QuadPod 2 GPS Module

Thank you for purchasing the QuadPod 2 GPS Module. This plug-in upgrade will equip the aircraft with GPS guidance, allowing it to hover fully automatically, and return to home in the event of radio signal interruption. It can also provide “headless” flying, in which the flight controls relate to the pilot, rather than to the direction in which the aircraft is facing. This helps to prevent disorientation.

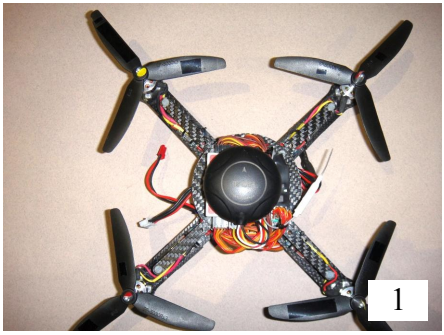
1) Installation

1) Disconnect the QuadPod's battery, and remove the transparent dome, if fitted.

2) The GPS module will be installed on top of the main red Naza Lite unit, using the double-sided adhesive pads provided. It should be mounted:

a) With the wires exiting at the rear

b) As centrally as possible within the circular platform area on the QuadPod. This is to allow the dome to fit over it. Although it cannot be positioned exactly in the middle, by making sure that the receiver is mounted as far forward and to the right as possible it can be placed inward enough to clear the dome (Photo 1).


1

3) The top of the Naza Lite has a stepped surface. To allow for this, three adhesive pads should be stacked up on the front lower part, while a single one is applied at the rear (Photo 2).

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4) The installation should now be completed by plugging the connectors into the Naza Lite unit. The wide connector should be plugged into the socket labelled "EXP" on the rear. The smaller connector should be plugged into X1. Both connectors are shaped so that they will only fit one way around.

5) The excess cable length should be wound up and placed along the right hand side of the Naza Lite. A cable tie can be used to keep it tidy.

2) Flight Modes and Transmitter Setup

When the GPS module is installed, new flight modes become available and the Channel 5 switch on the transmitter needs to be set so that it operates them correctly. Which modes are selectable depends upon whether the transmitter has a two or three position switch, and how its endpoints are set. For information about setting the switch endpoints please refer to Step 19 on page 11 of the QuadPod 2 manual, whilst noting the points below:

- With the GPS module fitted, "GPS" mode will appear at the left hand end of the "Control Mode Switch" slider in the Naza-M Lite Assistant program. "Atti" will still be in the centre position, and "Manual" will be on the right.
- When using the Snelflight "Ghost" radio system, these three modes will be selected by the transmitter's switch.
- When using another transmitter, the switch endpoints can be set according to preference.
- A two-position switch can be set to select between GPS and Atti modes, leaving Manual mode unavailable.
- A three-position switch can be set to select "Failsafe" as an alternative to Manual flight mode. When activated, this option will cause the aircraft to return home and land.

The modes function as follows:

GPS Mode: In this flight mode, the QuadPod is capable of fully automatic stationary hovering. This makes flying much easier because the aircraft will hold its position when the transmitter joysticks are centred. It is also very helpful if a camera is being carried.

GPS operation begins even before take-off. Once six or more GPS satellites have been locked on for at least 8 seconds, the system will record its "home position" as the throttle is raised to begin flying. This is the location to which the aircraft will return if the go-home function is activated.

After take-off, the GPS guidance system will hold the aircraft in its current location while the transmitter joysticks are at their centre (neutral) positions, compensating for drift and wind. Altitude is also actively maintained, using an on-board barometric altitude sensor.

Please note the following:

- GPS is not perfect! It is only accurate to about 3 metres, so the aircraft can drift within this radius, and may be blown beyond it by a sudden strong gust, though it should return as the system recognizes the problem. It is particularly important to understand that the "home position" will not be spot-on, so there is a danger that the aircraft will bump into something if auto-landing in a confined space. It is therefore safer to fly from an open area.
- GPS can sometimes fail altogether, due to signal interference or adverse atmospheric conditions. It also works poorly among tall trees and buildings, which can sometimes generate rogue signals which send the aircraft chasing off after a phantom satellite.
- Barometric height control can be affected by a gust of wind, which has a lower pressure than still air. This fools the system into thinking that the altitude has increased suddenly, so it responds by making the aircraft descend.
- The number of satellites visible in the sky varies during the day, due to their continuous orbits around the Earth. When fewer satellites are visible it will be more difficult to acquire enough for reliable control. This is most often experienced as a difficulty in locking onto enough satellites before take-off (please see LED indications on page 5), but satellites can also be "lost" during flight.

These issues tend to be relatively unimportant if the aircraft is high in the air, but can get you into trouble at low altitudes. Do not rely too heavily on the automatic systems!

Atti Mode: Short for "attitude control mode", this is the same as self-levelling mode before the GPS module was installed. The system maintains level flight using the onboard inertial sensors, but the aircraft cannot control its own position. Barometric height control is operational, but the aircraft must be guided around the sky manually by the pilot. It is a good idea to become practiced in this mode for occasions when GPS is unavailable or insufficient, such as when flying indoors or in a confined environment.

Please note that although the aircraft will return to level flight when the right-hand joystick is centred, it will not automatically stop moving. It will slow down gradually, but to stop it quickly an opposite joystick input must be applied. This needs plenty of practice!

Manual: If the transmitter has a two position switch then its endpoints should generally be set so that the switch can select either GPS or Atti mode. With a three-position switch, Manual flight can be made available as well.

In Manual mode, none of the automatic flight controls are operational. The aircraft will not self-level, and barometric height control will be inactive. The aircraft will fly like a conventional helicopter, which is great fun and provides the most agility in the air. This type of flying takes longer to learn, but is extremely satisfying and allows the pilot to fly a wide variety of aircraft.

Go Home: As an alternative to Manual mode, the transmitter switch endpoint can be set so that the third switch position selects Go Home (Failsafe) mode. When this is activated, the QuadPod will attempt to use GPS guidance to return to the recorded home position, where it will execute an automated landing. If GPS is unavailable then the aircraft will land at its present location.

When the Flight Mode switch is first set to Go Home, the status LED will change to continuous rapid yellow blinking. The aircraft will hover for about 10 seconds, before ascending to 60 feet altitude if it is not this high already. It will hover for another 15 seconds, then turn to face home and fly back at medium speed, stopping over the home position. It will then descend, pausing several times to check its position, correcting if necessary. The final landing should be very gentle, after which the motors will stop.

Please note:

- The final landing place may be as much as 3 metres from the true home position, which can cause collisions in a confined area.
- The joysticks have no effect in Go Home mode.
- The pilot can resume control at any time by switching out of Go Home mode. But please note that it is necessary to **toggle between Atti and GPS** in order to reactivate the joysticks. Just deselecting Go Home is not enough.

Failsafe: If the transmitter signal is lost for any reason, the QuadPod will automatically enter Go Home mode. This might be because

- The transmitter has been turned off
- Its batteries have run out
- Interference or an obstruction is preventing reception.

If the signal is recovered during the return flight then the rapid yellow blinking will stop, and the LED will revert to its previous signal. **However pilot control will not be restored until the mode switch has been toggled between Atti and GPS.** This prevents control reverting to the pilot inadvertently.

3) Operation

The pre-flight checks and start-up procedures are the same with GPS as they were without. However the LED indications are different. To familiarize yourself with the new ones, it is a good idea to perform a test before going outside to fly:

a) Switch on the transmitter and then power up the QuadPod as usual. If GPS mode has been selected on the transmitter switch, the Naza's status LED should show the following pattern after the start-up sequence:

The green blink indicates that GPS mode is selected, whilst the three red blinks mean that satellite reception is at its worst. GPS doesn't work indoors!

b) If one of the transmitter joysticks is moved, then the blink pattern will change to this:

The double green blink indicates that one of the joysticks is off-centre.

c) If Atti mode is selected then the green blink will change to yellow:

For a full explanation of all status LED blink patterns and their meanings, please see page 7.

Compass Calibration

The GPS module includes an electronic compass, which is crucial to automated flight. Although GPS provides location information, it cannot measure what direction the aircraft is facing. This information is needed to allow the aircraft to control its position, and it is provided by the compass.

Unfortunately the earth's magnetic field is not perfectly consistent or uniform. In particular, the direction of magnetic north differs from true geographic north by an angle called its declination, which varies from one place to another. To allow effective flight control the Naza Lite contains a database of declinations around the globe, which can be as great as 20° at moderate latitudes. However local variations also occur, due to large metal objects in the area as well as various mineral deposits in the ground. To allow for these, the compass needs to be calibrated prior to flying at a new site.

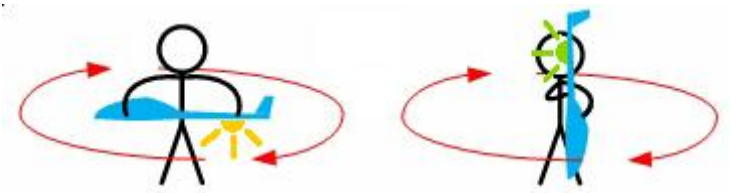
The procedure is very quick and easy, and is carried out as follows:

a) Switch on the transmitter, and then power up the QuadPod. Select GPS mode and wait until the status LED begins its repeating blink pattern.

b) Move the flight mode switch fully from one end to the other and back again, seven times in rapid succession. You should finish in GPS mode. The status LED should change to solid yellow, indicating that the system is ready for compass calibration.

c) Next, pick up the aircraft and hold it horizontally. Rotate it clockwise fully through 360° - it is easiest just to turn yourself on the spot. When the circle is complete, the status light will turn green.

d) Now hold the QuadPod nose downwards, and repeat the clockwise 360° rotation. When the circle is complete the status LED should revert to its normal repeating blink pattern. All done!



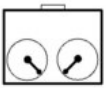
If the compass is out of calibration when hovering under GPS control, the QuadPod will move in the wrong direction when trying to maintain/correct its position. This will lead to a new position error and a new misguided movement, and so on. The result will be a circular flight pattern colourfully referred to as a "toilet bowl". It can be halted by switching off GPS; the cure is to land and calibrate the compass.

4) First Flight with GPS

1) It is a good idea to try the first flight on a calm day in an area with plenty of space. Place the aircraft on level ground and stand about 3 metres behind it, so that it is facing away from you. Any spectators should stand behind you.

2) Select GPS mode, and wait for the satellites to be acquired. This will be indicated by a reduction in the number of red LED blinks between each green one, and the flight should not begin until at least 6 satellites are locked on, indicated by single red blinks. Preferably the red blinks will have ceased altogether, indicating 7 or more satellites locked on. Wait until the LED signal has been stable for at least 10 seconds.

3) To start the motors, pull both joysticks back into the "cross-eyed" position as described in Step 20 of the main QuadPod 2 manual.



4) Once the motors start, the QuadPod is ready to go. To take off, push the left hand (throttle) joystick upwards about half-way. As the throttle is raised, the Home Position will be recorded. The motors will rev up, and the aircraft will lift into the air. Let it ascend to a height of about 6 feet, and then lower the joystick to the centre again. The aircraft should now hover in this position, guided by GPS. It may drift about slightly, and its height may also fluctuate. Watch the way it behaves, and try ascending or descending by small amounts.

5) Once you feel comfortable, you can try steering the QuadPod by moving the left hand joystick from side-to-side. Use small inputs and watch the effect on the aircraft.

6) Next, steer the QuadPod so that it is facing away from you, and then try applying small inputs to the right hand joystick. The aircraft will tilt in the direction of joystick input, and proceed to fly in that direction. When the joystick is centred the aircraft should slow down and resume hovering in its new position. Note that it will not stop instantly and to bring it to a rapid halt, an opposing joystick input must be applied.

7) Landing: It is best to land well before the flight battery runs low, so that you are not rushed. Bring the aircraft to a height of about 6 feet, and guide it back to the landing area. To land, lower the left hand joystick just slightly, so that the aircraft descends very slowly. When it touches the ground, pull the left hand joystick fully down and hold it there until the motors stop (a few seconds).

Congratulations! You have just completed your first flight. We recommend that you practice flying in Atti mode as well as GPS, so that you can recover the QuadPod if GPS fails for some reason. Flight behaviour is similar in Atti mode, except that the aircraft will drift about more, and will blow downwind. So you must learn to fly against the wind to stay in position.

5) Intelligent Orientation Control (IOC)

Intelligent Orientation Control is a facility provided by the GPS system. It makes the aircraft's direction of forward flight independent of the direction in which the nose is actually pointing. Also called "headless" mode, it helps to prevent control difficulties if the pilot loses track of the aircraft's orientation. There are two different modes of IOC flight:

Course Lock: In this mode, the aircraft's forward direction will always be at the same point of the compass, regardless of which way the aircraft is actually facing. The forward direction is recorded prior to take off.

Home Lock: In this mode, the aircraft's forward direction will always point away from the Failsafe home position in a radial fashion, regardless of which way the aircraft is actually facing.

In order to use IOC, a sixth radio channel needs to be connected to the X2 socket on the rear of the Naza Lite. Ideally this will be operated by a 3-position switch, but a two-position switch or a rotary control can be used. The switch endpoints need to be set in a similar way as on the flight mode switch. There is another pointer position display in the Naza M Lite Assistant program, under "**Advanced / IOC**".

Full IOC operation details start on page 25 of the Naza M Lite manual, which is included with the Naza Lite software on the Snelflight web site Support page. However we have found the IOC system quite clumsy and complicated to use, and generally less helpful than it sounds. It's one more thing to worry about, and since the GPS-guided aircraft is so easy to fly in any case, it just doesn't seem worthwhile.

6) Status LED Indications

The status LED will illuminate and blink in various patterns to indicate different system conditions. These are detailed in the table below.

At Power Up	
System start and self-check.	
Before Take-off and During Flight	
GPS Flight Mode	
Atti Flight Mode	
If one or more transmitter joysticks is moved off-centre, then the single blinks become double.	
The green or yellow blinks are interleaved with red ones according to the number of satellites which the system has locked onto. Fewer red blinks is better, so as more satellites are acquired, the number of red blinks reduces.	
4 or less satellites - not enough to work.	
5 satellites - enough to auto-hover but the system will not register the home position before take-off.	

6 satellites - minimum needed to register the home position before take-off.	
7 or more satellites - ideal reception.	No red blinks
Bad attitude status: If this appears, please hover the aircraft until it disappears. This allows the system to auto-adjust.	
In manual flight mode, there are no yellow or green blinks. If 7 or more satellites are locked on, there will be no red blinks either. The aircraft will not self-level, and the throttle is completely manual with no barometric height control.	
Manual go-home activated, or failsafe auto go-home triggered by loss of transmitter signal.	
Low flight battery voltage warning. Land as soon as possible. When the voltage drops a little further, the aircraft will start to descend automatically in an attempt to land before control is lost.	
Compass Calibration	
Begin horizontal calibration.	
Begin nose-down calibration.	
Calibration failure - try again. This happens rarely.	
IOC	
IOC automatic Forward Direction recording 30 seconds after power-up, or manual recording.	
Instead of the usual yellow or green blinks indicating Atti or GPS mode, in IOC mode you get one of each.	
If a joystick is off-centre then the green blink becomes double.	
These blinks are interleaved by the usual red ones indicating the number of satellites locked on.	
Other	
USB connected.