Check (less than 3.0)
	Ground Speed – Check (less than 0.5m/s)
8	**Speed Settings (Refer to Section 5.8.8)**
	Slow: 1 [m/s] ; Cruise: 3 [m/s] ; Dash: 6 [m/s]
	Speed Setting – Set as desired
9	**Flight Plan (Refer to Section 5.8.9)**
	LOAD PLAN or MAKE PLAN as desired
10	**Camera (Refer to Section 5.8.10)**
	Verify SD Card(s) Installation
	HD Camera - Power on and record if desired
	IR Camera (if installed) - Remove lens cover
	CAMS menu - Select active camera as desired

FLIGHT PREPERATION	
11	**Flight Preparation**
	Check area for non-participants and potential hazards
12	**Enable Engines**
	Enable Engine – Press
	Compare actual altitude with minimum/maximum mission limits
	Remote Control Timer – Activate
13	**Launch**
	Launch Now – Press
	First Fly-to-Waypoint – Select then click "Go to Waypoint"

POST FLIGHT CHECKS
In PCC "Land Now" – Select and Confirm
Wait for Aircraft to Land
Timer - Stop (Announce Flight Time to VO for Logbook)
Flight Battery – Disconnect
Camera– Stop recording and power off
Check motors for excessive heat (**Warning**: motors can be Hot!)
Radio Controller– OFF
Ground Station Transceiver Battery - OFF
Antennas – Remove (Video Monitor, RDASS, Ground Station)
Tough PAD Power – OFF
Flight Logs – Record
Camera – Review Recording
Post Flight Debrief– Complete

	CREW BRIEF
1	**Aircraft**
	Time Available on Flight Battery with five minute reserve
	Time Available on SD Data Recorder and Camera Configuration
	Altitude Settings in PccLite
	Battery Settings in PccLite
	Mission Limit Settings in PccLite
	Flight Termination Settings in PccLite
2	**Scheme of Maneuver**
	Timeline of Events & Radio Controller Timer Settings
	Route of Flight, Altitudes, Airspeeds
3	**Airspace**
	Required Radio Calls
	Satellite Coverage (Number Visible)
	http://www.trimble.com/gnssplanningonline/
	Weather (Winds, Visibility, Ceiling)
	Obstacles and Hazards
4	**Crew Duties**
	Designate a Pilot in Command
	Operator Controlling the Aircraft:
	1) Fly aircraft
	2) Traffic/obstacles avoidance
	3) Monitor Flight Clock
	Operator Not Controlling the Aircraft:
	1) Assist avoiding traffic/obstacles
	2) Cross check Flight Clock
	3) Assist in Maintaining Aircraft Position and Orientation
	5) Monitor and transmit on radio
	6) Perform other duties as assigned by the Pilot on the controls
5	**Transfer of Aircraft Control**
	3-Way Positive Transfer of the Controls
6	**Crew Coordination**
	Two challenge rule
	Most Conservative Approach
	Avoid Excessive Professional Courtesy
7	**Post Flight Responsibilities**
	Disconnecting the Flight Battery
	Battery Charging Procedures
	Logbook and Records
8	**Back Brief**

7. PERFORMANCE AND LIMITS

Flight in measurable precipitation is not recommend. Special care shall be taken to prevent the Remote Control and Flight Tablet from becoming wet.

7.1 Aircraft Specifications

Platform Type	Multi-Rotor (four fixed- pitch rotors)
Rotor tip to rotor tip dimensions	31 ½ inches (80.1 cm)
Operating Temperature	14°F ~ 122°F (-10°C ~ 50°C)
Take-off Weight	7 lbs. 13 ounces (3539g)
Hovering Accuracy (GPS Mode)	Vertical: ± 31in (0.8m) Horizontal: ± 98 in (2.5m)
Max Yaw Angular Velocity	60°/s
Wind Limits	25 mph (22 knots,11 m/s)
Vertical Speed Limits	800 feet/min. (4.1 m/s)
Operational Range	0.5 mi. (750 m)
Max. Power Consumption	900 Watts (1.2 hp)
Max Slope Limits for takeoff/landing	5°

7.2 Flight Time Calculation

Example: RDASS flew 14 minutes and 19 seconds. Flight Battery required 5459[mAh] to fully charge. How much available flight time is there? (Under similar flight conditions this battery can be flown 18 minutes and 53 seconds)

1) Convert minutes and seconds to decimal minutes

$$\left(\frac{19\ [sec.]}{60\ [sec.]} + 14[min.]\right) = 14.31\ mintes$$

2) Multiply the decimal minutes by 80% of battery capacity

$$14.31\ [min.]\ x\ 7200\ [mAh] = 103,080\ [min \cdot mAh]$$

3) Divide the result from step 2 by the required charge

$$\frac{103,080\ [min \cdot mAh]}{5459\ [mAh]} = 18.88\ [min.]$$

4) Multiply by 60 to convert decimal minutes to seconds

$$18.88\ [min.] = (0.88\ x\ 60) + 18 = 18\text{:}53$$

7.3 Weight and Center of Gravity Limits

No payload other than the factory installed Camera(s) and gimbal is authorized

44
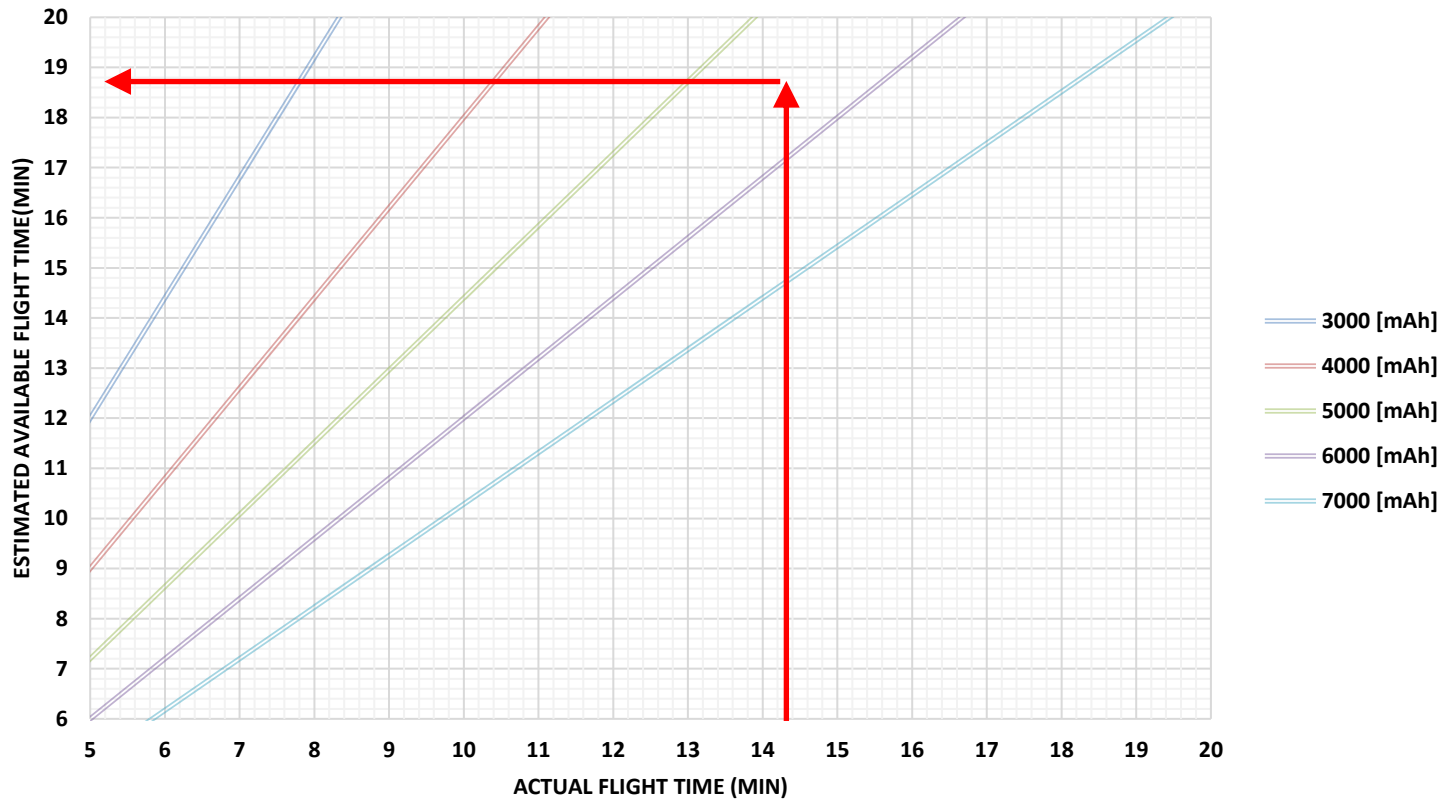
8. USER-LEVEL MAINTENANCE

8.1   Rotor Removal

1. Use a 10 mm wrench to remove the nut by turning counter-clockwise
2. Remove and save the anodized black washer for use with new rotor blade
3. Remove the damaged rotor blade from the motor post
4. Remove and save the aluminum bushing from the motor post. (If the bushing remained inside the rotor blade, remove the bushing from the rotor blade

8.2 Rotor Installation

1. Place the aluminum bushing on the motor post
2. Install the correct rotor blade
3. Install the anodized washer
4. Install the 10mm nut finger-tight by turning clockwise until increasing resistance is felt
5. Use a 10mm wrench to turn the nut an additional quarter turn to fully tighten the nut
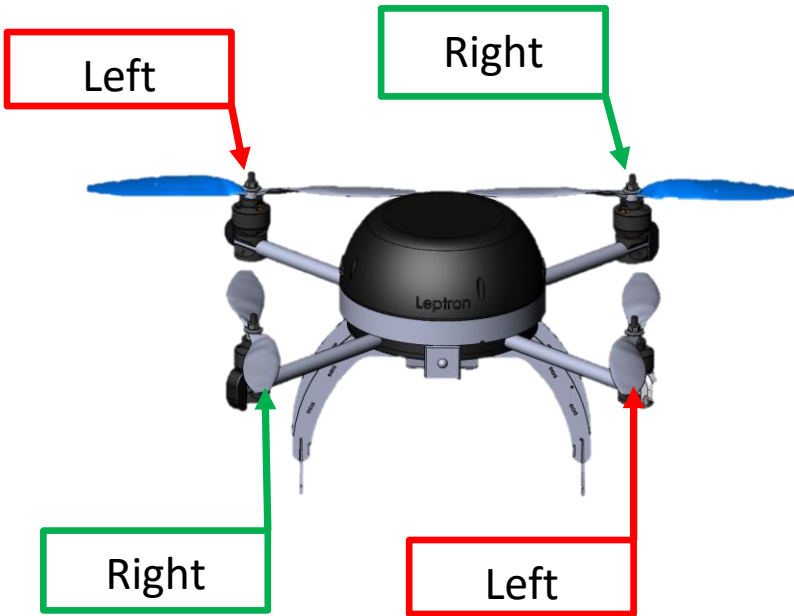
8.3   Ground Compass Calibration

1. Launch PCC
2. Establish communication with the aircraft
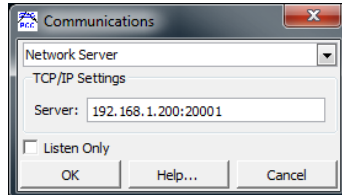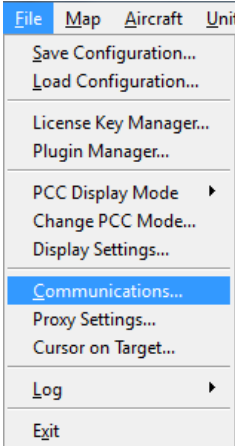
3. Open the Preflight Window
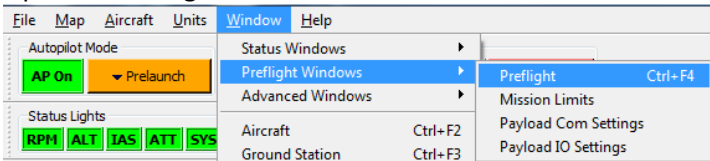
4. Unlock the configuration
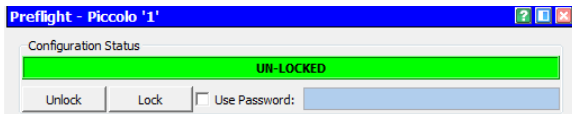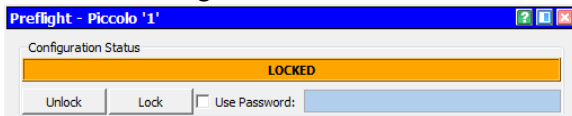
5. Open the Sensor Configuration Window
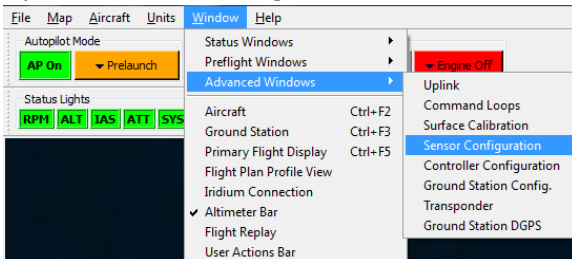
6. Navigate to "Errors/Magnetometer Cal" Tab
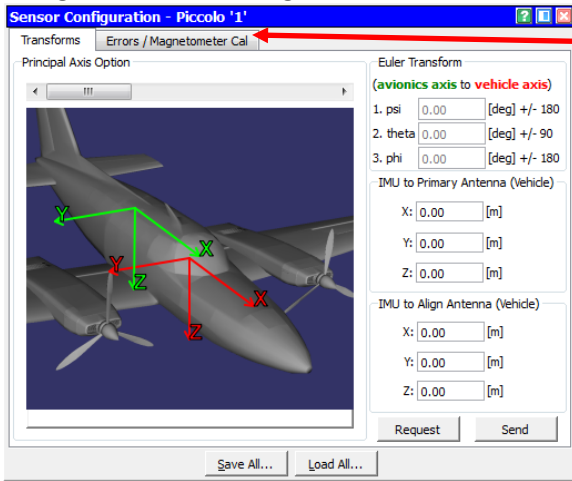
7. Click on "Cal 3D"
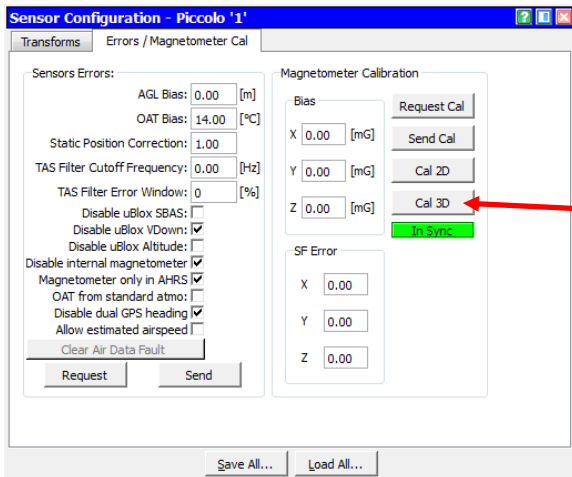
8. Rotate 360° while wobbling the aircraft about it's vertical axis. Pitch and Roll shall both be excercised ±30° in order to simulate flight conditions.
9. Click on Send Cal Once Complete
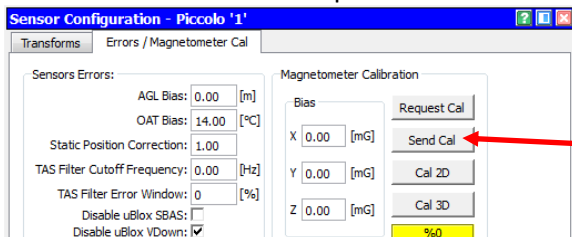
8.4 Air Compass Calibration

1. Prepare the aircraft for flight in accordance with the Pre-Flight Checklist.
2. Launch PCC Application on the Flight Tablet
3. Establish communication with the aircraft
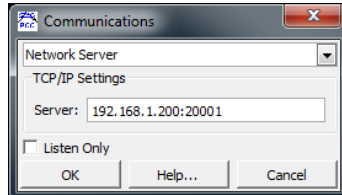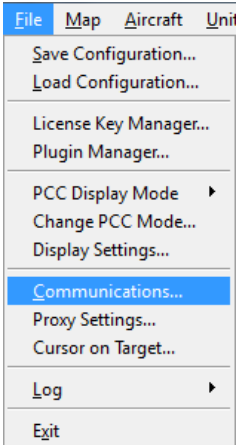
4. Open the Preflight Window
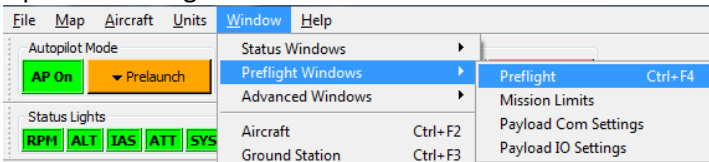
5. Unlock the configuration
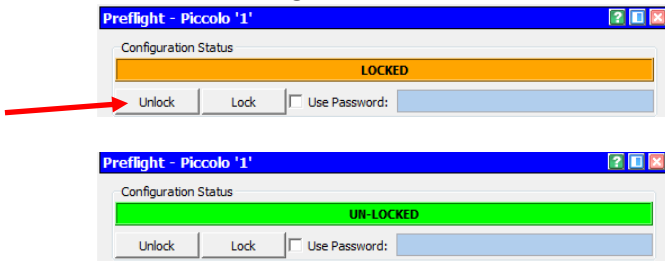
6. Disconnect and Reconnect the flight battery

7. Compare Yaw and Compass headings. The difference shall not exceed 10° between these two values

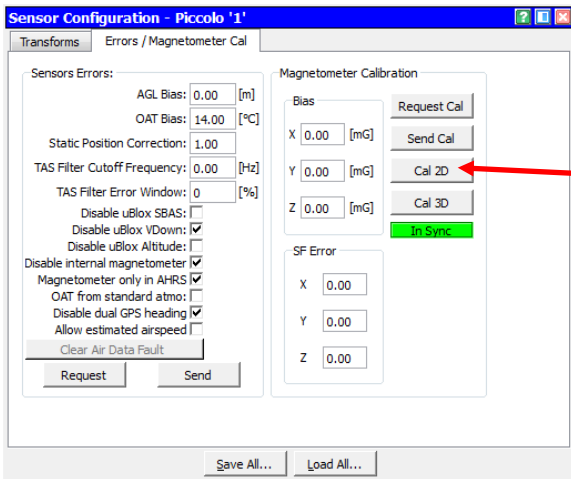8. Open the Sensor Configuration Window
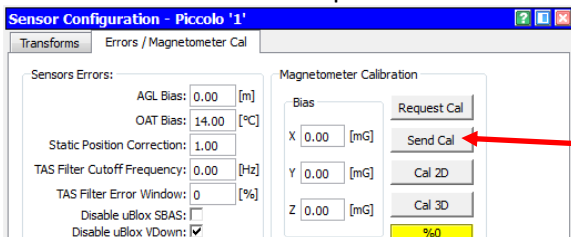
10. Navigate to "Errors/Magnetometer Cal" Tab

11. Establish a hover between 5 and 10 meters above the ground.
12. Click on "Cal 2D"

13. Yaw 360° using either the flight tablet or the Remote Control with Steering Mode engaged.
14. Click on Send Cal Once Complete

9. EMERGENCY PROCEDURES

Flight Command Latency – greater than 1.5 second delay

1. Engage Autopilot Mode.
2. Command "Land Now".
3. After landing Kill Engines on Flight Tablet