

# X8-M

## Operation Manual



Thank you for purchasing an X8-M! This manual contains important information about your aerial mapping platform. Please read these instructions before your first flight.

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An aerial photograph showing a wide river flowing through a lush green forest. The river has a sandy or rocky bar in the middle. The surrounding area is densely wooded with various shades of green. In the top left corner, there's a small clearing with some buildings and a paved area.

Online information portal:  
3DR support:  
Terms and conditions:  
Pix4D instructions:

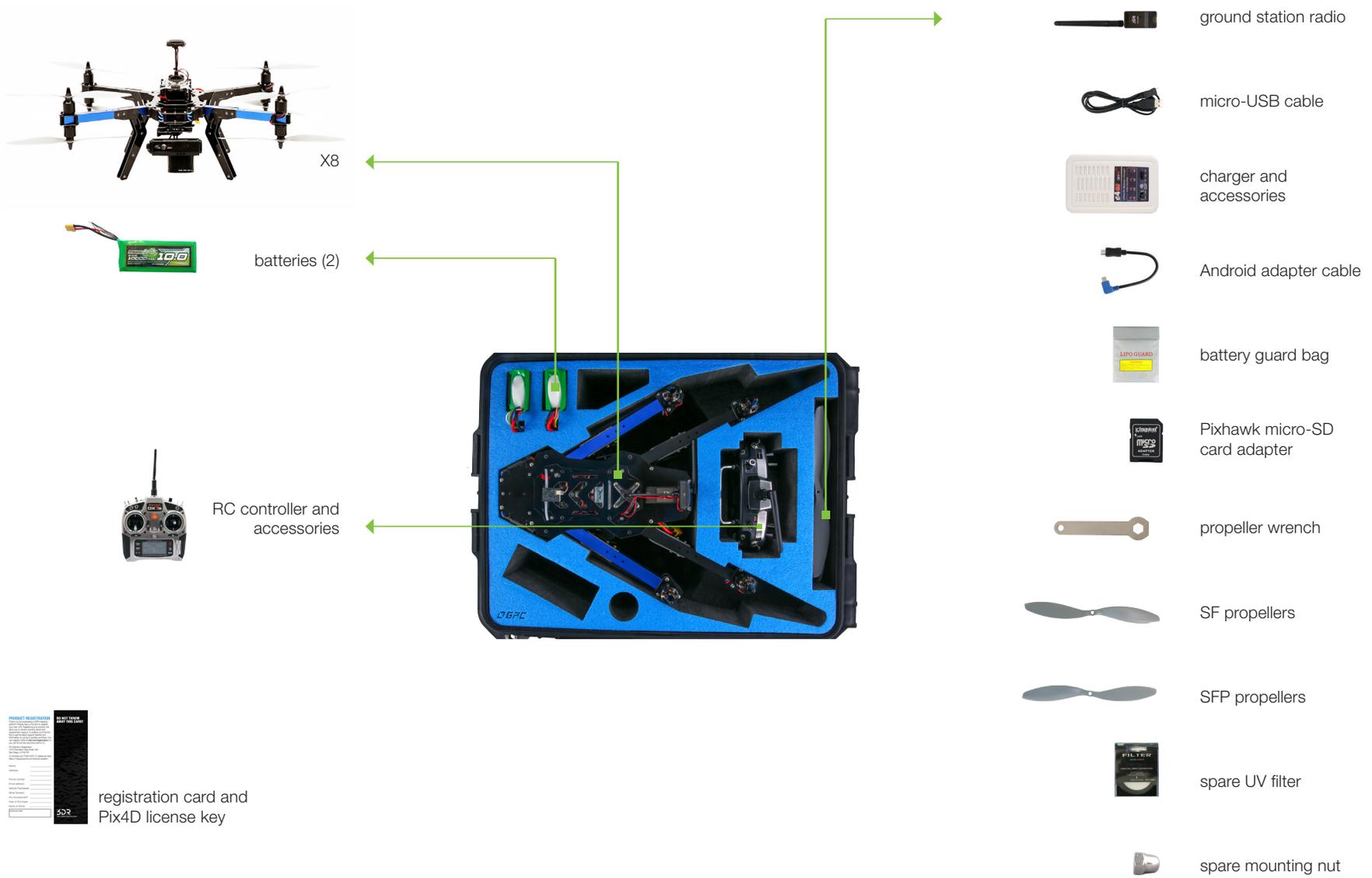
[3DR.com/X8-M](http://3DR.com/X8-M)  
[help@3DR.com](mailto:help@3DR.com)  
[3DR.com/terms](http://3DR.com/terms)  
[support.Pix4D.com](http://support.Pix4D.com)



## I Plan

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# Parts



## FPV/OSD System

If you selected to receive a FPV/OSD system, those components will be included with the X8's accessories. See page 27 for parts and instructions.

# Flight Battery

The X8 is powered by a rechargeable lithium polymer (LiPo) battery. Charge the battery before your first flight.

## Charging

- 1 Connect the charger to the power adapter cable and a wall outlet. Connect the red cable to the + port and the black cable to the - port.



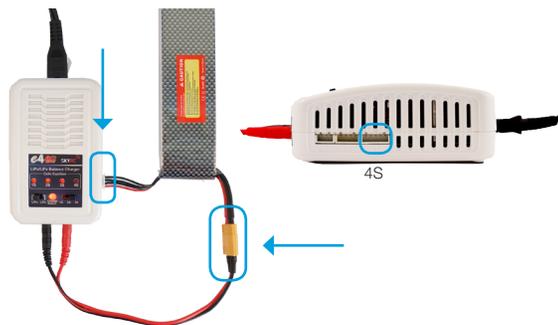
Charger with power cable and split-wire charging cable

- 2 Set the charger to LiPo and 3A.



Charger settings

- 3 Connect the white connector to the 4S port, and join the two yellow connectors together.



Flight battery charging wiring

- 4 Secure the battery inside the guard bag, and charge until the status indicator displays green.



Charging in process

## Safety



Flying with a low battery is a safety risk and can render the battery permanently unusable. Always fly with a fully charged battery.

Charge the battery using a designated LiPo balance charger only. Always monitor the battery while charging. Protect the battery from extreme heat, extreme cold, puncturing, and flammable surfaces. Always transport, charge, and store the battery in the guard bag.

Inspect the battery for damage before and after flying. If you observe any swelling of the package or the battery ceases to function, do not use the battery; locate your local battery recycling center, and dispose of the battery. In the US and Canada, visit [call2recycle.org](http://call2recycle.org) to find a location. Do not dispose of the battery in the trash.

# Powering the X8

1

Turn on the controller. To avoid triggering the controller's startup alarm, ensure that all switches are set back (away from you) and the throttle stick is set fully down.



RC controller

2

Attach the battery to the underside of the copter using the velcro straps, and join the yellow connectors.



It is important to establish communication before powering on the X8. Always turn on the controller before connecting the battery. When powering off the X8, disconnect the battery before turning off the controller.

# Camera Setup

The X8 includes a Canon PowerShot S100 running the 3DR EAI script.

## 3DR EAI (Exposure-Aperture-ISO)

3DR EAI runs on the Canon Hacker Development Kit (CHDK), a powerful open-source tool that expands the functionality of Canon point-and-shoot cameras. 3DR EAI optimizes image exposure and integrates with the Pixhawk autopilot to enable distance-based imaging.

This software is designed to load off the camera's SD card, leaving the original Canon programming intact. The yellow switch on the side of the SD card allows you to lock or unlock the card. Lock the SD card to run 3DR EAI; unlock the SD card to save images to your ground station or to boot the camera with its original programming.

For more information about 3DR EAI, see page 36.



**SD card locked**  
Load 3DR EAI

» Fly a mapping mission



Camera running 3DR EAI



**SD card unlocked**  
Load default Canon software

» View images on camera  
» Save images to ground station  
» Update script



Camera running Canon software



Power off the camera before removing the SD card.

## Charging

Charge the camera battery before your first flight. Once fully charged, insert the battery into the camera.



Canon battery charger

## Starting a Mission

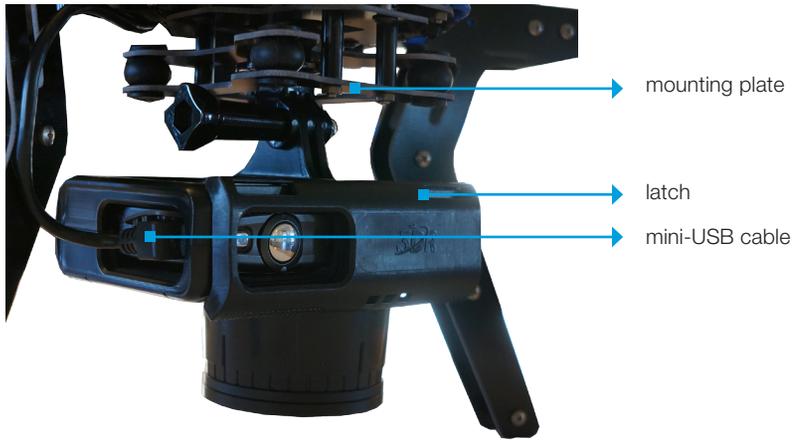
To prepare the camera to fly a mapping mission, ensure that the mode dial is set to *P* (*program*) mode. Power on the camera using the silver button on the top. 3DR EAI will start automatically, and you will see the script messages on the camera display. Check to see that the last line of the script reads *waiting on USB signal*. The camera is now ready to map!



Camera ready to map: *waiting on USB signal*

# Mounting

When the camera is ready to start the mission, open the latch, and insert the camera into the mount. Close the latch, and rotate the mount so the camera faces down. Connect the mini-USB cable to the camera.



Camera (side)

The camera mount includes a cap to protect the UV filter during travel. Before you fly, remove the cap, and check that the filter contains no dirt particles or scratches that could affect image quality. If you notice any damage to the filter that could affect image quality, screw off the filter and replace with the extra filter provided with the X8.



Camera enclosure with cap



Camera enclosure with cap removed

# Ground Station Setup

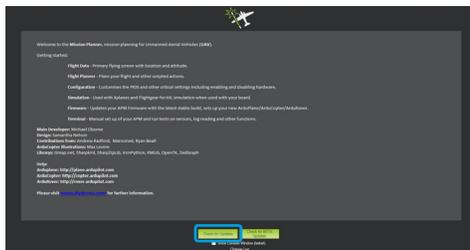
Mission Planner allows you to turn a Windows laptop into a full-featured ground station for configuring and monitoring autonomous missions. You will need to take this laptop into the field when you fly the mission. As part of the mission procedure, you will use the Pix4D Rapid Check to verify the quality of the image set before leaving the field.

## Download Software

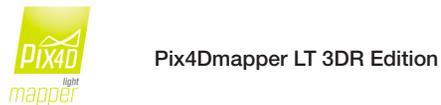


Mission Planner is a full-featured ground station application for planning missions and monitoring the X8 in flight. Download Mission Planner from [3DR.com/download\\_software](http://3DR.com/download_software).

If you already have Mission Planner installed, make sure you're running the most recent version: Select the *Help* tab and *Check for Updates*.



Mission Planner: *Help* tab



Your license key for Pix4Dmapper can be found on the registration card inside the documents package.

Visit [mapper.pix4d.com/license-redeem](http://mapper.pix4d.com/license-redeem) to create an account and redeem your license key; then visit [pix4d.com/download](http://pix4d.com/download) to download Pix4Dmapper Discovery. Pix4D will automatically upgrade from the Discovery edition to the LT 3DR Edition (or Pro Edition if you selected to upgrade) when you log in to the program with your Pix4D account information.

## Connect to Radio

To connect the X8 to Mission Planner, connect the ground station radio to the laptop, and power the X8.

- 1 Connect the ground station radio to your laptop using the micro-USB cable. Open Mission Planner.
- 2 Select *57600* and *AUTO*, then select *CONNECT*. (When connecting directly to Pixhawk's micro-USB port, set the rate to 115200.)



Ground station laptop with radio connected



Mission Planner *Connect* tool (top-right corner)

- 3 Select *Flight Data* to view live data from the X8.

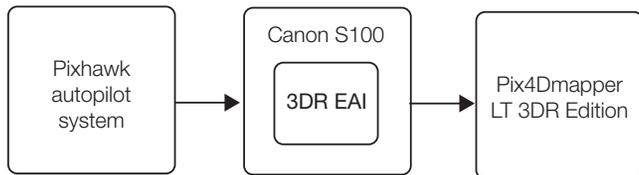


Mission Planner *Flight Data* tab: connected to aircraft

# Mission Planning

## Operating Parameters

The X8 is a complete solution for creating high-resolution visual-spectrum aerial maps.



To create a map, the X8 flies an autonomous mission over the survey site, using the integration between the Pixhawk autopilot and custom-programmed camera to capture images at a consistent distance interval. Pix4Dmapper then stitches these images together into a georeferenced, orthorectified mosaic.

The accuracy of the map depends on the configuration of the mission. Planning a mission that captures high-quality images requires balancing the X8's operating parameters with the environmental factors at the survey site.

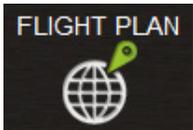
### Operating Parameters

Camera	Canon S100
Camera Orientation	Landscape (top facing forward)
Operating Altitude	50-120 m
Default Altitude	60 m
Low-Wind Conditions	0-6 m/s
High-Wind Conditions	7-10 m/s
Maximum Wind Conditions	10 m/s
Operating Speed	1-17 m/s
Default Speed	5 m/s
Estimated Maximum Flight Time	14 min
Estimated Ground Resolution	2 cm/pixel
Estimated Maximum Survey Area	.1 km <sup>2</sup>
Minimum Photo Interval	2 seconds

# Load Maps

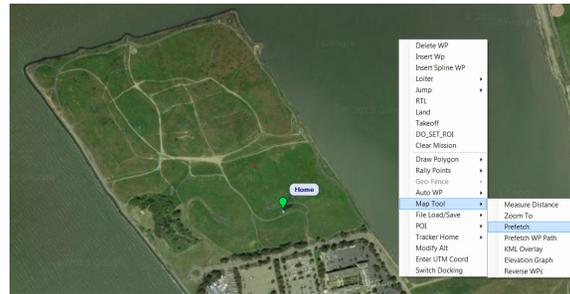
Mission Planner allows you to plan the mission away from the mapping location; however, it is important to assess the environmental conditions on site at the time of the mission and adjust the flight plan if necessary. Alternatively, you can plan the entire mission at the mapping location. To create or alter the mission, Mission Planner requires an Internet connection to access the maps. If you're unable to access the Internet on site, follow the instructions below to pre-fetch the maps within Mission Planner while you have Internet access.

- 1 Open Mission Planner, select *Flight Plan*, and zoom to your flying location.



Mission Planner *Flight Plan* tab: zoom to mapping location

- 2 Right-click on the map, select *Map Tool* and *Prefetch*, and accept the default prompts. Mission Planner will download the maps for the selected location to your computer.



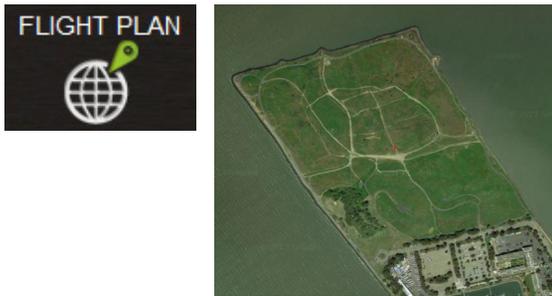
Mission Planner *Flight Plan* tab: Select *Prefetch*

- 3 Mission Planner will attempt to load the map data from the current level of zoom down to the closest level of zoom available. However, it can take hours to pre-fetch every level of zoom, and it is unlikely that the closer levels will be useful in planning the mission. To shortcut this process, check the slider on the right side of the map. The levels of zoom are represented by this slider from 0 (bottom) to 25 (top). Press the ESC key to skip levels of zoom at a greater detail than you need for mission planning.

# Draw Polygon

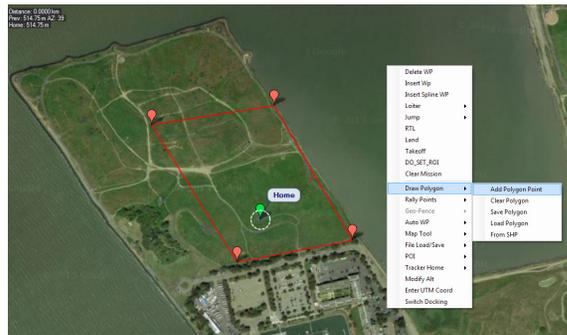
To begin planning the mapping mission, select the area you want to map using the *Polygon* tool. You'll be able to adjust the size and shape of the polygon later in the mission configuration process.

- 1 Select *Flight Plan*, and zoom to your mapping location.



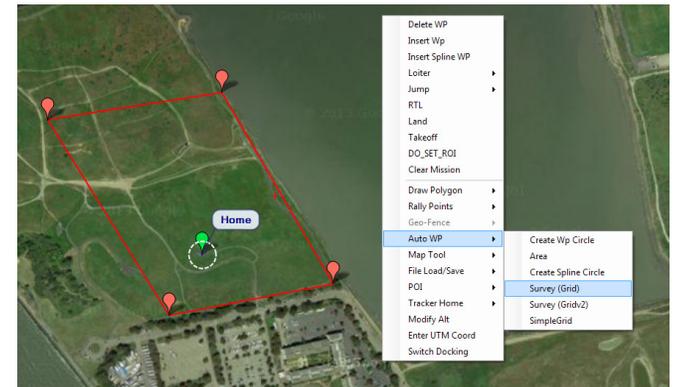
Mission Planner *Flight Plan* tab: zoom to mapping location

- 2 Right click on the map. Select *Draw Polygon* and *Add Polygon Point*. Click and drag to add points around the area you want to map.



Mission Planner *Flight Plan* tab: draw polygon

- 3 Right click on the polygon. Select *Auto WP* and *Survey (Grid)* to open the Survey Tool.



Mission Planner *Flight Plan* tab: open Survey tool



## Units

The Survey Tool uses metric units. If your Mission Planner is set to imperial units, please change the settings to use metric to plan the mission. Support for imperial units in Mission Planner is coming soon; check [3DR.com/X8-M](http://3DR.com/X8-M) for updates.

# Configure Survey: Set Default Parameters

The Survey tool allows you to configure a mapping mission according to the X8's operating parameters and the current environmental conditions at the mapping location. First, set the default values for the X8.

Simple

Simple Options

Camera: Canon S100-S120

Altitude [m]: 60

Angle [deg]: 264

Camera top facing forward

Flying Speed [m/s] (est): 5

Use speed for this mission

Add Takeoff and Land WP's

Use RTL

Display

Boundary

Markers

Grid

Internals

Footprints

Advanced Options

Accept

Stats

Area:	99925 m <sup>2</sup>	Pictures:	103	Flight Time (est):	15:25 Minutes
Distance:	3.7 km	No of Strips:	11	Photo every (est):	6:07 Seconds
Distance between images:	30 m	Footprint:	82.3 x 60.7 m		
Ground Resolution:	2.02 cm	Dist between lines:	32.91 m		

Set Camera  
Canon S100-S120

Set Camera Orientation  
Check the option for *Camera top facing forward*.

Simple

Simple Options

Camera: Canon S100-S120

Altitude [m]: 60

Angle [deg]: 264

Camera top facing forward

Flying Speed [m/s] (est): 5

Use speed for this mission

Add Takeoff and Land WP's

Use RTL

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Area:	99925 m <sup>2</sup>	Pictures:	103	Flight Time (est):	15:25 Minutes
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Distance between images:	30 m	Footprint:	82.3 x 60.7 m		
Ground Resolution:	2.02 cm	Dist between lines:	32.91 m		

Set Default Speed  
5 m/s

Apply Survey Speed  
Check the option for *Use speed for this mission*.  
If unchecked, the mission will use the X8's default speed of 5 m/s regardless of the speed selected in the Survey Tool.

# Configure Survey: Set Angle

Next configure the angle of the flight path for the current wind conditions.



Mission Planner Survey tool

Set Angle

## Wind Direction

In environments with winds of less than 6 m/s, set the angle so that the X8 flies into the wind. In winds from 7-10 m/s, configure the flight path to travel perpendicular to the wind so the X8 flies cross-wind.

## No. of Strips

Adjust the angle so that the X8 makes as few turns as possible to complete its course. The **No. of Strips** parameter shows how many passes the X8 will make as you adjust the angle.

## Review Wind Conditions On-Site

Always assess the wind conditions at your survey site at the time of the mission and adjust the mission accordingly.



Angle in low winds (1-6 m/s)



Angle in high winds (7-10 m/s)

## Mission Planner Tip: Adjust Polygon

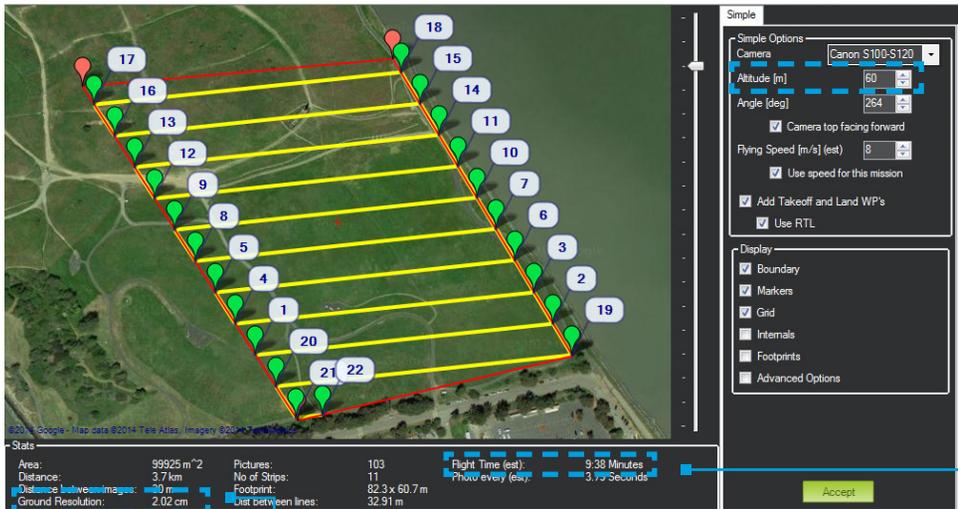
Click and drag the red polygon points to adjust the size and shape of the polygon from the Survey Tool.



Use caution when flying in winds over 10m/s. Mapping results may degrade as a result of inability to make headway or maintain appropriate groundspeed.

# Configure Survey: Set Altitude

The survey altitude determines the duration of the mission and the ground resolution of the final map. Adjust altitude to balance flight time and power consumption with the current environmental conditions.



Mission Planner Survey tool

## Check Ground Resolution

Ground Resolution is the centimeters per pixel that you will have in the map and corresponds to the amount of detail that you will see.

To improve ground resolution by decreasing the number of centimeters per pixel, decrease altitude.

## Set Altitude

Recommended altitude: 60 m  
Operating altitude: 50-100 m

Increasing altitude decreases flight time, allowing you to cover more area per minute. Decreasing altitude improves ground resolution. Set the altitude to get the best ground resolution while keeping the flight time under 14 min and the altitude under 120 m.



Keep altitude below 120 m, and ensure that the altitude is appropriate for your flying area and local regulations.

## Check Flight Time

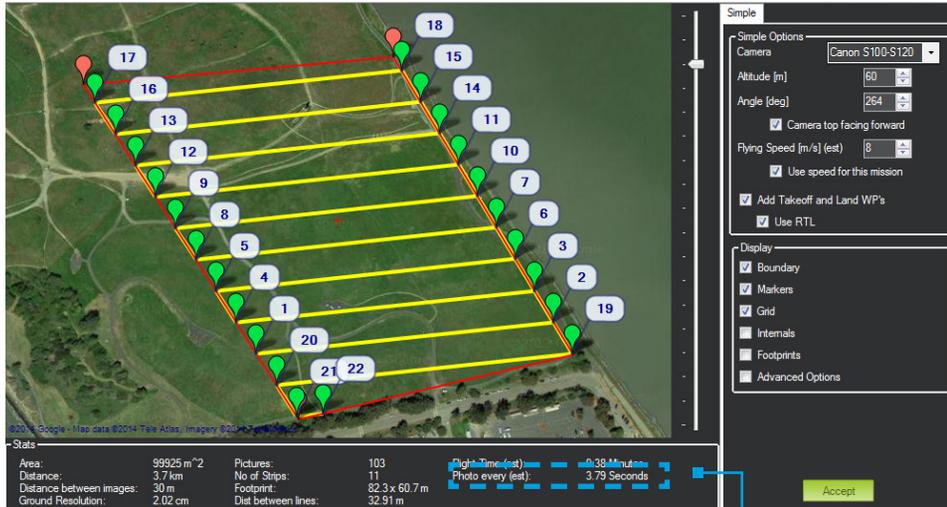
**Flight Time** estimates the duration of the mission. The total estimated flight time must be under 14 min for a fully charged X8 battery. To decrease flight time, increase altitude or speed.

High winds, humidity, high altitude, and extreme heat can affect power consumption and reduce flight time. Consider the environmental factors at your site when configuring flight time.

In this example, we increased speed to 8 m/s to keep flight time below 14 min while allowing for moderate wind conditions. When increasing speed, keep in mind that the increased power required to travel faster will impact flight time.

# Configure Survey: Check Photo Interval

With the basic parameters in place, verify that the photo interval calculated from the altitude and speed complies with the operating parameters for the camera.



Mission Planner Survey tool

## Check Photo Interval

*Photo Every* must be longer than 2 seconds for the S100 camera.

## Altitude

Increasing altitude increases photo interval.



Keep altitude below 120 m, and ensure that the altitude is appropriate for your flying area and local regulations.

## Speed

Decreasing speed increases photo interval.



Ensure that the *Use speed for this mission* option is checked.

# Configure Survey: Set Takeoff and Landing

Now select a takeoff and landing pattern, either manual or automatic.



Mission Planner *Survey* tool

→ Takeoff and Land WP's

## For automatic takeoff and landing (recommended)

Check the *Add Takeoff and Land WP's* option.

Check the *Use RTL* option.

After initiating the mission, the X8 will automatically take off, climb to the survey altitude, and begin the mission. At the end of the mission, the X8 will automatically return to the launch point and land.

## For manual takeoff and automatic landing

Uncheck the *Add Takeoff and Land WP's* option.

Check the *Use RTL* option.

Take off manually, and initiate the mission in flight. To end the mission, the X8 will land automatically at the launch point.

# Configure Survey: Advanced Options

## Mission Planner: Survey Tool



Check Advanced Options to view the Survey Tool's advanced configuration options.

## Survey Tool: Grid Options (Advanced)



Select Grid Options

Adjust StartFrom

During the mission, you will maintain contact with the X8 through the RC controller and ground station signals. If these signals are lost during flight, the X8 will respond with the assigned failsafe behaviors. See page 29. If your mission is likely to experience a loss of signal, it is best practice to start from the corner of the mission farthest from the launch point.

Adjust Overlap and Sidelap

Overlap and sidelap are set to 50% and 60%, respectively, by default. See page 35 for an in-depth discussion of these parameters.



Camera Config

The options under the Camera Config tab allow you to configure a camera other than the S100 and won't be used for operating the X8.

# Configure Survey: Accept Survey

Before accepting the survey, check that the mission complies with the X8's operating parameters. Once you accept the survey, you will not be able to edit it directly by re-opening the Survey Tool. If you need to adjust the survey, clear the mission (right click, select Clear Mission), and repeat the survey configuration process.



## Operating Parameters

**Camera**  
Canon S100-S120

**Altitude**  
50-100 m

**Camera top facing forward**  
checked

**Flying speed**  
1-17 m/s

**Use speed for this mission**  
checked (optional if speed set to default speed of 5 m/s)

**Photo Every**  
greater than 2 s

**Flight time**  
under 14 min depending on environmental conditions

**Accept**  
Select *Accept* to save the mission.

If Mission Planner prompts you for a home altitude, enter the altitude that you specified in the Survey Tool.



Do not accept the mission if any of the parameters exceed the X8's operating limits.

# Save and Write Mission

On the Flight Plan screen, save the waypoint file to your computer and write the mission to the X8.



Select Save WP File

to save the mission file to your computer. To repeat this mapping mission, load the saved WP file from your computer.

Select Write WPs

to save the mission to the X8.



## 2 Fly

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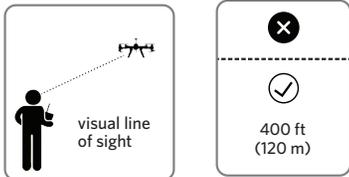
# Safety

To ensure safe and successful flying, familiarize yourself with the safety information on this page. Always fly in accordance with your location regulations and these best operating practices.

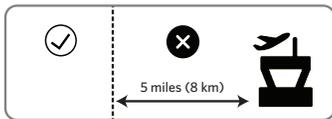
Before you fly, determine the boundaries of your safe flying area. If the X8 moves outside the designated area or exhibits instability in flight, switch to altitude hold mode and land the copter manually.

The X8 will not avoid obstacles on its own, including during missions. As the operator, it's your job to recognize and avoid obstructions while flying. Always be ready to regain manual control of the copter in the event of an unsafe situation.

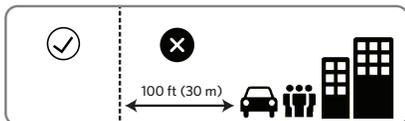
## Location



Always fly below 400 ft (120 m) and within your visual line of sight. Don't let the X8 get too far away from you; make sure you can always see its orientation. Don't fly in low light, heavy wind, rain, or other conditions that might impede visibility.



Always fly at least 5 miles (8 km) away from airports and other areas where pilots operate manned aircraft.



Always fly at least 100 feet (30 m) away from people, vehicles, and buildings. Make the safety of people and property your first priority!

## Propeller



Spinning propellers can cause serious injury. The safety button indicates the status of the motors to help you prevent hazardous contact with the X8's high-speed propellers.

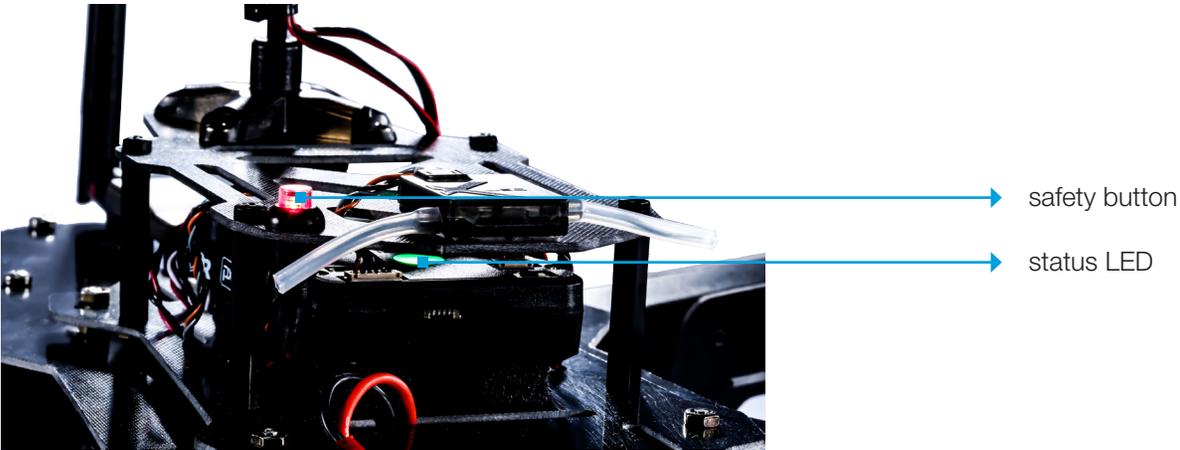
- When the X8 is powered on, the safety button will blink red, indicating that the motors are inactive and the propellers are safe to handle.
- When you're ready to fly, press and hold the safety button until it shows solid red. This indicates that the motors are active and the propellers can spin if armed. To make the propellers safe to handle again, press and hold the safety button until it blinks red.



You can find more safety tips throughout these instructions where you see this yellow box.

# Aircraft Operation

## Components

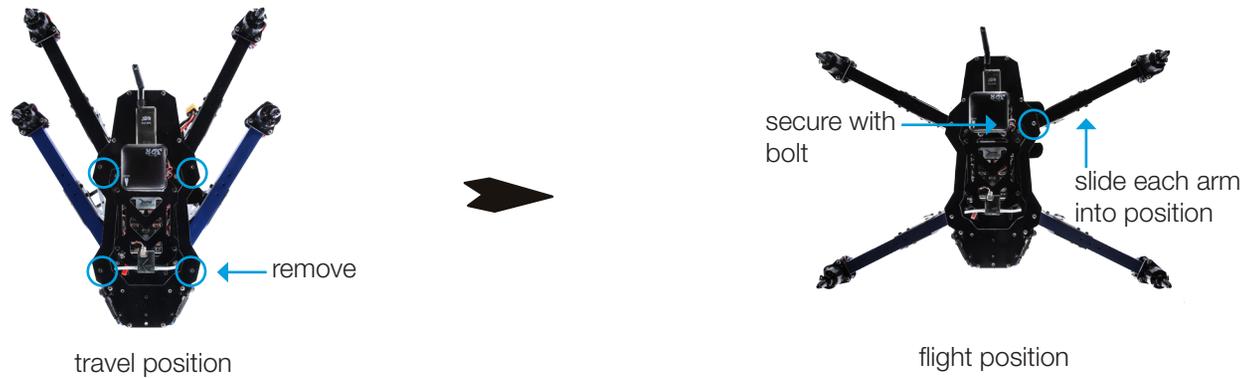


# Assembly

The X8 arrives in travel configuration. Complete these steps to prepare the copter for flight.

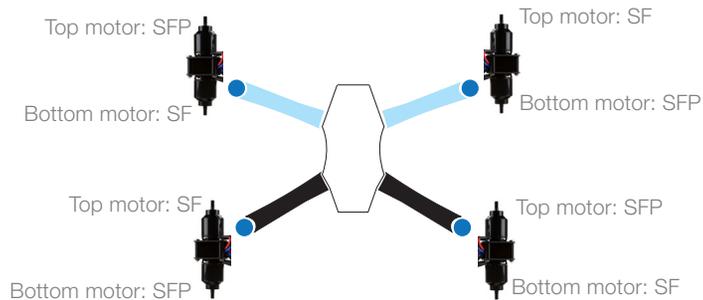
## Arms

Remove the bolt and nut outside each arm. Rotate the arm into position, insert the bolt through the plates and the arm, and secure the arm in place with the nut.



## Propellers

Remove the nuts and washers from the motors. Add SFP propellers and SF propellers as marked below with the writing on the propellers facing towards the sky. This will be a tight fit; apply pressure and twist the propeller onto the shaft.



Place the washer over the propeller, and secure the nut tightly on top using the propeller wrench.



Ensure writing on all propellers faces the sky.

# Controls

Fly the X8 manually using the RC controller.



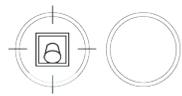
**Throttle:** Move the left stick forward and backward to control altitude and acceleration.

**Yaw:** Move the left stick horizontally to rotate and control orientation. Navigate by orienting the X8 with the blue arms facing forward.

**Pitch:** Move the right stick vertically to fly forward and backward.

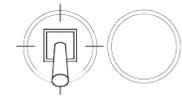
**Roll:** Move the right stick horizontally to fly to the left and to the right.

throttle up



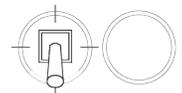
Increase speed and altitude.

throttle down



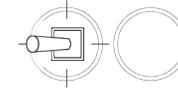
Decrease speed and altitude.

throttle fully down



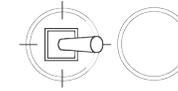
Land.

yaw left



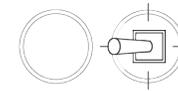
Rotate counterclockwise.

yaw right



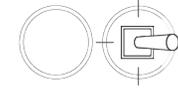
Rotate clockwise.

roll left



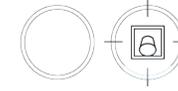
Fly to the left.

roll right



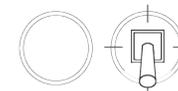
Fly to the right.

roll and pitch center



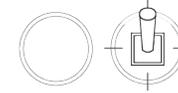
Automatically level.

pitch up



Fly forward.

pitch down



Fly backward.

# Modes

## **Auto** - *fly a mission*

Fly an autonomous mission. This is the mode that the X8 will use to create the map.

## **Altitude hold** - *assisted manual control*

Altitude hold mode provides manual control of roll, pitch, and yaw, while allowing the autopilot to maintain the current altitude automatically. Set the left stick to center, and the copter will automatically maintain the current altitude. Raise the throttle stick above center to increase altitude (and to take off), and lower the throttle stick below center to decrease altitude. Adjust altitude and orientation with the left stick, and navigate with the right stick.

## **Loiter** - *hover*

With automatic autopilot control of altitude, position, and orientation, loiter is the easiest way to fly. Just release the sticks and the copter will hover in place.

## **Return to launch (RTL)** - *recall and land*

Activate RTL during the mission to end your flight automatically. RTL commands the X8 to achieve a minimum altitude of 15 meters, return to the launch point, hover for five seconds, and land. Use the right stick to adjust the position of the X8 during landing. After landing, the X8 will automatically disarm after a few seconds.

## **Stabilize** - *full manual control*

Stabilize allows full manual control of altitude, position, and orientation without autopilot assistance.

## To select a flight mode:

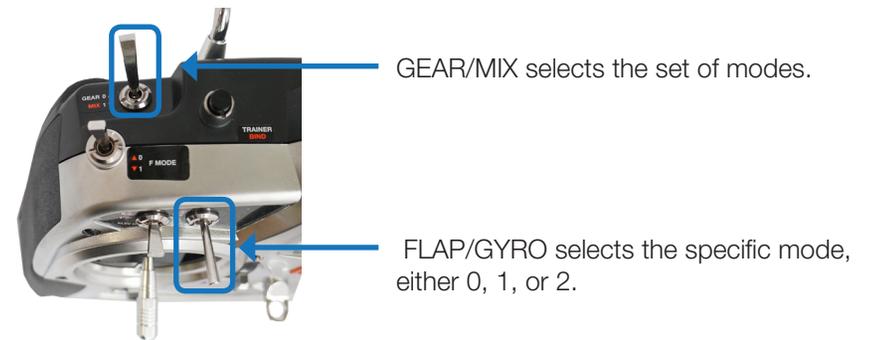
First, set the GEAR/MIX switch to select a set of modes. Then use the FLAP/GYRO switch to 0, 1, or 2 to select a specific mode.

With GEAR/MIX set to **GEAR**,

set FLAP/GYRO to:      0 for **Stabilize**  
                                     1 for **Loiter**  
                                     2 for **Auto**

With GEAR/MIX set to **MIX**,

set FLAP/GYRO to:      0 for **Stabilize**  
                                     1 for **Altitude hold**  
                                     2 for **RTL**



RC controller (top)

# Pre-flight Checks

## Visual Check

Before flying, examine the X8 to verify the following:

- » All propellers are tightly attached in the correct order with the writing on each propeller facing the sky.
- » All propellers can spin without obstruction.
- » The antenna is oriented vertically.

## Test Flight

Before flying the mission, fly a brief test flight to verify that the X8:

- » Responds to controls correctly in stabilize mode.
- » Holds position in loiter mode.
- » Correctly executes a return-to-launch command.

---

## LED Indicators

-  Initializing, please wait
-  Acquiring GPS, please wait
-  Autopilot ready, GPS locked
-  Armed
-  Loss of RC signal, automatic landing
-  Low battery, automatic landing
-  Loss of GPS signal, automatic landing
-  System error, see troubleshooting guide

## GPS Lock

Auto, RTL, and loiter modes requires GPS lock. When powered, the autopilot will automatically search for GPS lock. If you plan to use auto, RTL, or loiter modes during your flight, ensure that the autopilot acquires GPS lock before takeoff, indicated by a blinking green status LED.

---

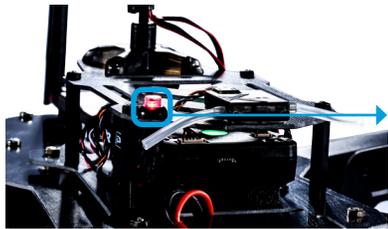
## Tones

Visit [3DR.com/X8-M](http://3DR.com/X8-M) to listen to Pixhawk's status tones.

# Arming and Disarming

Arming and disarming are important steps that must be completed before takeoff and after landing. There are two steps to arming the X8: the safety button and the throttle stick.

Before arming, check the status LED. Before you fly, wait for the autopilot to acquire GPS lock. The LED will flash blue while the X8 acquires GPS; this can take a few minutes. Once you see the flashing green LED, the autopilot has acquired GPS lock.



- Initializing, please wait.
- Autopilot ready, no GPS
- Autopilot ready, GPS locked
- Pre-arm check failure, see page 39.

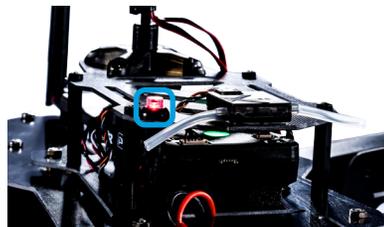
## Arming

**1**  
When you're ready to fly, place the copter at a clear launch point, with the blue arms facing away from you.



**2**  
Press and hold the safety button until it displays solid red. This indicates that the X8 is now active. Stand back!

- Motors inactive, safe to handle
- Motors active, deactivate before handling



**3**  
To arm the motors, hold the left stick down/right until the motors spin.



The arming and disarming procedures ensure that you can safely start and stop motors without risk of injury.

The X8's motors will spin when armed! Make sure the propellers are clear of any obstructions, including your hands, before arming.

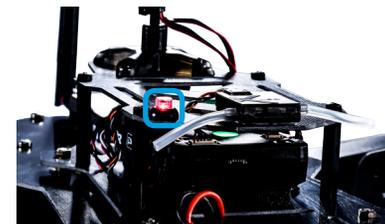
Do not handle the propellers or pick up the copter while the safety button is active (solid red).

## Disarming

**1**  
To disarm the motors, hold the left stick down/left until the motors stop.



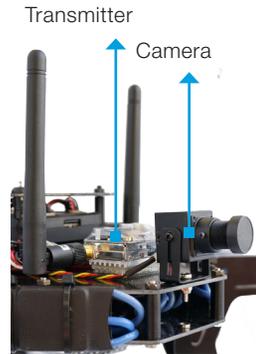
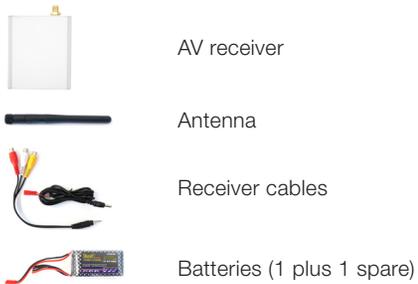
**2**  
Press and hold the safety button until it blinks red. The motors are now inactive, and the X8 is safe to handle.



# FPV System Operation

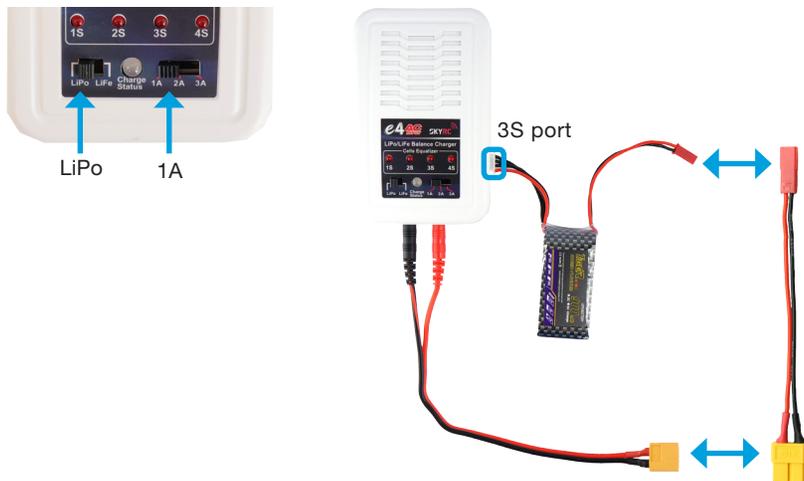
If you selected to receive an optional FPV/OSD system, the components are pre-installed into the X8 to transmit on-board video.

## Parts



## 1 Charge battery

Charge both batteries before your first flight. Set the charger to LiPo and 1A. Connect the white battery connector to the 3S port, and connect the XT60-JST charger adapter to the red battery connector and yellow charger connector.



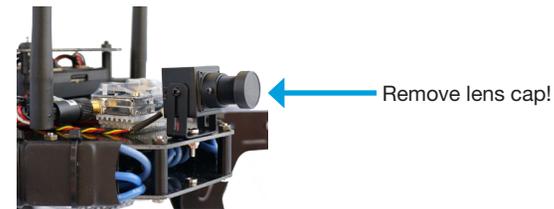
## 2 Wire and power receiver

Attach an antenna to the receiver. Connect the AV output cable to either receiver AV OUT port. Connect the RC power cable to the receiver DC IN port, and attach a battery to the red connector.



## 3 Remove lens cap

The video transmitter is powered by the main flight battery and will automatically turn on when the X8 is powered. To turn off the transmitter, disconnect the red JST connector. Remove the lens cap from the camera before takeoff.



## 4 Viewing video

When using a 3DR Black Pearl Monitor to view your video, set the mode to *DIV* (M button changes modes), the channel to *8* (+ and - buttons), and the band to *E* (press the power button to access the menu).

For more information about configuring the FPV/OSD system, visit [3DR.com/X8-M](http://3DR.com/X8-M).

# Flying Mapping Missions

## Takeoff Checklist

Before flying the mission, check the following:

- » Camera is on with mission script ready and is secured into the mount with the mini-USB cable connected and the cap removed.
- » X8 is powered and connected to the ground station with all pre-flight checks passed.
- » The survey mission has been adjusted to account for present environmental conditions and saved to the X8.

## Initiating

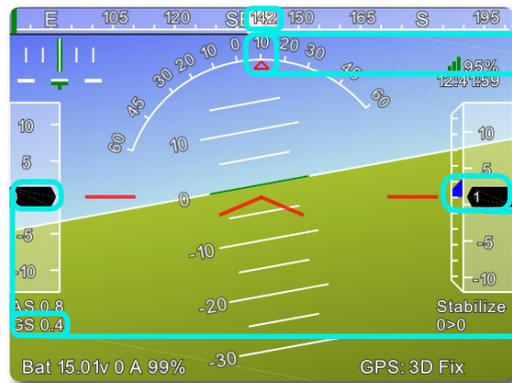
For automatic takeoff, arm the X8 in stabilize mode. Switch to auto mode, and raise the throttle to initiate the mission.

For manual takeoff, initiate the mission in flight by switching to auto mode.

## Monitoring

Monitor the X8 closely during the mission using your line of sight and the Mission Planner Flight Data screen.

Mission Planner Flight Data: Attitude



- 1 Heading direction
- 2 Bank angle
- 3 **Altitude\*** (black) and rate of climb (blue bar)
- 4 Ground speed

Status

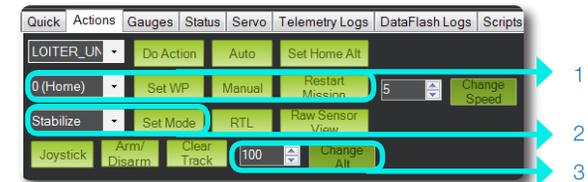


- 1 **Ground station signal\***
- 2 GPS time
- 3 Currently enabled mode
- 4 Distance to current waypoint > current waypoint number
- 5 **GPS status\***
- 6 **Battery status\***  
Full battery: 16.8 V  
Low battery failsafe: 14 V



**End your flight at 14.1 V!**

Actions



- 1 Change waypoints or restart a mission
- 2 Change modes
- 3 Change altitude

Flight Map



- 1 **Current heading**
- 2 **Direct path to current waypoint**
- 3 GPS-reported direction of travel
- 4 Actual flight path
- 5 Latitude, longitude
- 6 Altitude

\*Failsafe behavior enabled

# Failsafes

The X8 is programmed with a set of failsafe behaviors to prevent a crash in the event of a loss of one of the data or communication channels required for autonomous flight. Although certain failsafes have assigned LED indicators and tones, it is unlikely that you will be able to see these at a distance. Monitor the Flight Data screen for failsafe indications. If a failsafe is triggered, the assigned behavior will activate. To override the failsafe behavior (RTL in most cases), use the controller to regain manual control.

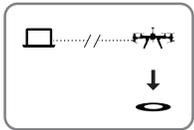
## Regaining Manual Control

To regain manual control during the mission, switch to altitude hold mode using the controller. If you're a confident operator, switch to stabilize mode for full manual control. If you observe instability in the X8's flight behavior or it the aircraft moves outside your designated safe flying area, switch to RTL. Turning off the controller will automatically trigger an RTL and can be used in an emergency situation as a hard recall command.

## Ground Station Signal Failsafe

Physical obstructions and interference from nearby wireless signals can affect the X8's connection with the ground station. Use the Mission Planner Flight Data display to monitor the ground station connection strength during flight.

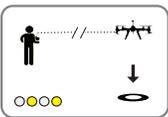
If the X8 loses contact with the ground station for over five seconds, it will automatically return to the launch point and land.



## RC Controller Signal Failsafe

Physical obstructions and interference from nearby wireless signals can affect the X8's connection with the RC controller.

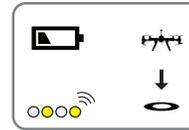
If the X8 loses contact with the RC controller, it will return to the launch point automatically and land, indicated by a blinking yellow status LED.



## Low Battery Failsafe

Environmental conditions can affect power consumption. Use the Mission Planner Flight Data display to monitor the voltage of the battery during flight.

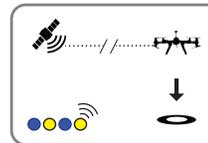
If the battery reaches 14 V, the X8 will land automatically at the current position, indicated by a blinking yellow status LED and a quick repeating tone.



## GPS Failsafe

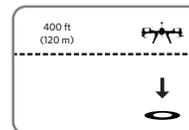
Enclosed areas, physical obstructions, and lack of available satellites can affect GPS strength. Use the Mission Planner Flight Data display to monitor the GPS during flight.

If the X8 loses GPS lock for over five seconds, it will land automatically at the current position.



## Altitude Failsafe

The X8 has a 120 m altitude geofence enabled by default. If the geofence is breached, the X8 will automatically RTL.





### 3 Process

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Download Log File	32
Pix4D Rapid Check	33
<b>Full Processing</b>	<b>33</b>

## On-Site Quality Check

Before leaving the survey site, check the images using Pix4D to ensure sufficient quality for mapping by downloading the images from the SD card, downloading the log file from the X8, and completing Rapid Check Initial Processing in Pix4D.

If you observe poor image quality or the quality report returns errors, see the Image Quality Troubleshooting section on page 38 and repeat the mission.

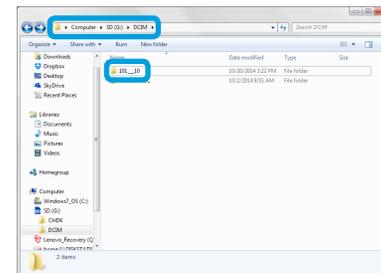
## Spot Check (Optional)

The quickest way to see the images after a flight is to unlock the SD card and restart the camera. The camera will load the default Canon programming and you can select the playback button to review the images.



## Download Images

Unlock the SD card and load into your ground station. Select the DCIM folder and locate the folder for your flight. Copy the files into a project folder on the ground station and delete them from the SD card.



SD card file structure: Download images

# Download Log File

Pix4D uses the GPS data from the X8's log file to georeference the images. To download the X8's dataflash log, power the X8 and connect to Mission Planner. The download process will be faster if you connect the micro-USB cable directly to Pixhawk's micro-USB port instead of connecting using the ground station radio. (When connecting directly to the X8, set the rate to 115200.)

On the Flight Plan screen, select the *DataFlash Logs* tab under the heads-up display, and select *Download DataFlash Log over Mavlink*.

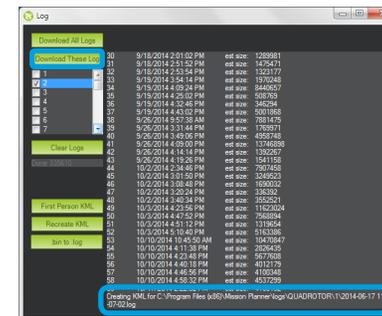
Mission Planner: Flight Data heads-up display



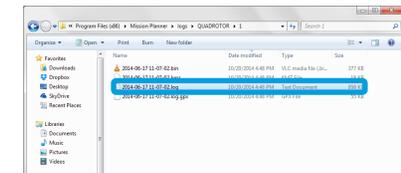
The Log window shows the X8's recent flights. Select the flight for your mission, and select *Download These Logs*. This will save the log file to your computer in the location displayed under the list of flights.

To retrieve the log file, access your computer's file structure under *Program Files/Mission Planner/logs/OCTOROTOR*, and select the .log file for the date of your flight.

Mission Planner: Download Logs



Program Files: Retrieve log file

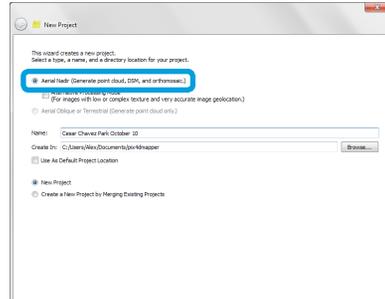


# Pix4Dmapper Rapid Check: Create Project

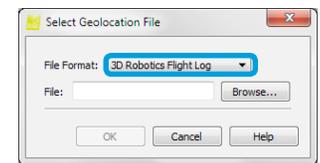
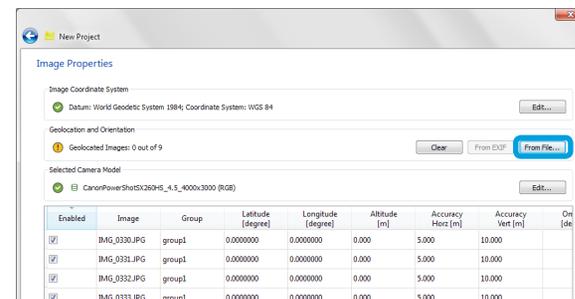
**1** Open Pix4D Mapper, and create a new project.



**2** Select Aerial Nadir as the project type.



**3** After adding the images, select *From File* to add the geolocation data from the X8's log file. In the pop-up window, select 3D Robotics Flight Log as the file format, and upload the dataflash log file downloaded from Mission Planner.



# Pix4Dmapper Rapid Check: Initial Processing

After creating the project, select the Local Processing screen (Process menu). Check the option for Initial Processing and Rapid Check. Uncheck all other local processing options, and select Start.



Pix4D will generate a Quality Report that will indicate if the images are of sufficient quality to create a map.

## Quality Report



See [Quality Report Help](#) for detailed explanations. Generated with version 1.1.21

### Summary [\(help\)](#)

Project:	mining_quarry
Processed:	2014-Apr-25 16:30:49
Camera name:	CanonIXUS220HS_4.3_4000x3000
Average Ground Sampling Distance (GSD):	9.3 cm
Area covered:	0.5979 km <sup>2</sup> / 59.7946 ha / 0.231 sq. mi.
Image coordinate system:	WGS84
Ground Control Point (GCP) coordinate system:	WGS84
Output coordinate system:	WGS84 / UTM zone 32N
Processing type:	full (scale 1) aerial nadir
Time for initial processing (without report):	24m:01s

### Quality Check [\(help\)](#)

Images:	median of 31313 keypoints per image	✓
Dataset:	127 out of 127 images calibrated (100%), all images enabled	✓
Camera optimization quality:	0.43% relative difference between initial and final focal length	✓
Matching quality:	median of 11203 matches per calibrated image	✓
Georeferencing:	7 GCPs (7 3D), 0.045 m	✓

# Full Processing

To complete full processing for the map, visit [support.pix4d.com](http://support.pix4d.com) for instructions.



## Appendix

Aerial Imaging Concepts	35
3DR EAI	36
Image Quality Troubleshooting	38
Operational Troubleshooting	39

# Aerial Imaging Concepts

Understanding key concepts in aerial images can help you understand the mission planning process and create better maps.

## Distance-Based Imaging

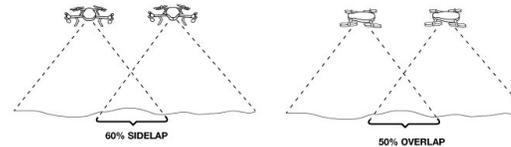
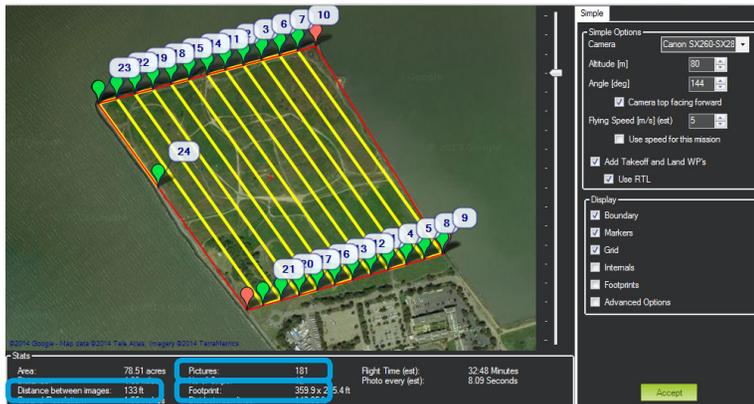
By default, the camera captures only the images required to create the map. The Pixhawk monitors the distance traveled by the aircraft and sends a command to the camera to capture an image at the distance interval specified by the camera trigger distance parameter (*CAM\_TRIGG\_DIST*). This parameter is set by the Mission Planner Survey tool during survey configuration by calculating the minimum distance between images based on the parameters specified for the survey (altitude, overlap, sidelap). This distance-based imaging allows for more precise data collection, resulting in less images and data storage cost. Once configured, the Survey tool creates an event at the start of the mission script (after takeoff) to set the camera trigger distance to 0. This distance-based imaging allows for more precise data collection, resulting in less images and data storage cost. Once configured, the Survey tool creates an event at the start of the mission script (after takeoff) to set the camera trigger distance to 0 and an event at the end of the mission (before landing) to reset the camera trigger distance to 0.

## Time-Based Imaging

The camera is also equipped to capture images at a consistent time interval instead of using distance. This function can be useful if you want to capture images over an area without planning a mission. This time-based imaging results in more images per area, and therefore more processing time and storage cost. See the Trigger Type options on page xx to enable time-based imaging.

## Overlap and Sidelap

To capture images for the map, the aircraft flies a lawnmower-like pattern in strips across the survey site. The front-to-back overlap between sequential images is called overlap; the side overlaps of adjacent pictures in different strips is called sidelap. The overlap and sidelap parameters in the Survey tool (see Advanced Options page xx) determine the distance between images and the number of images to be captured based on the projected ground area that each image will cover, called a footprint. Increasing overlap and sidelap improves the accuracy of the map while increasing flight time and processing time.



In the Survey tool, *Distance between Images* shows the specified camera trigger distance that will be assigned to the mission. You can also see the projected image footprint size and the total number of images to be captured.

Default overlap: 50%  
Default sidelap: 60%

# 3DR EAI

3DR EAI is based on KAP UAV Exposure Control Script v3.1: a great open-source project for kite and UAV aerial photography.

## Start and Stop Script

Ensure the camera is set to P (program) mode before powering the camera. Upon startup, 3DR EAI starts automatically and listens for commands from the autopilot, indicated by *waiting for USB signal*. To stop (and re-start) the script, press the shutter button. The script will display INTERRUPTED when stopped.



Script start: waiting on USB signal



Script stopped: INTERRUPTED FINISHED

## CHDK Menu

The CHDK menu contains all the standard options provided with CHDK. To access the CHDK menu, stop the script and select the **MENU** button.



CHDK menu

## Script Menu

The script menu allows you to change the parameters associated with the script itself, including changing the trigger mode and adjusting exposure. To open the script menu, stop the script and select the **FUNC.SET** button. These parameters are configured for the S100 and do not require adjustment as part of standard operation.



Script menu

## Trigger Type

This parameter allows you to control how the camera captures images. Trigger type defaults to *USB* for distance-based imaging during mapping missions. For time-based imaging, select *Interval* and specify the length in the *Shot Interval* parameter.

*Trigger Type* default: *USB* (mapping)

Variable intervalometer: *Interval* (default to 2 seconds, specified by *Shot Interval*)



Script menu: Trigger Type

## Memory Reset

If the battery is left out of the camera for too long, the camera will reset its memory. To re-configure the camera in this case, visit [3DR.com/X8-M](http://3DR.com/X8-M) for instructions.

## Online Resources and Information

Visit [3DR.com/X8-M](http://3DR.com/X8-M) for links to updates, more information about KAP UAV, and full CHDK instructions.

# Image Quality Troubleshooting

If you observe poor image quality during the spot check or if you receive error messages during processing, use the settings below to troubleshoot the image quality.

## Blurry Images

To correct motion blur, adjust the shutter speed using the *Target Tv* parameter in the script menu.

*Target Tv* (shutter speed) default: 1/1250  
 To correct moderate motion blur: Set to 1/1600.  
 To correct severe motion blur: Set to 1/2000.



Example image: motion blur



Script menu: Target Tv

## Overexposure

If the images are overexposed but do not show any motion blur, it can be due to flying in extremely bright conditions. To correct this, set the *Allow use of ND filter* parameter to YES in the script menu.

*Allow use of ND filter* default: No  
 To correct overexposure: Set to Yes.



Example image: overexposure

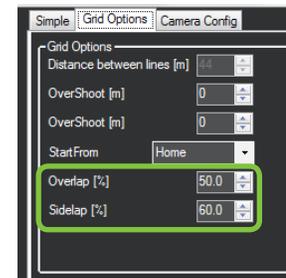


Script menu: ND Filter

## Processing Errors

If you receive errors from Pix4Dmapper regarding the images, dataset, or matching points, increase the overlap and sidelap during survey configuration to improve the quality of the image set.

Overlap default: 50%  
 Sidelap default: 60%  
 To improve processing: Set overlap to 60% and sidelap to 70%.



Mission Planner Survey tool Advanced Grid Options: Overlap and Sidelap

# Operational Troubleshooting

## No Images Captured

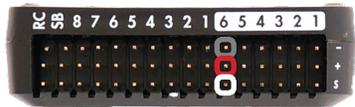
- 1 If the camera did not capture any images during the mission, first perform a physical inspection on the X8.

Is the mini-USB cable connected to the camera's USB port?



Camera (side)

Are the AUX OUT 6 pins connected on Pixhawk?



AUX OUT 6: black (-), red (+), white (s)

Pixhawk (side)

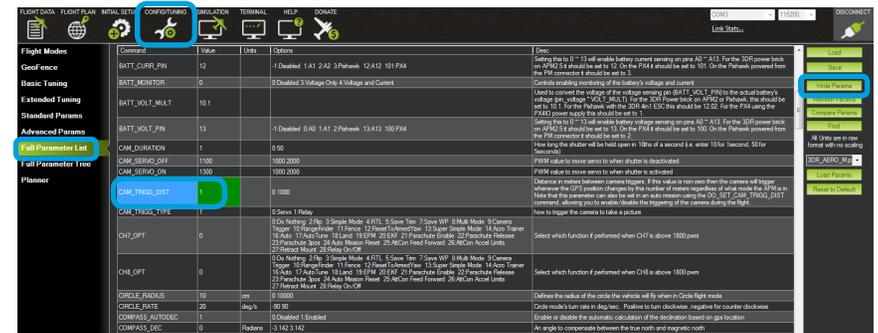
Is the camera battery charged? Unlock the SD card to view the Canon's battery level indicator.



Camera with SD card unlocked, running Canon software

- 2 Take a distance-triggered test image on the ground by manually setting the camera trigger distance parameter to 1 m.

Power the aircraft and connect to Mission Planner. Select **Config/Tuning** and **Full Parameter List**. Change the **CAM\_TRIGG\_DIST** parameter to 1, and select **Write Params**. Now carry the X8 for a few meters to see if the autopilot triggers the camera.



Mission Planner Full Parameter List: Set CAM\_TRIGG\_DIST to 1.

## LED Error Indicator

If the status LED displays blinking yellow, the X8 is failing one of the pre-arm safety checks. To determine the specific failure, check the heads-up display on the Mission Planner Flight Data screen. There will be an error message specifying the failed check.

Radio Calibration Failure:

Perform Radio Calibration in Mission Planner or RC controller re-binding

Accelerometer Calibration Failure:

Perform Accelerometer Calibration in Mission Planner

Compass Calibration Failure:

Perform Compass Calibration in Mission Planner

GPS Failure:

Wait for improved GPS signal or move to a more open area