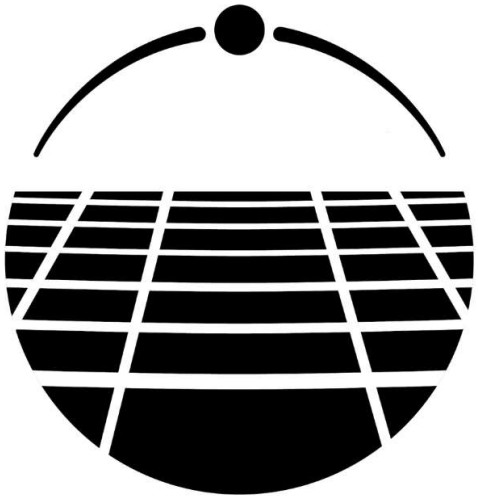

Earth Systems Management

Operations Manual

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July 2024

Table of Contents (Requires Updating)

Purpose

1. The Operations Manual includes all part needed for conducting field research with hydro drones and data collection.
2. An outline of DJM's knowledge of the "Hydrodrone Solo" hydro drone with additional manuals, links, images and videos appended to DJM's original document.
3. DJM's original document can be found here: Manual: DJM Transfer Manual.

Navigating the Operations Manual

1. Navigating the Operations Manual is possible by utilizing the Table of Contents or the Navigator which is located on the sidebar.
2. Press Ctrl-Click to jump to chapters in the Table of Contents.
3. Scroll to the right hand side of the document in LibreOffice Writer.
4. Find the compass button.
5. Right before you click on the compass button, the "Navigator" label should appear.
6. The headings, images and hyperlinks of the document will appear underneath the Navigator section. The main categories in the Navigator include Headings, Images, Hyperlinks and Indexes.
7. Select boxes with positive signs (+) to view the sub-headed categories. This action can be reversed by selecting the boxes with negative signs (-).
8. Double click on the section you want to view.
9. Simultaneously press Ctrl-Click to open hyperlinks.
10. The first portion of the hyperlinks are the chapters with their page numbers in the Table of Contents. Beneath the chapters are hyperlinks to manuals, informative pages, videos, and instructions for parts found online.

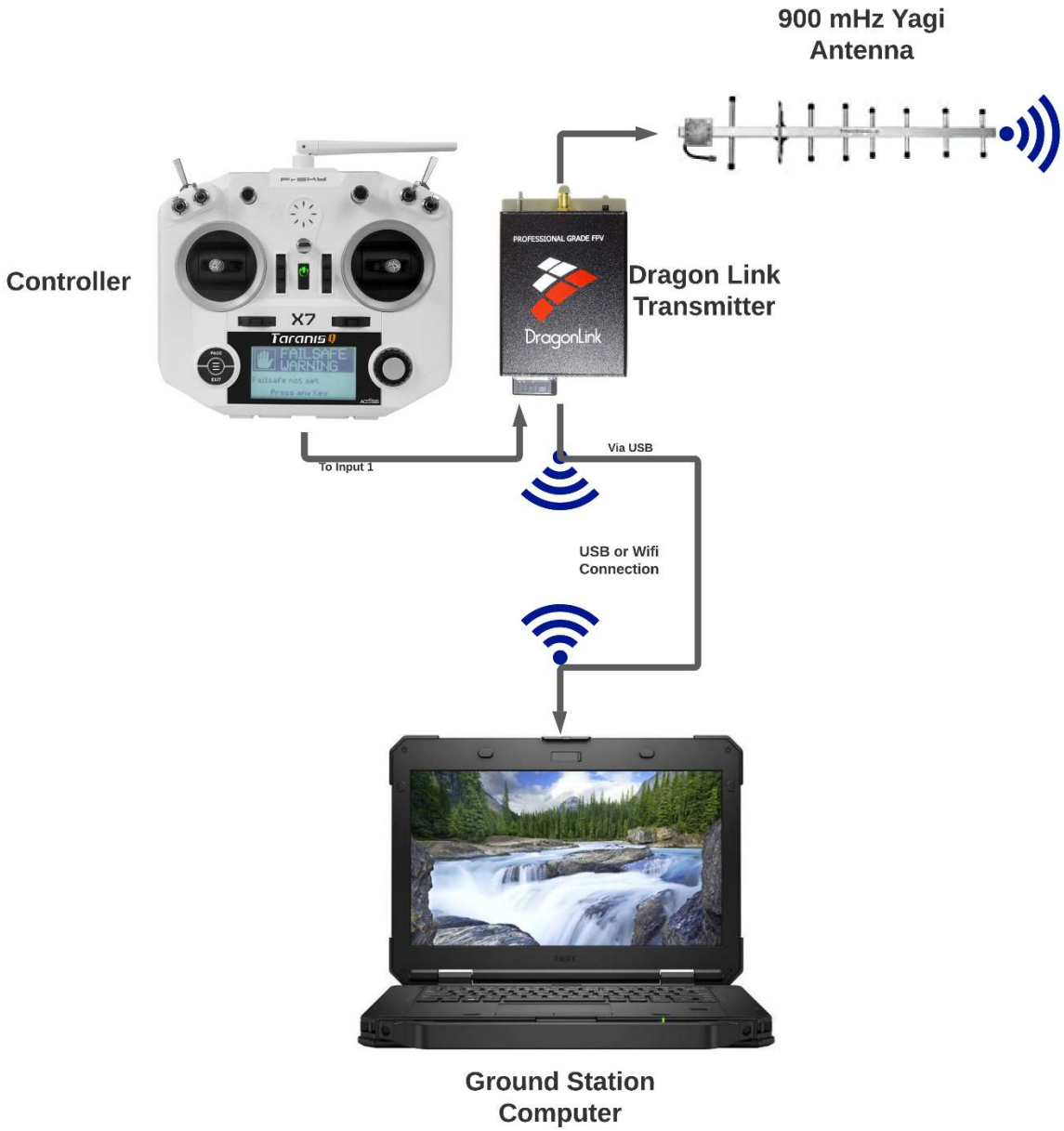
Important Vocabulary

1. TX – Transmitter
2. RX – Receiver
3. GS – Ground Station
4. JST – Japanese Solderless Terminal
5. Telemetry – Two-way communication

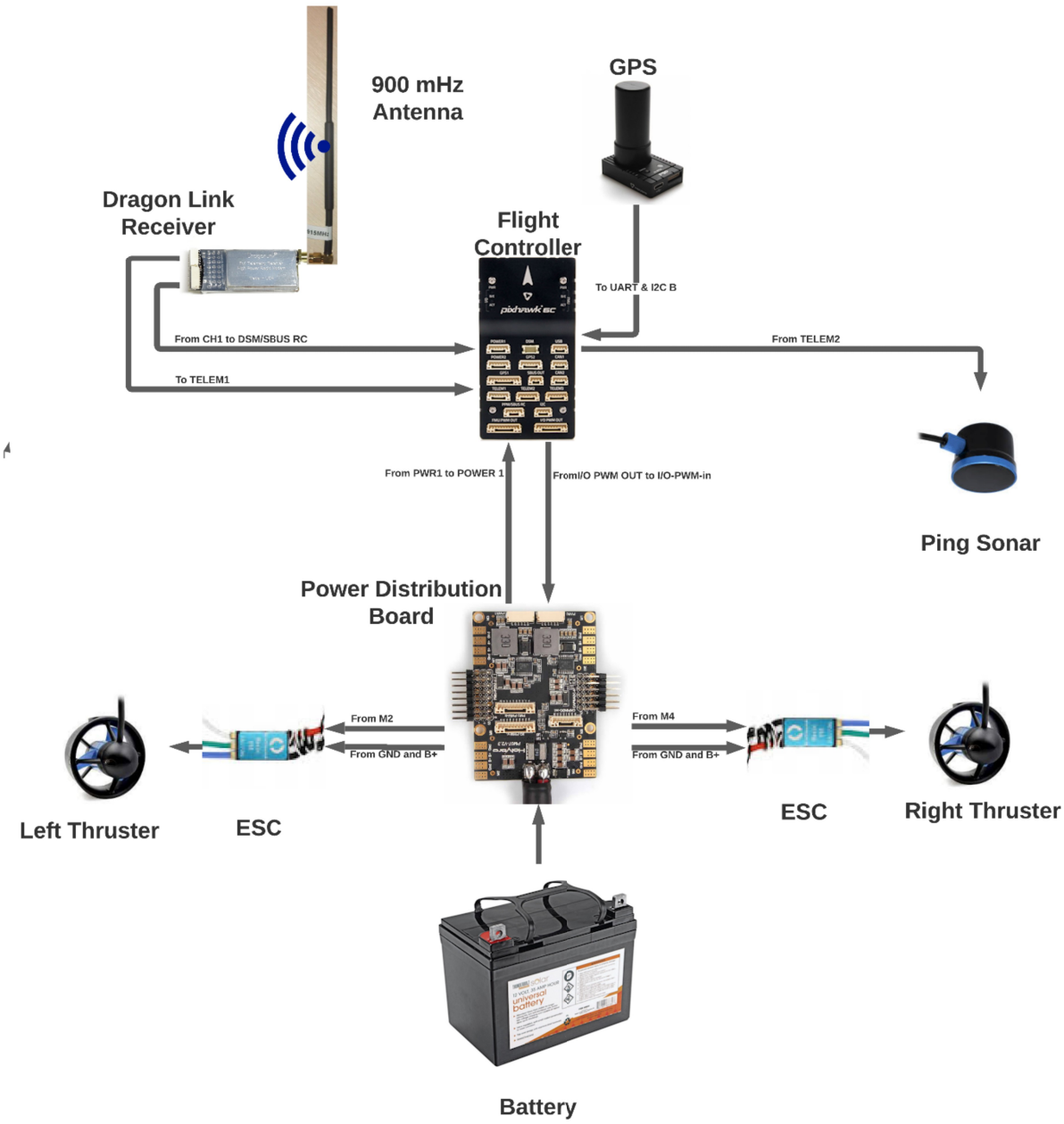
General Overview of the Drone

System:

Shore Side System Diagram



Drone Side System Diagram



Operations and Planning

Launching Procedure.

1. Ensure thrusters, sonar and navigation box, and well nuts are secured before placing the drone in the water. Secure any lose cabling or straps to prevent damage.
2. Connect Dragon-link transmitter to desired antenna (likely 900 MHz Yagi)
3. Hold power button on controller until 4 dots appear on the screen then release the button, clear any error messages by pressing exit and ensure the front left switch is toggled down to disarm.
4. Put drone hull in the water.
5. Secure or tie off drone if necessary in conditions with high currents.
6. Lower battery into the drone and secure it with straps.
7. Connect large power connector to large two pin bulkhead connector on the yellow battery box.
8. Ensure that blue thruster connectors are attached tot heir corresponding bulkhead connector.

9. Listen for the faint ringtone played by the Pixhawk after it receives power, and then the two tone beeps from the thrusters. You may wait as long as 30 seconds to hear the thrusters beep as they will only be armed once the system is receiving satellites and ready to be armed.
10. The drone can be armed and operated manually or automatically at this point without the ground station. So long as there are no errors it will complete whatever mission is saved on the device.
11. Open laptop and connect via QGroundControl or Mission planner, following the relevant instructions laid out in this document.

10. a When connecting to the ground station software the drone will send its current mission and parameters to the ground station. If the drone has a weak telemetry signal (caused by distance between the dragonlink receiver on the drone and the transmitter on the controller) it can fail to download the mission to the ground station and you will need to get closer and reconnect.

12. Check to ensure the desired mission is loaded and the drone is ready to arm.
13. Arm the drone by flipping the left front switch towards yourself, leaving the top left switch away from you to keep the drone in manual mode. (Check images below)
14. Move the gimbals to test forward, reverse, left and right turning of the thrusters.
15. Click the purple Q in the top left of QGC and select analyze tools.
16. Navigate to mavlink inspector and check the rangefinder to ensure the sonar is operating correctly.
17. Remove anything securing the drone.
18. IMPORTANT: Drive the drone manually clear from the launch boat or platform and in a location in which it will not impact it when navigating to its mission.
19. When ready, switch the left switch on the top of the controller to the central position to set it into auto mode.

Armed in manual Mode

Armed in auto mode

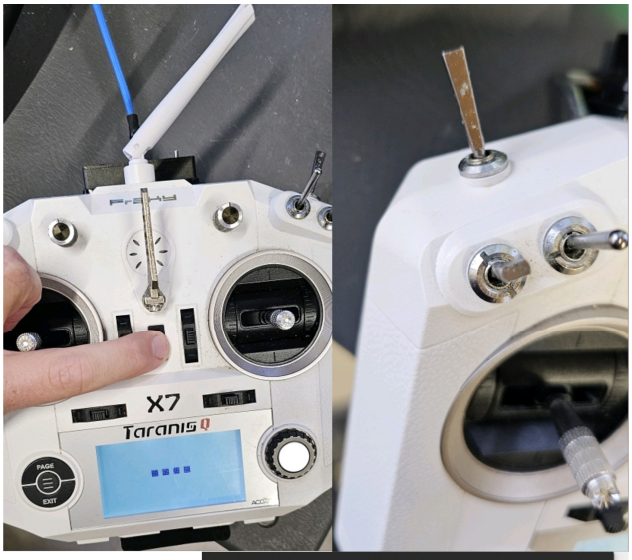
How to connect to Ground Station Software:

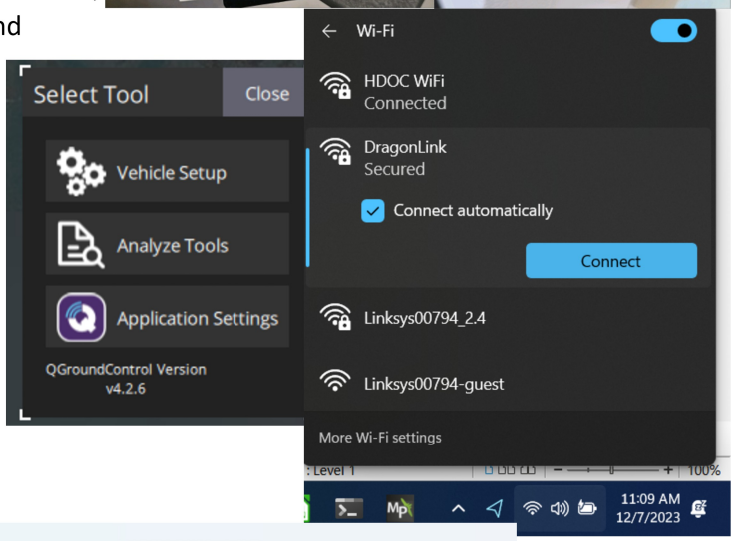
Use one of the following methods to establish a link between the Hydrodrone, the controller and the ground station computer.

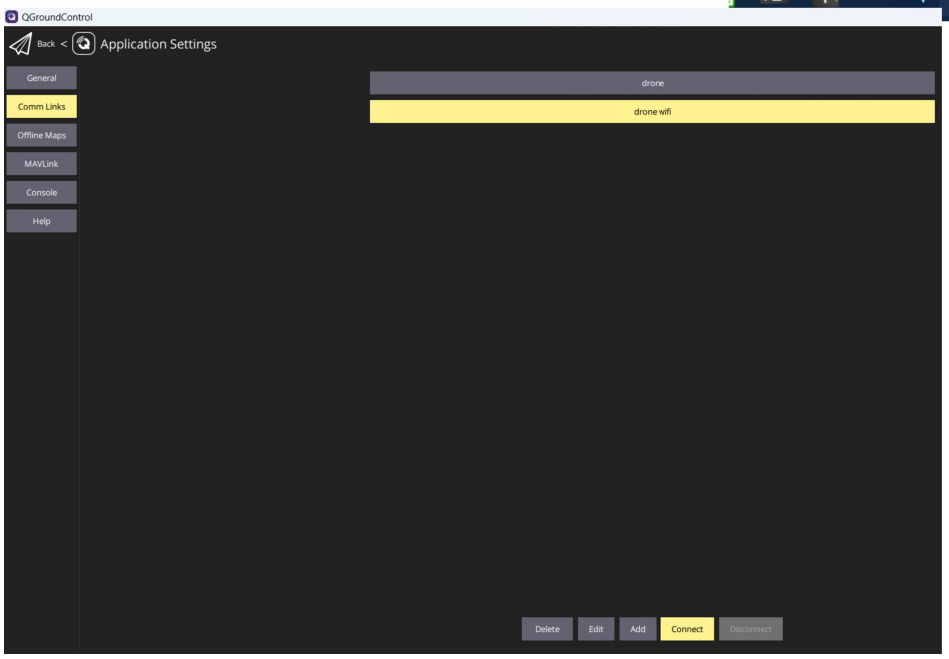
Method 1: Connecting to QGroundControl via Mavlink:

1. Make sure X7 is unplugged from power source before plugging in.
2. Ensure an antenna is attached tightly to the dragon link.
3. Hold center power button of controller until 4 dots appear and then release.

4. Press Exit repeatedly to set ensure all error messages are closed.
5. Ensure the left switch on the top of the controller and the upper left switch on the face of the controller are set away from you.
6. Connect the drone to the battery.
7. The Light on the Dragonlink transmitter should turn from green to blue once the connection to the drone through the receiver is established.
8. Connect to the Dragonlink network via wifi, it may take some time to appear and connect. The password is “DragonLink”
9. Open QGC.
10. Select the  icon in the top left. Then open application settings.
11. Connect to “drone wifi” under the Comm links tab.

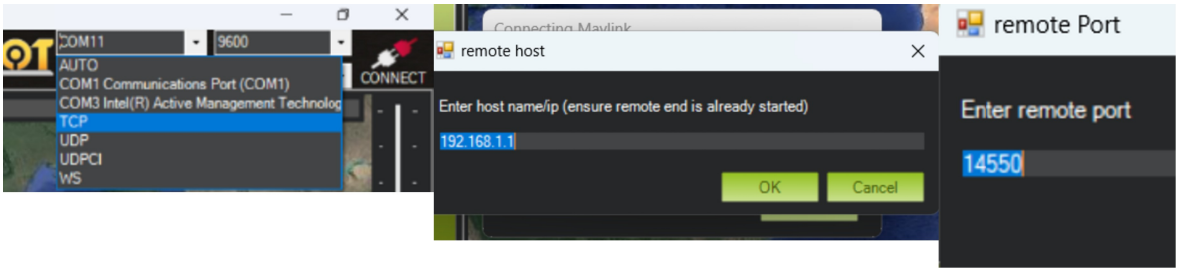






Method 2: Connecting to Ardupilot Mission Planner via Mavlink.

1. Repeat steps 1-11 of the previous procedure.
2. Open mission planner
3. In the top right of the window, click the drop down menu immediately to the right of the ardupilot logo and select TCP
4. Baud should be the same as is specified in “External Connections” in the Dragon Link GUI
5. Enter the IP address of 192.168.1.1 and port of 14550.
6. Ardupilot will download parameters and connect.



Method 3: Connecting to QGroundControl via USB:

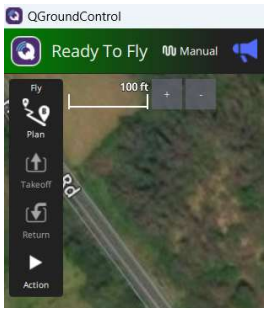
1. Connect drone to computer with USB cable.
2. Open Q Ground Control
3. The drone should automatically connect.
4. If the drone was previously connected in QGC and lost connection, click disconnect at the top to reset the connection and allow the QGC to automatically reconnect.

Method 4: Connecting to Ardupilot Mission Planner via USB

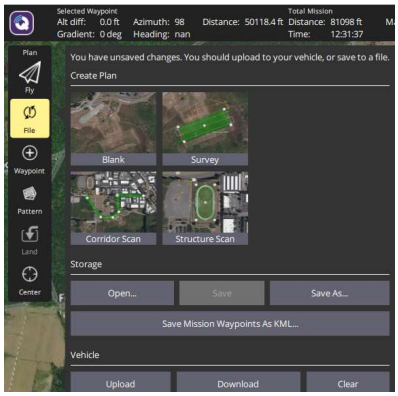
1. Connect drone to computer with USB cable.
2. Open mission planner.
3. In the top left of the window, click the drop down menu immediately to the right of the ardupilot logo and select COM9 or COM11 USB Serial Device
4. Click Connect

Planning Missions

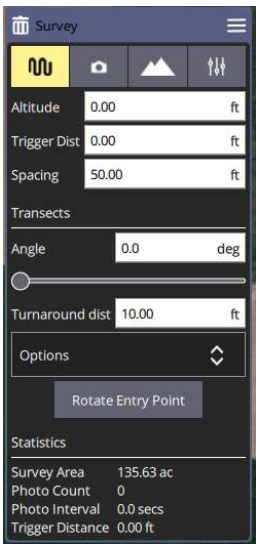
Planning Procedure in Q Ground Control:

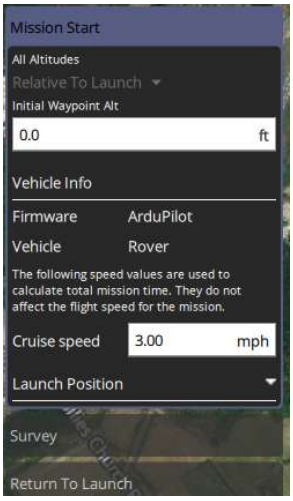


1. Select plan in the top left of Q Ground Control
2. Click File, and select survey.
3. Under the mission tab on the right of the screen, choose survey.
4. From here, shapes can be imported via KML from Google Earth or traced on the map.
5. Additional survey or waypoint commands can be added by clicking on pattern, then selecting survey on the left bar.



6. After a shape is determined the survey settings can be changed.
    - Altitude is unused as we're operating a surface vessel and can be left at 0.
    - Trigger distance is the distance the drone will travel before taking a photograph with any attached camera that's linked to the pixhawk. At the time of this writing we're not using it and have left it at zero.
    - Spacing determines the distance between the track lines inside of the survey area. We have used 100 for Burtons bay.
    - Angle determines the angle relative to 0 degrees North the track lines will follow. We've found due to the peculiarities of the GPS and currents on the Bay that 0, for North-South tracking to be ideal.
    - Turn around distance will be added to the end of each track line to give the vehicle enough distance to turn around without missing anything. For most of our mapping we've used 10ft but due to the low speed and high maneuverability of our drone it could be left much lower.
    - The statistics list a number of the attributes of the created survey area. With the current configuration of the drone as of 12.12.2023 the drone can consistently map about 70 acres with the 12V marine battery experiencing enough of a voltage drop to stop the drone around 65% total charge, typical of 85 acres of mapping.





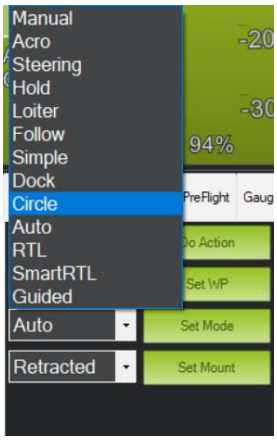
    - Items can be deleted or moved from the trash can or bars respectively of each command in the mission tab.

7. Once the mission has been created the total mission will display a time estimate for completing the mission based on the cruise speed entered under the mission start command and the total distance of the mission.
8. When ready the mission will need to be uploaded either over USB or MAVLINK by clicking "Upload Required."

Calibration Procedure:

See the linked video tutorials.

QuikTuning Procedure:



1. Connect to the drone via mission planner as described previously.
2. Navigate to the actions tab and select the dropdown menu to the set mode button and select circle.
3. Drive the hydrodrone out away from any obstacles and select set mode.
4. Set the leftmost switch at the top right of the controller to the middle position to start the tuning process after the hydrodrone begins circling.
5. Select the message tab to view the progress of the tune.
6. When the tuning is complete, flip the switch all the way towards yourself to save the gains.
7. After you get the gains saved message flip the switch all the way forward.

   Further Instructions can be found here: https://discuss.ardupilot.org/t/rover-quiktune-simplified-testers-wanted/109733

If the resultant gains from Quiktune still cause your vehicle to oscillate along the track manual tuning will be required. Follow the instructions found here: https://ardupilot.org/rover/docs/rover-tuning-process.html

Components

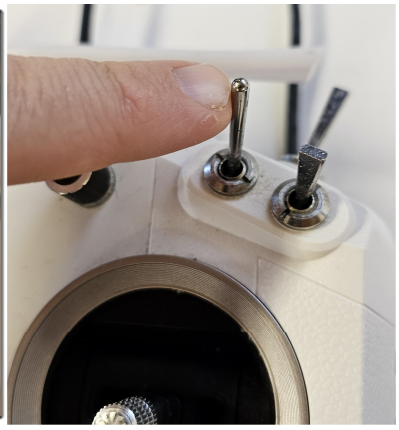
Product Name	Quantity	Notes	Unit Cost	Shipping	Cumulative Cost	Link
CNLINKO LP 20 Bulkhead and	2	Color: Plug and Socket 3 PIN	$10.48	$6.82	$27.78	https://www.aliexpress.us/item/3256804934349811.htn
CNLINKO LP 20 Plugs and Socket Wire-to-wire connectors	2	Color: 3 PIN	$10.47	$6.82	$27.76	https://www.aliexpress.us/item/3256805710464706.htn
Pelican Solo Kids Kayak	1	Color: Cyan	$169.99	$0.00	$169.99	https://www.walmart.com/ip/Pelican-Solo-Kids-Kayak-
M3 Rubber-Coated Brass Insulating Rivet Nut	1	Pack of 10	$5.54	$0.00	$5.54	https://www.mcmaster.com/93495A502/
M6 Rubber-Coated Brass Insula	1	Pack of 10	$8.36	$0.00	$8.36	https://www.mcmaster.com/93495A506/
M4 Rubber-Coated Brass Insulating Rivet Nut	1	Pack of 10	$7.20	$0.00	$7.20	https://www.mcmaster.com/93495A615/
M4x20 Super Corrosion Resista	1	Pack of 25	$9.54	$0.00	$9.54	https://www.mcmaster.com/92290A168/
M6x30mm Super Corrosion Resistant Socket Head Screws	1	Pack of 25	$17.70	$0.00	$17.70	https://www.mcmaster.com/92290A332/
M3x0.5mm Super Corrosion Resistant Socket Head Screws	1	Pack of 50	$15.87	$0.00	$15.87	https://www.mcmaster.com/92290A762/
CNLinko M28 Power Connector with Bulkhead	1	Color: 2 PIN	$19.04	$0.00	$19.04	https://www.aliexpress.us/item/2255800343053926.htn
Kimbluth 6 Gauge Duplex Marine Wire	1	10ft 6AWG	$39.99	$0.00	$39.99	https://www.amazon.com/Kimbluth-Standard-Automot
6x3/8 Tinned Copper Ring Terminal Connectors 6 AWG	1	6AWGX3/8” 12 Pack	$13.99	$0.00	$13.99	https://www.amazon.com/Tinned-Copper-Terminal-Co
Thunderbolt Sealed 35ah Lead A	1		$76.99	$0.00	$76.99	https://www.harborfreight.com/12v-35-ah-sealed-lead-a
Pixhawk 6c+Pm07 Power Modu	1		$257.99	$0.00	$257.99	https://holybro.com/products/pixhawk-6c?variant=4242
Ticonn Electrical Junction Box	1		$76.99	$0.00	$76.99	https://www.amazon.com/TICONN-Waterproof-Electri
Holybro F9P GNSS Series	1		$359.99	$0.00	$359.99	https://holybro.com/products/h-rtk-f9p-gnss-series?vari
Dragon Link 915 mHz reciever a	1		$336.00	$0.00	$336.00	http://www.fpvpro.com/dragon-link-advanced-900-mhz
FRSky TaranisQ X7Controller	1		$124.00	$0.00	$124.00	https://www.amazon.com/FrSky-2-4GHz-Taranis-Acce
16 AWG Undersea Cable	2	2 Meters	$15.00	$0.00	$30.00	https://bluerobotics.com/store/cables-connectors/high-t
Bluerobotics T200	2	Basic ESCs	$236.00	$0.00	$472.00	https://bluerobotics.com/store/thrusters/t100-t200-thrus
			Total	$13.64	$2,096.72	

Full List of Components as of 2024.03.26

Controller

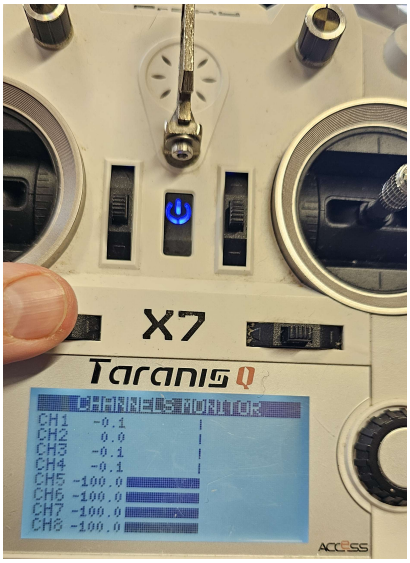
5. This is a FrSky TARANIS Q X7
6. This has all the buttons and switches used to manually control the drone.
7. It contains a 2.4 mHz transmitter but the dragon link transmitter is being used instead to boost range.

8. The top left switch is used to arm and disarm the drone
    I. Away= Disarm.
    II. Close= Arm.
9. The left most switch is used to switch the mode of the drone. The two gimbals are used to control the drone.
    I. Away= Manual
    II. Middle= Auto
    III. Close= Loiter



10. The leftmost switch on the upper right panel adjusts tuning settings.
    I. Away = No Tuning Enabled
    II. Middle = Enable Quiktune (Requires armed and set to AUTO mode)
    III. Close = Save tuning gains
11. The four trim adjustment switches adjust the trim for throttle control. These can be moved back and forth to try to get as close to zero as possible on channels 1-4, usually within .1. The gimbals

are programmed to ignore throttle input below a certain percentage value so unless set quite high these will not cause the thrusters to fire without gimbals input.



12. All other buttons and switches are not currently used.
13. To power on the drone, press and HOLD the power button.
14. The battery is stored in the back of the controller and can be swapped out for one with more capacity if necessary.
15. The Dragon link is plugged into the pins in the module bay as seen below:

16. These pins are specific to this style of controller.
17. The controller will beep when not in use. Simply move the gimbals or flip a blank switch to reset the idle alarm.
18. IMPORTANT: Instructional videos that are useful for configuring the FrSky Taranis QXY.

19. Video: Taranis Video 1
20. Video: Taranis Video 2
21. The following images are pages of the instruction manual for the FrSky Taranis Q X7. The full manual can also be found by following this link: Manual: FrSky Taranis Controller

Page 1 of the FrSky TARANIS Q X7 Manual

FrSky 2.4GHz Taranis Q X7/X7S ACCESS Manual

Version 1.0

Introduction

The Taranis Q X7/X7S ACCESS features 24 channels with a faster baud rate and lower latency thanks to its high-speed module digital interface. As with the rest of the ACCESS transmitters, it provides a secure and reliable link, along with wireless firmware updating making it fully compatible with our newest line of OTA receivers. The battery compartment now uses 2 18650 Li-Ion batteries and can be balance charged via the Mini USB interface.

The Taranis Q X7S ACCESS version features Hall-sensor gimbals and the PARA wireless trainer function, making it compatible with the FrSky Free Link App and AirLink S, while the wired training port is still retained.

Due to unforeseen changes in production, the information contained in this manual is subject to change without notice. Pay special attention to safety where indicated by the following marks:

Meanings of Special Markings

DANGER - procedures which may lead to dangerous conditions and cause death/serious injury if not carried out properly.

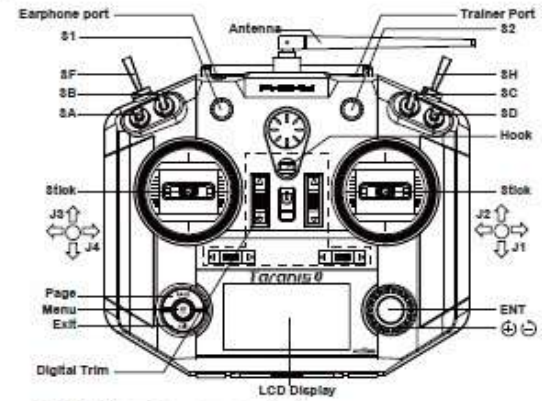
WARNING - Procedures which may lead to a dangerous condition or cause serious injury and even death to the user if not carried out properly or procedures where the probability of superficial injury or physical damage is high.

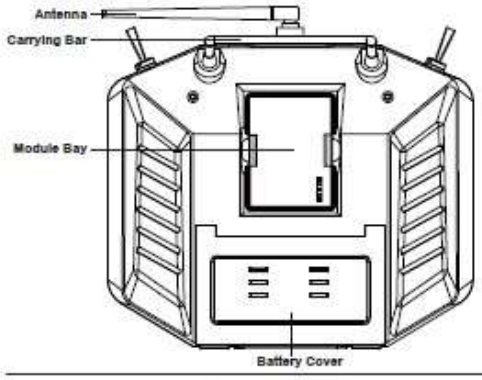
CAUTION - Procedures where the possibility of serious injury to the user is small, but there is a danger of injury or physical damage, if not carried out properly.

NOTE – Steps, Tips or information

WARNING - Always keep electrical components away from children.

Overview



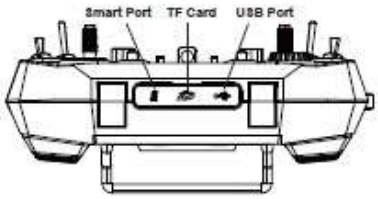


Switch Default Settings

- SA: 3 positions; Short Lever
- SB: 3 positions; Long Lever
- SC: 3 positions; Long Lever
- SD: 3 positions; Short Lever
- SF: 2 positions; Long Lever
- SH: 2 positions; Momentary, Long lever

Battery Connector Polarity

Ensure that the battery connector polarity is correct when connecting batteries into the battery compartment, otherwise the Taranis Q X7/X7S ACCESS might be damaged.



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Page 2 of the FrSky TARANIS Q X7 Manual

Specifications

- Model name: Taranis Q X7/X7S ACCESS
- Dimension: 202.2mm*189.4mm*96mm
- Weight: Taranis Q X7 ACCESS: 613g (without battery)
  Taranis Q X7S ACCESS: 639g (without battery)
- Operating system: Open source operating system
- Number of channels: 16 (ACCST D16) / 24 (ACCESS) channels
- Operating Voltage Range: 6.5V~8.4V (2 S LI-battery, not including LiFePO battery)
- Operating Current: 160mA@7.2V typ
- Operating Temperature: -10℃~60℃ (14℉~140℉)
- Backlight LCD resolution: 128*64
- Model memories: 60 models (expandable by Micro SD card)
- Smart Port, Micro SD card slot, Mini USB Port and DSC Port

Features

- Ergonomic and compact design
- Installed with ACCESS protocol
- Supports spectrum analyzer function
- High-speed module digital interface
- Supports wired training function
- Haptic vibration alerts and voice speech outputs
- Easily accessible battery compartment (*Batteries not included, adaptive with replaceable 18650 Li-ion batteries)

Comparison List

	Taranis Q X7 ACCESS	Taranis Q X7S ACCESS
Communication Protocol	ACCESS/ACCST D16	ACCESS/ACCST D16
Gimbal	G7 Noble potentiometer gimbal	M7 hall gimbal
High-speed module digital interface	√	√
Wired Training System	√	√
Haptic Vibration Alerts	√	√
Voice Speech Outputs	√	√
Easily Accessible Battery Compartment	√	√
Battery Charging System (via mini USB Port) - 2S Li-battery	√	√
New PARA wireless training system - High-speed training system with a lower latency - Compatible with FrSky Free Link App and AirLink S via mobile devices	×	√

About USB 2S Li-battery balance charging :
The Green Power indicator LED state:
Led on: charging Led off: charge end Led flash: charge fault

LiFePO battery is not supported.
***USB adapter Voltage**: 5V+0.2V **Current**: >2.0A

ⓘ **Note:**

1. **Charge the battery with the USB adapter (Voltage:5V+0.2V Current: >2.0A) when you use the USB charging function.**
2. **The lower the initial charging voltage, the better the charging effect is when the voltage difference between the two cells exceed 50 mV.**

FrSky Electronic Co., Ltd. www.frsky-rc.com Contact us: frsky@frsky-rc.com
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Page 3 of the FrSky TARANIS Q X7 Manual

⚠ Warnings for Battery

Do not remove the battery from the Taranis Q X7/X7S ACCESS transmitter while the voltage warning is blinking as this could cause internal settings and memories to be destroyed.

Do not use the transmitter if a "Backup Error" warning occurs.

Navigate the Menu

To navigate the menus, Taranis Q X7/X7S ACCESS has the following elements:

- Encoder Button
- MENU Button
- PAGE Button
- EXIT Button

Taranis Q X7/X7S ACCESS supports OpenTX system

Encoder Button

To navigate menus or widgets, turn the button to left or right as navigation.

MENU Button

To go to the [Model] menu, press the button.
To go to the [RADIO SETUP] menu, press the button, and hold for one second.

PAGE Button

To go to switch the page, press the button.
To go to the [Telemetry] menu, press the button, and hold for one second.

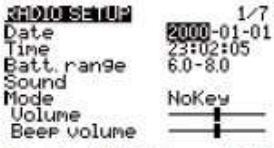
EXIT Button

To exit current page or operation widgets.

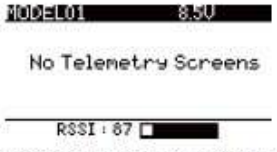
Where am I in the menu tree

Overview of the menu tree

Press the MENU button.



Press the MENU button and hold for one second.



Press the PAGE button and hold for one second.

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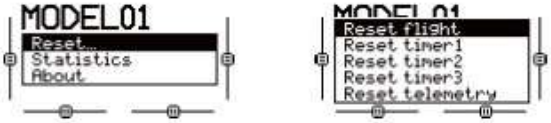
Quick select options



Long press the Encoder Button there will generate a pop-up where the user can reset timer, reset telemetry values, reset all above, jump to the tele setup page.

Model Setup for Taranis Q X7/X7S ACCESS Internal RF Module

Enter the MODEL SETUP menu.

Step 1: Set the Mode for Taranis Q X7/X7S ACCESS Internal RF.
Go to the MODEL SETUP menu, and select the Internal RF, select [Mode] [ACCESS].

Step 2: Set the Channel Range
The Internal RF module of Taranis Q X7/X7S ACCESS supports up to 24 channels. The channel range is configurable,and needs to be confirmed before use.

Step 3: Set the Receiver Number
When you create a new model, the system will assign you a receiver number automatically, but this can be easily changed. The range of the receiver number is 00-63, with the default number being 01 (use 00 is not recommended). Once the receiver is set to desired number and is bound to the Taranis Q X7/X7S ACCESS, the bind procedure will not need to be repeated unless the receiver number is changed. In this case, either set the receiver number to the previous one or repeat the bind procedure.

Step 4: Registration
In ACCESS, select the Module [Reg] into Registration status. Then Press the F/S button and power on your receiver, and select the "RX Name XX" and [ENTER] to complete the Registration process then power down the receiver.

ⓘ **Note:**
If two or three receivers are used at the same time, the UID should be set to different values.

Step 5: Automatic binding (Smart Match™)
Move the cursor to Receiver1[Bnd],and select it , power your receiver, select the RX, and complete the process, the system will confirm "Bind successful". (You do not need to press the "F/S" button in ACCESS to Bind. Refer to the receivers manual for details)

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Step 6: Set Failsafe mode
There are 4 failsafe modes: No pulse, Hold, Custom and receiver.
No Pulse: on loss of signal the receiver produces no pulses on any channel. To use this type, select it in the menu and wait 9 seconds for the failsafe to take effect.

Hold: the receiver continues to output the last positions before signal was lost. To use this type, select it in the menu and wait 9 seconds for the failsafe to take effect.

Custom: pre-set to required positions on lost signal. Move the cursor to "Set" and press the Encoder Button, and you can see FAILSAFE SETTING screen below.
Move the cursor to the channel you want to set failsafe on, and press the Encoder Button.
When moving the corresponding sticks or switches, you will see the channel bar moving. Move the channel bar to the place you want for failsafe and long press the Encoder Button to finish the setting. Wait 9 seconds before failsafe takes effect.

Receiver: set the failsafe on the receiver (see receiver instructions) in ACCESS, select it in the menu and wait 9 seconds for the failsafe to take effect.

Step 7: Range
Range refers to Taranis Q X7/X7S ACCESS range check mode. A pre-flight range check should be done before each flying session. Move the cursor to [Rng] and press the Encoder Button. In range check mode, the effective distance will be decreased to 1/30. Press the Encoder Button or EXIT to exit.

Model Setup for Taranis Q X7/X7S ACCESS External RF Module

The external RF module can be powered on or off by software. The setup process is the same as that for the internal RF.

FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules

CE

The product may be used freely in these countries: Germany, UK, Italy, Spain, Belgium, Netherlands, Portugal, Greece, Ireland, Denmark, Luxembourg, Austria, Finland, Sweden, Norway, France and Iceland.

FLYING SAFETY

⚠ Warning:

To ensure the safety of yourself and others, please observe the following precautions.

ⓘ **Have regular maintenance performed.** Although your Taranis Q X7/X7S ACCESS protects the model memories with non-volatile EEPROM memory (which does not require periodic replacement) and of a battery, it still should have regular check-ups for wear and tear. We recommend sending your system to your FrSky Service Center annually during your non-flying-season for a complete check-up and service.

Battery

ⓘ Using a fully charged battery (DC 6.5~8.4V). A low battery will soon die, causing loss of control and a crash. When you begin your flying session, reset your transmitter's built-in timer, and during the session pay attention to the duration of usage. Also, if your model used a separate receiver battery, make sure it is fully charged before each flying session.

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Stop flying long before your batteries become over discharged. Do not rely on your radio's low battery warning systems, intended only as a precaution, to tell you when to recharge. Always check your transmitter and receiver batteries prior to each flight.

Where to Fly

We recommend that you fly at a recognized model airplane flying field. You can find model clubs and fields by asking your nearest hobby dealer.

Always pay particular attention to the flying field's rules, as well as the presence and location of spectators, the wind direction, and any obstacles on the field. Be very careful flying in areas near power lines, tall buildings, or communication facilities as there may be radio interference in their vicinity.

At the flying field

To prevent possible damage to your radio gear, turn the power switches on and off in the proper sequence:

1. Pull throttle stick to idle position, or otherwise disarm your motor/engine.
2. Turn on the transmitter power and allow your transmitter to reach its home screen.
3. Confirm the proper model memory has been selected.
4. Turn on your receiver power.
5. Test all controls. If a servo operates abnormally, don't attempt to fly until you determine the cause of the problem.
6. Start your engine.
7. Complete a full range check.
8. After flying, bring the throttle stick to idle position, engage any kill switches or otherwise disarm your motor/engine.

If you do not turn on your system on and off in this order, you may damage your servos or control surfaces, flood your engine, or in the case of electric-powered or gasoline-powered models, the engine may unexpectedly turn on and cause a severe injury.

Make sure your transmitter can't tip it over. If it is knocked over, the throttle stick may be accidentally moved, causing the engine to speed up. Also, damage to your transmitter may occur.

In order to maintain complete control of your aircraft it is important that it remains visible at all times. Flying behind large objects such as buildings, grain bins, etc. must be avoided. Doing so may interrupt the radio frequency link to the model, resulting in loss of control.

Do not grasp the transmitter's antenna during flight. Doing so may degrade the quality of the radio frequency transmission and could result in loss of control.

As with all radio frequency transmissions, the strongest area of signal transmission is from the sides of the transmitter's antenna. As such, the antenna should not be pointed directly at the model. If your flying style creates this situation, easily move the antenna to correct this situation.

Before taxiing, be sure to extend the transmitter antenna to its full length.
A collapsed antenna will reduce your flying range and cause a loss of control. It is a good idea to avoid pointing the transmitter antenna directly at the model, since the signal is weakest in that direction.

Don't fly in the rain! Water or moisture may enter the transmitter through the antenna or stick openings and cause erratic operation or loss of control. If you must fly in wet weather during a contest, be sure to cover your transmitter with a plastic bag or waterproof barrier. Never fly if lightning is expected.

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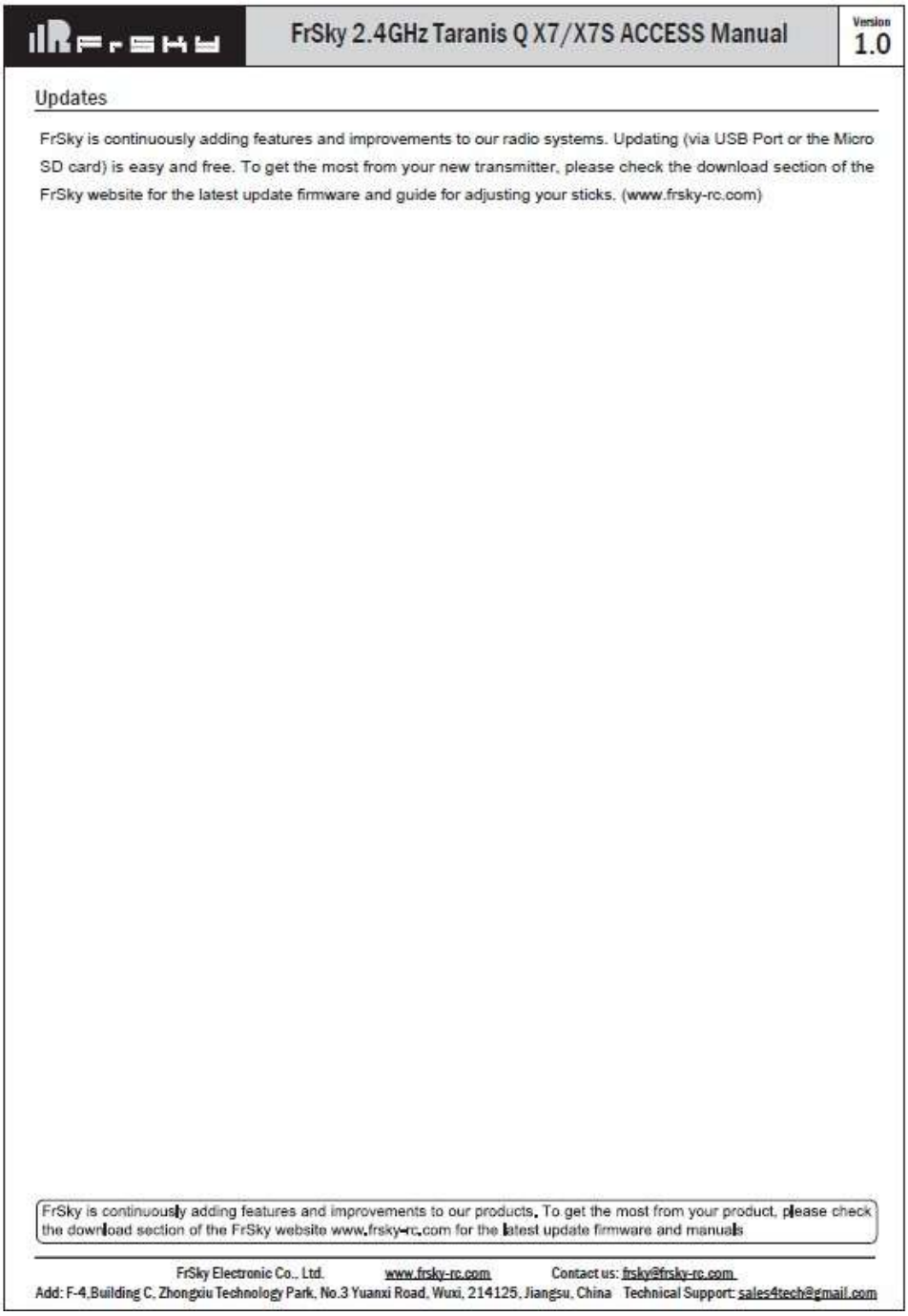


FrSky 2.4GHz Taranis Q X7/X7S ACCESS Manual

Version 1.0

Updates

FrSky is continuously adding features and improvements to our radio systems. Updating (via USB Port or the Micro SD card) is easy and free. To get the most from your new transmitter, please check the download section of the FrSky website for the latest update firmware and guide for adjusting your sticks. (www.frsky-rc.com)

FrSky is continuously adding features and improvements to our products. To get the most from your product, please check the download section of the FrSky website www.frsky-rc.com for the latest update firmware and manuals

FrSky Electronic Co., Ltd. www.frsky-rc.com Contact us: frsky@frsky-rc.com
Add: F-4,Building C, Zhongxiu Technology Park, No.3 Yuanxi Road, Wuxi, 214125, Jiangsu, China Technical Support: sales4tech@gmail.com

Ground Station Computer

1. This computer is what you plan missions and view the telemetry data from the drone with.

2. You control the drone using QGroundControl or Mission Planner software. These are outlined in the software_videos folder.
3. Link to QGroundControl Video 1: Video: QGround Control Part 1
4. Link to Qground Control Video 2: Video: QGround Control Part 2
5. Link to Qground Control Video 3: Video: QGround Control Part 3
6. Link to Mission Planner Video 1: Video: Mission Planner Part 1
7. Link to Mission Planner Video 2: Video: Mission Planner Part 2

900 mHz Portable Antenna

20. This is a high-quality antenna for the Dragon Link receiver.
21. You can purchase it at this link: Link : ebay
22. Here is the email of the manufacturer: Link : 900 mHz Antenna Manufacturer Email
23. Carbon fiber, metal, and other materials will interfere if they are near the antenna.

900 mHz Yagi Antenna

1. This is a high gain (very directional) antenna.

2.The original antenna that came with the Dragon link had a dBi of 3 and broke prematurely.

Technical characteristics of the antenna:

Polarization	linear
Resonant frequency, MHz	915
Gain, dBi	13,3
VSWR, not more	1,2
Impedance, Ohm	50
Input power, W	10
Jack	SMA male(can change by your request)
Cable Length, cm	40
Weight, g	350
Operating temperature, deg. Celsius	-40 Ã· +50

3.

4.Here is a link discussing antenna gain: Link : Antenna Gain Wikipedia Page

5.You can purchase these links on Link : ebay

6.Here is the email of the manufacturer: Link : Yagi Antenna Manufacturer Email

7.Note: There are different kinds of antenna jacks (plugs). There are two kinds of SMA connectors you need to be aware of. RP SMA will not fit in a regular SMA..

8.The following link describes the difference between Standard SMA and RP SMA antenna jacks: Link : Information on SMA and RP SMA Antenna Jacks

N.B. 3/2024:

The antenna was damaged after a fall. Ensure the driven ring element is pressed up against the plastic mount where it snapped off. It is unknown how much the damage affects performance.

DragonLink Transmitter

5. This is a UHF (Ultra High Frequency) transmitter used for long range communication.
6. It transmits up to 1 watt at 900 mHz. Power can be adjusted in the GUI.
7. Radio Frequency band explained: Link : Radio Frequency Wikipedia Page
8. Transmitter power output explained: Link : Transmitter Power Output Wikipedia Page
9. Legally, you need an amateur radio license to operate a 900mhz radio. Most Dragon Link owners do not however because it uses a frequency hopping band. This reduces the impact to other 900mHz “listeners”.
10. Frequency hopping explained: Link : Frequency Hopping Wikipedia Page
11. It receives power and a PPM signal (not PWM) from the controller.
12. If it is not receiving enough power (at least 6.5v), it will beep and the LED on the top will tun red.
13. This is powered by the Controller or USB. USB will only supply 5v however.
14. A blue led means it is connected to the RX.
15. A green led means it is receiving a valid PPM signal from the controller but is not connected to the RX.
16. Here are the steps to bind the TX and the RX (you should only need to do this once unless you make certain edits):
    1. Power off the TX and RX
    2. Hold down the “menu” button on the TX
    3. Power on the TX and wait until the LED turns blue
    4. Release the “menu” button

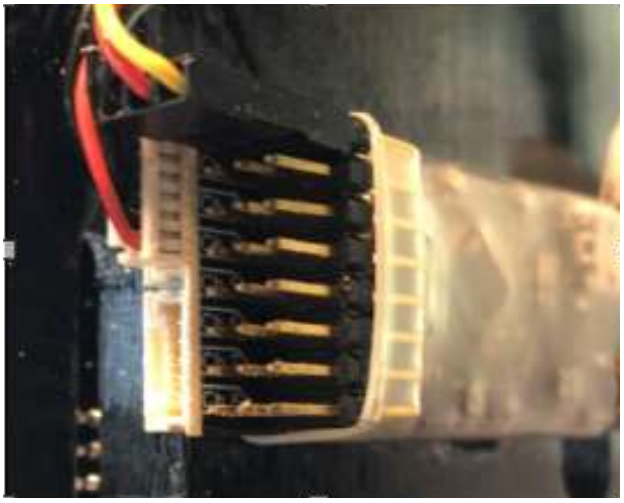
5. Power on the RX
6. Both the TX and RX should have a blue led
7. Power both systems off
8. Power both systems on

17. DragonLink GUI is used to set up the hardware. Additionally, the DragonLink GUI can be used to change the settings on the DragonLink transmitter, receiver and OSD.
18. This video demonstrates how to set up the settings of the DragonLink transmitter: Video: DragonLink GUI Transmitter Settings
19. It can connect to the ground station computer via USB or WIFI. This is set up in the GUI under "Extenal Connections".
20. We preferred using USB because it was more reliable.
21. QGround Control could not connect via WIFI.
    1. For WIfi connection, go to the GUI and change the Wifi/Bluetooth option to Radio Modem.
    2. Change the USB function to GUI.
22. To connect to the drone using Mission planner over wifi:
    1. Connect the GS computer to Dragon Link Wifi.
    2. Open Mission Planner.
    3. Select TCP in the top left drop down instead of COM_ .
    4. Baud should be the same as is specified in "External Connections" in the Dragon Link GUI.
    5. Type IP address of 192.168.1.1 and port of 14550.
23. Here is some info: Link : DragonLink Wifi Setup Instructions (note, the firmware has already been updated).
24. IMPORTANT: Do not power on the transmitter without an antenna screwed on. The antenna acts as a resistor and the circuitry will fry without it.
25. Here is the link to purchase it: Link : purchase DragonLink Transmitter

Dragon Link Receiver

1. This receives information from the transmitter and relays it to the Flight Controller.
2. This is a 1W receiver that operates at 900mhz.

3. You can purchase it at this link: Link : Purchasing DragonLink Receiver
4. Ensure you purchase the 1000mW not the 25mW.
5. If the blue light is on, it is bound to the transmitter.
6. There are two cables connecting it to the Flight Controller. The RX's 6pin JST connector connects to TELEM 1 of the Flight Controller. The servo connector plugged into Ch 1 on the RX connects to DSM/SBUS RC on the Flight Controller. This is shown in the system diagram.
7. The second (SBUS) cable is not necessary if the system is configured properly (as it has been in the past). The Flight controller was receiving telemetry information but not manual control information so, in the interest of time, we configured (in the dragon link GUI) Ch 1 as a SUBS out and connected it to the Flight controller's SBUS in. This works well and we have had no problems with it.
8. DragonLink GUI is used to set up the hardware. Additionally, the DragonLink GUI can be used to change the settings on the DragonLink transmitter, receiver and OSD.
9. This video demonstrates how to set up the settings of the DragonLink receiver: Video: DragonLink GUI Receiver Settings
10. IMPORTANT: Do not power on the RX without an antenna. This will fry it.
11. JST explained: Link : JST Connector Definition



GPS: Holybro H-RTK F9P Helical

1. This supplies location and orientation information to the flight controller.
2. This is a F9P module created by UBLOX and placed in a case and sold by Holybro. This module is configured into a base station or rover gps. The unit was purchased to act as a base station but

performed excellently inside of the case and has been the primary GPS unit since the first kayak based hydrodrone.

3. It is preferable to hook up the GPS to the Pixhawk 6 using the GPS module port, but UART & 12C B can also be used as an alternative option.
4. If the GPS starts to lose connection, point it towards the antenna on the Taranis FrSky Controller.
5. Here is the link to the manual for the F9P: Manual: F9P Module
6. Here is the link to purchase it: Link : Purchase F9P
7. Here is a link with info about GPS: Link : More Information about GPS

Ping Sonar: Blue Robotics Ping V1

1. This uses sound to determine the depth of water.
2. This is plugged into the TELEM 2 port of the Flight Controller.
3. Ping sonar Pixhawk setup: Instructions: Ping Sonar Pixhawk Setup
4. Link about sonar Link : Sonar Description
5. Link to purchase it Link : Purchase Ping Sonar

Power Distribution Board: Holybro PM07 v2.7

1. Also known as a PDB, this one comes with the Pixhawk 6C. It supplies power to all the systems on the drone.
2. The flight controller can be plugged into the PWR1 or PWR2 port.
3. The I/O-PWM-in port is connected to the flight controller's I/O PWM out port.
4. The signal to control the thrusters comes from the flight controller and is routed through the PDB before going to the ESCs

Flight Controller: Holybro Pixhawk 6C

1. This is the "brain" of the drone. It is a computer that receives information from the GPS and internal sensors and decides how much power to provide each thruster.

2. It runs on open source ArduRover firmware. Which supports multiple frames including boat, rover and balancebot.
3. It operates on the same framework as Ardupilot which is meant for aerial vehicles including quadcopters and fixed wing drones.
4. The Pixhawk 6C typically comes with Pixhawk4 but we flashed it with ArduRover firmware.
5. Here is a video describing how to flash ArduPilot on a Pixhawk 4:
6. Flashing Ardupilot on Pixhawk 6C
7. ArduPilot and Drone Code worked together to make the Pixhawk 4, but relations fell apart after its release. Drone Code stole the “Pixhawk” name and subsequent models of ArduPilot’s flight controllers were called “Pixhawk Cubes” or just “Cubes”. There is far more support for ArduPilot systems than Pixhawk 4 systems. Because of this we will use a Cube in our next build.
8. Here is the **most important link**. It gives clear explanations on how to configure almost anything about the flight controller: Link : ArduPilot Flight Controller Instructions
9. The flight controller is configured in Mission Planner or QGroundControl. This is outlined the videos under software_videos.
10. Link to QGroundControl Video 1: Video: QGround Control Part 1
11. Link to Qground Control Video 2: Video: QGround Control Part 2
12. Link to Qground Control Video 3: Video: QGround Control Part 3
13. Link to Mission Planner Video 1: Video: Mission Planner Part 1
14. Link to Mission Planner Video 2: Video: Mission Planner Part 2

ESC

8. The thrusters require large amounts of amperage. Because you would fry the flight controller if you pumped this power through it, you need Electronic Speed Controllers. These receive a PWM signal from the flight controller and power from the PDB (this power is directly from the battery. The PDB is just like a wire) and output a regulated voltage through the three wires connected to the thruster.
9. Link about PWM signals Link : PWM Signals Information
10. Here is a video on how ESCs and brushless motors work Video: ESCs and Brushless Motors

Thrusters

1. These are Blue Robotics T200 Thrusters with the CNLINKO LP20s attached. cable.

2. The link to purchase them is here [Link : Purchase Left/Right Thruster]

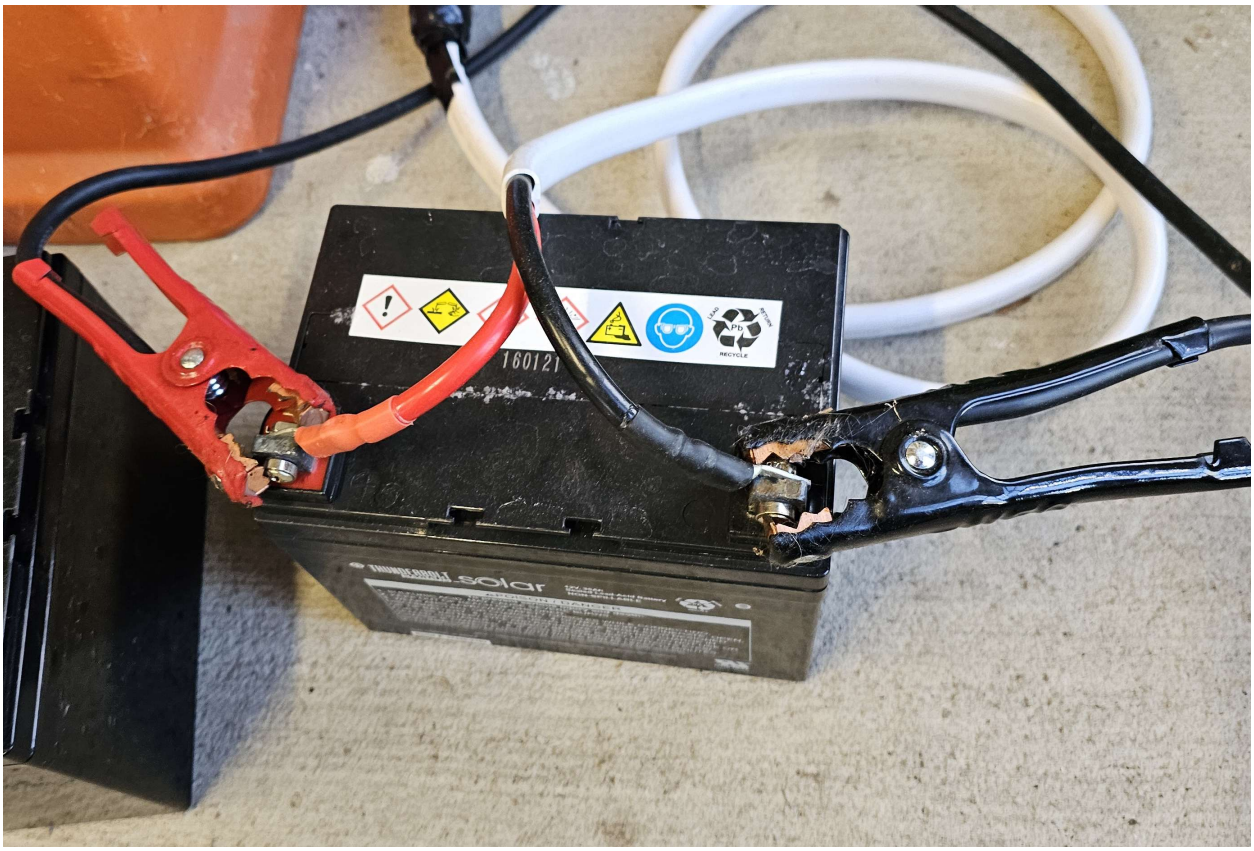
3. Schedule of maintenance:
    - Every Use: Rinse with fresh water
    - Every 3-4 uses or after being clogged with organic material: Complete disassembly and cleaning.
    - As needed: Replace small hardware/

Battery

We use a 35ah deep cycle sealed lead acid battery. It gives us a typical mapping time of around 2 hours and 10 minutes with an approximate range of 35,000 feet traveled in mixed current conditions.

It can be found here: https://www.harborfreight.com/12v-35-ah-sealed-lead-acid-battery-56770.html

To Charge:



1. Connect the red positive lead of the battery charger to the corresponding red terminal on the battery.
2. Connect the black (negative) lead to the corresponding negative terminal on the battery.

2. Flip the switch on the left side of the charger to the frost position.
3. Press the button on the left of the red display to view the battery charge percentage.
4. Press the large red button to begin charging.
   Depending on how low the battery is charging may take several hours. We typically leave it charging overnight. After the charge is completed the charger will maintain it at 100%.

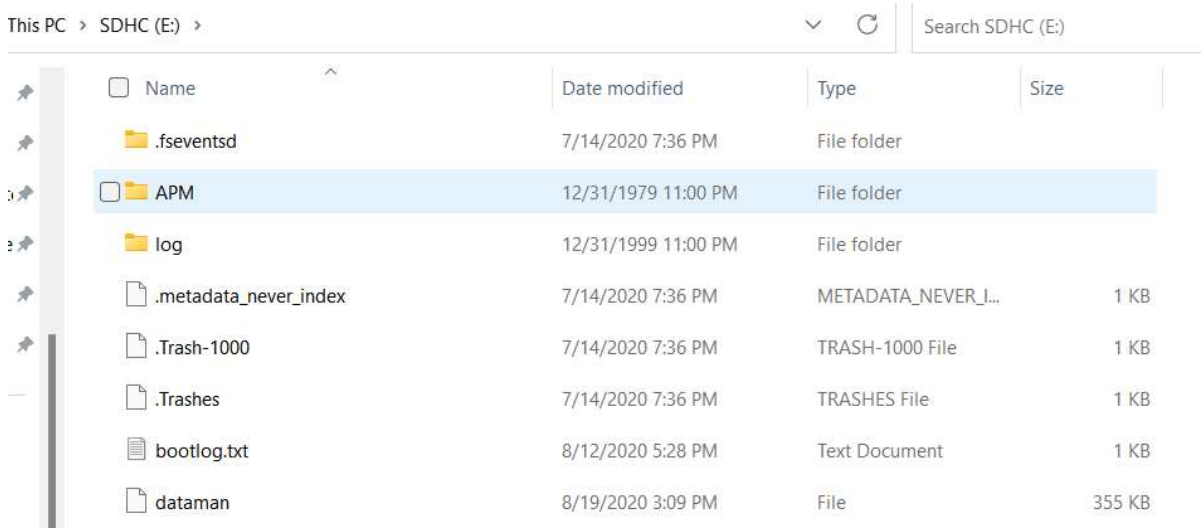
Data Extraction Process

1. Remove the micro SD card from the Pixhawk. This can most easily be done by gently pushing it inwards until a click is heard. Then slowly release pressure on the card and it should pop out.

2. Insert the micro SD card into the adapter. The connectors on both should have the same orientation and direction.

3. Insert the SD card adapter into the computer.

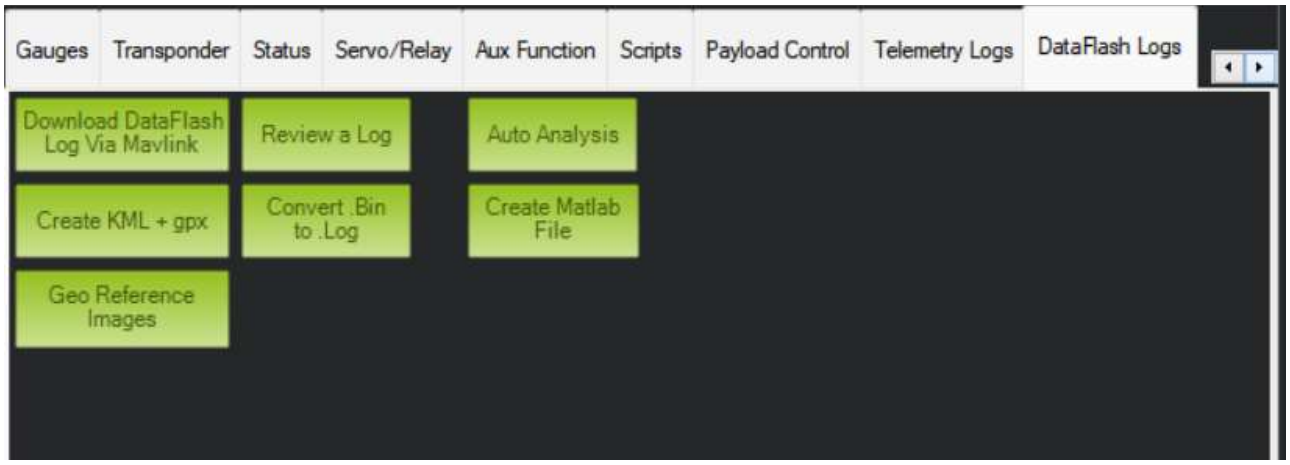
4. Copy the log file stored under the folder APM>LOGS. You can verify it is the correct log by looking at the date edited.



5. Paste the .bin log into a new folder named yyyy.mm.dd_description in the logs folder.

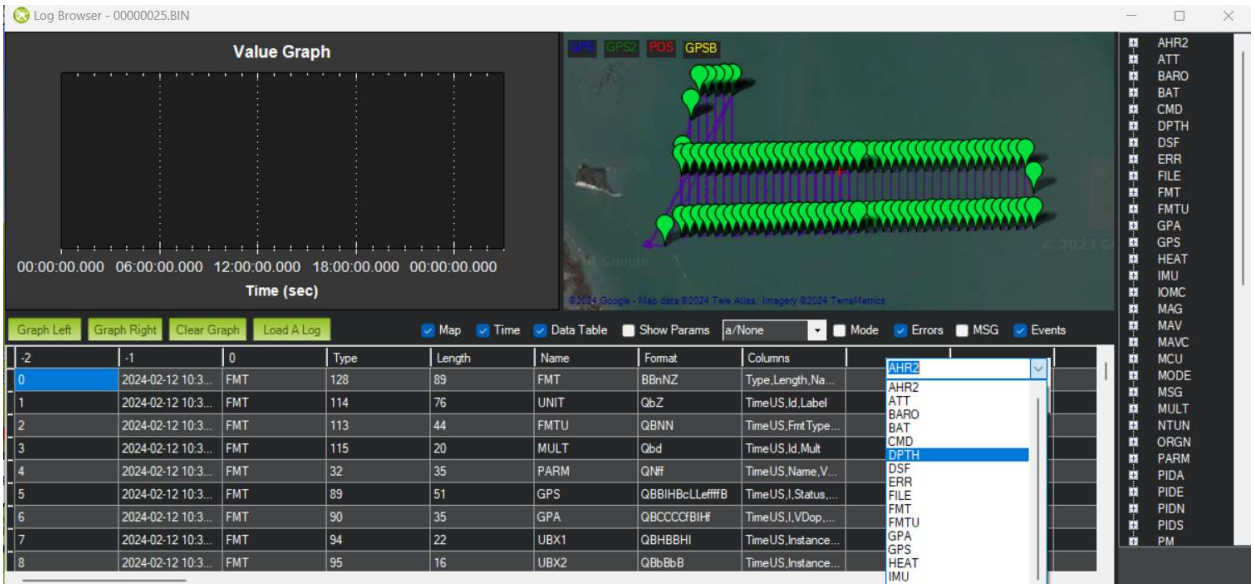
8. Open Mission Planner.

9. Select “DataFlash Logs” after scrolling right in the window in the bottom left of the screen.



10. Select “Review a log”.

11. Find and select the .bin file.



13. Click one of the blank columns headers and from the drop down menu select DPTH, then select Filter.

14. Right click anywhere in the data fields and select export visible.

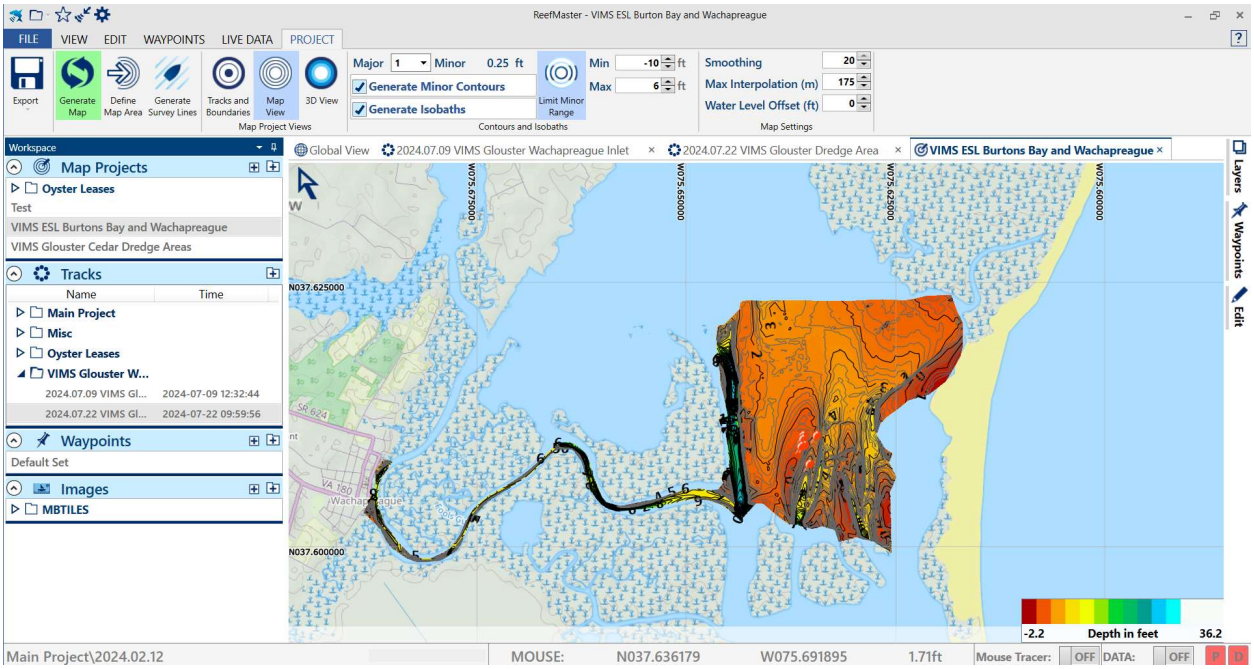
15. Name the CSV the date of the log in the format YEAR.MM.DD.

Collecting Tide data from NOAA:

1. Go to https://www.tidesandcurrents.noaa.gov/api-helper/url-generator.html
2. Select Data API
3. Select your local station, water level (6 minutes), set your data range, datum, time zone, format (we use CSV), and units.
4. A URL will be presented on the right, either copy that and navigate to that URL or click the submit button.
5. Save the CSV to your computer to be used in adjusting data in Reefmaster.

Reefmaster:

Reefmaster is a mapping software originally designed to help fisherman map their favorite fishing spots by utilizing data from their commercial GPS and transducer units. It's able to handle a large amount of data very easily and allows for easy data processing, and export and is able to generate bathymetric maps using TINS (Triangular Irregular Networks).



A sample screenshot of our Burtons Bay Project in Reefmaster 2.0

Reefmaster Documents: https://reefmaster.com.au/reference2/index.htm

Reefmaster Ardupilot reference: https://ardupilot.org/rover/docs/reefmaster-for-bathymetry.html

Tutorial videos on our data processing procedures can be found here:

Collecting NOAA tides from the API builder

Data Processing Part 1: Mission Planner

Data Processing Part 2: Reefmaster

Pixhawk setup links

1. ArduRover First time Setup: Instructions: ArduRover Setup
2. ArduRover First Drive and Tuning: https://ardupilot.org/rover/docs/rover-first-drive.html
3. This website will answer 90% of the questions you have; just look for the topic in the table on the left.
4. ArduRover Full Parameter list: Link : ArduRover Full Parameter List

5. Dragon Link Setup: Instructions: DragonLink Setup
6. Dragon Link Support Forum: Link : DragonLink Support Forum for Pixhawk Setup
7. Ping Sonar Setup: Instructions: Ping Sonar Setup
8. This is the ArduRover support forum: Link : ArduRover Support Forum
9. Previous working parameters can be found in "C:\Users\Dell\Documents\Earth Systems Management Projects\2023 ESM Hydrodrone Kayak\Parameters". .param Files are mission planner parameters and .params are used in QGC. You must use the correct format for that particular ground station when setting up the Hydrodrone.
10. Hydrodrone Documents:
    1. Hydrodrone Checklist
11. Archived Hydrodrone Documents (Pre 2023/2024 Refit):
    1. Manual: Pixhawk 4 Write-Up
    2. Manual: Pixhawk 4 Field Test Procedure
    3. Manual: Pixhawk 4 Test Write-Up
    4. Manual: Overview of the Pixhawk 4 Autonomous System

Tide Gauge Deployment

1. The tide gauge is essential for monitoring water levels. Sensors are attached to the tide gauge and they are used to record the height of the water levels. sensors to
2. Below is a photo of the tide gauge assembled in 2022

3. The following link outlines the assembly procedure of the Tide Gauge: Manual: Tide Gauge Deployment Procedures
4. More information on tide gauges can be found on the NOAA website: Link : Description of Tide Gauges

Procedures for Collecting Historical Mapping Data

NCEI Bathymetric Data Viewer

1. The NCEI Bathymetric Data Viewer is useful for identifying and retrieving historical Bathymetric and mapping data.
2. The following link goes to the NCEI Bathymetric Data Viewer: Link : NCEI Bathymetric Data Viewer
3. The following manual provides details of how to utilize the NCEI Bathymetric Data Viewer: Manual: Collecting Historical Survey and Map Data

Collecting Historical Map Data from Topoview

1. Historical map data can also be found on the USGS Topoview Website.
2. The link to the USGS Topographic Maps can be found here: Link : USGS Topographic Maps
3. Procedures for using topoview can be found in the following manual: Manual: Topoview Manual

Computer and Web Related Manuals

1. Instructions on how to connect to the Z83 remote workstation can be found here: Manual: Remote Desktop Connection
2. The Giving Fuel website is useful for Earth Systems Management since it allows the company to make sites for gifts, donations and selling merchandise.
3. The Giving Fuel Help Page can be found following this link: Link : Giving Fuel Help Page
4. RegFox is another website that is useful for getting people to register and pay for events hosted by Earth Systems Management.
5. The RegFox Help Page can be found using this link: Link : RegFox Help Page
6. Jotform is an additional website that is useful for making online forms such as contracts and job applications.
7. The Jotform help page can be found here: Link : Jotform Help Page
8. Steps for using the Giving Fuel, RegFox and Jotform websites can be found in the following manual: Manual: Giving Fuel RegFox and Jotform Basics.

Operating QGround Control

1. Calibration of the hydro drone can be done on QGround Control.
2. The three sensor calibration tests necessary to calibrate the hydro drone are Accelerometer, Compass and Gyro.
3. The following manual provides you with in depth instructions on how to turn on the Taranis FrSky controller and operate Q Ground Control: Manual: QGround Control Setup.

Update History:

June 2023: Finalized By JL.

March 11 2024: Merged with Seabison manual and updating in progress by AW. Deleted ODU drone section. Refined controller instructions.

April 17 2024 Added battery information and updated data extraction methods. AW.

April 22 2024 Added an addendum to operating procedure and some more images. Reformatted. AW.

July 2024: Clarified ground station connection instructions, removed out of date instructions and replaced them. Added more hyperlinks. AW.