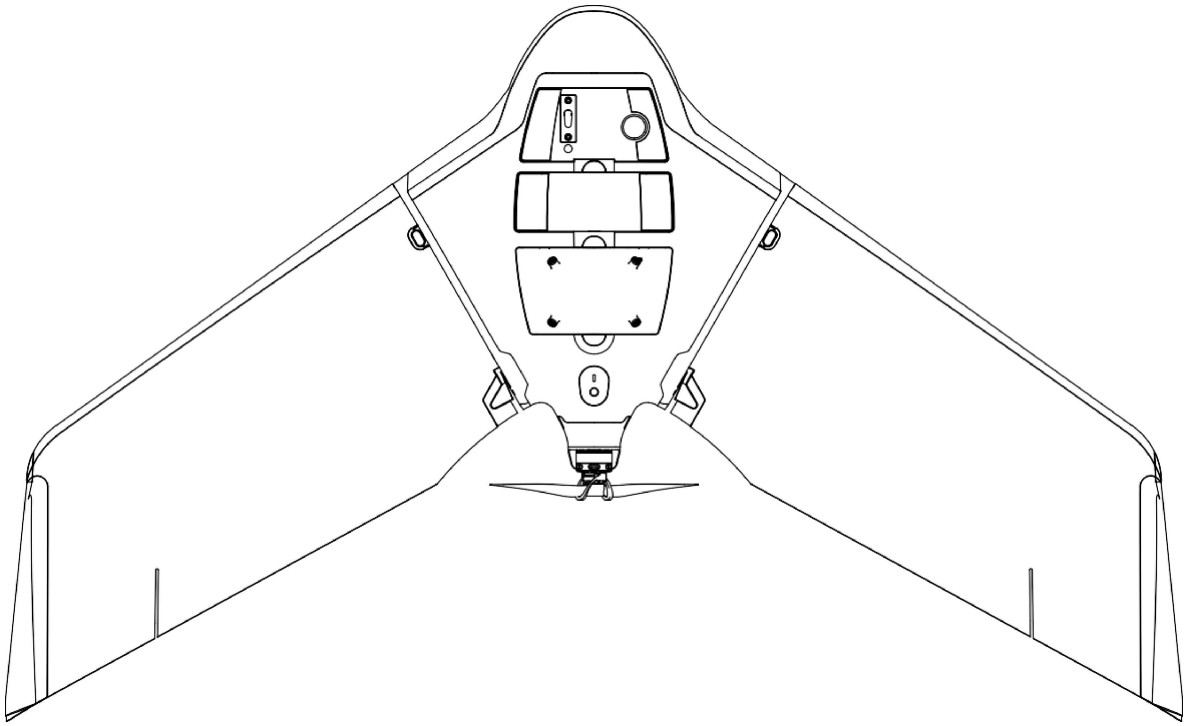
eBee X series drone

USA Operations Over People User Manual

Revision 1.0 / October 2022



senseFly
AN AGEAGLE COMPANY

GENERAL INFORMATION

IMPORTANT: The eBee X series is eligible to conduct operations over people in FAA Category 3 provided the remote pilot complies with the modification instructions. Any modification to the small unmanned aircraft not provided for in the remote pilot operating instructions may affect eligibility for operations over people. Please take the time to read this entire instruction manual for more information on operating safety and according to the Federal Aviation Regulations.

NOTE: Before any person may conduct operations of the eBee X, you should create an account online with senseFly, at https://my.sensefly.com/. This will enable you to receive important updates regarding the small unmanned aircraft and its eligibility to operate over people, as well as updates, bulletins, instructional videos and more.

Civil aviation regulations

senseFly products ("Product(s)") are subject to Civil Aviation regulations. Regulations may vary depending on the country where you intend to operate your Product.

ALL USE OF THE PRODUCT INCLUDING, BUT NOT LIMITED TO, THE USE CONFORM TO THE APPLICABLE LAW OF THE COUNTRY IN WHICH THE PRODUCT IS OPER- ATED, IS UNDER THE CLIENT'S SOLE RESPONSIBILITY.

THE CLIENT SHOULD INFORM HIMSELF/HERSELF/THEMSELVES BEFORE USING THE PRODUCT. SOME COUNTRIES MAY HAVE LAWS THAT LIMIT THE USE OF UNMANNED AIRCRAFTS TO "LINE-OF-SIGHT" OPERATIONS AND/OR PROHIBIT THE USE OF UNMANNED AIRCRAFTS IN SOME SPECIFIC AREAS.

Other laws and regulations - privacy

Recording and circulating an image of an individual, a building or a creative work may constitute an infringement of the image rights, privacy or of intellectual property rights including copyrights of the author/owner for which you can be liable. Ask for authorisation before taking pictures of an individual, a building or creative work protected by intellectual property rights, particularly if you want to keep your recording and/or circulate images on the web or any other medium. Do not circulate degrading images or ones that could undermine the reputation or dignity of an individual. Do not use your Product for espionage purposes. Always comply, when using your Product and cameras on board, with applicable laws and regulations including but not limited to, laws and regulations on privacy, intellectual property rights and national security in the country where you operate your Product.

Address

senseFly SA
Route de Genève 38
1033 Cheseaux-Lausanne
Switzerland

Website: https://ageagle.com/

Technical support

senseFly and our resellers are dedicated to providing you with full professional product support. To submit a support ticket and/or view your outstanding tickets, please use our customer portal my.senseFly (http://my.senseFly.com). Log in with the same account details you used to download your drone's software (see the separate software information document in your *eBee X series drone*'s case).

In addition to support access, my.senseFly includes:

- Details of all your senseFly drones, including their serial numbers.
- The Knowledge Base – packed full of helpful articles, tips, tutorials, and webinars.
- Download links for the latest versions of our software.

eBee X series

eBee X
The winglets and stickers are yellow.
Compatible sensors: all the senseFly payloads

eBee Geo
The winglets and stickers are blue.
Compatible sensor: S.O.D.A. RGB camera

eBee Ag
The winglets and stickers are red.
Compatible sensor: Duet M multispectral camera

eBee TAC
The EPP is grey and black.
The winglets and stickers are grey.
Compatible sensors: all the senseFly payloads

Contents

1 About this user manual

This manual is dedicated to Operations Over People and Over Moving Vehicles with the eBee X series according to FAA Category 3 in the United States of America (USA).

A complete guide to your senseFly *eBee X series drone* comprises:

- **The *eMotion* software user manual**
  An in-depth guide to mission planning and monitoring with *eMotion* software.
- **eBee X series user manual**
  A guide to your eBee X series hardware, completing and complementing the eMotion user manual.
- **A camera user manual**
  A guide to using your drone's camera.
- **A charger user manual**
  A guide to using your battery's eBee X series charger.

With these, you have a complete guide to using an *eBee X series drone*. You'll find all the user manuals you need within *eMotion*'s Help function tab. All senseFly user manuals are also available in my.sensefly[1].

Caution: Please, read all manual and familiarize yourself with the eBee X and eMotion before flying

Note: You can always find the latest version of *eMotion* in my.senseFly. An *eBee X series drone* requires

[1] https://my.sensefly.com

2 Units used in this user manual

In general, dimensions are given in the appropriate SI units with, when relevant, the Imperial unit in brackets, for example, 30 m (98 ft).

Dimension	Units used	
Distance	km (mi)	kilometres (miles)
Length	m (ft)	metres (feet)
Length	cm (in)	centimetres (inches)
Length	mm (in)	millimetres (inches)
Speed	m/s (kts)	metres per second (nautical miles per hour)
Climb rate	m/s (ft/min)	metres per second (feet per minute)
Mass	kg (lbs)	kilograms (pounds)
Mass	g (oz)	grams (ounces)
Temperature	°C (°F)	degrees Celsius (degrees Fahrenheit)
Frequency	Hz	hertz
Area	m^2 (sq ft)	square metres (square feet)
Area	km^2 (sq mi)	square kilometres (square miles)
Area	ha (ac)	hectares (acres)
Heading	°	degrees from true north
Angle	°	degrees
Thrust	kgf (N, lbf)	kilogram-force (newton, pound-force)

The Imperial unit used for speed is knot (kts).

1 kts = 1 nm/h (nautical mile per hour)

All headings are given in reference to true north (geodetic north), not magnetic north.

3 Operations Over People and over Moving Vehicles (FAA Category 3) guidelines

- **Maximum Take-Off Mass**

The eBee X complies with the Operations Over People (OOP) FAA Category 3 up to 1423 grams (1.33 lbs.). Operations over people above this weight is forbidden. Make sure before each flight the mass is under this threshold. The following configurations can be used:

  - eBee X series (X, GEO, or TAC) with the standard battery and S.O.D.A. camera
  - eBee X series (X, GEO, or TAC) with the endurance battery and S.O.D.A. camera
  - eBee X series (X, GEO, or TAC) with the standard battery and S.O.D.A. Corridor camera
  - eBee X series (X, GEO, or TAC) with the endurance battery and S.O.D.A. Corridor camera
  - eBee X series (X, GEO, or TAC) with the standard battery and S.O.D.A. 3D camera
  - eBee X series (X, GEO, or TAC) with the standard battery and Sequoia+ camera

- **Preflight checks**

The recommended eBee X manual and automated preflight checks will be performed before every flight (per the eBee X manual)

- **10 hours inspection**

Every 10 hours of product flight the eBee X will undergo the full airframe and sensor inspection by the operator (per the eBee X manual)

- **100 hours service**

Every 100 hours of product flight the eBee X will undergo the 100-hour maintenance service by the supplier or a supplier-authorized service center

- **Weather conditions**

The operator will check the weather conditions prior to each flight in accordance with the eBee X manual

- **Maximum wind speed**

For operations over people the eBee X should not be launched nor operated if the wind speed exceeds 10 m/s (36 km/h, 22.4 mph, 19.4 kts)

- **Automatic safety actions**

When planning a mission for operations over people the following settings must be used and set in the mission prior to flight:

  - Return to Home if strong wind detected – On
  - Return to Home in case of low endurance – On
  - Return to Home if ground proximity detected – On
  - Return to Home if ground modem link is lost – On
  - Return to Home if GNSS accuracy degrades – On
  - Climb if ground proximity is detected – On

- **Manual control mode**

Manual flight with the Remote Control is not allowed during operations over people.

4 Required components

FAA Category 3 required components:

1) eBee X series UA
2) eBee X firmware updated with eMotion 3.22 version (or newer)
3) The Ground Modem
4) Laptop with eMotion software version 3.22 (or newer)
5) USB to Micro USB Cable
6) 3700mAh or 4900mAh LiPo Battery
7) S.O.D.A., S.O.D.A. Corridor, S.O.D.A. 3D or Sequoia+ camera
8) Rotor blade & rubber bands

5 Optional components

For Operations Over People, the eBee X can only be used with one of the following configurations:

1) S.O.D.A. camera and standard battery; or
2) S.O.D.A. camera and endurance battery; or
3) S.O.D.A. Corridor camera and standard battery; or
4) S.O.D.A. Corridor camera and endurance battery; or
5) S.O.D.A. 3D camera and standard battery; or
6) Sequoia+ camera and standard battery.

Additionally, for operations over people in accordance with FAA Category 3, you may not affix any other payload to the eBee X unless it is listed in this remote pilot operating instructions and the maximum take-off mass is lower than 1423 grams (3.137 lbs.). Any permissible payload you affix to the small unmanned aircraft must be securely attached throughout the duration of all operations that occur in accordance with FAA Category 3.
Failure to adhere to these requirements will result in the ineligibility of the eBee X to operate over people in accordance with FAA Category 3.

6 Before you fly

6.1 Charging your batteries

Before leaving for the field to perform a flight, be sure to fully charge your eBee X series drone batteries[2]. An eBee X series drone's camera takes its power from the drone's battery. It does not have its own battery.

6.2 Crew health precautions

To operate the eBee X series drone with maximum safety, we recommend that you answer these questions before each flight day:

I	Illness	Do you have any symptoms?
M	Medication	Have you been taking any pills?
S	Stress	Do you have any financial, family or health stressors?
A	Alcohol	Have you been drinking within the last 12 hours?
F	Fatigue	Are you tired and not adequately rested?
E	Emotion	Are you emotionally upset?

6.3 Weather check

Before each flight, you should be aware of the weather conditions. The *eBee X series drone* is a small drone that cannot fly in heavy rain or strong wind conditions.

For Operations Over People in accordance with FAA Category 3, the wind speed must remain under 10m/s (32.8ft/s)

Icing conditions must also be avoided. In case of doubt, make sure to check a weather bulletin including wind estimations in the flight area. Note that wind is often stronger at higher altitudes and that the wind perceived at the surface is not always a good reference to estimate the wind at flight altitude. Cloud velocity or tall tree movements can help you to estimate the wind speed once you are out in the field.

Weather forecasts may use various units to measure wind speed. As a reference:

1 m/s = 3.6 km/h = 2.24 mph = 1.94 kts (nm/h).

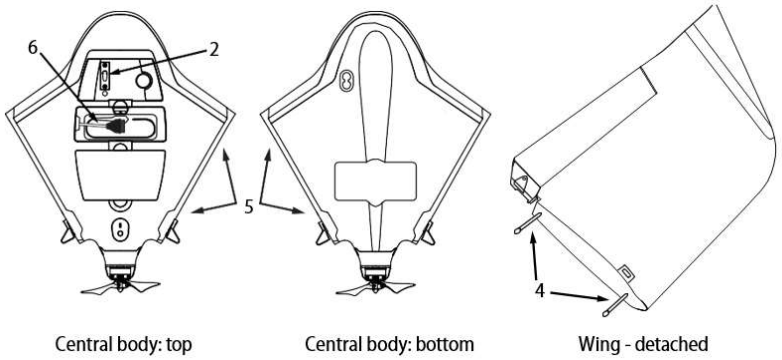
Caution: For Operations Over People in accordance with FAA Category 3, the wind speed shall remain under 10m/s (32.8ft/s)

[2] when delivered, an *eBee X series drone* battery may not be fully charged

7 General inspection

The *eBee X series drone*'s simple design means it can go from the box to being ready for flight in minutes. We recommend that you perform the following steps before every flight to ensure that the platform is best prepared for flight.

Caution: Do not perform the inspection, propeller, camera, or wing installation with the battery connected to the drone.



Central body: top | Central body: bottom | Wing - detached

Visually inspect the drone for damage or wear using the following steps:

1. Check the central body and wings for cracks or other damage.
2. Verify that the pitot probe is properly attached to the airframe and that the holes in the probe are free of obstructions.
3. Verify that the ground sensor is clean, dry and free of obstructions.
4. Verify that the wing struts are not split or damaged in any way.
5. Verify that the tubes within the Central Body that hold the wing struts are not cracked or damaged in any way.

Caution: It is vital to carefully inspect the wing struts and tubes within the Central Body before every flight, as they may cause a crash if they are damaged in any way. This is particularly important if the wings were found separated from the Central Body after a previous flight.

6. Verify that the power cables within the battery compartment are well insulated and not damaged.
7. Verify that the propeller rubber bands are all in place and are in good condition.
8. Verify that the propeller is in good condition for flight and is properly attached.
9. Verify that the servos turn smoothly.
10. Verify that the camera's lens is clean.

Note: You must perform a general inspection before every flight. It is also good practice to perform a full airframe check regularly to keep your *eBee X series drone* in good shape.

8 Flying your eBee X series drone

Note: We recommend that you perform your first flight in a large obstacle-free area and limit the length of the mission in order to familiarize yourself with your *eBee X series drone* in flight.

8.1 Potential in-flight errors

The drone can encounter two types of error messages while flying: Warnings and Critical failures. Warnings typically indicate a dangerous situation such as a low battery or strong winds and typically result in a safety action such as a return to Home.

See your *eMotion* user manual for a full description of Warnings and Critical failures that may occur.

Note: It is important to keep track of the location of the drone during a Critical failure until the moment it reaches the ground. Its position's coordinates can aid in finding it afterwards.

8.2 Post flight procedure

Disconnect the battery

After the landing, disconnect the battery first and remove the battery from the eBee X.
Take care to pull the cable from the main black part and not directly from the cable itself.
Visually inspect the battery for damage. In case of distortion, abnormal shape or cables wear don't use it anymore and destroy it following the local regulation.

Detach the wings

Detach the wings by pushing on the appropriate button and pull it horizontally.
Visually inspect each wing for cracks or wear. Do not use again a damaged wing.

1. Verify that the wing struts are not split or damaged in any way.
2. Verify that the joint between the wing and the aileron is not damaged or torn.
3. Verify that the winglet is in good condition.

General inspection of the central body

Visually inspect the drone for damage or wear using the following steps:

4. Check the central body and wings for cracks or other damage.
5. Verify that the pitot probe is properly attached to the airframe and that the holes in the probe are free of obstructions.
6. Verify that the antenna is properly attached to the airframe.
7. Verify that the tubes within the Central Body that hold the wing struts are not cracked or damaged in any way.
8. Verify that the servos turn smoothly.
9. Verify that the propeller rubber bands are all in place and are in good condition.
10. Verify that the propeller is in good condition and is properly attached.
11. Verify that the power cables within the battery compartment are well insulated and not damaged.
12. Verify that the camera's lens is clean.

The payload

If necessary, remove the camera from the drone and extract the payload SD card which withhold the images and basic flight log information from the flight.

9 Maintenance and repair of an *eBee X series drone*

Goal of this section: This section describes how to update the accompanying software and on-board firmware, keep your drone in good working condition and perform small repairs such as cracks in the airframe.

9.1 Updating an *eBee X series drone*'s software and firmware

Occasionally, senseFly releases an *eMotion* software and *eBee X series drone* firmware upgrade to provide additional features to our users or to correct potential issues. *eMotion* will check for new versions during start-up[3] and will display a message with update instructions if a new version is available.

We also recommend that you check my.senseFly[4] regularly for updates to ensure you have the latest version of the software. Download the installer from my.senseFly and follow the installation procedure described in your *eMotion* user manual. You do not need to uninstall the previous version before installing the new one.

It is important that the drone's firmware and *eMotion* version are kept in step. senseFly will always release *eMotion*
and firmware updates together. Make sure that you keep both up-to-date and aligned.

To check which version of *eMotion* you have installed, click About eMotion on its Welcome page. Your *eBee X series drone*'s firmware version is also shown in *eMotion* when it's connected to your drone (see your *eMotion* user manual for details).

Caution: We are constantly working to improve the performance of our products and we are dedicated to providing our customers with the newest software as soon as it becomes available. Since the highest level of flight safety can only be achieved with the latest software release, senseFly can only offer warranty service for products that have been properly updated.

9.2 How to update an *eBee X series drone*'s firmware

Every version of *eMotion* is packaged with an accompanying firmware revision which must be installed on the drone before it can be used.

1. Remove the drone's propeller[5].
2. Connect the USB cable between the computer on which you installed *eMotion* and your drone's autopilot socket (inside the camera bay, marked).
3. Connect the battery to the drone. The status LED will pulse yellow.
4. Launch *eMotion*.
5. In *eMotion*, click the Updater tab and follow the instructions. While updating the LED blinks yellow. After a successful update, the LED pulses white. After a failed update, the LED shines red.
6. Once the update has completed, restart your drone. If it's still blinking yellow after 10 minutes, restart your drone.
7. Replace the propeller. Never try to start the motor without the propeller.

[3] provided that there is an internet connection
[4] https://my.sensefly.com
[5] there is a small risk that the propeller spins during the update

9.3 Full airframe and sensor inspection

Beyond the general airframe inspection that is performed before every flight[6], senseFly recommends that the operator performs a full airframe and sensor inspection every 10 flight hours, on removal from extended storage and after any repair, heavy landing or other unexpected incident. This will give the aircraft a safety rate comparable to manned aircraft and keep your *eBee X series drone* in good operating condition.

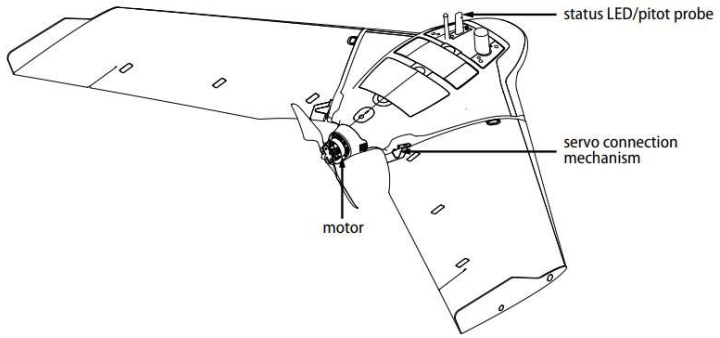
Caution: The autopilot, sensors and actuators within the Central Body of the *eBee X series drone* are specially calibrated and should only be modified by senseFly or a certified *eBee X series drone* reseller. Opening the Central Body of an *eBee X series drone* will void the warranty.

Carry out this full inspection with the wings and a propeller attached.

Check 1: Motor and Servos

eBee X series drone uses a brushless DC motor to turn its propeller and generate thrust. The servos are the two actuators connected through a servo connection mechanism to both ailerons.

The motor must be clean and spin smoothly without friction to function correctly. The servos must turn smoothly. Damaged servos can prevent the drone from flying correctly and thus it is important to ensure their proper functioning.



To check the motor and servos, follow these steps:

1. Ensure that there are no sand or other obstructions within the motor. If there is something blocking the motor from spinning smoothly blow some air through the motor to dislodge the obstruction.
2. Turn the servos and ensure that they move smoothly and have the full range of motion.

In case of doubt, record a short video and follow the instructions in *Reporting a problem with your eBee X series drone* for advice.

Check 2: Inertial sensors

The inertial sensors are used by the autopilot to compute the attitude (i.e. its orientation in space) of the drone. The attitude is displayed by the attitude indicator in *eMotion*. To check the inertial sensors, follow these steps:

1. Switch your *eBee X series drone* on by connecting the battery and connect to *eMotion*.
2. Put the drone on a flat surface (typically an office floor) and check that the attitude indicator is level.

[6] See *Getting your* eBee X series drone *ready to fly* in your eBee X manual

3. Take the drone in your hands, tilt the nose up and down and tilt the wings to the left and right. Make sure that the attitude indicator in *eMotion* displays the corresponding orientation.

The attitude indicator should follow smoothly the motion of the *eBee X series drone* and it should not drift when the drone is not moving. In case of doubt, take a short video and follow the instructions in *Reporting a problem with your eBee X series drone* for advice.

Check 3: Barometric pressure sensor

The barometric pressure sensor is used to measure the altitude from the take-off spot. To check it, follow these steps:

1. Switch your *eBee X series drone* on by connecting the battery and connect to *eMotion*.
2. Move the drone from your feet to above your head (about 2 m (7 ft) altitude variation).
3. Check the altitude shown in *eMotion*.
4. Move the drone back down, from above your head to your feet (about -2 m (-7 ft) altitude variation).

The displayed altitude should follow the drone motion, i.e. if the drone is raised by 2 m (7 ft), the altitude reading should increase by about 2 m (7 ft), then decrease again when the drone is lowered. When the drone is not moving, the altitude reading may slowly drift by up to ±10 m (±33 ft).

Check 4: Air speed sensor

The air speed sensor is connected to the pitot probe by a pair of tubes. To check it, follow these steps:

1. Visually check the pitot probe. Make sure that it is properly fixed to the airframe. The holes in the probe must be clear and free of dirt or other small obstructions.
2. Switch the drone on by connecting the battery and connect to *eMotion*.
3. Very gently blow into the front opening of the pitot tube from a distance of around 5 cm (2 in). The airflow direction should match the natural flow experienced in flight.
4. Check the air speed displayed in *eMotion*.

At rest, the displayed air speed should be close to zero (it may drift up to about 2 m/s (4 kts)). When blowing in the pitot probe the air speed indicated in *eMotion* that should easily reach values above 8 m/s (16 kts).

Check 5: Ground sensor

The ground sensor is a LiDAR sensor. The apertures must be clean and unobstructed for the sensor to work correctly. To check it:

1. Make sure that it is properly fixed in place. Visually check the ground sensor. The lenses must be clear and free of dirt or other obstructions.
2. Place the drone on the ground and power it on by connecting the battery.
3. Connect the drone to *eMotion*.
4. Hold the drone approximately 1 m (3 ft) above the ground. Check that the Ground sensor height in *eMotion* is approximately that height. If it is incorrect or shows only a hyphen (-), your ground sensor is faulty.

9.4 Repairing your eBee X series drone

The senseFly support team or the certified *eBee X series drone* reseller need the logs to determine what happened during the flight in case of an incident. The flight logs files (.bbz) will be needed. Do as follow to recover the logs and be able to send them:

1. Connect the battery (blue status).
2. Connect the appropriate cable (modem's cable) from the drone to the computer (white status).
3. In your file explorer, open the folder called "LOGS".
4. Select "SFBBZ".
5. Download the desired flight.
6. Send it to the SenseFly support team or the certified eBee X series drone reseller.

Caution: The *eBee X series drone*' advanced materials and construction mean that it has very few user- serviceable parts.

- Only carry out the basic repairs described in this user manual.
- Do not try and disassemble the drone beyond the procedures described in this manual.
- Do not try and repair carbon fibre parts, for example, the wing struts.
- If your drone is damaged, contact senseFly or a certified *eBee X series drone* reseller.

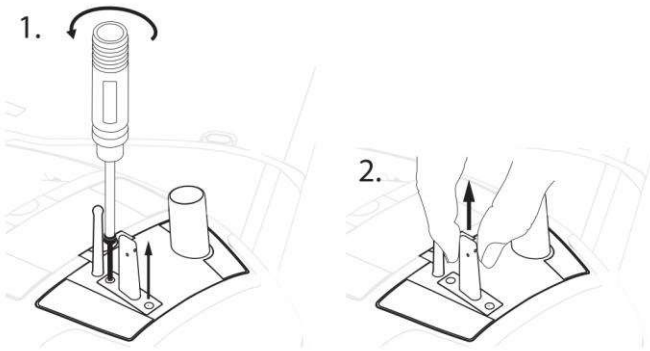
Caution: The autopilot, sensors and actuators within the Central Body of the *eBee X series drone* are specially calibrated and should only be modified by your *eBee X series drone* reseller. Opening the Central Body of the *eBee X series drone* will void the warranty.

The following parts can be replaced by the operator:

- Pitot tube and airspeed sensor
- Rubber bands and propeller
- Vertical surfaces

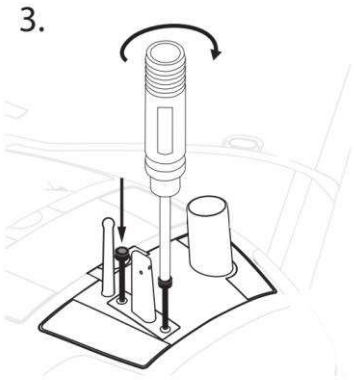
Replacing the pitot tube and airspeed sensor

If dirt, dust, or excessive humidity reaches the drone's airspeed sensor, it may malfunction. Your *eBee X series drone* is supplied with a spare pitot tube and airspeed sensor unit.



1. Use a hexagonal 2.5mm screwdriver to remove the 2 screws that hold the air speed sensor in place.
2. Gently pull the old sensor out of its socket.

Caution: Ensure that the translucent white seal is correctly positioned on the replacement pitot tube.



3. Gently insert the new pitot tube into the socket on the drone. You should feel no resistance. Screw the 2 screws back in without over-tightening them.

Replacing the rubber bands and propeller

Rubber bands

A rubber band in good condition has no cracks in it. If cracks appear, replace the rubber bands with new ones. Always replace all three rubber bands.

We recommend regularly removing the rubber bands and inspecting them for cracks. It is especially important to inspect the part of the rubber band that passes under the propeller mount. This is an area where the rubber band experiences higher forces, and cracks can be hidden there.

The rubber's lifetime depends on the conditions under which it has been used, for example, external temperature, exposure to UV light and the number of flights. For this reason, although we recommend making a habit of checking the rubber bands regularly, we also recommend changing them every 6 months even if there are no apparent cracks.

Propeller

You should also check the propeller regularly. A propeller in good condition still has its original overall shape. Pay special attention to the tip where wear is most common. If any part of the propeller appears worn down, replace it.

Replacing the vertical surfaces

The plastic vertical surfaces onto which the wings clip need replacing if a clip is broken.
There are left and right-hand surfaces; make sure you have the correct one.

1. Carefully unscrew the 4 screws that hold the vertical surface in place.
2. Gently pull the vertical surface off and manoeuvre it around the servos.
3. Gently manoeuvre the new surface into place.
4. Screw all 4 screws back in firmly but without over-tightening them.

Repairing the EPP

Small repairs of cracks in the airframe can be done using contact glue such as UHU® POR glue. Take care to use only contact glues that are specifically designed for Expanded Polypropylene (EPP). If you have doubts about the extent of the damage, always contact a certified *eBee X series drone* reseller to verify if the damage can be easily repaired by yourself or if you need to send your drone in for repair to senseFly.

Caution: Never fly your *eBee X series drone* if it has cracks in it.

9.5 Cleaning an eBee X series drone

Use a damp cloth to wipe off dirt from the *eBee X series drone*' sensor modules, wings, body, motors and propellers. Use the cloth, cleaning fluid and cleaning tool provided to clean the camera lense and ground sensor.

Caution: Never bring an *eBee X series drone* into direct contact with water; this may damage its electronics.

9.6 Storing your eBee X series drone

Always clean the *eBee X series drone* before returning it to its case for storage. Whenever possible, store your *eBee X series drone* in the case it was supplied in.
If you must store the drone outside its case, to avoid wing deformation, store it on a flat surface at room temperature. Do not store the drone near a heat source, in direct sunlight or in a hot place.

Caution: As with most electronic equipment, to avoid a malfunction due to condensation forming inside the drone, avoid powering it on immediately after moving it from a cold to a warm environment.

9.7 Battery care and safety

Proper care of your *eBee X series drone*'s battery is important to prevent damage to your drone and to maximise flight time. Frequent altitude changes, presence of wind, use of old batteries and/or frequent photo acquisition may significantly reduce the flight endurance. Batteries perform better at medium or high air temperature and it is normal to observe shorter flight times in cold weather.

The *eBee X series drone* is powered by a LiHV (High Voltage Lithium Polymer) battery composed of four cells connected in series. It has an empty battery voltage of 15.2 V and a fully-charged battery voltage of 17.4 V. A well-balanced and healthy battery should have all cells at a voltage very close to each other. Your battery's

total voltage is shown in *eMotion* when the drone is connected.

The charger delivered with your drone automatically checks for healthy voltages of all cells and only attempts charging if they are within limits. If the cells are out of balance, the charger will take care of balancing them.

- Always charge **eBee X series drone** batteries using the supplied cable. Do not use the **eBee X series drone**
  charging cable to charge any other batteries.
- Always connect the battery to the charger with the correct polarity.
- Never leave or store a battery with its cable attached.
- Never leave the charger unattended while charging.
- Use the charger in a well-ventilated area, away from electrically conductive and flammable materials.
- The charger may become hot during use. Take care when handling it.
- If the battery or the charger behaves unexpectedly during charging (for example, overheating, smoking, melting, leaking, etc) immediately disconnect the mains and store the battery and charger in a safe location.
- Keep the charger away from dust, moisture, rain, heat sources, direct sunlight, and vibration. Never drop the charger.
- Only power the charger with the specified operating voltages.
- Place the charger and battery on a heat-resistant, non-flammable, non-conductive surface. Never place them on an upholstered surface such as a car seat or carpet.
- Keep all inflammable liquids and materials away from the battery and charger.

If the charger detects a charging voltage outside of the allowable range it will sound an alarm. Carry out the following procedure:

1. Check that the charging cable is properly connected with the correct polarity.
2. If the alarm continues to sound, the battery has developed a fault and should be discarded.

Caution: The batteries delivered with your drone are designed to be charged only with approved senseFly chargers. senseFly cannot be held responsible for any consequences resulting from using any other charger. In particular, using a charger improperly configured or designed for other types of batteries may lead the battery to be permanently damaged or to catch fire.

LiHV batteries do not exhibit any memory effect. You do not need to fully discharge them before charging them again. Recharging them when only partially discharged does not reduce their total charge, damage the battery or shorten its useful life.

When not using the battery store it in the carrying case provided with your drone. Avoid leaving the battery in direct sunlight. Don't store a fully-charged battery for more than two weeks. Batteries should be stored charged to about 60%.

Caution: If any of the cells of your battery pack have been overly discharged the battery may be irreversibly damaged and dangerous to charge. If the battery swells beyond its regular size or if any of the cells are punctured it is also likely damaged and should be discarded. Forcefully charging a damaged battery may cause it to catch fire. **Do not attempt to charge an over-discharged or damaged battery. Dispose of the battery safely.**

Maximising safety and battery lifetime

If treated well, your *eBee X series drone*'s batteries have the potential to last for many cycles (charging then discharging).

As a general rule, the lower you push the battery charge during your flights, the shorter the lifetime of the battery will be.

In addition, flying with low battery isn't safe. At lower battery charge levels, less power is available for the motors to generate thrust. Unexpected wind conditions, the arrival of people or the arrival of an obstacle in the landing zone can force you to hold, abort the landing and climb, manoeuvre or counter the wind, all of which require battery power.

For trouble-free flight and long battery life:

- Land your drone before the battery runs out. Thanks to their smart-battery technology, the low endurance safety action (which brings the drone to Home) is based on accurate battery capacity. Leaving the low endurance safety action on is recommended to optimise flight time and safety[7]. You should consider returning the drone to the home waypoint before the low endurance Warning if you judge it necessary.
- Minimise the number of times you allow the battery charge to drop below 10%.
- Avoid taking the battery down to 0% charge. This can greatly reduce battery lifetime and reliability.

Deep discharge

eBee X series drone batteries' 4 cells must remain balanced and stay above a minimum voltage. Following a deep discharge—one or more of the cells are pushed below 2.5 V—they become damaged, affecting the reliability of the battery. If this has happened to a battery, it will be no longer possible to charge that battery.

Gradual discharge when not in use

Even when the battery is not in use, it will continue to gradually discharge (between 2 and 6% per month). Eventually, the battery could enter a state of deep discharge.

To avoid this:

- After flying, do not leave the battery in a low-charge condition for a long time. Recharge the battery as soon as possible.
- When batteries are in storage, check the battery level every 3 months and recharge to 70% when below.

9.8 Reporting a problem with your *eBee X series drone*

If there is a problem with your *eBee X series drone*, whether it is a software malfunction, damaged airframe or any other problem, carry out the following actions before flying again:

[7] see your *eMotion* user manual

1. If there is an error message displayed in *eMotion*, begin by checking your *eMotion* user manual to see if there is a solution to the particular message.
2. Check our Knowledge Base, part of my.senseFly[8], to see if there is a solution to your problem.
3. If you have still not found a solution, contact your *eBee X series drone* support provider. Please include the following information with your inquiry:
    a. The serial number of your drone, in the format AB-XX-XXX. You can find this number inside the battery enclosure. Please include this serial number in the subject line of your message.
    b. A detailed description of the problem, including:
        i. any *eMotion* error messages
        ii. *eMotion* screenshots where possible and relevant
        iii. details of any troubleshooting or tests you have carried out
    c. The flight logs from the drone (.bbz and .bb3) for the flight that had a problem[9].
    d. If the drone's flight logs cannot be copied off the drone, the logs on the camera's SD card in the LOGS folder.
    e. The eMotion Flight Log (_em.bb3) file of the flight that had a problem. You can find this file in the eMotion/logs/ directory which is created in My Documents on Windows.
    f. Photos or video of the *eBee X series drone* airframe, if required.

Note: To provide support, senseFly may request the flight log files for inspection. Copy the logs off the drone before the next flight.

9.9 Replacement parts

		EBEE X	EBEE GEO	EBEE AG	EBEE TAC
ASSEMBLY	COMPONENT	SENSEFLY PART NUMBER			
CENTRAL BODY	ASSEMBLY	SM051000	SM052000	SM053000	SM054000 or SM055000
	Servos	MCMOT00033	Same	Same	Same
	Motor	MCMOT00059	Same	Same	Same
	Pitot tube	SI050004	Same	Same	Same
	Skid Plate – Lower protection	MCPLA01630	Same	Same	MCPLA02065 or MCPLA01630
	Battery Cover	MCPLA01706	Same	Same	Same
Wings	Assembly	SI050009 (LH) SI050008 (RH)	Same	Same	SI054002 (LH) SI054001 (RH) or SI050009 (LH) SI050008 (RH)

[8] https://my.sensefly.com
[9] see your *eMotion* user manual for instructions on retrieving this file from the *eBee X series drone*

Peripherals	Payload (Cameras)	senseFly S.O.D.A SF050005 senseFly S.O.D.A 3D SF050054 senseFly S.O.D.A Corridor SF050006 senseFly AeriaX SF050018 senseFly Duet-T SF050027 senseFly Duet- M SF050036 Micasense RE- MX SF050029 Parrot Sequoia+ PF740000	senseFly S.O.D.A SF050005	senseFly Duet- M SF050036	senseFly S.O.D.A SF050005 senseFly S.O.D.A 3D SF050054 senseFly S.O.D.A Corridor SF050006 senseFly AeriaX SF050018 senseFly Duet-T SF050027 senseFly Duet- M SF050036 Micasense RE- MX SF050029 Parrot Sequoia+ PF740000
	Battery charger	SI050022	Same	Same	Same
	Tracking Device	SF200004	Same	Same	Same

9.10 Life limited parts

	Systematic	Normal use
Wings	n/a	When necessary, depending on the condition
Pitot	100 hours inspection	
Blister		
Propeller		
Rubber bands		

9.11 Maintenance and inspection log

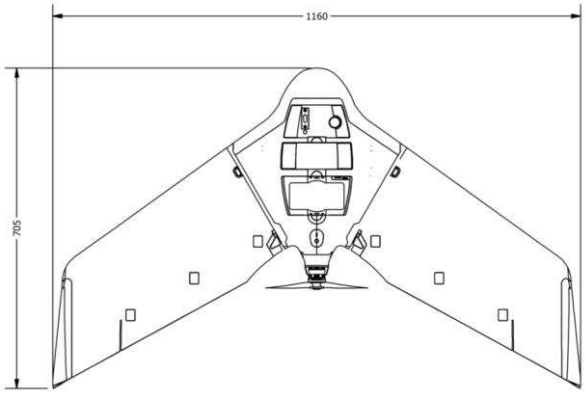
Date	A/C model	S/N	Hours	General/Full	Maintenance activity	Inspected by

10 Drone specifications

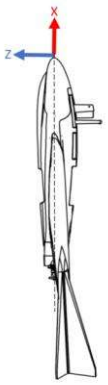
Wingspan	116 cm (45.7 in)
Maximum take-off weight	1.6 kg (3.5 lbs)
Central body drone weight	665 g
Standard battery weight	332 g
Endurance battery weight	422 g
Wings weight	195 g
Beacon weight	9 g
Propulsion	Low-noise, electric brushless motor
Maximum propeller speed	10322 tr/min
Material	EPP foam, carbon structure & composite parts
Standard battery	4-cell 3700 mAh LiHV (0.3 kg (0.7 lbs)) - model SI050003
Endurance battery	4-cell 4900 mAh LiHV (0.4 kg (0.9 lbs)) - model SI050017
Battery consumption	15.2 V DC, 3.7/4.9 A
Nominal endurance[10]	up to 59 minutes (flight time with standard battery)
Extended endurance[11]	up to 90 minutes (flight time with endurance battery)
Landing	Linear landing at 20° Steep landing at 35°
Cruise speed	12-17 m/s (43-61 km/h - 27-38 mph)
Standard climb rate	3 m/s (10 ft/s)
Maximum flight altitude	5000m AMSL
Maximum Take-Off altitude	3000m AMSL
Maximum climb rate	5.4 m/s (17.7 ft/s)
Maximum turn rate	69°/s
Minimum turn radius	50m
Maximum bank angle	60°
Maximum vertical speed at landing	5m/s (25° of airslope and 12 m/s of airspeed)
Wind limitation	10 m/s (36 km/h, 22.4 mph, 19.4 kts)
Operating temperature	-15 to 35 °C (5 to 95 °F)
Navigation	Up to 500 waypoints
Carry case dimensions	75 x 51 x 33 cm (29.5 x 20.1 x 13.0 in)
Communication security during flight	Obfuscation link 2.4Ghz (AES transmission standard)
Communication security during firmware update	USB (information not visible)
Communication security during logs download	USB (obfuscation)

[10] endurance can vary depending on external factors such as wind, altitude change and temperature or payload and accessory
[11] endurance can vary depending on external factors such as wind, altitude change and temperature or payload and accessory

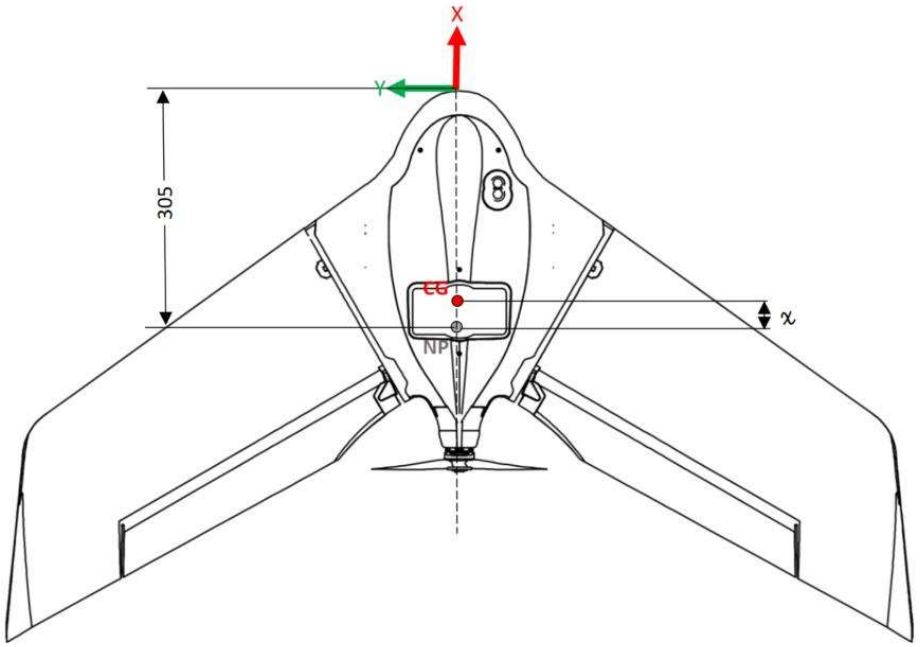
11 Drone dimensions



Bottom-View
SCALE 1 : 8



Side-View
SCALE 1 : 8



Top-View
SCALE 1 : 8

12 Compatible payloads for Operations Over People (FAA Category 3)

Sensor model	Manufacturer	Weight	Dimensions (mm) LxHxW	Picture
S.O.D.A.	senseFly	132 g	155x86x68 With lens protection: 155x86x75	
S.O.D.A. Corridor	senseFly	137 g	155x86x68 With lens protection: 155x86x75	
S.O.D.A. 3D	senseFly	226 g	155x86x78 With lens protection: 155x86x85	
Sequoia+	Parrot	182 g	155x86x69 With lens protection: N/A	

Specifications of the payloads are available in each appropriate camera user manual.

Communication devices

Ground modem *Frequency*	2.4 GHz
Nominal range[12]	approx. 3 km (2 mi)
Maximum working range[13]	approx. 8 km (5 mi)
Certification	FCC, IC, CE, JP, BR, KCC, India

[12] can vary greatly depending on external factors such as cruise altitude, presence of obstacles and radio-frequency interference.
[13] can vary greatly depending on external factors such as cruise altitude, presence of obstacles and radio-frequency interference.

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