Operation Manual

EML4552-C Senior Design, Spring 2013, Deliverable

AIAA Design Build Fly Competition
Team # 16

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Introduction

This operation manual is intended to provide sufficient familiarity with the radio-controlled UAV named P.E.G.A.S.U.S. (Pedestrian-operable Electronically Generated Stealth Unmanned System). This manual provides steps to understand how the unit operates, what to expect in operation, how to prepare the unit for use, how to maintain the unit, how to repair the unit in certain instances, and which parts should be on hand in the event that the unit requires them for operation.

Function Analysis

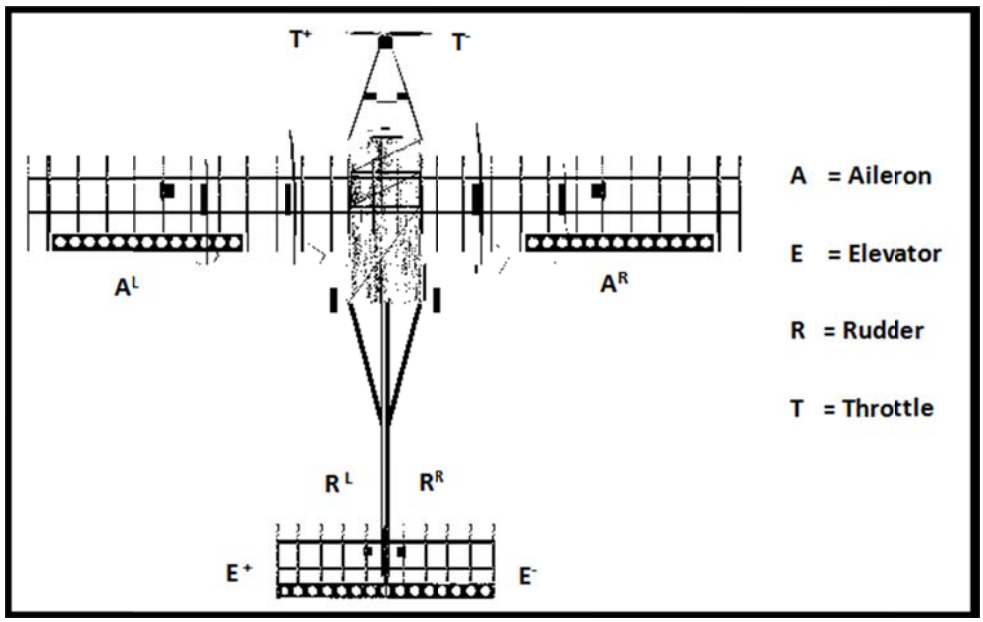


Figure1

The aircraft will become fully operable after the propulsion system begins. This begins by starting the motor and pushing the throttle to begin aircraft movement. The propulsion system is powered by a 1500 mAh, 9.6 V battery pack. The plane is controlled remotely by an operator (or pilot) on the ground using a hand-held radio transmitter. The transmitter communicates with a receiver (discussed in further detail later) within the aircraft that sends signals to servos which move the control surfaces based on the position of joysticks on the transmitter. These servos are located along the wing of the aircraft, as well as the tail. Therefore, the control surfaces directly affect the flight and orientation of the plane.

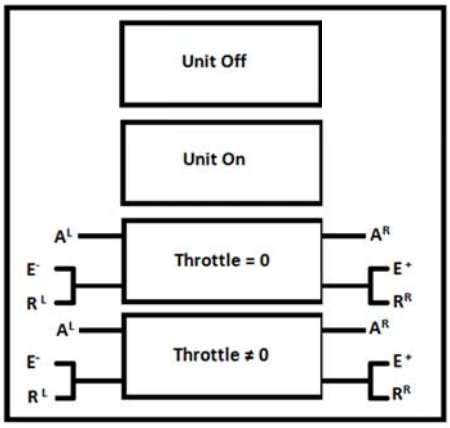


Figure 2

In Figure 1 above, a functional diagram of the controls system is outlined. Once the unit is turned on (by placing the fuse into the fuse box, completing the circuit through the connected battery) the system is idle. The lower half of the diagram illustrates that if the throttle is off, full control surface operability is possible. This is also true when the throttle is not running. Note that the ailerons are connected such that a turn means A^R and A^L

If at any time should the aircraft become inoperable, there are precautions taken before the actual flight take place (discussed in further detail under the 'Instructions' section). The servo attachment is shown below in Figure 3. Take special note of the channel settings of each servo. These must be properly programmed for full functionality. Note: Figure 3 is an adapted image from the Futaba instruction manual.

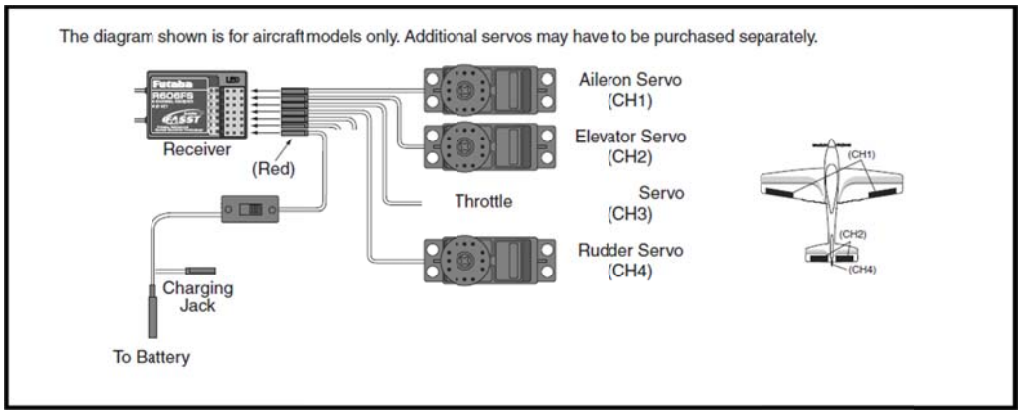


Figure 3

Product Specs/Performance Expectations

Wingspan: 197.54 cm
Length: 106.67 cm
Tail span: 25.0 cm
Rudder Length: 25.0 cm

Empty Weight: 6.0 lbs
Loaded Weight: 9.0 lbs
Minimum Take-off Length: 30 ft
Max Speed: 60 mph
Max Motor Current Draw: 18.8 Amps
Max Servo Voltage Supply: 4.8 Volts
Full Throttle Battery Life: 5 minutes

Instructions on Procedure for Operation

Binding

The AR7000 receiver must be bound to the transmitter before it will operate. Binding is the process of teaching the receiver the specific code of the transmitter so it will connect to that specific transmitter. Once bound, the receiver will only connect to the transmitter when the previously bound model memory is selected. If another model memory is selected, the receiver will not connect. This feature is called "Model Match" and prevents flying a model using the wrong model memory. Once this process is completed, the aircraft is operation ready.

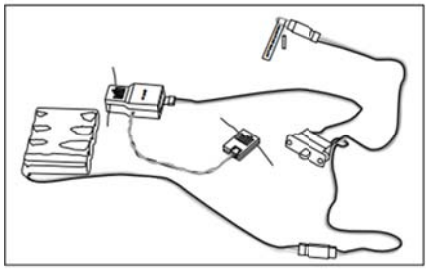
Fail Safe

Fail safe mode does several key things during operation of the aircraft. It prevents unintentional electric motor response on start-up. It also eliminates the possibility of overdriving the servos upon start-up. A very important feature is that fail safe mode establishes low-throttle failsafe if the RF signal is lost. Lastly, it maintains last-commanded control surface position in the event of RF link interruption. The failsafe requirement for our competition is the following set of commands.

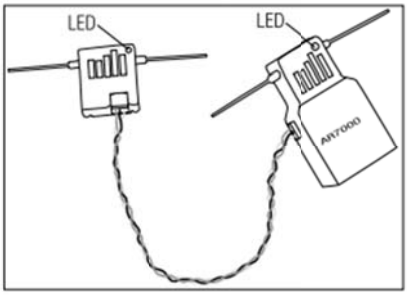
1) Throttle Closed 2) Full Up Elevator 3) Full Right Rudder 4) Full Right Aileron.

The fail safe mode is operated as follows:

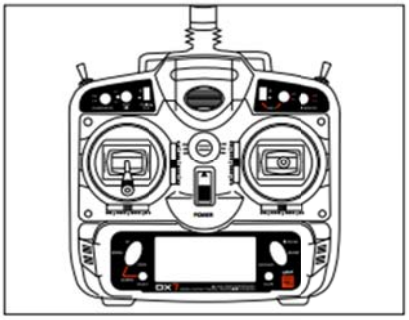
1. With the system hooked up as shown in the figure below, insert the bind plug in the charge plug receptacle.



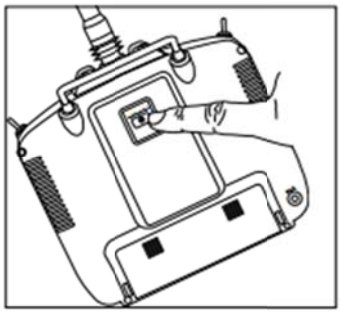
2. Turn on the receiver switch. Note that the LED's on both receivers should be flashing, indicating that the receiver is ready to bind.



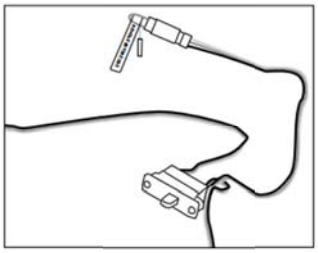
3. Establish the desired failsafe stick positions: normally low throttle and flight controls neutral.



4. Press and hold the bind button on the back of the transmitter while turning on the power switch. The bind button should flash and within a few seconds the system should connect. The LED's on the receivers should go solid indicating the system has connected.



5. Remove the bind plug from the receiver and store it in a convenient place.



6. After you've programmed your model, it's important to rebind the system so the true low throttle and neutral control surface positions are programmed.

Motor

This brushless motor requires the use of a sensor-less brushless speed control. Failure to use the correct speed control may result in damage to the motor and/or speed control. When mounting the motor, the correct length of screws must be used so damage to the inside of the motor will not occur. The wires must be properly insulated in order to prevent shorting. If you add connectors and you no longer wish to use them, never cut the motor wires. Remove them by properly "desoldering" them. Shortening the motor wires is considered an improper modification of the motor and may cause the motor to fail. When the motor is connected, check the rotation direction of the motor. If you find the rotation is reversed, switching any two motor wires will reverse the direction so the motor rotates properly. Proper cooling of the motor is very important during operation. New technology has brought much higher capacity batteries with higher discharge rates, which can cause extreme motor temperatures during operation. It is the responsibility of the user to monitor the temperature and prevent overheating. You can install the propeller on the motor shaft after you have confirmed proper rotation direction. Also consult the instruction included with your sensor-less electronic speed control for proper adjustments and timing. Once the battery is connected to the motor, please use extreme caution.

Additional Required Assembly

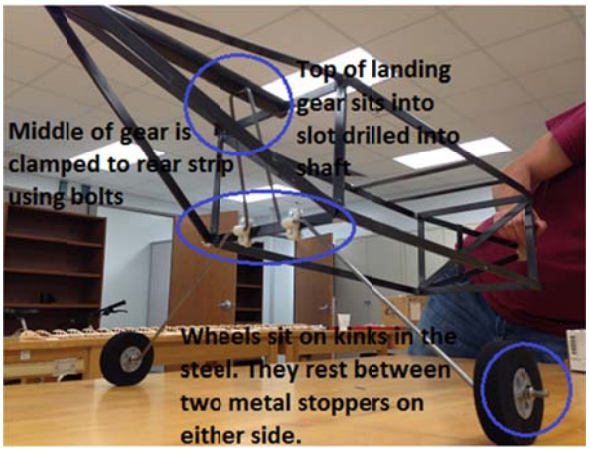
Upon opening the package including all of the components, it will be found that the wing, fuselage, and landing gear are separated. These instructions will aid in assembling these components into a functioning aircraft.

Wing

The one-piece wing is attached to the upper portion of the composite fuselage. Foursmall L-brackets and other associated hardware will then connect the two horizontal carbon composite reinforcement strips on the top of the fuselage frame to the main and secondary spars of the wing. A basswood plate is permanently mounted to the fuselage's composite frame. The carbon mounting strips are there to provide a solid contact point for the L-brackets to be attached, as the basswood provides a large enough surface area of support. This area allows the reaction forces to be spread between the wing and fuselage contact points.

Landing Gear

The landing gear is composed of a small quantity of steel piano wire. The piano wire was bent to fit the eight inch base of the fuselage, bent to fasten securely to the tail attachment tube and the back plate of the fuselage and bending it once more to be able to attach the wheels.



Routine Maintenance Outline

The batteries must be replaced after each flight, and charged. This must be done in order to prevent them from burning out. At such a high discharge rate, which is required for this application, the batteries could easily overheat. After flight, each battery unit (there is a propulsion battery pack, and an additional pack to power the servos) must be disconnected in order to prevent possible corrosion.

Future Repairs/Replacements

A potential problem after successful, repeated flight is that the landing gear may need to be replaced due to strain from repeated impact. The steel piano wire used for the landing gear will be subject to absorbing the landing impact largely on its own, and its characteristics show that a replacement will be necessary.

List of Spare Parts needed to avoid operation interruption

Spare Batteries for Servos
Spare Batteries of Motor
Charger for Servo Batteries
Charger for Motor Batteries
Spare Wheels for wear damage

References

http://manuals.hobbico.com/fut/6ex-2_4ghz-manual.pdf
http://www.spektrumrc.com/ProdInfo/Files/DX7_Manual.pdf
http://www.e-fliterc.com/ProdInfo/Files/EFLPower15Instructions.pdf
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