

**Xflight Technologies LLC**

**AP TUNING KIT User & Installation Guide**

**Version 1.5**

**October 2021**

**(This manual is an addendum to the AUTOPILOT manual and needs to be read in conjunction with that manual)**



**Xflighttech.com**



## **A. Terms, Conditions and Warranty.**

These products are only intended to be used in LSA Class Experimental Aircraft or Ultralights (as defined by the FAA in the USA) under the full responsibility of the pilot. AHRS and Autopilot components are intended to be used for informational purposes or to manipulate secondary control surfaces only, allowing the pilot full manual control of the aircraft

**See Appendix A for details**

## **B. Setup and Connection:**

**Note this is a temporary installation solely for tuning the AUTOPILOT parameters in flight**

The AUTOPILOT needs to already be installed and connected to the flight controller, power and servos as per the autopilot installation manual. The on-ground servo orientation section also needs to have been completed.

1. Connect the TUNING box to one of the AUTOPILOT's (Raspberry Pi) USB sockets (note this can be plugged in and out as required with the AP switched on, unlike the other USB connections, which need to be connected permanently).
2. When tuning is complete, remove the TUNING box from the AUTOPILOT

## C. Test and Operation

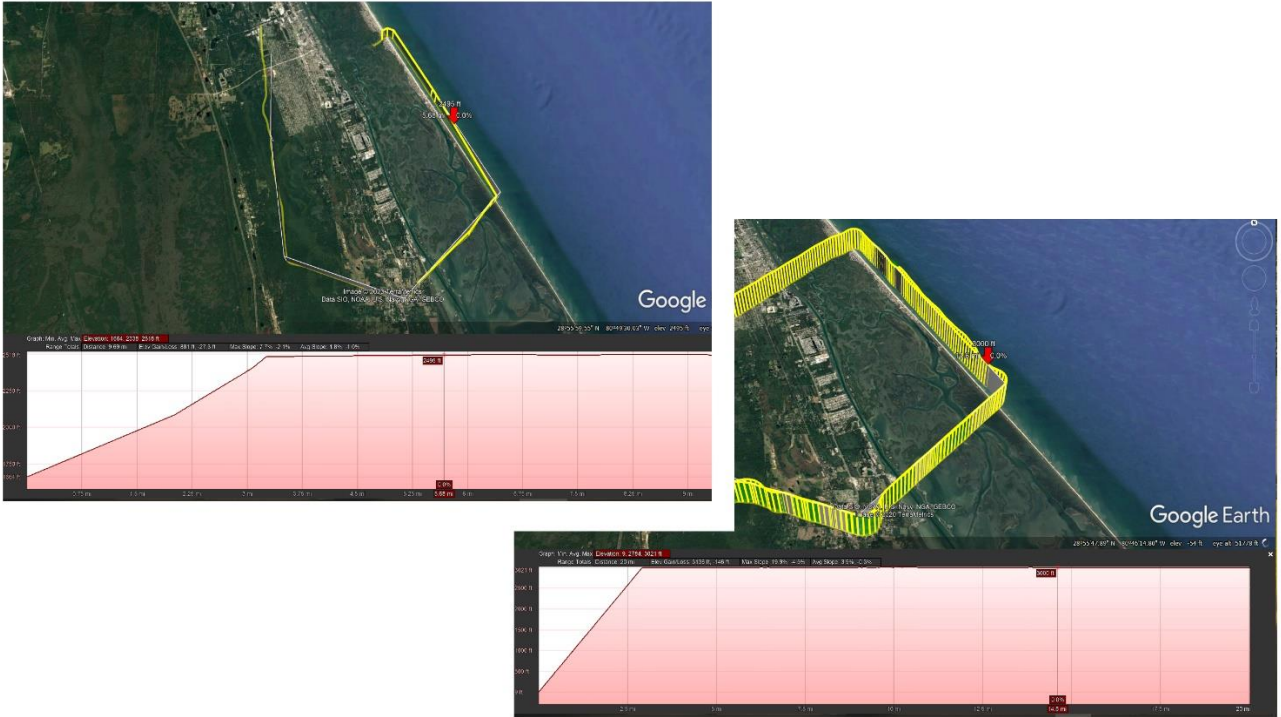
1. Power up the AUTOPILOT (Leave the SERVO circuit powered down).
2. With the TUNING box connected to a USB port, the LED light should blink, indicating it has successfully connected to the AUTOPILOT
3. You should see the current pitch and roll **P** values (**PTCH2SRV\_P** and **ROLL2SRV\_P**) on the screen as well as the **L1** value (**NAVL1\_PERIOD**). See the AUTOPILOT manual for a description of these parameters
4. Turning the first knob on the TUNING box changes the pitch gains up and down (clockwise to increase, anti-clockwise to decrease). The second knob changes the roll gain, and the third changes the **L1** gain. The knobs are quite sensitive, and the response may be a little delayed when viewed on the AHRS display.

Note: with the knobs at center, the values start off at approximately:  
Pitch / Roll: 2.5 and NAV L1: 25

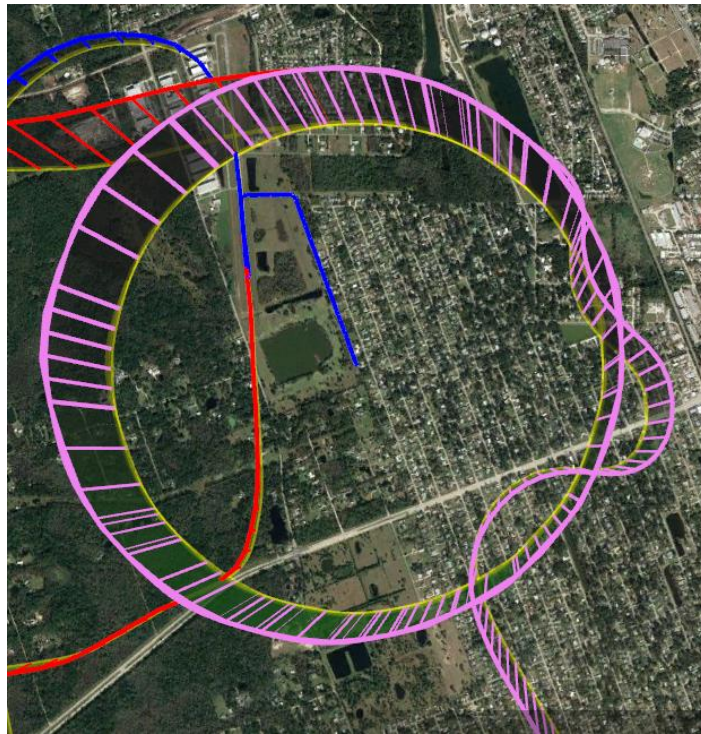
5. Default values are: P=3, R=3, L1 =35
6. The min/max ranges are:
  - Pitch & Roll: 1 to 5 (**increase** to increase sensitivity for STABILITY mode)
  - Nav L1: 10 to 50 (**decrease** to increase sensitivity in CRUISE, HOME and NAV Mission turns)
7. Note that as you change the **P** values, the associated **I**, **D** and **FF** values are automatically updated by the same percentage from their starting points. These values are automatically written to the Flight Controller, and so persist after flight.  
These parameters can of course be accessed by Mission Planner on the ground in the usual way; this allows you to change the values before flight, if you did not want to start from the default values.
8. You should now refer to the AUTOPILOT manual in-flight tuning sections to carry out the tuning process
9. You can further tune the **I**, **D** and **FF** values independently of the **P** values as required on the ground via Mission Planner if needed.



Tracks and waypoints on QGroundControl App during a NAV mission. (Tune with NAV L1 Parameter)



*Tracks and Elevation Profiles (speed/altitude) on Google Earth during NAV missions*



*The pink tracks above show the HOME / RTL (Return to Land) tracks and 1-mile radius loiter circles at the HOME location. There are 2 ½ circles here, with the autopilot maintaining very high precision orbits.*

## Appendix A.

### Xflight Technologies LLC Terms, Conditions and Warranty

1. **PARTIES.** This Contract represents the terms and conditions of sale of Xflight Technologies Products by and between Xflight Technologies LLC, of 1982 State Rd 44, New Smyrna Beach, Florida 32168, USA ("Seller"), and Buyer ("Buyer").
2. **ITEMS PURCHASED.** Seller agrees to sell, and Buyer agrees to buy, one or more of the following products (the "Goods") in accordance with the terms and conditions of this Contract:

| Products                                     |
|--|
| Xflight AutoPilot and related sub-components |
| Xflight AHRS and related sub-components      |

3. **FLIGHT CONTROLLER.** Note that the use of the Ardupilot opensource firmware, as used in 3<sup>rd</sup> party Flight Controllers, in this application is contrary to Ardupilot's Code of Conduct for use in Manned Vehicles, for more info see: <https://firmware.ardupilot.org/>
4. **INTELLECTUAL PROPERTY.** Intellectual property created, made, or originated by the officers, employees, or contractors of Seller shall remain the sole and exclusive property of Seller. Any intellectual property associated with Goods, specifically the software, shall remain the property of Seller. Seller retains all rights to its pre-existing intellectual property and any intellectual property it creates in connection with the development and manufacturing of the Goods of this agreement. Parties agree that Seller will retain ownership of all rights in any invention and work product developed pursuant to the agreement and acknowledges that all materials created by the Seller pursuant to and related to the agreement belong to the Seller under United States intellectual property laws.
5. **WARRANTIES.** The Goods are sold on an "AS IS" basis. SELLER SHALL IN NO EVENT BE LIABLE FOR ANY INCIDENTAL, SPECIAL, OR CONSEQUENTIAL DAMAGES OF ANY NATURE, EVEN IF SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Seller's liability, if any, for defective Goods, is limited to replacement, repair or refund of the defective Goods, at Seller's option for up to 30 days from date of purchase.
6. **PERSONAL USE.** Buyer agrees to limit the operation and use of purchased Goods to personal recreational use. Buyer agrees to not develop or resell Goods, its components, or documentation to another party without Seller's written authorization.

7. **PRODUCT RISKS.** Buyer acknowledges that the ownership and operation of newly developed autopilot and AHRS products, including the subject Goods contemplated by this contract, comes with many unforeseeable risks and potential hazards. Buyer has reviewed the risks, safety hazards and recommendations provided by Seller in the User Guide. Buyer has considered these risks and represents himself as a consumer with a sophisticated understanding of aircraft operation and mechanics, vehicle physics, flying safety protocols, and the concepts underlying the Goods' design. Buyer accepts all foreseeable and unforeseeable risks associated with the ownership and operation of the Goods, components, and related equipment.
8. **INDEMNIFICATION.** Buyer shall defend, indemnify, and hold harmless Seller, including its officers and agents, from any and all actual or alleged claims, demands, causes of action, liability, loss, damage and/or injury (to property or persons, including without limitation wrongful death), associated with the ownership and operation of the Goods of this contract. This indemnity shall apply in all actions, whether brought by an individual or other entity, or imposed by a court of law or by administrative action of any federal, state, or local governmental body or agency, arising out of or incident to any acts, omissions, negligence, or willful misconduct of Buyer, its personnel, employees, agents, contractors, or volunteers in connection with or arising out of Buyer's actions. This indemnification applies to and includes, without limitation, the payment of all penalties, fines, judgments, awards, decrees, attorneys' fees, and related costs or expenses, and any reimbursements to Seller for all legal expenses and costs incurred by it.
9. **REMEDIES ON DEFAULT.** In addition to any and all other rights a party may have available according to law, if a party defaults by failing to substantially perform any provision, term or condition of this Contract (including without limitation the failure to make a monetary payment when due), the other party may terminate the Contract by providing written notice to the defaulting party. This notice shall describe with sufficient detail the nature of the default. The party receiving such notice shall have 30 days from the effective date of such notice to cure the default(s). Unless waived by a party providing notice, the failure to cure the default(s) within such time period shall result in the automatic termination of this Contract.
10. **ARBITRATION.** Any controversies or disputes arising out of or relating to this Contract shall be resolved by binding arbitration in accordance with the then-current Commercial Arbitration Rules of the American Arbitration Association. The parties shall select a mutually acceptable arbitrator knowledgeable about issues relating to the subject matter of this Contract. In the event the parties are unable to agree to such a selection, each party will select an arbitrator and the two arbitrators in turn shall select a third arbitrator, all three of whom shall preside jointly over the matter. The arbitration shall take place at a location that is reasonably centrally located between the parties, or otherwise mutually agreed upon by the parties. All documents, materials, and

information in the possession of each party that are in any way relevant to the dispute shall be made available to the other party for review and copying no later than 30 days after the notice of arbitration is served. The arbitrator(s) shall not have the authority to modify any provision of this Contract or to award punitive damages. The arbitrator(s) shall have the power to issue mandatory orders and restraint orders in connection with the arbitration. The decision rendered by the arbitrator(s) shall be final and binding on the parties, and judgment may be entered in conformity with the decision in any court having jurisdiction. The agreement to arbitration shall be specifically enforceable under the prevailing arbitration law. During the continuance of any arbitration proceeding, the parties shall continue to perform their respective obligations under this Contract.

11. **NOTICE.** Any notice or communication required or permitted under this Contract shall be sufficiently given if delivered in person or by certified mail, return receipt requested, to the addresses listed above or to such other address as one party may have furnished to the other in writing. The notice shall be deemed received when delivered or signed for, or on the third day after mailing if not signed for.
12. **ASSIGNMENT.** Neither party may assign or transfer this Contract without prior written consent of the other party, which consent shall not be unreasonably withheld.
13. **ENTIRE CONTRACT.** This Contract contains the entire agreement of the parties regarding the subject matter of this Contract, and there are no other promises or conditions in any other agreement whether oral or written. This Contract supersedes any prior written or oral agreements between the parties.
14. **SEVERABILITY.** If any provision of this Contract shall be held to be invalid or unenforceable for any reason, the remaining provisions shall continue to be valid and enforceable. If a court finds that any provision of this Contract is invalid or unenforceable, but that by limiting such provision it would become valid and enforceable, then such provision shall be deemed to be written, construed, and enforced as so limited.
15. **WAIVER OF CONTRACTUAL RIGHT.** The failure of either party to enforce any provision of this Contract shall not be construed as a waiver or limitation of that party's right to subsequently enforce and compel strict compliance with every provision of this Contract.
16. **APPLICABLE LAW.** This Contract shall be governed by the laws of the State of Florida in the USA.



## EXCHANGE OF GOODS

*The following provisions relate to the physical exchange of Goods and payment forming the transaction of this agreement.*

17. **TITLE/RISK OF LOSS.** Title to and risk of loss of goods shall pass to the buyer upon delivery F.O.B. at the seller's place of home or business to an agent of the buyer including a common carrier, notwithstanding any prepayment or allowance of freight by the seller.
18. **INSPECTION.** Buyer, upon receiving possession of Goods, shall have a reasonable opportunity to inspect the Goods to determine if the Goods conform to the requirements of this Contract. If Buyer, in good faith, determines that all or a portion of the Goods are non-conforming, Buyer may return the Goods to Seller at Buyer's expense. Buyer agrees to securely mail the goods back to buyer with electronic tracking to the address listed above.
19. **PAYMENT.** Payment due shall be made to Xflight Technologies LLC by cash, bank transfer, credit card or PayPal prior to shipment of Goods. If an invoice is not paid when due, seller will not ship Goods to Buyer. In addition to any other right or remedy provided by law, if Buyer fails to pay for the Goods when due or reverses credit card charges after shipment of Goods, Seller has the option to treat such failure to pay as a material breach of this Contract, and may cancel this Contract and/or seek legal remedies.
20. **PAYMENT OF TAXES.** Buyer agrees to pay all taxes of every description, country, federal, state, and municipal, that arise as a result of this sale, excluding income taxes.