OVIWUN™

Powered-Lift RC Aircraft
Operator's Manual V1.5

Beta Version April 2006

Trek Aerospace™

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TABLE OF CONTENTS

SECTION 1 – INTRODUCTION

INTRODUCTION

Congratulations on your purchase of the first power-lift, dual-ducted, VTOL, research vehicle on the market. It is our goal to provide you with the best experience possible with respect to your purchase of this vehicle. OVIWUN has been designed by our team of expert engineers over a period of nine years, and built by skilled craftsmen. We stand behind our design and will assist you in any reasonable way we can.

This vehicle has been tested before being delivered to you. We strongly recommend that you attend one of our training classes before attempting to operate this vehicle. We also recommend that you carefully read this Operator's Manual before attempting to operate this vehicle.

Your ultimate success with this vehicle is all up to you. Understanding what you have purchased and how it operates are key to that success. This one-of-a-kind vehicle is easier to fly than some RC helicopters and more difficult to fly than most fixed-wing airplanes. You need to carefully read and fully understand the entire Operator's Manual before you begin to work on and to fly your OVIWUN vehicle.

⚠ WARNING

This vehicle is not a toy.

It is capable of causing serious injury and/or damage if not assembled, operated, and/or maintained properly. While the vehicle is less dangerous than some RC helicopters or fixed-wing airplanes, it can still cause serious injury. We strongly suggest that you find a knowledgeable OVIWUN operator or an experienced helicopter pilot to assist you.

VEHICLE OVERVIEW

OVIWUN is a first generation, radio controlled, electrically powered, dual ducted, VTOL research aircraft. There is a pair of ducts, approximately nine inches in diameter, mounted on the upper end of the airframe. Each duct contains a fan consisting of three blades, which produce thrust in the vertical direction. The fans counter-rotate, eliminating the torque that is normally associated with a single rotor. The ducts and fans tilt, individually, about a common axis for pitch and yaw control. Roll control is achieved by modulating the speed of the individual motors within the ducts. The vehicle is powered by two 450-watt electric motors.

This vehicle generates approximately twelve pounds of thrust at full power. This gives this vehicle the unique characteristic of being able to lift more than twice its own weight.

The vehicle, including installed batteries, weighs less than six pounds, yielding a maximum payload greater than six pounds. While OVIWUN can do this when substantial control authority is needed, it is not recommended to do so for extended periods of time.

A line-of-sight, seven-channel radio, operates the Beta version of the vehicle. Future versions will contain autonomous operation, including flight planning and changing operating parameters "on-the-fly".

The vehicle is shaped similar to a truncated pyramid. At the top are two ducted fans. Each duct is attached to the airframe with a control arm giving them a "lollipop" look when detached from the machine.

The aircraft is about 26" wide, 14" tall, and about 16" deep. The body of the airframe is constructed out of fiberglass. The airframe is divided into two major components. The upper part of the airframe contains the "workings" of vehicle, while the lower, detachable part is the payload bay. The entire vehicle stands on two landing skids.

The all-up-weight of the vehicle is less than six pounds. This includes the "standard" batteries necessary to operate the vehicle. The batteries include two – 14.8 volt 4000 mAh Lithium Polymer battery packs. There is a radio receiver on the vehicle in the upper part of the airframe.

The range of the machine is currently limited to the distance of the radio signal you are using to control it. With the supplied radio, that is approximately 5,500 feet. The operating endurance is approximately 20 minutes with a one-pound payload. As you increase the payload, the endurance will decrease. Currently we recommend a maximum payload of three pounds. This allows you sufficient excess power to easily operate and maneuver the vehicle.

OPERATING OVERVIEW

OVIWUN has been designed to be easy to operate. It has advanced computer algorithms located on an onboard computer. The onboard computer is a powerful single board computer with enhanced communications and sensor signal processing capabilities. There is also a calibrated digital sensor and servo control system designed specifically for use in Radio Control (R/C) vehicles. The onboard sensor package includes accelerometers, angular rate sensors, and magnetometers for use in inner loop control applications as well as static pressure (altitude) and dynamic pressure (airspeed) sensors for use in airborne robotics. There is even a GPS sensor included so that you can develop your own path planning and navigation.

The vehicle works much like an R/C mini helicopter, but without the cyclic or collective.

SERVICING OVERVIEW

Mechanically there is nothing to service on this vehicle. The bearings are sealed. The control linkages should last for thousands of hours. The motors require no lubrication. Running the vehicle should provide enough airflow to clean dust out of the engine area. The airframe requires no scheduled servicing. Repair work on the airframe can be accomplished with fiberglass and epoxy.

Your should physically check the vehicle for any frayed wiring, or other signs of wear before each use, and replace any part that appears damaged or worn.

MODIFICATION POTENTIAL

OVIWUN is an experimental aircraft, which has undergone only limited testing and development. Many of you will want to modify the vehicle in one way or another. While we encourage you and challenge you to improve on our design we have to state that modification of, additions to, or subtractions from the equipment provided may cause the vehicle to not operate, to operate in an unsafe manner, or to operate other than intended. Trek Aerospace is not responsible for the operation of the vehicle or the modifications you may have made.

PERFORMANCE SPECIFICATIONS

This vehicle has been designed and tested to operate with the equipment provided. The Beta version of OVIWUN has only been tested to an airspeed of 7 mph and a density altitude of 2500 feet, in calm conditions (as of October 2005). This is the guaranteed performance envelope until further software refinements and testing have been performed. As software upgrades become available, they will be provided, free of charge, to purchasers of Beta versions of OVIWUN. Modification of or additions to that equipment may cause the vehicle to operate other than intended.

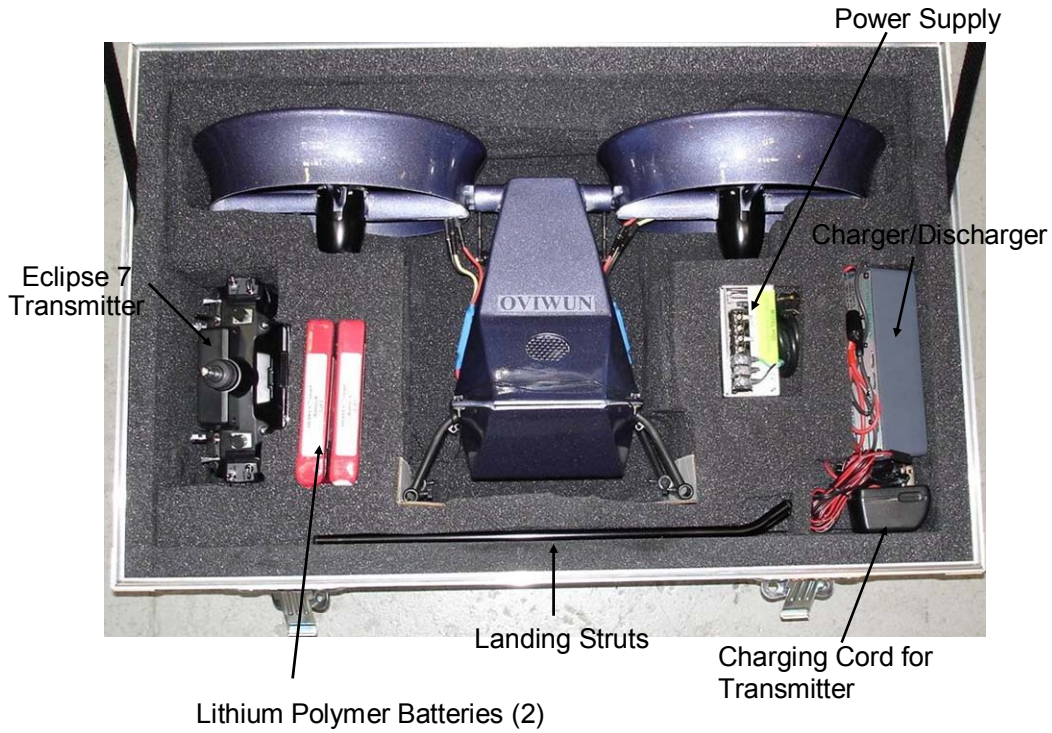
WARRANTY

We guarantee this kit to be free from defects in material and workmanship at the time of purchase. This warranty does not cover any component parts damaged by use, modification, or deterioration resulting from the application of adhesives or other products not specified in the Instructions. In no event shall our liability exceed the original purchase price of the kit.

We reserve the right to change or modify this warranty without notice.

SECTION 2 ASSEMBLY AND INITIAL SET UP

UNPACKING



OVIWUN comes packaged in two boxes. The "storage/shipping" box pictured above and a box of support materials. The storage/shipping box includes everything needed to fly right out of the box.

1. An assembled OVIWUN unit, which includes:
    a. The basic airframe
    b. Two brushless electric motors
    c. Servos (2 pieces)
    d. Two – motor controllers
    e. Basic flight control software, installed
2. Two - 14.8 V. / 4000 mAh Lithium Polymer battery packs
3. AstroFlight Model 109 Lithium Charger/Discharger
4. Astro #120 Power Supply
5. Landing rails
6. Hitec Eclipse 7 Advanced Digital Radio Control System with the Hitec Spectra Module installed

The box of support materials includes:

1. Ambicom Compact Flash Card, ModelWL1100C-CF
2. CBNM-06 Cable
3. Crossbow Stargate Support CD
4. GlobeTek ITE Power Supply, Model GT-A81051-0505UW2
5. Stargate Daughter Card
6. Logitech QuickCam Pro 4000
7. Crossbow MNAU100CA Support Packet
    a. MNAV100CA Supprt CD
    b. GPS Antenna
    c. Power Lead
    d. RS32 Adapter (Black, white & grey cable)
    e. RS32 Adapter (Black, green & yellow cable)
8. Owners Manual Packet
    a. Eclipse 7 Owner's Manual
    b. Model 109 Lithium Charger/Discharger Owner's Manual
    c. Model 120 Power Supply Owner's Manual
    d. Hitec Warranty Card
    e. Astro Flight Warranty Cards

PRE ASSEMBLY REQUIREMENT AND TOOLKIT

OVIWUN arrives nearly preassembled in the shipping and storage case. Your first task upon receipt is to make sure all of the parts listed as being in the box are indeed in the box. The following list will serve as a guideline.

1. Airframe
2. Batteries (Shipped and stored separately for safety)
3. Transmitter
4. Battery Charger
5. Power Supply
6. Landing Skids
7. 7T Torx Allen Wrench

You should need no additional tools when assembling or servicing OVIWUN.

ASSEMBLY

OVIWUN has already been assembled and tested at the factory. It has been slightly disassembled for packing and shipping. Before operating, you will need to install the landing skids and batteries.

1. Installing the Landing Skids
    a. Remove the aircraft and the skids from the transport container.
    b. While holding the aircraft by the landing strut, slide each landing skid into the landing strut, pushing the skid in from the front of the vehicle. A slight rotating motion may help.
    c. Continue to push the skid through both struts, until the skid protrudes 3¼" (~8 cm) from the rear strut.
    d. Tighten the thumbscrews attached to the strut to secure the skid.

SAFETY AND HAZARDS

One of OVIWUN's greatest advantages is its ducted fan propulsion system. The ducted fan offers greater safety than the exposed rotors of a helicopter or the propeller on a fixed wing plane. However, this does not mean that we have eliminated all the safety concerns. Although the blades are shielded within the duct, they are still operating at a high RPM, have relatively sharp edges, and can cause serious damage.

⚠ WARNING

Never wear any loose clothing while operating the vehicle.

Ties, cords from sweatshirts, loose T-shirts, and many other things can be indigested into the duct and wrapped around the blade. When operating the vehicle be on the look out for loose and particularly lightweight objects, which may be ingested into the duct or fan.

⚠ WARNING

Ingested materials may cause the vehicle to travel in an undesired direction.
In doing so, it may inadvertently hit something or someone causing harm.

Ingested material, which passes through the ducted fan could come out the other side and eject towards someone or something causing severe damage. Everyone near the vehicle when it is operating should be wearing protective eyewear and hearing protection.

OVIWUN uses several Lithium Polymer batteries. All batteries get hot during use, especially so during longer flights. Heat can cause damage to the vehicle's operating systems and subsystems. They can also get hot enough to burn you if you touch them. After operating the vehicle use extreme caution when handling the batteries.

The heat from the batteries may also cause damage to objects on which they reside or are in close proximity to. You must carefully and completely check the entire system before and after each flight for possible damage from the heat of the batteries. Wires can become overheated or stressed from the heat causing the vehicle to malfunction, which, in turn, may cause harm to those operating or near the vehicle.

The batteries also pose a hazard when being charged. Again, the batteries heat up during the charging process and can cause fire or burns. Carefully and completely follow the instructions provided on charging your batteries.

Although we have tried to inculde as much information as possible about the safe handling of the vehicle, it's batteries, and the hazards that may exist, we have, undoubtedly, missed some combination of events which can lead to someone or something getting hurt. You must use all care in operating the vehicle.

SOFTWARE SET UP

All the software necessary to operate OVIWUN comes preloaded into the vehicle. There are two parts of the software: 1) open source code software for Stargate and μNav, 2) Trek's Flight Control Code that has already been compiled and loaded on the μNav.

INITIAL TRAINING RECOMMENDATIONS

OVIWUN is easy to operate, but you should make yourself familiar with the machine before attempting to operate it. You should begin by first reading this entire operating manual to become familiar with the vehicle. The information in Appendix B will also give you some guidance on your initial operation of the vehicle.

We suggest you have an experienced OVIWUN operator "check you out" on the operation of the vehicle before you begin. Quarterly we offer training classes on operating the vehicle. Go to www.trekaero.com/OVIWUN_Training.html to get information on classes.

INITIAL TESTING AND CHECK OUT

⚠ WARNING

You should always check your vehicle in a safe environment.

You should have a clear area sufficient to operate the vehicle and "get away" from your vehicle should it become uncontrollable. There should not be any obstacles, loose materials, or objects, which may be blown away by the thrust from the fans, or ingested by the fans. You should not have any loose clothing or jewelry, which may be ingested by the fans, or flung, into your face obscuring your vision. You should remove any metal from your fingers (rings) and wrists (watches). Only once you have such an area are you prepared to begin testing and checking out your OVIWUN unit.

1. Remove the batteries from the case and make sure they are fully charged. They have been charged and tested prior to shipping; however, they should always be tested for a full charge before beginning any test or flight. (See battery-charging section of this manual and the manual for the battery charger for details.)
2. Remove the vehicle from the case and install the landing skids. If you have not already done so, see assembly instructions above.
3. Gently and smoothly, remove the back cover from the vehicle.
4. Check the frequency of the receiver with that of the transmitter. Again, they have been set at the factory but should be rechecked. (See the transmitter instructions)
5. Check the charge on the transmitter. Charge the battery in the transmitter if necessary.
6. Check the fans. The fans should be secure and rotate freely within the ducts.
7. Examine the control linkages. They should be straight and be connected. The screws holding the linkage should be tight.
8. Verify that the wires from the motor controllers to the motors are tightly connected. The black and white wires on the #1 side of the vehicle are reversed on purpose. The fans are counter rotating and this configuration allows this.
9. Remove the cargo bay and check the weights in the cargo bay. They should be positioned and attached by the Velcro™. The position of the weights can affect the weight and balance of the vehicle. This may throw the center of gravity off. Reinstall the cargo bay – make sure the receiver antenna and other wires are free and not pinched when reinstalling.
10. Looking inside the vehicle, starting at the top:
    a. Check the duct retaining thumbscrews. They should be tight.
    b. The RC receiver should be securely fastened by Velcro™.
    c. There are two battery elimination circuits in the next bay. They should be securely fastened to the sides of the airframe with Velcro™.
    d. Check to see that the Stargate and µNav are secure.
11. Place the batteries in the airframe. (However, do NOT connect them.) The battery placement can affect the center of gravity of the vehicle. They should be centered left to right, side-to-side, and front to back in the lower bay.

⚠ WARNING

Do not plug the batteries in – Yet.

12. Turn on the transmitter.
13. Set the controls on the transmitter
    a. The collective/throttle stick should be down (toward the bottom the transmitter) and locked into this position.
    b. The collective/throttle trim control should be set at -50.
    c. Center (zero out) the other three trim controls. [Roll trim control MUST BE ZEROED out before the vehicle is booted up, before EVERY flight!]
    d. VR 1 & 2 should be set to zero (centered)
    e. Flight Mode switch should be centered.
    f. Rudder D/R and Elevator D/R switches should be in the down position.
    g. Channel 7 and Aileron D/R switches should be in the down position.
    h. Flight Condition Switch should be forward (towards the front of the transmitter)
    i. Gear Switch should be in the forward position (towards the front of the transmitter). With the Gear Switch in the forward position, the vehicle operates in the PD mode, the back position the vehicle operates in the PID mode.
14. Extend the transmitter antenna.
15. Double check – is the collective/throttle stick in the down position? Is it locked? If not - this is your last chance to do so. If the collective/throttle stick is not in the down position, your motor controllers will go into the programming mode when you boot up, and your unit may need to be returned to the factory for reprogramming.

⚠ CAUTION

Have someone restrain the vehicle while you complete the next four steps.

They should do so by holding the machine firmly on the ground by placing a hand on the machine between the ducts and pressing down.

⚠ WARNING

The vehicle will be active with the next step.

Have the vehicle in a clear and open space. If the switches are improperly set and procedures not followed, the fans may start without any warning!

16. Double check the polarity of the batteries, the first battery should be connected to the bus bar in one smooth and definite operation. Avoid multiple touches of the connectors. Immediately the motor controllers, µNav, and Stargate will go through the boot procedure. The ducts will move and you will hear a series of

single beeps from the motor controllers. RF interference may cause one or both of the fans to spin briefly.

17. You should see the red LED on the µNav and red, yellow and green LEDs on the Stargate come on. The LEDs on the Stargate will flash on and off.
18. Double check the polarity of the batteries, in one smooth and definite operation, plug the second battery into the bus bar.
19. Carefully tuck the bus bar into the lower bay and replace the back cover.
20. You can now check the controls.
    a. Lift the machine GENTLY, SLOWLY and SLIGHTLY pitch the machine forward and backwards. The ducts should move in response to your pitch movement. They will be attempting to keep the machine level.
    b. Repeat the motion in yaw, turning the vehicle GENTLY, SLOWLY and SLIGHTLY to the right and left.
    c. If the machine does not respond, follow the SHUTDOWN PROCEDURE on the next page and start over.
21. The vehicle is now ready to fly.

SHUTDOWN PROCEDURE

⚠ WARNING

Do not turn off the transmitter until told to do so.

1. Lock the collective/throttle in the down position.
2. Remove the rear cover.
3. Pull out the bus bar.
4. Disconnect both batteries.
5. Check the power state by looking at the LEDs on the µNav, and Stargate. They should be off.
6. Gently and slowly, move the machine and determine that the ducts are not responding.
7. Now – turn off the transmitter.
8. Remove the batteries from the lower bay and let them cool.

⚠ CAUTION

The batteries may be warm or hot to the touch.

You are ready to repack your machine in its case.

SECTION 3 SYSTEMS DESCRIPTION

VEHICLE SPECIFICATIONS

Propulsion

Motor	Two 450 w, brushless motors
Batteries	Two 14.8 VDC, 4000 mAH Li-Poly

Dimensions

Height (to top of fan hub)	36.2 cm (14.26 inches)
Width (over ducts)	64.7 cm (25.46 inches)
Length (of skids)	41.1 cm (16.19 inches)

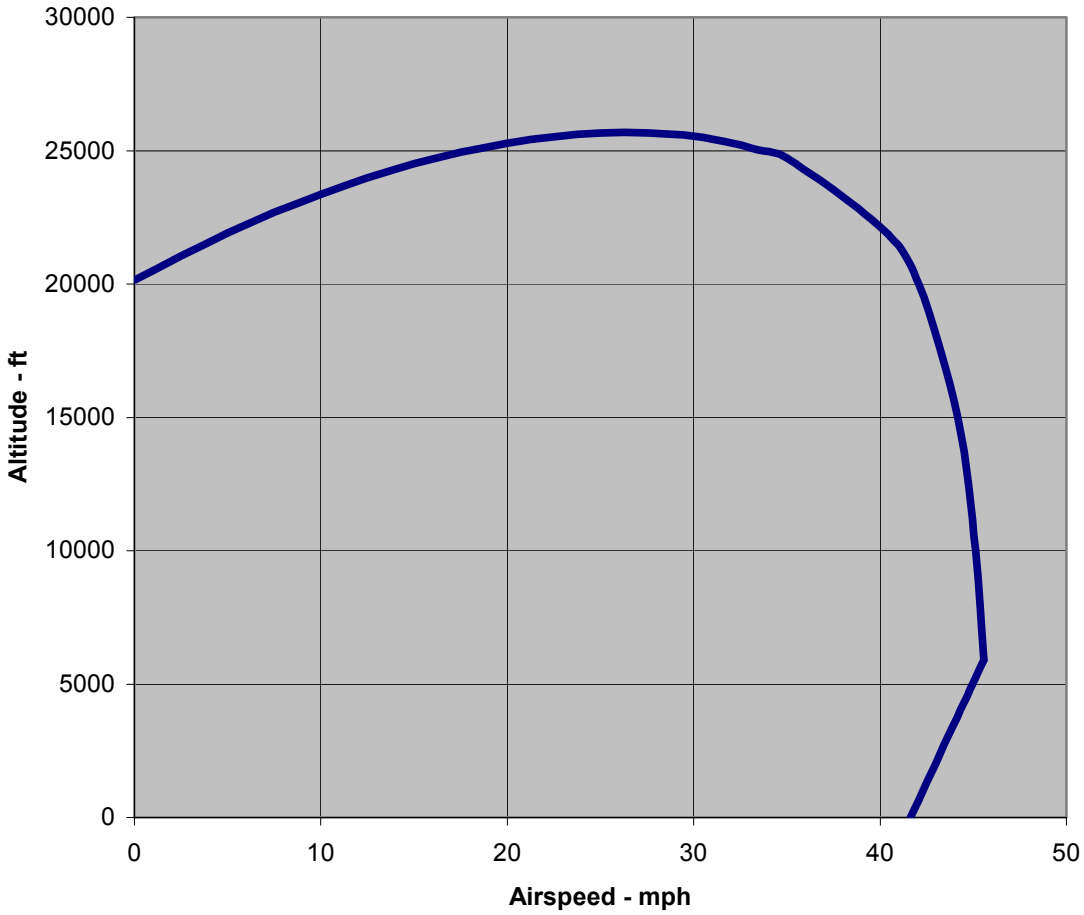
Weights

Empty, with batteries installed	2550 g (5.62 pounds)
Normal Payload	500 g (1.10 pounds)
Normal Flight Weight	3050 g (6.73 pounds)
Maximum Recommended Payload	1500 g (3.31 pounds)

PERFORMANCE SPECIFICATIONS

Maximum Speed	73 kph (45 mph)
Cruise Speed	50 kph (31 mph)
Hover Ceiling	6140 m (20150 ft)
Endurance	20 minutes
Rate of Climb	695 m/min (2280 fpm)

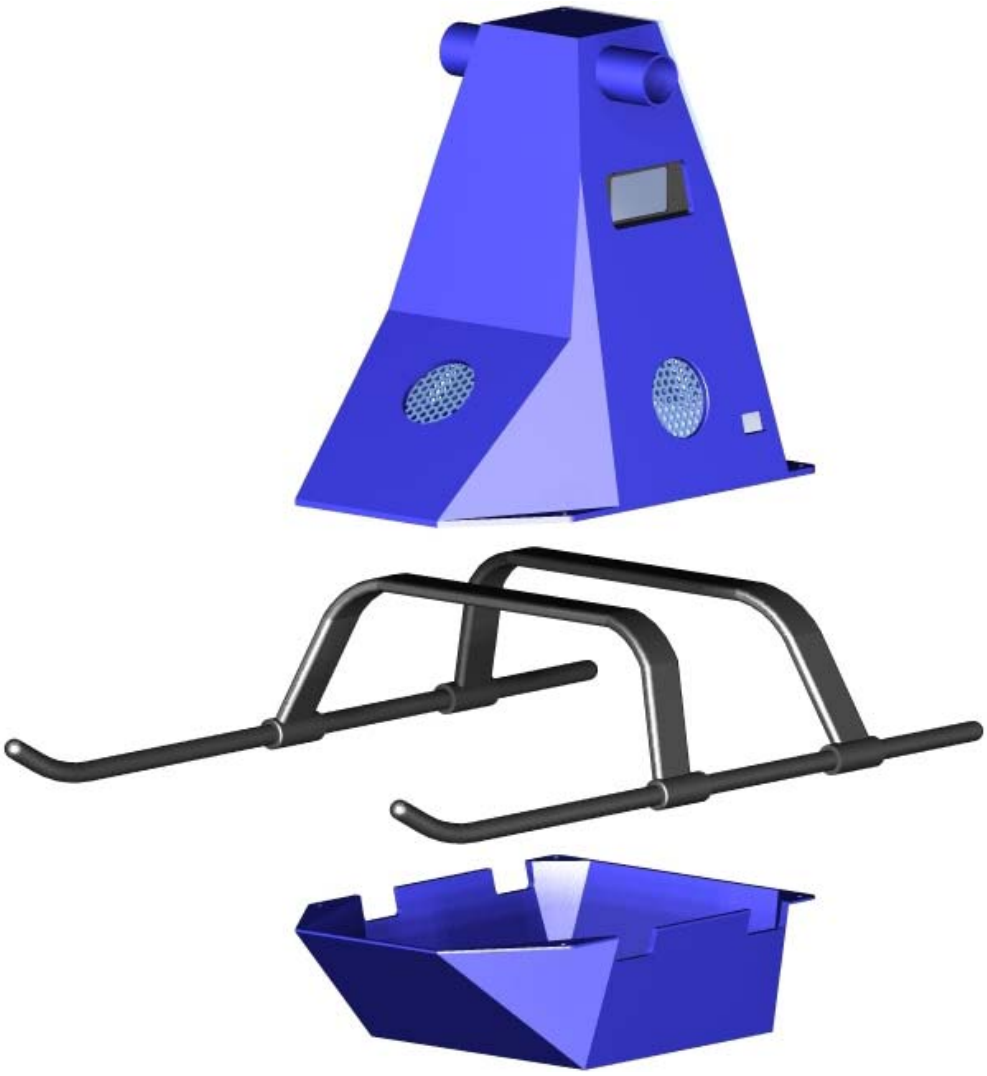
OVIWUN
Flight Envelope
with 500g payload



VEHICLE LIMITATIONS

The Beta version of OVIWUN has only been tested to an airspeed of 7 mph and a density altitude of 2500 feet, in calm conditions. This is the guaranteed performance envelope until further software refinements and testing have been performed. As software upgrades become available, they will be provided, free of charge, to purchasers of Beta versions of OVIWUN.

AIRFRAME



OVIWUN's airframe is comprised of three major components:

a. Upper Body - The upper body has compartments that house batteries and flight systems. These compartments are accessible through the rear of the airframe. The removable access cover attaches to the upper body with Velcro™.
b. Cargo Pod - The cargo pod provides storage space for payloads and is easily removed by loosening four thumbscrews.
c. Landing Skids - The landing skid struts are pre-assembled, attached to the upper body. The skids are removable, for storage, by loosening four thumbscrews.

DUCTS

The ducts easily detach from OVIWUN's airframe by loosening two thumbscrews per duct and disconnecting the motor wires. Each duct unit is comprised of:

1. Duct Assembly - The duct assembly includes the duct, duct support vanes, motor mount, lollipop arm with fairing, and two bearings.
2. Fan Assembly - The fan assembly includes the fan (either right or left) and the prop collet adapter.
3. Spinner Assembly - The spinner assembly includes the spinner, spinner base plate, and attaching screws.
4. Center-body Assembly - The center-body assembly covers the motor and includes the center-body and its attaching screws.

AERODYNAMICS

OVIWUN is unlike any aircraft you have ever flown before. Unlike fixed-wing aircraft, no takeoff or landing rolls are required; there are no separate propulsion units and lifting surfaces. Unlike rotary wing aircraft, there are no cyclic and collective controls. OVIWUN is a powered-lift vehicle. In hover, the fans provide the majority of the lift; in forward flight, the ducts provide the majority of the lift.

The core of OVIWUN is its dual duct system. The fans rotate in opposite directions, negating torque effects. Advanced CFD analysis has been used to match the geometries of the fan and the duct. Working together, they exhibit sensational lift-to-power ratios.

All control of OVIWUN is generated through two methods; duct tilt and fan speed modulation. The ducts tilt individually on a common lateral axis. By tilting the ducts in unison in the fore and aft direction, forward and rearward motion of the machine is generated. By tilting the ducts in opposite directions, a yawing motion is created. By altering fan speed in unison, altitude control is achieved. By altering fan speed differentially, a rolling motion created. There is no pitch control, per se, for the airframe. The aircraft "hangs" from the duct assembly, always maintaining a nearly vertical position.

In hover, the fans generate 55% of the lift. The remaining 45% is created by the induced airflow over the ducts. In forward flight, the increased airflow over the ducts generates even more lift. This is analogous to translational lift on conventional rotary wing aircraft.

The effect is that less power and lower fan speeds are required to maintain level flight at moderate forward flight speeds than are required to hover. Conversely, if you transition to forward flight without reducing power, OVIWUN will climb.

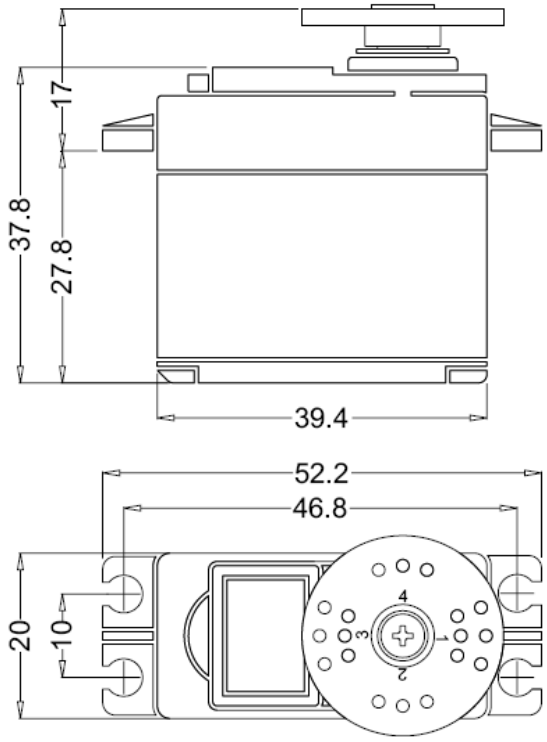
SERVOS

Your OVIWUN unit comes equipped with two HiTec HS-945MG Digital High Torque Servos. At the heart of the HS-945MG unbreakable gear train is the MP Gear. The MP Gear is made utilizing a revolutionary production technique that injects a high impact plastic around a metal pinion gear to form an unbreakable first gear. By utilizing this gear, Hitec has successfully reduced the amount of drive train noise that is common in metal gear servos while at the same time added considerable strength to the gear train.

Announced Specification for HS-945MG		
Technical Values	At 4.8V	At 6.0V
Control System	+Pulse Width Control 1500usec Neutral	
Operating Voltage Range	4.8 V to 6.0V	
Operating Temperature Range	-20ºC to +60ºC	
Operating Speed	0.16sec/60º AT NO LOAD	0.12sec/60º AT NO LOAD
Stall Torque	8.8kg.cm (122.2oz.in)	11kg.cm (152.75oz.in)
Operating Angle	45º/One side pulse traveling 400usec	
Direction	Clock wise/Pulse Traveling 1500 to 1900usec	
Idle Current	5.3mA	6.6mA
Running Current	400mA	500mA
Dead Band Width	4usec	
Connector Wire Length	300mm (11.81in)	
Dimensions	39.4x20x8mm (1.55x0.78x1.48in)	
Weight	56g (1.97oz)	

Information supplied by HiTec RC USA, Inc. Trek Aerospace is not responsible for content.

Features:
Coreless Motor
Long Life Potentiometer
30Metal Gears & 1-Resin Metal Gear
Dual Ball Bearing
Waterproof & Dustproof
Indirect Drive Potentiometer
Gold Plated Contacts
MOS FET Motor Drivers



MOTORS

OVIWUN comes with two Model Motors Ltd's AXI2826/10 brushless electric motors. These brushless motors, with neodymium magnets in a rotating case, are manufactured using advanced technology from the highest quality materials. A hardened steel driveshaft, mounted in two ball bearings, and overall robust but lightweight construction ensure long motor life.

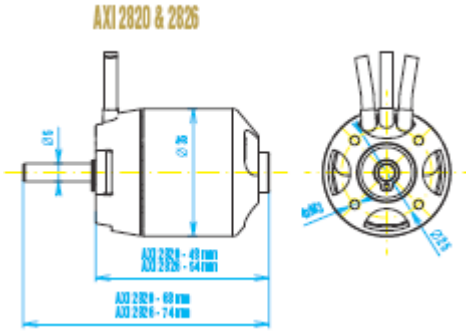
The motors come installed in the vehicle. When connecting the motors to the motor controller you must be careful to install the wires correctly. Connecting the wires incorrectly may cause the motors to operate in the same direction or in the wrong direction. Please consult the installation section for further details.

Please note that your AXI is a high performance electric motor working under high current loading which produces some heat. Proper cooling is essential in just that same way as it is with an internal combustion engine. Overheating of your motor causes increased wear in the bearings and partial demagnetization, which decreases performance of the motor. As with all types of magnetic material, complete demagnetization of the neodymium magnets can occur at over 130 ˚C. Please make sure that cooling air can flow through the holes in the front plate to allow cooling of the armature and magnets.

Avoid running your motor under dusty or wet conditions. Avoid foreign matter getting into the cooling holes of your motor. Beware of small bolts, screws and other small items that can be attracted to the magnets of your motor. Do not disassemble motor. The bearings of this motor are greased with special high quality grease that will last through

the expected life of the motor. Do not use any organic solvents, cleaners or detergents to clean your motor, these agents may wash out the grease and substantially decrease the lifetime of your motor. If there is some dirt in your motor (after an accident), do not try to rotate the shaft. First, carefully remove the dirt with compressed air. In the case of serious damage, the motor should be returned for service. Never try to straighten a bent shaft. If the large diameter hardened steel shaft becomes bent, there will be more serious damage inside the motor. If you are in doubt, replace your motor. Avoid unnecessary dismantling of your motor.

870 RMP/Volt
83% Maximum Efficiency
Max. Efficiency Current 15 – 25A (>75%)
Current Capacity 42 A/60 s
Dimensions 35 x 54 mm
Shaft Diameter 5mm
Weight with cables 181 g

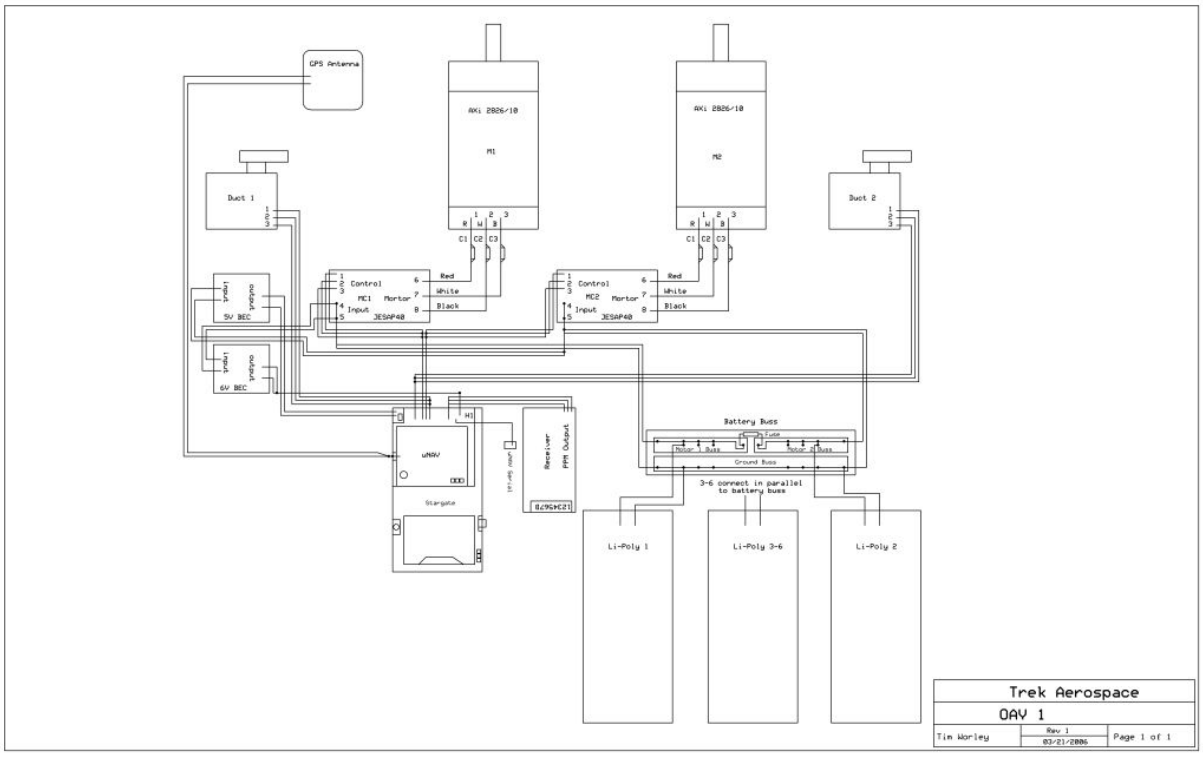


SPEED CONTROLLERS

OVIWUN comes equipped with two speed controllers. We have chosen the Jeti Model Advance 40 Opto Plus speed controller. This is a new type of sensor-less speed controller especially designed for your AXI 2826/10 brushless motor. Temperature overload protection is built into the speed controller, which turns off the motor when the temperature reaches 110° centigrade. These speed controllers are equipped with protection functions that take care of the correct start and operation of the motor across the whole range of revolutions and current.

Do not connect the speed controller to just 'any' kind of power source. Take care to ensure the correct polarity of the supplied batteries.

ELECTRICAL SYSTEM



The electrical system on OVIWUN is relatively simple. There are two brushless electrical motors mounted in the duct housing. Each of these is connected to a sensor-less speed controller by three wires. On the #1 side of OVIWUN the black and white wires are reversed so that the motor operates in the opposite direction. The motor controllers are then connected to the battery buss bar. The battery bus bar has two (or more) 14.8 v, 4-cell Li-Poly batteries connected to it using Deans Connectors.

The battery bus bar also has leads running to two battery elimination circuits (BEC). On the #1 side is a 5V BEC that supplies power to the Stargate and µNav. On the #2 side is a 6V BEC that supplies power to the servos and receiver. There are leads running from the µNav units to the servos on the ducts. There is also a lead running from the µNav to the GPS antenna. This arrangement depicted in the Battery section below.

BATTERY

Your OVIWUN comes with two Lithium Polymer rechargeable battery packs. Lithium Polymer rechargeable batteries utilize the latest technology to become available for consumer use. Lithium

Polymer batteries have high voltage per cell (3.7 volts avg.) and excellent energy on both a weight and volume basis providing more energy per gram and resulting in more watt hours/Kg than their counterparts such as NiCd/NiMH. These Li-Poly batteries are specifically designed to be as thin as possible with large footprint configurations.

There are several different types of polymer technologies and chemistries. Some require high temperatures to operate effectively, while others work efficiently over a broad temperature range. The Lithium Polymer rechargeable batteries, which came with your OVIWUN, work over a board range of temperatures, but they can adversely be affected and their performance reduced if they overheat, are allowed to get too cold, or are improperly discharged. It is crucial that you familiarize yourself with the proper handling and storage of these types of batteries.

Each battery pack provided with your OVIWUN contains four (4) cells. Each battery pack has a normal capacity of 4 amp hours (4000 mAH). A fully charged, 4-cell pack will have a voltage of 16.60 to 16.80 volts.

NAVIGATION & GUIDANCE

CROSSBOW'S μNAV

The μNAV100CA is a calibrated digital sensor and servo control system designed for use in Radio Control (R/C) vehicles. The onboard sensor package includes accelerometers, angular rate sensors, and magnetometers for use in inner loop control applications as well as static pressure (altitude) and dynamic pressure (airspeed) sensors for use in airborne robotics. A GPS sensor is included for both path planning and navigation.

The MNAV100CA's comprehensive onboard servo control solution includes both R/C servo control hardware and an R/C receiver Pulse Position Modulation (PPM) interface. R/C servo hardware provides users with software-based control of up to nine separate servos while the PPM interface enables software interpretation of R/C receiver commands thereby offering users both automated software control as well as manual "takeover" capability.

Output data is provided in a digital (RS-232) format. Each μNAV100CA system comes with a GPS antenna, interface cables, and User's Manual. Crossbow's MICRO-VIEW software is included to assist users with sensor calibration, servo control, data collection, and overall system development.

When connected to Crossbow's Stargate Processor Board (SPB400), via the standard 51-pin connector, the μNAV100CA combines with the SPB400 to form a sophisticated, open-source, robotics platform. This comprehensive robotics solution offers users a flexible development platform for state estimation, WiFi telemetry command uplink/downlink and closed-loop navigation and control. Payload sensors (e.g. USB image sensor) can be connected and processed by the Stargate to support intelligent robotics applications.

The Crossbow manuals and data sheets enclosed with the kit have additional information on the μNav.

CROSSBOW'S STARGATE

The Stargate is a powerful single board computer with enhanced communications and sensor signal processing capabilities. The Stargate uses Intel's® latest generation 400MHz X-Scale® processor (PXA255). This product was designed within Intel's Ubiquitous Computing Research Program, and licensed to Crossbow for production. In addition to traditional single board computer applications, the Stargate directly supports applications designed around Intel's Open-Source Robotics initiative as well as Tiny OS-based Wireless Sensor Networks.

Crossbow's manuals and data sheets enclosed with the kit have additional information on the Stargate.

FLIGHT CONTROL SYSTEM

As of the writing of this manual, the flight control system on OVIWUN is a work-in-progress. The flight control software is located within the μNav. The system is rate based only, as it is only using the rate sensors on the μNav to assist in flight. It is rated based in all three axes.

Roll control is achieved by differentiating the RPM of the motors. When the transmitter sends a roll control command, the vehicle will differentiate the speed of the motors around the current position of the collective/throttle position.

Pitch is a "pure" pitch maneuver. This means that the ducts will pitch together, at the same angle of attack, when a pitch command is entered into the transmitter.

The Yaw maneuver differentiates the pitch on the ducts around the established pitch command. The command will cause the ducts to differentiate equally.

The collective/throttle is used for altitude and momentum. This is achieved by increasing or decreasing the RPM of the motors. The collective/throttle does not provide for different speeds, but increases or decreases the speed of the motors simultaneously.

The "Gear" switch on the transmitter is used to control one of the two modes of operation. The normal operating mode is PD. Meaning that the rates are taken proportionally and differentially. There is also a PID mode, meaning rates are taken proportionally, integrally and differentially. This mode is currently used for data collection and is primarily reserved for future enhancements. The PID mode allows the vehicle to self-trim.

There are many features of the Stargate and μNav system, which are not currently being employed in the Beta version. It is our goal to eventually integrate these features into the flight control system.

RC TRANSMITTER & RECEIVER

OVIWUN comes complete with a transmitter and receiver. We have chosen the HiTec Eclipse 7. This radio features 7-channels, with model memory and specific programming for different vehicles. It has most of the commonly needed features as well as added extras like shift changeability and an optional 50-channel PLL module, which is included in your kit. You should refer to the HiTec manual, included in your materials, for specifics on the operation of this transmitter.

HITEC ECLIPSE 7 PQCM TRANSMITTER

The controls on your radio have been programmed to do specific things for your OVIWUN aircraft. The Eclipse 7 should be in "Mode 2" when operating OVIWUN. Each control has the following operation.

Left top of Receiver
Trainer toggle switch – This switch is used by the trainer when operating the transmitter in conjunction with a student.
Flight mode toggle switch – Not Currently Used – see transmitter manual for description.
VR 1 +/- - Not Currently Used – see transmitter manual for description.
Rudder D/R – Not Currently Used – see transmitter manual for description.
Elevator D/R – Not Currently Used – see transmitter manual for description.

Right top of receiver
Flt Control – Not Currently Used – see transmitter manual for description.
Gear – Forward is PD control and Backward is PID Control
VR 2 +/- - Not Currently Used – see transmitter manual for description.
Ch 7 – Not Currently Used – see transmitter manual for description.
Aileron D/R – Not Currently Used – see transmitter manual for description.

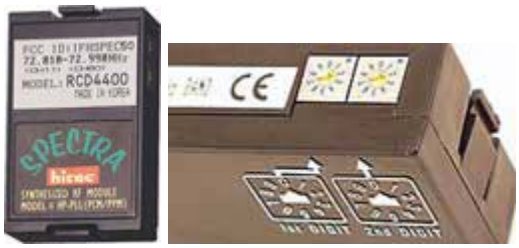
Center body of receiver
Left joy stick – Up/Down is the collective/throttle; Right/Left is Yaw Control

Left trim switch (just below left joy stick) – Yaw Trim
On/Off – Turns receiver on and off
Left center trim switch – Collective/Throttle Trim
Right center trim switch – Pitch Trim
Right joy stick – Up/Down is Pitch Control; Right/Left is Roll Control
Right trim switch (just below right joy stick) – Roll Trim

Lower body of receiver
Edit display up – Used in programming, see transmitter manual.
Edit display down – Used in programming, see transmitter manual.
Cursor left - Used in programming, see transmitter manual.
Cursor right - Used in programming, see transmitter manual.
Timer off – Used in programming, see transmitter manual.
Timer start/stop – Used in programming, see transmitter manual.
Data increase – Used in programming, see transmitter manual.
Data decrease – Used in programming, see transmitter manual.
Save left – Used in programming, see transmitter manual.
Save right – Used in programming, see transmitter manual.
Clear active/inhibit – Used in programming, see transmitter manual.
Engine lock – Used to lock the Collective/Throttle Position
Engine cut – Not Currently Used – see transmitter manual for description.

SPECTRA MODULE

Spectra 72MHz frequency synthesizer module allows you to transmit on any of the fifty 72MHz channels with the twist of a dial. The Spectra module is mounted in the back of the receiver.



RECEIVER

A Hitec RCD 3500 Supreme Receiver in included in your kit. This is an 8-channel receiver operating at 72MHz and it has a range of 5,500 feet. Each receiver is fitted with a single crystal.

BATTERY CHARGER

Your OVIWUN kit comes complete with an AstroFlight 109D Lithium Polymer (Li-Poly) charger/discharger and an AstroFlight Model 120 power supply. The manual for the charger is included in your kit. The following is a brief summary of its features, it is important that you read and thoroughly understand the manual before attempting to charge your Li-Poly batteries.

ASTRO 109 ASTRO 120

Before using your AstroFlight 109 please read the instructions carefully. The Astro Model 109 Lithium Charger is specially designed to charge and discharge Lithium Polymer battery packs. This charger can handle the batteries packaged with your OVIWUN vehicle. The cells in the battery pack have been arranged in parallel to increase the battery pack capacity.

It is very important to use a charger that was designed specifically to charge your Lithium Polymer (Li-Poly) batteries. The Model #109 Lithium charger uses a proprietary 8-bit microprocessor to perform all of the necessary mathematical computations required to insure foolproof charging and discharging Lithium Polymer battery packs. A two line digital display indicates the status of the charging sequence and shows you the charge current, the number of cells in the battery pack, the battery voltage, the duration of the charge, and the actual number of milliamp hours of charge put into the battery pack. A built in voltage converter boosts the input from 12 volts to 40 volts so that battery packs containing one to nine cells can be charged. This charger is designed to be powered from a 12 to 15 volt regulated power source.

Note: A fully charged, 4-cell pack will have a voltage of 16.60 to 16.80 volts.

⚠ WARNING

Never use an automobile battery charger as a power source; it could damage your new Model #109 Lithium Charger.

Also included in your OVIWUN kit is an Astro Model #120 power supply. The power supply is rated 13.8 Volts at 12.5 Amps and is used to operate the Astro Model 109 Lithium Charger. It runs on 110 Volts A/C.

Remember, the battery charging and discharging guidelines provided in this manual are just an overview. To ensure safely when handling your Li-Poly batteries, is imperative that you familiarize yourself with the specific charger and manual that came with your OVIWUN vehicle.

SECTION 4 VEHICLE OPERATION

MINIMUM EQUIPMENT

T7 Torx wrench
Allen wrenches (sizes 7/64", 3/32", 1/16", and 2 mm)
Open end wrench (size ¼")
#1 Philips Head screwdriver

PRE-FLIGHT

⚠ WARNING

You should always fly your vehicle in a safe environment.

You should select an area that is both large enough and clear of obstacles in which to operate your vehicle. Have planned exits should the vehicle get out of control. Remember the fans, by their nature, swirl the air and may cause any loose objects to be blown around. Loose objects may also be ingested by the fans and thrown out of the fans with great velocity. You should not operate the vehicle while wearing any loose clothing or jewelry. When handling your vehicle you should remove any metal from your fingers (rings) and wrists (watches).

Once you have chosen and prepared your flight area you are ready to begin.

1. Remove the batteries from the case and make sure they are fully charged. You should never begin a flight without making sure your batteries are fully charged. (See battery-charging section of this manual and the manual for the battery charger for details.)
2. Check the charge on the transmitter. Charge the battery in the transmitter if necessary.
3. Remove the vehicle from the case and install the landing skids. If you have not already done so, see the assembly instructions above.
4. Do a general visual check of your OVIWUN unit. Look for any nicks, scrapes, gouges, or other signs of wear and tear. Inspect the ducts and fans with particular ardor. These should be repaired before any flight.
5. Remove the back cover from the vehicle.
6. Match the frequency of the receiver with that of the transmitter. Check with other people operating any RC controlled vehicle in the vicinity to ensure that you will not be operating on the same frequency.
7. Check the fans. The fans should be secure and rotate freely within the ducts.
8. Examine the control linkages. They should be straight and be connected. The screws holding the linkage should be tight.

9. Verify that the wires from the motor controllers to the motors are tightly connected. The black and white wires on the #1 side of the vehicle are reversed on purpose. The fans are counter rotating and this configuration allows this.
10. Remove the cargo bay and check the weights in the cargo bay. They should be positioned and attached by the Velcro™. The position of the weights can affect the weight and balance of the vehicle. This may throw the center of gravity off. Reinstall the cargo bay – make sure the receiver antenna and other wires are free and not pinched when reinstalling.
11. Looking inside the vehicle, starting at the top:
    a. Check the duct retaining thumbscrews. They should be tight.
    b. The RC receiver should be securely fastened by Velcro™.
    c. There are two battery elimination circuits in the next bay. They should be securely fastened to the sides of the airframe with Velcro™.
    d. Check to see that the Stargate and µNav are secure.
12. Place the batteries in the airframe. The battery placement can affect the center of gravity of the vehicle. They should be centered left to right, side-to-side and front to back in the lower bay.

⚠ WARNING

Do not plug the batteries in – Yet.

13. Turn on the transmitter.
14. Set the controls on the transmitter
    a. The collective/throttle stick should be down (toward the bottom the transmitter) and locked into this position.
    b. The collective/throttle trim control should be set at -50.
    c. Center (zero out) the other three trim controls. [Roll trim control MUST BE ZEROED out before the vehicle is booted up, before EVERY flight!]
    d. VR 1 & 2 should be set to zero (centered)
    e. Flight Mode switch should be centered.
    f. Rudder D/R and Elevator D/R switches should be in the down position.
    g. Channel 7 and Aileron D/R switches should be in the down position.
    h. Flight Condition Switch should be forward (towards the front of the transmitter)
15. Gear Switch should be in the forward position (towards the front of the transmitter). With the Gear Switch in the forward position, the vehicle operates in the PD mode, the back position the vehicle operates in the PID mode. Extend the transmitter antenna.
16. Check Radio Antenna: Lead the receiver antenna out of the body of the vehicle and attach it with tape to one of the landing rails, leaving the full length of the antenna hanging free. It is very important that the antenna should be hanging free to help prevent Radio Frequency Interference (RFI) interference.

⚠ CAUTION

Do not run or tape the antenna alongside any carbon fiber components as this may cause unexpected radio interference.

17. Double check – is the collective/throttle stick in the down position? Is it locked? If not - this is your last chance to do so. If the collective/throttle stick is not in the down position, your motor controllers will go into the programming mode when you boot up, and your unit may need to be returned to the factory for reprogramming.

⚠ CAUTION

Have someone restrain the vehicle while you complete the next four steps.

They should do so by holding the machine firmly on the ground by placing a hand on the machine between the ducts and pressing down.

⚠ WARNING

The vehicle will be active with the next step.

Have the vehicle in a clear and open space. If the switches are improperly set and procedures not followed, the fans may start without any warning!

18. Ensure that the batteries are properly charged, and are free from defects or damage. (A fully charged, 4-cell pack will have a voltage of 16.60 to 16.80 volts.)
19. After double-checking the polarity, the first battery should be connected to the bus bar in one smooth and definite operation. Avoid multiple touches of the connectors. Immediately after connecting the battery, the motor controllers, µNav, and Stargate will go through the boot procedure. The ducts will move and you will hear a series of single beeps from the motor controllers. RF interference may cause one or both of the fans to spin.
20. You should see the red LED on the µNav and red, yellow, and green LEDs on the Stargate come on. The LEDs on the Stargate will flash on and off.
21. Double check the polarity of the second battery, and in one smooth and definite operation, plug the second battery into the bus bar.
22. Carefully tuck the bus bar into the lower bay and replace the back cover.
23. You can now check the controls.
    a. Lift the machine. GENTLY, SLOWLY and SLIGHTLY pitch the machine forward and backwards. The ducts should move in response to your pitch movement. They will be attempting to keep the machine level.
    b. Repeat the motion in yaw, turning the vehicle GENTLY, SLOWLY and SLIGHTLY to the right and left.
    □ If the machine does not respond, follow the SHUTDOWN PROCEDURE on page 15 and start over.
24. Your OVIWUN is now ready to fly.

FLIGHT OPERATIONS

⚠ WARNING

Having a safe environment in which to operate you OVIWUN vehicle is extremely important.

The area you chose should be clear and free of any loose debris. You should have adequate room to maneuver the vehicle and "get away" from your vehicle should it become uncontrollable.

POST FLIGHT/SHUTDOWN

DO NOT TURN OFF THE TRANSMITTER UNTIL TOLD TO DO SO.

1. Lock the collective/throttle in the down position.
2. Remove the rear cover.
3. Pull out the bus bar.
4. Disconnect both batteries.
5. Check the power state by looking at the LEDs on the μNav, and Stargate. They should be off.
6. Gently and slowly, move the machine and determine that the ducts are not responding.
7. Now – turn off the transmitter.
8. Remove the batteries from the lower bay and let them cool. Examine the batteries for any damage before storage, if damaged or in doubt, dispose of them per the appropriate disposal procedures for Lithium Polymer batteries.

⚠ CAUTION

The batteries may be warm or hot to the touch.

9. Do a general visual check of your OVIWUN unit. Look for any nicks, scrapes, gouges, or other signs of wear and tear. Inspect the ducts and fans with particular ardor. These should be repaired before any flight.
10. If you are going to repack you machine in the case, you need to remove the landing skids.
11. Before repacking, make sure the batteries are cool.
12. You are ready to repack your machine in its case.

SAFETY, EMERGENCIES AND HAZARDS

Remote operable vehicles, such as OVIWUN can pose a hazard if not operated in a safe environment. As with any vehicle, your OVIWUN should be treated with the utmost respect and caution. For most users this is just using common sense while operating your aircraft. Keeping fingers and small objects away from the blades, and knowing how to react if you inadvertently fly into a hazardous situation.

It is recommended, that users wear eye and ear protection when flying the machine. As an added precaution, a first aid kit should be kept on hand in case of minor emergencies. Sand or a dry fire extinguisher should be kept at hand in case of a battery fire. In extreme cases, you should establish the location of and quickest method of transport to the nearest emergency medical treatment facility.

⚠ WARNING

Do not place anything in the ducts while the vehicle is operating!

When flying your OVIWUN always should ensure that people and animals are safely out of range. While bumping up against the duct will not cause damage, loose clothing or appendages can be sucked into the ducts if they get too close and may cause major damage. Likewise, if loose items are drawn into the ducts, they are liable to be ejected at great speeds.

⚠ WARNING

Always wear eye protection during the operation of your vehicle.

OVIWUN is not very loud, especially at distances. However, within a hundred or so feet it is loud enough to cause ear damage with prolonged exposure.

⚠ WARNING

Always wear hearing protection during the operation of your vehicle.

Should OVIWUN become unstable during flight and you are unable to recover control, you should first put your collective/throttle stick to zero. OVIWUN should respond by losing power and falling. Be careful where it is going to fall and chose a place where damage will be nonexistent or at least minimal. Should this fail turn off the transmitter, or try flying into a stationary object such as a wall, tree, or bush. Do not try to catch the machine by the ducts or fly towards someone hoping they will “catch” the machine. Otherwise, simply wait out the batteries.

This is an electrical vehicle and as such, electrical shock is possible. Flying in the rain, snow, or wet conditions is not recommended. As with any other electrical device use caution not to touch power leads. NEVER expose the batteries to water! (With the exception of salt water, which is only used on Lithium Polymer batteries during the battery disposal process.)

⚠ WARNING

Always unplug the batteries before attempting any repair or carrying the vehicle.

Static electricity can damage your Stargate and µNav units. Make sure you only touch these components after you have discharged any static electricity that may be built up on either you or the machine.

STORAGE

The case in which your OVIWUN was delivered has been designed for storage, transportation, and shipping.

Before storing your OVIWUN unit, you must remove the batteries from the vehicle.

⚠ CAUTION

Never store the vehicle with the batteries in place.

You should inspect and clean your vehicle before storing it. Flying in the rain, snow, or wet conditions is not recommended. If a vehicle becomes wet, it should be dried before storage. If the inside of the case becomes damp, be sure to let it air dry thoroughly before storing your vehicle.

If you are going to store your vehicle for an extended period, you should remove the battery from the transmitter, and follow the manufacturer's recommendations for proper battery storage. As a precaution, all batteries should be stored in a separate location if they will not be used for extended periods.

⚠ CAUTION

Never attempt to store your batteries in the case if they are hot.
Wait until the batteries have cooled before placing in the storage container.

The case and vehicle should be stored in a cool dry location. Excessive heat and moisture can cause damage to the components.

SECTION 5 ROUTINE SERVICING

ROUTINE SERVICE SCHEDULE

The only routine service on the vehicle is keeping it clean, dry and dust free. There are no serviceable parts on the vehicle. The bearings are sealed. The control linkages should last for thousands of hours. The motors require no lubrication.

The transmitter, power supply and battery charger should also be kept clean, dry and dust free. These are not customer serviceable parts. If your unit becomes damaged or stops working, you should replace it or return it for service.

SERVICE TOOLKIT REQUIREMENTS

T7 Torx wrench
Allen wrenches (sizes 7/64", 3/32", 1/16", and 2 mm)
Open end wrench (size ¼")
#1 Philips Head screwdriver

BATTERY CHARGING

When OVIWUN sounds as if it is slowing down, begins to descend by itself, or is not able to take-off, you most likely need to recharge the battery pack.

Your OVIWUN vehicle comes with two Lithium Polymer (Li-Poly) rechargeable battery packs. Lithium Polymer rechargeable batteries utilize the latest technology available for consumer use. Since the electrolyte is a solid polymer, not liquid, these polymer battery cells are designed to be safer than most batteries on the market. However, we recommend familiarizing yourself with this new technology, to ensure the batteries are used properly, as they dangerous if not used per the manufacturer's specifications.

The Lithium Polymer batteries included with your OVIWUN have high voltage per cell (3.7 volts average) and excellent energy on weight and volume basis providing more energy per gram and resulting in more watt hours/Kg than their counterparts such as NiCd/NiMH. These Li-Poly batteries are specifically designed to be as thin as possible with large footprint configurations.

The Lithium Polymer rechargeable batteries, which came with your OVIWUN, work over a board range of temperatures. Each battery pack contains four (4) cells. (A fully charged, 4-cell pack will have a voltage of 16.60 to 16.80 volts.) These packs have a normal capacity of 4 amp hours (4000 mAH).

Li-Poly Batteries can adversely be affected and their performance reduced if they overheat, are allowed to get too cold, or are improperly discharged. To avoid cell damage from over discharge, it is important to land when you hear a drop in speed or performance of your OVIWUN.

It is crucial that the batteries are charged on a unit specifically designed for Li-Poly batteries (their optimal charge rate is 1C); fast charging on a NiCd/NiMH or other charger will damage the cells permanently.

SAFETY PRECAUTIONS FOR LITHIUM POLYMER BATTERY PACKS

1. Lithium Polymer batteries should not be "fast charged"; their optimal charge rate is 1C). Do not charge at a mA higher than the capacity of the battery.
2. Never charge your Lithium Polymer Battery pack at any rate unattended.
3. Only charge Lithium Polymer Battery pack with a charger designed specifically for Lithium Polymer chemistry. Your kit includes the AstroFlight 109 battery charger. This is our recommended charger. (WARNING: fast charging on a NiCd/NiMH charger will damage the cells permanently.)
4. It is extremely important to double check the correct polarity when connecting cell packs to the charger or to your vehicle.
5. Never place exposed tabs on conductive materials; if a tab is torn off, the battery is no longer useable.
6. Li-Poly cells can ignite because of unmatched cell capacity or voltage, cell damage, charger failure, incorrect charger settings, improper discharge, or other factors. Always check your batteries for damage before and after each flight.
7. Always use the correct charging voltage. Read and understand the manual for the AstroFlight 109 charger that was provided with your vehicle.
8. To prevent permanent damage, not over discharge your Lithium Polymer cells. This can be avoided by ensuring properly charged batteries are used when flying and landing when you hear a drop in speed or performance of your OVIWUN.
9. The Lithium Polymer Battery pack may ignite if connected to a charger supplying more than 6 volts per cell.
10. Always assure the AstroFlight 109 charger is working properly.
11. Always charge your Lithium Polymer Battery pack in a safe environment away from flammable or combustible materials, and where no harm can result.
12. Never charge your Lithium Polymer Battery pack in the OVIWUN vehicle. A hot pack may cause damage to your vehicle or components.
13. Never charge your Lithium Polymer Battery pack inside a motor vehicle, or in a vehicle's engine compartment.
14. Never charge your Lithium Polymer Battery pack on a wooden workbench, or on any flammable material.
15. The seal of Polymer cells can degrade at excessive temperatures and cause electrolyte leakage. (Especially when left in the trunk of a car or on the dash.) If you come in contact with this electrolyte, scrub the area with soap and water. If the electrolyte splashes into your eyes, flush with water and seek immediate medical attention.
16. If your Lithium Polymer Battery pack is involved in a crash:
    a. Remove the Lithium Polymer Battery pack from the vehicle.
    b. Carefully inspect the pack for shorts in the wiring or connections. If in doubt replace the battery pack with a new one.

c. Inspect cells for dents, crack, splits, warping, or leaking. Dispose of the damaged cells per the instructions below.

17. Dispose of cells/packs as follows:
    a. Discharge: with the pack in a safe area, use your battery charger to discharge the pack to the recommended cut-off voltage. (Usually 3.0 volts per cell.) CAUTION: pack may get hot
    b. Allow to cool, and then puncture each cell in the battery pack and immerse in salt water for several hours.
    c. Apply electricians' tape over the terminals, and place in a sealed bag.
    d. They are then safe to dispose of in your regular trash.
18. Handle all cells/packs with care, as they can deliver high currents if shorted. Shorting by a ring, for example, can result in the loss of your finger.
19. Always store cells/packs in a secure location where they cannot be shorted, dropped, overheated to 140°F /60°C, or handled by children.
20. Follow the manufacturer's recommendations for proper long-term battery storage.

BATTERY CHARGER BASICS—ASTROFLIGHT 109

There are two power cords on the AstroFlight 109 **charger/discharger.** The four-foot long cord with the alligator clips is the **input cord** and should be connected to the Astro Model #120 power supply. The short cord is the **output cord** and is fitted with an Astro Zero Loss Connector #526. Connect the **output cord** to the Lithium Polymer battery being charged or discharged. The charger has a current adjust knob on the front panel. Charging current can then be adjusted between fifty milliamps and eight amps. Discharging current is electronically limited to 1.25 amps.

Six messages are displayed during a normal charging sequence.

1. The amount of charging current flowing into the Lithium Polymer battery pack
2. The number of cells the charger "thinks" the battery contains
3. The charging mode
4. The voltage of the battery being charged
5. The duration of charge in hours, minutes, and seconds
6. The number of milliamp-hours of charge put into the battery pack

When the Lithium charger software detects the fully charged condition, charging will automatically stop. The digital display will indicate the maximum battery voltage reached, the duration of the charge and the total milliamp hours of charge delivered to the battery. The buzzer will then beep three times.

Three messages will be displayed during the discharging sequence.

1. The voltage of the battery packs being discharged
2. The duration of the discharge in hours, minutes, and seconds
3. The total number of milliamp hours delivered to the load

When the Lithium Polymer battery has been discharged to a voltage of approximately 3-volts per cell, the discharging will automatically stop.

Charging your Lithium Polymer Battery

Connect the alligator cords to the Astro Model 120. After a few seconds, the digital display should first announce "AstroFlight Lithium" and then **"waiting for battery".**

Wait for the display to say **"waiting for battery"** then connect the short output cord to the Lithium Polymer battery you wish to charge. The charging sequence will automatically begin. If your battery is not connected, has a loose connection, is connected backwards, or is drained to less than 3-volts, the microprocessor will not detect the battery and "**waiting for battery"** will still be displayed. If your battery is properly connected, the display will begin indicating the charge current, the battery voltage, the duration of the charge and the milliamp hours delivered to the battery.

⚠ CAUTION

Always start charging with the current adjust at zero amps, slowly increasing the charging rate until the rate equals the capacity of the battery pack.

We recommend charging Lithium Polymer batteries at a 1C rate (a rate equal to the mahr rating of the cells).

After a few minutes, the charging current may decrease slightly as the battery voltage rises, so you may want to re-adjust the rate.

During the first few seconds of charging the display will show the charging mode and the number of cells that the microprocessor **thinks** are in the battery pack. The display will read 1C1 on a single cell, 2C1 on two cells and 3C1 on three cells etc.

Discharging your Lithium Polymer Battery

You can use the discharge function to measure the capacity of your battery. **First, fully charge the battery** then after it is fully charged disconnect the alligator clips to the power source and reconnect the alligator clips to the Astro Model #120 power supply. Discharging will automatically begin.

During Discharge the digital display will indicate battery voltage, duration of discharge in hours, minutes and seconds, and the milliamp hours delivered from the Lithium Polymer battery to the electronic load in the charger.

When Discharge is complete the discharging will automatically stop. As long as the pack remains connected, the display will be frozen with the values of final discharge voltage and the number of milliamp hours taken from the pack. **To go back to charging,**

remove the battery pack, wait for the display to say **"waiting for battery"** and then connect the next battery.

Error Messages

"Over voltage error"

The "**Over Voltage Error**" message is displayed if a battery pack with more than 39 volts is connected to the charger.

The "**Over Voltage Error**" may be displayed if the battery is disconnected while being charged and the charger attempts to charge an open circuit. This is very likely to occur if the charging current is higher than three amps.

The "**Over Voltage Error"** will be displayed during Mode 2 or Mode 3 if the battery voltage goes above 4.3 volts per cell based on the cell count detected in Mode 1.

If you see the **"Over Voltage error"** message, it means that charging has stopped and the charging sequence if frozen. Please remove the lithium battery pack and disconnect the alligator clips from the 12-volt power source. Then set the charge current to minimum and reconnect the lithium battery. If you have modified your charger to a different connector, please check to make sure that the polarity of your connector is correct and that you have done a good solder job. Wiggle all connections just to be sure.

"Shorted Output"

The "**Shorted Output**" message will occur if the lithium battery voltage drops below 3 volts while charging. This should never happen on a good lithium battery. You have either a bad connection, or a bad battery. Another possibility is that you have long wires between the charger and the battery. These wires should be no longer than 1 foot. Find out what is wrong before proceeding.

The "**Shorted Output**" message will also occur in Mode 2 and Mode 3 if the resting battery voltage drops below 3 volts per cell based on the cell count detected during Mode 1. Again, you have a bad connection, a bad battery, or long wires.

To continue, first remove the lithium battery pack then disconnect from the 12-volt source and re-connect the 12-volt source to reset the microprocessor in the charger. Then reconnect the battery to continue charging.

"Timed Out"

The "**Timed Out**" message will be displayed if the charger has not reached Mode 3 within one hour. Remove the lithium battery then reconnect to continue charging. On future charges, you may want to increase the charge rate a bit.

AIRFRAME SERVICING

The airframe requires no scheduled servicing. Repair work can be accomplished with fiberglass and epoxy.

COMPONENT REPLACEMENT SCHEDULE

There is no component replacement schedule. The parts used should last the lifetime of the vehicle. Periodic inspection of the servos may show wear in the gear train. If that occurs, the servos can be replaced.

REPLACEMENTS PARTS ORDERING

If it is time to replace one or more parts on the vehicle, you can order replacements parts directly from us. You will find a list of parts in Appendix A. You can also call us at the number below, or email us at parts@trekaero.com.

CONTACT US

You can contact us by phone, web, email, writing us, or visiting us.

Our phone number is (209) 368-5800 our webpage is at www.trekaero.com

You can email us at:
info@trekaero.com – the general questions or comments
parts@trekaero.com – for parts questions or orders
service@trekaero.com – for service questions
sales@trekaero.com – for sales and ordering

You can write us at:
Trek Aerospace, Inc.
PO Box 748
Acampo, CA 95220-0748
USA

You can visit us at:
Trek Aerospace, Inc.
23987 N Hwy 99 Hanger 21
Acampo CA 95220
USA

SECTION 6 MAINTENANCE

MAINTENANCE TOOLKIT REQUIREMENTS

T7 Torx wrench
Allen wrenches (sizes 7/64", 3/32", 1/16", and 2 mm)
Open end wrench (size ¼")
#1 Philips Head screwdriver
Soft cloth for cleaning and drying the airframe

TROUBLESHOOTING

We are still developing this section of the manual. While we have nearly 100 hours of flight on OVIWUN, we have not encountered that many problems. As you operate your OVIWUN and encounter different issues, please let us know what happened, the conditions under which it happened, and what your remedy was. We will catalogue those issues and include them and the remedy in future issues of the manual. Send an email to sevice@trekaero.com.

Problem: Vehicle is non-responsive to commands. We have discovered that you really need to top off the batteries before each flight, and keep track of the flight times. As the batteries wear down the vehicle loses its ability to implement your commands. So, if you are out there flying around and the vehicle begins to falter, land and check your batteries. Be sure to check the charge in the transmitter as well.

Problem: Does not boot. The most common problem seems to be that during the pre-flight, when plugging in the batteries, the machine does not boot. The lights on the Stargate and μNav may be on, but the vehicle is not responsive to your moving it around. The only solution we can offer now is to unplug the batteries and start over. This works nearly every time.

BATTERY MAINTENANCE

You should inspect your battery packs before and after each flight. You should look for frayed wiring, discoloration, "bubbles" in the protective cover, burn marks, and anything else that would indicate the battery has been damaged. If you find the battery has been damaged in any way – REPLACE IT!

1. If your Lithium Polymer Battery pack is involved in a crash, dropped, or exposed to excessive heat:
    a. Remove the Lithium Polymer Battery pack from the vehicle.
    b. Carefully inspect the pack for shorts in the wiring or connections. If in doubt replace the battery pack with a new one.
    c. Inspect cells for punctures, dents, cracks, tears, and splits.
    d. Examine cells for leakage or an electrolyte smell.

2. Dispose of cells/packs as follows:
    a. Discharge: with the pack in a safe area, use your battery charger to discharge the pack to the recommended cut-off voltage. (Usually 3.0 volts per cell.) CAUTION: pack may get hot
    b. Allow to cool, and then puncture each cell in the battery pack and immerse in salt water for several hours.
    c. Apply electricians' tape over the terminals, and place in a sealed bag.
    d. They are then safe to dispose of in your regular trash.
3. Handle all cells/packs with care, as they can deliver high currents if shorted. Shorting by a ring, for example, can result in the loss of your finger.
4. Always store cells/packs in a secure location where they cannot be shorted, dropped, overheated to 140°F /60°C, or handled by children.
5. Follow the manufacturer's recommendations for proper long-term battery storage.

AIRFRAME MAINTENANCE

Minor airframe repairs can be accomplished with fiberglass and epoxy. For more extensive damage, it is suggested that individual airframe components (i.e., Upper Body, Cargo Pod, Duct Assembly) be replaced.

BLADE REPLACEMENT

If a fan becomes chipped or cracked, you will need to replace it. This is done by:

1. Using the supplied Torx wrench, remove the three screws holding the spinner in place.
2. Remove the spinner. If damaged, replace; otherwise, set aside.
3. Using the supplied Torx wrench, remove the three screws holding the center-body in place.
4. Remove the center-body. If damaged, replace; otherwise, set aside.
5. Insert the long arm of the Torx wrench, or any Allen wrench, through the hole in the nosepiece of the prop adapter.
6. Holding the motor casing, loosen the prop adapter.
7. Once the prop adapter is loose, slide the prop off the motor shaft.
8. Remove the prop adapter from the damaged prop and discard the damaged prop.
9. Make sure that you are replacing the prop with a prop of the same type (i.e., left or right handed).
10. Loosely install the prop adapter to the replacement prop and slide it all the way on to the motor shaft.
11. Holding the motor casing, tighten the prop adapter.
12. Gently pull on the prop to make sure a secure installation has been achieved.
13. Reinstall the center-body and spinner.

DUCT MAINTENANCE

Minor duct repairs can be accomplished with fiberglass and epoxy. For more extensive damage, it is suggested that the duct assembly be replaced.

To replace a duct assembly:

1. Remove the thumbscrew securing the control linkage to the duct.
2. Disconnect the electrical connection.
3. Remove the thumbscrew in the cross-tube in the upper compartment of the Upper Body.
4. Slide the Duct Assembly out of the cross-tube.
5. Remove the fan (see instructions above for blade replacement).
6. Remove the four screws holding the motor in place.
7. Gently pull the electrical wires through the lollipop arm fairing.
8. Remove the motor.
9. Discard the damaged Duct Assembly.
10. Reverse the above procedure to install the new Duct Assembly.

PARTS ORDERING

If you discover some damage to one or more parts on the vehicle, you can order replacements parts directly from us. You will find a list of parts in Appendix A. You can also call us at the number below, or email us at parts@trekaero.com.

CONTACT INFORMATION

You can contact us by phone, web, email, writing us, or visiting us

Our phone number is (209) 368-5800 our webpage is at www.trekaero.com

You can email us at:
info@trekaero.com – the general questions or comments
parts@trekaero.com – for parts questions or orders
service@trekaero.com – for service questions
sales@trekaero.com – for sales and ordering

You can write us at:
Trek Aerospace, Inc.
PO Box 748
Acampo, CA 95220-0748
USA

You can visit us at:
Trek Aerospace, Inc.
23987 N Hwy 99 Hanger 21
Acampo CA 95220
USA

SECTION 7 ADVANCED FLIGHT CONTROL MODIFICATIONS

SETTING THE DEFAULT GAINS

The default gains are factory set. If the machine loses its default gains, you will need to reload the factory default settings. All support documentation and software are located on the Trek Aerospace OVIWUN support CD. If you did not receive a support CD with your unit(s) call or email Trek Aerospace and one will be provided. Re-loading the default settings will require an upload to the onboard IMU. Instructions for loading <*Oviwun.*hex> file are located at the following link:
http://www.xbow.com/Support/Support_pdf_files/MNAV100CA_Users_Manual.pdf

Additionally Crossbow support CDs are shipped with all new units.

On your OVIWUN support CD locate the *Oviwun.hex* file in the hex folder and follow the instructions laid out in the Crossbow manual, Section 5.3. Connect to the uNAV using the Crossbow support tool (Loader.exe), locate the *Oviwun.hex* file, and start the upload. The unit will be reset to the Trek Aerospace default. Do not confuse this *Oviwun.hex* file with the Crossbow uNAV default hex file. The OVIWUN will not function and may become unstable if this Crossbow .hex file is loaded.

MODIFYING THE GAINS

To modify the OVIWUN software you must first set up the AVR GCC Toolchain on your development system. You may purchase a ready-to-system from Trek Aerospace or setup your own. To set up a development system follow the instructions laid out in Section 5.0 of the uNAV user manual. After you have installed the development tools on you target computer open programmers note pad. Start programmers note pad (pn.exe) and import the control code from the OVIWUN support CD located in the Code folder. You may modify the gains by editing the *control.h* file. Use the "make all" function to create a new hex file and upload the hex file using the instructions outlined above in the "Setting the Default Gains" section of this manual.

OPEN SOURCE CODE

Open source code is available from the following link:

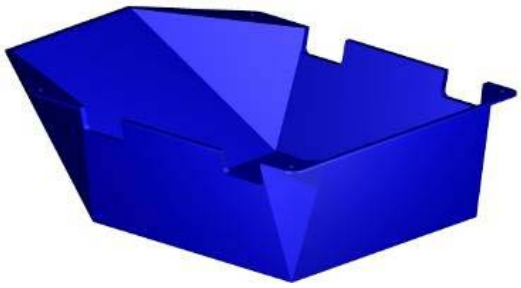
http://sourceforge.net/projects/micronav

This link contains Stargate code for a basic Kalman Filter AHRS solution using uNAV, uNAV firmware and ground station code.

SECTION 8 PAYLOAD ADDITIONS AND MODIFICATIONS

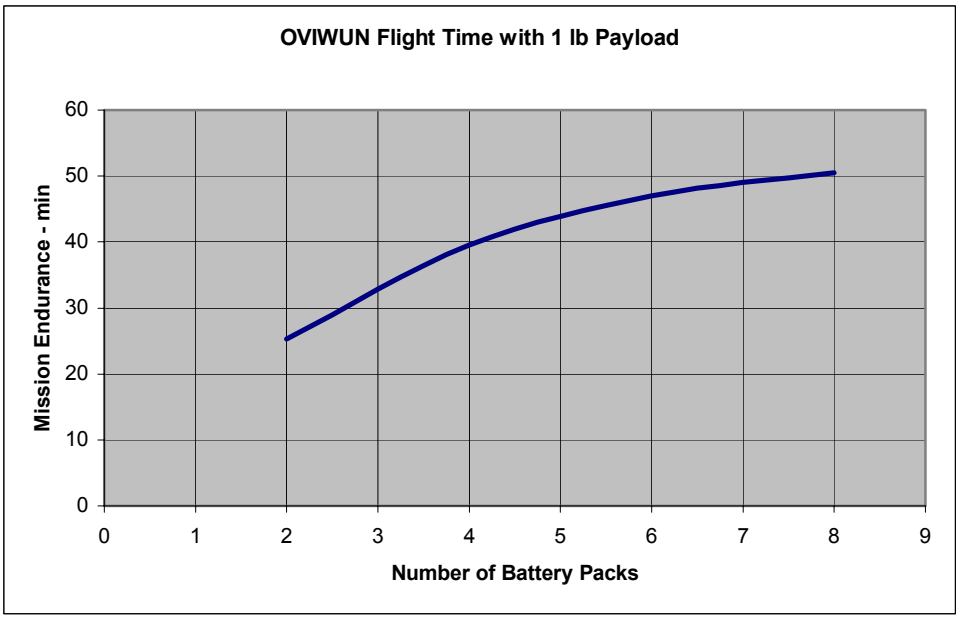
PAYLOAD VOLUME

OVIWUN has been designed to accept various payloads in its cargo pod. The cargo pod provides 1.45 liters (88 cubic inches) of payload space. The base of the pod is 13 x 13 cm (5.1 x 5.1 inches). Internal depth of the pod is 6 cm (2.37 inches). The cargo pod easily detaches from the airframe by loosening four thumbscrews.

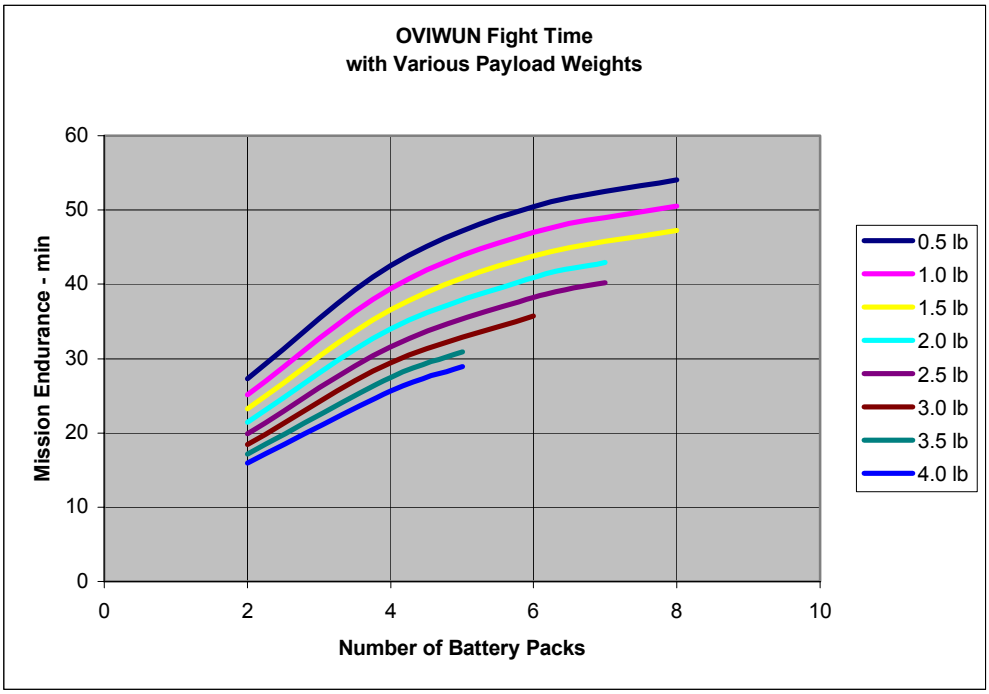


WEIGHT POTENTIAL

OVIWUN, with a nominal 500-gram (1.1 pound) payload and the provided twin battery pack, has a hover endurance of nearly 20 minutes. Higher payloads can be carried, at reduced endurance times. The maximum payload OVIWUN can lift is slightly more than 2950 kg (6.5 pounds). To allow for maneuvering and atmospheric condition margins, Trek Aerospace recommends that the user does not exceed a payload of 1500 grams (3.3 pounds). For increased endurance, additional battery packs may be installed, as shown below. The weight of the extra batteries however does reduce the maximum payload capability. These charts are based on Li-Poly batteries.



Mission profile is 90% loiter and 10% hover, at sea level.



Mission profile is 90% loiter and 10% hover, at sea level

RADIO FREQUENCY INTERFERENCE CONSIDERATIONS

Radio Frequency Interference (RFI) is also known as Electromagnetic Interference (EMI) and can affect anything that receives transmissions, including radios, televisions, phones, wireless computers, and remote operable vehicles such as OVIWUN. Radio Frequency Interference results when unwanted signals are received by the device and prevent the desired signal from getting through.

As a radio controlled vehicle, OVIWUN is susceptible to a number of RFI issues. Keeping your antenna free from electromagnetic interference avoids one of the most common. Make sure it is hanging freely, not touching any of the electric or electromechanical parts of the vehicle.

The radio frequencies used in the transmitters supplied are common frequencies used by most radio controlled aircraft hobbyists. When flying at an RC airfield or with a group of RC aircrafts, the best RFI prevention is to create a “pilot's box”, approximately 15 to 20 feet apart, for each flyer; and never walk too close to another flyer if your antennas are up. Keep in mind other devices or flyers may be transmitting signals on these same frequencies, and it is important that when flying in a group to display your transmitter channel number on your antenna when flying. Always check the area you are operating in to be sure that no one else is operating on the same frequency; never try to fly more than one vehicle on the same channel.

If you change the equipment on your OVIWUN, such as replacing the motor controllers, motors, batteries, or other electrical devices, which have not been tested for RFI conditions, you should be prepared for possible spurious (false) commands. One of these may be the unintentional start up of the fans. This can be very dangerous. Of course, this can also happen if any unwanted signal is received once the vehicle is active. Always use proper care when you make your vehicle systems active.

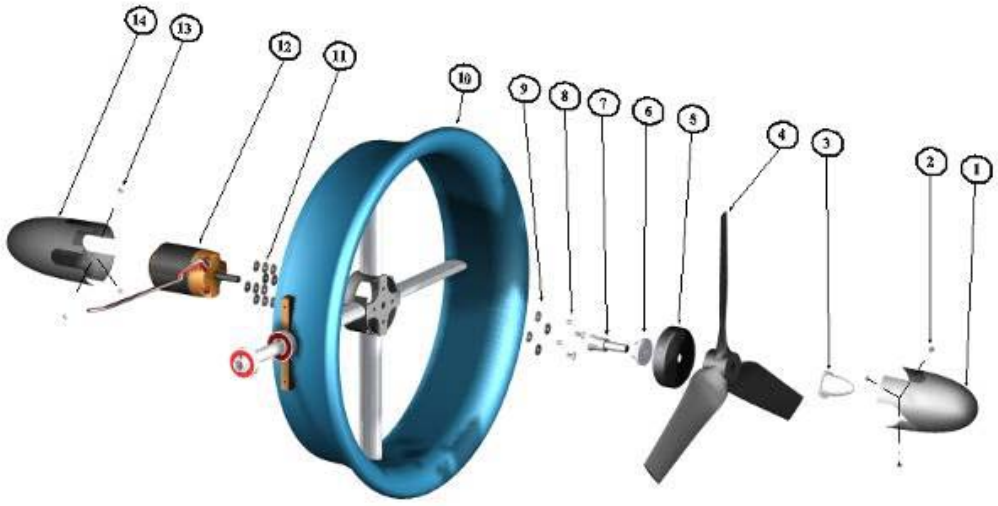
For additional information on setting up your radio and ways to avoid RFI problems, please refer to your HiTec Eclipse 7 Manual.

ADDING RADIO LINKS

You may be interested in adding a range of extra radio links for gathering additional data. When doing so you should always make sure to test for possible interference with the onboard systems.

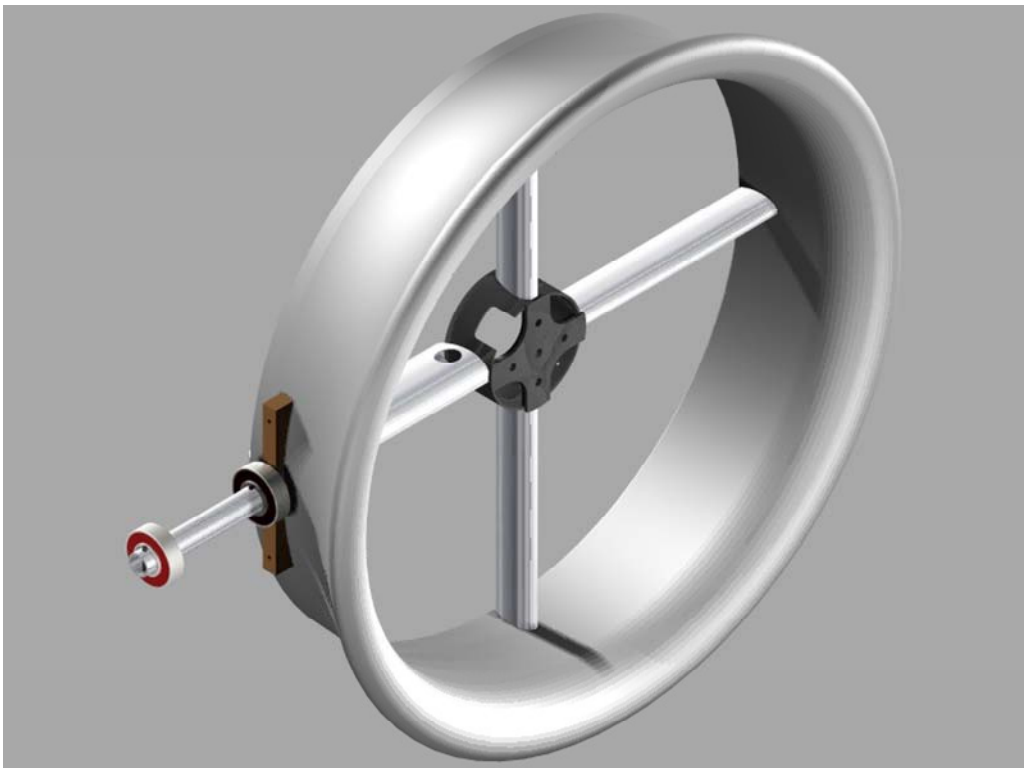
APPENDIX A—DETAILED PARTS LIST

OVIWUN DUCT EXPLODED VIEW A



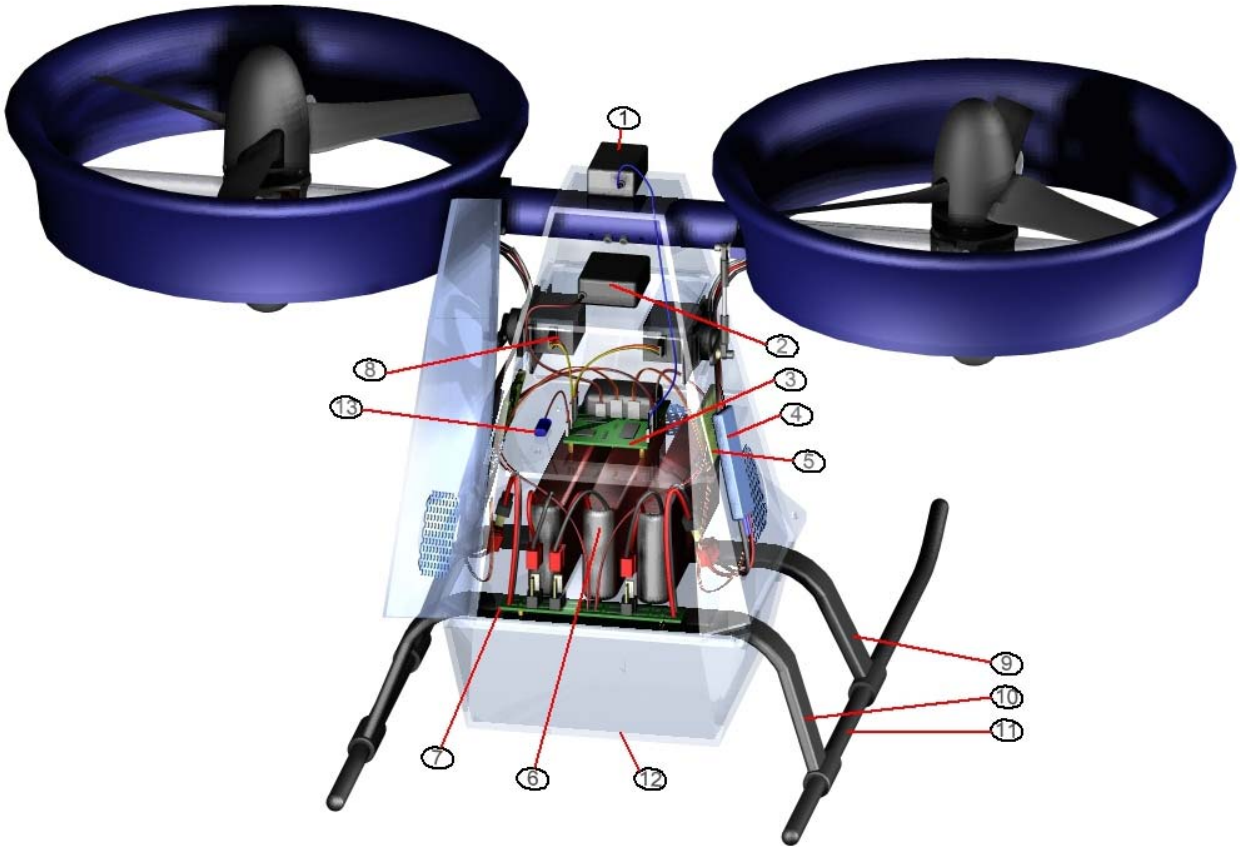
DESCRIPTION OF PARTS ON DUCT EXPLODED VIEW A			
Part No. On View	**Description**	**Trek Part Number**	Quantity
1A	**Spinner (Port Side)**	03-9001-24	1
1B	**Spinner (Starboard Side)**	03-9001-25	1
2	**18-8 SS Torx Screw Pan Head, 1/4" Length**	03-9001-40	3
3	**Collet Prop Adapter (1 of 3)**	03-9001-10	1
4A	**Propeller (Port)**	03-9001-54	1
4B	**Propeller (Starboard)**	03-9001-55	1
5	**Spinner Base**	03-9001-26	1
6	**Collet Prop Adapter (2 of 3)**	03-9001-10	1
7	**Collet Prop Adapter (3 of 3)**	03-9001-10	1
8	**SS Button Head Socket Cap Screw M3 x 8**	03-9001-32	4
9	**Aluminum Washer, Flat, AN960-PD4**	03-9001-43	4
10	**Duct SubAssembly**	03-9001-57	1
11	**Aluminum Washer, Flat, AN960-PD4**	03-9001-43	12
12	**Motor 2826/10**	03-9001-01	1
13	**18-8 SS Torx Screw Pan Head, 1/4" Length**	03-9001-40	3
14	**Centerbody**	03-9001-27	1

OVIWUN DUCT SUB-ASSEMBLY



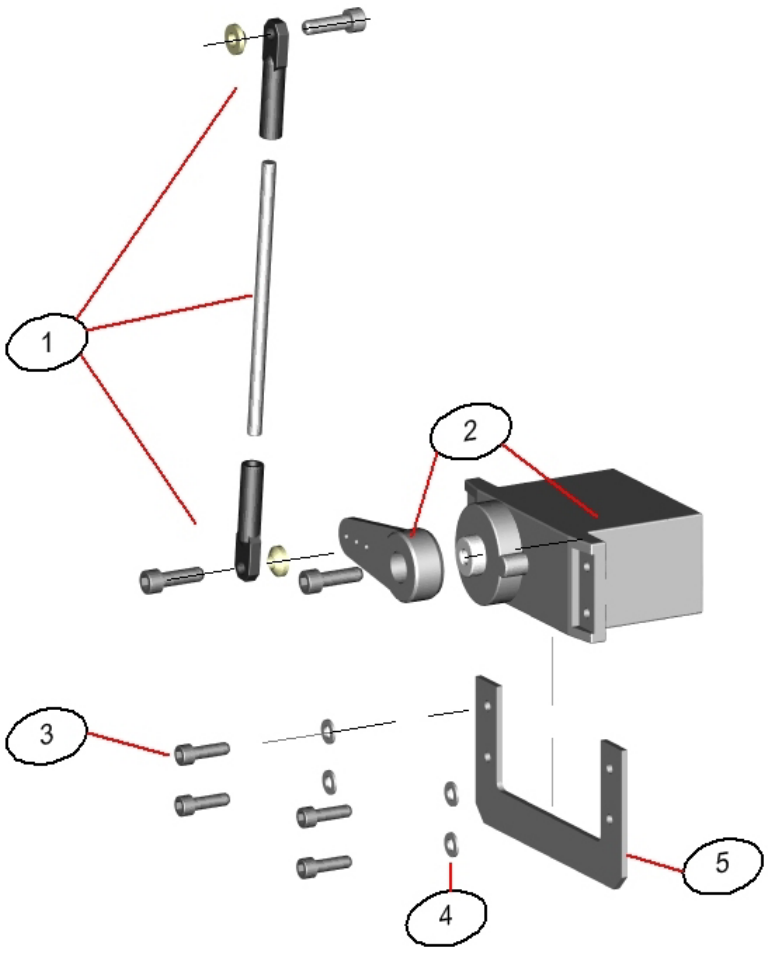
OVIWUN Duct Sub-Assembly

AIRFRAME GLASS VIEW B



DESCRIPTION OF PARTS ON AIRFRAME GLASS VIEW B			
Part No. On View	**Description**	**Trek Part Number**	Quantity
1	**GPS Antenna**	03-9001-xxA	1
2	**RF Receiver**	03-9001-05	1
3A	**MNav**	03-9001-48	1
3B	**Stargate**	03-9001-49	1
4	**Motor Controller**	03-9001-02	2
5A	**6V BEC**	03-9001-59	1
5B	**5V BEC**	03-9001-58	1
6	**Battery Pack**	03-9001-14	2 – 6
7	**Battery Bus Bar**	03-9001-60	1
8	**Servo (see detail below)**	Below	2
9	**Front Landing Strut Support**	03-9000-11A	1
10	**Aft Landing Strut Support**	03-9000-11B	1
11	**Landing Strut**	03-9000-11C	2
12	**Cargo pod**	03-9001-61	1
13	**µNav Serial Input Feed**	Inc 03-9002-48	1

SERVO EXPLODED VIEW



DESCRIPTION OF PARTS ON SERVO EXPLODED VIEW (2 Per Vehicle)

Part No.	Description	Trek Part Number	Quantity
1	Control Linkage	03-9001-29A	2
1A	Thumb Screw 17/32 4-40*	03-9001-42	2
1B	Spacer*	03-9001-53B	2
2	Servo	03-9001-09	3
3	18-8 SS Socket Head Cap Screw 2-56 Thread, 1/2" Length	03-9001-34	4
4	18-8 S S Flat Washer 2 Screw Size, 3/32" ID, 1/4" OD, .018" - .039" Thick	03-9001-33	4
5	Servo Backplate	03-9001-50	1
	*Sold as a single unit		

PARTS ON OVIWUN NOT PRESENTED IN EITHER A GLASS OR EXPLODED VIEW

DESCRIPTION OF PARTS ON AIRFRAME NOT DETAILED

Part No.	Description	Trek Part Number	Quantity
1	Torx wrench (for spinner assemblies)	03-9001-29	1
2	18-8 S S Socket Head Cap Screw 4-40 Thread, 3/16" Length	03-9001-35	2
2	Duct Retaining Thumb Screw 4-40 Thread, 9/32" Length	03-9001-41	2
3	Cargo Pod Retaining Thumb Screw		4
	Landing Rail to Strut Thumb Screw 4-40 Thread, 9/32" Length	03-9001-41	4
4	Landing Strut to Air Frame 18-8 SS Button Head Socket Cap Screw 4-40 Thread, 3/4" Length	03-9001-38	4
5	Landing Strut to Air Frame Aluminum Washer, Flat, AN960-PD4	03-9001-43	4
6	Landing Strut to Air Frame 8-18 Stainless Steel Hex Nylon-Insert Locknut 4-40 Screw Size, 1/4" Width, 9/64" Height	03-9001-31	4
7	RC Transmitter	03-9001-04	1

APPENDIX B—LEARNING TO FLY OVIWUN – A PRIMER

STUDENT – BEGINNING FLIGHT LESSONS

⚠ CAUTION

If you are a beginner, you should seek assistance from an experienced OVIWUN pilot.

You should be aware that although the propellers are inside the ducts they are turning at a very high rpm and are capable of injuring someone. We recommend learning to fly in an area that affords as much room as possible.

Starting your flight training indoors allows you learn to operate the vehicle without "natural" disturbances. You must take care when you are flying indoors to make sure there are no children or animals in the room. In addition, make sure the room is large enough with no obstacles, such as furniture, that could be hit while you are learning how to operate OVIWUN.

Suitable indoor flying spaces should be large enough to allow free movement of the vehicle. The room should be free of obstacles. You should have all doors closed, as any wind can affect your control of the vehicle. If there is air-conditioning or heating in the room, this should be turned off until, you get used to the characteristics and feel of operating OVIWUN.

The floor should be a smooth surface. Be prepared, until the flight rpm has been reached, that OVIWUN may slide around on the floor. We suggest that you avoid using carpet for your first flights as the skids can catch on the carpeting and cause the vehicle to flip over.

Step 1

Preflight the vehicle as you normally would. Place OVIWUN in the middle of the room. If everything checks out in the preflight, position yourself at least six feet (1.8 meters) behind the vehicle and slightly off to one side. Please be sure that you are able to clearly see the vehicle.

Please note when flying that you always watch the nose of the vehicle. Watch the nose and slightly apply enough throttle until the vehicle becomes light on its skids. Always when applying the throttle, please apply it softly. Too much throttle will make the vehicle climb too quickly and you may have difficulties in correcting it quickly enough.

Step 2

First flights should be what are called “bunny hops”. This is initially applying a slight amount of power to get the vehicle light on its skids. Once this has happened, apply more power to lift the vehicle so it is approximately two feet (60 centimeters) off the ground. Watch for any change of direction of the vehicle. If you cannot correct it immediately, decrease the throttle and land.

This is the initial step in learning to operate the vehicle. You should do this until you believe you are controlling the vehicle and understand the commands necessary to operate the vehicle. How many times and how many batteries you will need to achieve this level of understanding it will depend on your ability to become familiar with the feeling and feedback from the vehicle.

We find two feet (60 centimeters) is best for flight training. Always make sure you watch the nose of your vehicle. Keep practicing and you will find that your flights will become more under control and longer.

Also, please note that depending on the size of your room, the air created by the vehicle can circulate around the room within a few seconds and cause turbulence. If you find this is making operating the vehicle difficult, we suggest that you land and let the air settle.

Please remember that the vehicle is meant to fly, no matter how hard you try there will be some movement even when attempting to hover on station. The vehicle will always require some form of input to stop the drift or the tendency to turn. This is not a sign of something faulty with the vehicle, but more the nature of the vehicle.

As you become more familiar with your vehicle, you will find that your hand and eye co-ordination will enable input to correct the movement of the vehicle as soon as it starts, and this will start to show smooth flight.

Step 3

Once you become familiar with the basic hovering of OVIWUN, you should start expanding your ability by yawing the vehicle slightly to the left or right. This is accomplished by moving the left hand stick right and left.

Always remember that if you have yawed your vehicle and you find you are losing control, yaw the vehicle back in the opposite direction so you have the rear of the vehicle pointing at you for easier reference.

Take-off is a little easier than landing. This is due to the ground effect turbulence from the ducted fans. However, spot landing at a modest rate of descent is not as difficult as it might seem.

As you become more proficient with your OVIWUN, find a larger hall so you can expand your ability to control the vehicle during maneuvers. On dead calm days, you can go outside to achieve some forward flying circuits. If you do fly outside, please remember any wind will affect the performance of the vehicle. Keep this in mind and do not get surprised if it suddenly climbs or drops without you making any input. A slight breeze or even a thermal wind coming through can cause this.

Remember practice makes perfect. We suggest practicing on a computer flight simulator to enhance and speed up the learning process. In addition, a simulator allows you to expand your abilities without damaging the vehicle or property. If you notice that the performance of the vehicle is dropping, this is a sign that the battery pack is going flat. We suggest that you immediately land and recharge your battery. Remember the proper environment of no wind and a large space without obstacles is the key to learning.

Step 4

You are now ready to "go outside". We suggest that you begin on days when the winds are dead clam. Begin again with expanding your ability by yawing the vehicle slightly to the left or right. Once you feel you are able to fully control the vehicle, pick a large area with unobstructed views and transition the vehicle to forward flight.

You should begin by combining "bunny hops" with forward movement. Slowly expanding the distance, you travel forward. Follow your vehicle from a safe distance, about six feet (1.8 meters). Once you have successfully mastered this operation, pick a simple pattern, such as a square, and work your vehicle to the corners, yaw in the next direction, and repeat until you have successfully completed the task.

From this point forward you can determine various flight patterns that challenge your abilities without overtaxing them. Once you are thoroughly familiar with the vehicle, you can begin operating the vehicle under increasing wind conditions.

Good luck, and have fun!

APPENDIX C—OPERATIONS CHECKLISTS

PRE-FLIGHT

Ground Check

- ☐ Is the area you are planning to operate in large enough?
- ☐ Is it clear of any loose objects to be blown around?
- ☐ Have you removed any loose objects of clothing?
- ☐ Have you removed any metal from your fingers (rings) and wrists (watches)?
- ☐ Is there a safe place to exit to should it be necessary?
- ☐ Are observers aware of the danger and do they have an emergency plan?

Pre-Flight Vehicle Check

- ☐ Are all the batteries, transmitter, and vehicle, fully charged?
- ☐ Remove the vehicle from the case and install the landing skids.
- ☐ Conduct a visual check of your OVIWUN unit. Look for any nicks, scrapes, gouges, or other signs of wear and tear. Inspect the ducts and fans with particular ardor. These should be repaired before any flight.
- ☐ Check that the frequency of the receiver and the transmitter are the same.
- ☐ Check the surrounding area for any possible RFI. Are there other people operating any RC controlled vehicle in the vicinity? Are you operating on a unique frequency?
- ☐ Check that the fans are secure and rotate freely within the ducts.
- ☐ Examine the control linkages. They should be straight and be connected. The screws holding the linkage should be tight.
- ☐ Verify that the wires from the motor controllers to the motors are tightly connected. Remember the black and white wires on the #1 side of the vehicle are reversed on purpose.
- ☐ Check the weights in the cargo bay. They should be positioned and securely attached.
- ☐ Make sure the receiver antenna and other wires are free and not pinched.
- ☐ Check the duct retaining thumbscrews. They should be tight.
- ☐ Check that the RC receiver is securely fastened.
- ☐ Make sure that the battery elimination circuits are securely fastened to the sides of the airframe.
- ☐ Check to see that the Stargate and µNav are secure.
- ☐ Place the batteries in the center of the airframe, but do not plug them in.

⚠ WARNING

DO NOT PLUG THE BATTERIES IN – YET.

Transmitter

- ☐ Set the controls on the transmitter
  - ☐ The collective/throttle stick should be down (toward the bottom the transmitter) and locked into this position.
  - ☐ The collective/throttle trim control should be set at -50.
  - ☐ Center (zero out) the other three trim controls. [Roll trim control MUST BE ZEROED out before the vehicle is booted up, before EVERY flight!]
  - ☐ VR 1 & 2 should be set to zero (centered)
  - ☐ Flight Mode switch should be centered.
  - ☐ Rudder D/R and Elevator D/R switches should be in the down position.
  - ☐ Channel 7 and Aileron D/R switches should be in the down position.
  - ☐ Flight Condition Switch should be forward (towards the front of the transmitter)
  - ☐ Gear Switch should be in the forward position (towards the front of the transmitter).
- ☐ Double check – is the collective/throttle stick in the down position? Is it locked? If not - this is your last chance to do so. If the collective/throttle stick is not in the down position, your motor controllers will go into the programming mode when you boot up, and your unit may need to be returned to the Trek Aerospace factory for reprogramming.

⚠ CAUTION

Have someone restrain the vehicle while you complete the next four steps.

They should do so by holding the machine firmly on the ground by placing a hand on the machine between the ducts and pressing down.

⚠ WARNING

THE VEHICLE WILL BE ACTIVE WITH THE NEXT STEP.

Have the vehicle in a clear and open space. If the switches are improperly set and procedures are not followed, the fans may start without any warning!

Batteries

- ☐ Double check the polarity of the batteries, and connect the first battery to the bus bar in one smooth and definite operation. Avoid multiple touches of the connectors, or touching the connectors on anything that can carry a charge. Immediately after connecting the battery, the motor controllers, µNav, and Stargate will go through the boot procedure. The ducts will move and you will hear a series of single beeps from the motor controllers. RF interference may cause one or both of the fans to spin.
- ☐ Are the red LED on the µNav and red, yellow, and green LEDs on the Stargate on? Are the LEDs on the Stargate flashing on and off?
- ☐ Double check the polarity of the batteries, and connect the second battery into the bus bar in one smooth and definite operation.

The Final Steps

- ☐ Tuck the bus bar into the lower bay.
- ☐ Replace the back cover.
- ☐ Check the controls.
    a. Lift the machine GENTLY, SLOWLY and SLIGHTLY pitch the machine forward and backwards. The ducts should move in response to your pitch movement. They will be attempting to keep the machine level.
    b. Repeat the motion in yaw, turning the vehicle GENTLY, SLOWLY and SLIGHTLY to the right and left.
    c. IF THE MACHINE DOES NOT RESPOND, FOLLOW THE SHUT DOWN PROCEDURE AND START OVER.
- ☐ Your OVIWUN is now ready to fly.

POST FLIGHT

- ☐ Lock the collective/throttle in the down position.
- ☐ Remove the rear cover.
- ☐ Pull out the bus bar.
- ☐ Disconnect both batteries, and store safely so the connectors do not touch anything. Never place the exposed tabs on or near conductive material.
- ☐ Check the power state by looking at the LEDs on the µNav, and Stargate. They should be off.
- ☐ Gently and slowly, move the machine and determine that the ducts are not responding.
- ☐ Now – turn off the transmitter.
- ☐ Remove the batteries from the lower bay and let them cool.

⚠ CAUTION

The batteries may be warm or hot to the touch.

- ☐ Do a general visual check of your OVIWUN unit. Look for any nicks, scrapes, gouges, or other signs of wear and tear. Inspect the ducts and fans with particular ardor. These should be repaired before any flight.
- ☐ If you are going to repack you machine in the case, you need to remove the landing skids. Before repacking, make sure the batteries are cool.

You are ready to repack your machine in its case.

STORAGE

The case in which your OVIWUN was delivered has been designed for storage, transportation, and shipping.

- ☐ Before storing your OVIWUN unit, you must remove the batteries from the vehicle.
- ☐ Be sure to inspect the batteries for damage—tears, rips, dents, signs of leakage, or if you smell electrolyte the battery is no longer operable.

  NOTE: Immediately dispose of any damaged battery safely by following the Lithium Polymer battery disposal instructions.

⚠ CAUTION

Never store the vehicle with the batteries in place.

- ☐ Have the batteries cooled down? They should be cool to the touch before storage.

⚠ CAUTION

Never attempt to store your batteries in the case in they are hot.

Wait until the batteries have cooled before placing them in the storage container.

- ☐ Inspect, clean and dry your vehicle before storing it.
- ☐ Is the inside of the case wet? Let it air dry thoroughly before attempting to store your vehicle.
- ☐ Are you going to store your vehicle for an extended period? If so, you should remove the battery from the transmitter. It is better to store the batteries in a separate location for extended periods.
    - Remember to keep your batteries in a place away from excessive heat or flammable materials.
    - We recommend using extra precautions when handling Lithium Polymer batteries and storing them in a fireproof container.)
- ☐ The case and vehicle should be stored in a cool dry location. Excessive heat and moisture may cause damage to the components.

APPENDIX D—SERVICE AND MAINTENANCE CHECKLISTS

BATTERY CHARGING

Your OVIWUN vehicle comes with two Lithium Polymer rechargeable battery packs. Your transmitter also comes with a battery and has a built in charger.

NOTE: The following Safety Tips are guidelines for the safely using Lithium Polymer batteries, it is **important** for you to familiarize yourself with and follow the manufacturer's requirements regarding the safe handling, charging, and discharging of Lithium Polymer batteries.

SAFETY TIPS FOR HANDLING BATTERIES

- ☐ **Never** charge any battery type **unattended**.
- ☐ Only charge a battery with a charger designed specifically for that type of battery.
- ☐ Lithium Polymer cells can ignite because of unmatched cell capacity or voltage, cell damage, charger failure, incorrect charger settings and other factors. **Never** combine different sized packs, capacities, or cells together in series or parallel.

⚠ WARNING

IN CASE OF A FIRE, NEVER EXTINGUISH WITH WATER! ALWAYS USE SAND OR A DRY FIRE EXTINGUISHER.

- ☐ It is extremely important to double check the correct polarity when connecting cell packs to the charger or to your vehicle.
- ☐ Always check your batteries for damage before and after each charging sequence.
- ☐ Always use the correct charging voltage.
- ☐ The Lithium Polymer Battery pack may ignite if connected to a charger supplying more than 6 volts per cell.
- ☐ Check your charger to assure it is working properly.
- ☐ Charge your batteries in a safe area where no harm can result.
- ☐ Never attempt to charge your batteries while they are in the OVIWUN vehicle. This may cause damage to your vehicle or its components.
- ☐ Do not charge your batteries inside a motor vehicle, or in a vehicle's engine compartment. Additionally, do not store or leave your batteries in a vehicle where they can overheat.
- ☐ Do not charge your batteries on a wooden workbench, or on or near any flammable material. (Wood, plastic, foam, etc.)
- ☐ The seal of Lithium Polymer cells can degrade at excessive temperatures and cause electrolyte leakage. (Especially when left in the trunk of a car or on the dash.) If you come in contact with this electrolyte, scrub the area with soap and water. If the electrolyte splashes into your eyes, flush with water and seek immediate medical attention.

- ☐ If your Lithium Polymer batteries are involved in a crash, drop, or excessive heat:
    a. Remove the Lithium Polymer Battery pack from the vehicle.
    b. Carefully inspect the pack for shorts in the wiring or connections. If in doubt replace the battery pack with a new one.
    c. Inspect cells for punctures, dents, cracks, tears, and splits.
    d. Examine cells for leakage or an electrolyte smell.
    e. If your batteries have been damaged, dispose of damaged cells cells/packs as follows:
        a. Discharge: with the pack in a safe area, use your battery charger to discharge the pack to the recommended cut-off voltage. (Usually 3.0 volts per cell.) CAUTION: pack may get hot
        b. Allow to cool, and then puncture each cell in the battery pack and immerse in salt water for several hours.
        c. Apply electricians' tape over the terminals, and place in a sealed plastic bag.
        d. They are then safe to dispose of in your regular trash.
- ☐ Always handle your batteries with care. They can deliver high currents if shorted.
- ☐ Remove any rings or other metal before handling your batteries. Shorting by a ring can result in the loss of a finger.
- ☐ Always store cells/packs in a secure location where they cannot be shorted, dropped, overheated to 140°F /60°C, or handled by children.
- ☐ Follow the manufacturer's recommendations for proper long-term battery storage.

CHARGING YOUR BATTERY

- ☐ Connect the power supply to an appropriate outlet.
- ☐ Connect the alligator cords to the power supply.
- ☐ Wait a few seconds; the digital display should first announce "AstroFlight Lithium" and then **"waiting for battery".**
- ☐ Double check the correct polarity when connecting cell packs to the charger.
- ☐ Connect the short output cord to the Lithium Polymer battery you wish to charge.
- ☐ The charging sequence will automatically begin. If your battery is properly connected, the display will begin indicating the charge current, the battery voltage, the duration of the charge and the milliamp hours delivered to the battery.

⚠ CAUTION

Always start charging with the current adjust at zero amps, slowly increasing the charging rate until the rate equals the capacity of the battery pack.

We recommend charging Lithium Polymer batteries at a 1C rate.
(a rate equal to the mahr rating of the cells)

- ☐ If your battery is not connected, has a loose connection, is connected backwards, or is drained to less than 3 volts, the microprocessor will not detect the battery and "**waiting for battery"** will still be displayed. Check your battery, and the connections, attempt to charge again.
  NOTE: Some manufacturers recommend NEVER disconnecting your battery without turning the charger off first. Always follow the manufacturer's recommendations when charging your batteries.
- ☐ During the first few seconds of charging the display will show the charging mode and the number of cells that the microprocessor thinks are in the battery pack. The display should be "**4C1**" for the batteries packaged with your unit.

⚠ WARNING

If the display reads more cells than your battery contains STOP AT ONCE!!!! Something is wrong.

Your battery could have a damaged or high resistance cell, it could already be fully charged, or you could be trying to charge too fast. Turn the current back to zero and try to determine what is causing the problem.

- ☐ During Mode 1, the charger will continue charging your battery for three minutes regardless of the battery voltage. It acts like a dumb charger during this first phase. This is necessary in order to be able to charge packs that have been discharged to a very low voltage.

⚠ WARNING

If your battery is already charged do not try over charge it.

A fully charged, 4-cell pack will have a voltage of 16.60 to 16.80 volts.

- ☐ After three minutes, the charger automatically switches from Mode 1 to Mode 2. The display changes to indicate Mode 2 and will now read "**4C2**". Mode 2 will last about 45 minutes.
- ☐ At the end of Mode 2, the battery charger automatically switches to Mode 3. In Mode 3, the charging current is turned on and off periodically.
- ☐ After charging is complete, the digital display will indicate that the battery charging is complete. The display will show the highest resting voltage reached and the number of milliamp hours of charge put into the battery.

DUCT REPLACEMENT

There are two methods of replacing the duct. The first, and by far the easiest, is to purchase an entire duct assembly. A duct assembly comes already assembled with the motor, spinner, and center-body. It is as simple as removing the duct and "plugging" the new one it. This is the preferred method as it insures that the support arm, bearings and other components, which may also be damaged, are replaced at the same time.

However, you can also replace just the duct. You should completely remove and disassemble the duct assembly. You should carefully inspect all the various components to determine if they are damaged as well. If you determine that the various components are in acceptable condition, proceed with a partial replacement of the duct assembly.

REMOVING THE DUCT

- ☐ Make sure the machine is inactive.
- ☐ Remove the batteries.
- ☐ Disconnect the control linkage from the duct using a 3/32 Allen wrench. Hold the duct gently, but firmly, while loosening the bolt, holding the control linkage in place.
  Note: There is a brass spacer on the screw between the control linkage and the duct.
- ☐ Disconnect the motor controller from the motor. Three wires are connected by press fittings. They should pull apart easily. Hold the wire on either side of the press fitting and pull gently until they separate.
- ☐ Remove the duct-retaining thumbscrew. This screw is in the uppermost bay of the airframe. This may require the 3/32 Allen wrench to loosen. There are TWO small aluminum washers to watch out for.
- ☐ Gently and yet firmly hold the machine by the center top of the airframe and pull the duct assembly gently from the support tube.
  Note: Pull straight from the support tube; be careful not to pull at an angle, as it may damage the support tube.
- ☐ The full duct assembly has now been removed.

If you are replacing the entire assembly, you are done otherwise proceed to the next page.

- ☐ To remove the components, begin by removing the spinner and center-body. There are three screws holding each piece. Use the T7 Torx wrench to remove the screws. Once the screws have been removed, each piece should pull away easily.
- ☐ Using a 3/32 Allen wrench as a lever, unscrew the top of the prop collet. Put the Allen wrench through the hole in the top of the collet, hold the prop at the same time, and turn the collet counter-clockwise.

- ☐ Remove the prop subassembly by pulling the prop gently straight up off the motor shaft. There are four parts here: prop, spinner back-plate, and the bottom two parts of the collet.
- ☐ Carefully feed the wires from the motor back through the vane until they are free of the vane.
- ☐ Using a 2 mm Allen wrench, remove the four screws holding the motor to the motor mount.
  Note: There are four washers on each screw, one under the screw head and three between the motor and motor mount plate. The motor should fall free.
- ☐ There is no need to remove the two bearings on the support arm. The replacement duct will come with the bearings installed.
- ☐ The full duct assembly and its components has now been removed

REASSEMBLING THE DUCT

- ☐ Make sure the machine is inactive.
- ☐ If they have not been removed, remove the batteries.
- ☐ Mount the motor first. You will need the 2 mm Allen wrench. There are four screws holding the motor to the motor mount.
  Note: There are four washers on each screw, three between the motor and motor mount and one under the head of the screw. Get all four screws started, and then tighten in rotation.
- ☐ Carefully feed the wires from the motor back through the vane. Leave a small amount of slack; do not pull the wires tight.
- ☐ Place the collet shaft over the motor shaft. Place the collet pressure fitting on the collet shaft, large end down.
- ☐ Place the spinner back-plate on the collet shaft, flange side down.
- ☐ Place the prop on the collet shaft.
- ☐ Screw the top of the prop collet on the collet shaft. Tighten using a 3/32 Allen wrench as a lever. Hold the prop in place and get a good, tight fit. Note that the screw holes in the spinner back-plate must be positioned to mate with the spinner.
- ☐ Attach the center-body. Place the center-body over the motor and line up the screw holes with the motor mount. Be sure to align the cutout for the motor wires. Three screws hold the center-body it in place. Use the T7 Torx wrench to tighten the screws.
- ☐ Attach the spinner. Place the spinner over the prop and line up the screws. Three screws hold it in place. Use the T7 Torx wrench to tighten the screws.
- ☐ All the components are now in place. You have a complete Duct Assembly.

If you purchased a full duct assembly, begin here.

- ☐ Gently, yet firmly, hold the machine by the center top of the airframe and insert the duct assembly carefully into the support tube.
  Note: Stay level and even with the support tube, being careful not to force the Duct Assembly in at an angle, as it may damage the support tube.

- ☐ Replace the duct-retaining thumbscrew. This screw is in the uppermost bay of the airframe. This may require the 3/32 Allen wrench. Remember there are TWO small aluminum washers on this screw. If they are not there, you may damage the support arm and/or restrict the operation of the duct.
- ☐ Connect the motor controller to the motor. There are three wires that are connected by press fittings. They should slide together easily. Hold the wire on either side of the press fitting and slide gently until they "pop". The fitting itself should not show, just the covering. (Remember the black and white wires on the #1 side of the vehicle are intentionally reversed.)
- ☐ Test the duct to see if the movement is easy.
- ☐ Connect the control linkage to the duct using a 3/32 Allen wrench. Place the screw into the control linkage. Place the brass spacer between the control linkage and the duct with the flat side of the spacer against the duct.
- ☐ All the components are now in place. You have a complete Duct Assembly.

MOTOR REPLACEMENT

REMOVING THE MOTOR

- ☐ Make sure the machine is inactive.
- ☐ Remove the batteries.
- ☐ Disconnect the motor controller from the motor. Three wires are connected by press fittings. They should pull apart easily. Hold the wire on either side of the press fitting and pull gently until they separate.
- ☐ Remove the spinner and center-body. Three screws hold each piece. Use the T7 Torx wrench. Once the screws have been removed, each piece should pull away easily.
- ☐ Using a 3/32 Allen wrench as a lever, unscrew the top of the prop collet. Put the Allen wrench through the hole in the top of the collet, hold the prop at the same time, and turn the collet counter-clockwise.
- ☐ Remove the prop subassembly by pulling the prop gently straight up off the motor shaft. There are four parts here: prop, spinner back-plate, and the bottom two parts of the collet.
- ☐ Carefully feed the wires from the motor back through the vane until they are free of the vane.
- ☐ Using a 2 mm Allen wrench, remove the four screws holding the motor to the motor mount.
  Note: There are four washers on each screw, one under the screw head and three between the motor and motor mount. The motor should fall free.
- ☐ Motor removal is complete.

REPLACING THE MOTOR

- ☐ Make sure the machine is inactive.
- ☐ If they are not removed, remove the batteries.
- ☐ Mount the motor first. You will need the 2 mm Allen wrench. There are four screws holding the motor to the motor mount.
  Note: There are four washers on each screw, three between the motor and motor mount and one under the head of the screw. Get all four screws started, and then tighten in rotation.
- ☐ Carefully feed the wires from the motor back through the vane. Leave a small amount of slack; do not pull the wires tight.
- ☐ Place the collet shaft over the motor shaft. Place the collet pressure fitting on the collet shaft, large end down.
- ☐ Place the spinner back-plate on the collet shaft, flange side down.
- ☐ Place the prop on the collet shaft.
- ☐ Screw the top of the prop collet on the collet shaft. Tighten using a 3/32 Allen wrench as a lever. Hold the prop in place and get a good, tight fit. Note that the screw holes in the spinner back-plate must be positioned to mate with the spinner.
- ☐ Attach the center-body. Place the center-body over the motor and line up the screw holes with the motor mount. Be sure to align the cutout for the motor wires. Three screws hold the center-body it in place. Use the T7 Torx wrench to tighten the screws.
- ☐ Attach the spinner. Place the spinner over the prop and line up the screws. Three screws hold it in place. Use the T7 Torx wrench to tighten the screws.
- ☐ Connect the motor controller to the motor. Three wires are connected by press fittings. They should slide together easily. Hold the wire on either side of the press fitting and slide gently until they “pop”. The fitting itself should not show, just the covering.
- ☐ Motor replacement is complete.

µNAV & STARGATE REPLACEMENT

Removing the units.

- ☐ First, make sure the machine is inactive.
- ☐ If they are not removed, remove the batteries.
- ☐ **ESD WARNING:** The Stargate Processor Board, Daughter Card and µNav are electronic devices and therefore can be damaged by Electrostatic Discharge (ESD). While handling these devices, follow ESD prevention procedures and use an ESD wrist strap.
- ☐ There are four thumbscrews, which attached the Stargate to the airframe. They are located in the top to the bottom bay.
- ☐ Turning the screws clockwise loosens them. Remove the four thumbscrews and set them aside. Each of the thumbscrews has short spacer.
- ☐ Loosen the BECs from the Velcro™ holding them in place on the right and left of the bay. Pull the forward so they are hanging out of the bay.
- ☐ Holding the Stargate by the right and left edges, gently and carefully slide the Stargate forward. Be careful of the servos hitting the µNav.
- ☐ When disconnecting the following items, hold the Stargate by the edges. Do Not put your thumb on the top of the µNAV as you can break the board.
- ☐ Disconnect the 5V BEC from the Stargate by holding the connector at the Stargate and gentle pulling it from the press fitting.
- ☐ Disconnect the 6V BEC from the µNAV by holding the connector at the µNAV connector bar (it is attached to the number two position) and gently pulling it from the press fitting.
- ☐ Disconnect the RC Receiver from the µNAV. It is attached to the number #5 position)
- ☐ Disconnect the servo #2 from the µNAV. It is attached to the number 10 position.
- ☐ Disconnect the motor controller #2 from the µNAV. It is attached to the number 11 position.
- ☐ Disconnect the motor controller #1 from the µNAV. It is attached to the number 12 position.
- ☐ Disconnect the servo #1 from the µNAV. It is attached to the number 14 position.
- ☐ There are two screws (2-56) which attach the µNAV to the Stargate. Each screw has a nut, a spacer, and washer. Hold the nut while loosening the screws.
- ☐ Once the nuts have been removed, you are now ready to replace either unit.

Replacing the Units

- ☐ Remove the Stargate or µNAV from the package. The "set-offs" should be on the same side of the Stargate as the PCIMA connection. If not, you need to move them there.
- ☐ **ESD WARNING:** The Stargate Processor Board, Daughter Card, and µNav are electronic devices and therefore can be damaged by Electrostatic Discharge (ESD). While handling these devices, follow ESD prevention procedures and use an ESD wrist strap.
- ☐ Hold the µNAV by the edge closest to the #1 connector, just above the Mote Connection and gently "wiggle" the two 51 pin connectors together.
- ☐ Place the one of the spacers on the Stargate card. Slide the washer on the screw and insert it into the hole. Slide the nut on the end of the screw and loosely tighten. Repeat with the second screw and nut.
- ☐ Make sure the µNAV is seated before tightening down the screws holding the µNAV on the Stargate.
- ☐ Connect the servo #1 to the µNAV. It is attached to the number 14 position. The yellow wire is towards the inside of the Stargate/ µNAV.
- ☐ Connect the motor controller #1 to the µNAV. It is attached to the number 12 position. The orange wire is towards the inside of the Stargate/ µNAV.
- ☐ Connect the motor controller #2 to the µNAV. It is attached to the number 11 position. The orange wire is towards the inside of the Stargate/ µNAV.
- ☐ Connect the Servo #2 to the µNAV. It is attached to the number 10 position. The yellow wire is towards the inside of the Stargate/ µNAV.
- ☐ Connect the RC Receiver to the µNAV. It is attached to the number #5 position. The ground-wire is to the outside.
- ☐ Connect the 6V BEC to the µNAV by holding the connector at the µNAV connector bar (it is attached to the number two position) and gently pushing unit it seats. The black ground-wire is to the outside
- ☐ Connect the 5V BEC to the Stargate by holding the connector gently pushing unit it seats. The black ground-wire is to the inside. This unit is not reverse polarity protected. Make sure you have it right, if you do not you will "blow" the board.
- ☐ There is a jumper, on the Stargate, next to Connector #1 on the µNAV. It needs to be set to the "inside" position. That is, the exposed lead should be that closest to the rear of the µNAV.
- ☐ Holding the Stargate by the right and left edges, gently and carefully slide the Stargate into the bay. Be careful of the servos hitting the µNav.
- ☐ There are four thumbscrews, which attached the Stargate to the airframe. They are located in the top to the bottom bay.
- ☐ Loosely attach the screws to the Stargate by turning them counter-clockwise. Once all four of the thumbscrews are in place you can tighten them down. Do not forget the short spacer as it will make removing the unit later easier.
- ☐ Replace the BECs using the Velcro™ to holding them in place on the right and left of the sides of the bay.
- ☐ Ok, you are back in business.

CONTROL SERVO REPLACEMENT

Removing the Servo

- ☐ Make sure the machine is inactive.
- ☐ Remove the batteries.
- ☐ Disconnect the servo from the μNAV. This is a friction fitting and should pull apart easily.
- ☐ Disconnect the control linkage from the duct using a 3/32 Allen wrench. Hold the duct gently but firmly while loosening the screw holding the control linkage in place. Note there is a brass spacer between the control linkage and the duct.
- ☐ Disconnect the control linkage from the servo using a 3/32 Allen wrench. Hold the servo gently but firmly while loosening the screw holding the control linkage to the servo. Note there is a brass spacer between the control linkage and the servo.
- ☐ The control servo is held in place with four screws and a threaded back-plate. Using a 5/64 Allen wrench remove the screws. It may be easier to disconnect the wires leading from the motor controller to the motor.
- ☐ The servo should be removed though the center of airframe.

Replacing the Servo

- ☐ Make sure the machine is inactive.
- ☐ Remove the batteries.
- ☐ Place the servo on its shelf inside the center of the airframe.
- ☐ Place the back-plate against the servo, inside the center of airframe.
- ☐ Hand-thread the four screws through the airframe and servo into the back-plate. Tighten the screws with a 5/64 Allen wrench.
- ☐ Connect the control linkage to the servo using a 3/32 Allen wrench. Hold the servo gently but firmly while tightening the screw that holds the control linkage to the servo.
  Note: There is a brass spacer between the control linkage and the servo. The flat side of the brass spacer goes against the servo.
- ☐ Connect the control linkage to the duct using a 3/32 Allen wrench. Hold the duct gently but firmly while tightening the screw holding the control linkage in place. **Note:** There is a brass spacer between the control linkage and the bolt. The flat side of the brass spacer goes against the duct.
- ☐ Connect the servo to the μNAV. This is a friction fitting and they should easily slip together.

LANDING SKID & STRUT REPLACEMENT

If a landing skid becomes broken or bent, you can replace the skid by loosening the two retaining thumbscrews and sliding the skid out of the struts. Inspect the struts for damage before placing a new skid in the strut.

Should a strut become damaged it can also be replaced. Remove the cargo bay and loosen the two nuts holding the strut in place. The batteries will have to be removed from the vehicle to do this. Put a new strut in its place and tighten the nuts back into place.

AIRFRAME REPLACEMENT

If you feel for some reason that, the entire airframe needs to be replaced. It is recommended that you return your vehicle and all of its components to Trek Aerospace for inspection and replacement.

APPENDIX E—COVERED CODE DISCLAIMER

DISCLAIMER OF WARRANTY

Covered code is provided under this license on an "as is" basis, without warranty of any kind, either expressed or implied, including, without limitation, warranties that the covered code is free of defects, merchantable, fit for a particular purpose or non-infringing. The entire risk as to the quality and performance of the covered code is with you. Should any covered code prove defective in any respect, you (not the initial developer or any other contributor) assume the cost of any necessary servicing, repair or correction. This disclaimer of warranty constitutes an essential part of this license. No use of any covered code is authorized hereunder except under this disclaimer.

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